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MINERAL RESOURCES OF THE UNITED STATES FOR 1914—PART II.

SAND-LIME BRICK.

By Jefferson Middleton.

INTRODUCTION.

The sand-lime brick industry has been established in the United States since 1901, when the first plant was started at Michigan City, Ind. Since that time it has passed through the various stages of a new industry. In the beginning it suffered severely from the "boomer," whose glittering promises to make for a few dollars a thousand brick that would sell in competition with high-grade face clay brick caused plants to be established for the manufacture of sand-lime brick without regard to market, transportation facilities, or even a supply of suitable material. Some plants constructed under these conditions never even attempted to market their product. Then came the natural reaction when the number of the plants and the value of the product decreased even more rapidly than commercial conditions would have seemed to warrant. Since that stage, within the last few years, the industry appears to have become firmly established.

In common with most new building materials, sand-lime brick has had to overcome prejudice in the minds of some architects and builders. This prejudice was sometimes justified by the poor brick resulting from ignorance or lack of technical skill. The plants making this poor material have either gone out of business or have improved their product, so that to-day at many places sand-lime brick is successfully meeting the competition of clay building brick. When this material was first produced in the United States, it was thought that it would be used as wall coping, ornamental pieces for garden and lawn, window sills, trimmings, lintels, columns, and capitals, as well as for building. None of these uses have been made extensively. The tendency has been to make only building brick.

The condition of the sand-lime brick industry in the United States in 1914 was on the whole rather unsatisfactory to the manufacturers, though in some States, notably in Florida and Indiana, considerable progress was made. The year opened with good prospects for a prosperous season, and many operators reported that these prospects were in a fair way to be realized when conditions arising from the European war put a check to building activities, and from that time forward business was reported poor. The number of active operators reporting decreased as compared with 1913, and one State that reported business in 1913 dropped from the list of producers. In 1914 the value of the output was $1,058,512. Compared with 1913, this was a decrease of $179,813, or 14.52 per cent; compared with 1912, it was a decrease of $141,711, or 11.81 per cent; but compared with 1911, it was an increase of $160,848, or 17.92 per cent. The average value of output per active plant in 1914 was $17,073; in 1913 it was $18,211; and in 1911 it was $13,601. Nine of the 23 States reporting marketed product in 1914 showed increase and 14 showed decrease. These increases and decreases were confined to no one section of the country. Florida, Indiana, South Dakota, and Wisconsin showed the principal increases; California, District of Columbia, Massachusetts, Michigan, New York, Pennsylvania, Texas, and Washington showed the largest decreases.

PRODUCTION.

The following table shows the production of sand-lime brick in the United States from 1903 to 1914, inclusive:

Value of production of sand-lime brick in the United States, 1903–1914.

Year.	Number of active firms reporting.	Value of product.	Year.	Number of active firms reporting.	Value of product.
1903	16	$155,040	1909	74	$1,150,580
1904	57	463,128	1910	76	1,169,153
1905	84	972,064	1911	66	897,664
1906	87	1,170,005	1912	71	1,200,223
1907	94	1,225,769	1913	68	1,238,325
1908	87	1,029,699	1914	62	1,058,512

This table shows that the value of sand-lime brick marketed and the number of active plants reporting rose rapidly until 1907. In 1908 there was a decrease, in common with other industries. In 1909 and 1910 there were slight increases. In 1911 the lowest value ($897,664) was reached since 1904, when the industry first became well established. In 1912 and 1913 there were gains in value, the total for 1913 being the maximum; but in 1914 there was a decrease, the value of the product in that year being the lowest since 1908 except in 1911. The number (62) of active firms reporting in 1914 was the smallest since 1904.

The domestic production of sand-lime brick in 1913 and 1914 by States and kinds is shown in the following tables:

Production of sand-lime brick in the United States in 1913, by States and kinds.

State.	Number of active firms reporting.	Common brick.		Front brick.		Total value.
		Quantity (thousands).	Value.	Quantity (thousands).	Value.	
California	5	1,237	$8,414	a 2,267	a $30,425	$38,839
Colorado, Iowa, and Nebraska	4	1,336	10,260	288	3,458	13,718
Florida	4	12,621	72,665	750	7,014	79,679
Idaho	3	1,234	13,839	a 99	a 2,640	16,479
Indiana	4	12,091	58,150	40	400	58,550
Kansas, Oklahoma, and Texas	4	7,418	66,940	300	3,421	70,361
Massachusetts	3	5,315	34,348	a 607	a 7,801	42,149
Michigan	12	49,373	315,882	692	5,363	321,245
Minnesota	4	23,293	127,794	120	1,370	129,164
New Jersey	4	415	2,115	1,706	13,642	15,757
New York	5	21,251	133,303	330	2,710	136,013
North Dakota and South Dakota	3	3,942	30,364			30,364
Pennsylvania	3	11,984	73,674			73,674
Wisconsin	4	12,302	75,130	222	2,434	77,564
Other States b	6	14,540	95,524	a 3,886	a 39,245	134,769
Total	68	178,352	1,118,402	11,307	119,923	1,238,325
Average price per M			6.27		10.61	

a Includes fancy brick.
b Includes the District of Columbia, Georgia, Kentucky, Ohio, and Washington.

Production of sand-lime brick in the United States in 1914, by States and kinds.

State.	Number of active firms reporting.	Common brick.a	
		Quantity (thousands).	Value.
California	4	1,484	$15,387
Florida	4	18,476	105,435
Idaho	3	1,670	17,466
Indiana	4	16,288	76,175
Massachusetts	4	3,530	28,713
Michigan	12	42,465	255,784
Minnesota	4	19,958	119,271
New York	4	18,347	107,633
Pennsylvania	3	9,960	54,418
South Dakota	3	3,864	27,665
Wisconsin	4	14,588	86,682
Other States b	13	c 21,999	c 163,883
Total	62	172,629	1,058,512

a Includes 7,630,000 front brick, valued at $69,263, made in the following States: California (693,000, valued at $9,105), District of Columbia, Florida (1,367,000, valued at $11,115), Idaho, Indiana, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, South Dakota, and Wisconsin.
b Includes Colorado, District of Columbia, Georgia, Iowa, Kentucky, Nebraska, New Jersey, North Dakota, Ohio, Oklahoma, Texas, and Washington.
c Includes fancy brick.

These tables show that the value of the output in 1914 decreased $179,813, or 14.52 per cent. The number of States in which production was reported in 1914 was 23, a decrease of 1 from 1913 (Kansas). Michigan continues to be the leading State, the value of its product constituting 24.16 per cent of the total value of all sand-lime brick in 1914, and 25.94 per cent of the total in 1913. Minnesota was second in 1914, reporting 11.27 per cent of the total; it displaced New York, which was third with 10.17 per cent of the total value.

Of the States for which totals are given, 6—California, Massachusetts, Michigan, Minnesota, New York, and Pennsylvania—showed decrease in 1914, and 5—Florida, Idaho, Indiana, South Dakota, and Wisconsin—showed increase. The greatest decrease was in Michigan, $65,461, and the greatest increase was in Florida, $25,756.

Michigan had the largest number (12) of active firms reporting in 1914, the same number as in 1913. California and New York, which each had 5 active firms reporting in 1913, had only 4 in 1914. Florida Indiana, Massachusetts, Minnesota, and Wisconsin also had 4 producers each in 1914. No other State had as many as 4 producers in that year.

The average price per thousand for common sand-lime brick was $5.99 in 1914, as compared with $6.27 in 1913, $6.46 in 1912, and $6.09 in 1911. For front brick the average price was $9.08 in 1914, $10.61 in 1913, $10.41 in 1912, and $9.53 in 1911. In 1914 common brick represented 93.38 per cent of the value of all products and front and fancy brick 6.62 per cent. In 1913 common brick represented 90.32 per cent of the value of all products and front and fancy brick 9.68 per cent.

SAND-LIME BRICK INDUSTRY BY STATES.

California.—In California the production of sand-lime brick in 1914 showed a decrease from 1913 of $23,452, or 60.38 per cent. One plant had not begun operations, and one company retired from business, having dismantled its plant. There were four active plants in the State in 1914—a decrease of one from 1913.

Colorado.—Only one company reported from Colorado in 1914. Building conditions were extremely dull and the plant was idle, but sales were made from the stock on hand at the beginning of the year.

District of Columbia.—There is only one sand-lime brick company in the District of Columbia. Business was reported considerably poorer in 1914 than in 1913.

Florida.—Florida was the fourth State in the value of sand-lime brick in 1913 and 1914, and was one of the few States to show a considerable increase in 1914. Business was generally reported good, especially during the first half of the year. There were four active operators reporting for 1914 and one plant was idle. The increase in value of output over 1913 was $25,756, or 32.32 per cent.

Idaho.—Idaho showed a slight gain in value of sand-lime brick in 1914 over 1913 of $987, or 5.99 per cent. Three operators reported. Business was poor with little demand for brick.

Indiana.—Four plants in Indiana reported for 1914 sand-lime brick valued at $76,175, an increase over 1913 of $17,625, or 30.10 per cent. The industry had its beginning in the United States in 1901 in this State, which has been a steady producer ever since, though in recent years it has not been one of the leading States, being sixth in value of output in 1914. Business was reported by some producers as having been better in 1914 than in 1913, and by others not so good.

Iowa.—There are two plants in Iowa, only one of which was active in 1914; the other had not begun operations at the close of the year. The active plant reported business much improved over 1913.

Kentucky.—There is only one sand-lime brick plant in Kentucky, business was reported about the same as in 1913.

Massachusetts.—There were four active plants in Massachusetts in 1914—an increase of one. Notwithstanding this increase in the number of plants, the value of the product decreased $13,436, or 31.88 per cent. There were no plants inactive in the State, though one was shut down until September, and one was under construction at the close of the year.

Michigan.—Michigan has been the leading State in number of plants and in value of production of sand-lime brick since the beginning of the industry in this country, with the exception of one year—1906. Twelve plants reported production for 1914, the same number as for 1913. There was one inactive plant and one new plant. With but few exceptions, operators reported business not so good as in 1913. The value of sand-lime brick decreased in Michigan $65,461, or 20.38 per cent, in 1914. Michigan's production in 1914 was more than twice as great in value as that of Minnesota, the second State, and constituted more than 24 per cent of the total. The principal producing locality was Wayne County, in which Detroit is located. The output of this county in 1914 was 12,249,000 common brick, valued at $73,288, or $5.98 per thousand. The other producing counties were Genesee, Houghton, Huron, Jackson, Kalamazoo, Kent, Menominee, Oakland, and Saginaw.

Minnesota.—Minnesota was the second State in value of sand-lime brick in 1914, rising from third in 1913 and displacing New York. Four plants were active in 1914, the same number as in 1913. There was, however, a decrease in the value of the product in 1914 of $9,893, or 7.66 per cent. One plant was under construction during the year and one was idle but reported sales of brick from stock on hand. The others reported business about the same as in 1913. The active plants were located in Goodhue, Hennepin, Ramsey, and Rock counties.

Nebraska.—There were two plants in Nebraska in 1913, but one went out of business in 1914. The active operator reported business better in 1914 than in 1913.

New Jersey.—Of the four operators in New Jersey that reported production of sand-lime brick for 1913, only one was active in 1914, two have retired from the business, and one was idle. In consequence of this diminution in the number of plants the value of the output showed a large decrease in 1914 compared with 1913.

New York.—New York, which was the second State in the value of sand-lime brick in 1913, was third in 1914 and reported a product valued at $107,633, a decrease of $28,380, or 20.87 per cent. Four active operators reported for 1914, one less than in 1913. One plant had not begun operations at the close of the year, and five plants reported no sales. Business was reported as poor, especially during the latter part of the year. The active plants were located in Erie, Monroe, Onondaga, and Warren counties.

North Dakota.—There is only one plant in North Dakota, located in McHenry County. Business conditions in 1914 were reported as poorer than in 1913.

Ohio.—Ohio, the second State in the clay brick and tile industries, had only one active sand-lime brick plant reporting for 1914. This plant is located in Montgomery County. Demand for building material was reported as much lighter in 1914 than in 1913.

Oklahoma.—One active plant reported from Oklahoma for 1914, as for 1913, and business conditions were reported very poor as compared with 1913.

Pennsylvania.—Pennsylvania, the leading State in the production of clay brick and tile, was seventh in the production of sand-lime brick in 1914, and showed a large decrease in value of output—$19,256, or 26.14 per cent. Three active operators reported for 1914, and one company retired from the business. Business conditions were said generally to be poor, only one operator reporting them better than in 1913.

South Dakota.—Three active operators in South Dakota reported for 1914, an increase of one over 1913. One of these was new and the others reported business about the same as in 1913, or better. The value of the output showed a large proportionate increase in 1914 over 1913.

Texas.—Only two active operators reported from Texas for 1914, as for 1913, and one plant had not begun operations at the close of the year. Business conditions were not so good as in 1913, and the value of the product showed a considerable decrease.

Washington.—Only one active operator in Washington reported for 1914—a decrease of one from 1913.

Wisconsin.—Wisconsin was the fifth State in the value of sand-lime brick output in 1914, as in 1913. Business conditions were reported as good, and the value of the output increased $9,118 in 1914, or 11.76 per cent over 1913. The active plants are located in Columbia, Dane, Milwaukee, and Washington counties.

LITERATURE.

The literature in English on the sand-lime brick industry is very meager, though the Illinois State Geological Survey[1] published a list of 61 papers on the subject. The great majority of these are foreign, mostly German. The following list is taken principally from the Illinois Survey publication.

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POTASH SALTS.

By W. C. PHALEN.

INTRODUCTION.

The war in Europe caused a shortage of potash salts in the United States in 1914, a shortage later accentuated by an embargo on the export of potash salts promulgated by the German Government at the end of January, 1915. Voluminous discussions as to the remedy for this condition have appeared, especially with regard to the fertilizer industry, which consumes large quantities of potash salts. Other industries, for example, the soap, match, glass-making, photographic, and pharmaceutical industries and the chemical industry in general, have felt the deficiency of potash, for, although the agriculturists and the manufacturers of fertilizer differ as to the present necessity for a supply of potash salts, there is no doubt that the purely chemical industries are feeling the need greatly.

It is the purpose of this chapter to discuss briefly the work that has been done in this country in 1914 with a view to finding a domestic supply of potash salts which may, in part even, satisfy the domestic demand.

CONSUMPTION OF POTASH SALTS IN THE UNITED STATES.

The following table shows the potash salts, not including kainite and manure salts, imported into the United States during the calendar years 1911 to 1914, inclusive:

Potash salts imported for consumption into the United States for the calendar years 1911–1914, in pounds.

	1911		1912	
	Quantity.	Value.	Quantity.	Value.
Potash:				
Carbonate of, crude	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

Potash salts imported for consumption into the United States for the calendar years 1911-1914, in pounds—Continued.

	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Potash:				
Carbonate of, crude	9,715,878	$272,973	9,326,899	$265,158
Caustic, not including refined	[a] 8,648,753	342,056	[a] 7,284,176	285,739
Cyanide of	1,470,987	216,844	417,139	59,278
Chloride of	475,261,595	7,075,745	371,521,920	5,745,385
Nitrate of, saltpeter, crude	9,652,366	261,078	2,230,528	74,869
Sulphate of	88,698,193	1,677,429	80,447,360	1,557,224
All other	19,067,144	959,595	14,590,437	756,320
Total	612,514,916	10,805,720	485,818,459	8,743,973

[a] Including refined.

The decrease in quantity and value of the potash salts imported in 1914 amounted, respectively, to 126,696,457 pounds and $2,061,747, or 21 per cent in quantity and 19 per cent in value. The following table shows clearly at what time in 1914 this decrease took place and what normal imports might have been expected. This table shows also that the imports during the first and second quarters of 1914 exceeded those of the corresponding periods in 1913.

It is not easy to make close or safe broad comparisons, especially in considering salts of character so varied and uses so diverse as those shown in these tables. The carbonate of potash is used to a considerable extent in the glass-making industry, the cyanide in the metallurgical industry, the nitrate in the explosive industry, the sulphate and the chloride in the fertilizer industry, and these industries are constantly undergoing changes caused by local conditions and followed by variations in the demand for raw material.

The figures representing total imports in 1914 by kinds of potash are, however, interesting. The total imports of crude carbonate in 1914 were somewhat less than those in 1913; the imports of caustic potash declined considerably, as did also those of the chloride, the sulphate, as well as "all other" kinds. The imports of the cyanide and of crude nitrate showed a sharp decline. The decline in crude nitrate is very suggestive, especially if considered by quarters, for the imports during the second and third quarters of 1914 showed great increase over those of the first quarter, but there were no imports at all during the last quarter. Furthermore, the imports of this commodity during the first two quarters of 1914 appear widely different from those for the corresponding quarters of 1913.

Potash salts imported for consumption into the United States for the calendar years 1913 and 1914, by quarters, in pounds.

1913.

	First quarter.		Second quarter.		Third quarter.		Fourth quarter.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Potash:										
Carbonate of, crude	3,020,504	$91,792	3,511,542	$95,298	1,451,573	$39,034	1,732,259	$46,849	9,715,878	$272,973
Caustic, including refined	2,075,918	78,667	2,301,056	94,267	2,005,078	79,598	2,266,701	89,524	8,648,753	342,056
Cyanide of	92,693	14,248	439,198	60,131	231,312	35,648	707,784	106,817	1,470,987	216,844
Chloride of	129,669,971	1,863,097	87,039,624	1,456,270	114,392,320	1,675,627	144,159,680	2,080,751	475,261,595	7,075,745
Nitrate of, saltpeter, crude	5,350,423	122,489	2,314,289	75,905	1,203,654	35,216	784,000	27,468	9,652,366	261,078
Sulphate of	32,452,534	588,094	9,487,899	225,853	17,015,040	315,029	29,742,720	548,453	88,698,193	1,677,429
All other	4,906,530	259,599	5,955,537	234,744	3,621,430	166,368	4,583,647	298,884	19,067,144	959,595
Total	177,568,573	3,017,986	111,049,145	2,242,468	139,920,407	2,346,520	183,976,791	3,198,746	612,514,916	10,805,720

1914.

	First quarter.		Second quarter.		Third quarter.		Fourth quarter.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Potash:										
Carbonate of, crude	3,189,469	80,788	2,673,001	73,780	1,445,977	42,769	2,018,452	67,821	9,326,899	265,158
Caustic, including refined	1,932,744	73,586	2,379,680	85,920	919,320	36,723	2,052,432	89,510	7,284,176	285,739
Cyanide of	263,877	35,664	33,826	5,130	48,278	7,882	71,158	10,602	417,139	59,278
Chloride of	136,044,160	2,114,932	131,481,280	2,054,471	71,621,760	1,048,776	32,374,720	527,206	371,521,920	5,745,385
Nitrate of, saltpeter, crude	246,699	9,081	1,312,899	43,705	670,930	22,083	....	....	2,230,528	74,869
Sulphate of	31,568,320	592,537	22,442,560	431,472	16,383,360	324,325	10,053,120	208,890	80,447,360	1,557,224
All other	5,195,610	244,574	5,490,522	257,658	1,565,296	105,192	2,339,009	148,896	14,590,437	756,320
Total	178,440,879	3,151,162	165,813,768	2,952,136	92,654,921	1,587,750	48,908,891	1,052,925	485,818,459	8,743,973

The following table [1] shows the imports of potash salts in February, 1915, after the German embargo was passed, compared with February, 1914, which may be considered a normal month. The average prices per unit of quantity have been calculated in this office. The figures are so grouped as to show those potash salts, including kainite and manure salts, which are used chiefly as fertilizers and which are entered by the long ton, and the finer chemicals used in the arts and the chemical industries, in which the importing unit of quantity is the pound.

Imports of potash salts in the month of February, 1914 and 1915.

	February, 1914.			February, 1915.		
	Quantity.	Value.	Average price.	Quantity.	Value.	Average price.
Fertilizer salts:	*Long tons.*		*Per ton.*	*Long tons.*		*Per ton.*
Kainite	72,008	$321,723	$4.47	1,852	$18,445	$9.95
Manure salts	12,451	124,422	9.99	900	14,748	16.39
Sulphate of potash	5,098	210,327	41.26	1,378	59,804	43.40
Chloride of potash	13,172	431,820	32.78	22,818	836,368	36.65
Other potash salts:	*Pounds.*		*Per pound.*	*Pounds.*		*Per pound.*
Carbonate of potash	1,674,685	49,110	$0.03	1,317,849	46,015	$0.03
Caustic potash	520,166	19,607	.04	308,805	17,508	.06
Nitrate of potash	22,699	928	.04			
Cyanide of potash	5,641	890	.16	266,654	39,327	.15
Other potash salts	638,112	52,119	.08	456,011	42,429	.09

Among the striking points in this table are the great reduction in quantity and the great advance in the average price per ton of fertilizer materials imported in February, 1915, as compared with February, 1914. The reductions in the imports of other potash salts are not so marked, except for nitrate. The figures for cyanide in both February, 1914, and February, 1915, are very peculiar; the writer has no explanation of them to suggest.

The increased imports of chloride in February, 1915, are explicable on the ground that it was profitable to import only the most concentrated salts—that is, salts containing the largest quantity of potash (K_2O) per given weight of material. The high-grade sulphate and chloride come in this class, and of these two the chloride contains the larger quantity of potash (K_2O).

The potash salts given in the first two tables by years are only a portion of those entering the United States from Germany. Other low-grade potash fertilizer materials, such as kainite and manure salts, should be added. This latter class of material is imported by the ton.

[1] Daily Cons. and Trade Repts., March 25, 1915.

The following table gives the imports for consumption of fertilizers from 1910 to 1914, inclusive:

Fertilizers imported and entered for consumption in the United States, 1910–1914, in long tons.

Fertilizer.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Apatite			20	$300	100	$1,400
Bone dust or animal carbon, and bone ash, fit only for fertilizing purposes	48,979	$1,140,476	36,856	943,472	117,717	878,686
Calcium cyanamid or lime nitrogen	3,540	177,552	5,292	292,496	9,311	493,519
Guano	33,565	667,870	36,869	774,315	19,128	329,624
Kainite	582,197	2,798,198	563,957	2,748,140	511,976	2,386,362
Manure salts, including double manure salts	147,242	1,013,009	159,796	1,660,040	171,757	1,797,057
Phosphates, crude	21,706	235,040	16,153	157,394	28,821	231,255
Slag, basic, ground or unground	10,774	93,650	12,622	87,994	12,596	114,300
All other substances used only for manure	195,991	3,394,279	197,810	4,098,321	127,932	2,660,887
Total	1,043,994	9,520,074	1,029,375	10,762,472	999,338	8,893,090

Fertilizer.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Apatite	2,962	$22,471	20	$300
Bone dust or animal carbon, and bone ash, fit only for fertilizing purposes	35,012	851,136	36,000	892,529
Calcium cyanamid or lime nitrogen	26,729	1,410,248	21,793	1,119,785
Guano	16,674	518,429	25,335	761,562
Kainite	465,336	2,201,730	313,898	1,551,115
Manure salts, including double manure salts	223,687	2,245,509	168,969	1,846,475
Phosphates, crude	17,121	124,815	15,079	136,526
Slag, basic, ground or unground	13,186	130,455	9,199	105,272
All other substances used only for manure	154,729	3,314,460	171,603	3,507,875
Total	955,436	10,819,253	761,896	9,921,439

For comparison the tables for 1913 and 1914, showing imports of fertilizers by quarters, are also given below.

The figures for 1914 show a decrease in quantity of fertilizers imported of 193,540 long tons, or 20 per cent, but a decrease in value of only $897,814, or 8 per cent; that is, the declared value of these commodities greatly increased. The decreased importation of fertilizer materials is explained both by the difficulty of getting the raw materials and by the lack of steamers and the resultant high freight rates.

The effect of the war on the cotton industry also probably tended to decrease the imports of fertilizers in 1914.

Fertilizers imported and entered for consumption in the United States during the calendar years 1913 and 1914, by quarters, in long tons.

1913.

	First quarter.		Second quarter.		Third quarter.		Fourth quarter.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Apatite	2,870	$21,675	20	$300	72	$496	....	....	2,962	$22,471
Bone dust, etc	7,164	175,159	8,455	195,283	10,598	258,624	8,795	$222,070	35,012	851,136
Calcium cyanamid or lime nitrogen	8,479	451,974	1,549	85,079	4,634	260,835	12,067	612,360	26,729	1,410,248
Guano	2,478	66,220	2,537	64,439	2,127	44,157	9,532	343,613	16,674	518,429
Kainite	127,197	581,727	53,447	241,321	111,297	519,851	173,395	858,831	465,336	2,201,730
Manure salts	37,801	381,023	39,724	368,492	68,661	696,734	77,501	799,260	223,687	2,245,509
Phosphates, crude	6,371	60,358	1,447	13,027	7,078	35,737	2,225	15,693	17,121	124,815
Slag, basic	11,435	113,532	815	6,843	505	6,046	431	4,034	13,186	130,455
All other substances used only for manure	39,796	694,979	23,356	483,014	42,045	1,048,838	49,532	1,087,629	154,729	3,314,460
Total	243,591	2,546,647	131,350	1,457,798	247,017	2,871,318	333,478	3,943,490	955,436	10,819,253

1914.

	First quarter.		Second quarter.		Third quarter.		Fourth quarter.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Apatite	20	$300	....	....	....	....	....	....	20	$300
Bone dust, etc	12,388	313,922	9,665	$241,877	10,732	$257,070	3,215	$79,660	36,000	892,529
Calcium cyanamid or lime nitrogen	8,695	490,333	4,140	226,476	4,440	195,802	4,518	207,174	21,793	1,119,785
Guano	6,295	214,232	3,899	152,725	3,432	68,535	11,709	326,070	25,335	761,562
Kainite	185,836	938,560	55,584	262,377	71,788	346,302	690	3,876	313,898	1,551,115
Manure salts	46,661	488,453	68,154	772,566	42,905	444,652	11,249	140,804	168,969	1,846,475
Phosphates, crude	5,496	71,913	8,753	54,495	615	6,702	215	3,416	15,079	136,526
Slag, basic	6,940	82,901	1,633	15,584	626	6,787	....	....	9,199	105,272
All other substances used only for manure	57,437	1,186,912	48,151	917,906	29,565	565,024	36,450	838,033	171,603	3,507,875
Total	329,768	3,787,526	199,979	2,644,006	164,103	1,890,874	68,046	1,599,033	761,896	9,921,439

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 1911–1914, 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

	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Imports:[a]				
Fertilizers	955,436	$10,819,253	761,896	$9,921,439
Potassium chloride	212,170	7,075,745	165,858	5,745,385
Potassium sulphate	39,597	1,677,429	35,914	1,557,224
Sodium nitrate	612,861	21,630,811	545,730	15,204,539
Domestic phosphate rock	3,111,221	11,796,231	2,734,043	9,608,041
Total	....	52,999,469	....	42,036,628

[a] Imports for consumption.

Some of the main causes of the decrease in quantity and value of the imported commodities reported in the preceding tables, with the exception of sodium nitrate, have been explained. Without doubt some of these causes helped to decrease the imports of sodium nitrate, one such cause especially being the shortage in the world's carrying capacity. All the sodium nitrate imported is not used in the fertilizer industry. A large part of it is converted into nitric acid and into potassium nitrate, which is used in making gunpowder and other explosives and matches, in pyrotechnics, in assaying, in metallurgical and analytical operations, and in curing meat. The large imports of this material are, however, significant. For sodium nitrate, as for potash, the United States is entirely dependent on a foreign country.

PROGRESS IN SURVEY POTASH INVESTIGATIONS.

PRELIMINARY STATEMENT.

The search made by the United States Geological Survey in 1914 for commercial deposits of potash has consisted principally of exploration by deep drilling in the Black Rock Desert in Nevada and of incidental chemical work. Some general exploration and chemical research were also carried on during the year with a view of keeping all phases of the general potash investigation in progress. On account of the high cost of the work the field investigations have been limited to the drilling of a single deep well, to general reconnaissance, and to tracing and checking reported discoveries or possibilities.

As a result of the Survey's experience in drilling the Timberlake well, in the Carson Desert, 18 miles north of Fallon, Nev., in 1911 and 1912, it was suggested that further work might possibly be more efficiently accomplished by contract with an established well-drilling firm. Accordingly specifications for a well in the Black Rock Desert were issued and bids were called for. Most of the bids received were made in terms so indefinite that they could not be accepted as the basis of a Government contract. The other bids ranged from about $10,000 to $25,000 for a 1,500-foot well. These figures were so high that it was decided to do the work by day labor. D. H. Walker, of Tonopah, Nev., was made superintendent of the drilling crew and director of the mechanical details of the work, and performed his task with dispatch and efficiency. Acknowledgment is also due to the other members of the crew, consisting of J. W. Weaver and A. J. Proctor, drillers, and Homer Buckley and J. P. Gibson, driller's assistants. The Government rig used for the work done near Fallon was again used; the well was drilled with standard churn tools and was cased throughout. Drilling was started on September 6, 1914, and completed to the depth of 1,500 feet on November 16, covering 72 days in all, without notable mishap.

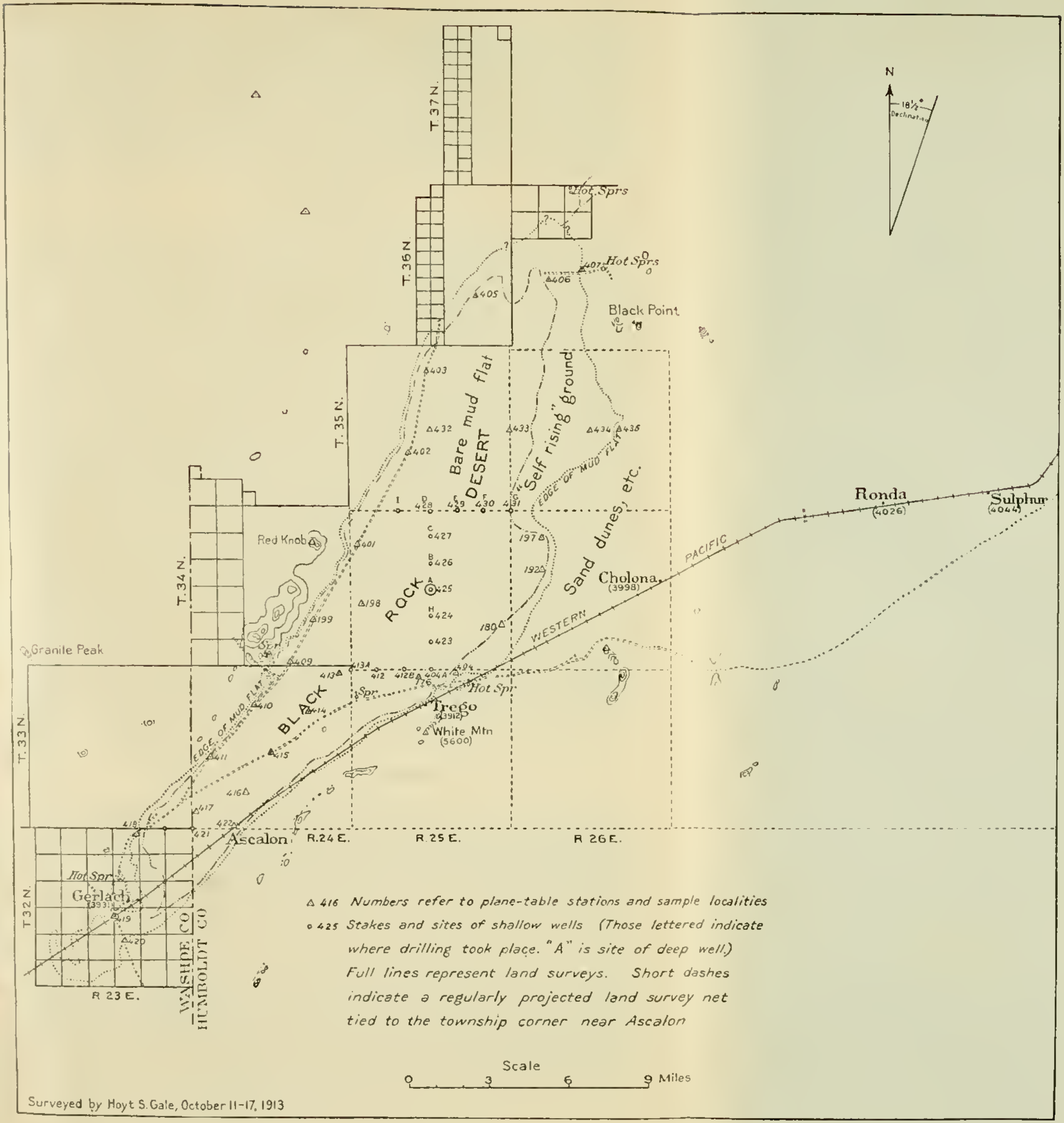
The sampling and study of the well record was in charge of M. I. Goldman, of the United States Geological Survey, who was assisted by A. T. Crandall during the season of drilling. Mr. Goldman is now engaged in a petrologic and analytical study of the materials obtained.

LOCATION.

The site selected for the boring is in the center of the Black Rock Desert, about 4½ miles due north of the flag station Trego, on the Western Pacific Railway, and 18 miles northeast of Gerlach, a division point on the railroad. The accompanying map (Pl. I) shows the location of the well and the outline of the desert or bare mud flat in which the work was done. The work of the season of 1914 had been preceded by the boring of 9 shallow wells to depths of 100 feet or less during the fall of 1913. The location of all these holes is noted on the map. The plan of the work was based on a theory discussed in several Survey publications, namely, that saline deposits must have been left by the evaporation of the immense body of water that formerly occupied these basins and that was a part of the prehistoric Lake Lahontan.

MATERIALS ENCOUNTERED.

The materials encountered consisted almost entirely of green and black clays. There were a few layers of hard limestone or marl, from 1 inch to 6 inches thick, and some rather sandy beds. At 505 feet a sandy bed was penetrated that carried water under sufficient pressure to raise a plug of sand, clay, and water about 300 feet in the well. This water seemed to be fresh. Another flow was noted at a depth



MAP OF THE BLACK ROCK DESERT, NEVADA, SHOWING LOCATION OF BOTH DEEP AND SHALLOW BORINGS BY THE UNITED STATES GEOLOGICAL SURVEY.

of 215 feet, and still another, which was very saline, at a depth of 7 feet below the surface of the playa clays. Samples of all materials penetrated by the drill were taken from nearly every bailing, so that they represent an average interval of 3 feet. Samples of water were taken systematically at intervals of 25 feet, as well as at intermediate levels where flows such as are described above were recognized or suspected. These samples were sent to the Survey in Washington, where some of them are now being studied and analyzed in preparation for a report.

CONCLUSIONS.

No bed of potash or other salts was encountered in this well; hence no discovery, such as was hoped for in this undertaking, has been made. No saline deposits that sufficiently represent the soluble salts believed to have been concentrated in this ancient body of water appear on the surface in this region, and it seems probable that somewhere in these desert basins such deposits, comparable in size with if not larger than that now known at Searles Lake, in southern California, may yet be found by drilling, perhaps to shallow depths. If such a deposit is found it should be essentially of the Searles Lake type and it should yield by pumping a large quantity of potash-bearing brines, valuable as a source of potash. This theory underlies the explorations that have been made by the Survey in the desert-basin region, explorations which so far have not led to any significant success in the development of potash deposits in the basins of northern Nevada, where most of the work has been done. The work has not yet been carried far enough to justify a definite conclusion either for or against the original desert-basin hypothesis of the occurrence of workable bodies of soluble potash salts. The field to be explored is large and the facilities for exploration have limited the trials to a few localities, so that a decisive test of the hypothesis may be missed through failure to try at just the right place. As the work proceeds, confidence increases with the understanding gained of the actual history and constitution of desert-basin deposits, and it is hoped that another season's work may lead to a definite conclusion.

WORK IN THE "RED BEDS."[1]

While the tests in the desert basins have been going on attention has also been given to the one other principal phase of the exploration for potash by the Survey in this country, namely, the search in the Permo-Triassic or "red bed" salines in the hope of finding deposits of the Stassfurt or marine type. Reports of such discoveries are received from time to time, particularly from Texas and New Mexico, and it is hoped that some important developments may be made in this region.

During parts of the last two seasons N. H. Darton, of the United States Geological Survey, has been examining the "red beds" of New Mexico to ascertain whether or not they are likely to include deposits of potash salts. These red strata contain vast beds of gypsum and considerable sodium chloride, both evidences of prolonged desiccation

[1] See also descriptions under Texas.

of an inland sea. In certain areas this process may have continued until the more soluble salts were also deposited, and those should contain considerable potash. Moreover, the "red beds," with their deposits of gypsum and salt, closely resemble the series of beds that yield potash in Germany. It is not expected that materials so soluble as potash minerals would outcrop at the surface, but by close study of the distribution of the products of desiccation in the "red beds" it may be possible to locate points at which exploratory borings could be made to best advantage.

SEARCH FOR NITRATES BY THE GEOLOGICAL SURVEY.

Many samples of nitrate-bearing materials, including both sodium and potassium nitrates, were collected and examined during 1914. Press announcements noting the discovery of such materials in the vicinity of Homedale, Idaho, Rodeo, N. Mex., and at other places have been followed by inquiry and by the analysis of specimens submitted. Members of the Survey examined the deposit at Homedale, Idaho, and similar deposits near Gerlach and Soldier Meadows, Idaho, and McDermitt, Oreg.

All these examinations have led to essentially the same conclusion. The niter occurs as incrustations in crevices, in cliffs, in caves, or on the fractured surface parts of the country rock, usually a lava or a tuff. Some selected samples give a very high content of nitrate, but, so far as it has been possible to determine, these rocks do not carry enough nitrates to justify commercial work on them. Attempts have repeatedly been made to exploit such deposits in many parts of the country, but except that they produced small quantities of niter from cave deposits during the stress of war, these attempts have not been successful.

INVESTIGATIONS BY THE BUREAU OF SOILS.[1]

During 1914 the Bureau of Soils of the Department of Agriculture accomplished a large volume of work in advising persons throughout the country regarding possible sources of potash salts, and in determining the character and probable value of samples submitted.

The strictly investigational work of the bureau has been much curtailed, but some work was done on the potash-bearing silicates and on alunite. Two important papers were issued by the bureau, which are summarized farther on in this report. The major work of the bureau was done on Pacific coast kelp. (See pp. 32–33.)

SEARLES LAKE (CAL.) POTASH DEPOSITS.

Notes on the saline deposits at Searles Lake, Cal., have been published in Mineral Resources for both 1912 and 1913.[2] The locality still continues to attract attention as the site of the most important potential source of soluble potash salts in the United States now known, and for this reason the descriptions already published will here be supplemented by notes from the literature that appeared on these deposits during 1914.

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[1] Acknowledgment is hereby made to Dr. F. K. Cameron, of the Bureau of Soils, for this statement regarding the work of the bureau in 1914.

[2] Potash salts, summary for 1912: U. S. Geol. Survey Mineral Resources, 1912, pt. 2, pp. 884–889, 1913; idem for 1913: U. S. Geol. Survey Mineral Resources, 1913, pt. 2, pp. 87–89, 1914.

Searles Lake, known also as Slate Range Marsh and Borax Flat, is a broad, roughly elliptical valley, 8 to 10 miles from east to west and 20 to 25 miles from north to south. It lies between the Argus range on the west or northwest and the Slate range on the east, in the extreme northwestern part of San Bernadino County, near Kern and Inyo counties. The camp at the old soda works in the Searles Basin is in the northwestern part of the main desert flat, about 25 miles by road from Searles post office, formerly Garden station, an old stage station on the overland route through this part of the desert country. Garden station is now only about a mile east of the branch line of the Southern Pacific Railroad. Searles Lake was formerly reached by the regular stage that runs from Johannesburg, via Garden station or Searles, to Searles Lake and thence on to Ballarat and Skidoo, and passenger traffic doubtless still goes this way; but the branch railroad that connects Searles Basin with the main line of the Southern Pacific Railroad is now completed.

In a privately published pamphlet E. E. Free [1] has outlined the history of Searles Lake with reference to its content of potash salts, and the reader is referred to this pamphlet for a concise statement of the progress of developments at that locality.

The American Trona Corporation was incorporated in 1913 to operate works for refining and marketing certain of the saline constituents of the Searles Lake deposits. An outline of the plan of treatment of the bitterns was published in this report for 1913. The initial unit there referred to has enabled the corporation to test different types of apparatus, such as heaters, coolers, filters, and condensers. The present plant has cost about $150,000, but the corporation hopes to save as much as this amount in the construction of the final works by knowledge gained during the operation of this large-scale testing plant.

Some of the first precipitations in the experimental plant have already been made, and sodium carbonate, sodium chloride, and sodium sulphate have been separated. Potassium chloride is the last salt to be recovered.

No potash salts were produced in 1914 at the American Trona Corporation's plant at Searles Lake, and, according to report at the end of the year, no potash salts would be ready for the market until late in 1915.

During the year 1914, C. E. Dolbear, of Berkeley, Cal., patented processes for the recovery of the more valuable saline constituents of a bittern, such as occurs at Searles Lake, Cal.[2]

TEXAS.[3]

SPUR WELL, DICKENS COUNTY, TEX.

In the search for a deep source of potable water at Spur, Dickens County, Tex., a deep well was drilled by S. M. Swenson & Sons, of New York. The total depth of the well is 4,489 feet.

The presence of much anhydrite and salt in the section led to the suggestion by J. A. Udden, of the Bureau of Economic Geology and Technology of the University of Texas, that the deposits might

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[1] Searles potash lands: Historical statement, January, 1915.
[2] See U. S. patents Nos. 1088216 and 1088333, both dated Feb. 24, 1914.
[3] Udden, J. A., The deep boring at Spur: Texas Univ. Bull. 363, pp. 82–89, Oct. 5, 1914.

contain potash salts. The well had in the meantime been cased below 1,300 feet. A sample was taken after the water had been baled to a depth of 2,200 feet and was examined by S. H. Worrell, then connected with the bureau, with the following result:

Analysis of water from well at Spur, Tex.

	Grains per gallon.
Calcium sulphate	1,406.19
Calcium chloride	679.02
Magnesium chloride	219.20
Sodium chloride	3,410.55
Potassium chloride	324.14
	6,039.10

The potassium chloride, therefore, amounts to 5 grams per liter and constitutes more than 5.4 per cent of the total solids. As this quantity of potash salts is somewhat high for a natural water, arrangements were later made for obtaining samples from different depths below the foot of the casing (1,350 feet). Fourteen samples were obtained about two months later and were tested for potash salts; but only one of them, a sample taken at the same depth as that which by the earlier tests showed a marked content of potassium chloride, contained any considerable quantity of potash salts, and the quantity found was only about one-third of that shown by the earlier sample. The results, therefore, seem to indicate the presence in the well of a potash-bearing layer, bed, or stratum approximately 2,200 feet below the surface.

Dr. Udden writes:[1]

In either direction north or south from Spur the formations lie practically horizontal for at least a hundred miles, and the potash-bearing horizon, whether it be such or not in other places, must be at about the same depth as here, in these directions. It seems to the writer that the general conditions indicated in [the Spur] boring, the existence of great salt beds and beds of anhydrite, together with the proved potash-bearing stratum, warrant an examination for potash in water from the same horizon in any boring made in this territory.

The strata in the region dip to the west; hence the depth to this horizon will be greater westward and less eastward.

The elevation of the railroad depot at Spur is 2,274 feet above sea level. This is 666 feet higher than the elevation at Cisco, about 120 miles to the east-southeast. A line connecting these two points may be taken to follow the direction of the general dip of the formations to the west. The bottom of the well may be taken to represent the beds outcropping at Cisco. On this assumption the general dip between Cisco and Spur, a distance of 120 miles, will be equal to the depth of the Spur well, less the difference in elevation of the two places. This gives us a dip to the west of nearly 32 feet per mile. Our inability to fix the precise level in the Cisco formation reached in the boring may make this figure either a little too high or too low, but it can not be far from right. Taking into consideration the general east slope of the land surface, which averages 6 feet per mile, any stratum should come nearer the surface at the rate of 38 feet per mile eastward from Spur.

OUTCROP OF THE POTASH-BEARING HORIZON.

Assuming now that this general dip is constant between [Spur and Cisco], and that the formations are continuous, the horizon which yielded potash in the Spur well should outcrop in a belt where the land surface intersects the dipping plane lying 2,200 feet below the surface at Spur. This belt would extend through Haskell and Jones counties. It is not to be expected that potash should be found in any outcropping rock in this belt, owing to the surface leaching, but well waters there should show its former existence.

[1] Idem, pp. 87-89.

A number of water samples from wells near Haskell have been analyzed and found to contain an unusually large quantity of nitrate, which is not believed to be derived from the surface.

It is suspected that this nitrate exists in the form of a potassium compound, as saltpeter. Along the line of the Kansas City, Mexico & Orient Railroad in these counties the potash-bearing horizon may be looked for at depths of from 100 to 400 feet.

NITRATES IN TEXAS.

In August, 1914, William B. Phillips,[1] director of the Bureau of Economic Geology and Technology, University of Texas, visited a locality in Texas from which he had received a sample of a mixture of sodium nitrate and potassium nitrate. The locality is in section 120, block G–4, Brewster County, Tex., about 5 miles east of Maverick Mountain, between this mountain and the more immediate western foothills of the Chisos Mountains. The nearest railroad point is Marathon or Alpine, both stations of the Southern Pacific Railroad, in Brewster County, from 230 to 260 miles southeast of El Paso. The Terlingua quicksilver district is from 6 to 12 miles west of the locality.

The nitrate occurs as incrustations on and thin seams in a porous sandstone of Cretaceous age. A few inches within the sandstone no nitrate is found. Thin seams of nitrate of potassium occur also in red porphyry in the vicinity. With reference to the occurrence in the Cretaceous sandstone, Phillips concludes that the nitrate of potassium has not been derived from deep-lying deposits by capillary action, but that it probably originated from animal excreta.

Other occurrences of nitrate in Texas are mentioned, for example, on Devils River, Val Verde County, and near Candelaria, Presidio County; but in summing up the entire situation, Phillips concludes—

that the only hopeful outlook for the existence of workable beds of potash salts in Texas is in the direction already indicated by Dr. Udden and in the almost wholly unknown region southeast of and bordering on New Mexico. Explorations in either of these areas would have to be in depth, with systematic chemical examination of cuttings and return waters.

ALUNITE.

UTILIZATION OF ALUNITE.

The principal uses that have been suggested for the mineral alunite, which is a hydrous sulphate of potassium and aluminum, are as a source of potash salts, as a fertilizer, and as a possible source of alumina. In certain patents which have been issued for apparatus for treating alunite, means have been devised for conserving the fumes given off in roasting. Owing to the expense attached to conserving these fumes, to the small market for sulphuric acid in the West at the present time, and to the fact that the utilization of alunite is still in the problematic stages, it is very unlikely that the conservation of sulphuric acid from alunite will be seriously considered for some years at least.

Another use that has been suggested for alunite is in making certain kinds of semiopaque glass, since both potash and alumina are essential to the manufacture of such glass.

[1] Am. Inst. Min. Eng. Bull. 98, pp. 121–127, February, 1915.

Since attention has been directed to the mineral alunite as a possible source of potash salts and alumina, it has been found to be of widespread occurrence in certain Western States and alunitization is now recognized as a rather common form of rock alteration; the deposits in Utah, however, and especially those nearest Marysvale, are the only ones that have been thus far regarded as of commercial importance. The composition of the Marysvale mineral is indicated below:

Analyses of alunite from deposit near Marysvale, Utah.

	18	19	Dana.		18	19	Dana.
Al_2O_3	37.18	34.40	37.0	H_2O+	12.90	13.08	13.0
Fe_2O_3	Trace.	Trace.		H_2O-	.09	.11	
SO_3	38.34	36.54	38.6	SiO_2	.22	5.28	
P_2O_5	.58	.50					
K_2O	10.46	9.71	11.4		100.10	100.18	100.0
Na_2O	.33	.56					

No. 18 is a selected specimen of the supposedly best material. It consists of clear pink, subtransparent, coarsely granular, crystalline rock. No. 19 is a selected specimen of a light pink, very finely granular rock, of almost porcelain-like conchoidal fracture and no distinct structure.

Among the plans suggested for exploiting the Marysville alunite is that of erecting a refining plant, to be installed in 1915. Because of the possible injury to the forests from the fumes of the oxides of sulphur given off during the roasting of the mineral, it is thought that the plant will not be permitted in the mountains near the deposit itself. It is therefore probable that it will be built near the Denver & Rio Grande station at Marysvale, where the prevailing winds will carry the acid fumes into the barren foothills of the ranges east of the valley. A tramway is projected to convey the ore from Cottonwood Canyon to the plant.

It is reported that the Florence Mining & Milling Co. has let a contract for the extraction and transportation of 350 tons of alunite from this property. The ore is to be sent to Cincinnati, Ohio, for experimental work.[1]

RECENTLY STUDIED ALUNITE DEPOSITS IN UTAH.

Since the publication by the Survey in 1912 of descriptions of alunite in the vicinity of Marysvale, Piute County, Utah, notices of several other occurrences of this mineral have been published in Mineral Resources. The most important deposits near Marysvale are those on the east side of the Tushar Range, but an interesting deposit on the west side of the range in the Newton mining district, about 9 miles northeast of Beaver, Beaver County, was mentioned in these pages in 1913. The deposits on both the east and the west sides of the range were visited and studied by G. F. Loughlin, of the Survey, in the summer of 1914. The following notes are contributed by Mr. Loughlin.

The principal groups of alunite prospects occur in three roughly parallel zones trending north or northwest. The western and the

[1] Min. Press [Min. and Sci. Press], Jan. 16, 1915, p. 123.

middle zones are controlled by the Florence Mining & Milling Co.; the eastern zone has its northern end within the southeast corner of this company's property, but lies chiefly within the Custer group of claims, belonging to the Mineral Products Co.

The western zone has a northwest course and is roughly parallel to the North Branch of the Main Fork of Little Cottonwood Creek. In this zone alunite has been exposed at a number of places and the true thickness of the largest vein here must be at least 25 feet. A section made by pacing along a trench shows that the vein contains about 80 per cent high-grade alunite. Scattered fragments of alunite or float suggest the possibility that there may be several veins in this zone or that the main vein may branch. Another vein, 8 feet thick, was noted. Other exposures were observed southeast of the thick one first mentioned, one of which appears to include a thickness of 20 feet of high-grade alunite.

The middle zone extends along the crest of the ridge which divides the North Fork from the Middle or Main Fork of Little Cottonwood Creek. Alunite has been traced in this zone from Edna Peak (Edna "Geyser") southward to the fork of the ridge. It has been prospected, however, only in shallow trenches. At Edna Peak alunite has been found on the northwestern and southeastern slopes of the ridge, but only one vein has been traced southward, namely, that on the southeastern slope, which, 900 feet south of Edna Peak, has been exposed for a width of 15 feet. It is exposed by trenches here for 650 feet, the distance from Edna Peak to the southernmost of these trenches being about 1,550 feet. About 400 feet farther south alunite is again exposed.

A partial analysis of the coarsely crystalline alunite from this vein on the Sunshine Fraction claim is given in column 1 of the following table:

Analyses of alunite from claims near Marysvale, Utah.

	1	2
Loss on ignition	42.8	42.1
Insoluble residue (alumina with perhaps a little silica)	39.3	37.6
Potassium sulphate (K_2SO_4)	16.8	18.5
(Equivalent potassa (K_2O))	(9.1)	(10.0)

1. 1,000-pound sample from Sunshine claim.
2. 1,000 pound sample from North Fork claim.

DEPOSITS ON THE WEST SLOPE OF TUSHAR MOUNTAINS.

A few deposits of alunite have been reported from the west slope of Tushar Mountains, but that at Sheep Rock, 9 miles northeast of Beaver, was the only one visited in 1914. This deposit was noted in this report for 1913. Mr. Loughlin thinks it is of too low grade to be of immediate importance as a source of alunite.

The material of highest grade was found in the talus on the north slope of Sheep Rock. This high-grade material, however, contains so much silica that, compared with the much purer product in the Marysvale veins, the cost of crushing and calcining it will be so great as to prohibit its use for any but local purposes.

KELP.

UTILIZATION OF KELP.[1]

The American Potash Co., with headquarters at Long Beach, Cal., is now making nearly pure potash salts from kelp and is arranging to increase its capacity in the near future. The company is saving the crude by-products but has not yet prepared them for the market.

A kelp project known as the Kelp Products Co. was incorporated in San Francisco early in 1914. According to the prospectus of the company the initial plant is to be located at San Diego and the intention is to market dry ground kelp and products from it—that is, potash salts and iodine. Early in 1915 it was stated that the first unit of the project would be in operation in February of that year, and that it is the intention of the company to build 10 units in rapid succession.

Other companies that have been reported as proposing to engage in the production of potash salts from kelp are: The Consolidated Potash Co., Los Angeles, Cal., and the Columbia Chemical Co., Los Angeles, Cal.

PROCESS OF RECOVERING POTASH SALTS FROM KELP.

Harry Wilson[2] has patented a process of recovering potassium chloride and potassium nitrate from kelp. The kelp is placed in a filtering vessel from which light is excluded. Decomposition ensues within the vessel and the potassium chloride effloresces, accumulating on its outside. After the moisture in the vessel is evaporated, water is added, and evaporation and efflorescence proceed as before, by which process the potassium nitrate is obtained. The whole process takes considerable time. The residue in the vessel may be dried, pulverized, and used as a fertilizer, as it contains sufficient nitrate, potash, and phosphate salts to make it suitable for this purpose.

PAPER ON ECONOMIC VALUE OF KELP INDUSTRY.

In a paper by John S. Burd,[3] discussing the economic value of Pacific coast kelp and the possibility of developing a kelp industry, the significant statement is made that—

> the production of manufactured products from kelp is unquestionably a relatively complicated process. The estimates show that the gross income derivable from the various products is not great. It would seem, therefore, that expectations of enormous profits from the development of a kelp industry are not likely to be realized. On the other hand, the data do not exclude the possibility of some profit.

PROCESS OF RECOVERING POTASH SALTS IN CEMENT MANUFACTURE.

The mixture of limestone or marl and clay or shale which is calcined to form Portland cement clinker contains an appreciable quantity of sodium and potassium, the proportion of potassium in the raw material often exceeding 1 per cent. In the ordinary process of making cement clinker by burning, these alkali metals contained in the

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[1] See investigations by the Bureau of Soils on page 18. E. E. Free, chemical engineer, in a report to clients, dated San Francisco, Sept. 17, 1914, gives some interesting data, together with estimates on the cost and the profits involved in the manufacture of potash salts from kelp.

[2] U. S. patent No. 1087477, dated Feb. 17, 1914. See also U. S. patent No. 1087478, dated Feb. 17, 1914, in which device for drying kelp is described.

[3] California Univ. Exper. Sta. Bull. 248, p. 211, February, 1915.

flue dust are for the most part in a form insoluble in water and are therefore incapable of being recovered in an aqueous solution. A considerable proportion of the alkali of certain raw materials is, however, given off in form soluble in water and is capable of recovery by a process described by S. B. Newberry.[1]

The most practical and economical method of accomplishing the absorption by water, according to Newberry, is to cause the gases to meet a stream of water moving in the opposite direction, and in this manner to extract practically all the water-soluble salts and at the same time to concentrate the resulting solution by evaporation to the point of crystallization or even to complete dryness. This is accomplished by causing the gases to pass upward through a tower filled with an open checkerwork of brick, at the top of which a spray of water is introduced. The flow of water is so adjusted that most of it is evaporated in its descent over the brickwork surface in contact with the gases. A small stream of concentrated solution of salts is continually discharged at the bottom of the tower. Of course, instead of water a solution of alkali-metal salts obtained by leaching the flue dust with water may be employed for absorbing the salts from the flue gases. The text of the patent is illustrated by diagrams.

SILICATE ROCKS AS A SOURCE OF POTASH SALTS.

CUSHMAN AND COGGESHALL PROCESS.

A large part of all the potash salts used in the manufacture of commercial fertilizers is consumed east of the Allegheny Mountains, and by far the greatest quantity goes into the Southern States, especially to North Carolina, South Carolina, Georgia, and Alabama. The additional fact that some of the great masses of feldspar-bearing rocks of the Appalachian Mountain region are in close proximity to those regions where potash salts are in greatest demand makes the extraction of potash from feldspar a problem of more than usual interest to the chemist and the chemical engineer. A paper by A. S. Cushman and G. W. Coggeshall[2] outlines in great detail a method of such extraction and the cost involved. For these details the reader is referred to the original article.

The paper, which may be considered an elaboration of a previous one, referred to in this report for 1912, gives the results of later investigations on feldspar as a source of potash salts. The general opinion among investigators of the feldspars appears to be that these salts alone will not pay for the cost of extraction and that, unless other commercial products also are recovered, the attempt to extract potash salts must be a failure. After a close study of the problem for some years, these writers express the opinion that "the economic feasibility of turning to the feldspars as a source of potash is, to say the least, open to debate."

The previous paper of these investigators described a process whereby insoluble potash in feldspars was converted to a soluble chloride, which, however, was not separated from the residual material. The product contained about 4.5 per cent of water-soluble potash (K_2O) in the form of 7.1 per cent of potassium chloride (KCl)

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[1] U. S. patent No. 1121532, dated Dec. 15, 1914.

[2] Feldspar as a possible source of American potash. Presented before the Seventh Ann. Mtg. Am. Inst. Chem. Eng., Philadelphia, Pa., Dec. 2, 1914.

and about 16 per cent of free lime, the remainder being insoluble mineral matter. The feasibility of producing this material continuously and regularly, as noted in the last paper, was completely demonstrated, and moreover the field experiments in its use have proved to be favorable.

The following description of the process used is taken from the paper of Cushman and Coggeshall:[1]

METHOD OF PRODUCTION.

A mixture of ground feldspar, containing about 10 per cent of K_2O and burned limestone, is formed into rounded aggregates or "clumps" about one-fourth inch in diameter by the device already employed, using a solution of calcium chloride for this purpose. Calcium chloride is the by-product of the ammonia-soda alkali process and is the reactive agent in unlocking the potash from the silica. Mixtures of powdered rock and dry calcium chloride are almost impossible to make, due to the attraction of the chloride for moisture. Moreover, simple mixing of two materials in the form of fine powder does not give an intimate enough contact of the reacting particles to produce good yields in furnacing operations in which neither of the particles is melted, so as to "wet" the other. In this particular case it was found that a proportion of burned lime mixed with the powdered feldspar will unite with $CaCl_2$, from a solution sprinkled on the powder, to form an oxy-chloride compound which cements the whole powder into aggregates, giving such a very intimate union of the particles that when heated the reaction yields are high.

These aggregates or "clumps" pass directly into the rotary kiln heated either by oil or powdered-coal flame. The clumps fall out of the kiln in the same form in which they entered it, but the potash has been converted from the insoluble form into the water-soluble chloride. These red-hot clumps fall into water in leaching vats, where the potassium chloride goes into solution. Several of these leaching vats are used, so that the solution of the salt, the leaching, washing, etc., are continually performed. The strong solutions are pumped to the evaporators. The weaker wash liquors are used as leaching liquids for a new lot of processed clumps. The strong liquor containing roughly 10 per cent of KCl will be continuously sprayed down through the hot gases passing out of the kilns to the stacks. * * *

The bulk of the water in these solutions is thus evaporated and only very concentrated solutions or sludges are allowed to pass out. These very strong, hot liquors are finally dried out in a rotary drier placed at the head of the lime-burning kiln, using its hot waste gases. The crusts formed are then ground for the market.

The concentrated solution before complete drying contains a small proportion of sodium chloride, corresponding in amount to the proportion of Na_2O in the original feldspar. On a spar running 10 per cent K_2O the Na_2O content has averaged from 1.5 to 2 per cent. This would give from the liquors completely dried at once, without any fractional separation of the NaCl, a product having about the following composition: KCl, 70 to 80 per cent; NaCl, 14 to 16 per cent, and the balance a very small amount of lime salts and moisture.

To compare this initial product with imported German chlorides the following analyses are given, upon which such salts are usually bought in this country:

	Chloride, 70 to 75 per cent.	Chloride, 80 to 85 per cent.		Chloride, 70 to 75 per cent.	Chloride, 80 to 85 per cent.
KCl	72.5	83.5	$CaSO_4$	0.2	
K_2SO_4	1.7		Insoluble	.5	0.2
$MgSO_4$	.8	.4	Water	2.5	1.1
$MgCl_2$	.6	.3			
NaCl	21.2	14.5		100.0	100.0

It is thus seen that, without any attempt at fractional separation, chloride of potash may be made from our American feldspar equal in character to the usual imported muriates, and that [it is] as well adapted to be used in commercial mixed fertilizers as those imported.

[1] Reprinted in the American Fertilizer, Dec. 12, 1914, pp. 24-25.

COWLES PROCESS.[1]

As bearing on the problem of procuring potash salts from silicate rocks or feldspar, the following process for making alkali-silico-aluminate richer in alkali than feldspar, patented by A. H. Cowles, is of interest. Cowles describes the process as follows: Finely divided clay or potash feldspar, or feldspar mixed with clay or bauxite in powdered form or in the form of small masses, is subjected in a rotary or other form of chamber furnace to the action of the vapor of salt and water.

The rapidity of the conversion into alkali-silico-aluminate is dependent on the amount of surface exposed to the vapors of the salt and water. It takes place almost instantly when finely ground feldspar or clay, freed from uncombined water, is reduced to dust form and so treated. The following is the reaction that takes place, and for pure clay it is typical of the process:

$$Al_2O_3.2SiO_2+4NaCl+2H_2O+yH_2O=$$
$$(Na_2O)_2(SiO_2)_2Al_2O_3+4HCl+yH_2O$$

From this it will be seen that the hydrochloric acid (4HCl) must have sufficient water, $2H_2O$ (and yH_2O), either from the admission of steam or from the combustion gases to furnish the requisite amount of water in the vapors for the full reaction and to materially aid in the condensation of the hydrochloric acid produced. This quantity of water will vary according to the design of the hydrochloric acid condensing system and the amount of water that may be admitted as water to the coke towers.

HART PROCESS.

The Hart process for procuring potash and aluminum compounds from raw materials containing them in insoluble form was outlined in this report for 1913. It is reported [2] that a plant will be built at Easton, Pa., to work out experimentally the details of the process. E. Hart, the inventor of the process, will be the head of the company.

The process is as follows: [3] When feldspar or similar rock is mixed with potassium or sodium sulphate and carbon and heated to fusion in a furnace, there is formed a soluble glass, consisting of a potassium or sodium aluminum silicate. This glass may readily be decomposed by the addition of a suitable acid, such as sulphuric. The decomposition yields practically pure silica and a solution from which potassium and aluminum may be obtained in the form of common potash alum, the residue being a mother liquor that contains sulphates of potassium, sodium, or aluminum, some free sulphuric acid, and other sulphates formed by the action of the acid.

The mother liquor is evaporated to dryness and fused with a suitable quantity of carbon. The residue from this consists chiefly of aluminate of soda or potash or both, together with alumina. If water be added to this residue, the aluminate of soda or potash will be largely dissolved and there will be left an insoluble residue consisting

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[1] U. S. patent No. 1111881, dated Sept. 29, 1914; see also patent by Cowles on a method of making alkali-silico-aluminate, U. S. patent No. 1123693, dated Jan. 5, 1915.
[2] Am. Fertilizer, Dec. 26, 1914, p. 23.
[3] U. S. patent No. 1062278, dated May 20, 1913.

chiefly of sulphide of iron with possibly some alumina. From the solution of the aluminate of soda or potash, alumina may be obtained by the usual methods.

FOREIGN DEPOSITS OF POTASH SALTS.

The principal foreign deposits of potash salts are in the neighborhood of Stassfurt, in the Magdeburg-Halberstadt region of Germany, a region which for many years has been the source of the world's supply. The fact that potash salts deposits occur also in Alsace is interesting, especially in view of the problematic status of that province at the close of the present European war.[1]

The deposits in Galicia have also assumed unusual interest in connection with the war. Early in 1914 it was reported that the deposits near Kalusz, which have been known for some years, were to be developed on a much larger scale than before and that a company which had acquired prospecting rights for potash salts all over Galicia had started to sink a shaft and would reach the producing stage in the fall of 1914.[2] The war without doubt has completely changed all these plans.

POTASH DEPOSITS IN SPAIN.

LOCATION.

During the last three or four years valuable deposits of potassium salts have been found in shafts sunk in construction work in mining salt near Suria, south of Cardona, near Barcelona, in northeastern Spain. The following notes on these deposits are given by C. B. Hurst:[3]

The tracts in Cataluna (Catalonia) in which the beds of potassium salts exist are chiefly in the two Provinces of Barcelona and Lerida, particularly in the latter, near the towns of Suria and Cardona on the Cardona River. At present, concessions do not go beyond Solsona on the north and the towns of Tarrega, Servera, and Manresa on the south, the entire district being practically confined between the Segre and Llobregat Rivers. In this region a number of claims for mining concessions have been made on lands where there is no conclusive proof that potash exists in commercial quantities, although it is possible that these lands contain potash and that the potash-producing area may extend considerably beyond the confines mentioned. Thus far the prospecting has been satisfactory at and near Suria, but a thorough investigation must be made at Cardona and Callus, nearly midway between which Suria is situated.

There will be some difficulty in arriving at an accurate estimate as to the extent of the potash beds, because the salt does not lie in a regular basin, as in upper Alsace and at Stassfurt, Germany. Borings will have to be made with expert knowledge of the geological formation of the country under consideration. A Spanish mining engineer has stated that an appreciable amount of capital will be required to make the necessary survey in Cataluna but that the chances for finding potash in remunerative quantity are favorable.

When this discovery became known some important foreign companies, with the help of Spanish interests, sought for many extensive mining concessions, both near Suria and in many other localities where there was any geological indication that potash might possibly exist. Up to August 1, 1914, borings were being made in various parts of the territory in question by one or another of the interested companies in order to determine the exact chances of exploiting potash mines.

Up to the present potash has not been extracted in Spain in commercial quantities. It has been proved, however, that potash does exist near Barcelona; that it is fairly

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[1] Witt, O. N., Chem. Zeitung, Oct. 8, 1914, pp. 1117-1119.
[2] Min. Jour. (London), July 11, 1914.
[3] Hurst, C. B., U. S. Consul General at Barcelona, Daily Cons. and Trade Repts., Nov. 6, 1914.

amenable to refining; and that the deposits may become a basis of a world trade with Barcelona as an export center. Examination and tests thus far have indicated only enough potash for consumption in Spain, but they have been so limited that it is impossible to estimate the quantity and grade of the deposits and the difficulties that may have to be undertaken in mining for this salt.

It is presumed from the varied data gathered that the potash beds are extensive and rich and likely to have an important bearing on agriculture and certain highly important manufacturing industries, both in the Peninsula and abroad. What is now needed is a scientific and extensive survey of the regions in this part of Spain where marked traces of potassium salts have been found. For local consumption it is now probably possible to put certain quantities of potash on the market. As an article for export in regular and unfailing shipments, present indications do not point to a definite or even early conclusion.

In July, 1914, a bill was presented to the Cortes by the minister of public works for the purpose of submitting to state intervention the exploitation of potassium salts and other minerals of great national importance. The bill, which has not yet become law, provides that uninterrupted working of concessions be granted, whether for carrying on experimental boring or for exploiting potash itself. The state will be empowered to subordinate the exploitation to the interests of the country and impose special conditions in favor of the consumption in Spain independently of the financial measures that may be adopted relative to exploitation. A mine that produces potash may not suspend its operations as long as the potash is minable, except for the following reasons: On account of an accident or force majeur; through a possible crisis which affects the consuming markets and the minerals produced in the mine; or when the net value of the products extracted does not cover the cost of production of the same. The state may reserve to itself the right of concessions to mineral-producing lands that may be brought to its attention by official experts.

A royal decree published October 1, 1914, directs that the state may reserve the right to exclude either temporarily or definitely concessions for free lands; that the ministry of public works may designate for the purpose of investigating, discovering, or, if seen fit, using such lands as may be productive of marketable mineral substances used as agricultural fertilizers or as minerals that can be employed in the manufacture of the same. The Geological Institute of Spain will designate the lands or zones which should be reserved or investigated. This work will be carried out by the proper technical departments of the Spanish Government. The reservation of such lands in favor of the state will be of three kinds: Provisional, for preliminary study; temporary, for thorough investigation; definite, for exploitation. If the investigations carried out by the Geological Institute result in the discovery of mineral wealth, or indicate its existence, the rights to such land as is productive thereof having been temporarily reserved will be vested in the State.

Furthermore, the state may preempt, lease, or exploit on its own account the deposits that it reserves, in conformity with the mining laws or such other laws as may hereafter be enacted. The mining engineers belonging to any of the auxiliary investigating bureaus or departments who have been instrumental in locating mineral deposits, such as indicated and which the state reserves definitely, will have the right to a special reward in proportion to the value of the deposits discovered. These rewards will be adjusted according to the following scale: 1 per cent of a valuation less than 1,000,000 pesetas ($180,000); three-fourths of 1 per cent for a valuation from 1,000,000 pesetas ($180,000) to 5,000,000 pesetas ($900,000), both inclusive; one-half of 1 per cent for a valuation above 5,000,000 pesetas ($900,000).

The state now reserves temporarily the right to the lands in the Provinces of Barcelona and Lerida, concerning which the Geological Institute has made investigations as to potassium salts, and which from now on will be reserved and excluded temporarily from the right of private preemption, and also all the lands embraced within the perimeter indicated by the towns of Balaguer, Tarraga, Igualada, Manresa, Vich, Berga, and Isons.

Moreover, the right to exploit potash will be suspended in case it is found in lands that have been preempted for other classes of minerals. The Geological Institute is enjoined to proceed immediately with a detailed study of the territory mentioned in the reserved perimeter, submitting to the Spanish Government the plan and estimate appropriate for the investigation in question and render an official report of its labors and operations.

It is thought that Spanish potash can be put on the market at much lower figures than those now quoted for the imported article. The consumption is growing rapidly in Spain, where the potash is extensively used in the olive groves, vineyards, and wheat fields.

PAPERS ON POTASH SALTS IN 1914.

In 1914 there were several valuable contributions by Government officials to the literature relating to potash salts and the conditions under which they have accumulated or are found. The titles of these contributions are listed in the bibliography at the end of this chapter. No attempt will be made here to review these papers, but the more important conclusions reached by the authors will be briefly summarized.

E. E. Free [1] has written a paper on the topographic features of the desert basins of the United States with reference to the possible occurrence of potash. Mr. Free briefly describes nearly 200 inclosed basins and tabulates the more important of them. His first table gives the names, brief descriptions, and areas of 126 basins. Many of these basins can not be regarded as likely sources of potash salts, and after eliminating those not likely to contain such salts only 39 remain. These 39 basins Mr. Free divides into three classes, as follows:

(1) Basins in which all known conditions are favorable to the accumulation of potash salts; (2) basins in which some of the known conditions are unfavorable to the accumulation of potash salts, but which can not be definitely rejected; and (3) basins whose classification and promise are doubtful.

The basins in the first class, with their areas, are as follows:

Basins in which all known conditions are favorable to the accumulation of potash salts given in order of area.

	Square miles.		Square miles.
Lahontan	45,730	Gabbs	1,280
Death Valley	23,560	Edwards Creek	990
Railroad Valley	6,340	Kane	900
Searles	4,850	Ivanpah	900
Alvord	3,200	Saline	845
Diamond	2,800	Eureka	775
Surprise	2,350	Mono	770
Dixie	2,290	Frenchman Flat	740
Warner	2,000	Gold Flat	640
Panamint	1,950	Opal Mountain	580
Hualpai	1,450	Clayton	550
Columbus	1,350		

G. J. Young [2] published a paper in 1914 on potash salts and other salines in the Great Basin region. Mr. Young, in his conclusion, says that—

> The question of deep deposits being uncertain, the field becomes narrowed to the deposits which might have resulted from the desiccation periods of the most recent Quaternary lakes. Only in Searles have we surface deposits of this nature. In all other basins, if older deposits than those at present forming exist, they must be sought for at depth. The size of such a deposit would depend upon the area of the drainage basin and the area and depth of the Quaternary lake occupying it. Desert basins showing no signs of former lakes might well be placed in a separate and unimportant class. Such basins can not be said not to have saline beds at depth, but the existence of such beds and their value are doubtful.

[1] Free, E. E., The topographic features of the desert basins of the United States with reference to the possible occurrence of potash: U. S. Dept. Agr. Bull. 54, May 8, 1914.

[2] Young, G. J., Potash salts and other salines in the Great Basin region: U. S. Dept. Agr. Bull. 61, June 30, 1914.

Upon the criteria stated Young has divided the desert basins into two groups, as follows: (*a*) Basins formerly occupied by Quaternary lakes; (*b*) basins in which there are no evidences of Quaternary lakes.

Under the first group he differentiates four classes, as follows:

(1) Basins in which the Quaternary lake was more than 300 feet in depth; (2) basins in which the Quaternary lake was 300 feet or less in depth; (3) basins which are now occupied by lakes; (4) doubtful basins.

The first two classes comprise the lakes indicated below:

(1) Basins in which the Quaternary lake was more than 300 feet in depth.

[In order of magnitude on the basis of area.]

	Square miles.
Carson and Humboldt	27,575
Black Rock and Smoky Creek deserts	10,500
Searles (area includes Owens)	4,850
Panamint	1,950

(2) Basins in which the Quaternary lake was 300 feet or less in depth.

	Square miles.
Railroad Valley	6,340
Columbus Marsh (including Big Smoky Valley)	5,225
Buena Vista (part of Carson and Humboldt)	4,000
Dixie Valley	2,660

H. S. Gale[1] prepared a paper on the salines in Owens, Searles, and Panamint basins, in southeastern California. Some of his conclusions are that random drilling in the desert basins in search of large saline deposits is not justified by present evidence, and that only in basins where large and deep saline lakes have existed and have dried up under favorable conditions are massive deposits of salts free from mud to be looked for. These conditions are somewhat exceptional, but the hope is expressed that the exceptional conditions exist in places, and that even larger and more valuable deposits may yet be discovered—deposits larger than that in Searles Lake, which may be considered as a typical example.

W. B. Hicks prepared a paper[2] entitled "The composition of muds from Columbus Marsh, Nevada," which was issued by the United States Geological Survey as Professional Paper 95-A. The results of previous explorations for potash in the marsh are summarized, and the data relating to well 900, drilled by the Survey during 1913, are given. The analytical results show that the muds contain a rather high percentage of potassium, a large part of which is soluble in ammonium chloride solution, though only a small part can be extracted from the muds by pure water. These facts lead to the belief that much of the potassium in the muds has been absorbed from percolating solutions and is held in loose combination. This conclusion suggests a possible explanation of the apparent disappearance of the potassium from the brines and saline deposits of the desert-basin region.

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[1] Gale, H. S., Salines in the Owens, Searles, and Panamint basins, southeastern California: U. S. Geol. Survey Bull. 580, pp. 251-323, 1914.

[2] Hicks, W. B., Composition of muds from Columbus Marsh, Nevada: U. S. Geol. Survey Prof. Paper 95, pp. 1-11, 1915.

WORK ON KELP BY THE BUREAU OF SOILS.

While the advance chapter on potash salts was in press an important contribution on the subject of potash from kelp was published by the Bureau of Soils.[1] This report contains a discussion and maps of the kelp groves of the Pacific coast and islands of the United States and Lower California.

Of the large number of kelps growing on the Pacific coast only three—*Macrocystis pyrifera*, *Nereocystis luetkeana*, and *Alaria fistulosa*—appear to offer any promise as possible sources of potash salts. In addition to having a high potash content, these kelps occur in large masses and grow in the open water, where they can easily be harvested. The analyses made by the Bureau of Soils showed the following results:

Analyses of samples of kelp.

[Oven-dried at 105° C.]

	1	2	3
Total soluble salts	30.00	46.9	24.4
Potash (K_2O)	12.59	20.1	9.1
Iodine (I)	.23	.13	Trace.
Nitrogen (N)	1.57	1.9	2.6
Ash	5.9	4.2	7.5

1, *Macrocystis pyrifera*, average of 58 samples; 2, *Nereocystis luetkeana*, average of 51 samples; 3, *Alaria fistulosa*, average of 15 samples.

In the average for Macrocystis the figures for potash and nitrogen are somewhat too low, as the variations are from 3.10 to 27.66 per cent for potash and 0.53 to 3.17 per cent for nitrogen. The variations in Nereocystis are from 6.58 to 31.62 per cent for potash and from 0.81 to 3.06 per cent for nitrogen, and the average figures given in the table fairly represent the salt contents of this plant. In Alaria the variation in potash is from 2.9 to 13.1 per cent, and in nitrogen from 2.1 to 3.3 per cent, so that the average for potash given in the table is thought to be too low.

Macrocystis is probably a perennial, and it is thought that it can be harvested at least twice a year without danger to its continued growth. Nereocystis appears to be an annual, and consequently some care must be taken in order that harvesting may not deplete or destroy the beds. Alaria is a perennial and is found in the tideways of the Alaskan coast.

The salts contained in kelp are mainly potassium and sodium chlorides. The problem of the separation of these salts from the organic residue has not yet been properly solved, but experiments indicate that a way will be found whereby the organic tissues will be coagulated and thus filtration rendered practicable. Under the heading "Preparation of pure potassium chloride" is outlined a method of separating the potassium chloride and sodium chloride by fractional crystallization.

Freshly cut kelp contains 80 to 90 per cent of water, the average probably being nearer 90 per cent. To handle the kelp commercially this quantity of water must be reduced to the minimum. On the Mexican coast, where the climate is hot and dry, air drying appears to be feasible, but in most places artificial methods must be used. Of the different types of driers the rotating drum or tube through which is passed a current or draft of preheated air seems best adapted.

[1] Cameron, F. K., and others, Potash from kelp: U. S. Dept. Agr., Bur. Soils, Rept. 100, April 10, 1915.

Dried powdered kelp appears to be adapted to making mixed fertilizers. The eastern and especially the southern Atlantic States are large users of this product, which contains potassium salts. The opening of the Panama Canal appears to offer an opportunity for the delivery of this potash fertilizer in a region where the consumption is large. The West Indies are also large consumers of potassium salts, and there exists also the possibility of markets in Hawaii and Japan. On the Pacific coast comparatively little fertilizer is used, and in California, especially, potassium sulphate is more in favor than the chloride, the form in which the potash is found in kelp. As sulphuric-acid factories are operating on the California coast, the chloride may be converted to the sulphate, salable hydrochloric acid being produced at the same time.

In the following table are given estimates of the area, tonnage of fresh kelp, and tonnage of equivalent potash chloride in the regions thus far mapped by the Bureau of Soils. In the estimates it is assumed that the kelp will be cut to an average depth of at least 1 fathom. The giant kelps of the Pacific coast harvested to a depth of 1 fathom are estimated to yield an annual output of potassium chloride about six times the equivalent of the potassium salts now imported into the United States. The cost of obtaining pure potassium chloride from kelp can not be stated, as sufficient experience has not yet been accumulated to justify exact estimates, and it is also impossible to give any close estimate of the value of the possible kelp harvest.

Area of commercially available kelp beds of the Pacific coast, quantity of kelp, and content of potassium chloride.

Region.	Area.	Fresh kelp.	Potassium chloride.
	Square miles.	*Short tons.*	*Short tons.*
Cedros Island to San Diego	91.36	[a]16,979,800	649,000
San Diego to Point Conception	97.92	[a]18,195,300	696,000
Point Conception to Cape Flattery	36.24	4,377,400	167,000
Puget Sound	5.00	520,000	20,000
Southeastern Alaska (estimated)	70.78	7,833,000	299,000
Western Alaska	17.86	3,567,000	136,000
	389.94	59,305,500	2,266,000

[a] Two cuttings annually.

The three factors influencing the attitude of capitalists toward exploiting kelp beds are (1) control of the beds, (2) cost of manipulation, (3) location, extent, and character of the beds. Data on all these factors are contained in the report cited or in others emanating from the Bureau of Soils.

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FULLER'S EARTH.

By JEFFERSON MIDDLETON.

INTRODUCTION.

The fuller's earth industry showed considerable progress in 1914, the marketed production increasing in both quantity and value, the former from 38,594 short tons in 1913 to 40,981 short tons in 1914, and the latter from $369,750 in 1913 to $403,646 in 1914—an increase of 2,387 tons in quantity and of $33,896 in value.

The imports showed even larger increase than the domestic production in 1914 in both quantity and value. The quantity imported during the last half of the year was larger than that imported during the first half, and considerably greater than that imported during the corresponding period of 1913.

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 for the market in 1914 in only seven States, namely, Arkansas, California, Colorado, Florida, Georgia, Massachusetts, and Texas, the same number as in 1913, but South Carolina dropped out in 1914 and Texas reentered the list of producers.

USES.

Fuller's earth obtains its name from its original use in fulling cloth. Little is now used in this country for this purpose, it being used principally in bleaching, clarifying, or filtering fats, greases, and oils. It is also used in the manufacture of pigments for printing wall papers, for detecting certain coloring matters in some food products, and as a substitute for talcum powder.[1] The common practice in filtering mineral oils is to dry the earth carefully and then to grind it to suitable sizes and run it into long cylinders, through which the crude, dark mineral oils are allowed to percolate slowly. As a result, the oil that comes out first is perfectly water white and much thinner than that which follows. The oil is allowed to percolate through the earth until its color reaches a certain maximum shade.

The process of filtering vegetable oils is radically different. The oil is heated in large tanks beyond the boiling point of water, from 5 to 10 per cent of its weight of fuller's earth is 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 performed with sufficient care.

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[1] Bur. Mines Bull. 71, p. 19, 1913.

HISTORY.

Fuller's earth was first discovered in the United States in 1891 near Alexander, Ark., by John Olsen, who is still a producer. This earth was used for a time by the Southern Cotton Oil Co., at Little Rock, but its use was finally abandoned.[1] In 1893 fuller's earth was discovered near Quincy, Fla., by accident. An effort was made to burn brick on the property of the Owl Cigar Co.; the effort failed, but an employee of the company called attention to the close resemblance of the clay used to the German fuller's earth. This discovery caused considerable excitement, and deposits of supposed fuller's earth were reported from a number of States, but the material in most of these deposits was found to be of no value as fuller's earth.

Florida has been the leading producing State almost from the beginning of the industry. In 1897–1899 fuller's earth was produced in Florida, Colorado, and New York, and a very small quantity in 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, and it has ranked second since 1909. In 1904 Alabama and Massachusetts, in 1907 South Carolina and Texas, and in 1909 California first reported production.

PRODUCTION.

The following table shows the production of fuller's earth in the United States since the industry assumed commercial importance:

Marketed production of fuller's earth in the United States, 1895–1914, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1895	6,900	$41,400	$6.00	1905	25,178	$214,497	$8.52
1896	9,872	59,360	6.01	1906	32,040	265,400	8.28
1897	17,113	112,272	6.56	1907	32,851	291,773	8.88
1898	14,860	106,500	7.17	1908	29,714	278,367	9.37
1899	12,381	79,644	6.43	1909	33,486	301,604	9.01
1900	9,698	67,535	6.96	1910	32,822	293,709	8.95
1901	14,112	96,835	6.86	1911	40,697	383,124	9.41
1902	11,492	98,144	8.54	1912	32,715	305,522	9.34
1903	20,693	190,277	9.20	1913	38,594	369,750	9.58
1904	29,480	168,500	5.72	1914	40,981	403,646	9.85

This table shows the large growth of the industry since it first assumed commercial importance, in 1895. In that year the production was 6,900 short tons, valued at $41,400, an average of $6 a ton, compared with 40,981 tons in 1914, valued at $403,646, or $9.85 a ton. During the first 10-year period the production rose rapidly, the output and value in 1904 being more than four times as great as in 1895. In the second 10-year period the increase was not so great, though the output in 1914 was more than one and a half times as great as that in 1905. For the first 10-year period the average yearly output was 14,660 tons and the average price per ton was $6.96, compared with an average yearly output

[1] Branner, J. C., An early discovery of fuller's earth in Arkansas: Am. Inst. Min. Eng. Trans., vol. 43, pp. 520–522, 1913.

of 33,908 tons in the second 10-year period and an average price per ton of $9.16.

This table shows a decrease in the fuller's earth industry in 1912 from 1911, a partial recovery in 1913, and the maximum production in 1914. In 1914 the quantity increased 2,387 short tons, or 6.18 per cent, over that of 1913 and the value increased $33,896, or 9.17 per cent. Compared with 1911, the year of maximum production prior to 1914, there was an increase of 284 short tons, or 0.70 per cent, in quantity and of $20,522, or 5.36 per cent, in value. The average price in 1914, $9.85 a ton, was the highest yet reached for domestic fuller's earth and was 27 cents higher than the preceding highest price, that for 1913.

The following table shows the marketed production of fuller's earth in 1913 and 1914, by sections of the country:

Marketed production of fuller's earth in the United States, 1913–1914, in short tons.

	1913				1914			
	Number of operators.	Quantity.	Value.	Average price per ton.	Number of operators.	Quantity.	Value.	Average price per ton.
Eastern States [a]	7	37,869	$361,175	$9.54	7	39,259	$388,959	$9.91
Western States [b]	3	725	8,575	11.83	7	1,722	14,687	8.53
Total	10	38,594	369,750	9.58	14	40,981	403,646	9.85

[a] Includes, 1913: Florida, Georgia, Massachusetts, and South Carolina; 1914: Florida, Georgia, and Massachusetts.
[b] Includes, 1913: Arkansas, California, Colorado; 1914: Arkansas, California, Colorado, and Texas.

Owing to the small number of producers in some States, it is impossible to publish totals except for one or two States, and consequently the statistics of production have been distributed simply by Eastern and Western States. The eastern section of the country continues to produce by far the larger part of the fuller's earth marketed, its seven operators reporting 95.80 per cent of the quantity and 96.36 per cent of the value of the entire output. Fuller's earth was marketed in seven States in 1914. Named in order of their production they were Florida, Georgia, California, Arkansas, Massachusetts, Colorado, and Texas. Florida and Georgia together contributed more than 95 per cent of the quantity and value of the fuller's earth marketed in 1914.

Both sections increased in production and value in 1914, but the average price per ton in the Western States decreased from $11.83 in 1913 to $8.53 in 1914.

NOTES ON THE FULLER'S EARTH INDUSTRY BY STATES.

Arizona.—No shipments were made in 1914 from the fuller's earth deposit of the Arizona Earth Products Co., near Benson, Cochise County, Ariz., though it is expected that shipments will be made during 1915.

Arkansas.—Only one fuller's earth mine was operated in Arkansas in 1914, that of John Olsen, at Klondyke, Saline County. The earth from this mine is used for refining edible oils and animal fats.

California.—Four miners of fuller's earth in California reported marketed product in 1914, the quantity being 922 short tons, valued at $6,057. California fuller's earth is used in refining mineral and vegetable oils and animal fats.

Colorado.—Only one producer of fuller's earth in Colorado reported an output in 1914—the American Clay Co., at Akron. This company's business in 1914 was about the same as in 1913. Its product is used for refining vegetable oils and animal fats.

Florida.—Of the five owners of fuller's earth properties in Florida four were active, namely, the Atlantic Refining Co. and the Manatee Fuller's Earth Co., at Ellenton, Manatee County; the Floridin Co., at Jamieson and Quincy, Gadsden County; and the Fuller's Earth Co., at Midway, Gadsden County. The Florida earth is used in filtering mineral and vegetable oils. Florida is the leading State in the production of fuller's earth, having reported for 1914 more than 75 per cent of the total quantity and value. The average price per ton of Florida earth in 1914 was $10.07, compared with $9.91 per ton for all Eastern States, and $9.85 per ton for the whole country.

Georgia.—There are only two operators in Georgia, both of whom were active in 1914—the Lester Clay Co., with mine at Attapulgus, Decatur County; and the General Reduction Co., with mine at Dry Branch, Twiggs County. Business was reported not quite so good as in 1913. The Georgia earth is used in refining mineral and vegetable oils.

Massachusetts.—Only one firm has produced fuller's earth in Massachusetts for several years—J. E. & R. M. Farnsworth, of Lancaster, Worcester County. This earth is used in fulling woolens.

Texas.—One of the six owners of fuller's earth deposits in Texas reported marketed product in 1914—the Somerville Development & Improvement Co., of Somerville, Burleson County.

IMPORTS.

The following table shows the imports of fuller's earth for consumption from 1897 to 1914, inclusive:

Fuller's earth imported for consumption into the United States, 1897 to 1914, 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
1913	1,916	12,344	6.44	16,712	133,657	8.00	18,628	146,001	7.84
1914	1,468	9,283	6.32	23,509	185,800	7.90	24,977	195,083	7.81

[a] July to December.

The imports of fuller's earth reached their maximum in both quantity and value in 1914, increasing 6,349 short tons, or 34.08 per cent, in quantity and $49,082, or 33.62 per cent, in value over 1913. The average price per ton ($7.81) of imported earth was, however, 3 cents less than that of 1913, and 12 cents less than the maximum ($7.93), which was attained in 1909. The gain in 1914 was in the wrought or manufactured earth imported; the quantity, value, and average prices per ton of the crude earth imported declined. The imports are nearly all of wrought or manufactured earth, 94.12 per cent of the quantity and 95.24 per cent of the value of the total imports being of that kind. The decrease in the average price per ton of fuller's earth imported was 12 cents for crude and 10 cents for wrought earth in 1914 compared with 1913.

The following table shows the quantity and value of the fuller's earth imported from 1867 to 1883 by fiscal years. The wrought and the unwrought earths were not classified separately during this period. From July 1, 1883, to June 30, 1897, fuller's earth was not reported separately in the 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			

A comparison of the imports of the first years for which figures are available with later returns shows the growth of the use of fuller's earth in this country. Imports were at first equivalent to consumption, as there was no domestic production from 1867 to 1876. The average yearly imports of fuller's earth in the first 10 years, 1867 to 1876, were 302 tons; for the last 10 years, 1905 to 1914, they were 16,851 tons, or 56 times greater than during the first 10 years. If the production and the imports during the last 10 years be added together, which will approximately give consumption, the domestic use of fuller's earth is seen to be still greater. This annual combined average from 1905 to 1914 is 50,759 short tons, or 168 times greater than the average annual consumption during the years from 1867 to 1876. The average price per short ton of imports during the first 10-year period was $10.54, and during the last 10-year period it was $7.68.

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PHOSPHATE ROCK.

By W. C. Phalen.

MARKETED PRODUCTION.[1]

The marketed production of phosphate rock in the United States in 1914 was 2,734,043 long tons, valued at $9,608,041. Compared with the production of 1913, which was 3,111,221 long tons, valued at $11,796,231, there was a decrease amounting in quantity to 377,178 long tons, or 12 per cent, and in value to $2,188,190, or nearly 19 per cent. As compared with 1912 also there was a decrease in 1914 of 8 per cent in quantity and of nearly 18 per cent in value.

The production of phosphate rock has been steadily increasing for many years, with an occasional exception, until 1914, when, for causes chiefly outside the country, a diminished output has to be recorded. The average production for the four-year period prior to 1914 was 2,948,205 long tons, valued at $11,572,425. The output of 1914 compared with this average was 214,162 long tons (7 per cent) less in quantity and $1,964,384 (17 per cent) less in value.

The marketed production of the various kinds of phosphate rock, by States, in 1913 and 1914, was as follows:

Production of phosphate rock in the United States, 1913–14, based on the quantity marketed, by States, in long tons.

State.	1913			1914		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Florida:						
Hard rock	489,794	$2,987,274	$6.10	309,689	$1,912,197	$6.17
Land pebble	a 2,055,482	6,575,810	3.20	a 1,829,202	5,442,547	2.98
River pebble	(a)	(a)		(a)	(a)	
Total	2,545,276	9,563,084	3.76	2,138,891	7,354,744	3.44
South Carolina:						
Land rock	109,333	440,588	4.03	106,919	415,039	3.88
River rock	0	0		0	0	
Total	109,333	440,588	4.03	106,919	415,039	3.88
Tennessee:						
Brown rock, Blue rock	451,559	1,774,392	3.93	483,203	1,822,770	3.77
White rock	0	0		0	0	
Total	451,559	1,774,392	3.93	483,203	1,822,770	3.77
Western States	b 5,053	18,167	3.60	b 5,030	15,488	3.08
Grand total	3,111,221	11,796,231	3.79	2,734,043	9,608,041	3.51

a Small quantity of river pebble included with land pebble. b Includes Idaho and Wyoming.

[1] The tables of production of phosphate rock in this report have been prepared by Miss L. M. Jones, statistical clerk.

The total production of phosphate rock in the United States from the beginning of the industry in 1867 to 1914 is shown in the following table. Up to 1885 the figures are for the year ending May 31; in 1885 the figures are as follows: June 1, 1884, to May 31, 1885, 395,403 tons, $2,339,468; June 1 to December 31, 1885, 277,789 tons, $1,805,629. Thus the figures given for 1885 represent the output for 19 months. Subsequent years are calendar years.

Marketed production of phosphate rock in the United States, 1867–1914, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1867–1880	1,449,676	$7,248,380	1899	1,515,702	$5,084,076
1881	266,734	1,980,259	1900	1,491,216	5,359,248
1882	332,077	1,992,462	1901	1,483,723	5,316,403
1883	378,380	2,270,280	1902	1,490,314	4,693,444
1884	431,779	2,374,784	1903	1,581,576	5,319,294
1885	673,192	4,145,097	1904	1,874,428	6,580,875
1886	430,549	1,848,939	1905	1,947,190	6,763,403
1887	480,558	1,836,818	1906	2,080,957	8,579,437
1888	448,567	2,018,552	1907	2,265,343	10,653,558
1889	550,245	2,937,776	1908	2,386,138	11,399,124
1890	510,499	3,213,795	1909	2,338,264	10,796,456
1891	587,988	3,651,150	1910	2,654,988	10,917,000
1892	681,571	3,296,227	1911	3,053,279	11,900,693
1893	941,368	4,136,070	1912	2,973,332	11,675,774
1894	996,949	3,479,547	1913	3,111,221	11,796,231
1895	1,038,551	3,606,094	1914	2,734,043	9,608,041
1896	930,779	2,803,372			
1897	1,039,345	2,673,202	Total	48,459,406	195,409,321
1898	1,308,885	3,453,460			

In connection with this table the following historical notes are of interest:

The history of phosphate mining in the United States began in 1867, when the Charleston, S. C., Mining & Manufacturing Co. was organized to work the deposits along Ashley River, near Tenmile Hill, above Charleston, S.C. The first small cargoes were shipped in April, 1868. Land rock was the kind first mined in South Carolina, river rock not being mined for marketing until 1870.

Florida rock was first actually mined in 1888 or 1889, and the first cargo was shipped in April, 1890.[1] The production in Florida exceeded that in South Carolina in 1894. Tennessee rock was put on the market about 1893. Its production increased rapidly and in 1899 exceeded that of South Carolina. Until about 1885 South Carolina furnished more than 95 per cent of the phosphate rock marketed in the United States. In 1914 its production was only 3.9 per cent of the total.

The first of the western phosphate fields was discovered in 1906, and although for economic reasons these fields have not yet made a large output it is probable that most of the production of the future will come from the West, where the principal deposits are on public lands. The slow development of the western phosphate fields is due to the recency of their discovery, their remoteness from centers of consumption, the lack of transportation facilities, and high freight rates.

[1] Millar, C. C. H., Florida, South Carolina, and Canadian phosphates, p. 78, London, 1892.

Since the western fields were discovered they have been systematically investigated by the United States Geological Survey, and some of the results have been published. The Survey has discovered valuable deposits and has greatly increased the knowledge of the extent and quantity of minable phosphate rock in the West.

PHOSPHATE ROCK MINED.

The quantity of phosphate rock mined in 1914 was 2,649,174 long tons. Compared with the quantity mined in 1913, which was 3,152,208 long tons, this was a decrease of 503,034 tons, or nearly 16 per cent. In Florida the decrease amounted to nearly 19 per cent; in Tennesses it was 3 per cent; in South Carolina, 1.4 per cent; and in the Western States, 13 per cent. No rock was reported mined in 1914 in Arkansas, Kentucky, or Utah.

STOCK ON HAND.

Stocks on hand at the close of 1914 showed a decrease for the entire country amounting to nearly 9 per cent. In Florida the decrease amounted to 5 per cent; in Tennessee it was 26 per cent; in South Carolina, 6 per cent. In the Western States there was a slight increase in the stocks on hand.

PRODUCTION BY STATES.

FLORIDA.

In 1914, Florida, the leading State in the production of phosphate rock, marketed 2,138,891 long tons of phosphate rock, valued at $7,354,744, or 78 per cent of the entire production of the United States. As compared with the marketed production of 1913, that in 1914 decreased 406,385 long tons, or 16 per cent, in quantity and $2,208,340, or 23 per cent, in value. The quantity sold during the year is the least since 1910.

The phosphate rock produced in Florida consists of hard rock, land pebble, and river pebble. No river pebble was mined in the State in 1914, but a small quantity was sold from De Soto County. These sales are included with land pebble to avoid divulging confidential information. There was a decrease of 37 per cent in the quantity of hard rock sold. This decrease is not surprising in view of the fact that this is the chief export rock. In sales of land pebble, the decrease amounted to 11 per cent.

As will be observed from the first table given in this report, the average price of hard rock increased 7 cents a ton, and the price of land pebble decreased 22 cents a ton. The average price for the entire production was 32 cents less a ton than in 1913.

The hard rock marketed came from Alachua, Citrus, Hernando, Marion, and Suwanee counties. Some rock was mined, but not shipped, from Levy County. The land pebble came from Polk and Hillsborough counties. Some river pebble was shipped from De Soto County.

The following table shows the quantity and value based on marketed output of each variety of phosphate rock produced in Florida from 1910 to 1914, inclusive:

Phosphate rock marketed in Florida, 1910–1914, classified by grades, in long tons.

Year.	Hard rock.		Land pebble.		River pebble.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1910	438,347	$3,051,827	1,629,160	$5,595,947	....	....	2,067,507	$8,647,774
1911	443,511	2,761,449	[a]1,992,737	6,712,189	([b])	([b])	2,436,248	9,473,638
1912	493,481	3,293,168	[a]1,913,418	6,168,129	([b])	([b])	2,406,899	9,461,297
1913	489,794	2,987,274	[a]2,055,482	6,575,810	([b])	([b])	2,545,276	9,563,084
1914	309,689	1,912,197	[a]1,829,202	5,442,547	([b])	([b])	2,138,891	7,354,744

[a] Includes a small quantity of river pebble. [b] Included in land pebble.

TENNESSEE.

The production of phosphate rock in Tennessee in 1914 was 483,203 long tons, valued at $1,822,770. Compared with 1913, this was a gain of 31,644 long tons, or 7 per cent, in quantity and of $48,378, or 3 per cent, in value. The average price per ton of Tennessee phosphate rock decreased 16 cents per ton in 1914.

Tennessee furnished 18 per cent of the phosphate rock marketed in the United States in 1914. The rock from this State is classified as brown, blue, and white—though none of the last is now produced. In 1914 brown rock came from Giles, Hickman, Lewis, Maury, and Sumner counties, and blue rock from Lewis and Maury counties.

The following table shows the quantity and value of each grade of Tennessee phosphate rock marketed from 1910 to 1914, inclusive:

Phosphate rock marketed in Tennessee, 1910–1914, classified by grades, in long tons.

Year.	Brown rock.		Blue rock.		White rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	[c]451,559	1,774,392	([d])	([d])	....	....	451,559	1,774,392
1914	[c]483,203	1,822,770	([d])	([d])	....	....	483,203	1,822,770

[a] Includes a small quantity of hard rock from Arkansas.
[b] Includes a small quantity from Kentucky.
[c] Includes blue rock.
[d] Included under brown rock.

SOUTH CAROLINA.

The production of phosphate rock in South Carolina in 1914 was 106,919 long tons, valued at $415,039. This was a decrease of 2,414 long tons, or 2 per cent, in quantity and of $25,549, or 6 per cent, in value, compared with 1913. Only land rock was mined and marketed, there having been no production of river rock since 1910. The value of the rock per ton was 15 cents less than in 1913. The output of the State constituted approximately 3.9 per cent of that of the country in 1914.

The following table gives the quantity and value of phosphate rock marketed in South Carolina from 1910 to 1914, inclusive:

Phosphate rock marketed in South Carolina, 1910–1914, classified by grades, in long tons.

Year.	Land rock.		River rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	109,333	440,588			109,333	440,588
1914	106,919	415,039			106,919	415,039

a Includes a small quantity of river rock. b Included in land rock.

WESTERN STATES.

The phosphate rock produced in the Western States in 1914 came from Bear Lake County, Idaho, and from near Border and Cokeville, Lincoln County, Wyo. The production was small, amounting to only 5,030 long tons, valued at $15,488, as compared with 5,053 tons, valued at $18,167, in 1913. As in 1913, the production constituted only about one-fifth of 1 per cent of that of the entire country. The average pirce was $3.08 per ton.

USE OF GROUND PHOSPHATE ROCK.

Since the ground rock phosphate industry has assumed importance, one of the questions which the Survey now asks in its annual statistical inquiry relates to the quantity of the material sold for direct application to the soil. The total of such direct returns from the miners, however, does not represent the total quantity of ground rock now sold for direct application to the soil since it is known that some lump rock is sold to grinders, who do not report to the Survey. The figures of phosphate rock published by the Survey relate to the product in the form that it first comes upon the market; hence to the lump and ground rock of the actual producers, and not to the sales of ground rock emanating from the grinders. It is therefore probable that the Survey's figures of sales of ground rock are incomplete.

There was reported to the Survey, in 1914, 48,317 long tons of phosphate rock as having been sold in finely ground form for direct application to the soil. The great bulk of this tonnage was reported from Tennessee, but ground rock is known to have been shipped also from other States both in the East and in the West.

IMPORTS OF FERTILIZER MATERIALS.

The fertilizer materials imported into the United States in 1914 include many compounds containing phosphorus, nitrogen, and potash. Those containing phosphorus include apatite, basic slag, and crude phosphate rock. The potash fertilizers include various potash salts, kainite, manure salts, and double-manure salts. The nitrogen compounds are chiefly cyanamid, nitrates, and ammonium salts. The use of calcium cyanamid, or lime nitrogen, as is shown by the table, is rapidly increasing. This substance was not separately classified in

1909, but has been itemized since 1910. It has been made at Niagara Falls, Ontario, Canada, since 1909 and has been shipped to fertilizer manufacturers in the United States and its insular possessions in the quantities shown below:[1]

Shipments of cyanamid from Canada to the United States and dependencies, 1909–1913.

Year	Short tons.	Year	Short tons.
1909	1,450	1912	11,100
1910	4,650	1913	27,400
1911	9,500		

The extensions to the factories of the American Cyanamid Co., which makes this substance, in part, by the extraction of nitrogen from the atmosphere, were completed in 1914 and enable it to produce more than 60,000 tons annually. The material is one of the sources of the nitrogen in so-called complete fertilizers.

The fertilizer materials imported in 1914 are given in the following table:

Fertilizers imported and entered for consumption in the United States, 1910–1914, in long tons.

Fertilizer.	1910		1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Apatite	....	....	20	$300	100	$1,400	2,962	$22,471	20	$300
Bone dust or animal carbon, and bone ash, fit only for fertilizing purposes	48,979	$1,140,476	36,856	943,472	117,717	878,686	35,012	851,136	36,000	892,529
Calcium cyanamid or lime nitrogen	3,540	177,552	5,292	292,496	9,311	493,519	26,729	1,410,248	21,793	1,119,785
Guano	33,565	667,870	36,869	774,315	19,128	329,624	16,674	518,429	25,335	761,562
Kainit	582,197	2,798,198	563,957	2,748,140	511,976	2,386,362	465,336	2,201,730	313,898	1,551,115
Manure salts, including double manure salts	147,242	1,013,009	159,796	1,660,040	171,757	1,797,057	223,687	2,245,509	168,969	1,846,475
Phosphates, crude	21,706	235,040	16,153	157,394	28,821	231,255	17,121	124,815	15,079	136,526
Slag, basic, ground or unground	10,774	93,650	12,622	87,994	12,596	114,300	13,186	130,455	9,199	105,272
All other substances used only for manure	195,991	3,394,279	197,810	4,098,321	127,932	2,660,887	154,729	3,314,460	171,603	3,507,875
Total	1,043,994	9,520,074	1,029,375	10,762,472	999,338	8,893,090	955,436	10,819,253	761,896	9,921,439

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 salts are potassium chloride and potassium 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 into potassium nitrate, which is used in the manufacture of gunpowder and other explosives,

[1] Figures furnished by the American Cyanamid Co.

matches, pyrotechnics, in assaying and analytical operations, for curing meats, and for other purposes. The large importation of sodium nitrate is very significant. Sodium nitrate and potash salts are commodities for which the United States is entirely dependent on foreign countries.

The following table shows the imports for consumption of materials that are used in the domestic fertilizer industry, as indicated above:

Imports for consumption of materials entering largely into the fertilizer industry in the United States for the years 1912–1914, in long tons.

	1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fertilizers	999,338	$8,893,090	955,436	$10,819,253	761,896	$9,921,439
Potassium chloride	215,415	7,229,121	212,170	7,075,745	165,858	5,745,385
Potassium sulphate	43,856	1,783,846	39,597	1,677,429	35,914	1,557,224
Sodium nitrate	486,779	16,544,511	612,861	21,630,811	545,730	15,204,539
Total	1,745,388	34,450,568	1,820,064	41,203,238	1,509,398	32,428,587

By adding the production of domestic phosphate rock to the imports of fertilizers and fertilizer materials an idea may be gained of the approximate quantity and value of the chief constituents of our manufactured fertilizers. In this connection the quantity of phosphate rock sold for direct application to the soil should be noted. It must not, however, be understood that the following table includes all the materials used in making fertilizer. It includes chiefly the mineral ingredients, most of which have undergone preliminary purification and concentration. But there are exceptions to even this statement. For example, calcium cyanamid is a manufactured product, and some other fertilizers listed in the table of imports are of organic origin or are by-products in the manufacture of other sub stances. The omissions include also other organic material, such as fish scrap, dried blood, and tankage, as well as ammonium sulphate.

Materials entering largely into the fertilizer industry in the United States for the years 1912–1914, in long tons.

	1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Imports: [a]						
Fertilizers	999,338	$8,893,090	955,436	$10,819,253	761,896	$9,921,439
Potassium chloride	215,415	7,229,121	212,170	7,075,745	165,858	5,745,385
Potassium sulphate	43,856	1,783,846	39,597	1,677,429	35,914	1,557,224
Sodium nitrate	486,779	16,544,511	612,861	21,630,811	545,730	15,204,539
Domestic phosphate rock	2,973,332	11,675,774	3,111,221	11,796,231	2,734,043	9,608,041
Total	4,718,720	46,126,342	4,931,285	52,999,469	4,243,441	42,036,628

[a] Imports are for consumption.

EXPORTS.

During 1914 there were exported 964,114 long tons of phosphate rock, valued at $6,771,652. As compared with 1913, this was a decrease of 402,394 tons in quantity and of $3,224,928 in value.

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 observed that the marketed production of Florida in 1914 was 2,138,891 long tons, valued at $7,354,744, whereas the exports, which amounted to 964,114 long tons, were valued at $6,771,652, or only $583,092 less than the total value of the marketed production.

It is evident that land pebble or lower-grade rock largely predominates in the Florida production and that the total value is consequently proportionately lowered. In 1914, as in most other years, the proportion of hard rock in the exported material was greater than in the total production, but during that year the value of the exports fell below that of the production, on account of the considerable decrease in the quantity exported and in spite of the fact that the price per ton of the exported rock was considerably higher than the price of the hard rock as given in the table showing the production. According to the Survey's figures, hard rock constituted 19.24 per cent of total Florida production in 1913 and 14.48 per cent in 1914.

The exports of phosphate rock are 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 the rock given. The figures showing the exportation for 1914 include rock shipped possibly from Tennessee and from other localities. 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. The addition of freight charges and the large proportion of high-grade and consequently more valuable rock included in the product exported as compared with the ordinary product explains the apparent lack of correspondence in valuation.

PRODUCTION IN PRINCIPAL COUNTRIES.

The production of phosphate rock in the principal producing countries of the world for the years 1911 to 1913, inclusive, was as follows:

Production of phosphate rock in principal producing countries, 1911–1913, in metric tons.

Country.	1911		1912		1913	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	738,935	$2,139,217	207,111	$759,455	(a)	(a)
Australia	5,893	28,226	6,198	29,686	(a)	(a)
Belgium	196,780	319,039	203,110	316,703	(a)	(a)
Canada	563	5,206	148	1,640	349	$3,643
Christmas Island (Straits Settlements)	[b] 155,311	(c)	[b] 159,459	2,024,036	(a)	(a)
Dutch West Indies:						
Aruba	[b] 27,658	88,430	[b] 17,215	99,627	(a)	(a)
Curacao	[b] 1,836	3,071			(a)	(a)
France	312,204	1,172,404	313,151	1,169,401	(a)	(a)
French Guiana	(a)	(a)	(a)	(a)	(a)	(a)
French Oceania, Society Islands	[b] 12,102	46,378	39,104	149,840	(a)	(a)
South Africa, Natal					(a)	(a)
Tunis	1,592,000	6,824,974	2,050,200	(c)	(a)	(a)
United States	3,102,131	11,900,693	3,020,905	11,675,774	3,161,001	11,796,231

[a] Statistics not yet available. [b] Exports. [c] Value not reported.

DOMESTIC PHOSPHATE RESERVES.

Lands remaining in Government ownership that are known to contain valuable phosphate deposits and those that are believed to contain such deposits have been withdrawn from entry temporarily. These phosphate reserves are in Florida, Idaho, Utah, Wyoming, and Montana. The work of surveying the western phosphate lands is still going on, and the following table shows the extent of the territory covered in the preliminary surveys.

Approximate area of phosphate lands in the United States, 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
1913	800	1,500	2,300	360	1,020
1914	1,800	470	2,270	100	505
Total	6,600	4,470	11,070	10,070	6,022

The classification of phosphate lands under presidential orders has resulted in including 2,611,115 acres of land in the phosphate reserves as of January 1, 1915. The phosphate land withdrawn, restored, and outstanding at the end of 1914 is shown in the following table:[1]

Phosphate land withdrawn, restored, and outstanding on Jan. 1, 1915, by States, in acres.

State.	Total withdrawals.	Restorations.	Outstanding withdrawals.
Florida	122,656	2,559	120,097
Idaho	2,306,019	1,318,122	987,897
Montana	308,975	178,760	130,215
Utah	581,039	544,846	36,193
Wyoming	3,154,227	1,817,514	1,336,713
Total	6,472,916	3,861,801	2,611,115

THE PHOSPHATE INDUSTRY IN THE SOUTHERN STATES.

FLORIDA.

DEPOSITS.

The Florida phosphate deposits are the most extensively developed in the United States. They comprise three classes of phosphate—hard rock, land pebble, and river pebble. The land-pebble industry is the most important at present. The hard-rock industry ranks next. No river pebble was mined in 1914, but a small quantity was sold from stock on hand. The area of hard-rock phosphate deposits forms a narrow strip along the western part of the Florida Peninsula

[1] For a complete discussion of the classification of the public lands underlain not only by phosphate rock but by coal, gas, salines, and other mineral deposits the reader is referred to Bulletin 537 of the Survey. Copies of this bulletin can be obtained free of charge by addressing the Director of the U. S. Geological Survey, Washington, D. C.

from Suwannee and Columbia counties on the north to Citrus and Hernando counties on the south—a distance of approximately 100 miles. The land-pebble area is farther south, in Polk and Hillsborough counties.

The hard-rock phosphate occurs in a soft matrix of phosphate sands, clay, and other material. The bowlder deposits of this class occur in irregularly sized pockets, the bowlders themselves ranging in diameter from a few inches to several feet.

The phosphate content of deposits of this class ranges from less than 10 to more than 30 per cent, the marketable product being not more than 15 per cent of the total material mined. 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.

The land-pebble deposits occur in beds that are of varying thickness but that are much more regular than the hard rock and for this reason can be mined cheaply. Moreover, improvements in mining and handling have made it possible to procure relatively low grade rock at low cost. These advantages have contributed to the recent great activity in the land-pebble industry. The phosphate content of most of the marketed land pebble ranges from 60 to 75 per cent tricalcium phosphate.

MINING AND PREPARATION.

The methods of mining the two main classes of phosphate rock in Florida differ considerably. The hard-rock phosphate is either dug out or dredged; the pebble phosphate is removed by hydraulic mining.

E. H. Sellards,[1] in a recent paper, describes the methods of preparing Florida phosphate rock for market as follows:

WASHING.

The hard-rock phosphate of Florida when brought from the pit is dumped on to grizzlies with 2 or 2½ inch openings. The fine materials of the matrix pass through, while the coarse materials, including phosphate, flint, and limestone bowlders and clay balls, are lodged on the grating. The phosphate bowlders are then thrown by hand into a rock crusher near by, while the flint and limestone bowlders and clay balls are discarded. That part of the matrix which passes the grizzly, together with the rock from the crusher, is dropped into a log washer beneath. The practice in the land-pebble mines is somewhat different from that followed in the hard-rock section, the matrix, as pumped from the pit, being thrown as a rule into a large revolving tube, known as a separator, punched "hit and miss" with holes 1 or 2 inches in diameter. As the separator revolves the phosphate pebble, as well as the finer materials of the matrix, fall through the openings and lodge on a screen beneath, while the coarser materials, including sand, rock, and clay balls, remain in the separator, from which they are carried to the waste dump. From the screen beneath the separator the phosphate rock passes into the log washer. While this is the usual arrangement in the land-pebble phosphate mines, yet in some of the newer plants it has been found practicable to omit the separator altogether, the rock from the dump being allowed to enter the log washer after passing over a screen of about one-sixteenth-inch mesh. When the separator is omitted practically all the matrix from the pit passes through the log washers, and it has usually been found necessary in these plants to install a crusher, which is then placed between the two logs. The larger pieces of bone and phosphate rock, as well as the clay balls, if not disintegrated by the washer, are broken up in the crusher, and the phosphate which they contain is saved.

The log washer through which the phosphate rock is passed consists of two cylinders or logs placed side by side in a box or trough. A series of blades arranged in a spiral

[1] Sellards, E. H., The origin, mining, and preparation of phosphate rock: Am. Inst. Min. Eng. Bull. 93, pp. 2379-2395, September, 1914.

is fastened to each cylinder. The trough is inclined, the phosphate being run in the lower end, and as the logs are made to revolve in opposite directions the phosphate rock is pushed forward by the blades, meeting as it goes a constant stream of water. By this means the rock is pretty thoroughly washed, the water carrying all the finer materials of the matrix escaping at the lower end or in the newer washers through an opening at the side of the trough. Frequently the phosphate rock is passed through a second log of the same type as the first, and in all cases receives a final rinsing while passing over screens.

In the hard-rock phosphate mines of Florida the coarse phosphate, after leaving the rinser, is made to pass over a picker belt, which is usually made in the form of a large revolving table. The phosphate rock remains on the picker belt during one complete revolution of the table, being carefully inspected by men and boys stationed around the table. The inferior rock, clay balls, flint, and limestone fragments, so far as recognized, are picked out and discarded at this time, thus bringing up the grade of the shipment. In the land-pebble mines the phosphate rock from the last washer falls on the jig screens, the finer of which are $\frac{3}{64}$ or $\frac{1}{32}$ inch mesh. From these screens the rock is elevated by endless cup chains to the loading bin.

DRYING.

After being taken from the pit the phosphate rock must be dried before being marketed. Two methods of drying are in use. The first of these, which is adapted to drying coarse rock, consists in piling the phosphate rock on ricks of wood. The wood is then burned, thus drying the rock. This method assists somewhat in cleaning, since clay and sand adhering to the rock tend, after drying, to loosen and fall away in subsequent handling.

The second method of drying, which is now largely used, is by the use of heated rotary cylinders through which the rock is passed. The rock is introduced usually at the cool end of the cylinder, and by means of various devices is made to pass through, escaping at the furnace or heated end. This method is adapted to drying small pebble rock; the coarser rock must be crushed before being dried by this method.

COMMENTS ON THE INDUSTRY.

In August, 1914, soon after the outbreak of the war in Europe, the phosphate-mining companies of Florida either curtailed production very materially or suspended mining completely, not only the companies that produce the higher grade rock for export but those that supply the domestic trade. The companies doing an export business were more seriously affected than those engaged in a combined export and domestic trade or in the domestic trade alone. Of 51 plants operating in Florida during the year 1914, only 19 were in operation at its close.

Shipments of phosphate rock to Germany, which has been a large consumer, have almost entirely ceased and those to other European countries have been seriously interrupted. Though foreign shipments were still being made at the end of 1914, business had been greatly retarded by lack of steamers and by increased freight rates, and there seems to be little likelihood of improvement until peace is declared.

TENNESSEE DEPOSITS.

Phosphate rock in Tennessee is classified as brown, blue, and white rock, from the characteristic colors of the material. The deposits are in the middle part of the State, the brown rock in 1914 having come from Maury, Giles, Hickman, Lewis, and Sumner counties, and the blue rock from Lewis and Maury counties. White rock is found chiefly in Perry and Decatur counties, but none of this variety was marketed in 1914.

BROWN-ROCK PHOSPHATE.

Brown-rock phosphate is variable, its character depending on the formation from which it has been derived. It occurs in plates of varying thickness and also as a porous material which disintegrates to a phosphate sand. The two forms are commonly associated.

The beds occur in two distinct forms, known as collar deposits and blanket deposits, the collar deposits occurring where the horizontal phosphatic limestone bed outcrops on the slope of a steep hill, and the blanket deposits, as the name implies, occurring near the surface in broad, more nearly level areas. In the Mount Pleasant region, in Maury County, about 10 miles southwest of Columbia, the county seat; at the Century mines of the Federal Chemical Co., 8 miles west of Columbia, near Wales, Giles County; and on lower Swan Creek the conditions have been favorable for the formation of brown-rock deposits. As they are secondary deposits they are of irregular thickness and include scattered chimneys, bowlders, or horses of the original phosphatic limestone. The brown rock is sold under guaranty of 70 to 80 per cent tricalcium phosphate.

BLUE-ROCK PHOSPHATE.

Deposits of blue-rock phosphate occur along Leatherwood Creek in the western part of Maury County, south and east of Centerville and on both sides of Swan Creek in Hickman County, and in the eastern part of Lewis County. Deposits are also known in Perry and Wayne counties.

Owing to its sedimentary origin, the blue rock is mixed with clay, sand, pebbles, and gravel derived from various sources. Thus all stages occur from sandstone and shale at one end of the series to pure blue phosphate rock at the other. In thickness the phosphate stratum ranges from a few inches to 2 or 3 feet and rarely to 4 feet. The rock contains 30 to 85 per cent calcium phosphate, but rock having the higher content does not occur in large quantities.

METHODS OF HANDLING.[1]

BROWN ROCK.

Mining.—The phosphate rock in the brown-rock phosphate field is overlain by clay of varying thickness. The greater part of this clay, especially where the clay is heavy, is now removed by drag-line excavators. Hydraulic stripping also is employed where the overburden is excessively thick, or where this method can advantageously be used. Horse-drawn scrapers as well as steam shovels are also employed.

In the Mount Pleasant field the greater part of the rock is mined by hand, for it occurs in deep "cutters" of very irregular shape that lie below the main level of the limestone table of the region. Steam shovels have been tried for this work, but they seem to have been discarded, as they do not permit hand sorting of the clay and the flint pebbles. Hydraulic methods are employed, and at the plant of the Hoover & Mason Co. a device known as a cantilever is used as an auxiliary in moving the phosphate rock to the cars. The cantilever moves on tracks close to the pit being mined, following the drag-line

[1] For detailed description of the Tennessee practice in phosphate mining see Barr, J. A., Tennessee phosphate practice: Am. Inst. Min. Eng. Bull. 93, pp. 2397-2413, September, 1914.

excavator. It is provided with a long arm from which buckets are lowered to be filled by the miners and raised, moved along, and dumped through a hopper into small cars which take the rock to the washer for further treatment. The cantilever may also be used for mining on smooth ground between the limestone "horses."

The phosphate rock may be hauled to the plant in ordinary dump carts. A great deal of the work in the Mount Pleasant field consists of reworking ground that has already been mined. As the ground is somewhat irregular the ore is removed in carts, but hydraulic mining also is used. The rock is generally hauled to the washers in tram cars pulled by small locomotives.

Washing.—After first being crushed, the rock is dumped into sets of log washers. From the second set of log washers it goes to a rinsing screen with spray pipe extending through its center. The oversize is then carefully picked to remove limestone, flint, and mud balls. The plate rock is then ready for drying. The sand phosphate undergoes different treatment, the details of which were outlined in this report for 1912. The rock has been dried by piling it on wood in the open and setting the wood on fire, but the more modern way is to dry it in rotary kilns.

BLUE ROCK.

Blue rock is a tough granular rock resembling limestone. It is not possible to remove its impurities by washing; hence its preparation for market consists of mining, crushing, drying, screening, and stocking.

Blue rock is mined first by blasting and stripping around the face of the hill with steam shovels, and subsequently by the same operations that are generally employed in mining any flat-lying bed where the overburden is too thick to remove. The room-and-pillar method of mining is employed. Tunnels are run from the surface, and from these tunnels rooms 25 feet wide are turned at right angles and at regular intervals, leaving pillars about the same width. These rooms may be run any distance, and when this work is complete the pillars are drawn, allowing the roof to cave. The roof as a rule forms an excellent support and requires no considerable timbering to prevent falls.

The rock is cut by drills, loosened by blasting, and then broken up with picks. The crushed material is next loaded on tram cars and hauled to the mouth of the adit and then to the drying and crushing plant, where it is prepared for shipment. Washing is not necessary for blue rock, as it is for brown rock, and the ore is fed from the tram cars to the crusher, where it is broken into fragments an inch and a half in diameter. From the crusher it goes to a rotary kiln drier. The rock contains a low percentage of moisture, and some producers do not consider drying necessary. The drying tends to increase the proportion of bone phosphate, however, for it removes the organic matter and the carbonate of lime.

KENTUCKY.

The phosphate field of central Kentucky is chiefly in Woodford County, near Wallace. Here important quantities of rock have been mined in past years. In 1914, though no rock was mined so far as the writer knows, some was shipped, but just how much the Survey has been unable to ascertain. Phosphate rock occurs not only near Wallace, but in the vicinity of Lexington, Fayette County, and in Franklin, Scott, Clark, and Jessamine counties. A very interesting report on these deposits has been issued by the Kentucky Geological Survey.[1] The writer visited this field in the summer of 1914, when many drillings were made. A report on the results of this work will be issued later.

The property near Wallace was first worked by the Lexington Phosphate Co. It was then taken over by the Central Kentucky Phosphate Co. In February, 1915, the property, it is understood, again changed hands.

WESTERN FIELD.

The western phosphate field is in Idaho, Montana, Utah, and Wyoming. In 1914 phosphate rock was produced only in Idaho and Wyoming. In March the United States Phosphate Co., at Border, Wyo., completed a mill of 100 tons daily capacity in which phosphate rock is ground fine enough to allow 95 per cent to pass through a 100-mesh screen.

FOREIGN PHOSPHATE DEPOSITS.

EGYPT.

According to Consul General Olney Arnold,[2] of Alexandria, Egypt, the Egyptian Gazette has summarized the government reports on the developing phosphate industry of Egypt as follows:

> The development of the extensive deposits of phosphate near the Red Sea has during the past two years assumed important proportions. The mines, which are worked by the Egyptian Phosphate Co., a British concern, are connected by a 20-mile railway with Port Safaga, on the Red Sea, where the rock is loaded on steamers for export. The rock is extremely rich, containing 65 per cent or more of tricalcic phosphate.
>
> The Societa Egiziana per l'Estrazione ed il Commercio dei Phosphalti, a company managed by Italians and founded in 1912, has obtained extensive concessions about 12 miles inland from Kosseir and also at Sebaia, on the eastern bank of the Nile, between Keneh and Assouan. We are informed by this company that the former concession is being linked up to the port of Kosseir with a light railway, which should shortly be completed, and the rock from the latter mines will be transported down the Nile by a ropeway and thence to Alexandria by boat for shipment. The company states that the work of development is being actively pushed and it expects to be in a position to begin exporting during the present summer.[3]
>
> The total output of phosphate in Egypt for the years 1908 to 1912, according to the Survey Department, was as follows: 1908, 700 tons; 1909, 1,000 tons; 1910, 2,397 tons; 1911, 11,925 tons; and 1912, 69,958 tons. According to the Financial Adviser's report, the output during 1913 exceeded that for 1912 by about 33,000 tons.
>
> Although other beds of phosphate are found in various districts in Egypt on both sides of the Nile Valley, the Red Sea area is responsible for almost the whole output. The rapid development of the business of the Egyptian Phosphate Co. and the impending commencement of active operations by the other company lead one to expect a considerable increase in production.
>
> Practically all the raw phosphate produced is shipped from Egypt, principally to Japan. That country in 1912 took about 49,000 tons out of a total export of 52,000 tons, and in 1913, 59,000 tons out of a total of 64,000. According to the customs returns the average value of the raw phosphate shipped during 1913 at Port Safaga was about £1 ($4.87) per ton.
>
> The local demand for raw phosphates for manure is practically negligible, but about 13,000 tons of superphosphates were imported during the past year.

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[1] Foerste, A. E., The phosphate deposits in the upper Trenton limestones of central Kentucky: Kentucky Geol. Survey, 4th ser., vol. 1, pp. 391-439, July, 1913.

[2] U. S. Daily Cons. and Trade Repts., p. 991, Aug. 20, 1914.

[3] See also table of production in principal countries, p. 48.

Projects for the manufacture of superphosphates at Alexandria, with the aid of pyrites imported from Greece, are said to be under consideration, and the reported discovery of pyrites in the Sinai Peninsula is of interest, in view of the proximity to the Red Sea phosphate field. Should the manufacture of superphosphates be established on a considerable scale in Egypt, the working of other deposits might become commercially possible.

CHILE.[1]

A large, rich deposit of phosphate has been discovered in the valley of the Huasco River, about 300 miles north of Valparaiso. Government engineers are preparing a report thereon, and it is considered of much importance, since the use of phosphate on the farms of Chile is increasing rapidly, with good results. In 1905 only 3,726 metric tons were consumed in Chile, against 20,000 metric tons for 1912. The Government railways give a reduction of 30 per cent on transportation charges for fertilizers.

CURAÇAO (DUTCH WEST INDIES).[2]

The reorganized Curaçao Phosphate Mining Co. began operations in June, 1913, at its Santa Barbara mines, shipped its first cargo in October, and is pushing business now. The phosphate goes to Germany and England. About 200 men are employed, and in one way or another a considerable amount of money is left in the island because of the industry.

OTHER FOREIGN DEPOSITS.

Other important foreign phosphate deposits are in Tunis and Algeria, a description of the deposits in Algeria country having been outlined in this report for 1913. In the South Pacific, Nauru (Pleasant), Banaba (Ocean), and Makatea (Aurora) islands all contain important deposits of phosphate rock. Christmas Island, south of the west end of Java, is also an important source of this commodity.

SURVEY PUBLICATIONS RELATING TO PHOSPHATES.

The following papers relating to phosphates 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. Those indicated as being "Out of print" or "Exhausted" are not available for distribution but may be seen at the larger libraries of the country.

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[1] Daily Cons. and Trade Repts., June 15, 1914.
[2] Consul Elias H. Cheney, U. S. Daily Cons. and Trade Repts., p. 359, Apr. 20, 1914.

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FUEL BRIQUETTING.

By Edward W. Parker.

INTRODUCTION.

Although the number of briquetting plants in the United States was reduced by 1, from 17 in 1913 to 16 in 1914, there was a substantial increase in the quantity of briquetted fuel produced and sold. The tendency to operate in large units is illustrated in the statistics of this collateral branch of the coal-mining industry, notwithstanding the fact that it is still in the early stages of development, the smaller plants going out of existence and the new establishments being of greater capacity.

Owing to the fact that in only one State were there more than two operating plants, the statistics have been grouped according to Eastern, Central, and Pacific coast States. In each of these groups the production in 1914 showed an increase over that of 1913—in the Eastern States from 62,244 short tons, valued at $240,643, in 1913 to 101,782 tons, valued at $273,046, in 1914; in the Central States from 73,287 short tons, valued at $360,408, to 94,325 tons, valued at $456,069; and in the Pacific coast States from 46,328 short tons, valued at $406,276, to 54,528 tons, valued at $425,563. There were in the Eastern States 7 plants in 1914, a decrease of 1 from 1913, one of the establishments in New York being temporarily idle on account of change of location. In the Central States 6 plants were operated in 1914, an increase of 1 over 1913, for although operations at the plant in Indiana were discontinued, a new plant was established in Missouri and North Dakota was added to the list of producers. The number of plants in the Pacific coast States was reduced from 4 in 1913 to 3 in 1914. A plant at Oakland, Cal., was abandoned, and another at Seattle, Wash., operated commercially in 1913, was used only as a demonstration plant in 1914. One new plant was completed by the Pacific Coast Coal Co. in September, 1914, and had a substantial output during the last four months of the year.

Of the 16 plants in operation during 1914, 5 used anthracite culm as a raw material; 2, semianthracite; 2, bituminous slack; 2, a mixture of anthracite culm and bituminous slack; 2, petroleum residuum; 2, semi-bituminous slack; and 1, a mixture of anthracite culm, bituminous slack, coke, and lignite. Nine plants used coal-tar pitch for a binder, 4 used secret binders, and 1 used petrolastic cement. No binder is required in briquetting carbon residues from oil-gas works.

PRODUCTION.

The production of briquetted fuel in the United States in 1914 amounted to 250,635 short tons, valued at $1,154,678, compared with 181,859 tons, valued at $1,007,327, in 1913, the increase amounting to 68,776 short tons, or 37.82 per cent, in quantity and $147,351, or 14.63 per cent, in value. The quantity of fuel briquets produced in 1914 was the largest in the seven years for which these statistics have been collected by the United States Geological Survey. The year of largest production prior to 1914 was 1912, when the output was 220,064 short tons, valued at $952,261. Compared with this, the output in 1914 shows an increase of 30,571 short tons, or 13.89 per cent, in quantity and of $202,416, or 21.26 per cent, in value. Distributed by Eastern, Central, and Pacific coast divisions, the production in 1913 and 1914 was as follows:

Production of briquets in 1913 and 1914, by groups of States, in short tons.

	1913			1914		
	Number of operating plants.	Quantity.	Value.	Number of operating plants.	Quantity.	Value.
Eastern States:						
Maryland	1			1		
New Jersey	1			1		
New York	2			1		
Pennsylvania	3			3		
Virginia	1			1		
	8	62,244	$240,643	7	101,782	$273,046
Central States:						
Indiana [a]	1					
Michigan	1			1		
Missouri	1			2		
North Dakota [b]				1		
Wisconsin	2			2		
	5	73,287	360,408	6	94,325	456,069
Pacific Coast States:						
California	2			1		
Oregon	1			1		
Washington	1			1		
	4	46,328	406,276	3	54,528	425,563
Total	17	181,859	1,007,327	16	250,635	1,154,678

[a] No production from Indiana in 1914.
[b] No production from North Dakota in 1913.

In the seven years, 1907–1909 and 1911–1914, the production has been as follows:

Production of briquets in the United States in 1907–1909 and in 1911–1914, 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
1913	181,859	1,007,327
1914	250,635	1,154,678

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.

The briquets which appear to meet with favor in the Eastern States are of the boulet type, pillow or egg shaped, and about the size of anthracite nut. Those that are practically smokeless, as they should be, make an ideal fuel for the open grate or kitchen range, holding their shape until entirely consumed and then falling, when stirred, into a pulverulent clinkerless ash. In the Central and Pacific coast States the popular type of briquetted fuel appears to be the larger size, about that of egg coal, for which the raw materials available seem to be best adapted.

RAW MATERIALS.

The material available for the manufacture of briquets in the eastern group of States is culm from the anthracite mines of Pennsylvania and from the semianthracite mines of southwestern Virginia, and noncoking bituminous slack. Though culm is still obtainable in large quantities from the banks of the anthracite region, the mines and breakers are producing annually about 20,000,000 tons of coal below the size of pea, the average price for these small sizes being probably not much more than 50 per cent of the actual cost of production. The uniform size of the briquets makes them highly desirable as a domestic fuel in that their combustion in the furnace is practically complete, and if properly made they do not produce clinkers, that bugbear to the housekeeper and furnace man. The failure to make more substantial progress in the production of briquets from anthracite is probably due to the fact that an absolutely smokeless product has not been obtained, and consumers accustomed to smokeless anthracite object even to the small amount of smoke emitted from the briquets.

Slack from the noncoking bituminous and subbituminous coals of the Middle Western and the Rocky Mountain States is another cheap and abundant raw material for the manufacture of briquets. It is obtainable in any of the coal-mining regions from the Alleghenies to the Rocky Mountains and at many places is now wasted, practically given away, or burned on the slack dump, either intentionally or from spontaneous ignition. The quantity now used in the manufacture of briquets represents but a drop in 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 practice has taught is well adapted to briquetting, and is much more usable in that form than in the raw state.

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, if properly prepared, makes an excellent substitute for coal. The peat now produced in the United States is used for stable litter and fertilizer. None is used raw for fuel.

BINDERS.

As already stated, more than half the briquetting establishments use coal-tar pitch as a binder, and if to these are added those that use asphaltic and gas-tar pitch it will be seen that binders of this type are used in two-thirds of the briquetting plants that employ binders. The five establishments using binders other than pitch employ mixtures whose constituents are principally of vegetable origin. Inorganic binders, such as cement and lime, 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 of the fuel. Binders of organic material, however, such as pitches from coal tar, gas tar, or asphalt, or mixtures of vegetable origin, contribute combustible matter and do not increase the percentage of ash. A binder to produce an entirely satisfactory briquet should not materially add to the emission of smoke, particularly in communities where the use of smokeless anthracite is customary, as a tendency to smoke creates a prejudice against the use of briquets. The chief objection to the use of pitch binders is the emission of smoke when first fired, which results in the deposition in the flues and on other surfaces of a tarry soot, which is dfficult to remove.

BARYTES.

By James M. Hill.

PRODUCTION.

The production of crude barytes in the United States in 1914 was 51,547 short tons, valued at $153,715. Compared with the production of 1913, which was 45,298 short tons, valued at $156,275, this was an increase of 6,249 tons in quantity but a decrease of $2,560 in value.

The average price per ton was $4.09 in 1912, $3.45 in 1913, and $2.98 in 1914. 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 transporting by wagon, boat, or railway. The price of the crude material f. o. b. mines reported by most of the principal producers in 1914 was lower than in 1913. The average price for the State of Missouri was $3.37 a ton, which was substantially the average price in Washington County, Mo., the principal producing county in the State.

At the close of 1914 there were 7,809 short tons of crude domestic barytes unsold at the mines, according to reports from the producing districts, as compared with 9,181 tons in 1913. From Missouri 51 producers reported an output of crude barytes. There were 3 producers in Tennessee and Georgia and 1 producer each in Alabama, California, Kentucky, North Carolina, South Carolina, and Virginia.

The total quantity of refined barytes reported as sold by mills in 1914 was 35,815 short tons, valued at $463,858. As compared with the production in 1913, which was 37,033 short tons, valued at $525,300, this was a decrease of 1,218 tons in quantity and of $61,442 in value. The average price per ton reported as received for refined barytes was $12.97 in 1912, $14.18 in 1913, and $12.95 in 1914.

At the close of 1914 there were 4,086 tons of refined barytes still in the hands of the various refiners. Six firms reported production of refined barytes, their plants being located in Kentucky, Missouri, North Carolina, South Carolina, and Virginia.

The following table shows the production, total value, and average price per ton of crude barytes mined in the United States from 1912 to 1914, inclusive:

Production of crude barytes in the United States, 1912–1914, by States, in short tons.

State.	1912			1913			1914		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Missouri	24,530	$117,035	$4.77	31,131	$117,638	$3.78	33,317	$112,231	$3.37
Tennessee and Kentucky	[a] 3,718	8,682	2.34	[a] 2,098	3,568	1.70	8,932	14,393	1.61
Other States [b]	9,230	27,596	2.99	12,069	35,069	2.91	9,298	27,091	2.91
Total	37,478	153,313	4.09	45,298	156,275	3.45	51,547	153,715	2.98

[a] Production of Tennessee; no production of barytes reported for Kentucky in 1912 and 1913.
[b] Includes, 1912: Georgia, North Carolina, and Virginia; 1913: Georgia, North Carolina, South Carolina, and Virginia; 1914: Alabama, California, Georgia, North Carolina, South Carolina, and Virginia.

The following table gives the domestic production of crude barytes in short tons from 1883 to 1914, inclusive:

Production of crude barytes, 1883–1914.

	Short tons.		Short tons.		Short tons.
1883	30,240	1894	23,335	1905	48,235
1884	28,000	1895	21,529	1906	50,231
1885	16,800	1896	17,068	1907	89,621
1886	11,200	1897	26,042	1908	38,527
1887	16,800	1898	31,306	1909	61,945
1888	22,400	1899	41,894	1910	42,975
1889	21,460	1900	67,680	1911	38,445
1890	21,911	1901	49,070	1912	37,478
1891	31,069	1902	61,668	1913	45,298
1892	32,108	1903	50,397	1914	51,547
1893	28,970	1904	65,727		

IMPORTS.

The imports of barytes for consumption during the last five years and the value of imported barium compounds, from 1910 to 1914, are given in the following two tables:

Barytes imported and entered for consumption in the United States, 1910–1914, in short tons.

Year.	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
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
1913	5,463	38,155	35,840	61,409
1914	4,323	30,483	24,423	46,782

Value of the imports of barium compounds, 1910–1914.

Barium compounds.	1910	1911	1912	1913	1914
Barium carbonate, natural	$25,229	$27,351	$15,777	$13,116	$8,084
Barium carbonate, manufactured			9,938	38,949	28,221
Barium binoxide	341,631	270,917	252,320	239,000	332,709
Barium chloride	35,614	28,896	27,655	37,620	68,866
Blanc-fixe, or artificial barium sulphate	67,975	71,049	70,327	62,785	32,619
Total	470,449	398,213	376,017	391,470	470,499

BARYTES IN CANADA.

PRODUCTION.

The following table gives the production of barytes in Canada in 1912, 1913, and 1914, the figures for 1914 being subject to revision:

Production of barytes in Canada, 1912–1914, in short tons.

Year.	Quantity.	Value.
1912	464	$5,104
1913	641	6,410
1914	612	6,129

CHARACTER OF BARYTES.

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 it 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 many of the deposits in the United States. The commercial grades of the mineral as mined carry 95 to 98 per cent barium sulphate and 1 to 3 per cent of silica.

USES OF BARYTES.

Barytes is used principally as a pigment in mixed paints, in the manufacture of lithopone—a chemically prepared white pigment consisting of zinc sulphide and barium sulphate—and as a base upon which the lake pigments are precipitated. It is also used in the manufacture of white rubber goods, asbestos cement, and artificial ivory, and in the preparation of fertilizers, boiler compounds, insecticides, peroxide of hydrogen, and artificial driftwood salts. Barium carbonate and some barium chloride are used to prevent efflorescence on bricks; and the carbonate, sulphate, or nitrate[1] is used in the manufacture of rolled glass, hollow glass, crystal and table glass, and in special glasses such as the Jena phosphate crown glass.

OCCURRENCE OF BARYTES IN THE UNITED STATES.

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 the barytes has produced deposits of the mineral embedded in residual clay. 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 1914 the Missouri district furnished 64.63 per cent of the total production of the United States. The Missouri production came from the following counties named in the order of their output: Washington, St. Francois, Jefferson, Moniteau, Cole, Miller, Franklin, Morgan. Among the Appalachian States, Tennessee, Georgia, North Carolina, Virginia, South Carolina, Alabama, and Kentucky, named in the order of production, reported an output of crude barytes in 1914.

In the report on barytes in Mineral Resources for 1913 there was given a brief description of the principal localities in the United States from which barytes is shipped. During 1914 the Barbour Chemical

[1] Springer, L., Some of the uncommon constituents of glass: Eng. and Min. Jour., vol. 97, p. 181, Jan. 17, 1914.

Co., of San Francisco, opened a barite and witherite mine near El Portal, Mariposa County, Cal. Details of this mine are lacking, but in a letter to the writer the president of the company states that on the surface the veins contained only barite, but that where these veins were cut at depth witherite as well as barite was found. He says that some ore carries 93 per cent $BaCo_3$. In view of the demand for domestic witherite since the beginning of the European war the discovery of this deposit is interesting, and it is possible that other deposits similarly situated may be discovered. According to F. C. Calkins,[1] of the United States Geological Survey, the barite in the mine of the Barbour Chemical Co.—for there are other deposits than that being worked—occurs in veins in the sedimentary formations for at least 1 mile east of the main mass of intrusive granitic rock.

Some undeveloped deposits of barite were discovered by E. L. Jones,[2] of the United States Geological Survey, during 1914 in the Whipple Mountains, at the north end of the Colorado River Indian Reservation about 10 miles from Parker, Ariz. Small fissure veins in basalt flows, tuffs, and breccias, and in some places in sandstones, are filled with barite and some calcite. The material is considerably iron stained, and as the largest veins are not over 3½ feet wide and of little persistence along the strike, it is probable that these deposits will not prove of much commercial value.

TRADE CONDITIONS.

The curtailment of foreign barytes in the markets of the eastern United States on the outbreak of the European war and the prospect that no foreign barytes would be available drove a number of the large users of barytes to seek a domestic source for their supplies. It developed later, however, that the situation was not so serious as it was at first imagined. One eastern paint manufacturer has acquired barytes properties in a Southern State and expects to use domestic ore in place of imported material. In spite of the uncertain conditions of foreign supply, the price of crude barytes in the various States has not increased as might have been expected. On the western coast consumption was reduced, as the freight rate on barytes from the Central States was raised about 110 per cent. Early in April, however, the transcontinental railroads applied for permission to reduce all freight rates to the Pacific coast to correspond with the water rates. The decision on this question is still pending and is awaited with considerable interest.

Recently the development in the manufacture of barium salts in this country has been considerable. At Melrose, Cal., the Barbour Chemical Works is making barium sulphite, barium hydroxide, barium nitrate, and barium chloride. A plant has recently been built at Charleston, W. Va., and expects to begin the manufacture of barium oxide, barium hydrate, barium sulphide, barium nitrate, barium chloride, and barium binoxide.[3]

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1 Oral communication to the writer.
2 Notes furnished by E. L. Jones.
3 Mfrs. Record, p. 40, Dec. 17, 1914.

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STRONTIUM.

By JAMES M. HILL.

During 1914 no strontium was reported as mined in the United States. Some large deposits of strontium sulphate, celestite, are known near Gila Bend, Ariz., and Silver Lake, Cal.[1]

Recently the Survey has been informed [2] that a considerable body of celestite-bearing rock has been discovered near Columbia, Yavapai County, Ariz. Besides these relatively recent discoveries, there are the well-known deposits of celestite in Texas, Ohio, and New York, which have produced in the past. The barite mined in central Kentucky is known to contain strontium, and it is possible that the newly opened barite chemical plant located at Charleston, W. Va., may manufacture strontium salts as a by-product.

At the present time it is estimated that not more than 2,000 tons of strontium-bearing minerals are needed annually to meet the requirements of the trade. This is because of the fact that, aside from the very limited use in drugs, strontium finds practically its sole use in this country in the manufacture of fireworks and night signals used by railway and steamship companies.

It would seem, in view of the well-known efficiency of the strontia process in the manufacture of beet sugar, that there was a considerable field for the development of the deposits of celestite in the Western States. Germany, prior to the outbreak of the war, was using approximately 100,000 tons of strontium hydroxide annually in the beet-sugar industry,[3] and doubtless a quantity nearly as large was used in Russia. It is thought that a plant for the manufacture of strontium hydroxide located in Arizona would prove profitable in that it could supply the needs of the Colorado, Idaho, and Utah sugar refiners. It seems doubtful, in view of the present freight rates from the West, if a plant for refining strontium could be located profitably in the Central or Eastern States; yet the western railroads may meet the rates of water transportation and thus make possible a more centrally located refining plant.

It is understood that at present much of the strontium nitrate used in the manufacture of fireworks and night signals is made from English ores that are delivered in Philadelphia and other eastern ports at so low a cost that domestic ores can not successfully compete with them.

According to reports of the Bureau of Foreign and Domestic Commerce, Department of Commerce, the imports of strontia oxide, protoxide of strontium, and strontianite or mineral carbonate of strontia in 1913 were valued at $2,284 and in 1914, at $1,016. No figures of the imports of celestite or strontium carbonate are available.

[1] Phalen, W. C., Celestite deposits in California and Arizona; U. S. Geol. Survey Bull. 540, pp. 521–533, 1914.
[2] Personal letter.
[3] Meyer, H. C., Strontium in the best-sugar industry. Jour. Ind. & Eng. Chemistry, vol. 6, pp. 1036–1037, Dec., 1914.

MICA.

By Douglas B. Sterrett.

INTRODUCTION.

Of the numerous varieties of mica only two have received wide application in the industries. These are muscovite and phlogopite. Small quantities of biotite, some of the hydrated variety, have been used for special purposes within the last few years, and lepidolite, or lithia mica, has been used to a small extent as a source of lithia salts.

The value of mica lies in its physical properties, especially those of cleavage, flexibility, elasticity, nonconductivity of heat and electricity, transparency, and brilliancy of cleavage faces. These properties render mica valuable or even indispensable in several industries. Thus in the manufacture of electrical machinery and apparatus mica has been found of great utility and no substitute has been discovered for it in many of its applications. Mica still finds extensive use in the glazing trade, but different types of glass can be substituted in most uses except as windows for stoves. In the decorative trade, filings or flakes of aluminum, copper, or bronze may be substituted for mica, but at a greatly increased cost, so that mica proves almost indispensable in an industry so large as the manufacture of decorative wall paper.

Muscovite is a silicate of aluminum and potassium and phlogopite is a silicate of magnesium, aluminum, and potassium. In thin sheets muscovite is light colored and clear when free of inclusions. Phlogopite is generally yellow or brownish. In sheets of one-sixteenth of an inch or more in thickness muscovite may be colorless, gray, yellow inclining to amber, red, brown, or green. In sheets of less than one-sixteenth of an inch in thickness phlogopite may be yellow, brown, or black, and sometimes it has a coppery appearance. Muscovite in thin sheets is called white mica, and when it is in sheets of sufficient thickness to show strong color it is spoken of as "rum," "ruby," "smoked," "green" mica according to color. Phlogopite mica is called "amber" mica in the trade. The luster of muscovite is brilliant and glimmering on fresh surfaces, and that of phlogopite is less brilliant and more silvery or pearly.

OCCURRENCE.

Mica has been mined in several countries, but those contributing largely to the world's production are India, the United States, Canada, German East Africa, and Brazil. Mica has also been mined irregularly in South Africa, Ceylon, Norway, China, Japan, Argentina, and South Australia, and has been reported as occurring in deposits of future commercial value in still other countries.

In the United States mica deposits of probable value have been found in more than 20 States. The principal producing States have been North Carolina, New Hampshire, South Dakota, Idaho, New Mexico, Colorado, Virginia, South Carolina, Alabama, and Georgia. Variable productions have been reported from or promising deposits found in Maine, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, California, Nevada, Wyoming, Washington, Arizona, and Utah.

Muscovite is the only variety of mica mined in the United States. Phlogopite is obtained chiefly from Canada, but small quantities have been mined in Ceylon. Deposits of muscovite of commercial value are confined to pegmatite, a rock allied to granite in composition but of very much coarser grain and occurring in smaller deposits. The deposits are commonly associated with metamorphic or igneous rocks, the most common types being gneisses and schists with mica, garnet, kyanite, or hornblende as characterizing minerals. The occurrence of the pegmatite and of the mica in the pegmatite is quite irregular.

The almost universal association of mica-bearing pegmatites with crystalline rocks renders their geographical distribution more easily understood. The absence of areas of ancient metamorphic or of crystalline rocks from a good geologic map of a region would indicate the absence of good deposits of mica. On the other hand, the presence of such rocks does not mean the presence of mica, but only indicates a possibility of its occurrence.

A study of the geologic map of North America[1] shows the possibility of the occurrence of mica deposits in the following regions of the United States: In the eastern Appalachian region from Alabama to New York State and in the New England States; in northern Wisconsin, Michigan, and Minnesota, and in the region including corners of Minnesota and Iowa and part of South Dakota; in the Black Hills of South Dakota; in the Rocky Mountain region from New Mexico to Montana; and in many smaller more or less isolated areas in nearly all the Western States from Texas to California and Washington. The same map shows large areas in which younger sedimentary rocks cover the older crystalline rocks beneath a mantle ranging from hundreds to thousands of feet in thickness and in which, accordingly, mica deposits are not to be expected.

THE MICA INDUSTRY IN THE UNITED STATES.

GENERAL CONDITIONS.

From the first mica mining in the United States early in the last century until about 1867 New Hamsphire produced all the mica mined in the country. No records were kept of the quantity and value of the outputs for this period or later until 1880, by which time mica mines were opened in several other States. Until about 1890 the bulk of the mica was used in the glazing trade, for which only the large sizes of clear sheets were considered suitable. After 1890,

[1] Willis, Bailey, and Stose, G. W., U. S. Geol. Survey, Geologic map of North America: Scale 1 : 5,000,000, 1911.

along with the great growth in the manufacture of electrical apparatus and machinery, an increasing quantity of mica was used, and during the same period smaller patterns were applied in the glazing trade. About the same time ground mica for wall-paper decoration came into large demand and caused the consumption of much of what had formerly been waste mica.

Through 1880 and during a few following years the great demand for large sheet mica was supplied chiefly by the domestic production. After 1885 increased imports of mica from India made inroads on the domestic production, and this competition still continues. In 1890 an ad valorem duty of 35 per cent was placed on imported mica. The tendency of this duty was to prohibit imports of mica with large bulk and small value, such as small sheet mica and the material then classed as scrap. In 1897 the tariff was changed to 6 cents per pound for "unmanufactured" mica and 12 cents per pound for "cut" or "trimmed" mica, with an additional 20 per cent ad valorem for each. These rates of duty practically made the importation of small sheet and scrap mica impossible to meet the growing demand for those sizes and accordingly stimulated domestic mica mining. The tariff was changed again in 1909 to 5 and 10 cents per pound for "unmanufactured" and "cut" or "trimmed" mica, respectively, with 20 per cent ad valorem, without apparent effect on the mining industry. The tariff of October 3, 1913, provides for the following duties: "Unmanufactured" mica valued at not above 15 cents per pound, 25 per cent ad valorem; "cut mica," "mica splittings," "built-up mica," and all manufactures of mica, 30 per cent ad valorem; "ground mica," 15 per cent ad valorem.

NEW HAMPSHIRE.

Mica mining in the United States commenced in 1803 with the opening of the Ruggles mine, in Grafton County, N. H. This mine and others opened later have been operated intermittently ever since. Until mica mining began in North Carolina about 1867, New Hampshire furnished the mica production of the United States. After mines were opened in North Carolina and other States the production in New Hampshire declined somewhat but has been large during some years. The principal output has come from the larger mines, but a number of prospects have contributed intermittently to the production.

Mica deposits have been worked in Grafton, Cheshire, Sullivan, Merrimack, Strafford, and Coos counties. The best deposits lie in a belt extending from Keene through the middle of Cheshire County northward into Sullivan County, thence into the northwestern part of Merrimack County, and on, east of north, to about the center of Grafton County. The principal mining districts are around the towns of Rumney, Groton, Alexandria, Orange, Grafton, Alstead, and Gilsum.

Several well-equipped trimming and manufacturing plants have been erected in different parts of the mica region, and four of them were in operation during 1914, one at West Rumney, two at Keene, and one at Alstead. Two of these grind mica as well as punch, trim, and manufacture it. Another plant at Grafton Center, not in operation, is equipped with all machinery necessary for grinding, punching, trimming, and manufacturing. The General Electric Co. plant at West Rumney has been equipped with the best power trimming machinery, with which considerable experimental work has been done in order to determine to what extent rough mica can be manufactured mechanically instead of by hand. Small trimming houses are also operated at some of the mines in order to cut down the quantity of waste that must be hauled away and to grade the mica for better prices.

With these facilities for manufacture most of the mica mined in New Hampshire is brought to an advanced stage of preparation for the market, and some of it is made into finished products. Some of the mica mined by persons not connected with the manufacturing companies is sold on contract to these companies at so much per ton for all mica that will average over punch size. The contract price generally calls for $50 to more than $100 a ton according to the size, quality, and quantity the mine seems to be capable of yielding. The mica averaging punch size and less is held at the mine until quantities have accumulated and is then sold in bulk as scrap.

Mica is still obtained in quantity from the dumps of the old mines at which material suitable for small sheets was thrown away 30 years ago. During 1914 a considerable output of such mica was obtained from the Ruggles mine near Grafton Center and from the Palermo mine near North Groton. The dumps still to be worked over at these mines and at some of the other old mines are large.

NORTH CAROLINA.

For many years North Carolina has led in the production of mica in the United States. The industry commenced about 1867 or 1868 and in a few years was in a flourishing condition. Mica mining began in the mountain counties and has persisted there to the present. Good mines have been worked intermittently in several counties of the Piedmont Plateau, but the bulk of the production has come from the northwest side of the Blue Ridge. In the mountain region mica deposits have been worked in nearly every county from Macon and Jackson counties on the southwest to Ashe County on the northeast. Mitchell and Yancey region have probably been the largest producers, but Macon, Jackson, Haywood, and Ashe counties have also been important. In the Piedmont region large productions of mica have come from Cleveland, Gaston, Lincoln, and Stokes counties. Mines and prospects also occur in several other counties of this region.

A feature of mica mining in North Carolina is that much of the output is furnished by small mines or prospects worked intermittently by farmers at times when crops do not require attention. A number of large mines are also operated more or less regularly and yield much fine mica. Smaller quantities of mica are obtained, more or less as a by-product, during the mining of kaolin and feldspar. A part of the output of sheet mica of small size is obtained from the dumps of the old mines, but most of the dumps have now been pretty thoroughly worked over.

The greater part of the mica is handled by several large companies, most of which purchase from the small mines, although some companies both operate their own mines and also purchase from others.

Generally the mica is brought to an advanced stage of preparation for the market before being shipped from the State. Part is split, closely trimmed, graded as to quality and size, and is then shipped for final manufacture; part is trimmed or manufactured into patterns ready for use in the different trades. Only a small part of the sheet mica mined is shipped without being either manufactured or carefully graded. The bulk of the scrap mica is ground in the State. Small trimming plants for the first sorting of the roughly mined mica are scattered over the mica region and at many of the mines. Well-equipped trimming plants are located at Asheville, Plumtree, Spruce Pine, and Penland. Mica grinding mills are located at Asheville, Plumtree, Spruce Pine, and Micaville.

OTHER EASTERN STATES.

Mica has been mined in several Eastern States besides North Carolina and New Hampshire. Mining in some of these States probably commenced soon after the industry began in North Carolina.

The mines of Amelia County, Va., are said to have been opened before 1870. In the Tenth Census report on the mining of mica productions are reported from Maine and Massachusetts in 1880. The mines of Alabama were opened more than 30 years ago. Mica mining in the Eastern States other than North Carolina and New Hampshire has been very irregular, no productions being reported for periods of several years at a time. Some of the Virginia mines were operated on a rather extensive scale in the early days and at various subsequent times. The deposits are in the Piedmont counties, the largest works being in Amelia and Henry counties. Good mines or prospects have been opened also in Hanover, Goochland, Prince Edward, Franklin, and Bedford counties. Some of the mines of Amelia and Prince Edward counties have yielded feldspar for pottery manufacture also, and a few of those of Amelia County have furnished beautiful gem and specimen minerals, such as amazon stone, spessartite garnet, moonstone, and beautifully crystallized feldspars, and also monazite and other rare earth minerals.

In Maine small quantities of mica are saved during quarrying for feldspar and gem tourmalines in Oxford County, and some deposits have been found which could probably be worked for mica alone. In Massachusetts mica was mined some years ago in Hampden County. In Connecticut a little mica is obtained from the feldspar quarries in Middlesex County, and a large yield was taken from a mica-feldspar-gem beryl mine near New Milford before 1900. A little mica has been mined in Brewster County and in the southeastern part of New York State. Mica mines have been worked during several different periods in southeastern Pennsylvania, and in Maryland between Washington and Baltimore and to the north of Baltimore. In South Carolina good mica mines have been worked in Greenville and Anderson counties, and prospects have been opened in other counties of the Piedmont Plateau region. In Georgia mica mines have been operated at several places in the Piedmont counties and in the mountain region. The principal mines are in Rabun, Union, Lumpkin, Hall, Elbert, and Cherokee counties. Mica mining has not been pursued consecutively for many years in any part of Georgia.

Mica mines were opened in Alabama during the early days of mica mining in the Southern States. Prospects have been tested at various subsequent times, and considerable mining has been carried on at intervals during the last 20 years. The mines are located in Randolph, Clay, and Tallapoosa counties, and there are prospects in Lee, Coosa, and other counties. The mines of Randolph and Clay counties yield a very fine grade of clear "rum"-colored mica.

SOUTH DAKOTA.

Valuable deposits of mica were discovered in South Dakota in 1879. Within a year or two active mining was in progress, and large productions were reported in 1883 and 1884. Since that time mining has been pursued more or less interruptedly. The output has varied greatly, according to the number and character of the mines operated. In some years one or two of the larger mines have produced mica valued at more than $100,000. Some of these mines, such as the New York and the White Spar mines near Custer, have been equipped with electrical mining machinery and lights and have been worked extensively. Plants have been set up for preliminary trimming of the mica, but the more advanced work has been done in factories in Denver, Lincoln, Crawford, Chicago, and Pittsburgh. At present much of the mica is treated in the plant of the Mica Milling & Manufacturing Co., at Crawford, Nebr.

NEW MEXICO.

Mica deposits were discovered in New Mexico in about 1880. By 1884 some of the mines were in active operation, and mining has been carried on intermittently, first on a large scale and then at low ebb until the present time. The principal mining has been done in what is now Rio Arriba County, 10 to 12 miles west of the narrow-gage track of the Denver & Rio Grande Railroad from Santa Fe to Alamosa, Colo. The deposits are near and to the southwest of Petaca. Other mines have been worked in San Miguel County in the region north of Ribera and west of Las Vegas.

Some of the mines of the Petaca region are rich in mica and have been operated extensively. A large quantity of scrap mica is obtained with the sheet mica, but the distance of the mines from the markets prevents a realization on its value as great as is obtained in some other States. It is probable that some of the deposits could be profitably worked if they were located in the Southeastern States where labor is cheaper and markets nearer, but present conditions in New Mexico render the operation of only the better deposits profitable.

Most of the mica has been shipped in the rough or only partly graded, but conditions are favorable for the establishment of plants for further treatment of the mica before shipment. Much of the trimming, punching, and manufacturing could be done by native Mexican women probably as cheaply as it is done by women in the Eastern States.

IDAHO.

Mica deposits were discovered in Idaho soon after 1880, but it was not until several years later that any of the deposits were regularly mined. The principal mines are in Latah County, near Avon and Vassar. Other deposits are known in Washington County and in the

Coeur d'Alene region. The mines near Avon have been large producers, especially the "Muscovite" mine. Most of the mica has been only roughly trimmed and graded before shipping. The mines are from 3 to 6 miles from the Chicago, Milwaukee & Puget Sound Railway tracks. The long freight haul to the markets does not leave a large margin of profit on the scrap mica, but the yield of sheet mica has been large.

COLORADO.

Mica deposits were discovered in Colorado in 1885, but regular mining was not commenced until later. Mining in this State has been very irregular and intermittent, but some good mica has been obtained. Several deposits have been found in which mica suitable only for grinding occurs so plentifully that they could be worked for that variety alone if conditions of transportation were favorable. Mica deposits occur in Colorado at widely separated localities. Deposits have been worked in Fremont, Jefferson, and Larimer counties, and prospects are known in Chaffee, Routt, and Mesa counties.

OTHER WESTERN STATES.

Mica deposits have been worked or prospected in Wyoming, Washington, California, Nevada, Utah, and Arizona. Several localities where mica occurs are known in Wyoming. Among these the deposits in the Hartville Uplift, 10 to 12 miles northeast of Hartville, and in the Medicine Bow Range, about 12 miles west of Fox Park, in Albany County, are promising. Mica deposits are reported in several counties of California, and one deposit in Ventura County has been regularly mined. In Nevada a small amount of mining was done in 1893 in the Virgin Range in the southeastern part of Lincoln County. Work has been hindered in this region by difficulties of transportation. In Texas mica deposits have been prospected in the Van Horn Mountains of Culberson County and in Mason County.

USES.

The principal use of sheet mica is in the manufacture of electrical apparatus and machinery, but a quantity is used in the glazing trade for stoves, gas-lamp chimneys, lamp shades, etc. Only clear mica with perfect cleavage is used in the glazing trade.

In the manufacture of electrical apparatus and machinery mica is used in sheets of various sizes and shapes, including washers and disks, for places in which a noninflammable insulating material is necessary. Thus, properly trimmed sheets are used between the commutator segments of motors and dynamos, for tubes, sheets, and other forms in transformers, and for washers and rings around many bolts and screws requiring insulation. Large disks and washers are used in every arc light and smaller ones in the sockets of incandescent lamps. Flexible mica-covered cloth and tape find varied uses in many pieces of electrical apparatus.

Ground mica is used in largely increasing quantities for the decoration of wall paper, for the manufacture of lubricants, fancy paints, rubber goods, molded mica, roofing papers, and as covering for steam pipes. Finely ground mica is applied to wall paper to furnish luster and brightness. For this purpose wet-ground mica is the most satisfactory, because, it is claimed, the scales are cleaner and flatter than in the dry-ground product. Ground mica mixed with oil forms a good lubricant for axles and other bearings, and quantities are used for this purpose. For fancy and brocade paints ground mica is mixed with various pigments and serves the purpose of metallic paint. Many rubber goods contain finely ground mica used both as an adulterant and to furnish certain qualities desired in the rubber. Ground mica mixed with shellac or plaster is used in the form of "molded mica" for insulation of trolley wire and for similar supports. Tar and other roofing papers are coated with coarse flakes of "bran" mica to prevent sticking when they are rolled for shipment. Bran mica and coarser grades mixed with other materials furnish good fireproof and heat-retaining coverings for steam pipes and boilers.

Another use for rather coarsely ground or "bran" mica is in the manufacture of concrete facing material to give the effect of a finish of natural rock. This material is prepared in different ways, and various mixtures of other minerals, such as biotite, tourmaline, and hornblende, are used to heighten the effect. The Mica Milling & Manufacturing Co., of Crawford, Nebr., prepare "Micamima" for this purpose. It is suitable for various decorative effects, according to the variation in mixing. The Texas Mica Co., of Pecos, Tex., has another product, called "Micolith," also susceptible to variation, and furnishing very good rock effects in concrete facing works.

The Denver Mining & Manufacturing Co., of Denver, Colo., has placed a new mica product on the market under the name of "Tungash," which should prove of value in the decorative trade. It is a bronze-colored mica obtained by calcining hydrated biotite. The product obtained by heating assumes various shades of silver to golden bronze, with metallic luster, and some has a slightly greenish cast. The crude mica is dull greenish black. It expands or exfoliates immensely on heating and makes a light product, a little of which will go a long way when ground and applied as a coating. So far most of the coarse grades of the output have been used as a covering for patent roofing paper. The mica is found 5 miles southeast of Hecla, in the Turret Mountain mining district, Chaffee County, Colo.

PRODUCTION.

The total value of the mica produced in the United States in 1914 was $329,956. The production came from 13 States—North Carolina, New Hampshire, Idaho, Virginia, South Dakota, New Mexico, Alabama, Colorado, South Carolina, Maryland, Connecticut, Georgia, and Maine, named in the order of the value of their output. Of these States no production was reported from Maryland, Connecticut, Georgia, and Maine in 1913; and two States, Pennsylvania and New York, which produced mica in 1913, reported no production for 1914. The value of the production of mica in 1914 was less than in 1913 by $106,104.

The production of sheet mica as reported to the Survey amounted to 556,933 pounds, valued at $278,540, as compared with 1,700,677 pounds, valued at $353,517, in 1913. The production of scrap mica in 1914 amounted to 3,730 short tons, valued at $51,416, as compared with 5,322 short tons, valued at $82,543, in 1913. The output of sheet mica in 1914 falls considerably below the average for the preceding four years, but the production of scrap mica compares more favorably with the average production during the preceding four years.

The value of the production of mica in North Carolina in 1914 was $195,270, as compared with $267,913 in 1913. The production reported consisted of 274,121 pounds of sheet mica, valued at $171,370, and 1,789 tons of scrap mica, valued at $23,900. The production of sheet mica in 1913 amounted to 803,462 pounds, valued at $230,674, and of scrap mica to 2,729 tons, valued at $37,239.

In New Hampshire the total production of mica in 1914 was valued at $47,837, as compared with $79,671 in 1913. The output consisted of 133,556 pounds of sheet mica, valued at $39,588, and of 600 tons of scrap mica, valued at $8,249.

In Virginia the total production of mica in 1914 was valued at $24,653, as compared with $5,150 in 1913. The output consisted of 27,672 pounds of sheet mica, valued at $22,358, and of 153 tons of scrap mica, valued at $2,295.

The production of mica by other States is not given separately, since there were but one or two producers in each State and the publication of the figures would make known the outputs of individual companies, a policy not followed by the United States Geological Survey.

The production of mica in the United States since 1880 is shown in the following table:

Production of mica in the United States, 1880–1914.

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	1,000	$10,000	80,000
1887	70,500	142,250	2,000	15,000	157,250
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	80,629	156	8,300	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
1913	1,700,677	353,517	5,322	82,543	436,060
1914	556,933	278,540	3,730	51,416	329,956

PRICES AND GRADES OF MICA.

The average price of sheet mica in the United States during 1914, as deduced from the total production, was 50 cents a pound, as compared with 20.8 cents a pound in 1913 and 33.4 cents in 1912. The average price of sheet mica in North Carolina was 62.6 cents a pound, as compared with 28.8 cents a pound in 1913 and 44.9 cents in 1912; in New Hampshire the average price was 29.6 cents a pound, as compared with 8.8 cents a pound in 1913; in Idaho it was 74.4 cents a pound; in Virginia it was 81 cents a pound; in New Mexico it was 23.3 cents a pound; in South Dakota, 5 cents; in Alabama, 12 cents.

The variations in prices reported from different States in different years is largely due to the condition of manufacture in which the mica is reported. The mica sold in the rough at the mines necessarily includes a large proportion of scrap, and the prices are accordingly much lower than for trimmed sheet mica reported by companies with trimming plants.

The average price of scrap mica in 1914, as deduced from the total production, was $13.78 a short ton, as compared with $15.51 a ton in 1913; in North Carolina the price was $13.36, as compared with $13.64 in 1913; in New Hampshire, $13.74; in Idaho, $19.27; in South Dakota, $11.90; in New Mexico, $12.98.

In the sheet-mica trade, size is made the principal basis for grading rough trimmed mica after sorting for quality. The character of the grades are shown in the first three columns of the following table. For the convenience of the small miners, chiefly in the South, prices for mica with dimensions approximating these grades are quoted by the larger dealers. These are shown in the last three columns of the table. The prices represent those offered per pound for rough knife-trimmed mica sorted to cut the sizes and qualities indicated. The prices vary a little, and during 1914 they were probably 10 per cent lower than those shown in the table.

Grades and prices of mica.

Grades and sizes.			Price according to quality.		
Grade.	Size (in square inches).	Approximate corresponding sizes used as basis of purchase in South.	No. 1 and No. 2 quality.	Spotted or slightly clay stained.	Black "specked," heavily clay stained.
Extra special	48 and up	8 by 10	$6.00	$3.00	$2.25
Special	36 to 48	6 by 8	4.00	2.25	1.60
1	24 to 36	6 by 6	3.00	1.85	1.40
2	14 to 24	4 by 6	2.25	1.60	1.25
		3 by 5	1.70	1.25	1.00
3	9 to 14	3 by 4	1.35	1.00	.70
4	6 to 9	3 by 3	1.15	.70	.40
		2 by 3	.70	.30	.25
5	3 to 6	2 by 2	.30	.15	.07
6	— to 3	1½ by 2	.12	.07	
		Punch [a]	.035	.035	.03

[a] Punch mica will yield disks 1½ inches in diameter.

IMPORTS.

The imports for consumption of unmanufactured and trimmed sheet mica into the United States during 1914, as reported by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, were valued at $625,396, as compared with $943,018 in 1913. During 1914, 202 tons of ground mica, valued at $4,088, were imported, as compared with 145 tons, valued at $4,765, in 1913.

The quantity and value of mica imported for consumption into the United States annually from 1905 to 1914, inclusive, are shown in the following table:

Mica imported and entered for consumption in the United States, 1905–1914, 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
1913	2,047,571	751,092	(a)	191,926	(a)	943,018
1914	360,888	168,591	(a)	456,805	(a)	625,396

a Quantity not reported.

SLATE.

By A. T. Coons.

PRODUCTION.

Slate has been known and quarried in the United States for more than 150 years. There are records of the use of slate quarried as long ago as 1750 in Massachusetts, Maryland, and Pennsylvania, and in 1850 in New York, Vermont, Georgia, California, Virginia, and other States, but there are no statistics available for years prior to 1879.

Prior to 1890, except for the census years 1880 and 1889, the statistics of production were drawn from various reliable sources, but since 1890 they have been procured directly from the operators of the slate quarries and are as accurate as can be obtained.

As stated in previous reports, the statistics of the production of slate represent the output as reported by the quarrymen and include the quantity and value of roofing slate and of millstock sold by them and the value of a quantity of slate sold for other purposes. The values given for both millstock and roofing slate represent prices f. o. b. at the point of shipment, the millstock 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 following table shows the number of squares, the value, and the average price per square of roofing slate, and the quantity and value of millstock, by years, from 1879 to 1914, inclusive:

Quantity and value of roofing slate and millstock produced in the United States, 1879–1914.

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

a Estimated.

Quantity and value of roofing slate and millstock produced in the United States, 1879-1914—Continued.

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.		
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	$258,042	6,019,220
1908	1,333,171	5,186,167	3.89	4,793,812	793,304	.165	337,346	6,316,817
1909	1,133,713	4,394,597	3.87	5,112,894	876,089	.171	170,732	5,441,418
1910	1,260,621	4,844,664	3.84	5,181,498	999,098	.192	392,997	6,236,759
1911	1,124,677	4,348,571	3.87	5,744,577	1,027,605	.178	351,843	5,728,019
1912	1,197,288	4,636,185	3.87	5,765,273	1,013,220	.176	393,913	6,043,318
1913	1,113,944	4,461,062	4.00	6,312,011	1,233,838	.195	[a] 480,576	6,175,476
1914	1,019,553	4,160,832	4.08	5,361,925	977,930	.182	[a] 568,025	5,706,787

[a] Includes in 1913, 6,174,526 school slates, valued at $51,313, and 3,504,162 square feet of blackboard material, valued at $426,703; in 1914, 4,043,043 school slates, valued at $35,205, and 4,201,057 square feet of blackboard material, valued at $526,846.

As will be seen from this table, the values shown from 1879 to 1889 do not represent the entire value of the slate quarried, as no record was kept of slate used for mantels, school slates, pencils, tombstones, blackboards, and for other purposes. There was a steady increase in average price per square of roofing slate from 1879 to 1884, but the next year an abrupt decline took place—from $3.83 a square in 1884 to $3.05 a square in 1885. In 1886 and 1887 the average price declined to $3 a square. From 1888 to 1892 both the price and the production increased; but, owing to the financial troubles of 1893, the output decreased in value to $2,523,173 from $4,117,125 in 1892, and the price fell off not to regain its former level until 1903. In 1894 to 1896, inclusive, the total value fluctuated slightly. The annual value, aided by export trade, increased steadily from 1896 to 1903. In 1903, however, although the beginning of the year was marked by active operations in the slate industry, a great decrease in demand became evident, a condition due to strikes in the building trades, which also affected the industry in 1904 and 1905.

For the last 12 years the value of the output has remained practically stationary, fluctuating slightly with changes in trade and financial conditions. As compared with 1905, when the output was valued at $5,496,207, the value in 1914 ($5,706,787) showed an increase of only $210,580, or 3.8 per cent. The largest output reported was in 1908, when the value ($6,316,817) was $610,030, or 9.6 per cent, greater than in 1914. The average price per square of roofing slate in 1914 was the highest recorded; it was $4.08 and represented an advance of 39 cents in the 10 years since 1905, inclusive.

In 1914 the value of slate produced in the United States, including slate sold in squares for roofing, as slabs for milling, and for other uses, was $5,706,787—a decrease of 7.59 per cent from $6,175,476 in 1913. This decrease was not due to adverse conditions in the slate trade, but followed the general condition of the industries of the United States for the year 1914. Slate, in fact, showed a smaller relative decrease than some of the other mineral substances.

In 1913 the slate operators in general reported a better demand and better conditions of trade from January to September than in the latter part of the year; in 1914 the demand was generally reported as good up to October, when it dropped off 25 to 50 per cent. Many of the operators reported working only part of the time, with prices stationary. Lack of building operations curtailed the demand for both roofing and structural slate, although there was an increase in the demand for blackboard material.

The following table shows the total value of the slate produced in the United States from 1910 to 1914, inclusive, and the percentage of increase or decrease in 1914 compared with 1913:

Value of slate produced in the United States, 1910–1914, by States, with percentage of increase or decrease.

State.	1910	1911	1912	1913	1914	Percentage of increase (+) or decrease (−).
Arkansas		(a)	(a)			
California	(a)					
Georgia	(a)	(a)		(a)		
Maine	$249,005	$263,516	$282,678	$323,998	$277,419	−14.38
Maryland	78,573	76,035	92,184	83,993	77,391	− 7.86
New Jersey	(a)	(a)	(a)	(a)	(a)	(a)
New York	84,822	120,359	135,207	144,882	112,776	−22.16
Pennsylvania	3,740,806	3,431,351	3,474,247	3,733,581	3,609,959	− 3.31
Tennessee	(a)					
Utah					(a)	(a)
Vermont	1,894,659	1,624,941	1,849,975	1,697,820	1,414,247	−16.70
Virginia	148,721	188,808	195,392	175,830	204,139	+16.10
Other States	[b] 40,173	[c] 23,009	[d] 13,635	[e] 15,372	[f] 10,856	−29.38
Total	6,236,759	5,728,019	6,043,318	6,175,476	5,706,787	− 7.59

[a] Included in Other States.
[b] Includes California, Georgia, New Jersey, and Tennessee.
[c] Includes Arkansas, Georgia, and New Jersey.
[d] Includes Arkansas and New Jersey.
[e] Includes Georgia and New Jersey.
[f] Includes New Jersey and Utah.

The following table shows the production of slate in the United States in 1913 and 1914, by States, and uses:

Quantity and value of roofing, mill, and other slate produced in the United States in 1913 and 1914, by States, and uses.

1913.

State.	Number of operators.	Roofing slate.			Mill stock.						Other.	Total value.
		Number of squares.	Value.	Average price per square.	Manufactured.		Rough.		Total.			
					Quantity. (sq. ft.).	Value.	Quantity. (sq. ft.).	Value.	Quantity. (sq. ft.).	Value.		
Arkansas	2	(a)	(a)	$5.71								(a)
Maine	4	15,593	$89,933	5.77	513,745	$234,065			513,745	$234,065		$323,998
Maryland	3	15,913	82,981	5.21							$1,012	83,993
New Jersey	2	(a)	(a)	4.68							(a)	(a)
New York	10	29,868	139,970	4.69	21,300	4,899	42	$13	21,342	4,912		144,882
Pennsylvania	90	678,396	2,605,882	3.84	3,470,286	598,916	740,229	49,300	4,210,515	648,216	b 479,483	3,733,581
Vermont	53	332,642	1,351,175	4.06	1,111,174	254,347	455,235	92,298	1,566,409	346,645		1,697,820
Virginia	7	38,330	175,774	4.59							56	175,830
Other States c		3,202	15,347								25	15,372
Total	171	1,113,944	4,461,062	4.00	5,116,505	1,092,227	1,195,506	141,611	6,312,011	1,233,838	480,576	6,175,476

1914.

State.	Number of operators.	Number of squares.	Value.	Average price per square.	Manufactured Quantity (sq. ft.).	Manufactured Value.	Rough Quantity (sq. ft.).	Rough Value.	Total Quantity (sq. ft.).	Total Value.	Other.	Total value.
Maine	4	15,282	$88,527	$5.79	417,236	$188,892			417,236	$188,892		$277,419
Maryland	3	13,333	75,747	5.68							$1,644	77,391
New Jersey												(a)
New York	10	24,059	110,500	4.59	15,000	2,250	51	$26	15,051	2,276		112,776
Pennsylvania	84	614,863	2,463,944	4.01	3,272,891	540,791	673,685	39,624	3,946,576	580,415	d 565,600	3,609,959
Utah												(a)
Vermont	46	306,190	1,207,419	3.94	843,344	185,205	139,718	21,142	983,062	206,347	481	1,414,247
Virginia	7	43,312	204,139	4.71								204,139
Other States c	3	2,514	10,556	4.20							300	10,856
Total	157	1,019,553	4,160,832	4.08	4,548,471	917,138	813,454	60,792	5,361,925	977,930	568,025	5,706,787

a Included in other States.

b Composed of 6,174,526 school slates, valued at $51,313; 3,504,162 square feet of blackboard material, valued at $426,703; and slate used for structural and other purposes, valued at $1,467.

c Includes, in 1913, Georgia and New Jersey; in 1914, Utah and New Jersey.

d Composed of 4,043,043 school slates, valued at $35,205; 4,021,057 square feet of blackboard material, valued at $526,846; and slates used for structural and other purposes, valued at $3,549.

Virginia was the only State that showed an increase in 1914 over 1913 in both value of output—16.10 per cent—and average price per square of roofing slate. The other States decreased in value of output from 3.31 per cent in Pennsylvania to 22.16 per cent in New York. Maine, Maryland, and Pennsylvania reported a decrease in output and an increase in average price per square; and New Jersey, New York, and Vermont reported decrease in both output and price; but the increase in average price per square in such a large slate-producing district as Northampton County, Pa., was a large factor in the increase in price for the entire country. In 1913 the average price per square of roofing slate was $4; in 1914 it was $4.08.

Mill stock, exclusive of blackboard and school slates, decreased in quantity, in value, and in average price. Slate used for blackboards increased in output and value; slate used for school slates decreased in both; and slate for minor purposes increased in value in 1914 as compared with 1913.

In 1914 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 Utah. In 1913 the rank was the same, except that Georgia, which reported no production in 1914, gave place to Utah. Of more than 280 firms owning slate deposits, 157 companies were active in 1914. In 1913, 171 firms reported as active. The other firms reported their quarries as idle, as in course of development, or as abandoned.

CLASSIFICATION OF SLATE.

MILL STOCK.

Slate is classified as roofing slate and mill stock, and the use for these different purposes depends largely, although not entirely, on character of the slate. Mill stock requires a finer, more even-grained, and more compact material than roofing slate, and a material 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 mill stock, 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. 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, decreased from $1,714,414 in 1913 to $1,545,955 in 1914, a loss of $168,459. Exclusive of blackboard and school slates, the mill stock decreased from 6,312,011 square feet, valued at $1,233,838 in 1913 to 5,361,925 square feet, valued at $977,930 in 1914, a decrease of 950,086 square feet in quantity and of $255,908 in value. The average price per square foot was $0.192 in 1914 and $0.195 in 1913. The greater part of the slate was either milled by the producer or sold partly finished to other mills.

Mill stock includes slate used for 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 tops for billiard, laboratory, kitchen, and other tables. 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 a 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.

Lehigh and Northampton counties, Pa., report the only stock produced for school slates and blackboards. The quarries in these counties 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 blackboards increased and that for school slates decreased in 1914 as compared with 1913.

ROOFING SLATE.

Slate used for roofing is not necessarily of so fine a texture nor of so smooth a cleavage as the mill stock, but it must be hard, strong, and tough, and should not contain carbonates or iron pyrites, 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 on this account undesirable unless it weathers mottled, owing to irregular distribution of the coloring matter, and thus produces an unsightly roof. A description of the process of dressing roofing slates was given in the report on slate in Mineral Resources 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-sixteenth 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, 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 a square. The red slates of New York and the green slates of Vermont are the kinds generally prepared for special work.

Nearly 73 per cent of the value of the slate production in the United States in 1914 was represented by slate for roofing, and the roofing-slate output from Pennsylvania and Vermont represented, respectively, about 59 and 29 per cent of the total value of the roofing slate produced. 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 1914 the output of roofing slate was reported as 1,019,553 squares, valued at $4,160,832, the average price per square being $4.08; in 1913 there were reported 1, 113, 944 squares, valued at $4,461,062, with an average price per square of $4, a decrease in 1914 of 94,391 squares in quantity and of $300,230 in value, and an increase in average price per square of 8 cents. All the States except Virginia showed a decrease in the quantity of roofing slate sold. Maine, Maryland, Pennsylvania, and Virginia increased in average value per square and New Jersey, New York, and Vermont decreased. The increase in the total average price per square was, however, caused, as in 1913, by the increase in average price in Northampton County, Pa.

EXPORTS.

Slate from the United States is exported to Belgium, Denmark, Germany, the Netherlands, England, Ireland, Canada, the various islands in the West Indies, the principal South American countries, Africa, China, Japan, Australia, Tasmania, New Zealand, and the East Indies, principally British India. In 1913 the exports amounted to $226,413; in 1914, to $139,125.

The following table, compiled from the reports of the Bureau of Foreign and Domestic Commerce, Department of Commerce, shows the value of exports of roofing slate from the United States, by fiscal years from 1884 to 1904 and by calendar years from 1903 to 1914. No separate record has been kept of the manufactured product. No figures are available for 1910 and 1911, the slate exports not being kept separate in those years from those of other kinds of stone.

Value of exports of slate from the United States, by fiscal years, 1884–1904; by calendar years, 1903–1914.

1884	$79,464	1899	$1,363,617
1885	51,011	1900	950,543
1886	123,565	1901	898,262
1887	61,047	1902	945,352
1888	97,707	1903	838,683
1889	109,896	1904	449,743
1890	94,048	1905	408,309
1891	84,408	1906	255,785
1892	57,514	1907	220,995
1893	52,012	1908	197,216
1894	37,195	1909	209,338
1895	38,806	1912	[1] 171,775
1896	266,385	1913	226,413
1897	780,112	1914	139,125
1898	1,370,075		

For the year ending June 30, 1914, slate valued at $87,836, or nearly half of the slate exported, went to Canada; 15 per cent went to British India; nearly the same quantity to Ireland; and 8 per cent to British South Africa; in all, about 90 per cent of the exported slate went to British possessions.

According to the Slate Trade Gazette, of London, the exports of slate from the United States to Great Britain in 1913 were 2,498 long tons, valued at £9,362. In 1914 these exports decreased to 566 tons, valued at £2,322.

For a period of seven years, from 1897 to 1903, 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

[1] July 1 to Dec. 31.

of these exports were to Great Britain, where a strike in the large Welsh quarries enabled slates from other countries to gain a foothold. It is noticeable, however, that 1897, 1898, and 1899, were, in spite of the strike, years of great activity in the slate quarries of Great Britain, the output for these years being valued at £1,661,223, £1,900,228, and £1,787,071, respectively, or at an average of 1.9 times as much as at present. Since 1905 there has been a marked decrease in slate exported from the United States.

Next to the United States, Great Britain and France are the chief slate-producing countries. In 1912 the output of Great Britain was valued at £972,022 and that of France at £905,542, according to the British report on mines and quarries. Belgium ranks next. Other countries reporting an output of slate are India, Germany (Bavaria), and Canada.

In 1913 the value of the slate output of Great Britain was £926,739. No statistics are yet available for the other countries, nor for 1914.

IMPORTS.

Practically no slate is imported into the United States. In 1914, slate valued at $4,855 was imported in the form of mantels, chimney pieces, roofing slate, slabs, etc. In 1913, the imports were valued at $5,479, and included the same articles.

The duty under the tariff act of October, 1913, on slates, chimney pieces, mantels, slates for tables, roofing slates, and all other manufactures of slate is 10 per cent ad valorem.

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, this eastern slate is shipped to supply markets on the western coast as well as in the central and southern parts of the country. The locations 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 586 of the United States Geological Survey or in previous reports on the slate industry.

Arizona.—No operations, other than assessment work, were carried on during 1914 at the slate deposits in Maricopa County, belonging to the Arizona Slate Co. and the Phoenix Slate Co.

Arkansas.—Considerable activity was shown in 1914 by the companies organized for the development of the slate deposits in Montgomery and Polk counties, but no commercial slate was produced. This slate has been tested for roofing slate and mill stock, especially for electrical work, and is said to be very satisfactory. It is found in red, green, gray, and black colors.

California.—There was no commercial production of slate in California in 1914. The Eureka Slate Co., owning quarries near Placerville and Slatington, Eldorado County, reported that it expected to resume operations in May, 1915.

Colorado.—No work other than for assessment was done at Marble, Gunnison County, in 1914.

Georgia.—Slate has been quarried in Georgia at irregular intervals for many years near Rockmart, Polk County, but none was produced in 1914. The Rockmart slate is a very dark bluish gray "black" slate. Near Bolivar, Bartow County, the Southern Green Slate Co. leased the slate property of the Georgia Green Slate Co., but no slate was marketed during the year. This slate is a rather light greenish gray in color, and was described in the report on the slate industry for 1910.

Maine.—Four companies, the Brownville & Boston Slate Co., the Maine Slate Co., of Monson, the Monson Maine Slate Co., and the Portland-Monson Slate Co., operated slate quarries in Maine during 1914 with a decrease of over 14 per cent in the value of the output as compared with that of 1913. The entire output of the State is from Piscataquis County and decreased in value from $323,998 in 1913 to $277,419 in 1914, a loss of $46,579. A little over two-thirds of the product is mill stock, and much of it is used for electrical purposes, for which it is especially adapted. Demand was reported by the quarrymen as very poor, with lower prices prevailing, as is shown in the decrease in both quantity and value for both roofing slate and mill stock.

Maryland.—There were but three companies operating in Maryland in 1914—the Peach Bottom Slate Co., of Harford County, the Peerless Slate Co., and the Proctor Slate Manufacturing Co. These companies all work in the "Peach Bottom" district near Cardiff, Harford County, and produce the same slate as that quarried in York County, Pa. This is a black slate well known in the markets all over the world and is used almost entirely for roofing. Notwithstanding the fact that the quarrymen reported a very good demand, the output decreased nearly 8 per cent in 1914 as compared with 1913. The average price per square increased from $5.21 in 1913 to $5.68 in 1914. Practically all of the output is for roofing slate, which decreased from 15,913 squares, valued at $82,981, in 1913, to 13,333 squares, valued at $75,747, in 1914, a decrease of 2,580 squares in quantity and of $7,234 in value.

New Jersey.—In 1914 as in previous years the Newton Slate Co. and the Lafayette Slate Co., of La Fayette, both in Sussex County, were the companies producing slate in New Jersey. Conditions were reported as practically the same as in 1913. This slate is used almost entirely for roofing and is classed among the "black" slates.

New York.—Although all of the New York slate producers reported demand and prices equally good or better than in 1913, the output decreased 22.15 per cent, or from $144,882 in 1913 to $112,776 in 1914. The New York slate is used almost entirely for roofing and was all produced in Washington County in 1914, in the northeastern part of the State and adjacent to the slate-producing region of Rutland County, Vt. The average price per square decreased from $4.69 in 1913 to $4.01 in 1914.

Red slate, which until recent years has commanded particularly high prices, has not been in great demand and the increase or decrease of sales of this slate has for years caused considerable variation in the yearly average prices of New York slate. Some of the red slate is used in the manufacture of paint.

Pennsylvania.—Pennsylvania showed a decrease in value of output in 1914 of 3.31 per cent, as compared with an increase of about

7 per cent in 1913. This decrease was, however, smaller than that of any other State showing decreased slate production. The value of the production for 1914 was $3,609,959; in 1913 it was $3,733,581, a decrease in 1914 of $123,622. Pennsylvania slate is used both for roofing and for mill stock. In 1914 Pennsylvania produced 60.31 per cent of the total quantity and 59.22 per cent of the total value of the output of roofing slate in the United States. Besides leading in the production of roofing slate, Pennsylvania has a larger output of mill stock than any other State and produced in 1914, exclusive of blackboard stock and school slate, 59.35 per cent of the total value and 73.60 per cent of the total quantity of this material for the United States.

The fluctuations were as follows: In 1914 the output of roofing slate was 614,863 squares, valued at $2,463,944; in 1913 it was 678,396 squares, valued at $2,605,882, a decrease in 1914 of 63,533 squares in quantity and of $141,938 in value. The average price per square advanced from $3.84 in 1913 to $4.01 in 1914. The mill stock sold, exclusive of blackboard and school-slate material, was 3,946,576 square feet, valued at $580,415, in 1914, and 4,210,515 square feet, valued at $648,216, in 1913, a decrease in 1914 of 263,939 square feet in quantity and of $67,801 in value. The average price per square foot decreased from 15.4 cents in 1913 to 14.7 cents in 1914. Slate for blackboards, school slates, and a few minor uses increased in value $86,117, from $479,483 in 1913 to $565,600 in 1914. Pennsylvania produced 63.25 per cent of the value of the total slate output in the United States in 1914, as compared with 57.48 per cent in 1912, 59.98 per cent in 1910, and 61.79 per cent in 1908.

Blackboard slate increased from 3,504,162 square feet, valued at $426,703, in 1913 to 4,021,057 square feet, valued at $526,846, in 1914, an increase of 516,895 feet in quantity and of $100,143 in value. The average price per square foot was 12.2 cents in 1913 and 13.1 cents in 1914. The average thickness of this slate is three-eighths of an inch.

School slates decreased from 6,174,526 slates, valued at $51,313, in 1913 to 4,043,043 slates, valued at $35,205, in 1914, a decrease of 2,131,483 slates in quantity and of $16,108 in value. The average price per thousand was $8.31 in 1913 and $8.71 in 1914. The average size of the slates as reported is 7 by 11 inches—sometimes sold by the square of about 500 pieces.

In 1914 slate was quarried in Lancaster, Lehigh, Northampton, and York counties.

The slate from Lehigh County is used for roofing, for ordinary mill stock, and also, on account of the fineness of its cleavage, for school slates and blackboard material. There was a decrease both in quantity and in value of the roofing slate produced in this country in 1914 as compared with 1913, and the number of producers was three less. The average price per square of roofing slate, however, increased from $3.58 in 1913 to $3.68 in 1914. There was a considerable decrease both in quantity and value of mill stock. In 1911, 1912, and 1913 there was for each year a decrease in quantity but an increase in value of output. Blackboard material increased, both in quantity and in value, in 1914, but stock for school slates decreased.

The slate of Northampton County has the same uses as the slate of Lehigh County, but the total value of the output is over three and one-half times as large. There was a decrease of $93,293 in the output of this county in 1914 as compared with 1913. The value in 1914 was $2,803,912; in 1913 it was $2,897,205. The average price of roofing slate increased 18 cents per square in 1914, from $3.88 in 1913 to $4.06 in 1914. There was a decrease, however, in both the quantity and the value of the output. The increase in average price per square, however, for a county having so large an output was largely accountable for the increased average price for the entire country. Northampton County produced in 1914 nearly 47 per cent of the roofing slate quarried and sold in the United States. The figures for the years 1913 and 1914 are as follows: In 1914 there was sold in Northampton County 478,216 squares, valued at $1,942,555; in 1913, 525,286 squares, valued at $2,035,796, a decrease in 1914 of 47,070 squares in quantity and of $93,241 in value. There was a larger demand for blackboard material in 1914 than in 1913 as shown by increased output, but mill stock for other purposes, including school slate, showed a decided falling off. The value of the mill stock quarried in Northampton County in 1914 was about 56 per cent of the output for the entire United States.

York County produces nothing but roofing slate of the same Peach Bottom variety as that of Harford County, Md. There was a decrease in production for this county in 1914, and a decrease in average price—from $5.71 in 1913 to $5.20 in 1914.

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 following table shows in detail the production of slate in Pennsylvania, by counties and uses, in 1913 and 1914:

Production of slate in Pennsylvania in 1913 and 1914, by counties and uses.

1913.

County.	Number of operators.	Roofing slate.			Millstock.								Other (value).	Total value.
		Number of squares.	Value.	Price per square.	Manufactured.		Rough.		Blackboards.		School slates.			
					Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
					Square feet.		*Square feet.*		*Square feet.*		*Number.*			
Lancaster	2	9,965	$57,059	$6.00	....	....	....	....	....	....	....	....	....	$57,059
York ("Peachbottom slate")	3			5.71										
Lehigh	31	143,145	513,027	3.58	353,948	$63,632	191,902	$21,193	1,395,847	$147,119	4,126,144	$34,329	$17	779,317
Northampton	54	525,286	2,035,796	3.88	3,116,338	535,284	548,327	28,107	2,108,315	279,584	2,048,382	16,984	1,450	2,897,205
Total	90	678,396	2,605,882	3.84	3,470,286	598,916	740,229	49,300	3,504,162	426,703	6,174,526	51,313	1,467	3,733,581

1914.

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	11,499	$60,360	$6.25	....	....	....	....	....	....	....	....	....	$60,360
York ("Peachbottom slate")	3			5.20										
Lehigh	28	125,148	461,029	3.68	358,891	$44,064	162,549	$15,216	1,711,213	$196,845	3,037,027	$26,897	$1,636	745,687
Northampton	51	478,216	1,942,555	4.06	2,914,000	496,727	511,136	24,408	2,309,844	330,001	1,006,016	8,308	1,913	2,803,912
Total	84	614,863	2,463,944	4.01	3,272,891	540,791	673,685	39,624	4,021,057	526,846	4,043,043	35,205	3,549	3,609,959

Tennessee.—The deposits of slate in Tennessee, on which more or less development work has been done in recent years, are in Blount and Washington counties. The Southern Slate Co., of Columbus, Ohio, with a quarry located at Chilhowee, Blount County, reports that operations are hindered by lack of railroad transportation.

At Tellico Plains and Washington College in Washington County, The Tellico Co. and the Tennessee Slate Co. are owners of slate deposits, but no slate has yet been marketed.

Utah.—The Utah Slate & Granite Co., owning slate deposits near Provo, Utah County, shipped some of the slate waste taken out in the course of development of its quarry. This slate, according to Mr. F. W. C. Hathenbruck, was to be crushed and the granulated portion used in combination with asphaltum in the form of sheets about 12 by 16 inches in size for roofing purposes. In crushing, about 55 per cent is granulated and each ton is said to produce about eight roofing squares of 100 square feet. The powdered portion of the slate is reported to be available for making into sheets in combination with casein and other hydrocarbons, which have been first subjected to pressure and then dried in the air.

Vermont.—Vermont is second among the slate-producing States, being ranked by Pennsylvania. In 1914 Vermont produced 24.78 per cent of the total slate quarried in the United States, and Pennsylvania 63.25 per cent. In 1913 these figures for Vermont and Pennsylvania were 27.49 and 60.46 per cent, respectively—a decrease for Vermont and an increase for Pennsylvania in 1914. The total value of the slate production in Vermont decreased 16.70 per cent in 1914, that of Pennsylvania only 3.31 per cent. More than 85 per cent of the slate marketed in Vermont is roofing slate. This amounted to 306,190 squares, valued at $1,207,419 in 1914, as compared with 332,642 squares, valued at $1,351,175, in 1913, a decrease of 26,452 squares in quantity and of $143,756 in value. The average price per square declined from $4.06 in 1913 to $3.94 in 1914. The total mill stock manufactured decreased from 1,566,409 square feet, valued at $346,645 in 1913 to 983,062 square feet, valued at $206,347 in 1914, a decrease of 583,347 square feet in quantity and of $140,298 in value. The average price per square foot was 20.9 cents in 1914, as compared with 22.1 cents in 1913.

Of the mill stock (exclusive of blackboards and school slates) produced in the United States, Vermont supplied 21.10 per cent of the total value in 1914 compared with 59.35 per cent from Pennsylvania. In 1913, 53 quarries were reported in operation in Vermont; in 1914 the active firms numbered 46. 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, and was the only State showing an increase in output in 1914. The productive quarries are at Esmont, in Albemarle County; Snowden, in Amherst County; and Arvonia and Penlan, in Buckingham County. This slate is used entirely for roofing, and the production in 1914 was 43,312 squares, valued at $204,139, or $4.71 a square. This was an increase of 4,982 squares in quantity, and of $28,365 in value, as compared with 1913, when the output was 38,330 squares, valued at $175,774, or $4.59 a square.

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. The slate report for 1912 contains an article by T. N. Dale on the commercial qualities of the slates of the United States, and their localities.[1]

Bulletin 586 of the Survey,[2] which is a very comprehensive report on the slate deposits and slate industry of the United States, is a new and revised edition of Bulletin 275, and can be consulted in libraries or obtained while available upon application to the Director of the United States Geological Survey, Washington, D. C.

Maps showing the commercial deposits of slate are published in the reports on the stone industry of the United States for 1912, 1913, and 1914.

The United States Geological Survey has published a report on the slates of Arkansas, by A. H. Purdue.[3]

The State geological surveys of Arkansas, California, Maryland, and New Jersey have also published descriptions of the slate and the slate deposits of these States, and information as to these publications may be had by applying to the respective State geologists.

A publication by E. C. Eckel[4] 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., Commercial qualities of the slates of the United States and their localities: U. S. Geol. Survey Mineral Resources, 1912, pt. 2, pp. 693-707, 1913.

[2] Dale, T. N., and others, Slate deposits and slate industry of the United States: U. S. Geol. Survey Bull. 586, 1914.

[3] Purdue, A. H., The slates of Arkansas: U. S. Geol. Survey Bull. 430, pp. 317-334, 1910

[4] Eckel, E. C., Building stones and clays, their origin, character, and examination, John Wiley & Sons, New York, 1912.

ASBESTOS.

By J. S. Diller.

PRODUCTION.

The United States has never been a large producer of asbestos, although for many years it has kept up an annual production, ranging from 71 short tons in 1890 to 7,604 short tons in 1911. It is gratifying to announce that in 1914 there was an increasing output of high-grade crude fiber and that there is an encouraging outlook for the future. The total asbestos mined and sold in the United States in 1914 was 1,247 short tons, valued at $18,965, a gain as compared with 1,100 short tons, valued at $11,000, in 1913, of 13 per cent in quantity and of more than 72 per cent in value.

Annual marketed production of asbestos in the United States, 1890–1914, in short tons.

Year.	Production.			Year.	Production.		
	Quantity.	Value.	Average price per ton.		Quantity.	Value.	Average price per ton.
1890	71	$4,560	$64.23	1903	887	$16,760	$18.90
1891	66	3,960	60.00	1904	1,480	25,740	17.39
1892	104	6,416	61.69	1905	3,109	42,975	13.82
1893	50	2,500	50.00	1906	1,695	28,565	16.85
1894	325	4,463	13.73	1907	653	11,899	8.22
1895	795	13,525	17.01	1908	936	19,624	20.97
1896	504	6,100	12.10	1909	3,085	62,603	20.29
1897	580	6,450	11.12	1910	3,693	68,357	18.51
1898	605	10,300	17.02	1911	7,604	119,935	15.77
1899	681	11,740	17.24	1912	4,403	87,959	19.98
1900	1,054	16,310	15.47	1913	1,100	11,000	10.00
1901	747	13,498	18.07	1914	1,247	18,965	15.21
1902	1,005	16,200	16.12				

There were only three important producers, two in Georgia and one in Arizona, besides several small producers in California and Virginia. Georgia has much the larger production, but yields only mass fiber of the hornblende variety, which is relatively of low grade and can not be spun. It is all milled practically to one grade suitable for use in the manufacture of cement, plaster, shingles, flooring, and other fireproof material. Arizona produces chrysotile only of the cross-fiber type and spinning grade. It is all hand picked and none of it is now milled at the mine, but much material is accumulating on the dumps that may be milled later.

World's production of asbestos, 1909–1914, in short tons.

Country.	1909	1910	1911	1912	1913	1914
United States	3,085	3,693	7,604	4,403	1,100	1,247
Africa:						
Cape Colony	a 1,674	a 1,403	a 1,253	a 1,217	(b)	(b)
Natal and Union of South Africa	....	a 3	a 13	a 1,224	(b)	(b)
Rhodesia	a 272	a 332	a 460	c 1,234	(b)	d 487
Transvaal	....	a 77	....	(b)	(b)	(b)
Australia	a 3	....	....	(b)	(b)	(b)
Canada:						
Asbestos	e 63,349	e 77,508	e 101,393	e 111,561	f 136,951	f 96,542
Asbestic	e 23,951	e 24,707	e 26,021	e 24,740	f 24,135	f 21,031
Cyprus	a 172	a 487	a 799	a 861	(b)	(b)
India	....	a 3	....	(b)	(b)	(b)
Italy	....	....	g 184	g 186	(b)	(b)
Russia	a 16,850	a 13,862	a 17,399	d 18,138	h 18,594	(b)

a Statistics taken from Mines and Quarries: General Report with Statistics, pt. 4, London, up to 1913.
b Statistics not available.
c The Mineral Industry, 1912, New York.
d Min. Jour., London.
e Ann. Repts. mineral production of Canada, calendar years Ottawa, 1909–1913.
f Prelim. Rept. mineral production of Canada, 1914.
g Rivista del Servizio Minerario, Rome.
h Canadian Min. Jour., June 1, 1914, p. 370.

PRICES.

Nearly all the asbestos sold in the United States comes from Canada, and it is evident that the Canadian market controls prices in this country. The range in prices of the various grades of Canadian fiber in New York from 1912 to 1914 is shown in the accompanying table:

Range of New York prices per short ton for Canadian chrysotile fiber, 1912–1914.

	1912	1913	1914
No. 1 crude	$300–$325	$320–$350	$350–$375
No. 2 crude	175– 200	200– 225	225– 250
No. 1 fiber	....	100– 125	100– 125
No. 2 fiber	....	75– 100	75– 100
Shorter fibers	....	10– 30	10– 30

The average price of the Arizona crude No. 1 and No. 2 in New York should accord closely with Canadian crude of the same grades. The price of crude fiber continued to rise during the early months of 1915. The amphibole variety averaged nearly $10 a ton in 1914.

IMPORTS.

As Canada is the principal source of the world's supply of asbestos and the United States is its nearest neighbor, with every facility for intercourse, this country has naturally become the greatest importer of raw asbestos and the largest manufacturer of asbestos products.

The imports given in the second of the accompanying tables are total imports for calendar years and differ but little from the imports for consumption for the same period. 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, not counting asbestic, during the 12 months ending December 31, 1914, are reported [1] as 81,081 short tons, valued at $2,298,646.

Of this quantity 71,781 tons, that is nearly nine-tenths, came to the United States. The fact that the United States receives more than 74 per cent [2] of all the asbestos mined by Canada shows clearly that the United States is the largest asbestos user in the world, and this fact should encourage the development of asbestos property in this country.

The value of the manufactured and unmanufactured asbestos imported for consumption into the United States during the calendar years 1909 to 1914 is shown in the following table:

Value of asbestos imported for consumption into the United States, 1909–1914.

Year.	Unmanufactured.	Manufactured.	Total.
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
1913	1,928,705	378,961	2,307,666
1914	1,407,754	371,469	1,779,223

The total imports of unmanufactured asbestos in 1914, excluding the large quantity from Canada, amounted to only 85 tons. Of the imported asbestos manufactures in 1914, valued at $368,344, those from Canada were of much less value than those from England, Germany, or Austria-Hungary. The exports from the United States of manufactured asbestos are very much larger than the imports, but the figures are not yet available for 1914.

General imports of asbestos into the United States, calendar years 1913 and 1914, in short tons.

Country.	1913			1914		
	Unmanufactured.		Manufactures of.	Unmanufactured.		Manufactures of.
	Quantity.	Value.	Value.	Quantity.	Value.	Value.
Austria-Hungary			$75,770			$47,982
Belgium			28,616			20,267
Canada	96,951	$1,897,611	7,456	71,781	$1,393,732	19,007
England	1	1,546	176,413			159,098
France			4,202			2,863
Germany	19	3,547	88,526	11	2,209	104,368
Ireland						236
Italy	6	694	6,937	2	631	8,020
Japan			215			
Mexico						130
Russia in Europe	168	25,307		72	11,186	
Scotland			1,489			1,389
Switzerland			40			4,984
Total	97,145	1,928,705	389,664	71,866	1,407,758	368,344

[1] Preliminary report on the mineral production of Canada during the calendar year 1914, p. 23, Canada Dept. Mines.

[2] A large quantity of asbestos is shipped from Canada to Boston for reshipment abroad. The United States actually uses only about 60 per cent of the Canadian output.

ASBESTOS IN THE UNITED STATES.

ARIZONA.

The asbestos of Arizona is not only of excellent quality but is unique in mode of occurrence. It is chrysotile and occurs in cross-fiber veins with serpentine in limestone. The accompanying map (fig. 1) shows the localities of the asbestos mine on Ash Creek, northeast of Globe, as well as of the prospect north of Salt River and of the two prospects in the Grand Canyon, one under Grand View and the other 20 miles farther west, opposite Bass's. The chrysotile at

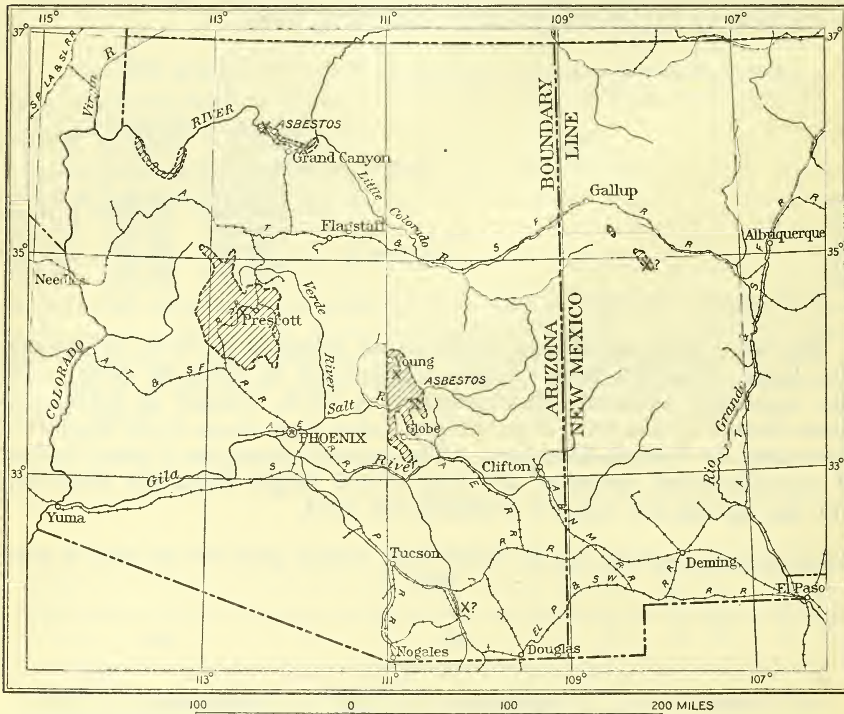

FIGURE 1.—Map showing asbestos mines (⚒) and prospects (×) in Arizona. Shading shows areas of pre-Cambrian rocks.

all the localities occurs in pre-Cambrian rocks, the distribution of which is broadly shown by the shaded areas of the map.

As far as known the chrysotile in Arizona is all of the same mode of occurrence, illustrated in figure 2, and is of excellent grade, so that it can be mined for the highest grades alone. It outcrops in steep-walled stream canyons, in which it is not easily accessible, but the rapid streams of the canyons provide water power for future handling and milling the lower grades taken out in winning the more valuable crude fiber.

The localities on Ash Creek and in the Grand Canyon—under Grand View and opposite Bass's—have been described,[1] but the locality northeast of Globe, beyond Salt River, near Young post office, has not been noted before. It was reported to the Survey recently by

[1] Asbestos: U. S. Geol. Survey Mineral Resources, 1913, pt. 2, pp. 342-347, 1914.

Mr. A. B. Wolf, of Young, Ariz., who sent good samples of the asbestos. He says the locality is about 10 miles southeast of Young post office and about 3 or 4 miles west of the Apache Indian Reservation. It is 12 miles north of Sombrero Butte, or 55 miles by trail and 80 miles by wagon road north of Globe. Globe is the nearest railroad station, with Salt Creek Canyon between, so that the region is practically inaccessible for commercial purposes. The Young asbestos field begins at the foot of the Sierra Ancha and runs an easterly course to Canyon Creek. The field is 10 or 12 miles long and 1 to 4 miles wide, somewhat larger than the Ash Creek field. Most of the ore shoots are from ½ to 1 inch in length, but veins 4 to 6 inches are known. The greater part of the material is mill stock. The geology of the asbestos occurrence, according to Mr. Wolf, is like that of Ash Creek—a view which is confirmed by the samples sent.

During the greater part of 1914 the asbestos on Ash Creek was mined by the Arizona Asbestos Association, Snell & Fisk, operators,

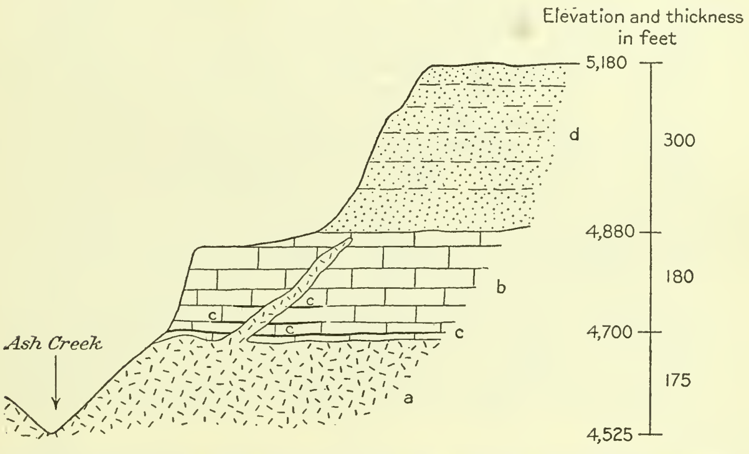

FIGURE 2.—Section on east slope of Ash Creek, 25 miles northeast of Globe, Ariz.; 220 miles S. 30° E. of Bass's Ferry in Grand Canyon. *a*, Diabase; *b*, gray limestone, in part cherty, locally banded and containing sheets and nodules of serpentine and some asbestos; *c*, three asbestos belts 12 to 24 inches in thickness lie parallel with the bedding in layers of gray to white limestone; *d*, mainly quartzite with some conglomerate. Nodules of serpentine occur here and there in the locally banded limestone near the asbestos belts.

and the output was brought by trail and wagon road about 35 miles to the railroad at Globe for shipment.

The asbestos is regularly mined by tunnels run into the walls of the canyon, a method of mining that contrasts strongly with the open-quarry method of mining the chrysotile in Canada. The application of regular mining methods to win the Arizona asbestos is necessitated by its mode of occurrence (fig. 2) and the large proportion of high-grade material. The underground workings, of which perhaps 1,000 feet have been run, average about 90 pounds of No. 1 fiber per foot of tunnel driven. It should be noted that the mode of occurrence and the mining methods necessarily limit the output, so that the yield of asbestos must always remain relatively small, although its high grade assures its value. It is more than probable that chrysotile will be found at other points in the Arizona field and ultimately form the basis of an industry. The fine exposures in the Grand Canyon are not worked, but success at other points will tend to make them of greater interest.

CALIFORNIA.

The most common rock associated with asbestos of high grade is serpentine, and from the fact that California has much serpentine it might reasonably be expected to contain considerable asbestos. This expectation is augmented by the additional fact that the serpentine of California has been subjected to great crushing strains and earth movements and is penetrated by a variety of dikes, which are generally considered as favoring the development of asbestos. Then, too, chromic iron ore occurs in the asbestos region of Canada, and its comparative abundance in the serpentines of California might well be regarded as a favorable indication.

The demand for asbestos on the Pacific coast has been large, but it has been supplied by material from the Canadian mines, by imports from abroad, and only to a very small extent by deposits in California. This condition is not due to the scarcity or absence of asbestos in California, for it has been reported in 12 counties of the State, and doubtless occurs in many others, and yet, notwithstanding all these apparently favoring conditions, there has never been developed anywhere within the State an important, persistent industry based on local asbestos. The cause is apparently in the quantity and the quality of the asbestos, but it is earnestly hoped that in the near future deposits may be found of character suitable to sustain successful commercial enterprise. In the search for mineral resources for exhibition at the Panama Exposition asbestos has received much attention from prospectors. The California State Mining Bureau states[1] that eight owners of asbestos properties filed reports for 1913 from five counties, Calaveras, Eldorado, Placer, Shasta, and Sierra. Among a number of individuals and companies reporting to the United States Geological Survey from California in 1914 there was only one that indicated a marketed production of asbestos. He stated that he had received asbestos from Shasta, Placer, Calaveras, and Alameda counties amounting to 65 tons, and had worked it up into goods and sold them.

The scene of greatest recent activity in prospecting has been north of San Francisco in the Coast Range, in Napa, Shasta, and Trinity counties.

A specimen of cross-fiber chrysotile, half an inch in length and of good quality in peridotite or in serpentine derived from peridotite, has been shown the writer as coming from near Canon House, which is on the stage road 18 miles northeast of Napa and 9 miles from Monticello. Other fiber of greater size and varying quality is reported from the same locality, which appears to be well worth investigation.

In Shasta County, about the head of Mears Creek, west of Sims station (Hazel Creek post office), there is a large area of serpentine that was prospected in 1913. (See map, fig. 3.) Much of the rock has completely changed to serpentine, but in places there are much olivine and pyroxene remaining to show the original character of the igneous rock from which the serpentine has been derived. The serpentine is cut by a variety of dikes in the vicinity of the asbestos deposits. Cross-fiber veins half an inch thick are common, but no large veins of high-grade chrysotile were observed. On the other

[1] California State Min. Bur. Bull. 68, p. 48, October, 1914.

hand, the property contains a remarkable deposit of slip fiber, in which the fiber lies nearly horizontal parallel to the vein, as if the motion producing it were horizontal, comparable to that of the faulting connected with the San Francisco earthquake. This clear, white fiber, softened by weathering on the outcrop but hard beneath, has a variable thickness ranging up to 3 or 4 feet. Lengthwise it has been traced more or less continuously for nearly a mile.

A few tons of the Mears Creek asbestos, including both cross-fiber and slip-fiber types, were shipped in 1913 to Oakland, Cal., it is said, for testing and experimental manufacture. No further production has been reported.

The locality is on a steep, rocky slope from 3 to 7 miles west of the Southern Pacific Railroad, and Mears Creek, which runs directly through the locality, affords good water power.

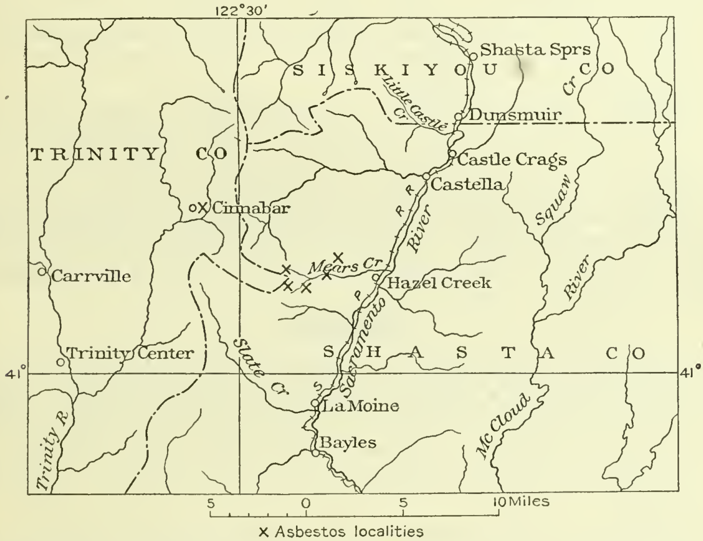

FIGURE 3.—Map showing asbestos localities in Shasta and Trinity counties, Cal.

In 1914 there was great activity in prospecting and developing asbestos property in Trinity County, about 15 miles northeast of Carville, near the old cinnabar mines (fig. 3). The Trinity Asbestos Mining Co. claims a large deposit with an abundance of good fiber, and reports that a plant consisting of a mill and other buildings has been constructed, and that a wagon road across the mountain to the railroad at Castella is being made. This deposit has not yet been visited by the writer, and its location as shown on the map may not be quite correct. No samples of the asbestos have been exhibited, but it is known that the asbestos near Cinnabar is in the same area of serpentine that contains the asbestos about the upper portion of Mears Creek, and the deposit may therefore be expected to be similar to that on Mears Creek, already described. The asbestos of Shasta and Trinity counties is well represented by exhibits at the Panama Pacific Exposition.

GEORGIA.

The asbestos deposits of Georgia have been mapped and described by Oliver B. Hopkins in a comprehensive work [1] that considers the whole subject of asbestos in a very helpful manner.

Georgia has been for years one of the chief producers of asbestos in the United States and bids fair to maintain that rank for some time to come. Only one type of asbestos, the mass type of amphibole (anthophyllite), is produced in the State. There are two producers, with an output in 1914 nearly 6 per cent greater than that of 1913.

Although asbestos prospects have been noted in more than a score of counties, forming a belt which extends northeast and southwest across the State, the asbestos has been mined almost wholly in White and Habersham counties, at Sall Mountain and at Hollywood. The rocks of that region in general are deeply weathered, and the asbestos workings are confined to open cuts or quarries in the weathered rock, composed of anthophyllite derived from the olivine and enstatite of the original basic intrusive rock. At greater depths the rock becomes harder and less fibrous.

As the rock near the surface is wholly fibrous, more than 90 per cent of the material quarried appears in the marketable product. Furthermore, the rock is so soft that the simple methods of quarrying and milling the material enable the producer to market it at a rate that should recommend it for the manufacture of asbestos shingles and lumber and for other uses in which a fibrous binder is needed. Georgia appears to have a sufficient supply to meet all demands.

VERMONT.

Vermont lies nearer than any other of the United States to the great asbestos field of Canada. In fact, the basic igneous rocks that contain the chrysotile at Thetford, Black Lake, and other asbestos centers of the Province of Quebec extend south into Vermont, where several attempts have been made to work the deposits commercially for asbestos.

The asbestos of Vermont has been well described by C. H. Richardson,[2] and in a recent report [3] the State geologist, quoting the late Dr. Cirkel, the Canadian authority on asbestos, remarks of the chrysotile mined in Vermont that it "compares favorably with that found in the Canadian mines." As might well be expected from the fact that many of the asbestos mines of Canada were not in operation in 1914, the mine in Vermont also was closed.

OTHER STATES.

Attention has been called to the effort to develop an asbestos industry based on the asbestos of Wyoming, which is of the cross-fiber type. Progress is reported, but no definite production and sales.

The deposits of mass-fiber asbestos (anthophyllite) which were discovered [4] in Idaho some years ago continue to attract attention.

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[1] A report on the asbestos, talc, and soapstone deposits of Georgia: Georgia Geol. Survey Bull. 29, pp. 75–189, 1914.

[2] Vermont State Geologist Rept., 1909–10, pp. 315–330, 1910.

[3] Idem, 1911–12, p. 269, 1912.

[4] Asbestos: U. S. Geol. Survey Mineral Resources, 1909, pt. 2, p. 729, 1911.

The character of the material is like that quarried and milled in Georgia, but thus far no enduring industry has developed in Idaho.

ASBESTOS IN FOREIGN COUNTRIES.

CANADA.

The great asbestos field of Canada lies in the Province of Quebec, a short distance north of Vermont, and the chief points of production are Black Lake, Danville, and Thetford.

The development of the industry has been rapid, as is shown by the production at stated intervals given in the following table:

Production of asbestos in Canada, 1878–1912, in short tons.

	Quantity.	Value.
1878	50	....
1882	810	$52,650
1892	6,082	390,462
1902	30,219	1,126,688
1912	111,195	3,059,084

A small part of this production is used for manufacture in Canada and some of it is exported from Canada abroad, but the bulk of it—more than 74 per cent—is brought to the United States for use here or for shipment abroad. This importation has much to do with retarding the development of the asbestos industry in this country.

The total Canadian asbestos produced in 1914 amounted to 107,668 short tons, as compared with 132,564 tons in 1913, a falling off of 18.8 per cent. The total output of the various grades of asbestos in 1914, as well as the quantity and value of the various grades sold and the stock of each on hand December 31, 1914, are given in the following table:

Output, sales, and stocks of Canadian asbestos in 1914, in short tons.[a]

	Output, quantity.	Sales.			Stock on hand Dec. 31.		
		Quantity.	Value.	Price per ton.	Quantity.	Value.	Value per ton.
Crude No. 1	1,451	1,336	$402,417	$301.23	984	$301,237	$306.04
Crude No. 2	2,610	2,812	370,776	131.87	1,411	187,338	132.78
Mill stock No. 1	16,144	19,388	932,893	48.12	4,616	229,361	49.69
Mill stock No. 2	58,362	47,851	963,973	20.15	15,114	305,809	20.23
Mill stock No. 3	29,101	25,155	222,207	8.83	9,046	76,522	8.46
Total asbestos	107,668	96,542	2,892,266	29.96	31,171	1,100,267	35.30
Asbestic	....	21,031	17,540	.83	....	....	....

[a] Canadian Min. Jour., Mar. 15, 1915, p. 189.

According to Theo. Denis, superintendent of mines of Quebec [1]—

The shipment of asbestos during the first six months of the year [1914] were in excess of the corresponding period of 1913; but during the last five months the conditions of the market compelled most of the producers to practically discontinue operations or decrease them to a fraction of what they would have been under nor-

[1] Canadian Min. Jour., Mar. 15, 1915, p. 189.

mal conditions. Germany was an important consumer of [Canadian] asbestos, much more so than appears from the tables of export figures, for most of the exports to Belgium went to Antwerp in transit to German consumers. This, however, is in the way of being remedied. Since the early part of January activity has been apparent in the Thetford district, and important shipments are now being made, particularly to the United States. It looks as if the South American trade of manufactured asbestos products, which was in a great measure monopolized by Germany, were being taken up by American manufacturers.

RUSSIA.

Next in rank to Canada as an asbestos producer is Russia. Its production has steadily increased from 5,785 short tons in 1903 to 18,594 short tons in 1913, of which the United States imported only 150 tons. The greater portion went to Germany. The Russian asbestos occurs like that of Canada, in cross-fiber veins of chrysotile in peridotite or serpentine. A brief account of the Russian deposits was published in this report for 1908.[1]

RECENT LITERATURE CONCERNING ASBESTOS.

The most important contribution to the literature of asbestos in the last few years is a paper by Oliver B. Hopkins concerning the asbestos deposits of Georgia, published as Bulletin 29 by the Geological Survey of Georgia. Although not intended to attain the completeness of Cirkel's monograph,[2] the paper is comprehensive and is a valuable source of general information concerning asbestos.[3] John A. Dresser describes [4] the asbestos in southern Quebec, giving briefly its history, geology, mode of occurrence, and mining, as well as the outlook of the asbestos industry.

Philip S. Smith [5] reports a small quantity of asbestos associated with greenstone intrusives near Shungnak, Alaska. Although of good color, it has slight tenacity, and therefore a value too low to bear expensive transportation.

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[1] U. S. Geol. Survey Mineral Resources, 1908, pt. 2, pp. 702–703, 1909.
[2] Cirkel, Fritz, Chrysotile asbestos, its occurrence, exploitation, milling, and uses, 2d ed.: Mines Branch, Canadian Dept. of Mines, Ottawa, 1910.
[3] See also shorter paper by the same author in Am. Inst. Min. Eng. Bull. 93, pp. 2275–2288, September, 1914.
[4] Idem, pp. 2267–2274.
[5] U. S. Geol. Survey Bull. 536, p. 154, 1913.

MINERAL PAINTS.

By James M. Hill.

INTRODUCTION.

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 the three classes the first two are included in the Survey's annual summary of the mineral production of the United States, as they are thought to 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 included in most of these pigments have been reported elsewhere, so that the publication of the statistics of the manufactured products would result in duplication. Many 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, mica, pyrite, quicksilver, 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 1, or natural mineral pigments, comprises ocher, umber, sienna, ground slate and shale, metallic paint, and mortar colors. The three ores of iron, hematite, siderite, and limonite, are the bases from which the metallic paints and mortar colors are derived.

Group 2, pigments made directly from ores, comprises zinc oxide, leaded zinc oxide, sublimed white lead, and sublimed blue lead. The last two are also known to the trade as basic sulphates of lead.

Group 3, 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 sold during 1914 and considered in this report were greater than in 1913. There was a slight decrease in the production of the natural mineral pigments, but in both the other classes there was a marked increase in output. The output of the pigments made directly from ores increased 9.45 per cent and the production of pigments made chemically increased about 12.09 per cent The decrease in the quantity of natural mineral pigments amounted to 5.4 per cent.

The following table shows the total marketed production of the three groups of pigments for the last two years:

Quantity and value of mineral paints sold in 1913 and 1914, in short tons.

	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Natural mineral pigments	70,595	$512,410	66,766	$473,036
Pigments made directly from ores	97,573	9,020,896	106,791	9,978,710
Chemically manufactured pigments	219,644	25,123,167	246,206	27,630,829
Total	387,812	34,656,473	419,763	38,082,575

In this issue a change will be noted in the form of the report. Heretofore brief statements concerning the utility of each pigment have been included in the notes which followed the statistics of production. These notes were, in the nature of the case, but abstracts or summaries of articles that have appeared in the trade and technical journals. Inasmuch as the statistics of production published by the Government are entirely unbiased, it is believed best to give abstracts of the various articles themselves rather than to summarize them in the text, so that there may be no confusion as to the responsibility for the statements. In view of this decision, the bibliography, which has heretofore been published at the end of this chapter, will be replaced by bibliographic abstracts of the more important articles published in domestic journals during 1914 and in 1915 up to the time of writing.

Thanks to the courteous assistance of Messrs. S. S. Voorhees, of the United States Bureau of Standards, G. W. Thompson, of the National Lead Co., and H. A. Gardner, of the Paint Manufacturers' Association of the United States, it is believed that the important papers dealing with the occurrence, chemistry, technology, and testing of mineral paints have been included in the last section of this report.

NATURAL MINERAL PIGMENTS.

MARKETED PRODUCTION.

As is probably well known to the readers of the reports published in Mineral Resources, the figures of production are obtained from the producers. The figures are given gladly by most producers, who recognize the value of accurate statistics. Unfortunately, three of the largest producers of the natural mineral pigments have declined to furnish the Survey any statement of their operations in 1914. In consequence the figures of production of the natural mineral pigments are not absolutely correct. Estimates of the output of the various pigments marketed by these companies have been made and are included in the following tables, but they are estimates only, and it is felt that the public should be so informed.

The marketed production of the natural mineral pigments in the United States in 1914, as reported to and estimated by the Survey, amounted to 66,766 short tons, valued at $473,036. Compared with the production of 1913, this was a decrease of 3,829 short tons, or slightly more than 5.4 per cent, in quantity and of $39,374, or about 8 per cent, in value. The output of ocher and ground slate and shale decreased; the production of umber and sienna, metallic paint, and mortar colors increased. The greatest change was in the output of ocher, which decreased 3,191 short tons, or 18 per cent. The output of umber and sienna increased 14 short tons; metallic paint, 849 short tons; mortar colors, 14 short tons; but the output of ground slate and shale decreased 1,515 short tons.

The following table gives the marketed production and value of the natural pigments during the last four years:

Marketed production of natural mineral pigments, 1911–1914, in short tons.

Pigment.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ocher	11,703	$109,465	15,269	$149,289	17,578	$173,944	14,387	$136,185
Umber, Sienna	1,005	26,225	805	21,975	776	20,790	790	21,070
Metallic paint	25,599	181,163	28,347	181,352	30,098	171,264	30,947	179,653
Mortar colors	7,922	76,517	9,272	87,595	5 357	35,443	5,371	47,723
Slate and shale, ground	16,510	105,451	20,964	121,482	16,786	110,969	15,271	88,405
Total	62,739	498,821	74,657	561,693	70,595	512,410	66,766	473,036

This table represents approximately the output of natural mineral pigments; the figures are the best obtainable under present conditions but are known to be inaccurate, probably being at least 25 per cent below the actual output.

The following table shows the prices per ton at the point of production of the different mineral paints for the last five years:

Average price per short ton of natural mineral pigments, 1910–1914.

Pigment.	1910	1911	1912	1913	1914
Ocher	$9.60	$9.35	$9.78	$9.90	$9.47
Umber and sienna	26.31	26.09	27.30	26.79	26.67
Metallic paint [a]	6.28	7.08	6.40	5.69	5.81
Mortar color	10.82	9.66	9.45	6.62	8.88
Slate and shale	5.81	6.39	5.79	6.61	5.79.

[a] Includes crude iron ore sold for paint, which accounts in part for the low value per ton.

The prices per ton of metallic paints and mortar colors apparently advanced 12 cents and $2.26, respectively. The other pigments decreased in price, the decrease being 12 cents for umber and sienna, 82 cents for ground slate and shale, and 43 cents for ocher.

OCHER.

MARKETED PRODUCTION.

The quantity of ocher sold in 1914 was 14,387 short tons, valued at $136,185, compared with 17,578 short tons, valued at $173,944, in 1913, a decrease of 3,191 short tons in quantity and of $37,759 in value. The average price per ton was $9.78 in 1912, $9.90 in 1913, and $9.47 in 1914.

In 1914 ocher was produced in Georgia, Pennsylvania, Virginia, Alabama, Iowa, California, Vermont, the States being named in the order of their producing importance. The Georgia output, practically all of which came from the vicinity of Cartersville, Bartow County, was about 60 per cent of the total production of the United States. Mines located in Berks, Northampton, and Lehigh counties, Pa., produced a little less than 27 per cent of the total output. In Virginia the production was as usual from Page and Pulaski counties.

The following table gives the quantity of ocher sold by States from 1911 to 1914, inclusive:

Marketed production of ocher, 1911–1914, by States, in short tons.

State.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Georgia	7,395	$69,447	10,107	$101,790	11,420	$123,090	8,607	$84,193
Pennsylvania	3,013	28,101	3,300	28,950	3,935	32,175	3,799	34,223
Vermont	(a)	(a)	531	6,346	(a)	(a)	(a)	(a)
Other States [b]	1,295	11,917	1,331	12,203	2,223	18,679	1,981	17,769
Total	11,703	109,465	15,269	149,289	17,578	173,944	14,387	136,185

[a] Included in "Other States."
[b] Includes, 1911: California, Iowa, Vermont, and Virginia; 1912: California, Iowa, and Virginia; 1913 and 1914: Alabama, California, Iowa, Vermont, and Virginia.

IMPORTS.

In the following table are given the imports of ocher for the last five years:

Imports of ocher, 1910–1914, in pounds.

Year.	Crude.		Dry.		Ground in oil or water.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	[a] 321,671	3,282	[a] 12,126,238	104,212	[a] 13,068	770	16,697,098	143,720
1914	....	....	....	....	....	....	22,066,006	141,704

[a] Figures for Jan. 1 to Oct. 3, inclusive, 1913; since Oct. 4, under the new tariff, the figures for crude, dry, and ground in oil or water are given together by the Bureau of Foreign and Domestic Commerce. Total figures are correct for the year.

The imports of crude and dry ocher and ocher ground in oil and water amounted in all to 22,066,006 pounds, or approximately 11,033 tons in 1914. This was equal to about 76 per cent of the reported domestic production. The value of the imported ocher was $141,704, or at the rate of $12.84 a ton.

NOTES ON OCHER.

Ocher is a clay permeated by hydrated ferric oxide. It has a specific gravity of about 3.5 and a decidedly golden-yellow color. As viewed under the microscope with a considerable enlargement, the particles composing ocher appear flocculent and uniform. 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.

Ocherous clays and true ocher are not unusual in most parts of the country. The Survey is constantly in receipt of samples of yellow material, some of which would make good paints, but many of which are certainly not salable for use as pigments. During the year deposits have been opened in Utah, California, Wisconsin, and Tennessee, and several samples have been received from workings in the old Vermont field.

Since the beginning of the European war domestic ochers have been more used than heretofore. It is the general opinion among the users of this pigment that the domestic ocher does not compare with the French ocher in tone, color, or strength. It seems to be the case, as in many American industries, that the producers will not prepare their materials with the care used by the foreign manufacturers. It is the belief of the writer that some domestic ochers could be made equal to the French ochers in every respect if American producers would give more attention to the details of cleaning and floating. It has been said of American ochers[1] that, "by skillful handling, a thoroughly satisfactory color can be obtained. This is done by tinting the ocher with American chrome yellow until the correct shade is obtained."

UMBER AND SIENNA.

MARKETED PRODUCTION.

The total quantity of umber and sienna sold in the United States in 1914 as reported to the Survey was 790 short tons, valued at $21,070, an increase of 14 tons in quantity and of $280 in value, as compared with the production of 1913. The average price of umber and sienna per ton in 1914 was $26.67, as compared with $26.79 in 1913.

In the following table is given the marketed production of umber and sienna in the United States for the period 1910–1914:

Marketed production of umber and sienna, 1910–1914, in short tons.

Year.	Quantity.	Value.
1910	1,015	$26,700
1911	1,005	26,225
1912	805	21,975
1913	776	20,790
1914	790	21,070

[1] Paint, Oil, and Drug Rev., vol. 58, p. 4, Sept. 16, 1914.

IMPORTS.

In the following tables are given the imports of umber and sienna for the last five years:

Imports for consumption of umber, 1910–1914, in pounds.

Year.	Dry.		Ground in oil or water.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	4,857,706	31,408	3,179	218	4,860,885	31,626
1913	[a] 4,537,505	31,476	[a] 6,042	374	5,236,489	36,771
1914					7,886,716	45,280

[a] Figures for Jan. 1 to Oct. 3, inclusive; since Oct. 4, under the new tariff, the figures for dry and ground in oil or water are given together by the Bureau of Foreign and Domestic Commerce. Total figures are correct for the year.

Imports for consumption of sienna, 1910–1914, in pounds.

Year.	Dry.		Ground in oil or water.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	[a] 2,367,963	34,793	[a] 2,502	92	3,273,217	48,535
1914					7,815,323	63,958

[a] Figures for Jan. 1 to Oct. 3, inclusive; since Oct. 4, under the new tariff, the figures for dry and ground in oil or water are given together by the Bureau of Foreign and Domestic Commerce. Total figures are correct for the year.

The quantity of umber imported in 1914 amounted to a little more than 3,943 short tons, considerably more than the domestic production of umber and sienna combined; the imports of sienna amounted to about 3,908 short tons, the total imports for both products being 7,851 short tons, or 7,061 short tons in excess of the domestic output. The value of the imported umber and sienna in 1914 was $109,238, or more than five times the value of the domestic production. Imported umber was valued at $11.48 a short ton and sienna at $16.37 a short ton, as compared with $26.67 a short ton, the average price of combined domestic umber and sienna.

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. The only State reporting a production of umber or sienna to the Survey in 1914 was Pennsylvania.

Sienna is composed essentially of silicates of iron and aluminum with less manganese oxide than umber and is of a lighter color. Large particles are present in the raw sienna, but burnt sienna is fine grained. Sienna and umber are used principally as pigments in the manufacture of ready-mixed paints and linoleum.

PRODUCTION IN PRINCIPAL COUNTRIES.

The following table gives the output of ocher and umber in certain of the principal producing countries from 1909 to 1913, inclusive, as far as statistics are available:

Production of ocher and umber in principal producing countries, 1909–1913, in short tons.

Year	United States.		United Kingdom.		France.		German Empire (Bavaria and Saxony).	
	Quantity.	Value.	Quantity.[a]	Value.	Quantity.[b]	Value.	Quantity.	Value.
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	38,075	313,276	3,434	10,324
1912	15,644	156,589	15,621	66,481	46,087	420,248	7,668	14,072
1913	17,963	181,404	16,951	70,370	(c)	(c)	(c)	(c)

Year.	Canada.		Belgium.		Spain.		Cyprus.	
	Quantity.[b]	Value.	Quantity.[b]	Value.	Quantity.[b]	Value.	Quantity.[d]	Value.
1909	3,940	$28,093	771	$1,351	461	$813	3,781	$20,011
1910	4,813	33,185	661	1,158	837	1,442	3,441	15,748
1911	3,622	28,333	595	965	686	1,200	4,221	15,850
1912	7,654	32,410	716	1,592	661	1,168	5,259	20,945
1913	5,987	41,774	(c)	(c)	(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 Umber exports.

METALLIC PAINT.

MARKETED PRODUCTION.

The marketed production of metallic paint reported to the Survey in 1914 was 30,947 short tons, valued at $179,653, as compared with 30,098 short tons, valued at $171,264, in 1913. The production of metallic paints is reported from some States mainly in terms of the dry ground product, the average price per ton of which is considerably greater than of the crude ore produced in the same States and sold as such to the paint mills. The price of the crude ore sold as such apparently varied between $1.56 and $3.58 a ton. The higher average value for metallic paint is probably to be explained by the fact that the large producers operate their own mines and the material is marketed by them in the ground form.

The table following gives the marketed production of metallic paint from 1911 to 1914, inclusive.

Marketed production of metallic paint, 1911–1914, by States, in short tons.

State.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Maryland	(a)	(a)	562	$1,930	(b)	(b)	(b)	(b)
New York	[c]7,993	$28,569	[c]10,951	29,547	[c]14,949	$34,041	[c]14,678	$33,864
Pennsylvania	7,676	100,837	8,970	107,499	8,312	106,172	9,862	121,888
Tennessee	[a]3,282	25,381	(b)	(b)	(b)	(b)	(b)	(b)
Wisconsin	[c]2,048	11,258	[c]2,106	9,953	[c]2,144	11,584	[c]2,339	8,389
Other States[d]	4,600	15,118	5,758	32,423	4,693	19,467	4,068	15,512
Total	25,599	181,163	28,347	181,352	30,098	171,264	30,947	179,653

[a] Maryland is included in Tennessee.
[b] Included in "Other States."
[c] Principally crude iron ore sold for paint.
[d] Includes, 1911: Georgia, Michigan, Missouri, Virginia, Washington; 1912: Michigan, Missouri, Tennessee, Virginia, Washington; 1913: California, Georgia, Maryland, Michigan, Tennessee, Virginia, Washington; 1914: Arizona, California, Georgia, Maryland, Michigan, Missouri, Tennessee, and Washington.

NOTES ON METALLIC PAINT.

Natural 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 Wisconsin, and the gray siderite found near Lehigh Gap, Pa., are the chief sources of the raw ore supply.

Several by-products are also sold as metallic paints. Blast-furnace dust, a grayish-brown mixture of oxide of iron and coke that is collected at many furnaces, 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 that is sometimes ground to form a pigment. Another by-product that has been utilized as a metallic paint is the residue left after extracting aluminum salts from bauxite. Ferrous sulphate or copperas also is roasted with lime or gypsum and sold as metallic paint. Differences in the conditions surrounding the roasting produce different shades, called by various names, as Indian red and purple oxide. In 1914 by-product metallic paints amounting to 1,735 short tons were sold for $28,303, or at the rate of $16.50 a short ton.

MORTAR COLORS.

MARKETED PRODUCTION.

The marketed production of mortar colors reported to the Survey in 1914 was 5,371 short tons, valued at $47,723, an increase of 14 tons in quantity and of $12,280 in value as compared with 1913.

It is questionable whether figures for mortar colors should be included as a separate item of production, since a large part of the material sold under that name should probably be included with metallic paint or ground slate and shale. 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. The average price per ton for mortar colors was $8.88 in 1914, as compared with $6.62 in 1913. A large proportion of the material entered the market first in the dry ground condition, hence the apparent increase in price as compared with the preceding year, when the proportion of crude ore was greater.

In the following table is given the production of mortar colors from 1911 to 1914, inclusive:

Marketed production of mortar colors, 1911–1914, by States, in short tons.

State.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	2 518	$24,723	3,309	$29,969	5,357	$35,443	5,371	$47,723
Pennsylvania	3,248	30,442	2,550	24,857				
Other States [a]	2,156	21,352	3,413	32,769				
Total	7,922	76,517	9,272	87,595	5,357	35,443	5,371	47,723

[a] Includes Maryland and Tennessee.

SLATE AND SHALE.

MARKETED PRODUCTION.

The quantity of slate and shale ground for paints and fillers in 1914 was 15,271 short tons, valued at $88,405, a decrease of 1,515 short tons in quantity, and of $22,564 in value, as compared with 1913. The average price of the material was $6.61 in 1913 and $5.79 in 1914.

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, 1910–1914, in short tons.

Year.	Quantity.	Value.
1910	16,515	$96,001
1911	16,510	105,451
1912	20,964	121,482
1913	16,786	110,969
1914	15,271	88,405

In the 1913 report the quantity of slate and shale was given as 21,786 short tons. After the report had been issued it was found that 5,000 tons of shale, reported as sold for $10,000 for paint was actually sold for fire clay; therefore the figures for 1913 have been revised in the present report.

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 1914 in Pennsylvania, New York, Georgia, and Indiana, named in the order of their producing importance, Pennsylvania producing about 87 per cent of the total. The shales used in the paint trades may be divided into three classes—black, yellow, and red shales. Black shale is used to some extent in paint for buildings, but chiefly in the manufacture of a black filler for iron work. Ground yellow shales have been utilized in the manufacture of paint, but are principally used in the manufacture of oilcloth and linoleum. They are considerably lighter in color than the ochers and contain a much lower percentage of hydrous iron oxide, though they are usually called ochers.

WHITING.

Whiting is prepared by grinding various forms of white limestone and calcite. Some whiting, prepared artificially, is finer grained and a little lighter in weight than the natural whiting. It is used largely in the manufacture of putty, in distemper work, and in small quantities in ready-mixed paints.

Whiting was produced in Kentucky, Michigan, and Missouri in 1914. It is doubtful if whiting should be included in the production of mineral paints, for it seems probable that only a small part of the output is actually used as a pigment, and certainly the Survey does not receive complete figures of output.

PIGMENTS MADE DIRECTLY FROM ORES.

PIGMENTS AND ORES.

The pigments here discussed are zinc oxide, leaded zinc oxide, sublimed white lead or "basic lead sulphate," and sublimed blue lead or "blue fume." The white pigments having zinc for a base, either wholly or in part, are zinc oxide and leaded zinc oxide. These pigments are made directly from the carbonate, silicate, and other zinc ores of the Mississippi Valley region, of New Mexico, and of Nevada, from mixed sulphide ores from various Western States, or from the franklinite ores of New Jersey.

MARKETED PRODUCTION.

In order to conceal individual returns, the statistics of production of zinc oxide, leaded zinc, and of white lead and blue lead produced by sublimation have to be combined. The total quantity of these pigments marketed amounted in 1914 to 106,791 short tons, valued at $9,978,710. As compared with the production of 1913, this was an increase of 9,218 tons, or 9 per cent, in quantity and of $957,814, or 10 per cent, in value.

The following table gives the production and value of pigments made directly from ores during the last four years:

Marketed production of pigments made directly from ores, 1911–1914, in short tons.

Pigment.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Sublimed blue lead ("blue fume") Sublimed white lead ("basic lead sulphate") Leaded zinc oxide Zinc oxide	80,611	$7,343,762	106,497	$9,507,895	97,573	$9,020,896	106,791	$9,978,710

ZINC OXIDE.

Zinc oxide is the most important of the zinc pigments. It is a white powder consisting, when chemically pure, of 80.34 per cent zinc and 19.66 per cent oxygen. 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. The plants which produced zinc oxide commercially in 1914 were the New Jersey Zinc Co. of Pennsylvania, with plants located at Palmerton and Freemansburg, Pa.; and the Mineral Point Zinc Co., located at Mineral Point, Wis. The Western Zinc Mining & Reduction Co. plant at Leadville, Colo., made little zinc oxide during 1914. Apparently the troubles[1] with this plant can be adjusted, and there seems to be no real reason why it should not be successfully operated during 1915.

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, 1910–1914, in pounds.

Year.	Dry.		In oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	6,580,944	410,493	284,150	23,663	6,865,094	434,156
1914	4,922,423	279,642	335,685	23,196	5,258,108	302,838

LEADED ZINC OXIDE.

Leaded zinc oxides are pigments consisting of zinc oxide and 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 zinc ores that carry a certain proportion of lead sulphide. In fineness they are similar to zinc oxide but are not quite so white. Leaded zinc pigment is manufactured by the Ozark Smelting & Mining Co., the Mineral Point Zinc Co., and the New Jersey Zinc Co.

No zinc-lead pigment was produced in the United States during 1914, according to reports received by the Survey.

SUBLIMED WHITE LEAD AND SUBLIMED BLUE LEAD.

Sublimed white lead or "basic lead sulphate" is made directly from soft (nonargentiferous) lead sulphide ore, galena. The basic lead sulphate is thought to be composed of two molecules of lead sulphate ($PbSO_4$) linked to one of lead oxide (PbO). It contains

[1] Leslie, E. H., Zinc pigments and the Leadville Works: Min. [Min. and Sci.] Press, vol. 110, pp. 433–438, Mar. 20, 1915.

approximately[1] 77 per cent of lead sulphate, 17 per cent of lead oxide, and 6 per cent of zinc oxide.

In the sublimation of galena a peculiar bluish-gray compound of lead is formed, which is known commercially as sublimed blue lead or "blue fume." Holley[2] says sublimed blue lead varies somewhat in composition but contains approximately 50 per cent lead sulphate, 35 per cent lead oxide, 5 per cent lead sulphide, 5 per cent lead sulphate, 3 per cent carbon, and 2 per cent zinc oxide.

The two firms manufacturing these products in the United States are the Picher Lead Co., of Joplin, Mo., and the St. Louis Smelting & Refining Co., whose plant is located at Collinsville, Ill.

CHEMICALLY MANUFACTURED PIGMENTS.

MARKETED 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 marketed production of chemically manufactured pigments in 1914 amounted to 246,206 short tons, valued at $27,630,829. This is an increase over the production of 1913 of 26,562 tons in quantity and of $2,507,662 in value.

The following table shows the marketed production and value of chemically prepared pigments during the last four years:

Marketed production of chemically manufactured pigments, 1911-1914, in short tons.

Pigment.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Basic carbonate white lead:								
In oil	106,778	$14,699,339	120,591	$16,041,100	118,430	$15,603,431	130,398	$16,983,587
Dry	25,834	2,693,902	26,242	2,642,361	24,196	2,508,788	29,076	2,959,652
Red lead	a 19,540	2,345,320	a 21,120	2,571,702	a 17,635	2,127,976	a 18,697	2,151,054
Litharge	25,190	2,773,196	29,111	3,194,194	23,093	2,524,707	27,345	2,856,092
Orange mineral	a 766	119,370	a 545	88,245	a 434	71,625	a 426	70,019
Lithopone	16,866	1,243,108	24,220	1,702,119	29,685	2,170,445	32,819	2,490,530
Venetian red	5,773	106,009	6,306	116,511	6,171	116,195	7,445	119,895
Total	200,747	23,980,244	228,135	26,356,232	219,644	25,123,167	246,206	27,630,829

a A small quantity of orange mineral is 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 1910 to 1914, inclusive.

The total value of the imports of the chemically manufactured pigments in 1914 was $368,452.

[1] Schaeffer, John A., The lead contents in sublimed white lead: Paint, Oil, and Drug Rev., vol. 57, pp 17-18, Apr. 29, 1914.

[2] Holley, C. D., The lead and zinc pigments, p. 120, John Wiley & Sons, 1909.

Imports for consumption of basic carbonate white lead, red lead, litharge, orange mineral, lithopone, and Venetian red, 1910–1914, 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.
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	33,854	32,443	1,550	334,551	20,914	5,904,475	153,303	2,828,627	22,916
1913....	672,109	45,266	99,832	4,903	34,023	1,750	330,525	22,205	5,066,535	152,980	3,341,517	25,927
1914....	596,567	40,203	12,554	2,934	33,651	1,805	240,388	16,388	8,072,567	277,822	3,373,266	29,300

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 are present.

The marketed production of basic carbonate (corroded) white lead in 1914, as reported to the Survey, was 159,474 short tons, valued at $19,943,239. Of this total, 130,398 short tons, valued at $16,983,587, were reported sold in oil, and 29,076 short tons, valued at $2,959,652, were reported sold dry. The sales for 1914 represented a net increase over those for 1913 of 16,848 short tons in quantity and of $1,831,020 in value.

The average price per ton of basic carbonate white lead ground in oil was $130.24 in 1914, as compared with $131.75 in 1913, a decrease of $1.51 a ton; and the average price per ton of dry white lead was $101.79 in 1914, as compared with $103.69 in 1913, a decrease of $1.90 a ton.

This pigment is manufactured by 4 firms in Pennsylvania, by 3 firms in Illinois, by 2 firms each in California, New Jersey, and New York, and by 1 firm in each of the following States: Michigan, Missouri, Nebraska, and Ohio.

LITHARGE.

The marketed production of litharge in 1914, as reported to the Survey, was 27,345 short tons, valued at $2,856,092, as compared with 23,093 short tons, valued at $2,524,707, in 1913, an increase in quantity of 4,252 tons and in value of $331,385. The average price per ton was $109.33 in 1913 and $104.45 in 1914.

Litharge, or lead monoxide, a buff-colored powder, is used in paints, in glazes, in storage batteries, and in fire assaying for gold and silver. It is produced at 2 plants in New York and Missouri, at 5 plants in Pennsylvania, and at 1 plant each in California, Massachusetts, Michigan, New Jersey, and Ohio.

RED LEAD.

The marketed production of red lead in 1914 was 18,697 short tons, valued at $2,151,054, an increase of 1,062 short tons in quantity and of $23,078 in value over the output of 1913. The average price per ton decreased from $120.67 in 1913 to $115.05 a ton in 1914, a decrease of $5.62. Red lead is produced by heating litharge in reverberatory furnaces. The particles of this pigment vary much in size. Red lead was made in 1914 at 4 plants in Pennsylvania, at

2 plants each in Missouri and New York, and at 1 plant each in California, Michigan, New Jersey, and Ohio.

ORANGE MINERAL.

The marketed production of orange mineral as reported to the Survey was 426 short tons, valued at $70,019, in 1914, as compared with 434 short tons, valued at $71,625, in 1913. The apparent average price per ton was $164.36 in 1914, as compared with $165.03 in 1913, a decrease of 67 cents a ton. The output given above does not include all orange mineral manufactured, as some producers combined their returns for orange mineral and red lead.

Orange mineral, one of the higher oxides of lead, is valued according to the depth and color of its bright orange shade. It is made at 3 plants in Pennsylvania, at 2 plants in New York, and at 1 plant each in California, Michigan, Missouri, and Ohio.

LITHOPONE.

The marketed production of lithopone in 1914 was reported as 32,819 short tons, valued at $2,490,530, as compared with 29,685 short tons, valued at $2,170,445, in 1913, an increase in quantity of 3,134 tons and in value of $320,085. The average price per ton in 1913 was $73.12, which rose to $75.89 in 1914. Lithopone contains approximately 70 per cent barium sulphate, from 25 to 29 per cent zinc sulphide, and from 1 to 5 per cent zinc oxide. It has a characteristic flocculent, noncrystalline appearance when examined under the microscope. In 1914, lithopone was made at 3 plants in New Jersey, at 2 plants in Pennsylvania, and at 1 plant in Delaware.

VENETIAN RED.

The marketed production of Venetian red in 1914, as reported to the Survey, was 7,445 short tons, valued at $119,895, compared with 6,171 short tons, valued at $116,195, in 1913, an increase in quantity of 1,274 tons and in value of $3,700. The apparent average price per ton was $18.83 in 1913, which dropped to $16.10 in 1914.

Venetian red is made by grinding red iron oxide with gypsum, by roasting ferrous sulphate with lime and grinding the residue, by grinding red oxide with calcium carbonate, by calcining pyrite and ferrous sulphate with terra alba, and in sundry other ways. It is sometimes marketed as metallic paint. It is manufactured by 3 companies in Pennsylvania, and by 1 company each in California, Maryland, and Missouri.

IMPORTS OF PAINTS AS AFFECTED BY THE EUROPEAN WAR.

Immediately after the outbreak of the European war the supply of foreign mineral paints of all descriptions was stopped, and for a time war prices prevailed. Many of the large pigment users had a supply of foreign colors sufficient to last for a considerable time, but the small consumers were forced to pay whatever was asked to obtain the desired materials. This condition apparently lasted only a few weeks, and by the middle of September, 1914, it was thought that the quantity of foreign colors imported would be curtailed but that there was no present danger of a complete stoppage of supplies. As this report goes to press [June, 1915] the arrival of foreign colors has become most uncertain. It seems probable that imports of French ochers, Italian siennas, and Turkish umbers will be very considerably curtailed if not stopped within a short time.

BIBLIOGRAPHIC ABSTRACTS.

In this section are included abstracts of the principal articles concerning mineral paints which have appeared in the American technical journals during the calendar year 1914 and in 1915 up to March 8. It is fully realized that there is a large current literature relating to the various oils and driers which would be of interest to the paint manufacturer, but the abstracts of those papers can not be included in this report.

Armstrong, H. E., and Klein, C. A., The behavior of paints under the conditions of practice with special reference to the aspersions cast upon white lead: Soc. Chem. Ind. Jour., vol. 32, pp. 320–331, 1914.

Authors give results of experiments with lead paints showing that vapors evolved from drying lead paints contain no volatile lead compounds, but do contain vapors of turpentine, benzine, or oxidation products of drying oils. Conclude that the whole available evidence indicates that the dangers attending the use of lead compounds are only the well-known mechanical dangers.

Buddecke, W. A., Barytes as a good pigment: Paint, Oil, and Drug Rev., vol. 57, p. 12, Feb. 11, 1914.

Calls attention to several actual service tests of barytes-zinc, barytes-lead, and barytes zinc and lead paints, and concludes that a good paint consists of plenty of barytes, linseed oil, and perhaps a little zinc and lead, provided that the barytes is ground in water and floated.

Calkins, E. E., Oxide of zinc: Paint, Oil, and Drug Rev., vol. 58, pp. 6–8, 1914.

Oxide of zinc first manufactured for pigments in France in latter part of eighteenth century, but little was made until 1850, when Le Clair began to manufacture. In 1850 the New Jersey Zinc. Co. began manufacturing zinc oxide, and in 1852 patented the process now in use. Describes the Palmerton, Pa., plant, at which is made spiegel, spelter, lithopone, and sulphuric acid from Franklin furnace ores. Suggests that advertising of zinc will help all branches of paint industry, as users of zinc oxide also use lead and the other pigments.

Drugs, Oils, and Paints, Some little-known white pigments: Vol. 30, pp. 21–23, June, 1914.

Calls attention to properties and use of zinconium oxide, tin oxide, titania antimony oxide, bismuth oxychloride, barium tungstate, and calcium tungstite as paint pigments.

Euston, Edwin, The constitution of white lead: Jour. Ind. and Eng. Chemistry, vol. 6, pp. 202–203, March, 1914.

Says possibility of both normal lead carbonate and some form of lead hydroxide in stack process; white lead must be admitted, as there can be no important control of conditions in stack over corroding period of 100 to 120 days.

Thenard's process of treating basic lead acetate with carbon dioxide found to be hard to control in the past, but Euston has attained good results with this process on a manufacturing scale. In this process the precipitate gradually takes up CO_2, passing through various stages represented as $PbCO_3$, $Pb(OH)_2$, $2PbCO_3$, $Pb(OH)_2$, $PbCO_3$. In the initial stages the lead hydroxide is held in combination with the carbonate and is not free. Properly prepared white lead contains only the following molecules: $PbCO_3$ $Pb(OH)_2$, and $PbCO_3$.

——— The nature of basic lead carbonate: Jour. Ind. and Eng. Chemistry, vol. 6, pp. 382–383, 1914.

Says that white lead consists of a mixture of normal lead carbonate with basic carbonate of lead of the compositions $PbCO_3$, $Pb(OH)_2$. Experiments indicate that basic carbonate of lead is a mixture of colloidal substances which acts as a chemical compound. Lead hydroxide probably not present as a mechanical mixture, and yet is not held in chemical combination. Normal lead carbonate can take lead hydroxide for a basic lead acetate solution. Euston also found that basic zinc carbonate, whiting, precipitated calcium carbonate, precipitated barium sulphate, and precipitated barium carbonate also have the power of taking lead hydroxide from basic lead acetate, forming compounds somewhat similar to basic lead carbonate; properly prepared white lead contains only the following molecules: $PbCO_3$ $Pb(OH)_2$, and $PbCO_3$.

Gardner, Henry A., Repainting tests on paint oils, with notes on the changes occurring in oils upon aging: Paint Mfrs. Assoc. U. S. Circular 30, 1914.

Gives notes on the preparation of panels, mixing of paints, and character of oils used in repainting a series of wooden test panels first exposed in May, 1911, at Washington, D. C.

——— Paints to prevent electrolysis in concrete structures: Paint Mfrs. Assoc. U. S. Bull. 47, 1915.

Gives notes on a series of tests of preservative coatings for reinforcing steel bars embedded in concrete. The tests were intended to give a rapid determination of the protective value of the films. Concludes that proper protection of reinforcing bars for concrete construction can be obtained by the use of paints made with a vehicle containing (1) boiled oils or other products which dry to fairly saturated films, (2) oils which dry by semipolymerization rather than by oxidation, (3) oils which dry to a flat rather than to highly gloss surface; containing also in the solid portion a percentage of (1) coarse pigments which will give a rough surface to film, (2) pigments which are inert and are not electrical conductors, (3) pigments which are either basic or of the chromate type.

——— Paint protection for Portland cement surfaces: Am. Soc. Testing Materials Proc., vol. 14, pt. 1, pp. 482–490, discussion pp. 491–501, 1914.

In tests on paints for exterior and interior cement stucco it was found that the quantity of free lime in fairly dry cement surfaces does not always affect high-grade oil paint. That the McNichol zinc-sulphate process may be used as a primer to neutralize free lime of damp surfaces with excellent results. That resinous paints are not well suited for use on cement.

Herbert Abraham says in discussion that zinc sulphate method is not good, as it is not practicable to determine quantity of lime present to be neutralized and excess of zinc sulphate is as injurious as lime. Paints made for concrete to be most successful should contain acid rosin or organic acids.

John Deware in discussion recommends zinc sulphate method.

Maximilian Toch in discussion says Gardner's conclusions are not warranted by experiments and facts given in report and that paints of the acid-rosin type have proved satisfactory.

——— The toxic and antiseptic properties of paint: Paint Mfrs. Assoc. U. S. Bull. 41, 1914; Paint, Oil, and Drug Rev., vol. 57, pp. 10–16, 1914.

In part 1 gives results of a series of tests to determine the gases evolved during the drying of vehicles and paints, and concludes (1) that drying linseed oil or similar drying oils evolve considerable quantities of carbon dioxide, organic substances, and small quantities of carbon monoxide; (2) that oil paints containing lead and zinc do not evolve volatile compound of a metallic nature; (3) that drying paints evolve water-soluble acid substances such as formic acid, substances of a fatty acid nature, carbon dioxide, and carbon monoxide; that the type of pigment determines the quantity of each evolved; and that basic pigments apparently stimulate the evolution of such products; (4) that aldehydic substances which are evolved probably account for the sanitary value ascribed to oil pigment paints.

In part 2 discusses the cause and prevention of toxic effects of pigments and concludes that with adoption of proper preventive measures, the installation of dust-retarding apparatus, and the wider use of prepared paints, lead poisoning will be done away with.

In part 3 discusses a series of experiments on guinea pigs to show the relative toxicity of volatile thinners, and concludes that with proper ventilation the vapors evolved are not harmful, but in closed spaces benzine and benzole may prove harmful.

——— Fire-retarding paints for shingles: Paint Mfrs. Assoc. U. S. Bull. 42, 1914; Paint, Oil, and Drug Rev., vol. 57, pp. 10–18, Feb. 4, 1914; Drugs, Oils, and Paints, vol. 29, pp. 270–374, 1914.

Wooden shingles dangerous, with possible exception of cypress. Suggests paints or use of metal or cement, which must be painted. Fire-retarding paints divided into two groups, oil paints and paints with no oil, of which the first is good. Fire-retarding solutions with which shingles may be impregnated are water solutions of ammonium phosphate, ammonium sulphate, ammonium chloride, sodium phosphate, calcium chloride, sodium carbonate, sodium chloride, borax, zinc chloride, and zinc sulphate; of these the best are sodium chloride (common salt) or sodium silicate.

Gardner, Henry A., Changes occurring in oils and paste paints due to autohydrolysis of the glycerides: Paint Mfrs. Assoc. U. S. Bull. 43, 1914; Franklin Inst. Jour., vol. 177, pp. 533–540, 1914.

Enzyms, existing in oil-producing seeds, may possibly continue to act in oil expressed from those seeds and hydrolyze other oils. Some linseed oil pressed from infected flaxseed will retain wilt spores which evolve enzyms that have fat-splitting properties. Use of much oil with basic pigments not good, as free, fatty acids form metallic soaps that are insoluble in paint and cause trouble in brushing out film. The mold-forming bacilli can be destroyed by rapidly heating oil to 100° C. and immediately withdrawing heat. Suggests that the smell of fish oils could be in large part destroyed by heating. Concludes that all oils should be heated to 100° C. to make them sterile, and should be well filtered to remove foots.

——— Zinc, lithopone, and lead: Drugs, Oils, and Paints, vol. 29, pp. 291–295, January, 1914.

Gives a brief consideration of these pigments from the standpoint of durability, economy, and hygienic properties. Concrete treated with zinc sulphate solution made with 3 pounds to a gallon of water can be painted with ordinary paints. Considers lithopone and zinc white best.

——— The composition of paint vapors: Jour. Ind. and Eng. Chemistry, vol. 6, pp. 91–93, 1914.

Peculiar odor of freshly painted surfaces, called by painters "leady smell," sometimes causes illness. This vapor does not contain lead, but apparently contains some carbon monoxide, the quantity of gas evolved being directly influenced by the type of pigment used. Drying oil films give off carbon dioxide, organic substances, and small quantities of carbon monoxide. Lead and zinc paints do not evolve metallic compounds. Drying paints, particularly basic pigments, evolve formic acid and fatty acids as well as carbon dioxide and monoxide.

——— Observations on painted lumber: Paint Mfrs. Assoc. U. S. Bull. 48. Address before the Thirty-first Annual Convention of the International Association of Painters and Decorators of the United States and Canada, Washington, D. C., February 10, 1915.

Says that well-seasoned lumber is requisite for successful painting, and cites some examples of defects of paint on unseasoned lumber. Recommends use of benzol and turpentine as thinners for priming coat of cypress. Discusses mildew of paint films; says he has found mildew only on paints which present soft chalky surfaces, and recommends the addition of certain mercury salts to paints, or use of solutions of certain poisonous salts painted on wood before priming to inhibit formation of mildew. Notes the effect of gases upon painted surfaces and thinks that lead paints are probably more susceptible to change than those containing zinc. Believes that the following four things should be of particular importance in conducting paint tests: (1) Pick lumber that is most often used in vicinity of test, then select only best pieces and have them of large size; (2) the paints to be used should be prepared on a commercial basis, but the formulas should be prepared from known pigments and oils; (3) the brush work should be done by an experienced painter; (4) the painting should be done outside.

——— and Heckel, G. B. Barytes as a paint pigment: Am. Inst. Min. Eng. Bull., pp. 2353–2357, September, 1914.

State that principal use of barium sulphate, both natural and artificially prepared (blanc fixe), is in the manufacture of mixed paints and lithopone, and as a base for the precipitation of adjective dyes. Conclude that there is no technical objection to the use of barytes in a paint, provided that the quantity used does not impair the opacity of the paint under the conditions of application and that it is not used as an adulterant.

Klein, C. A., The toxicity of paint vapors: Chem. World, vol. 3, pp. 252–255, 1914.

Does not think that Gardner's experiments prove that carbon monoxide is evolved from drying paints, but thinks that this gas was found by passing formic acid gas through sulphuric acid.

Kohn-Aberst Annual Chemical Analyst, The identification of direct zinc oxide: Drugs, Oils, and Paints, vol. 29, p. 374, 1914.

Direct process; roasting ore direct produces some basic lead sulphate. Indirect process consists of reducing ore to metallic zinc and then oxidizing. Gives tests to determine which method of manufacture was used.

LADD, E. V., Paint and paint materials: Paint, Oil, and Drug Rev., vol. 57, pp. 10–16, 1914; Drugs, Oils, and Paints, vol. 29, pp. 375–377, 1914.

Says that too much irrelevant and controversial matter has been printed with regard to paints in the past and that progress can not be made by statements of generalities based upon incomplete experiments. Thinks that much improvement is shown in the composition and wearing qualities of paints sold in North Dakota since the passage of paint law in 1905. Believes that tests of commercial paints are only good for comparison of those paints. Outlines the more recent tests using various pigments alone and in definite mixtures with other pigments and vehicles as being the rational way to find out the real worth of a certain pigment. Says that in North Dakota ocher has not proved successful as a priming coat, but that white lead or the mixed paints give better service. Colored paints outwear white paints. Discusses experiments with varnishes, paint, and varnish oils, lumbang oil, grape-seed oil, tomato-seed oil, and soy-bean oil, but says experiments are not far enough advanced to warrant a statement of results. Thoroughly believes in paint legislation, particularly such as to require the printing of formula on containers.

MUCKENFUSS, A. M., Report on a permeability test for paints and varnishes: Am. Soc. Testing Materials Proc., vol. 14, pt. 1, pp. 359–425; discussion, pp. 426–453, 1914.

Describes method of testing the actual permeability of a paint film. The experiments showed that permeability of a paint film is a property sensitive to all conditions and is much greater outward than inward. The characteristics of a coating are continually changing during exposure. The changes are dependent on one another, a measure of one indicating the alteration of the other characteristic.

Discussion by D. A. Koha brings out fact that other properties of paint besides its permeability must be considered.

Discussion by G. W. Thompson brings out danger of drawing conclusion concerning paints from tests on any one characteristic. Thinks permeability through pores is as important as permeability through film.

Discussion by Peter Freeman suggests that change in permeability may be dependent on chemical change in film.

NEMZEK, L. P., Painting concrete: Drugs, Oils, and Paints, vol. 30, pp. 54–55, 92, 1914.

Natural earth pigments best to incorporate in cements. MacNichol zinc sulphate treatment gives excellent results in preparing concrete surface for paints.

——— The relation of the technologist and the master painter: Paint, Oil, and Drug Rev., vol. 59, pp. 24–25, 1915. Paper read before Twenty-seventh Annual Convention of Pennsylvania Master Painters, January, 1915.

Painting is done, first, for protection of material and, second, for decoration. Estimates that in 1914 more than $100,000,000 worth of paint and more than $20,000,000 worth of varnish were used in the United States. Points out the necessity of the master painters, paint technologists, and paint manufacturers working in the closest relation to produce the best and most economical paints.

PATTERSON, F. C., Safety and sanitation in the manufacture of paints: Drugs, Oils, and Paints, vol. 29, pp. 295–296, 1914.

Gives outline for "safety first" signs and warnings.

PAINT, OIL, AND DRUG REVIEW, solves white lead drying problem, vol. 57, pp. 10–12, 1914.

Describes invention of W. R. Macklind, managing engineer Sherwin-Williams Co., Cleveland, Ohio. Invention installed at Ozark Smelting & Mining Co., Coffeyville, Kans., and in operation for 60 days. Continuous in operation, dustless, and of high efficiency. Will dry sludge successfully and without dust; capacity, 2,000 pounds of dried material per hour; initial moisture, 50 per cent to 55 per cent water.

SABIN, A. H., Painting structural steel with red lead: Drugs, Oils, and Paints, vol. 29, pp. 333–336, 1914.

Shows falsity of classifying paints as inhibitive or stimulative from experiments so far done. Inhibitors can only prevent air and moisture from reaching iron, so must be nonporous and durable. Believes that red lead is a good paint for iron if it does not contain much litharge, as it works well, covers good surface, will keep in oil for a long time, and dries slowly. Havre de Grace bridge tests show 9 good paints; 3 are red lead, and 1 red lead and clay.

Dr. Toch replies, taking exception to red lead, which he says is not as good as Prince's metallic or sublimed blue lead.

Gardner replies, saying that inhibitive paints are basic or chromate type.

Schaeffer, J. A., The lead contents of sublimed white lead: Jour. Ind. and Eng. Chemistry, vol. 6, pp. 200–202, 1914; Paint, Oil, and Drug Rev., vol. 57, pp. 17–18, April 29, 1914.

Describes special method of analyzing sublimed white lead. The average composition of Picher Lead Co.'s "sublimed white lead" as shown by 270 analyses of their product during a period of five months is: Lead sulphate, 76.68 per cent; lead oxide, 17.23 per cent; zinc oxide, 5.79 per cent—a total of 99.70 per cent; the remaining 0.3 per cent is moisture, gas, and ash.

Seligman, Franz, Rust, its cause and prevention: Paint, Oil, and Drug Rev., vol. 58, pp. 24–25, 1914.

Says paint for steel must be hard enough to stand rough usage and elastic enough to follow expansion and contraction of metal and always to form a waterproof coat. Says that dust, grease, mill scale, and rust must be removed before painting to insure best results. Pure red lead is best first coater. Graphite, asphalt base paints, and monoxide paints all give fair results.

Sinkerson, J. D., Red lead paste: Paper read before Wisconsin University. House Painters and Decorators' Assoc., Milwaukee, Wis., July, 1914; Paint, Oil, and Drug Rev., vol. 58, pp. 6–7, 1914.

The finely ground highly oxidized pigment, which is nearly pure red lead and does not contain any unaltered litharge, makes a good paint wherever a hard elastic film is needed. Recommends red lead for priming coat on cypress.

Smith, J. C., The drying of paints: Paper read before the convention of master painters and decorators at Chester, England: Paint, Oil, and Drug Rev., vol. 58, pp. 10–12–13, 1914.

Satisfactory drying preparation should (1) allow paint to set in 12 hours; (2) oil should not take up oxygen so fast as to make it decay; (3) oil should dry, not harden; (4) the quantity of drier should not have to be too exact; (5) color effect of drier on oil and paint should be known; (6) certain driers are to be used with certain pigments and the proper ones to use should be known; (7) a well-aged linseed oil should be used. Chalking is due to loss of elasticity from too quick drying, particularly true of zinc oxide. Lampblack and ocher retard drying; many lake colors are decomposed by driers, which may possibly be explanation of darkening of lithopone.

Thompson, G. W., Painting defects: Their causes and prevention: Drugs, Oils, and Paints, vol. 30, pp. 253–258, 1914.

Defects in a paint may be due either to the material of which the paint is made or to the manner of its application. Believes that most of the tests conducted by painted panels have not been conclusive, but thinks that actual service tests in conjunction with test panels have value, as the North Dakota tests and the Havre de Grace bridge tests have shown. Believes that checking and alligatoring can be avoided by allowing under coats to dry hard and by using a paint which will make a harder film than top coat. Remarks that the addition of 5 per cent acetate of lead seems to decrease tendency to check or alligator. Points out the fact that too hard a paint film may not have enough elasticity to follow contraction and expansion of surface upon which it rests, and so may scale off. Believes that no asphaltum, tar, bituminous materials, mineral oils not completely volatile, or rosin oil should be used for under-coat work; lampblack or yellow ocher are not good, but pigments which assist drying of linseed oil should be used. Thinks that as little drying oil as possible should be used for priming coat. Cracking may be in part due to shrinkage of wood and in part to contraction of paint film due to chemical action between pigment and vehicle in drying, or to combination of both. A paint film once cracked through to the wood allows moisture to get below film and so force it off, producing what is called scaling. One method to avoid scaling is to make the paint film as thin as possible and to have wood thoroughly dry and contracted before painting. Cause of scaling from galvanized iron unknown, but in part due to inability to get a proper bond between film and surface painted. Blistering and peeling due to water in the wood painted, particularly where a paint forming an impermeable paint film has been used. Blistering of paint on iron and steel due to formation of gases under paint film. Chalking and loss of gloss are probably due to destruction of the binder under influence of moisture, air, sunlight, and possibly of a chemical reaction between vehicle and pigment. Believes that chalking is the least objectionable of any of the forms of decay, as it leaves surface in better shape for repainting.

Also discusses causes and prevention of washing and discoloration, such as spotting, yellowing, and defects due to dust, to mildew, and to sulphur compounds.

WALKER, P. H., and VOORHEES, S. S., Some tests of paint for steel subject to alternate exposure to air and fresh water: Jour. Ind. and Eng. Chemistry, vol. 5, pp. 899–905, 1914.

Give details of a series of tests of oil paints made with 14 pigments painted on plates of basic open-hearth steel. Plates exposed during a total period of 1 year for 17 hours in water and for 7 hours in air each day. Conclude that the best paints as indicated by these tests were red lead and basic lead chromate.

——— and THOMPSON, G. W., Report of committee C–1 on preservative coatings for structural materials: Am. Soc. Testing Materials Proc., vol. 14, pt. 2, pp. 221–293, 1914.

Inspection of Havre de Grace bridge and Atlantic City test fence to be discontinued. Give results of inspection of Havre de Grace bridge after eight years' exposure and results of inspection of 49 original steel plates at Atlantic City, of which 23 have been rejected. Proposed standard definitions of terms used in paint specifications.

Give methods of analyzing the following pigments—basic carbonate of lead, basic sulphate of lead, zinc lead and leaded zincs, red lead, zinc white, lithopone, calcium pigments, whiting, Paris white, Spanish white, chalk, gypsum, terra alba, plaster of Paris, quick lime, slacked or hydrated lime, barium pigments, silica pigments, china clay, and asbestine.

Give report of inspection of white paint test fence at Washington, D. C. Inspected by Voorhees, MacNichol, Gardner, Rodgers, P. H. Walker, Smitton, and Boughton. Checking and chalking a feature in all panels. Inspectors state that, as tests are incomplete, final conclusions can not be drawn, but that tests indicate that none of single pigment paints are equal to composite pigments, except zinc-lead white; that in binary paints those containing zinc oxide show less cracking and checking and are whiter and cleaner than those paints without zinc oxide; that the quarternary group of paints is in the best condition.

WARE, E. E., and SCHOTT, S. M., Paint films as protective coatings for concrete: Jour. Ind. and Eng. Chemistry, vol. 6, pp. 184–189, March, 1914.

Say that cause of failure of concrete is lack of constancy of volume in concrete after settling; that changes in volume due to changes in temperature are small as compared to changes in volume due to alternate wetting and drying; and that electrolytic effect on steel reinforcements causes corrosion. Both of these troubles can be eliminated by proper waterproofing. Waterproofing materials are membranes, integrals, surface washes, and oil paint films. Integrals or surface washes are not efficient and use of membranes such as asphalt is not feasible in majority of cases, so paint films must be used. Paint films impervious to water can be made, but they must be able to withstand saponification action of lime. Classify concrete paints as (1) compounds of materials inert to action of alkalies; (2) compounds with free organic acids; (3) compounds to give bond impenetrable surface; (4) compounds to give an elastic and only slightly permeable film. Say a successful concrete paint should be made on same basis as a good wood paint with the necessary adjustments to form a nearly impervious coat that is elastic.

WEST, A. P., Analysis and composition of red lead: Philadelphia Jour. Sci., vol. 8, pp. 429–437, 1914.

Gives complete details of chemical analysis of red lead and concludes that this pigment is a mixture of PbO, Pb_3O_4, and Pb_4O_5.

FLUORSPAR AND CRYOLITE.

By Ernest F. Burchard.

FLUORSPAR.

PRODUCTION.

The total quantity of domestic fluorspar reported to the Survey as marketed in 1914 was 95,116 short tons, valued at $570,041, as compared with 115,580 short tons, valued at $736,286, marketed in 1913, a decrease in quantity of 20,464 short tons and in value of $166,245. This decrease represents 17.7 per cent of the quantity and about 22.5 per cent of the value of the product marketed in 1913. The average price per ton for the whole country, considering all grades of fluorspar—gravel, lump, and ground—was approximately $5.99 in 1914, as compared with $6.37 in 1913, a decrease of 38 cents a ton, or about 5.97 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 many of the mines reporting from Kentucky are near a railroad, so that the cost of long wagon hauls has not entered to an important extent into the reported value of the fluorspar from those States.

The total quantity of domestic gravel spar marketed in 1914 was 79,276 short tons, valued at $412,905, as compared with 101,767 short tons, valued at $597,024, in 1913, a decrease in quantity of 22,491 tons and in value of $184,119. The average price per ton of domestic gravel spar was $5.21 in 1914, as compared with $5.87 in 1913, a decrease of 66 cents a ton. The sales of domestic lump spar in 1914 were 8,842 short tons, valued at $74,708, as compared with 5,676 short tons, valued at $39,059, in 1913, an increase in quantity of 3,166 tons and in value of $35,649. The average price per ton of lump spar was approximately $8.45 in 1914, as compared with $6.88 in 1913. The sales of domestic ground spar in 1914 were 6,998 short tons, valued at $82,428, as compared with 8,137 short tons, valued at $100,203, a decrease in quantity of 1,139 tons and in value of $17,775. The average price per ton of ground spar was $11.78 in 1914, as compared with $12.31 in 1913, a decrease of 53 cents a ton. According to these statistics the decrease in the total quantity and value of fluorspar marketed in 1914 was borne by the gravel and the ground spar, the lump spar having shown a considerable increase in both quantity and value as compared with 1913. The statistics show also that the decrease in quantity and value of gravel spar marketed was greater than the net decreases in quantity and value for all classes of spar.

Fluorspar was marketed from four States in 1914—Illinois, Kentucky, Colorado, and New Hampshire, in the order named—and a small quantity was mined, but not sold, in Arizona. In 1913 these five States, with New Mexico in addition, reported sales of fluorspar. A slight increase in output of fluorspar in 1914 was reported from New Hampshire; the output of all the other States decreased. Gravel spar was marketed by all the States; sales of lump and ground spar were reported from Illinois and Kentucky. The product of the mines in New Hampshire is classed as gravel spar, since it is sold for flux in steel making, but much of the spar shipped from that State would yield an excellent grade of lump spar if it were hand picked.

It is not permissible to give in detail the production of fluorspar from Illinois and Kentucky separately, because in publishing the statistics of production of the various minerals it is the custom of the Survey to conceal the output 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. Thus, while it is possible to give the total production of fluorspar in Illinois and Kentucky for 1913 and 1914, it is not possible to give it by grades.

The total stocks of fluorspar reported at the mines or at shipping points December 31, 1914, were 10,386 short tons, as compared with 15,443 short tons on hand at the close of 1913, according to revised reports. Owing to the fact that stock tonnages are for the most part only roughly estimated by producers the figures for stocks 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, generally check reasonably well 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 1913 and 1914:

Fluorspar marketed in 1913 and 1914, in short tons.

State.	Gravel.		Lump.		Ground.		Total quantity.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
1913.								
Illinois	91,663	$525,456	5,676	$39,059	8,137	$100,203	85,854	$550,815
Kentucky							19,622	113,903
Other States [a]	[b] 10,104	71,568	([b])	([b])			10,104	71,568
Total	101,767	597,024	5,676	39,059	8,137	100,203	115,580	736,286
1914.								
Illinois	77,048	397,913	8,842	74,708	6,998	82,428	73,811	426,063
Kentucky							19,077	128,986
Other States [a]	[b] 2,228	14,992	([b])	([b])			2,228	14,992
Total	79,276	412,905	8,842	74,708	6,998	82,428	95,116	570,041

[a] Includes, 1913: Arizona, Colorado, New Hampshire, and New Mexico; 1914: Colorado and New Hampshire.
[b] Some lump spar included with gravel.

The annual production of fluorspar from 1883 to 1914 is given in the following table. Beginning with the year 1906, the quantities reported represent marketed production.

Production of fluorspar in the United States, 1883–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1883	4,000	$20,000	1900	18,450	$94,500
1884	4,000	20,000	1901	19,586	113,803
1885	5,000	22,500	1902	48,018	271,832
1886	5,000	22,000	1903	42,523	213,617
1887	5,000	20,000	1904	36,452	234,755
1888	6,000	30,000	1905	57,385	362,488
1889	9,500	45,835	1906	40,796	244,025
1890	8,250	55,328	1907	49,486	287,342
1891	10,044	78,330	1908	38,785	225,998
1892	12,250	89,000	1909	50,742	291,747
1893	12,400	84,000	1910	69,427	430,196
1894	7,500	47,500	1911	87,048	611,447
1895	4,000	24,000	1912	116,545	769,163
1896	6,500	52,000	1913	115,580	736,286
1897	5,062	37,159	1914	95,116	570,041
1898	7,675	63,050			
1899	15,900	96,650	Total	1,014,020	6,262,592

Figure 4 shows graphically the course of the production of fluorspar in the United States from 1883 to 1914. Two periods of fluctuation in output—between 1889 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. The decline since 1912, although the greatest in actual tonnage, is not greater in proportion to the current production than that from 1905 to 1906. 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 1914 was 90,412 short tons, as compared with 124,130 short tons mined in 1913.

TRADE CONDITIONS.

The market for the bulk of the fluorspar sold in the United States depends on the steel industry, and when that industry becomes depressed the demand for fluorspar quickly diminishes. Gravel spar is consumed as a flux in basic open-hearth steel furnaces and to a smaller extent in other metallurgical operations. In 1913 the marketed production of gravel spar constituted about 88 per cent of the total marketed output of domestic fluorspar; in 1914 it constituted about 83.3 per cent. The reduction in quantity of gravel spar sold in 1914 as compared with 1913 was 22.1 per cent, which is of interest in view of the decrease in output of basic open-hearth steel.

The market for lump fluorspar for the manufacture of hydrofluoric acid is reported to be improving. This appears to be confirmed by the increase of nearly 55.8 per cent in quantity and of 91.3 per cent in value of sales in 1914, in connection with which the price per ton increased about 22.8 per cent.

In Illinois the output in 1914 came from 3 mines, all in Hardin County. In Kentucky 10 mines shipped spar—9 in Crittenden County and 1 in Livingston County; and 1 mine in New Hampshire and 5 in Colorado shipped fluorspar during the year. The mines in Arizona and New Mexico reported that there was not demand for their product sufficient to warrant any shipments being made during 1914.

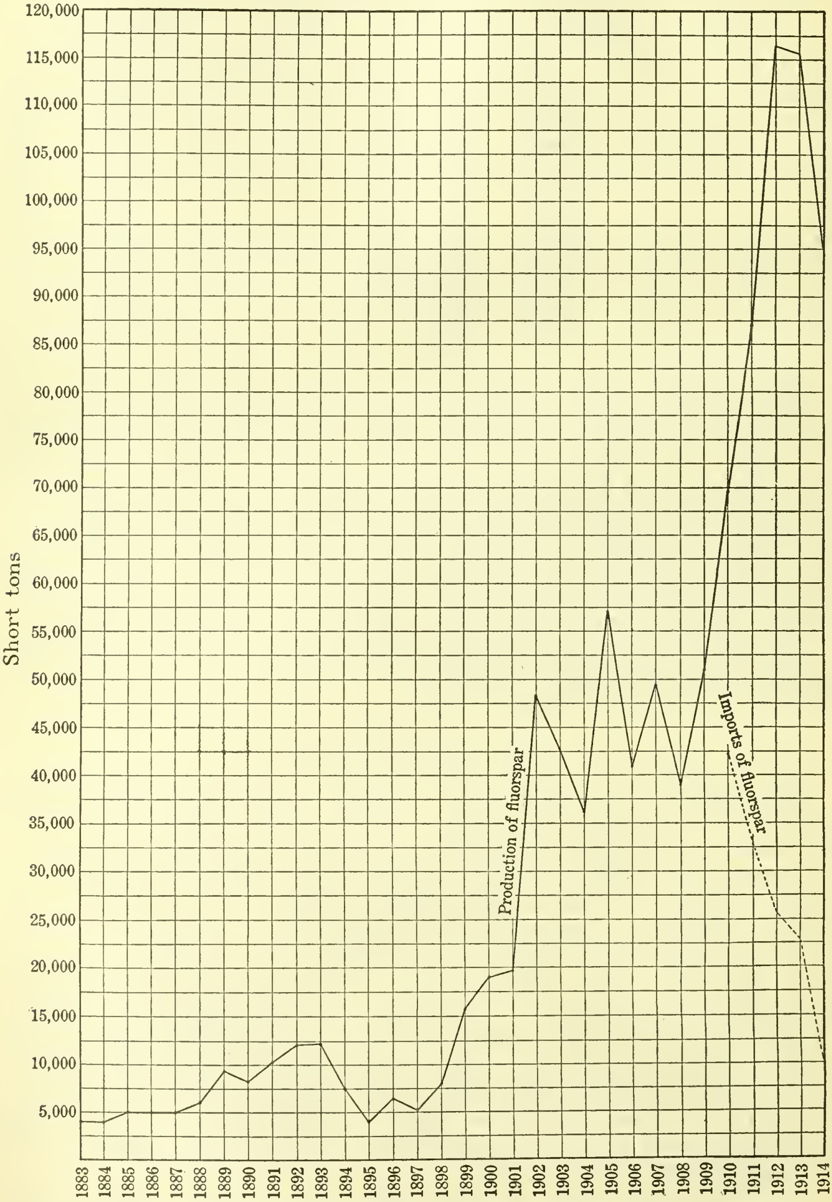

FIGURE 4.—Production of fluorspar in the United States 1883-1914, and imports 1910-1914.

The production of open-hearth steel, which has a most important bearing on the market for gravel spar, is shown for the years 1910 to 1914 in the following table:

Production of open-hearth steel in 1910–1914, in long tons.[a]

	Basic.	Acid.	Total.
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
1913	20,344,626	1,255,305	21,599,931
1914	16,271,129	903,555	17,174,684

[a] Statistics for 1910 and 1911 according to Ann. Repts. Am. Iron and Steel Association, and since 1911 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. A duty of $3 a ton on imported fluorspar continued in force from August, 1909, until October, 1913, when it was reduced under the present tariff to $1.50 a ton. 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 makers of open-hearth steel. According to American producers spar from England at present competes with American fluorspar as far west as Pittsburgh and practically fixes the market price at that point, while in the Lehigh and Susquehanna valleys of Pennsylvania and other localities near the Atlantic seaboard, English fluorspar can be purchased advantageously.

The imports of fluorspar entered for consumption into the United States in 1914 were 10,205 short tons, valued at $38,943, as compared with 22,682 short tons, valued at $71,463, in 1913. This represents a decrease in quantity of 12,477 short tons, or about 55 per cent, and in value of $32,520, or about 45.5 per cent. The value assigned to the imports in 1914 averaged $3.82 a ton, as compared with $3.15 a ton in 1913, an increase of 67 cents a ton, or about 21 per cent. The imports of fluorspar in 1914 amounted to about 12.9 per cent of the domestic production of gravel spar, as compared with about 22.3 per cent in 1913. The large falling off in the imports may, of course, be attributed in part to the interruptions to commerce caused by the war in Europe as well as to depression in the steel trade in the United States. The average reported price of imported spar at dock, exclusive of the duty, amounted to about 73.3 per cent of the average price of domestic gravel spar at mines or nearest shipping points in 1914. According to the prices reported, the average cost to the consumer, including the duty of $1.50 a ton, but excluding freight charges, was $5.32 a ton in 1914, as compared with $5.21 for domestic gravel spar at the mines or mills, and in the latter part of 1913 the cost of the imported material, including the duty of $1.50 a ton, was $4.65, as compared with $5.87 for domestic gravel spar. The freight charges on domestic spar to points where it is consumed are generally higher than on foreign spar from the docks to eastern steel plants, so that a slight advantage in price is still enjoyed by the imported spar at eastern steel plants. Foreign spar is, however, not of so high grade as the mechanically treated spar from Illinois and Kentucky, and since fluorspar is of value chiefly according to its purity, purchasers find that the purer American spar is more efficient and consequently cheaper in the end.

The following table (see also fig. 4) shows the imports of fluorspar into the United States since August 1, 1909:

Fluorspar imported, 1909–1914, in short tons.[a]

	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
1913	22,682	71,463	3.15
1914	10,205	38,943	3.82

a Statistics according to Bureau of Foreign and Domestic Commerce, Department of Commerce.

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 the manufacture of open-hearth steel 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, and the figures are not listed separately by the Bureau of Foreign and Domestic Commerce) 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 1914 was 105,321 short tons, as compared with 138,262 short tons in 1913, a decrease of more than 23.8 per cent.

The following table indicates the apparent consumption of fluorspar in the United States in the years 1910 to 1914:

Apparent consumption of fluorspar, 1910–1914, 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
1913	115,580	22,682	138,262
1914	95,116	10,205	105,321

GREAT BRITAIN.

The production of fluorspar in England has an important bearing on the industry in the United States, for practically all the competing spar is imported from that country. Since 1903 the output of Great Britain has exceeded 10,000 tons annually, and except in 1898, 1911, and 1912, there has been a steadily increasing annual production of spar up to 1913, the latest year for which statistics are available. According to the official report of output of mines and quarries issued by the Home Office at London, there were produced in 1912 a total of 47,246 long tons of fluorspar, valued at $84,010, or $1.78 a ton, as compared with 53,663 long tons, valued at $72,779, or $1.36 a ton, in 1913. In 1912, 23,862 tons were produced in Derbyshire, mostly from quarries and open workings (probably mine dumps), and 23,384 tons from mines and mine dumps in Durham. Of the 1913 output, 11,433 tons were produced from mines in Derbyshire, probably including large quantities produced from mine dumps, and 19,830 tons from quarries in the same county, while 22,400 tons were produced from mines and mine dumps in Durham. When the output of fluorspar in England in 1911 to 1913 is compared with the imports of fluorspar into the United States in those years and when the fact is recalled that the imports are derived almost wholly from England, it appears that more than 37 per cent of the production of England was shipped to the United States in 1913, as compared with about 49 per cent in 1912 and 52 per cent in 1911.

CRYOLITE.

IMPORTS AND PRICES.

No cryolite is produced in the United States, the entire supply used in this country being imported from Ivigtut, an Eskimo hamlet on the southern coast of Greenland.

The quantity of cryolite reported to have been imported for consumption in the United States in 1914 was 4,612 long tons, valued at $94,424, as compared with 2,559 long tons, valued at $52,557, in 1913. The average price per ton declared in 1914 was apparently $20.47, as compared with $20.54 in 1913. Cryolite is now imported free of duty.

SULPHUR, PYRITE, AND SULPHURIC ACID.

By W. C. Phalen.

SULPHUR.

PRODUCTION.

The marketed production of sulphur in the United States in 1914 was 327,634 long tons, valued at $5,954,236. Compared with the quantity of sulphur marketed in 1913, which was 311,590 long tons, valued at $5,479,849, this is an increase of 16,044 long tons in quantity and of $474,387 in value. As will be inferred, sulphur mined in 1914 but stocked at the mines is not included either in these figures or in those in the table of production below.

The production of sulphur in the United States since 1880 is given in the following table:[1]

Marketed production of sulphur in the United States, 1880–1914, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	536	$21,000	1892	2,400	$80,640	1904	127,292	$2,663,760
1881	536	21,000	1893	1,071	42,000	1905	181,677	3,706,560
1882	536	21,000	1894	446	20,000	1906	294,153	5,096,678
1883	893	27,000	1895	1,607	42,000	1907	293,106	5,142,850
1884	446	12,000	1896	4,696	87,200	1908	369,444	6,668,215
1885	638	17,875	1897	2,031	45,590	1909	239,312	4,432,066
1886	2,232	75,000	1898	1,071	32,960	1910	255,534	4,605,112
1887	2,679	100,000	1899	4,313	107,500	1911	265,664	4,787,049
1888	....	....	1900	3,147	88,100	1912	303,472	5,256,422
1889	402	7,850	1901	a 241,691	1,257,879	1913	311,590	5,479,849
1890	....	....	1902	a 207,874	947,089	1914	327,634	5,954,236
1891	1,071	39,600	1903	a 233,127	1,109,818			

a Includes the production of pyrite.

The marketed production of sulphur in the United States in 1914 came from Louisiana, Texas, Wyoming, and Nevada. The main production, of course, came from Louisiana, where the Union Sulphur Co. is operating. This is the second year that Texas has been a producer. A production of sulphur was also reported by the Northwest Sulphur Co., operating near Cody, Park County, Wyo. Sulphur was mined, but not sold, by the American Sulphur Co. operating near Thermopolis, Hot Springs County, Wyo. The Nevada Sulphur Co., operating at Sulphur, Humboldt County, Nev., reported a small quantity sold in 1914.

In the following pages are given descriptions of recent improvements and additions made at the plant of the Freeport Sulphur Co., Free-

[1] The tables of production of sulphur, pyrite, and sulphuric acid in this report have been prepared by Miss M. B. Clark, statistical clerk.

port, Brazoria County, Tex. In the foreign field recent information with reference to the sulphur industry in Sicily, Japan, and New Zealand is also given.

IMPORTS.

The table of imports given below shows that in 1914 there were imported for consumption 26,135 long tons of sulphur, valued at $477,937. In this figure are included imports of all classes of sulphur—crude, refined, flowers of sulphur, and grades not specifically described. In the second table following, the imports of crude sulphur alone are given by countries. This table shows that the crude sulphur imported came almost entirely from Japan. The imports from Sicily have become practically negligible, having amounted in 1914 to only 3 per cent of the imports of crude sulphur. The Japanese product enters chiefly at the Pacific coast ports named in the table.

Sulphur imported and entered for consumption in the United States for the calendar years 1910–1914, by kinds, in long tons.

Year.	Crude.		Flowers of sulphur.		Refined.		All other.[a]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1910	28,656	$496,073	1,024	$30,180	1,106	$25,869	47	$6,489	30,833	$558,611
1911	24,200	434,796	3,891	83,491	985	24,906	68	9,643	29,144	552,836
1912	26,885	494,778	1,311	39,126	1,665	40,933	66	9,137	29,927	583,974
1913	15,122	286,209	5,899	115,574	1,234	29,091	350	17,690	22,605	448,564
1914	23,610	398,984	621	17,214	1,800	47,568	104	14,171	26,135	477,937

[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, 1911–1914, in long tons.

Countries whence exported and customs districts through which imported.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRY.								
Canada	....	....	....	....	98	$2,372	....	....
United Kingdom	11	$248	....	....	101	2,905	123	$3,312
Italy	8,031	156,157	2,348	$46,003	125	3,046	747	19,691
Japan	16,185	279,991	24,505	447,946	14,317	269,730	21,913	385,498
Other countries	23	329	32	829	....	3	27	1,036
Total	24,250	436,725	26,885	494,778	14,641	278,056	22,810	409,537
CUSTOMS DISTRICT.								
Baltimore, Md	1,500	28,209	....	....	....	....	....	....
Boston and Charlestown, Mass	20	480	....	....	15	343	....	....
New York, N. Y	6,531	127,948	1,359	29,387	140	3,809	185	5,216
Los Angeles, Cal	700	11,330	850	13,757	1	42	1,320	26,493
San Francisco, Cal	9,664	85,928	15,984	280,010	5,110	86,146	12,460	218,842
Willamette and Portland, Oreg	4,661	19,274	7,646	149,612	6,802	128,709	7,164	124,907
Hawaii	1,100	161,720	1,000	20,916	523	8,923	1,182	22,669
All other	74	1,836	46	1,096	2,050	50,084	499	11,410
Total	24,250	436,725	26,885	494,778	14,641	278,056	22,810	409,537

EXPORTS.

In 1912, the United States exported 57,736 long tons of sulphur, valued at $1,076,414. In 1913, the exports of sulphur amounted to 89,221 long tons, valued at $1,599,761. In 1914, the exports were 98,153 long tons, valued at $1,807,334, and they would probably have been considerably greater but for the disturbed conditions in Europe. Even with such adverse conditions the excess of exports over imports amounted to 72,018 long tons, the balance of trade in favor of the United States being $1,329,397.

NOTES ON THE DOMESTIC SULPHUR INDUSTRY.

LOUISIANA.[1]

The principal producer of sulphur in the United States in 1914 was the Union Sulphur Co., whose properties are located at Sulphur, Calcasieu Parish, La. Some of the largest producing wells ever brought in were completed in 1914. Three wells were being pumped at the end of the year. The company increased its large stock of sulphur, notwithstanding that it operated at no time during the year more than half its well capacity.

TEXAS.

BRYAN HEIGHTS.

Mining.—Since the publication of notes on the sulphur industry in Texas in this report for 1913 the development of the sulphur field at Bryan Heights, near Freeport, at the mouth of Brazos River, Brazoria County, Tex., has been very active, and the operations of the Freeport Sulphur Co. have been materially perfected and extended.

The process of mining sulphur near Freeport has been so fully described in these reports as to require only brief mention here. The sulphur occurs in pockets and cavities and as streaks impregnating gypsum or a formation in which gypsum predominates. Cores from the deep drillings show varying percentages of sulphur. The sulphur is produced directly from the bed containing it, which is approximately 1,000 feet below the surface. The treatment consists simply in melting the sulphur in place, thus rendering it possible to raise it to the surface by means of an air lift. Superheated water at a temperature of 336° F. and under high pressure is forced into the sulphur-bearing formation. The water penetrates the deposit and melts the sulphur (whose melting point is 239° F.), which then flows to a pipe whence it issues at the surface and flows into bins. These bins are constructed of boards, which are raised as the mass increases, the final height of the bin being from 30 to 35 feet. The sulphur promptly congeals on exposure. As it issues from the pipe the molten sulphur has a peculiar and characteristic appearance, but, as the temperature decreases, it passes through variations of color until after a few hours it assumes the true sulphur yellow.

New plant.—The new plant is fireproof; it has concrete floors, water conduits, and a steel superstructure. As the entire energy

[1] Eng. and Min. Jour., Jan. 9, 1915.

of the plants is devoted to making steam for the purpose of heating water, the boiler capacity is necessarily large.

The steam produced in the boilers is used chiefly in four mine water heaters of special design and construction. Each of these heaters is capable of heating 1,000 gallons of water a minute from 60° F. to 336° F. under a pressure of 100 pounds.

Among other important additions to the plant made since the writing of the report for 1913 are the following:

1. A new fuel-oil pumping station at the oil docks on Brazos River, embracing 3 pumps of large capacity, 3 boilers, and the connections to 2 fuel-oil storage tanks of 55,000 barrels capacity each, both of which have been equipped with inclosed tubular heaters for raising the temperature of the oil when necessary. The oil consumption is now nearly 2,000 barrels daily. At present the oil used is light Mexican crude from 17° to 21° (Baumé) specific gravity, but a delivery of heavy Mexican crude oil has recently been made by the Freeport-Mexican Fuel Oil Co. for the purpose of test, the gravity of the oil being about 12° (Baumé).

2. An 8-inch pipe line approximately 4½ miles long leading from the oil pump station to the mines, in addition to the 4-inch line previously installed.

3. Three additional fuel-oil storage tanks at the mines.

4. Construction of a canal leading from Brazos River to the mines, a distance of about 3½ miles. This canal has been dredged to a minimum depth of 9 feet with a top width of 30 feet. At the terminus of the canal electrically driven centrifugal pumps take water from the canal and discharge it into a storage reservoir of 30,000,000 gallons capacity, from which ample flumes conduct the water to the pumps in the plants. The large motor-driven pumps discharge water into the reservoir at the rate of 9,000,000 gallons a day. As the daily consumption is about one-third that quantity, the operation of the pumps need not exceed 10 hours a day; thus provision is made for future increased demand. This canal practically brings Brazos River to the plant and supplies all the mine water that will be required. As the river water is not always desirable, however, for use in boilers, wells have been sunk in the coastal plain surrounding Bryan Heights to reenforce the supply of boiler water.

5. For the purpose of treating water for both boiler use and mine use a lime treating plant has been erected and put into operation. Two large steel tanks are provided, each of sufficient capacity to contain a day's supply of reagents in solution—the quantity and character being determined by daily tests of the water. These tanks are used alternately, their contents passing into a dilution tank where water is added to make it easily possible to pipe the solution to the entry points of the water. All tanks are equipped with agitators, which, as well as the pumps for delivery of this solution, are motor driven. In connection with this treating plant are warehouses for storage of lime, etc. If necessary to treat river water for boiler use, soda ash is used.

An interesting experiment is now in process in the hope of effecting a large economy in the heating of mine water. It has been proved that the normal temperature of the ground water in the geologic formation is 105° F. at all seasons of the year. As the water is now delivered to the plant for heating, its temperature varies with the season from 40° to 90° F. To raise this water to a temperature of 336° F. from 40° F. obviously consumes much more fuel than to raise it from 105° F. The ground water, however, contains scale-forming substances, and special equipment has been designed to prevent the precipitation of this scale within the heaters or piping.

6. The area covered by producing wells was somewhat increased during the year, but with the present plan of placing wells at corners of 100 feet squares only a small portion of the area known to be underlain by sulphur is supplying present requirements. The radius of heat influence undoubtedly varies greatly, according to variations in the character of the geologic formation, and the melt of one well is often communicated to its neighbor. Several wells are kept ready for steaming, so that whenever a well is exhausted interruption to production will be as short as possible. As wells fail contiguous wells are brought in in order to get the full benefit of communicated heat. At present two wells are steamed at once, with the expectation of soon steaming three at the same time.

Area underlain by sulphur.—An area embracing many acres, chiefly under the mound known as Bryan Heights, has been demonstrated to contain sulphur, and arrangements are now complete to prospect this large area thoroughly, in order to locate the richest spots. The present output is most satisfactory, but there may be territory of greater richness than that now under development. This can only be determined by systematic exploration.

Railroad facilities.—The railroad serving the sulphur mines, with switch tracks to various points, has been completed. It is an extension of the Houston & Brazos Valley Railway, operated by the Missouri, Kansas & Texas Railway. At present a railroad ferry carries trains across Brazos River, but a combination railroad and wagon bridge is under construction and will soon be completed, thus greatly improving railroad service to Freeport and the sulphur mines.

FOREIGN SULPHUR DEPOSITS.

SICILY.

In writing of the commercial development of eastern Sicily, Consul Alexander W. Weddell, of Catania, refers to the sulphur industry of Sicily as follows: [1]

The year 1913 was a fair one in the sulphur industry. There was a growing uneasiness, however, because of the anticipated progressive competition of American producers. This competition has been felt especially in the French market. The total exportations for 1913 were some 30,000 metric tons below those of 1912. Business, however, was reasonably active, with a declining tendency in the closing months of the year. At the beginning of 1913 stocks on hand amounted to 450,917 metric tons, and on December 31 [they] amounted to 378,365 metric tons. The decrease in stocks is explained by the shutting down of several mines on account of financial difficulties, while in others the presence of fires made production impossible. The average price of crude sulphur per metric ton as sold by the Consorzio Obbligatorio (the semi-Government monopoly for the protection of the producers), f. o. b. the nearest station to the mine, was $18.91.

The total exports of crude and manufactured sulphur from the island of Sicily for 1913 were 413,727 metric tons, compared with 447,590 metric tons for 1912. The ship-

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[1] U. S. Daily Cons. and Trade Repts., July 16, 1914, pp. 294–295.

ments of Sicilian sulphur and the countries of destination during the last two years were as follows:

Shipments of Sicilian sulphur, 1912–13, by countries, in metric tons.

Destination.	From Catania.		From other ports.		Total.	
	1912	1913	1912	1913	1912	1913
United States and Canada	2,591	1,383	303	....	2,894	1,383
Sicily	2,385	2,529	5,466	5,975	7,851	8,504
Continental Italy	38,209	32,368	39,187	40,603	77,396	72,971
Austria-Hungary	10,045	7,455	28,314	28,899	38,359	36,354
Belgium	1,974	2,053	8,748	11,268	10,722	13,321
Denmark	174	305	90	....	264	305
France	191	114	103,918	74,072	104,109	74,186
Germany	15,126	13,422	17,160	18,546	32,286	31,968
Greece	11,878	13,505	2,861	1,101	14,739	14,606
England and Malta	11,204	8,992	8,629	7,044	19,833	16,036
Netherlands	8,299	7,857	5,723	1,118	14,022	8,975
Portugal	10,385	5,238	3,802	9,519	14,187	14,757
Russia	3,954	4,156	21,608	21,736	25,562	25,892
Spain	4,052	4,027	3,075	2,657	7,127	6,684
Norway and Sweden	4,069	6,700	30,781	21,104	34,850	27,804
Turkey in Europe	697	1,904	....	7	697	1,911
South America and Central America	5,921	4,313	4,404	3,027	10,325	7,340
Egypt	842	615	....	....	842	615
Algeria and Tunis	2,792	2,134	1,694	1,108	4,486	3,242
Turkey in Asia	....	3,590	....	6	....	3,596
India	4,587	5,736	....	....	4,587	5,736
Australia	982	2,068	10,303	11,373	11,285	13,441
South Africa	969	1,243	1,902	12,498	2,871	13,741
All other countries	6,703	7,056	1,593	3,303	8,296	10,359
Total	148,029	138,763	299,561	274,964	447,590	413,727

With regard to the sulphur outlook, a member of the board of directors of the Consorzio Obbligatorio is quoted as follows:

"The Union Sulphur Co., of New York, has commenced to turn its activities into other fields. In 1912 it acquired new warehouses at Harburg, near Hamburg, and has secured from the city of Rotterdam, Netherlands, a concession for 25 years of a piece of land situated at the port and embracing an area of 12,800 square meters, on which it is about to construct a large storehouse and a mill for the milling and refining of sulphur. It is said that this company proposes to make Rotterdam the center of its commercial operations in Europe, and in connection with this it is stated that two large steamers will be bought that will augment the fleet possessed by our competitors."

In the opinion of a prominent refiner and exporter all sulphur mills in the district are now working far below their capacity and on a margin of profit which is extremely narrow.

The following were the high and low prices per metric ton f. o. b. Catania for several grades of manufactured sulphur during 1913: Sublimed extra, $26.50 to $28; double refined, $23.50 to $23.90; sifted, $27 to $28; and in sticks, $21.80 to $22.20.

JAPAN.

The discovery of sulphur on some of the islands of the Bonin group was reported toward the close of 1913. The production of sulphur in Japan shows a constant increase, the figures for 1912 and 1913 being as follows: 1912, 121,231,044 pounds, valued at $683,667; 1913, 130,933,333 pounds, valued at $771,900. The following table shows the exports of sulphur, by principal countries of destination, in 1912 and 1913:[1]

[1] Daily Cons. and Trade Repts., Aug. 15, 1914, pp. 905–906.

Exports of sulphur from Japan, 1912–13, by countries, in pounds.

Country.	1912		1913	
	Quantity.	Value.	Quantity.	Value.
Australia	29,315,551	$214,601	54,211,782	$426,244
United States	53,266,003	425,915	50,480,048	421,870
British America	15,657,012	131,100	5,037,212	40,557
China	1,821,715	15,611	2,125,447	19,534
All other countries	9,086,203	81,920	8,714,511	78,251
Total	109,146,484	869,147	120,569,000	986,456

At the outbreak of the war in Europe the sulphur market in Japan appeared to be unaffected, but as time went on dealers in sulphur became embarrassed indirectly. The war advanced the price of wheat, as a result of which wheat can not be shipped profitably any longer to the Japanese market. Hence there is less hold space available on the return journey, and American orders for sulphur have had to be refused through inability to ship. The home demand is also less than usual, and it is estimated that there are now over 10,000 tons of sulphur congesting the market. Holders of stocks in Hakodate have begun to sell for whatever they can get, and Osaka merchants are ready to sell the best Hokkaido sulphur at 30 yen ($14.94) a ton for cash payment. Unless there is an improvement the sulphur mines in remote parts, or with small capital, will have to close down. Bar sulphur is in good demand for special purposes, and its price is maintained.[1]

The output of sulphur produced in Hokkaido has shown a tendency to increase since January, 1914, the output of the principal mines there amounting to 10,413,729 pounds during the month of October. The total production for the first 10 months of 1914 amounted to 85,148,235 pounds, an increase of about 27,000,000 pounds over the output for the similar period of 1913.[2]

NEW ZEALAND.[3]

In this chapter in Mineral Resources for 1913 a description was given of the sulphur deposits on White Island, New Zealand. White Island has an area of approximately 600 acres and is located in the Bay of Plenty, on the coast of the North Island of New Zealand and about 30 miles from the mainland. A large and most remarkable deposit of sulphur is situated on this volcanic mountain.

The first effort to utilize the sulphur in a commercial way was made in 1886, but, owing to the isolation of the deposit, the exploiters found it impossible to keep a working force there. This fact and the lack of transportation facilities caused the industry to be abandoned, but in 1912 interest in it was revived. The New Zealand Sulphur Co. was organized for the purpose of acquiring and operating the deposit. Since then a well-equipped permanent camp has been established, retorts for the refining of the sulphur erected, and other facilities installed for handling the product. The output of the plant is

[1] Daily Cons. and Trade Repts., Jan. 18, 1915, p. 244.
[2] Daily Cons. and Trade Repts., Feb. 18, 1915.
[3] Hornaday, W. D., White Island sulphur deposit: Min. and Sci. Press, Dec. 12, 1914, p. 913.

now about 1,000 long tons a month, and it is to be greatly increased. Excellent arrangements are in effect for the transportation of the product to the different ports of New Zealand, Australia, the Straits Settlements, and islands in the Pacific Ocean. It takes about 30,000 tons of sulphur annually to supply the Australian market, and it is planned that all of this shall come from the deposit on White Island. The annual consumption of sulphur in New Zealand is about 3,000 tons and is increasing.

The boiling lake upon White Island is one of the awe-inspiring sights of New Zealand. It is surrounded by precipitous cliffs which give the lake the appearance of being the crater of an active volcano, as it doubtless is. After the company had spent $100,000 in preparation for mining, a volcanic disturbance wrecked the camp and killed 10 men.

DESULPHURIZING PROCESSES.

HALL PROCESS.[1]

The Hall process aims to eliminate sulphur from sulphide ores or matte without allowing any sulphur dioxide (SO_2) to escape, and to recover the sulphur thus eliminated.

According to H. F. Wierum, the following reactions are thought to take place: On the assumption that one atom of sulphur is distilled by heating FeS_2, a sulphide of iron is left, which corresponds roughly to FeS. This reacts with water thus: $6FeS + 6H_2O = 6FeO + 6H_2S$. The ferrous oxide combines with more oxygen formed from decomposing water and the next reaction of the cycle may be $6FeO + 3O = 3Fe_2O_3$. The last reaction is thought to be $3Fe_2O_3 + 6H_2S + 5O = 2Fe_3O_4 + 6H_2O + 6S$.

In discussing these reactions Wierum concludes:

> It seems fruitless, however, to discuss whether or not any such cycle of reactions actually occurs. I simply wish to emphasize one fact, that in the little furnace * * * FeS_2 carrying some 48 per cent of sulphur was freed from its sulphur down to about 5 per cent by a treatment with producer gas at a temperature of about 800° C., introduced with insufficient air to burn completely this producer gas, and with some steam present, at the same time maintaining such a strong back pressure that no suction whatever existed in the furnace and no outside air could possibly have been drawn in.

In subsequent tests furnaces of larger size were used than those in which the preliminary tests were made. In the later tests a record was kept of how long the ore was under treatment and also of how much sulphur dioxide was contained in the fumes. Chemically pure sulphide of iron corresponding to the symbol FeS was also tested and the results were identical with those in which pyrite was used. Some of the results obtained were as follows:

> Oil consumption, 16 to 17 gallons per ton of ore; 10-mesh calcine, 5.3 per cent of sulphur (although for two or three days the calcine ran between 2.8 and 3.6 per cent sulphur); and SO_2 frequently as low as 0.06 per cent. It is necessary to bear in mind the fact that these tests were all made in an existing furnace with all the mechanical arrangements, such as the speed, angle of the rabble blades, depth of the bed of ore carried, and the length of time in the furnace, adjusted for regular conventional pyrite

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[1] Wierum, H. F., Experimental development of the Hall process: Min. and Sci. Press, Oct. 3, 1914, pp. 518–521.

roasting operations, and it is not surprising that some of these conditions demanded alteration in order to obtain the best results from quite a different operation. Such alterations were beyond the bounds of possibility in the short time available, and metallurgical common sense must therefore come to the rescue in predetermining roughly what effect certain changes will have. I wish to avoid too many statements of my own private opinion, but will give for what it is worth the conclusion that my study of the matter has brought about in my own mind as to the possibilities. I think that with 10-mesh ore and arrangements for more frequent rabbling, and suitable means for keeping the ore in certain portions of the furnace for a greater length of time than the present conventional practice provides, the following results can without difficulty be maintained as a regular thing: In an 18-foot McDougall furnace I believe it possible to treat 40 tons of 10-mesh ore daily with a consumption of 500 gallons of oil, roasting it down to 5 per cent sulphur, and controlling the escaping fumes so that they will never exceed 0.3 per cent SO_2, and would probably average 0.15 per cent or less. I trust that no one will get the idea that this last set of results which I have given have actually been accomplished; they are simply my opinion, based upon the experience that I have had, of what can be attained in time.

As to the chemical reactions:

In the upper portion of the furnace, about one-half of the sulphur is distilled by mere heat. The lowest portion of the furnace, say one-third of the hearth area, is devoted to the oxidation of the iron, copper, and remaining sulphur by a free admission of air. In the middle third of the furnace portion, a strongly reducing atmosphere and rather high temperature, say 1,500° F., are maintained. It is in this central portion of the furnace [that] the SO_2 formed below is broken up and reduced to elementary sulphur. It is an undeniable fact that some H_2S is formed in the upper regions, and it is equally undeniable that H_2S will react upon SO_2 under certain conditions, forming water and sulphur; but I have not been able to prove that the H_2S+SO_2 reaction is the controlling feature in the reduction of SO_2. When a too strong reducing atmosphere is permitted in the presence of liberated elementary sulphur and steam, certain undetermined organic sulphides are formed, which seriously interfere with the production of sulphur. There seem to be two ways of avoiding this interference. First, the avoiding of too great an excess of fuel. Second, a quick drop in the temperatur-at the pont where these conditions of excess oil vapors and free sulphur exist. Nature ally, the former is the more economical way out, but both have been proved feasible.

The report describes the difficulties encountered in washing the gases free from sulphur, but a method is given which has proved satisfactory for similar work in Transylvania, Hungary, and which will no doubt prove efficient in connection with the Hall process. According to this method the elementary sulphur is washed out of the gases in simple and inexpensive wooden towers containing many baffle boards over which a saturated solution of calcium chloride is kept flowing. The consumption of calcium chloride is almost negligible. The emulsion which comes from the base of the towers is led into a series of tanks where the sulphur settles out without filtering. The clear solution of calcium chloride is again pumped to the top of the towers. The sulphur which has settled out is then heated in closed drums under light steam pressure and the molten sulphur is drawn off at the bottom. It was planned to experiment with this method of washing in Europe, but the plans have not yet been carried out.

S. W. YOUNG PROCESS.

Stewart W. Young, of Palo Alto, Cal., has patented certain improvements in his fume-destroying process, which are described in the text of U. S. patent No. 1094767, dated April 28, 1914.

Young's process depends on the fact that when gases or fumes containing sulphur dioxide are passed over any form of carbon, such as charcoal, coal, or coke, or are mixed with the vapor of petroleum, asphalt, natural gas, bitumen, or other hydrocarbon mixtures at high temperature, there takes place a series of reactions whereby the sulphur dioxide is reduced to sulphur.

He finds that the reduction of the sulphur dioxide is accelerated by the presence of lime, limestone, or any other sufficiently basic material. If we assume that lime is the particular basic substance used, its action in accelerating the reaction is explained as follows:

A portion of the sulphur dioxide coming in contact with the lime is absorbed by it, producing calcium sulphite. The carbon or the hydrocarbon vapors then react with this calcium sulphite and convert it into calcium sulphide. A second portion of the sulphur dioxide, coming into contact with this calcium sulphide, reconverts it into calcium sulphite, while at the same time a quantity of sulphur is generated in the free state. Thus the basic material used acts as a "carrier" for the reaction, and so long as the proper proportions of sulphur dioxide and carbon or hydrocarbon are maintained it does not lose its activity. It is also a matter of indifference whether in starting operations lime, lime rock, calcium sulphide, calcium sulphite, or calcium sulphate is used, since when the system has settled down the action will be a cyclical one of alternating conversion of sulphite to sulphide and vice versa. The process thus becomes a continuous one, the two reactions going on continuously and concurrently.

By "basic material" is meant any suitable substance which will neutralize the acid properties of sulphur dioxide by the formation of a sulphite, and the formation of this compound may either be temporary or permanent. The activity of the basic material used may also be increased by the addition to it of small quantities of oxides or salts of iron, copper, manganese, and many other metals, which act as so-called "catalytic" accelerators. The action of these catalytic substances increases the rapidity of reaction and prevents the formation of organic sulphur compounds which have an offensive odor. A temperature of 700° C. is a suitable one for the reaction, but this temperature may be varied within fairly wide limits without affecting the results unfavorably.

The text of the patent is illustrated by diagrams, and the methods described—in which a solid carbon fuel is used in the one case and a gaseous carbonaceous fuel in the other—are considered to be equivalent.

PYRITE.

PRODUCTION.

The marketed production of pyrite in the United States in 1914 amounted to 336,662 long tons, valued at $1,283,346, compared with 341,338 long tons, valued at $1,286,084, in 1913—a reduction of 4,676 long tons, or 1.4 per cent, in quantity and of $2,738, or one-fifth of 1 per cent, in value. Though the production of domestic pyrite has fallen off during the last two years as compared with the output of 1912, it can not be said that the decline is of great significance. The second table below gives the production of pyrite for the last 33 years and shows that the production of 1912 was the highest recorded during that time. But the average annual production for the five-year period beginning with 1910 was 314,400 tons, and the production of 1914 was 22,262 tons in excess of that quantity.

In the following table is given the production of pyrite by States during the last three years:

Marketed production of pyrite in the United States, 1912–1914, by States, in long tons.

State.	1912			1913			1914		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
California	61,812	$201,453	$3.26	70,536	$218,525	$3.10	71,272	$235,129	$3.30
Georgia	(a)	(a)	(a)	11,110	55,094	4.96	(a)	(a)	(a)
Illinois	27,008	62,980	2.33	11,246	31,966	2.84	22,538	59,079	2.62
Indiana	1,462	5,684	3.89	1,242	3,115	2.51	1,710	5,281	3.09
Ohio	14,487	43,853	3.03	13,622	34,998	2.57	7,279	19,718	2.71
Virginia	162,478	621,219	3.82	148,259	587,041	3.96	141,276	556,091	3.94
Wisconsin	17,898	70,518	3.94	25,328	94,727	3.74	14,188	78,460	5.53
Other States [b]	65,783	328,552	4.99	59,995	260,618	4.34	78,399	329,588	4.20
Total	350,928	1,334,259	3.80	341,338	1,286,084	3.77	336,662	1,283,346	3.81

[a] Included in "Other States."
[b] 1912: Georgia, Missouri, New York, and Pennsylvania; 1913: Missouri and New York; 1914: Georgia, Missouri, and New York

The marketed production of pyrite in the United States since 1882 is given in the following table:

Marketed production of pyrite in the United States, 1882–1914, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.	Year.	Quantity.	Value.
1882	12,000	$72,000	1893	75,777	$256,552	1904	207,081	$814,808
1883	25,000	137,500	1894	105,940	363,134	1905	253,000	938,492
1884	35,000	175,000	1895	99,549	322,845	1906	261,422	931,305
1885	49,000	220,500	1896	115,483	320,163	1907	247,387	794,949
1886	55,000	220,000	1897	143,201	391,541	1908	222,598	857,113
1887	52,000	210,000	1898	193,364	593,801	1909	247,070	1,028,157
1888	54,331	167,658	1899	174,734	543,249	1910	241,612	977,978
1889	93,705	202,119	1900	204,615	749,991	1911	301,458	1,164,871
1890	99,854	273,745	1901	[a] 241,691	1,257,879	1912	350,928	1,334,259
1891	106,536	338,880	1902	[a] 207,874	947,089	1913	341,338	1,286,084
1892	109,788	305,191	1903	[a] 233,127	1,109,818	1914	336,662	1,283,346

[a] Includes production of natural sulphur.

IMPORTS.

The pyrite imported into the United States in 1914 amounted to 1,026,617 long tons, valued at $4,797,236, an increase of 176,025 long tons in quantity and of $1,186,189 in value, as compared with imports in 1913. It is very evident from these figures that there has been no shortage in the supply of foreign pyrite on account of the war in Europe.

Speaking of the importation of Spanish pyrite in connection with the manufacture of sulphuric acid, C. Wilbur Miller, president of the Davison Chemical Co., which manufactures sulphuric acid, says:[1]

> Imported pyrite is almost exclusively obtained from Spain, and the manufacturers of sulphuric acid in this country are generally interested in the pyrite mines. We, ourselves, entirely own our source of supply. There is no likelihood of any interruption in shipments, as there are more than 200 ships in the service, and even in the event that a few of them were to be sunk it would not seriously interfere with our supplies. As a matter of fact, there is more pyrite available now than if the war was not on. The plants in Germany and France are practically shut down, and we have been offered shiploads of pyrite by independent owners whose markets have been cut off. We have more pyrite on hand now than we can conveniently find storage room for, and have found it necessary to restrict shipments rather than take thought of any practically impossible famine in supplies.

[1] Mfrs. Record, Sept. 3, 1914, p. 53.

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, 1910–1914, in long tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1910	803,551	$2,748,647	1913	850,592	$3,611,137
1911	1,006,310	3,788,803	1914	1,026,617	4,797,326
1912	970,785	3,841,683			

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 in sulphur.

Wherever possible the figures are taken from the official publication of the country concerned, which is the case with Canada, Belgium, France (in part), the German Empire (in part), and Italy; otherwise, the British Blue Book, known as Mines and Quarries, London, has been used except for 1913, when figures for all countries except Canada, Italy, and the United Kingdom are from Mineral Industry. The rapid increase in the production of pyrite in Canada is worthy of note.

Production of iron pyrite in principal producing countries and quantity of sulphur displaced, 1909–1914, in long tons.

Country.	1909	1910	1911	1912	1913	1914
North America:						
Canada	[a] 57,718	48,098	73,809	72,791	141,577	200,854
United States	247,070	241,612	301,458	350,928	341,338	336,662
Europe:						
Belgium	211	211	120	146	264	(b)
Bosnia and Herzegovina	7,151	56	3,069	6,118	7,580	(b)
France	268,918	246,488	273,565	277,758	306,267	(b)
German Empire	195,560	212,311	214,034	258,517	[c] 224,808	(b)
Greece	14,506	32,767	35,390	29,294	(b)	(b)
Hungary	97,412	91,008	95,231	102,174	104,950	(b)
Italy	[d] 130,152	133,492	143,823	244,697	287,477	(b)
Norway	[d] 278,352	[d] 324,457	[d] 363,243	[d] 457,014	[d] 434,342	(b)
Portugal	[e] 268,108	289,119	[e] 272,869	[e] 333,756	[e] 371,588	(b)
Russia	45,323	55,062	(b)	(b)	(b)	(b)
Servia	21,286	36,255	(f)	45,462	(b)	(b)
Spain	[g] 254,853	[g] 289,551	[g] 339,448	[g] 414,438	912,316	(b)
Sweden	15,850	25,044	29,622	31,334	33,779	(b)
Turkey	[h] 77,402	[i] 148,130	[i] 104,823	[i] 121,260	(b)	(b)
United Kingdom	8,429	9,380	10,114	10,522	11,427	(b)
Asia:						
Japan	21,170	78,421	72,585	74,594	(b)	(b)
Oceania:						
Australia	....	2,916	2,496	(b)	(b)	(b)
Total	2,009,471	2,264,378	2,335,699	2,830,803	3,177,713	....
Sulphur displaced [j]	904,262	1,018,970	1,051,065	1,273,861	1,429,971	....

[a] Includes cupreous iron pyrites.
[b] Statistics not available.
[c] Prussia. Statistics for German Empire not available.
[d] Cupreous iron pyrites.
[e] 1909: Composed of cupreous iron pyrites, 194,861 long tons, and sulphur ore, 73,247 long tons; 1911: Composed of cupreous iron pyrites, 9,595 long tons, and sulphur ore, 263,274 long tons; 1912 and 1913: Sulphur ore.
[f] Quantity not stated. Value, $54,101.
[g] Also 2,908,715 long tons in 1909, 3,180,530 long tons in 1910, 3,232,465 long tons in 1911, and 3,313,145 long tons in 1912, designated as "copper ore and cupreous iron pyrites."
[h] 1909: Year ending March, 1909.
[i] Exported from Stratoni.
[j] Based on estimated 45 per cent of sulphur content.

PYRITE INDUSTRY BY STATES.

CALIFORNIA.

California ranked second among the States in the production of pyrite in 1914, having an output of 71,272 long tons. This was only 736 tons more than the production of 1913, which was 70,536 long tons. In value of production, California ranked third. California pyrite came from near Melrose and Oakland, Alameda County, and from Keswick, Shasta County.

GEORGIA.

Georgia ranked sixth among the States in the production of pyrite in 1914. There was a slight increase in the quantity produced as compared with 1913. The pyrite production was reported from The Standard Pyrites Co., which operated at Ball Ground, Cherokee County, and the Sulphur Mining & Railroad Co., which operated at Villa Rica, Carroll County.

ILLINOIS.

Illinois ranked fourth among the States in quantity and fifth in value of pyrite produced in 1914. The production of the State was 22,538 long tons, valued at $59,079, as compared with 11,246 long tons, valued at $31,966, in 1913. The State's production in 1913, it should be explained, however, was abnormally low, being less than half what it was in 1912. The low value of Illinois pyrite per ton, $2.62, is accounted for by the fact that it is a by-product in coal mining.

Much of the so-called pyrite obtained in coal mining, not only in Illinois but in Ohio, Indiana, and Pennsylvania, is not pyrite at all, but marcasite. Marcasite has the same composition as pyrite and is difficult to distinguish from the latter, especially when in massive form. Both sulphides are commonly referred to by the miners as "sulphur." Marcasite has a slightly less specific gravity than pyrite (pyrite = 4.95 to 5.10; marcasite = 4.85 to 4.90.) Its color when fresh, or after treatment with acids, is paler than that of pyrite. When crystallized, it is easily distinguished by its form—pyrite crystallizes in the isometric system; marcasite is orthorhombic in form. With pyrite, moreover, there are certain forms which, like the cube and the pyritohedron, are exceedingly common. Marcasite tarnishes and decomposes more readily than pyrite.

Pyrite in Illinois was produced in 1914 in or near Danville, Catlin, Tilton, and Beavertown, Vermilion County; Glen Carbon, Madison County; and Soperville, Knox County. The total output of the State is made up of small quantities from many mines.

INDIANA.

The production of pyrite in Indiana in 1914 was 1,710 long tons, valued at $5,281, or 468 tons more than the production in 1913, which was 1,242 tons, valued at $3,115. Pyrite in Indiana is a by-product obtained in mining coal. It comes chiefly from the vicinity of Terre Haute and Seelyville, Vigo County.

MISSOURI.

The Rolla Mining Co., in 1914, operated a pyrite mine near Rolla, Phelps County. The mine was closed for two months, owing to its being flooded. During 1915, the Beulah Mining Co. expects to operate a pyrite mine 1 mile from Morrellton, Franklin County. No pyrite was reported from Missouri in 1914 in connection with coal mining.

NEW YORK.

During 1914, two pyrite mines were operated in New York, the Anna mine, of the St. Lawrence Pyrites Co., located near Hermon, and the Cole mine, operated by William J. Bulger, near Gouverneur, both in St. Lawrence County. The product of the Cole mine goes to the Hinckley Fiber Co., where it is utilized in making sulphurous acid for the manufacture of paper pulp. The Cole mine was shut down about half the year. To conceal individual production, the output from New York State is lumped with that of Georgia and Missouri. In quantity and value of the pyrite produced New York ranked third and second, respectively, among the States.

A detailed description of the occurrence of pyrite in New York was given in this report for 1913, as was also an account of the mining and milling processes employed by the St. Lawrence Pyrites Co., at Hermon. Those descriptions will therefore not be repeated here.

OHIO.

The production of pyrite in Ohio in 1914 was 7,279 long tons, valued at $19,718—considerably less than the production in 1913, which was 13,622 long tons, valued at $34,998. One of the reasons for this falling off was the long periods of idleness suffered by many of the coal mines which produce pyrite as a by-product. Strikes and suspensions also contributed to the shortage, and some producers complained of a lack of demand for their pyrite, as a result of which none was set aside for sale. A few mines which usually report productions of pyrite were abandoned either temporarily or permanently.

The pyrite came from Tippecanoe, Harrison County; Brilliant (Rush Run), Dillonvale, and Rayland, Jefferson County; Barnhill, Dennison, Midvale, New Philadelphia, Roswell, Uhrichsville, and Wainwright, Tuscarawas County.

VIRGINIA.

Though the production of pyrite in Virginia in 1914 was less than in 1913, the State still continues to be by far the leading producer in the United States. The production in 1914 was 141,276 long tons, valued at $556,091, as compared with 148,259 long tons, valued at $587,041, in 1913. The pyrite came from the Cabin Branch Mining Co., Dumfries, Prince William County; from the Arminius mines of the Arminius Chemical Co., and the mines of the Sulphur Mining & Railroad Co., at Mineral, Louisa County; and from the Gossan mine of the General Chemical Co., at Monarat, Carroll County. The Boyd-Smith mine, at Mineral, was engaged chiefly in development work in 1914.

WISCONSIN.

The production of pyrite (marcasite) in southwestern Wisconsin and northwestern Illinois is given in this report as from the State first mentioned, both for the reason that nearly all the production comes from Wisconsin and for the additional reason that it is impossible to differentiate the production of the two States. This latter condition is due to the fact that low-grade blende containing marcasite and originating in both States is shipped to separating plants in Wisconsin, after which it is impossible to credit correctly the original State quotas. Part of this pyrite is obtained with the zinc ores mined in the southwestern part of Wisconsin, in what is usually known as the Wisconsin or upper Mississippi Valley zinc district, which includes also Illinois and Iowa.

This pyrite (marcasite) comes chiefly from the Linden, Cuba City, and Benton districts, in Wisconsin, but a small quantity comes also from the Galena district of Illinois. The zinc sulphide and the iron sulphide from both States are separated by the Linden Zinc Co., at Linden; the Empire Roaster, at Platteville; the National Zinc Separating Co., at Cuba City; and the Wisconsin Separating Co., at Benton—all in Wisconsin.

The greater part of the marcasite credited to Wisconsin is, however, not obtained by any process of separation, but is sold as mined. This marcasite is produced at the Wilkinson mine, operated by the Vinegar Hill Zinc Co., in the Benton district, Wisconsin. The production from this district greatly decreased in 1914, as compared with 1913. Much of the pyrite from this region is high grade, and averages 45 per cent sulphur.

SULPHURIC-ACID INDUSTRY IN THE UNITED STATES.

INTRODUCTORY NOTE.

The year 1914 is the fourth for which statistics of sulphuric acid have been collected by the United States Geological Survey. As stated in the report for 1911, the first year for which such statistics were published, one of the reasons for adding the subject of sulphuric acid to the chapter on sulphur and pyrite is because it is a commodity so extensively used in the manufacture of other chemicals that it has come to be regarded as a criterion or gage of the activity of the country in chemical manufactures in general. Another reason of recent importance, since the beginning of the manufacture of by-product acid in the copper and zinc smelting industry, is that through sulphuric acid is offered the only means of expressing the value of the sulphur in those sulphides now used in making by-product acid—that sulphur which formerly went to waste in the air in the form of sulphur dioxide and sulphur trioxide.

GENERAL USES.

Sulphuric acid is probably used in a greater variety of ways in the chemical arts than 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, bleach-

[1] Manufacture of sulphuric acid and alkali, vol. 1, pt. 2, pp. 1169–1170, ed. 1903.

ing 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 metallurgy 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) the manufacture of fertilizers; (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.

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 in the tables which follow for the years prior to 1913 have been taken from the census reports for 1899 and 1904.[1]

In the production reported to the Survey for 1913 and 1914 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 guncotton, and that, finally, in petroleum refineries much of the acid is consumed in refining the crude oil. In the earlier census reports the sulphuric

[1] Census of manufactures, 1905, Bull. 92, pp. 15 and following, 1907.

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 1913 and 1914, except in the case of the sulphuric acid manufactured at smelters as a by-product.

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 to 60 per cent of free SO_3, or a total of 87 to 92 per cent of free and combined SO_3. It is essentially a solution of SO_3 dissolved in sulphuric acid.[1]

The production of sulphuric acid published by the Survey represents bona fide returns from producers, and the figures in the following tables are not estimates. For this reason the figures may be either equal to or less than the actual production. It is obvious that they can not exceed it so long as the returns are correct.

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 quantity of acid indicated in the footnote the output is also expressed in terms of 50° Baumé acid for the sake of comparison.

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[1] Molinari, Ettore, General and industrial chemistry, p. 274, 1912.

Production of sulphuric acid in the United States in 1899, 1904, 1909, 1913, and 1914, by grades, in short tons.

Grade.	1899			1904			1909		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
50° Baumé	953,439	$7,965,832	$8.35	1,169,141	$8,314,646	$7.11	1,624,178	$8,494,451	$5.23
60° Baumé	17,012	246,284	14.47	48,688	581,523	11.94	186,900	1,089,350	5.78
66° Baumé	382,279	6,035,069	15.78	411,165	5,917,699	14.38	558,078	6,719,259	12.04
Other grades	....	....	....	[a] 13,268	361,018	27.20	[a] 31,349	476,135	15.18
Total	1,352,730	14,247,185	....	1,642,262	15,174,886	....	2,400,505	16,779,195	....
Total reduced to 50° Baumé acid	[b] 1,548,123	....	9.20	[c] 1,869,437	....	....	[d] 2,748,527	....	....

Grade.	1913			1914		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
50° Baumé	1,643,318	$9,212,917	$5.61	1,628,402	$9,712,056	$5.96
60° Baumé	509,929	3,202,528	6.28	551,955	3,376,242	6.12
66° Baumé	797,104	9,282,422	11.65	916,192	10,509,471	11.47
Other grades	63,158	986 659	15.62	65 890	882,158	13.39
Total	3,013,509	22,684,526	7.53	3,162,439	24,479,927	7.74
Total reduced to 50° Baumé acid	[e] 3,538,980	[e] 22,366,482	6.32	[f] 3,762,417	[f] 24,163,331	6.42

[a] Reported as oleum by the census.
[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] 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.
[d] 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.
[e] Exclusive of 22,947 short tons of fuming acid, not convertible, valued at $318,044.
[f] Exclusive of 21,993 short tons of fuming acid, not convertible, valued at $316,596.

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 25 per cent of the total acid produced in the United States[1] during the year 1914. 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, 1911–1914, in short tons.[a]

[Reduced to 60° Baumé acid.]

Source.	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		

Source.	1913			1914		
	Quantity.	Value.	Price per ton.	Quantity.	Value.	Price per ton.
Copper smelters	336,019	$2,205,627	$6.56	348,727	$2,215,690	$6.35
Zinc smelters	296,218	2,140,645	7.23	411,911	2,974,603	7.22
Total	632,237	4,346,272	6.87	760,638	5,190,293	6.82
Total acid reduced to 50° Baumé	790,296			950,798		

[a] The acid reported to the Survey includes that of 50°, 53°, 55°, 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.

[1] Percentages based on the total 50° acid, namely, 3,762,417 tons.

TALC AND SOAPSTONE.

By J. S. Diller.

DEVELOPMENT OF TALC AND SOAPSTONE INDUSTRY.

The United States produces more talc and soapstone than all the rest of the world combined. The domestic output has nearly doubled in the last decade, and the comparatively uniform development of the industry indicates its stability and gives promise for continued increasing demand.

The following table illustrates the growth of the talc and soapstone industry in the United States since 1880:

Production of talc and soapstone in the United States, 1880–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880–1900	969,928	$11,224,652	1908	117,354	$1,401,222
1901	97,343	908,488	1909	130,338	1,221,959
1902	97,954	1,140,507	1910	150,716	1,592,393
1903	86,901	840,000	1911	143,551	1,646,018
1904	91,189	940,731	1912	159,270	1,706,963
1905	96,634	1,082,062	1913	175,833	1,908,097
1906	120,644	1,431,556	1914	172,296	1,865,087
1907	139,810	1,531,047			

The total marketed production of talc and soapstone in the United States in 1914 was 172,296 short tons, a decrease of 2 per cent as compared with the production of 1913. Rhode Island and Maryland in 1914 produced soapstone alone. The other States, except North Carolina, Vermont, and Virginia, produce talc only.

Marketed production of talc and soapstone in the United States, 1913–14, with increase and decrease in 1914, in short tons.

	1913		1914		Increase (+) or decrease (−) in quantity, 1914.	Percentage of increase (+) or decrease (−) in quantity.	Increase (+) or decrease (−) in value, 1914.	Percentage of increase (+) or decrease (−) in value.
	Quantity.	Value.	Quantity.	Value.				
California	952	$6,000	547	$8,786	− 405	−42.54	+$2,786	+46.43
New Jersey and Pennsylvania	11,308	80,780	7,732	54,549	−3,576	−31.62	−26,231	−32.47
New York	81,705	788,500	86,075	821,286	+4,370	+ 5.35	+32,786	+ 4.16
North Carolina	4,676	48,817	1,198	28,413	−3,478	−74.38	−20,404	−41.80
Vermont	45,547	327,375	50,698	363,465	+5,151	+11.31	+36,090	+11.02
Virginia	26,487	615,558	21,687	527,938	−4,800	−18.12	−87,620	−14.23
Other States [a]	5,158	41,067	4,359	60,650	− 799	−15.49	+19,583	+47.69
Total	175,833	1,908,097	172,296	1,865,087	−3,537	− 2.01	−43,010	− 2.25

[a] Includes Georgia, Maryland, Massachusetts, and Rhode Island.

Marketed production of talc and soapstone in the United States, 1911–1914, in short tons.

Condition in which marketed.	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
	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
	1913			1914		
Rough	3,898	$14,687	$3.77	3,080	$17,941	$5.83
Sawed into slabs	4,371	61,351	14.04	2,913	80,238	27.54
Manufactured articles [a]	20,465	593,331	28.99	17,824	498,802	27.98
Ground [b]	147,099	1,238,728	8.42	148,479	1,268,106	8.54
Total	175,833	1,908,097	10.85	172,296	1,865,087	10.82

[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 of the United States, as compared with that of other countries, is illustrated by the following table, showing the world's production. The figures for 1912 are not yet complete, but it will be noted that the United States contributed more than all the other countries combined.

Production of talc and soapstone in the principal producing countries, 1905–1912, in short tons.

Country.	1905 [a]	1906 [a]	1907 [a]	1908 [a]	1909 [a]	1910 [a]	1911 [a]	1912 [b]
United States [c]	96,634	120,644	139,810	117,354	130,338	150,716	143,551	159,270
Argentina [d]			28	7				(g)
Canada [d]	500	1,234	1,534	1,016	4,350	7,112	7,300	8,270
France [e]	25,956	29,061	38,262	37,053	38,433	42,316	51,050	60,629
German Empire (Bavaria [f])	2,064	2,131	2,203	2,424	2,567	3,398	3,781	3,551
India [f]	13	11	9	856	652	274	690	787
Ireland [f]								8
Italy [d]	7,154	9,624	13,574	12,048	13,228	13,727	17,218	17,901
Madagascar [f]							2	(g)
South Africa [f]							7	6
Spain [f]	4,810	3,978	15,294	5,214	6,154	5,142	6,225	(g)

[a] Figures taken from Mines and Quarries: General Rept. with Statistics, pt. 4, London, except the United States and Italy, the latter being credited to Rivista del Servizio minerario, Rome.
[b] Figures taken from various sources.
[c] Talc and soapstone.
[d] Talc.
[e] Talc, soapstone, and asbestos.
[f] Soapstone.
[g] Statistics not available.

DISTRIBUTION OF TALC AND SOAPSTONE IN THE UNITED STATES.

Talc is a definite mineral, of which soapstone, as the term is generally used, is only an impure massive form. Soapstone is also called steatite and sometimes potstone, from the fact that the Indians used it to make cooking utensils.

The distribution and character of the talc mines and the soapstone quarries of the United States were shown on maps and tables in this report for 1912. As there has been no important change during the last two years, the maps and tables need not be repeated here.

Talc and soapstone are crystalline, and their occurrence is limited to areas of crystalline rocks. By far the larger part of the known occurrences and producing localities are in the Blue Mountain region of the Atlantic States, from New England and New York to Georgia, although in recent years attention has been attracted to deposits in southeastern California.

Talc is generally mined in small fragments by underground methods. Soapstone, on the other hand, is quarried in large blocks in open pits. Commercial talc and soapstone are not generally found together, and only rarely are they produced by the same company. Prior to 1912 talc and soapstone have been considered together in the United States Geological Survey reports, but in that year they were also considered separately, a practice which is followed in this report for 1914.

TALC.

PRODUCTION.

The total marketed production of talc for 1914 was 151,088 short tons, valued at $1,340,874, an increase of 1,817 tons in quantity and of $60,854 in value over the production of 1913.

The relative rank of each of the producing States as to quantity and value of output in 1914 is given in the following table. The production of Pennsylvania and New Jersey and that of Georgia and Massachusetts are combined to conceal the output of individual producers.

Quantity and value of the talc marketed in the various States in 1913 and 1914, in short tons.

Rank (1914) and State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
1. New York	81,705	$788,500	86,075	$821,286
2. Vermont	44,447	302,375	50,123	358,465
3. Pennsylvania and New Jersey	11,308	80,780	7,732	54,549
4. Georgia and Massachusetts	3,309	35,416	3,627	57,927
5. Virginia	2,974	18,632	1,786	11,448
6. North Carolina	4,576	48,317	1,198	28,413
7. California	952	6,000	547	8,786
Total	149,271	1,280,020	151,088	1,340,874

New York continues to be the leading producer, with an increasing output, now more than 57 per cent of the total production of the United States and far outranking all other States except Vermont, which has in recent years so greatly increased its production that in 1914 it was more than 58 per cent of that of New York.

Production and value of the talc of New York, 1880–1914, as compared with that of talc and soapstone in all the other States combined, in short tons.

Year.	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
1913	81,705	788,500	9.65	94,128	1,119,597
1914	86,075	821,286	9.54	86,221	1,043,801
Total	1,568,094	14,254,520	9.09	1,183,177	16,186,322

Of the total output in 1914, by far the greater part, 147,756 short tons, was sold as ground talc; 698 tons was sold as pencils or blanks for making gas tips, etc.; and 2,634 tons was 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 1914 were 15,734 short tons, valued at $177,321, an increase of 14.4 per cent in quantity and of nearly 28.8 per cent in value as compared with the corresponding imports for 1913.

Talc imported for consumption into the United States, 1905 and 1908–1914, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1905	4,000	$48,225	$12.05	1911	7,113	$88,050	$12.38
1908	7,429	97,096	13.07	1912	10,989	122,956	11.19
1909	4,417	56,287	12.74	1913	13,770	137,680	10.00
1910	8,378	106,460	12.71	1914	15,734	177,321	11.21

As shown by the accompanying table, 35.3 per cent of the imported talc came from Italy, 28.1 per cent from France, and 32 per cent from Canada.

Imports of talc, ground or manufactured, into the United States, 1913 and 1914, by countries, in short tons.

Country.	1913			1914		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Argentina						
Austria-Hungary	391	$9,137	$23.37	587	$10,814	$18.43
Belgium	8	209	26.13			
Canada	3,348	33,107	9.89	5,006	56,052	11.20
England	34	557	16.38	62	853	13.76
France	5,466	28,242	5.17	4,398	23,022	5.24
Germany	15	1,846	123.07	53	5,966	112.55
Italy	4,510	65,163	14.45	5,535	79,795	14.41
Netherlands	2	52	26.00			
Japan				3	47	15.66
Total	13,774	138,313	10.04	15,644	176,549	11.29

The production of talc in Canada in 1914 was 10,808[1] short tons, of which 46 per cent, 5,006 tons, came to the United States, as compared with 3,348 tons imported from Canada in 1913.

The imported talc is chiefly of the higher grades, such as is used for making toilet powder and gas tips, for which purposes the supply in the United States is not equal to the demand.

PRICES.

The prices depend on the grade of talc, which determines the purpose for which it is used. The average price in the rough as it came from the mine in 1914 was, for the whole United States, $5.83 a ton. Some of it sold in 1914 as low as $2 a ton, while other material worked up into crayons, pencils, etc., sold at the rate of nearly $100 a ton. Ground pyrophyllite ranged in price from $2 a ton in the rough to $10 a ton ground, which is generally the selling price of New York talc. Lower grades of ground talc sell for $5 a ton; more of it sells for $6 and $7 a ton. The average price for manufactured talc in 1914 was $27.98 a short ton. The prices of imports ranged in 1914 from $112.55 for German talc to $5.24 for French ground talc.

The uses of talc, its modes of occurrence and distribution, and its preparation for market were discussed in the report for 1912. The talc industry, by States, is considered in the report for 1913, and as copies of the report for 1912 and 1913 are yet available these matters need not be taken up again at this time.

SOAPSTONE.

PRODUCTION.

The United States leads the world in the production of soapstone, with an output greater than that of all other countries combined. In 1914 the total production of the United States was 21,208 short tons, valued at $524,213, a decrease of 20 per cent in quantity and 17 per cent in value, as compared with the production of 1913.

[1] Preliminary report on the mineral production of Canada during the calendar year 1914 (subject to revision), Canada Dept. Mines.

There are five important producing States: Maryland, North Carolina, Rhode Island, Vermont, and Virginia. California has a small output. Virginia is by far the largest producer and has great resources for future use.

The following table shows that the total production of soapstone in Maryland, North Carolina, Rhode Island, and Vermont in 1914 was 1,307 short tons, valued at $7,723, a decrease of 57.1 per cent in quantity and 75.2 per cent in value as compared with the production and value of 1913. Virginia produced 15 times as much soapstone as the other four States combined, although its production decreased 3,612 tons, or 15 per cent, from the output of 1913.

There is 1 producer in each of the three States, Maryland, North Carolina, and Rhode Island; 2 in Vermont; and 6 in Virginia, all 6 in essentially the same belt stretching northeast through Nelson, Albemarle, and Orange counties, a distance of nearly 75 miles. The talc producers of Virginia lie farther northeast. One company west of Fredericksburg produces both talc and soapstone, a combination that enables the company to use nearly all its quarry products advantageously.

Marketed production of soapstone in 1913 and 1914, by States, in short tons.

State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Maryland North Carolina Rhode Island Vermont	3,049	$31,151	1,307	$7,723
Virginia	23,513	596,926	19,901	516,490
Total	26,562	628,077	21,208	524,213

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, for they determine the purpose to which it can be applied.

In the rough, as quarried, soapstone is valued at about $1.50 to $2 a ton; when sawed into slabs of good size and quality its value is increased to more than $15 a ton; and when manufactured into laundry tubs its average value is about $30 a ton.

NEW LITERATURE CONCERNING TALC.

Two important reports on talc appeared in 1914, one in Georgia and the other in Vermont. The "talc and soapstone deposits of Georgia" are described by Oliver B. Hopkins[1] and the "talc and talc deposits of Vermont" by E. C. Jacobs.[2]

These reports are both general and special and of much interest not only by the States specially considered but to the whole country.

[1] Georgia Geol. Survey Bull. 29, pp. 190-301, 1914.
[2] Vermont State Geologist Ninth Rept., pp. 381-429, 1914.

Mr. Jesse L. Jones[1] has recently investigated the various forms of talc used in foundry facing and speaks highly of Bull Run talc. He came to the conclusion that if the high price of graphite continues the use of talc ought to increase very greatly and that foundry men who desire good results ought to test the facing sold them very carefully. Extreme softness and extreme fineness are the qualities that assure successful results.

J. H. Pratt[2] has recently given a good account not only of talc but of pyrophyllite, an aluminum silicate which resembles talc and is used for the same purposes.

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1 The Metal Industry, New York, Sept., 1914, p. 379.

2 The mining industry of North Carolina during 1911 and 1912: North Carolina Geol. Survey Econ. Paper 34, 1914.

GRAPHITE.

By Edson S. Bastin.

INTRODUCTION.

The form of carbon known as graphite or plumbago occurs in nature in a variety of ways and serves a great many useful purposes, chief among which are its uses in the manufacture of crucibles and other refractory products, as lubricants, for foundry facings, as stove polishes, etc. Its properties, origin, and uses and its mode of occurrence at the principal localities of the United States have been fully described in the report on graphite in Mineral Resources for 1913, which will be sent free on request made to the Director, United States Geological Survey, Washington, D. C. That report also contains a bibliography of the more important publications dealing with the general character of graphite and its occurrence in this country.

The events of most importance in the graphite industry during 1914 were in the main the effects direct or indirect of the European war, and are discussed under the heading "Markets and prices."

Attention may be directed especially to the fact that the imports of graphite from Mexico nearly equaled those for 1913 in spite of the turbulent conditions in that Republic. The imports of Korean graphite were about half again as large in 1914 as in 1913, increasing from 4,170 to 6,327 tons. The importation from Ceylon on the other hand was about half that for 1913.

The two uses of graphite that seem to have shown the greatest gains during the year are its application to automobile lubrication and its use as a preparation to loosen boiler "scale." The effect of the graphite in the boilers is mechanical, not chemical. Being chemically inert it can not injure the iron of the boilers or affect the quality of the boiler water. It does not prevent the formation of scale, but the fine graphite particles by mixing with the scale during its formation render it soft and crumbly and prevent it from adhering strongly to the boiler. It can then be easily removed. It is said, moreover, that graphite is efficient in loosening old scale, the graphite particles working into the pores of the scale and between the scale and the boiler.

In October, 1913, patents were applied for in Austria and Germany by the Aflenzer Grafit und Talkstein Werkschaft, with office in Vienna and plant at Aflenz (Steiermark), covering the use of graphite as a coloring material and filler in the manufacture of gray to black paper, pasteboard, and textiles. The process, which is especially designed for paper and pasteboard manufacture, consists in incorporating in the goods powdered graphite, which may be added dry or as a fine slime. The graphite is said to be superior to gray mineral or chemical coloring matter hitherto used, in that the color does not fade in prolonged exposure to sunlight. Streaked and spotted defects, it is claimed, are less likely to appear during the process of making the paper. The opening of a new "flake" graphite property, 3 miles north of Ashland, Ala., by the Jennings Graphite Co. is noteworthy.

During the early part of 1915, the writer visited many graphite properties in California. The mode of occurrence of the graphite at two of these properties is somewhat different from that observed in any other part of the country and is briefly described under the discussion of the California deposits.

PRODUCTION AND IMPORTS.

Graphite (both natural and manufactured) produced in the United States in 1914 was approximately 73 per cent, by value, of that imported for consumption. Of the domestic production about one-third, by value, was natural graphite and two-thirds manufactured graphite.

NATURAL GRAPHITE.

PRODUCTION.

As usual the greater part of the crystalline graphite was produced by New York, Pennsylvania, and Alabama. The production of these States was all of the variety known in the trade as "flake" graphite that occurs as small flakes forming 5 to 10 per cent, by weight, of crystalline schists, from which it is separated by more or less complicated milling processes. In addition to this a small quantity of crystalline graphite, resembling in a general way the Ceylon graphite, was produced in Montana. The total production of crystalline graphite showed, as a result of increased production in Alabama, a slight increase both in quantity and in value, as compared with 1913. The number of producing firms was 7 in all, 3 in Alabama, 1 in Montana, 2 in New York, and 1 in Pennsylvania.

Amorphous graphite was produced by 3 firms, and the production was considerably below that for 1913. All of this material was of low grade, suited for paint pigment and foundry facings.

Details in regard to individual properties are given in the review by States and Territories.

Production of natural graphite, 1910–1914.

Year.	Amorphous.		Crystalline.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Pounds.*		*Short tons.*	
1910	1,407	$39,710	5,590,592	$295,733	4,202	$335,443
1911	1,223	32,415	4,790,600	256,050	3,618	288,465
1912	2,063	32,894	3,543,771	187,689	3,835	220,583
1913	2,243	39,428	5,064,727	254,328	4,775	293,756
1914	1,725	38,750	5,220,539	285,368	4,336	324,118

On account of the small number of producers, figures of production by States, except for Alabama, can not be published without revealing individual productions. The production of Alabama amounted to 2,410,200 pounds of crystalline graphite, valued at $118,000.

IMPORTS.

The imports of graphite into the United States in 1912, 1913, and 1914, by countries, are shown in the following table:

Imports of graphite into the United States, 1912, 1913, and 1914, by countries, in short tons.

Country.	1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Ceylon	16,791	$1,379,587	16,996	$1,674,764	8,374	$920,147
Mexico	3,518	163,107	4,435	198,000	4,259	190,075
Canada	2,688	122,216	1,662	98,665	1,806	92,536
Japan (Chosen via Japan)	1,574	22,875	4,170	58,199	6,327	96,433
Austria-Hungary	473	8,971	660	9,957	78	1,258
Italy	468	7,450	236	4,061	254	3,203
Germany	102	2,669	90	4,034		
England					381	42,446
France					194	20,278
British India					127	9,815
Madagascar					155	18,426
Other countries	29	2,462	630	62,111	47	3,644
Total	25,643	1,709,337	28,879	2,109,791	22,002	1,398,261

The following table shows the imports of graphite from 1910 to 1914, inclusive:

Imports of graphite into the United States, 1910–1914, in short tons.

Year.	Quantity.	Value.
1910	25,235	$1,872,592
1911	20,702	1,495,729
1912	25,643	1,709,337
1913	28,879	2,109,791
1914	22,002	1,398,261

WORLD'S PRODUCTION.

The world's production of natural graphite for the years 1910–1912 was as follows:

World's production of natural graphite, 1910, 1911, and 1912, in short tons.[a]

Country.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States [b]	4,202	$335,443	3,618	$288,465	2,694	$211,883
Canada	1,392	74,083	1,269	69,576	2,059	117,117
Mexico	2,571	36,207	3,050	36,353	3,158	96,668
Russia	(c)	(c)	(c)	(c)	(c)	(c)
Germany	8,174	76,404	12,454	72,754	13,814	81,514
Austria	36,520	281,220	46,855	332,489	50,017	378,867
Norway	[d] 882	[d] 8,575			285	1,898
Sweden	1,526	1,844	72	2,097	87	2,535
France	606	5,353	408	3,601	661	1,635
Italy	13,790	74,808	13,912	74,701	14,517	77,236
Japan	162	5,202	126	8,911	163	10,935
China			22	1,728	(c)	(c)
Chosen (Korea)		56,719		[d] 65,727		82,108
India	4,761	99,661	4,533	45,867	(c)	(c)
Ceylon	[d] 35,310	[d] 2,577,600	[d] 30,183	[d] 2,159,529	[d] 36,660	[d] 2,707,973
Madagascar	601	21,218	1,373	48,534	3,011	239,291
South Africa	40	6,755	44	6,365	42	5,621

[a] Mines and quarries: General Report with Statistics, pt. 4. London.
[b] Exclusive of manufactured graphite, figures for which are shown on the following page.
[c] Statistics not available.
[d] Export figures.

MANUFACTURED GRAPHITE.

Graphite in large quantities is manufactured by the International Acheson Graphite Co., at Niagara Falls, N. Y., which utilizes electric power generated at the Falls. The following table shows the production for the years 1910 to 1914, inclusive:

Production and value of manufactured graphite, 1910–1914.

Year.	Quantity.	Value.	Average price per pound.
	Pounds.		*Cents.*
1910	13,149,100	$945,000	7.20
1911	10,144,000	664,000	6.55
1912	12,896,347	830,193	6.44
1913	13,633,342	973,397	7.14
1914	10,455,139	698,800	6.68

MARKETS AND PRICES.

The prices paid by crucible makers and others for Ceylon graphite during 1914 were approximately as follows:

Prices of Ceylon graphite at New York in 1914.

	Cents per pound.
Ordinary lump:	
Best	8½–10½
Medium	7 – 9
Poor	6 – 8
Chip:	
Best	7 – 9
Medium	6 – 8
Poor	4 – 7
Dust:	
Best	4 –5½
Medium	3 –4
Poor	2 –3
Flying dust:	
Best	2½–3½
Medium	2 –3
Poor	1½–2

The high prices of Ceylon graphite reached in the latter part of 1913 were maintained in the early part of 1914, but began to decline in May and June, owing to the general business depression in the United States. The decline continued until the outbreak of the European war in August, after which prices remained fairly constant until the close of the year. The prices prevailing from August to December, 1914, were from 25 to 30 per cent lower than those that prevailed in the latter part of 1913 and the early part of 1914.

With the outbreak of the war the Ceylon graphite trade was greatly disturbed. The German markets, which in 1913 absorbed over one-fifth of the total output, were suddenly closed. This did not, however, lead to any decrease in the price of graphite in the United States, for freight rates at the same time increased, war insurance became necessary, and a German line of steamers that brought Ceylon graphite to this country ceased to operate. The increase in freight rates was due not only to the decreased number of vessels available but to the commandeering of coal at the usual coaling ports for military purposes, thus necessitating heavy coaling at the beginning of the voyage and proportionately reducing the space for cargo. Moreover a large number of graphite mines in Ceylon had closed even before the outbreak of the war because of a shortage in labor due to the bubonic plague and because of the flooding of mines by unusually heavy rains. According to one of the large importers, not over 25 per cent of the mines operated in 1913 were in operation at the close of 1914.

The net result of these conditions was that the prices of Ceylon graphite in the United States during August, September, and October remained at about the same level as just before the outbreak of the war.

On October 22 the governor of the Island of Ceylon proclaimed an embargo on plumbago to all ports except British ports, and from that date until the close of the year practically no Ceylon graphite was brought into the United States. Fortunately the principal American dealers had fairly large reserve stocks, so that there was no serious shortage during November and December. Since the close of 1914 trade has adjusted itself to the changed conditions, and Ceylon graphite is now coming into this country under certain restrictions by way of London.

Madagascar graphite continued to be imported in considerable quantity until the latter part of the year, when an embargo similar to that on Ceylon graphite was imposed by the French Government. Most of this graphite, which is of the "flake" variety, requires cleaning after its arrival in this country. It sold for $100 to $150 a ton c. i. f. New York, according to grade.

The price of crude Chosen (Korea) amorphous graphite during 1914 ranged from $22.50 to $25 a ton c. i. f. New York City. Most of this graphite carries from 80 to 85 per cent of graphitic carbon.

Refined Mexican amorphous graphite of lead-pencil grade commonly sold in New York during the year at 4 to 6 cents a pound. For certain grades as high as 8 cents a pound was obtained.

Most of the American firms that produced flake graphite in 1914 reported good markets for their product. This prosperous condition in spite of the general financial depression is attributable to the shortage of Ceylon graphite. The prices were extremely variable, but, as a rule, from 6 to 8 cents a pound f. o. b. cars was obtained for the better grades of finished crucible and lubricating flake. After the outbreak of the war as high as 10 cents a pound was obtained for a few carload lots.

REVIEW BY STATES AND TERRITORIES.

ALABAMA.

Three firms produced graphite in Alabama in 1914. They were the Quenelda Graphite Co. and the Ashland Graphite Co., in Clay County, and the Flaketown Graphite Co., in Chilton County. The last firm installed early in the year a Huff electrostatic separator for the final refining of the flake graphite, with a view especially to the elimination of admixed mica. According to H. B. Johnson, who installed the electrostatic equipment, the product obtained ran over 94 per cent carbon in carload lots. As this process avoids the use of burrstone mills, practically no graphite "dust" is produced, all the product being coarser than 60 mesh. The "dust" brings comparatively small prices, hence the economy effected in this particular is important.

About December 1 a new company, the Jennings Graphite Co., with office at Lineville, in Clay County, began the mining of graphite about 3 miles north of Ashland.

ALASKA.

At the property of the Uncle Sam Alaska Mining Syndicate, on the north side of the Kigluaik Mountains, only assessment work was done during 1914. The Alaska Graphite Co. continued development work, but shipped no graphite to the United States during the year.

CALIFORNIA.

The California graphite properties visited by the writer in March and April of 1915 will be described at length in a later report after opportunity has been had for more careful study of the samples collected. The more salient features, however, are described below.

The graphite deposits of Los Angeles and San Diego counties resemble the characteristic deposits of New York, Pennsylvania, and Alabama in that the graphite occurs as crystalline "flakes" disseminated through a schist. The flakes in the California graphite schists are, however, much smaller than those in the eastern occurrences, most of them not exceeding 0.25 millimeter in diameter. For this reason the problem of their concentration is entirely different from that of the eastern deposits, nor would the concentrate be adapted for use in the manufacture of crucibles or other refractory products, in which a coarse flake is essential. On the other hand, the percentage of graphite in the California deposits appears to be nearly twice that of most of the eastern deposits of flake graphite. Another advantageous feature is the absence or great scarcity of mica, a mineral which, because of its flaky character, is particularly difficult to separate from flake graphite.

The California properties present, therefore, a number of favorable features. The fineness of the graphite undoubtedly renders difficult its complete separation from the gangue minerals, but there should be no great difficulty in obtaining a partial concentrate sufficiently rich in graphite to serve for foundry facings, boiler "compound," and paint pigment, while at the same time conducting experiments with a view to securing a more perfect product. For the uses mentioned above the graphite would have to compete with Korean amorphous graphite, which can be bought in New York at from $22.50 to $25 a ton and on the Pacific coast at a still lower figure.

SAN BERNARDINO COUNTY.

Several small graphite prospects occur in Eva Canyon, just north of Ontario and Upland. These are from half a mile to 1 mile from the mouth of the canyon and occur in an area of crystalline schists, with some associated granite pegmatite. At the graphite prospects the schists are much decomposed, and locally there has been much slipping parallel or nearly parallel to their foliation. The greatest width of highly graphitic material noted was about 5 feet. The graphite is crystalline but very fine grained, and is so intimately mixed with silicates that it could probably not be separated from them economically in deposits of such small size. The graphite layers dip steeply and would have to be mined by tunneling and stoping. The graphite and associated silicates if ground without attempt at concentration might command a local market for foundry facings, boiler compound, and paint pigment.

LOS ANGELES COUNTY.

A graphite property developed by the California Graphite Co., of Los Angeles, is located about 20 miles northeast of Saugus near the junction of Bear and San Francisquito canyons. Saugus, the nearest railroad point, is 20 miles distant, the haul being down hill all of the way. The property was discovered by G. A. Skinner in 1906, and since that time considerable development work has been done and some experiments in concentration conducted. The workings are on the steep mountain sides, 500 feet or so above the level of the neighboring streams, which would furnish an abundant supply of water for wet concentration to any mill erected near them.

The graphite occurs disseminated in very small flakes through a schist which near the surface is very much decomposed, so that it can be excavated without blasting and is easily crushed preparatory to concentration.

Microscopic study of samples from Prince No. 1 and No. 4 claims shows that nearly all of the graphite is in flakes 0.25 millimeter or less in diameter, although at the head of the wire tram on claim No. 1 schist carrying graphite flakes up to 1 millimeter in diameter was noted. The principal mineral of the graphite schist is a colorless amphibole, probably anthophyllite; other minerals in approximate order of abundance are quartz, feldspar, and pyrite, the latter in very small quantities. Determinations were made in the Survey laboratory of the percentage of graphite in three samples collected by the writer from this property, with the following results:

Samples of graphite schist from Los Angeles County, Cal.

	Percentage of graphite.
Composite sample of graphitic schist from many different localities on Prince No. 1 claim	7.29
Composite sample taken at intervals of about 1 foot across 50 feet of graphitic schist exposed in crosscuts in tunnel on Prince No. 4 claim	12.00
Sample of richest type of graphite schist from same tunnel	17.48

The development on Prince No. 1 claim includes a shaft 64 feet deep and a tunnel 108 feet long, all in the graphitic schist. The graphitic schist where seen in this claim forms a band from 8 to 20 feet in width and has been traced for over one-fourth mile along the north side of San Francisquito Valley. The graphitic schist is locally much sheared and in places faulted into contact with altered granite.

The next most extensive development has been on Prince No. 4 claim, nearly half a mile east of Prince No. 1 claim. Here there is a tunnel about 200 feet in length parallel to the schist foliation, which strikes northeast and is nearly vertical. Crosscuts aggregating 100 feet in length expose fully 70 feet of schist measured at right angles to the foliation. At least 50 feet of this 70 is highly graphitic. A biotite granite, somewhat gneissic in texture, is associated with the graphitic schist on this claim. Large samples from Prince No. 4 claim sent to Germany for experimental treatment are said to have concentrated 6 into 1, yielding a concentrate of lubricating grade.

SAN DIEGO COUNTY.

The Leebrick graphite mine is situated in the Mason Valley about 3 miles east of the head of Oriflame Creek, sec. 10, T. 14 S., R. 5 E. The elevation of the mine is between 2,600 and 2,700 feet. It is about 80 miles distant by road from San Diego and about 50 miles from Foster, the terminus of the San Diego & Southeastern Railway.

The workings consist of a short tunnel and several small open pits. Only development work has been done up to the present time.

The deposit is a band of graphitic schist with a maximum width of 70 to 80 feet which is traceable for a length of about 400 feet. At the south end of their exposure these schists strike about N. 70° W. (magnetic), but farther northwest the strike shifts to N. 45° W. (magnetic). The average dip is about 65° NE. The graphitic schists terminate on the southeast just below the main tunnel at a small gulch, which probably follows a fault. Beyond this, in line with the strike of the graphitic schists, occur only granite gneiss and pegmatite.

The percentage by weight of graphite in a composite sample of graphitic schist collected by the writer from a large number of places in this graphite deposit was determined in the Survey laboratory as 11.9 per cent. Microscopic study of the sample showed that most of the graphite occurred in flakes less than 0.2 millimeters in diameter. The associated minerals are quartz, brown hornblende, and a little pyrite.

The Seyer graphite property lies about 2 miles north of the Leebrick mine and has been developed by W. B. Seyer, of Julian, Cal. The property was not visited by the writer, but according to Mr. Seyer there are two graphite bands 4 and 12 feet wide, respectively. The graphite at this property is crystalline and occurs in flakes as a constituent of a schist. Most of the flakes are under 0.2 millimeters in diameter. An unusual phenomenon is the aggregation of the flakes locally to form rounded nodules of nearly pure graphite up to 1 centimeter across.

COLORADO.

Mr. Dexter T. Sapp, of Gunnison, Colo., reported the discovery of a vein of graphite in Gunnison County. The property is undeveloped. A small sample sent to the writer was a hard amorphous graphite.

The property of the Colorado Graphite Co. near Crested Butte, also in Gunnison County, was idle.

The Federal Graphite Co., with mine at Turret, in Chaffee County, did not operate during the year.

MONTANA.

The Crystal Graphite Co. continued the development of its mine near Dillon, Mont., and shipped a small quantity of graphite to graphite dealers in the Eastern States. The graphite from this property is crystalline and of very high grade, resembling in a general way the Ceylon product, though somewhat softer. The development work during the year disclosed important reserves of graphite in addition to those previously found.

SOUTH DAKOTA.

The writer is indebted to Mr. L. M. McBride, of the Mica Milling & Manufacturing Co., of Crawford, Nebr., for information in regard to an occurrence of graphite in the Black Hills. The deposit is about 1.4 miles by wagon road north of Oreville station on the Chicago, Burlington & Quincy Ry., in secs. 10 and 15, T. 2 S., R. 4 E., Pennington County. Two analyses of the material are as follows:

Analyses of graphite from Black Hills, S. Dak.

	1	2
Carbon	31.82	33.26
Silica	40.62	39.74
Sulphur	.03	.026

A sample seen by the writer was amorphous and when finely ground should be suitable for paint pigment and for foundry facings.

LITERATURE.

GENERAL TREATISES AND NEW PUBLICATIONS.

The best general treatise in English on the occurrence, methods of treatment, and uses of graphite is that by Fritz Cirkel, listed as No. 14 of the bibliography. During 1912 a report by B. L. Miller on the graphite deposits of Pennsylvania was published; it is listed as No. 44 of the accompanying bibliography. It describes in detail, with maps and illustrations, the graphite deposits of that State, describes briefly the occurrences of graphite in other parts of the country, and gives a large amount of general information on the character, treatment, and uses of graphite. The report may be obtained from Richard R. Hice, State geologist, Beaver, Pa.

The best general treatise on the geologic occurrence of graphite is that by Stutzer, listed as No. 75 of the bibliography. This summarizes the geology of the more important deposits of the world, but only touches briefly on uses and methods of treatment. The book is in German.

Two general treatises in German are the following: Der Graphit, by A. Haenig, 1910, and Der Graphit, by E. Donath, 1904.

The literature dealing with graphite is voluminous and contains many abstracts and quotations. The following list is selected, so far as possible, to avoid duplication and yet to convey all the important information relative to the occurrence and production of the mineral in the United States. Under each reference the general scope of the paper is described, and attention is directed to its most important features. Canadian publications are not listed unless they are of general interest or include mention of United States deposits. For references to the voluminous Canadian literature and many foreign publications the reader is referred to the monograph by Fritz Cirkel, already referred to.

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3. Arsem, W. C., Transformation of other forms of carbon into graphite: Am. Electro-Chem. Soc. Trans., vol. 20, pp. 105–119, 1911. Discusses experiments by the author and others bearing upon the question whether the transformation of ordinary carbon into graphite can take place by simple heating or only in the presence of certain impurities, which act as catalytic agents. In the author's experiments all samples were fired in a small tube furnace for 15 minutes at temperatures of approximately 3,000° to 3,300° C. Comparative tests were made of various forms of carbon when pure and when mixed with 5 to 10 per cent of impurities. The presence of impurities seemed in most cases to retard rather than to accelerate the conversion to graphite. The character of the carbon used appeared to be important, some forms, such as petroleum coke, being readily converted, while others, such as lampblack, were not graphitized. The author suggests that graphite may be defined as "that allotropic form of carbon having a specific gravity of 2.25 to 2.26."

4. Bayley, W. S., and Stewart, C. A., Note on the occurrence of graphite schist in Tuxedo Park, N. Y.; Econ. Geology, vol. 3, pp. 535–538, 1908. Observations in the New York and New Jersey Highlands west of the Hudson River indicate that graphite occurs (1) as a component of Franklin limestone, (2) in gneisses which may be in part altered sediments but are in places certainly mashed pegmatites, (3) in coarse granite dikes and pegmatites, and (4) in fine-grained quartzitic micaceous schists, especially where these are associated with pegmatites. The last-named occurrences are the most important. Concentrating works at Bloomingdale, Highbridge, and near Brookside have all failed. Describes in detail the occurrence of graphite in schists at Tuxedo Park. The graphite plates are usually in parallel intergrowth with biotite plates. The graphitic schist is believed to be the product of metamorphism of a sediment rich in organic matter. The pegmatite is graphitic only near the schist or where it carries fragments of this rock.

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6. Bastin, Edson S., Origin of certain Adirondack graphite deposits: Econ. Geology, vol. 5, pp. 134–157, 1910. All these deposits have resulted directly or indirectly from the metamorphism of carbonaceous sediments. There are two principal groups:

[1] The numerals given in this index are the numbers prefixed to the entries in the bibliography, pp. 168 to 174.

(1) Those which originated through dynamic (regional) metamorphism alone, and (2) those which have been affected by both dynamic and igneous (contact) metamorphism. Most of the disseminated deposits of crystalline graphite which are worked belong to the first class. To the second or contact metamorphic class belong the deposit at Lead Hill, near Ticonderoga, and the deposits worked by the Crown Point Graphite Co., just north of Chilson Lake. A study of quartz associated with the graphite at the Lead Hill mine indicates that the temperatures at which the graphite and associated minerals crystallized probably did not exceed 575° C.

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50. ——— vol. 8, pp. 348–352, 1899. Description, by T. C. Hopkins, of the occurrence of graphite in Berks County, Pa. Discussion, by E. G. Acheson, of artificial graphite.

51. ——— vol. 9, pp. 378–383, 1900. Discussion, by F. S. Hyde, of assay of graphite by blast and fusion.

52. ——— vol. 10, pp. 367–373, 1901. Two pages devoted to manufactured graphite.

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63. ——— Bull. 120, pp. 29–31, 1907. Describes briefly mines near Conklingville, in Saratoga County, and near Rossie, in St. Lawrence County. Discusses effects of presence of mica and influence of size of graphite flake in concentration.

64. ——— Bull. 142, pp. 37–38, 1909. Describes the graphite property of W. H. Faxon, near "Graphite."

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81. Smith, Philip S., Investigations of the mineral deposits of Seward Peninsula: U. S. Geol. Survey Bull. 345, p. 250, 1908. Abstract in this report. Describes briefly (one-half page) the character and mode of occurrence of graphite on the north side of the Kigluaik Mountains, Alaska.

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83. Standish, Alfred, The electric furnace, pp. 142–149, 1908. Good summary of processes and principles of the commercial production of artificial graphite and diagrams of electric furnaces used.

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84. TOWNSEND, C. P., The artificial production of graphite: Elec. World and Engineer, vol. 37, pp. 546–550, 1901. An excellent review of the various methods of the artificial production of graphite, and a discussion of the chemical changes involved.

85. WALCOTT, C. D., Pre-Cambrian fossiliferous formations: Geol. Soc. America, Bull., vol. 10, p. 227, 1899. Devotes one paragraph to the mine at "Graphite" in Hague, Essex County, N. Y. "The appearance [of this graphitic bed] is that of a fossil coal bed, the alteration having changed the coal to graphite and the sandstone to indurated, garnetiferous, almost quartzitic sandstones." Reproduces photograph of graphitic bed (pl. 22).

86. WALKER, JOHN A., The manufacture and use of lead pencils: Graphite Tradesman (published by Joseph Dixon Crucible Co.), August 15, 1906. History and method of lead-pencil manufacture.

87. WATSON, THOMAS L., Mineral resources of Virginia, pp. 188–190, 1907. (Published by Jamestown Exposition Commission.) Mentions the localities at which graphite has been found in Virginia. No detailed descriptions.

88. WHITE, DAVID, Some problems of the formation of coal: Econ. Geology, vol. 3, p. 298, 1908. The discovery of hydrocarbon-bearing strata composed largely of such organisms (algæ) in rocks as old as the Ordovician strongly suggests an algal origin for the graphites interbedded in still older metamorphic sediments of the Laurentian or the Algonkian.

89. WINCHELL, ALEXANDER V., Graphite near Dillon, Mont.: U. S. Geol. Survey Bull. 470, pp. 528–532, 1911. See next reference.

90. ——— A theory for the origin of graphite as exemplified in the graphite deposit near Dillon, Mont.: Econ. Geology, vol. 6, pp. 218–230, 1911. This article covers in more detail the same ground as 89. It describes the mode of occurrence of graphite on the property of the Crystal Graphite Co., near Dillon, and discusses various theories of graphite formation. To account for the veinlike deposits the writer suggests that a reversible reaction may have taken place whereby the water vapor of a granitic magma first reacted with carbon in bordering carbonaceous rocks with the resulting formation of oxides of carbon (mainly CO) and hydrogen; that these gases became incorporated in the magma; and that they were finally given off as the magma cooled and penetrated fissures in the rock where, through a reversal of the reaction, graphitic carbon and water were formed.

MINERAL WATERS.

By R. B. Dole.

CHARACTER OF STATISTICS.

The following statistics on the production of domestic mineral waters have been compiled from individual reports furnished by the owners or operators of springs, and they are intended to include only statistics on natural waters that are bottled and sold in their natural state or only slightly altered from their natural state. Natural still waters that have been artificially carbonated and natural carbonated waters that have lost part of their carbon dioxide are included, and doubtless some waters from which iron has been removed are also included; but artificial waters and natural waters that have been flavored, concentrated, fortified, diluted, or otherwise essentially modified in chemical character are excluded in so far as available information permits such segregation. Waters that are sold by flat or meter rates or are delivered to consumers through pipes or that are otherwise obviously municipal supplies or adjuncts to them are excluded. This is the nearest that it is practicable to approach the commonly accepted definition of a natural mineral water. No distinction is made between mineral water flowing or pumped from a natural spring and that flowing or pumped from a dug, bored, driven, or drilled well. Many of the best known mineral waters in the United States come, not from springs, as is popularly supposed, but from wells.

Distinction for practical purposes between table and medicinal waters is entirely arbitrary. In general, table waters are clear and sparkling and without distinct mineral taste or odor; many medicinal waters are highly mineralized or have a distinct taste and odor. Yet some table waters are more strongly mineralized than some medicinal waters and many medicinal waters contain less mineral matter than certain city supplies. A logical distinction between medicinal and other waters might be based on minimum contents of certain substances that cause physiologic reaction; practically, however, no such distinction is made in this country. The basis used in this report for separating medicinal from table waters is the report of the spring owner, and his separation is based in turn on his personal knowledge that some of his customers buy the water to use regularly on their tables as a beverage and that others buy it for an aid during illness. A few strongly mineralized waters are not sold as table waters and a few widely sold table waters are not used medicinally, but most waters are sold for both uses.

The statistics do not include the water given away or consumed at spring resorts, which constitutes a large part of the annual production.

MINERAL-WATER TRADE IN 1914.

OUTPUT AND VALUE.

The two following tables give the production and value by States of mineral waters marketed in 1913 and 1914, the number of commercial springs, the average price per gallon, and the value both of medicinal and of table waters, together with the total quantity and value. The quantity of mineral water used in the manufacture of soft drinks and the quantity and value of imported waters are given in later tables.

Production and value of mineral waters in the United States, 1913 and 1914, by States.

1913.

State.	Commercial springs.	Quantity sold.	Average price per gallon.	Value of medicinal waters.	Value of table waters.	Total value.
		Gallons.	*Cents.*			
Alabama	15	169,687	11	$7,528	$11,815	$19,343
Arkansas	16	1,428,869	11	87,246	64,166	151,412
California	49	2,801,393	19	176,597	355,328	531,925
Colorado	11	1,053,429	9	11,008	78,812	89,820
Connecticut	43	2,458,327	6	1,566	135,312	136,878
Florida	10	343,123	11	20,290	17,184	37,474
Georgia	18	750,893	9	7,205	62,237	69,442
Illinois	21	1,216,442	6	6,872	61,677	68,549
Indiana	16	383,577	54	188,062	17,559	205,621
Iowa	5	48,665	15	1,495	5,874	7,369
Kansas	14	337,193	18	49,195	10,831	60,026
Kentucky	14	475,675	11	26,879	26,455	53,334
Louisiana	5	700,795	6	5,643	34,014	39,657
Maine	32	1,174,262	31	93,238	275,198	368,436
Maryland	12	1,390,437	9	6,000	120,883	126,883
Massachusetts	60	3,907,395	6	26,445	187,357	213,802
Michigan	20	884,893	6	3,605	49,037	52,642
Minnesota	16	4,802,053	4	5,682	178,077	183,759
Mississippi	12	346,652	24	70,855	10,945	81,800
Missouri	34	697,467	12	61,044	23,272	84,316
Montana	3	180,200	2	70	3,176	3,246
Nebraska	3	105,985	10	3,360	7,239	10,599
Nevada	3	4,897	32	0	1,584	1,584
New Hampshire	9	402,355	3	200	12,507	12,707
New Jersey	14	2,067,277	9	1,438	187,108	188,546
New Mexico	4	154,800	11	790	15,940	16,730
New York	64	9,801,255	9	67,705	803,896	871,601
North Carolina	17	176,068	14	18,006	5,871	23,877
North Dakota	5	582,356	3	2,003	12,400	14,403
Ohio	33	3,317,639	4	16,895	108,189	125,084
Oklahoma	12	502,439	5	3,370	22,861	26,231
Oregon	8	68,413	28	6,240	13,169	19,409
Pennsylvania	43	2,163,931	9	19,323	171,136	190,459
Rhode Island	7	444,036	6	0	28,535	28,535
South Carolina	15	261,412	19	36,681	12,518	49,199
Tennessee	23	1,088,034	6	44,762	20,143	64,905
Texas	38	1,187,612	11	127,361	5,127	132,488
Vermont	4	17,725	40	168	6,900	7,068
Virginia	49	2,873,288	10	105,498	192,975	298,473
Washington	6	150,498	13	9,175	9,659	18,834
West Virginia	10	316,749	17	21,659	30,600	52,259
Wisconsin	34	6,326,533	14	83,982	788,536	872,518
Wyoming	4	16,200	22	2,110	1,500	3,610
Other States [a]	7	286,470	6	754	15,784	16,538
Total	838	57,867,399	10	1,428,005	4,203,386	5,631,391

[a] Includes Delaware, District of Columbia, South Dakota, and Utah.

Production and value of mineral waters in the United States, 1913 and 1914, by States—Continued.

1914.

State.	Commercial springs.	Quantity sold.	Average price per gallon.	Value of medicinal waters.	Value of table waters.	Total value.
		Gallons.	*Cents.*			
Alabama	15	169,279	10	$7,614	$9,511	$17,125
Arkansas	18	1,314,159	9	67,260	47,945	115,205
California	48	2,282,569	22	212,067	285,856	497,923
Colorado	12	968,260	12	7,132	106,281	113,413
Connecticut	42	2,341,082	6	2,301	132,177	134,478
Florida	11	231,160	11	3,315	21,423	24,738
Georgia	19	652,566	8	8,601	41,058	49,659
Illinois	21	1,760,030	5	3,586	77,721	81,307
Indiana	17	382,247	36	125,975	12,143	138,118
Iowa	7	303,827	10	15,141	15,038	30,179
Kansas	15	272,722	21	52,065	4,375	56,440
Kentucky	12	437,334	13	32,950	23,544	56,494
Louisiana	5	576,138	6	3,643	27,919	31,562
Maine	29	1,082,631	31	88,348	244,886	333,234
Maryland	10	1,691,776	7	0	124,403	124,403
Massachusetts	52	3,084,385	6	19,435	154,889	174,324
Michigan	22	931,343	8	12,252	58,058	70,310
Minnesota	15	5,639,232	3	509	193,532	194,041
Mississippi	8	415,904	18	72,100	968	73,068
Missouri	36	583,288	13	56,647	18,146	74,793
Montana	3	100,700	6	10	5,545	5,555
Nebraska	3	10,900	14	650	840	1,490
Nevada	3	221,942	1	0	3,191	3,191
New Hampshire	7	194,418	6	875	10,856	11,731
New Jersey	17	1,710,030	9	1,500	154,149	155,649
New Mexico	3	41,000	16	90	6,510	6,600
New York	69	8,201,202	8	61,845	611,068	672,913
North Carolina	17	158,226	14	16,496	5,468	21,964
North Dakota	4	408,000	2	1,050	7,100	8,150
Ohio	35	3,558,413	4	19,232	126,354	145,586
Oklahoma	12	804,675	3	2,697	24,209	26,906
Oregon	7	57,800	22	2,115	10,695	12,810
Pennsylvania	47	2,457,626	9	11,372	202,380	213,752
Rhode Island	6	438,702	7	0	29,639	29,639
South Carolina	13	293,949	16	41,231	6,840	48,071
South Dakota	3	145,647	6	508	8,491	8,999
Tennessee	23	943,502	6	35,102	21,639	56,741
Texas	31	766,597	12	91,542	1,472	93,614
Vermont	4	51,151	17	1,700	6,900	8,600
Virginia	50	2,906,976	10	107,332	186,180	293,512
Washington	6	180,787	16	19,062	9,715	28,777
West Virginia	10	307,890	16	19,702	29,427	49,129
Wisconsin	35	5,145,452	11	69,412	518,961	588,373
Wyoming	3	69,658	13	3,950	4,852	8,802
Other States [a]	4	63,291	2	23	1,537	1,560
Total	829	54,358,466	9	1,298,437	3,593,891	4,892,328

[a] Includes Delaware, District of Columbia, and Utah.

Though reports were received for the first time from 78 springs, the active springs were fewer and the production and value of both medicinal and table water were less in 1914 than in 1913. The total quantity sold in 1914 was 54,358,466 gallons, valued at $4,892,328, whereas in 1913 the sales were 57,867,399 gallons, valued at $5,631,391. The decrease in production was 3,508,933 gallons, or 6 per cent, and the decrease in value was $739,063, or 13 per cent. The decrease in value was apportioned, to medicinal waters $129,568, and to table waters $609,495; in other words, the decline in value of table waters was nearly five times the decline in value of medicinal waters; and as the average price per gallon of table waters is considerably lower than that of medicinal waters the decrease in quantity of table water sold was correspondingly greater. The decrease in consumption of bottled table waters is doubtless caused mostly by improvement in the quality of municipal water supplies and the consequent decreased necessity for the more expensive bottled supplies. The slight decrease of the average price per gallon from 10 to 9 cents is caused partly by general decrease in the sales of high-priced waters, but mostly by decrease in the price of individual waters. The State of New York leads in number of commercial springs, in quantity and total value of water sold, and in value of table waters, though it is far behind in the value of medicinal waters, in the sales of which California takes first rank. Indiana and Virginia are also notable producers of medicinal waters. In the value of table waters Wisconsin is second only to New York and is followed at some distance by California, Maine, and Pennsylvania. Following New York in number of active springs are, in order, Massachusetts, Virginia, California, Pennsylvania, and Connecticut. In total value of output New York is followed, in order, by Wisconsin, California, Maine, and Virginia.

The number of springs that reported sales in 1914 was 829, as compared with 838 in 1913, a decrease of 9. No reports of mineral-water sales were received from Arizona or Idaho, and less than three active springs were reported from Delaware, Utah, and the District of Columbia; in all other States, however, three or more springs were active. Sales exceeded 5,000,000 gallons in three States—New York, Minnesota, and Wisconsin; and more than 1,000,000 gallons was produced in each of 14 States. The total value of the output in New York and Wisconsin exceeded $500,000, and in 15 States it exceeded $100,000.

CONDITION OF TRADE.

The maximum production and value of mineral waters in 1909 were not quite equaled in 1911, and since the latter year the returns have shown a distinct decrease in the business, despite extension of the field of inquiry and increase in the number of correspondents. This decline has apparently resulted from gradually decreasing demand for bottled water in cities whose public water supplies have been improved in quality. This falling off has been accompanied by a general drop in price that may be attributed chiefly to demand for good, pure, potable bottled drinking water in place of the former demand for water reputed to have exceptional curative properties.

In 1914, as in 1913, nearly half the trade in mineral waters was in the hands of a few very large producers. Five springs, as in 1913, sold more than 1,000,000 gallons each, and 18 springs, as compared with 20 in 1913, sold more than 500,000 gallons each. The total output of these 18 springs was 22,056,366 gallons, valued at $1,664,701; the total output of the 20 largest producers in 1913 was 23,408,057 gallons, valued at $2,090,126. Fifty-one springs in 1914 did more than $20,000 worth of business each, selling a total of 26,731,787 gallons for $3,050,563. Fifty-four springs in 1913 did more than $20,000 worth of business each, selling a total of 28,769,596 gallons for $3,642,964. The decrease in quantity of mineral waters sold by the large producers is equivalent to 7 per cent, nearly the same as the decrease for the entire country; the decrease in value is equivalent to 16 per cent, or slightly more than that for the entire country, the apparent discrepancy between these percentages being caused by general reduction in price. It should not be forgotten, however, that in addition to these few large producers there were 778 others whose sales ranged from $5 to $20,000 and whose fields of activity occupy every State in the Union except Arizona and Idaho.

Increase of production is reported from 15 States, as compared with 20 States in 1913. The sales in Iowa were four times and those in Nevada and Wyoming more than twice the sales in 1913. Among the 14 States of the million-gallon class, 6 report increase and 8 decrease of production, though in 1 of the 14 States the change was practically nothing. The greatest relative increase was in Illinois (45 per cent), and the greatest relative decreases were in Massachusetts (21 per cent), California (19 per cent), and Wisconsin (19 per cent).

Comparative production of mineral waters, 1913–1914.

State.	1913			1914			Increase (+) or decrease (−) in number of springs.	Increase (+) or decrease (−) in quantity sold.	Percentage of increase (+) or decrease (−) in quantity sold.	Increase (+) or decrease (−) in value of product.	Percentage of increase (+) or decrease (−) in value of product.
	Commercial springs.	Quantity sold.	Value.	Commercial springs.	Quantity sold.	Value.					
		Gallons.			*Gallons.*			*Gallons.*			
Alabama	15	169,687	$19,343	15	169,279	$17,125	0	− 408	− 0.2	− $2,218	− 11
Arkansas	16	1,428,869	151,412	18	1,314,159	115,205	+2	− 114,710	− 8	− 36,207	− 24
California	49	2,801,393	531,925	48	2,282,569	497,923	−1	− 518,824	− 19	− 34,002	− 6
Colorado	11	1,053,429	89,820	12	968,260	113,413	+1	− 85,169	− 8	+ 23,593	+ 26
Connecticut	43	2,458,327	136,878	42	2,341,082	134,478	−1	− 117,245	− 5	− 2,400	− 2
Delaware	1	(a)	(a)	1	(a)	(a)	0	(a)	(a)	(a)	(a)
District of Columbia	2	(a)	(a)	2	(a)	(a)	0	(a)	(a)	(a)	(a)
Florida	10	343,123	37,474	11	231,160	24,738	+1	− 111,963	− 33	− 12,736	− 34
Georgia	18	750,893	69,442	19	652,566	49,659	+1	− 98,327	− 13	− 19,783	− 29
Illinois	21	1,216,442	68,549	21	1,760,030	81,307	0	+ 543,588	+ 45	+ 12,758	+ 19
Indiana	16	383,577	205,621	17	382,247	138,118	+1	− 1,330	− .4	− 67,503	− 33
Iowa	5	48,665	7,369	7	303,827	30,179	+2	+ 255,162	+ 524	+ 22,810	+310
Kansas	14	337,193	60,026	15	272,722	56,440	+1	− 64,471	− 19	− 3,586	− 6
Kentucky	14	475,675	53,334	12	437,334	56,494	−2	− 38,341	− 8	+ 3,160	+ 6
Louisiana	5	700,795	39,657	5	576,138	31,562	0	− 124,657	− 18	− 8,095	− 20
Maine	32	1,174,262	368,436	29	1,082,631	333,234	−3	− 91,631	− 8	− 35,202	− 10
Maryland	12	1,390,437	126,883	10	1,691,776	124,403	−2	+ 301,339	+ 22	− 2,480	− 2
Massachusetts	60	3,907,395	213,802	52	3,084,385	174,324	−8	− 823,010	− 21	− 39,478	− 18
Michigan	20	884,893	52,642	22	931,343	70,310	+2	+ 46,450	+ 5	+ 17,668	+ 34
Minnesota	16	4,802,053	183,759	15	5,639,232	194,041	−1	+ 837,179	+ 17	+ 10,282	+ 6
Mississippi	12	346,652	81,800	8	415,904	73,068	−4	+ 69,252	+ 20	− 8,732	− 11
Missouri	34	697,467	84,316	36	583,288	74,793	+2	− 114,179	− 16	− 9,523	− 11
Montana	3	180,200	3,246	3	100,700	5,555	0	− 79,500	− 44	+ 2,309	+ 71
Nebraska	3	105,985	10,599	3	10,900	1,490	0	− 95,085	− 90	− 9,109	− 86
Nevada	3	4,897	1,584	3	221,942	3,191	0	+ 217,045	+4,432	+ 1,607	+101
New Hampshire	9	402,355	12,707	7	194,418	11,731	−2	− 207,937	− 52	− 976	− 8
New Jersey	14	2,067,277	188,546	17	1,710,030	155,649	+3	− 357,247	− 17	− 32,897	− 17
New Mexico	4	154,800	16,730	3	41,000	6,600	−1	− 113,800	− 74	− 10,130	− 61
New York	64	9,801,255	871,601	69	8,201,202	672,913	+5	−1,600,053	− 16	−198,688	− 23
North Carolina	17	176,068	23,877	17	158,226	21,964	0	− 17,842	− 10	− 1,913	− 8
North Dakota	5	582,356	14,403	4	408,000	8,150	−1	− 174,356	− 30	− 6,253	− 43
Ohio	33	3,317,639	125,084	35	3,558,413	145,586	+2	+ 240,774	+ 7	+ 20,502	+ 16
Oklahoma	12	502,439	26,231	12	804,675	26,906	0	+ 302,236	+ 60	+ 675	+ 3
Oregon	8	68,413	19,409	7	57,800	12,810	−1	− 10,613	− 16	− 6,599	− 34
Pennsylvania	43	2,163,931	190,459	47	2,457,626	213,752	+4	+ 293,695	+ 14	+ 23,293	+ 12
Rhode Island	7	444,036	28,535	6	438,702	29,639	−1	− 5,334	− 1	+ 1,104	+ 4
South Carolina	15	261,412	49,199	13	293,949	48,071	−2	+ 32,537	+ 12	− 1,128	− 2
South Dakota	2	(a)	(a)	3	145,647	8,999	+1	(a)	(a)	(a)	(a)

Tennessee	23	1,088,034	64,905	23	943,502	56,741	0	− 144,532	− 13	− 8,164	− 13
Texas	38	1,187,612	132,488	31	766,597	93,014	−7	− 421,015	− 35	− 39,474	− 30
Utah	2	(a)	(a)	1	(a)	(a)	−1	(a)	(a)	(a)	(a)
Vermont	4	17,725	7,068	4	51,151	8,600	0	+ 33,426	+ 189	+ 1,532	+ 22
Virginia	49	2,873,288	298,473	50	2,906,976	293,512	+1	+ 33,688	+ 1	− 4,961	− 2
Washington	6	150,498	18,834	6	180,787	28,777	0	+ 30,289	+ 20	+ 9,943	+ 53
West Virginia	10	316,749	52,259	10	307,890	49,129	0	− 8,859	− 3	− 3,130	− 6
Wisconsin	34	6,326,533	872,518	35	5,145,452	588,373	+1	−1,181,081	− 19	−284,145	− 33
Wyoming	4	16,200	3,610	3	69,658	8,802	−1	+ 53,458	+ 330	+ 5,192	+144
Other States [b]	....	286,470	16,538	....	63,291	1,560	....	− 77,532	− 27	− 5,979	− 36
Total	838	57,867,399	5,631,391	829	54,358,466	4,892,328	−9	−3,508,933	− 6	−739,033	− 13

[a] Included under other States.
[b] Includes in 1913 Delaware, District of Columbia, South Dakota, and Utah; in 1914 Delaware, District of Columbia, and Utah.

RANGE OF PRICE.

The following table shows the number of springs and the quantity and value of mineral water sold within certain ranges of price during 1913 and 1914. Effort has been made to eliminate freight and marketing charges and the value of returnable containers, and thus to give the net value of the waters at their sources.

Range of price per gallon of mineral water in 1913 and 1914.

1913.

Price per gallon (in cents).	Number of springs.	Quantity sold.	Value.	Percentage of number of springs.	Percentage of total quantity.	Percentage of total value.
		Gallons.				
Not more than 2	34	5,693,870	$91,631	4	10	2
More than 2 and not more than 5	215	17,563,048	673,467	26	30	12
More than 5 and not more than 10	280	22,601,519	1,875,768	34	39	33
More than 10 and not more than 20	146	7,559,012	1,191,177	18	13	21
More than 20 and not more than 30	59	1,828,538	440,667	7	3	8
More than 30 and not more than 50	62	1,762,602	689,389	8	3	12
More than 50 and not more than 100	19	812,787	610,085	2	2	11
More than 100	5	46,023	59,207	1	0	1
Total	[a] 820	57,867,399	5,631,391	100	100	100

1914.

Price per gallon (in cents).	Number of springs.	Quantity sold.	Value.	Percentage of number of springs.	Percentage of total quantity.	Percentage of total value.
Not more than 2	47	6,132,309	$86,803	6	11	2
More than 2 and not more than 5	213	17,475,662	656,734	26	32	13
More than 5 and not more than 10	265	20,518,356	1,649,027	32	38	34
More than 10 and not more than 20	135	6,802,412	981,820	17	13	20
More than 20 and not more than 30	65	1,149,407	287,933	8	2	6
More than 30 and not more than 50	59	1,438,353	612,120	7	3	12
More than 50 and not more than 100	23	799,131	564,267	3	1	12
More than 100	5	42,836	53,624	1	0	1
Total	[b] 812	54,358,466	4,892,328	100	100	100

[a] Exclusive of 18 springs whose waters are used exclusively for the manufacture of soft drinks.
[b] Exclusive of 17 springs whose waters are used exclusively for the manufacture of soft drinks.

Mineral waters as a class have a wider range of price than almost any other mineral product. During both 1913 and 1914 practically four-fifths of the mineral water was sold at prices ranging from one-half cent to 10 cents a gallon, and in 1914 only 4 per cent was sold at prices greater than 30 cents a gallon. In 1914 the water from 525 springs was sold for 10 cents or less a gallon, and the water from 5 springs was sold at prices ranging from about $1 to about $5 a gallon. Comparison of the prices for the two years reveals no marked differences in their general range, though the prices of many waters have been changed. As a general rule most of the higher priced waters are sold for medicinal use, though the demand for several well-known table waters has sustained their high prices. The average price per gallon in 1914 was 9 cents. The table on page 218 indicates that the general trend is toward decrease in price.

SOFT DRINKS.

Returns show that 6,261,743 gallons of mineral water was used in the United States in the manufacture of soft drinks during 1914, as compared with 5,259,494 gallons in 1913, an increase of 19 per cent.

The gross distribution of this consumption is indicated in the following table. Massachusetts, Wisconsin, and Minnesota head the list with consumptions of more than 500,000 gallons, and in each of 16 other States more than 100,000 gallons of mineral water was used in the manufacture of soft drinks. These data do not in any way represent the total production of soft drinks, by far the greater part of which are compounded with municipal and private supplies not classified as mineral waters.

Mineral water used in the manufacture of soft drinks, 1914, by States.

Rank.	State.	Quantity.	Rank.	State.	Quantity.
		Gallons.			*Gallons.*
1	Massachusetts	801,713	12	North Dakota	190,000
2	Wisconsin	722,659	13	Maine	189,393
3	Minnesota	581,032	14	Colorado	165,915
4	Connecticut	484,094	15	Arkansas	150,000
5	Ohio	357,831	16	Michigan	145,347
6	Missouri	310,816	17	Iowa	145,259
7	New Hampshire	280,644	18	Nebraska	121,200
8	Pennsylvania	276,357	19	Maryland	121,000
9	New York	222,925		Other States	531,633
10	Illinois	215,833			
11	South Carolina	193,092		Total	6,231,743

EXPORTS.

Large quantities of a few domestic waters are exported, but no statistics regarding such shipments are available. The quantity and the value of these waters are included in the statistics of production for the United States.

IMPORTS.

The total imports of natural and artificial waters entered for consumption in 1914, as reported by the Bureau of Foreign and Domestic Commerce, Department of Commerce, amounted to 2,786,142 gallons, valued at the points of shipment at $857,707. In 1913 the imports amounted to 3,364,676 gallons, valued at $955,788; thus there was in 1914 a decrease of 17 per cent in quantity and 10 per cent in value. Though the importation of mineral water has decreased every year since 1911, the decline in 1914 was more than might be attributed to decreased demand for foreign waters. As in 1913, more than two-thirds of the imported water consumed in the United States came from France, Germany, and Austria-Hungary. More than 1,000,000 gallons each was imported from France and Germany; the trade in mineral water with France increased about 10 per cent, while that with Germany decreased about 40 per cent. The imports from Austria-Hungary dropped from nearly 400,000 gallons in 1913 to slightly more than 300,000 gallons in 1914, the imports from Italy were doubled, and those from England and Spain were nearly the same as in 1913. The imports from Belgium were only one-third and those from the Netherlands one-half the imports in 1913. The rate of importation was slightly greater between July and December than between January and June.

Statistics regarding importations from 1883 to 1914, inclusive, are given on page 219.

MINERAL-WATER TRADE BY STATES.

ALABAMA.

Returns from Alabama indicate that the mineral-water trade in 1914 was much the same as in 1913. The sales amounted to 169,279 gallons, or 408 gallons less than in 1913, and the value of the output was $17,125, or $2,218 less than in 1913. The average price was 10 cents a gallon, against an average of 11 cents in 1913. The decrease in value was principally in table waters. Fourteen springs reported sales; four springs from which no reports were obtained have been considered idle. One spring idle in 1913 was active in 1914, and one spring's output which was not reported was estimated on the basis of sales in 1913. McCary Mineral Well and Talladega Spring reported sales for the first time. Six bathing establishments and 7 resorts accommodating about 1,200 guests were maintained. In addition to the quantity reported as sold, about 86,000 gallons of mineral water was used in the manufacture of soft drinks.

The following 14 springs reported sales:

Bailey Springs, Florence, Lauderdale County.
Bladon Springs, Bladon Springs, Choctaw County.
Bromberg Gulf Coast Lithia Spring, Bayou Labatre, Mobile County.
Cooks Spring, Cooks Springs, St. Clair County.
Dixie Spring, Dixie Spring, Walker County.
Ingram Lithia Well, near Ohatchee, Calhoun County.
Livingston Mineral Spring, Livingston, Sumter County.
Luverne Mineral Spring, Luverne, Crenshaw County.
McCary Mineral Well, near Birmingham, Jefferson County.
Matchless Mineral Wells, east of Greenville, Butler County.
Purity Spring, Spring Hill, Mobile County.
Shocco Spring, Talladega, Talladega County.
Talladega Springs, Talladega, Talladega County.
White Sulphur Wells, near Jackson, Clarke County.

ARKANSAS.

The mineral-water business in Arkansas decreased somewhat during 1914, the total sales having decreased from 1,428,869 gallons, valued at $151,412, in 1913 to 1,314,159 gallons, valued at $115,205, in 1914, a decrease of 8 per cent in quantity and of 24 per cent in value. The average price per gallon dropped from 11 to 9 cents. The disproportionate decrease in value, accompanied by a decrease in average price, was caused partly by decrease in the price of waters having large sales and partly by increased sales of low-priced waters.

The following table shows the record for the last five years:

Production and value of mineral waters in Arkansas, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	10	1,065,676	$89,772	8
1911	8	1,560,157	118,994	8
1912	11	1,396,032	132,257	10
1913	16	1,428,869	151,412	11
1914	18	1,314,159	115,205	9

Sales were reported for the first time from Crystal Lithox Spring and Raleigh Spring; one spring idle in 1913 was active in 1914 and one spring active in 1913 was idle in 1914; thus the number of active springs increased to 18. The number of bathing establishments increased from 3 to 4, and the accommodations for guests increased from 5,500 to 5,800, exclusive of the capacity of Hot Springs. Nearly two-thirds of the mineral water was sold for medicinal use.

The United States Government maintains under the direction of the Secretary of the Interior the Hot Springs Reservation of about 900 acres, including Hot Springs Mountain, North Mountain, West Mountain, Sugarloaf Mountain, and Whittington Lake Park. The springs are all grouped about the base of Hot Springs Mountain, their aggregate flow being somewhat more than 800,000 gallons a day. Twenty-three pay bath houses and the Army and Navy General Hospital are supplied with hot water from these springs. The majority of the active springs of Arkansas are at or near Hot Springs.

The 18 springs reporting sales are as follows:

Arkansas Lithia Springs, near Hope, Hempstead County.
Arsenic Spring, Hot Springs, Garland County.
Blue Spring, Eureka, Carroll County.
Chewaukla Spring, Hot Springs, Garland County.
Crystal Lithox Spring, Hot Springs, Garland County.
De Soto Springs, Hot Springs, Garland County.
Glenaqua Mineral Springs, Hot Springs, Garland County.
Happy Hollow Spring, Hot Springs, Garland County.
Imperial Spring, Hot Springs, Garland County.
Iron and Magnesia Springs, Hot Springs, Garland County.
Lithia and Sulphur Springs, Sulphur Springs, Benton County.
Mountain Blood Spring, near Hot Springs, Garland County.
Mountain Valley Springs, Mountain Valley, Garland County.
Oaklawn Mineral Well, Hot Springs, Garland County.
Ozarka Spring, Eureka Springs, Carroll County.
Park Springs, Bentonville, Benton County.
Potash Sulphur Springs, Lawrence, Garland County.
Raleigh Springs, Little Rock, Pulaski County.

CALIFORNIA.

There was a decrease during 1914 in the mineral-water sales of California, 2,282,569 gallons having been reported, as compared with 2,801,393 gallons in 1913, a decrease of 19 per cent. The total value of the product, however, changed less, being $497,923 in 1914, as compared with $531,925 in 1913, a decrease of 6 per cent. This was chiefly because the sales of several high-priced medicinal waters were greater in 1914 than in 1913, in consequence of which the average price per gallon rose from 19 to 22 cents. Nearly half the reported sales were medicinal waters, in the production of which California ranked first in 1914. The State also ranked fourth in number of commercial springs and third in value of output. The following record of sales for the last five years shows a decline in value since 1911.

Production and value of mineral waters in California, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	41	2,008,697	$394,841	20
1911	40	2,310,237	578,439	25
1912	41	2,089,951	532,971	26
1913	49	2,801,393	531,925	19
1914	48	2,282,569	497,923	22

Nine new springs were added to the list of producers and another spring idle in 1913 reported sales in 1914; eight springs active in 1913 were reported idle in 1914 and reports were not obtained from three others. The number of active springs was 48, or 1 less than in 1913. Mineral-water baths were maintained at 18 springs, and 19 resorts capable of accommodating nearly 8,500 guests were operated. In addition 46,000 gallons was reported as having been used in the manufacture of soft drinks.

The 48 active springs are as follows:

Adams Springs, Adams, Lake County.
Ætna Springs, Lidell, Napa County.
Agua Caliente Springs, Agua Caliente, Sonoma County.
Alder Glen Springs, Cloverdale, Sonoma County.
Alhambra Springs, Martinez, Contra Costa County.
Alma Spring, Alma, Santa Clara County.
Barcal Springs, Preston, Sonoma County.
Bimini Hot Spring, Los Angeles, Los Angeles County.
Black Rock Spring, Hermon, Los Angeles County.
Boyes Hot Springs, Boyes Springs, Sonoma County.
Bythinia Springs, Santa Barbara, Santa Barbara County.
Calavichy Spring, Willits, Mendocino County.
Castalian Water, Keeler, Inyo County.
Castle Rock Springs, Eubanks, Shasta County.
Conscle Spring, Colton, Riverside County.
Cooks Springs, near Williams, Colusa County.
Crystal Spring, Los Angeles, Los Angeles County.
Deerlick Springs, Deer Lick Springs, Trinity County.
El Granito Spring, El Cajon, San Diego County.
Elliotta White Sulphur Spring, Riverside, Riverside County.
Elysian Spring, Los Angeles, Los Angeles County.
Holly Spring, Hollywood, Los Angeles County.
Lepori Vichy Springs, near Napa, Napa County.
Marin Mountain Spring, Sausalito, Marin County.
Mokelumne Hill Mineral Spring, Mokelumne Hill, Calaveras County.
Monterey Mineral Well, Monterey, Monterey County.
Napa Rock Soda Springs, Napa Soda Springs, Napa County.
Pope Mineral Spring, Pope Valley, Napa County.
Purity Spring, Sausalito, Marin County.
Radium Sulphur Spring, Colegrove, Los Angeles County.
Redwing Springs, Middletown, Lake County.
Richardsons Springs, Chico, Butte County.
Rose Spring, Los Angeles, Los Angeles County.
Samuel Soda Springs, Monticello, Napa County.
San Benito Mineral Well, near Hollister, San Benito County.
Shasta Springs, Shasta Springs, Siskiyou County.
Table Rock Spring, Little Shasta, Siskiyou County.
Tamalpais Mineral Well, San Rafael, Marin County.
The Geysers, The Geysers, Sonoma County.
Tia Juana Springs, San Ysidro, San Diego County.

Tolenas Springs, near Suisun City, Solano County.
Tuscan Springs, Tuscan, Tehama County.
Upper Soda Spring, Dunsmuir, Siskiyou County.
Valley Springs, Valley Springs, Calaveras County.
Veronica Medicinal Springs, near Santa Barbara, Santa Barbara County.
Walters Mineral Springs, Pope Valley, Napa County.
Wheelers Hot Springs, Wheeler Springs, Ventura County.
Witter Medical Springs, Witter Springs, Lake County.

COLORADO.

Returns from Colorado indicate a decrease in the quantity of water sold and an increase in the value of the product in 1914. The sales reported were 968,260 gallons, valued at $113,413, as compared with 1,053,429 gallons, valued at $89,820, in 1913. Though the decrease in quantity amounts to 8 per cent, the total value of the product increased $23,593, or 26 per cent, this being accompanied by an increase in the average price from 9 to 12 cents. There was a similar increase in value and average price in 1913, and this condition of the trade has been caused chiefly by increased sales of relatively high-priced waters and by increase of price of some of them. The sales of table water increased by more than $27,000 and constituted 95 per cent of the total.

The following record of sales for the last five years indicates a gradual recovery from the depression in 1912:

Production and value of mineral waters in Colorado, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	14	1,638,984	$115,289	7
1911	14	1,436,066	104,763	7
1912	11	1,178,308	75,314	6
1913	11	1,053,429	89,820	9
1914	12	968,260	113,413	12

Reports were received for the first time from Green Mineral Well and Waunita Hot Springs, and one spring active in 1913 was idle in 1914. Four bathing establishments and 2 resorts, which accommodated about 150 guests, were operated. Besides the quantity of mineral water reported sold, 165,915 gallons was used in the manufacture of soft drinks.

The 12 springs reporting are as follows:

Boulder Springs, Boulder Springs, 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.
A. J. Green Mineral Well, Canon City, Fremont County.
Navajo, Shoshone, Manitou, and Cheyenne springs, Manitou, El Paso County.
Pueblo Mineral Spring, Pueblo, Pueblo County.
Ute Chief Spring, Manitou, El Paso County.
Ute, Iron, Ouray, Little Chief, and Geyser springs, Manitou, El Paso County.
Waunita Hot Springs, Waunita Hot Springs, Gunnison County.
Yampah Spring, Glenwood Springs, Garfield County.

CONNECTICUT.

The sales of mineral water in Connecticut during 1914 amounted to 2,341,082 gallons, a decrease of 117,245 gallons, or 5 per cent, from sales in 1913; and the value of the output dropped from $136,878 in 1913 to $134,478 in 1914, a decrease of 2 per cent. There was a general decrease in the sales of table waters throughout the State and particularly in the vicinity of New Haven. The average price per gallon in 1914 was 6 cents, as in 1913. The record of sales for the last five years follows:

Production and value of mineral waters in Connecticut, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	24	1,608,775	$109,853	7
1911	28	2,164,701	182,744	8
1912	28	2,110,231	153,383	7
1913	43	2,458,327	136,878	6
1914	42	2,341,082	134,478	6

Five new springs reported sales: Beaver Spring, Glacier Spring, Granite Rock Artesian Well, Pine Spring, and Stillson Spring. Six springs active in 1913 were reported idle in 1914; thus the number of active springs was 42. Nearly all the water was sold for table use. No resorts or mineral-water baths were reported as having been in operation at any of the springs, but about 480,000 gallons was used in the manufacture of soft drinks.

The 42 active springs are as follows:

Althea Spring, Waterbury, New Haven County.
Arethusa Spring, Seymour, New Haven County.
Aspinock Spring, Putnam Heights, Windham County.
Bailey Spring, Mill Plain, Fairfield County.
Barcla Spring, Danbury, Fairfield County.
Beaver Spring, Ansonia, New Haven County.
Berkshire Spring, Cornwall Bridge, Litchfield County.
Buttress Spring, New Haven, New Haven County.
Chalybeate Spring, Oxford, New Haven County.
Cherry Hill Spring, Highwood, New Haven County.
Crystal Spring, near Little River, Middlesex County.
Crystal Spring, near Derby, New Haven County.
Diamond Spring, Cheshire, New Haven County.
East Hill Spring, Derby, New Haven County.
Elco Spring, Bristol, Hartford County.
Ellis Mountain Spring, Danbury, Fairfield County.
Glacier Spring, Bridgeport, Fairfield County.
Granite Rock Spring, Higganum, Middlesex County.
Granite Rock Artesian Well, Danbury, Fairfield County.
Gra-Rock Spring, Canton, Hartford County.
Hermitage Spring, Montowese, New Haven County.
Highland Spring, near Mount Higbee, Middlesex County.
Hillside Spring, West Meriden, New Haven County.
Hosmer Mountain Spring, Willimantic, Windham County.
Indian Spring, Shelton, Fairfield County.
Live Elm Spring, Meriden, New Haven County.
Live Oak Spring, Meriden, New Haven County.
Mammanasco Spring, Ridgefield, Fairfield County.
Mohawk Spring, Torrington, Litchfield County.
Mountainville Spring, Danbury, Fairfield County.

Oak Spring, Middletown, Middlesex County.
Park Spring, Willimantic, Windham County.
Pequabuck Mountain Spring, Bristol, Hartford County.
Pequot Mineral Spring, Old Mystic, New London County.
Pine Spring, Wallingford, New Haven County.
Red Rock Spring, Meriden, New Haven County.
Richardson Spring, Torrington, Litchfield County.
St. George Spring, Ridgefield, Fairfield County.
Stillson Spring, Fairfield, Fairfield County.
Tonica Spring, Highland Park, Hartford County.
Varuna Spring, North Stamford, Fairfield County.
Venture Rock Spring, Stonington, New London County.

DELAWARE.

Reports have been received from only one spring in Delaware during the last four years, the water being used principally on the table by residents of Wilmington. The spring is:

Kiamensi Spring, near Wilmington, Newcastle County.

DISTRICT OF COLUMBIA.

As only two springs, whose water is sold for table use, mainly in Washington, reported sales from the District of Columbia in 1914, statistics on them have been included with those of States having less than three reporting springs.

The same springs have reported for the last four years and are:

Gitchie Crystal Spring, Benning.
Red Oak Spring, near Langdon.

FLORIDA.

The sales of mineral water in Florida during 1914 showed a marked decrease as compared with those in 1913. The total sales amounted to 231,160 gallons, valued at $24,738, as compared with 343,123 gallons, valued at $37,474, in 1913. The average price per gallon remained 11 cents. The sales of water for medicinal use were about one-sixth of those in 1913, but the sales of table water notably increased. Bathing establishments were maintained at 7 and resorts at 4 springs. Magnesia Spring reported production for the first time, the number of active springs thus being increased to 11, as follows:

Chumuckla Mineral Spring, Chumuckla, Santa Rosa County.
Espiritu Santo Spring, Safety Harbor, Pinellas County.
Lackawanna Spring, near Jacksonville, Duval County.
Magnesia Spring, Grove Park, Alachua County.
Newport Sulphur Spring, Newport, Wakulla County.
Orange City Mineral Spring, Orange City, Volusia County.
Panacea Spring, Panacea, Wakulla County.
Purity Spring, Tampa, Hillsboro County.
Quisisana Spring, Green Cove Springs, Clay County.
Stomawa Well, near Tampa, Hillsboro County.
Wekiwa Springs, near Apopka, Orange County.

GEORGIA.

The total returns from Georgia indicate a falling off in quantity and value during 1914. The reduction occurred in sales of table water, the sales of medicinal water having increased 19 per cent.

The average price per gallon dropped from 9 to 8 cents. The total sales in 1914 amounted to 652,566 gallons, valued at $49,659, as compared with 750,893 gallons, valued at $69,442 in 1913, these figures corresponding to a decrease of 13 per cent in quantity and of 29 per cent in value. Resorts accommodating about 700 people were in operation at 8 springs and mineral-water baths were maintained at 5. Panther Spring reported production for the first time; one spring active in 1913 was reported idle in 1914, and one apparently idle in 1913 was reported active in 1914; thus the number of active springs increased to 19, the names and locations of which are given in the appended list:

Benscot Mineral Springs, Austell, Cobb County.
Bowden Lithia Spring, Lithia Springs, Douglas County.
Catoosa Springs, Catoosa Springs, Catoosa County.
Chalybeate Springs, Chalybeate, Meriwether County.
Cohutta Spring, Crandall, Murray County.
Daniel Mineral Spring, Union Point, Greene County.
Duke Spring, near Cedartown, Polk County.
Electric Spring, Hillman, Taliaferro County.
High Rock Spring, near Atlanta, Fulton County.
Holly Springs, Hollysprings, Cherokee County.
Jay Bird Spring, near Helena, Dodge County.
Miller's Mineral Spring, Milledgeville, Baldwin County.
Murrow Spring, Tifton, Tift County.
Panther Spring, near Augusta, Richmond County.
Pine Mountain Spring, West Point, Harris County.
Swift Lithia Spring, Elberton, Elbert County.
Utoy-Flora Spring, Utoy, Fulton County.
White Elk Spring, Macon, Bibb County.
White Oak Mineral Wells, Macon, Bibb County.

ILLINOIS.

There was a marked increase in the mineral-water business in Illinois during 1914. The total sales amounted to 1,760,030 gallons, as compared with 1,216,442 gallons in 1913, an increase of 45 per cent in quantity; and the total value was $81,307, as compared with $68,549 in 1913, an increase of 19 per cent in value. The average price per gallon dropped from 6 to 5 cents, chiefly through increased sales of low-priced table waters. There was a marked decrease in the sales of medicinal waters, but a much greater increase in the sales of table waters. The record of the State for the last five years is as follows:

Production and value of mineral waters in Illinois, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	16	1,117,620	$83,148	7
1911	14	1,304,950	82,330	6
1912	17	1,143,625	74,445	7
1913	21	1,216,442	68,549	6
1914	21	1,760,030	81,307	5

Reports were received from 21 active springs, 3 of which are new, Glen Rock Mineral Spring, Minerva Spring, and Woodmen Artesian Well. Three springs active in 1913 were idle in 1914. In addition to the quantity reported as sold, nearly 216,000 gallons of mineral water was used in the manufacture of soft drinks. Bathing establishments were operated at 5 and resorts for guests at 4 springs.

Sales were reported from the following 21 springs:

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.
Cumberland Spring, Greenup, Cumberland County.
Glen Flora Mineral Spring, Waukegan, Lake County.
Glen Rock Mineral Spring, Waukegan, Lake County.
Gravel Spring, near Jacksonville, Morgan County.
Indian Spring, Streator, Lasalle County.
Macinac Mineral Springs, near Carlock, Woodford County.
Minerva Spring, Cary Station, McHenry County.
Mokena Mineral Spring, Mokena, Will County.
Montgomery Magnesia Spring, Montgomery, Kane County.
Namonomia and Old Ironsides Springs, Dixon Springs, Pope County.
Pekin Mineral Spring, Pekin, Tazewell County.
Perry Mineral Spring, Perry, Pike County.
Ripley Mineral Spring, Cooperstown, Brown County.
Sanicula Spring, South Ottawa, Lasalle County.
Sulphur Lick Spring, Wedron, Lasalle County.
Woodmen Artesian Well, Rock Island, Rock Island County.

INDIANA.

Statistics from Indiana show 382,247 gallons of mineral water sold in 1914 for $138,118, as compared with 383,577 gallons sold in 1913 for $205,621. Though the decrease in quantity was less than 1 per cent, the decrease in value amounted to 33 per cent and was accompanied by a drop in the average price from 54 to 36 cents. This remarkable change is traceable chiefly to general reduction in price, but partly to decrease in sales of certain mineral waters.

Holman Mineral Well and Mysenite Well were new producers, and two properties hitherto operated separately are now reported under one management; 1 spring active in 1913 was reported idle in 1914; thus the number of active spring properties in the State was increased to 17. As heretofore, the greater part of the water is sold for medicinal use. At 7 springs there are resorts accommodating more than 2,000 people, and at 4 springs the mineral water is used for bathing. Very little mineral water is used in Indiana for the manufacture of soft drinks.

The following 17 springs have reported sales:

Blue Cast Spring, Woodburn, Allen County.
Blue Lick Spring, Henryville, Clark County.
Bronson Spring, Terre Haute, Vigo County.
Carlson Mineral Springs, Laporte, Laporte County.
Cartersburg Mineral Springs, Cartersburg, Hendricks County.
Coats Spring, Littles, Pike County.
Colomagna Springs, Columbus, Bartholomew County.
Holman Mineral Well, Crawfordsville, Montgomery County.
Hunter Mineral and Mudlavia springs, Kramer, Warren County.
Knotts Mineral Spring, Porter, Porter County.
McCullough Spring, Oakland City, Gibson County.
Mysenite Well, Silverwood, Fountain 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 output of mineral water in Iowa during 1914 underwent a remarkable increase, chiefly because of greatly increased sales of table waters. The total sales amounted to 303,827 gallons, valued at $30,179, or at an average price of 10 cents a gallon. The sales reported in 1913 were 48,665 gallons, valued at $7,369, or at an average price of 15 cents a gallon. Grand Hotel Mineral Springs and Hawkeye Hygeia Spring reported production for the first time, and one spring idle in 1913 was active in 1914. Three other springs from which no reports could be obtained have been considered idle. About one-half the water was sold for table use, and in addition about 145,000 gallons of mineral water was used in the manufacture of soft drinks. One bathing establishment and 2 resorts were maintained.

The 7 springs reporting sales are as follows:

Colfax Spring, Colfax, Jasper County.
Crystal Spring, Estherville, Emmet County.
Egralharve Spring, Montgomery, Dickinson County.
Grand Hotel Mineral Springs, Colfax, Jasper County.
Hawkeye Hygeia Spring, Sioux City, Woodbury County.
Red Mineral Springs, Eddyville, Wapello County.
White Sulphur Spring, near Davenport, Scott County.

KANSAS.

The output of mineral water in Kansas during 1914 showed a marked decrease, the total sales amounting to 272,722 gallons, valued at $56,440, as compared with 337,193 gallons, valued at $60,026, in 1913. This corresponds to a decrease of 19 per cent in quantity and 6 per cent in value and to an increase in the average price from 18 to 21 cents a gallon. The trend of the trade was similar in 1913, and it has been caused by notable decrease in the sales of certain table waters. Production was reported for the first time from Viola Spring. As one spring from which no production was reported in 1913 was active in 1914 and another, delinquent for two years, has been considered idle, the number of commercial springs has increased to 15. Resorts with bathing establishments accommodated about 200 guests at 4 springs, and in addition a bathing establishment was maintained at 1 other spring.

The following 15 springs reported sales:

AbilenA Wells, Abilene, Dickinson County.
Aganippe Spring, near Independence, Montgomery County.
Blasing's Mineral Spring, near Manhattan, Riley County.
California Spring, Ottawa, Franklin County.
Crystal Spring, Coffeyville, Montgomery County.
Geyser Mineral Well, Rosedale, Wyandotte County.
Hiatts Crystal and Mineral Springs, Winfield, Cowley County.
Ke-Lo Artesian Well, Kingman, Kingman County.
Magnesium and Choteau springs, Independence, Montgomery County.
Phillips's Mineral Spring, Topeka, Shawnee County.
Riverview Mineral Springs, Winfield, Cowley County.
Sun Springs, Morrill, Brown County.
Sycamore Springs, Sabetha, Brown County.
Viola Spring, near Viola, Sedgwick County.
Waconda Springs, Waconda Springs, Mitchell County.

KENTUCKY.

The mineral-water business in Kentucky has been about the same during the last three years. The reported sales in 1914 were 437,334 gallons, as compared with 475,675 gallons in 1913, a decrease of 8 per cent, and the value of the sales was $56,494, as compared with $53,334 in 1913, an increase of 6 per cent. The average price increased from 11 to 13 cents, mostly through increase of price of certain waters. Nearly 60 per cent of the output was sold for medicinal use. There were resorts at 5 springs with accommodations for about 2,100 people, exclusive of the capacity of Dawson Springs, and bathing establishments were maintained at 3 springs. Reports were received for the first time from Audubon Spring and Knollwood Well. Three springs active in 1913 were reported idle in 1914, and another spring delinquent for two years, has been considered idle in 1914; thus the number of active springs has been reduced to 12, the names and locations of which are given in the following list:

Anita Spring, La Grange, Oldham County.
Audubon Spring, Dover, Mason County.
Blue Rock Spring, Fisherville, Jefferson County.
Glen Lily Lithia Wells, near Bowling Green, Warren County.
Hamby's Spring, Dawson Springs, Hopkins County.
Kentucky Carlsbad Spring, Dry Ridge, Grant County.
Kentucky Mineral Well, Lorain, Taylor County.
Knollwood Well, Bowling Green, Warren County.
Lexington Lithia Springs, Lexington, Fayette County.
Robson Spring, Fort Thomas, Campbell County.
Royal Magnesian Spring, near La Grange, Oldham County.
St. Patricks Well, Louisville, Jefferson County.

LOUISIANA.

Five springs in Louisiana, also active in 1913, reported in 1914 a total output of 576,138 gallons, valued at $31,562. The corresponding figures for 1913 are 700,795 gallons, valued at $39,657. This represents 18 per cent decrease in production and 20 per cent decrease in value. The average price per gallon remained at 6 cents. Seven-eighths of the water was sold for table use. The following record of sales for the last five years indicates steady decrease in production.

Production and value of mineral waters in Louisiana, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	4	2,313,000	$163,975	7
1911	5	1,520,550	110,998	7
1912	4	561,660	33,345	6
1913	5	700,795	39,657	6
1914	5	576,138	31,562	6

No resorts or bathing establishments were reported as having been operated at mineral springs. The 5 springs that made returns are as follows:

Abita Springs, Abita Springs, St. Tammany Parish.
Geyser Spring, Hammond, Tangipahoa Parish.
Greenwell Spring, Magnolia, East Baton Rouge Parish.
Krotz Spring, Krotz Springs, St. Landry Parish.
Ozone Spring, Pearl River, St. Tammany Parish.

MAINE.

The production of mineral water in Maine in 1914 was slightly less than in 1913. The quantity sold amounted to 1,082,631 gallons, valued at $333,234, as compared with 1,174,262 gallons, valued at $368,436, in 1913. Thus there was a decrease of 8 per cent in quantity and of 10 per cent in value, and the average price per gallon remained 31 cents.

The following table shows the record of sales for the last five years:

Production and value of mineral waters in Maine, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	29	1,238,171	$404,539	33
1911	28	1,254,783	431,740	34
1912	31	1,179,192	432,765	37
1913	32	1,174,262	368,436	31
1914	29	1,082,631	333,234	31

In addition to the quantity reported nearly 190,000 gallons, or twice the consumption in 1913, was used in the manufacture of soft drinks. Three resorts accommodating about 700 guests and 2 bathing establishments were operated. Two springs idle in 1913 were active in 1914. Four springs active in 1913 were idle in 1914, and one other spring from which no report could be obtained has been considered idle; the number of active springs thus became 29, the names of which are given in the following list:

Arctic Spring, Bangor, Penobscot County.
Bakers Puritan Spring, Pine Point, Cumberland County.
Blue Hill Mineral Spring, Blue Hill, Hancock County.
Forest Springs, Litchfield, Kennebec County.
Glenrock Cold Spring, Greene, Androscoggin County.
Glenwood Spring, Augusta, Kennebec County.
Glenwood Mineral Spring, St. Albans, Somerset County.
Hanover Spring, Hanover, Oxford County.
Highland Spring, Lewiston, Androscoggin County.
Indian Hermit Spring, Wells, York County.
Kennebunk Mineral Spring, Kennebunkport, York County.
Keystone Mineral Spring, East Poland, Androscoggin County.
Mount Desert Spring, Northeast Harbor, Hancock County.
Mt. Kebo Spring, Bar Harbor, Hancock County.
Mount Zircon Spring, Milton Plantation, Oxford County.
Mystic Spring, Saco, York County.
Oak Grove Spring, Brewer, Penobscot County.
Pine Spring, Topsham, Sagadahoc County.
Pine Croft Spring, Freeport, Cumberland County.
Poland Mineral Spring, South Poland, Androscoggin County.
Purity Spring, West Scarboro, Cumberland County.
Redman Farm Spring, Belfast, Waldo County.
Rocky Hill Spring, Fairfield, Somerset County.
Sabattus Mineral Spring, Sabattus, Androscoggin County.
Seal Rock Spring, Saco, York County.
Skowhegan Crystal Spring, Skowhegan, Somerset County.
Thorndike Mineral Spring, near Thorndike, Waldo County.
Virginia Spring, Rumford, Oxford County.
Wawa Lithia Spring, Ogunquit, York County.

MARYLAND.

The mineral-water business in Maryland increased 22 per cent in quantity but decreased 2 per cent in value during 1914, and the average price dropped from 9 to 7 cents a gallon. The sales were 1,691,776 gallons, valued at $124,403, whereas in 1913 the sales amounted to 1,390,437 gallons, valued at $126,883. The output is entirely table water and a large part of it is marketed in Baltimore. The following is the record of sales for the last five years.

Production and value of mineral waters in Maryland, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	8	1,163,828	$102,371	9
1911	12	1,657,756	150,966	9
1912	13	1,606,373	157,541	10
1913	12	1,390,437	126,883	9
1914	10	1,691,776	124,403	7

Powhatan Spring reported production for the first time. One spring active in 1913 was reported out of business in 1914; one from which no report could be obtained has been considered idle; and a third has been taken over by another company. Thus the number of active spring properties has been reduced to 10. One small resort for guests was maintained, and in addition to the production reported above, 121,000 gallons of spring water was used in the manufacture of soft drinks.

The 10 springs reporting sales are as follows:

Altamont Spring, near Deer Park, Garrett County.
Buena Vista Spring, Edgemont, Washington County.
Carroll Springs, Forest Glen, Montgomery County.
Caton Spring, Catonsville, Baltimore County.
Chattolanee Spring, Chattolanee, Baltimore County.
Crystal Rock Spring, Berwyn, Prince Georges County.
Gneiss Rock Artesian Well, Ruxton, Baltimore County.
Mardela Mineral Spring, Mardela Springs, Wicomico County.
Powhatan Spring, Baltimore, Baltimore County.
Rock Crystal Spring, Rognel Heights, Baltimore County.

MASSACHUSETTS.

Returns from Massachusetts for 1914 indicate a decline of 21 per cent in production and of 18 per cent in value of mineral water. The reported sales were 3,084,385 gallons, as compared with 3,907,395 gallons in 1913, the total value being $174,324 in 1914 and $213,802 in 1913. The average price—6 cents a gallon—remained the same. In addition to the quantity of mineral water reported as sold, 800,000 gallons was used in the manufacture of soft drinks. In spite of this decrease the State ranked second in number of commercial springs and fifth in total production.

The following record shows a gradual decline in trade since 1910:

Production and value of mineral waters in Massachusetts, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	55	4,691,159	$241,949	5
1911	56	4,610,474	218,870	5
1912	54	4,502,806	247,397	6
1913	60	3,907,395	213,802	6
1914	52	3,084,385	174,324	6

Output was reported by three new springs, and the output of three regarding which no returns have been obtained has been recorded as zero; one spring temporarily idle in 1913 was active in 1914, but nine springs that produced much table water in 1913 were idle in 1914. Hence the number of active springs in 1914 was 52. Two bathing establishments and one small resort were reported. Practically nine-tenths of the trade was in table water.

The 52 reporting springs are as follows:

Abbott Spring, Methuen, Essex County.
Ballardvale Spring, Ballardvale, Essex County.
Belmont Crystal Spring, Belmont, Middlesex County.
Burnham Spring, Methuen, Essex County.
Cadwells Crystal Spring, Woburn, Middlesex County.
Chapmans Crystal Spring, Stoneham, Middlesex County.
Chelmsford Spring, Chelmsford, Middlesex County.
Chickatawbut Spring, Hingham, Plymouth County.
Cochato Spring, South Braintree, Norfolk County.
Crescent Spring, Brockton, Plymouth County.
Crystal Spring, West Peabody, Essex County.
Deep Glen Spring, West Lynn, Essex County.
El-Azhar Spring, Tyngsboro, Middlesex County.
Goulding Spring, Whitman, Plymouth County.
Granite Rock Spring, Brockton, Plymouth County.
Great Radium Spring, Pittsfield, Berkshire 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.
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.
October Spring, Lenox, Berkshire County.
Pearl Hill Spring, Fitchburg, Worcester County.
Pepperell Spring, Pepperell, Middlesex County.
Pequot Mineral Spring, North Natick, Middlesex County.
Pocahontas Spring, Lynnfield Center, Essex County.
Puritan Spring, Andover, Essex County.
Purity Spring, Danvers, Essex County.
Purity Spring, Chelmsford, Middlesex 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.
Ye Cape Cod Pilgrim Spring, South Wellfleet, Barnstable County.

MICHIGAN.

Reported sales of mineral water in Michigan showed a marked increase in value and a distinct though less marked increase in quantity. The total production was 931,343 gallons, valued at $70,310, or at an average price of 8 cents a gallon, as compared with the production in 1913 of 884,893 gallons, valued at $52,642, or at an average price of 6 cents a gallon. These figures represent an increase of 5 per cent in output and of 34 per cent in value. The chief cause of this readjustment was increased sales of several moderately high-priced waters.

The following is the record of sales for the last five years:

Production and value of mineral waters in Michigan, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	17	1,454,020	$69,538	5
1911	19	1,713,401	72,253	4
1912	18	1,420,465	75,611	5
1913	20	884,893	52,642	6
1914	22	931,343	70,310	8

Six springs reported sales for the first time, and the output of one spring that failed to report was estimated on the basis of sales during 1913. Four springs active in 1913 were idle in 1914; thus the number of commercial springs increased to 22. In addition to the sales reported, about 145,000 gallons was used in the manufacture of soft drinks. Two bathing establishments and 3 resorts, accommodating 900 guests, were maintained at mineral springs.

The 21 springs reporting sales are:

Andrews Magnetic Mineral Spring, St. Louis, Gratiot County.
Arctic Spring, Grand Rapids, Kent County.
Bailey Marvel Spring, between Bellaire and Alden, Antrim County.
Beard Hills Spring, Atkins, St. Clair County.
Beaver Springs, Bangor, Van Buren County.
Bromo-Hygeia Well, Coldwater, Branch County.
Charlevoix Mineral Spring, Charlevoix, Charlevoix County.
Crystal Springs, Grand Rapids, Kent County.
Eastman Springs, Benton Harbor, Berrien County.
Eureka Spring, Mount Clemens, Macomb County.
Lake Superior Mineral Spring, Marquette, Marquette County.
Mount Clemens Crystal Springs, Mount Clemens, Macomb County.
Ogemaw Spring, Maltby, Ogemaw County.
Panacea Spring, Mount Clemens, Macomb County.
Ponce de Leon Spring, Paris Township, Kent County.

Sanitas Spring, Topinabee, Cheboygan County.
Spring Hill Crystal Spring, South Haven, Van Buren County.
Sterling Spring, Crystal Falls, Iron County.
Victory Spring, Mount Clemens, Macomb County.
Welcome Island Spring, Pontiac, Oakland County.
White Oak Spring, Battle Creek, Calhoun County.

MINNESOTA.

Minnesota ranked second in total production of mineral water in 1914. The sales increased markedly, especially those in the vicinity of the Twin Cities. The total sales were 5,639,232 gallons, valued at $194,041, as compared with 4,802,053 gallons, valued at $183,759, in 1913. This increase is equivalent to 17 per cent in quantity and 6 per cent in value, the disproportion between these increases being due to decrease in the average price from 4 to 3 cents a gallon.

The following table shows the record for the last five years:

Production and value of mineral waters in Minnesota, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	19	9,962,370	$281,009	3
1911	17	8,703,319	270,039	3
1912	18	8,881,018	252,277	3
1913	16	4,802,053	183,759	4
1914	15	5,639,232	194,041	3

Ward Springs reported production for the first time in 1914 and one delinquent spring has been considered idle. The number of active springs was 15. With the exception of water valued at $509, the water sold was for the table, and in addition to the quantity reported as sold, 581,032 gallons was used in the manufacture of soft drinks. A bathing establishment and a resort accommodating about 50 guests were maintained at 1 spring.

The 15 reporting springs are as follows:

Clear Spring, Excelsior, Hennepin County.
Deep Spring, Crookston, Polk 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.
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, Bigstone County.
Swasteka Spring, Cold Spring, Stearns County.
Trio Siloam Spring, Austin, Mower County.
Ward Springs, Ward Springs, Todd County.

MISSISSIPPI.

There was a marked increase in the quantity of mineral water sold in Mississippi during 1914. The reported production was 415,904 gallons, valued at $73,068, as compared with 346,652 gallons, valued at $81,800, in 1913, these changes being equivalent to an increase of 20 per cent in quantity and a decrease of 11 per cent in value. The average price per gallon dropped from 24 to 18 cents, chiefly through decrease in the price of individual spring waters. Nearly all the water was sold for medicinal use. Five resorts, accommodating 775 guests, and 4 mineral-water baths were operated. Morris Mineral Spring reported production for the first time, but five springs active in 1913 were idle in 1914, and thus the number of active springs was reduced from 12 to 8, the names of which follow:

Allison's Wells, Way, Madison County.
Browns Wells, near Hazlehurst, Copiah County.
Castalian Spring, near Durant, Holmes County.
Cooper's Well, Raymond, Hinds County.
Morris Mineral Spring, Vosburg, Jasper County.
Red Springs, Stewart, Choctaw County.
Robinson Springs, Madison County, near Pocahontas.
Stafford Mineral Springs, Vosburg, Jasper County.

MISSOURI.

According to statements received from spring owners in Missouri, the output in 1914 was 583,288 gallons, valued at $74,793, or at an average price of 13 cents a gallon. The output in 1913 was 697,467 gallons, valued at $84,316, or at an average price of 12 cents a gallon. These figures indicate a decrease of 16 per cent in quantity and of 11 per cent in value. About three-fourths of the total output is said to be used medicinally. Ponce de Leon Well reported activity for the first time. One spring from which no report could be obtained has been considered idle, and one spring idle in 1913 was active in 1914. The total number of commercial springs in 1914 was 36. Six resorts, exclusive of those at Excelsior Springs, and 7 mineral-water baths were operated during the year. In addition to the spring water reported sold, about 311,000 gallons was used in the manufacture of soft drinks.

The following 36 springs made returns of sales:

American Spring, St. Louis, St. Louis City County.
B. B. Spring, Bowling Green, Pike County.
Belcher Artesian Well, St. Louis, St. Louis City County.
Blue Lick Springs, Blue Lick, Saline County.
Bokert Springs, near De Soto, Jefferson County.
Carrollton Mineral Spring, Carrollton, Carroll County.
Chouteau Springs, near Boonville, Cooper County.
Crystal Spring, Excelsior Springs, Clay County.
Cusenbery Spring, Mount Washington, Jackson County.
Excelsior Saline Spring, Excelsior Springs, Clay County.
Grand River Mineral Spring, near Mercer, Mercer County.
Haymaker Spring, Mercer County, near Lineville, Iowa.
Jackson Lithia Spring, Mount Washington, Jackson County.
Lithia No. 1 Spring, Excelsior Springs, Clay County.
Livertone Spring, Bowling Green, Pike County.
McAllister Springs, near Houstonia, Saline County.
Mee Soda Well, Excelsior Springs, Clay County.
Musick Spring, Eldorado Springs, Cedar County.
Natrona Soda Spring, Excelsior Springs, Clay County.
Old Orchard Spring, Old Orchard, St. Louis County.
Paris Springs, Paris Springs, Lawrence County.
Peerless Spring, Excelsior Springs, Clay County.
Ponce de Leon Well, La Grange, Lewis County.
Regent, Siloam, Soterian, and Sulpho-Saline springs, Excelsior Springs, Clay County.
Salax Spring, Excelsior Springs, Clay County.

Salt Sulphur Well, Excelsior Springs, Clay County.
Soda Saline Spring, Excelsior Springs, Clay County.
Sweet Springs, Sweet Springs, Saline County.
Vaile Springs, Independence, Jackson County.
White Springs, Independence, Jackson County.
Windsor Spring, Windsor Springs, St. Louis County.
Wyaconda and La Grange springs, La Grange, Lewis County.

MONTANA.

Returns from Montana indicate a decrease in the quantity of mineral water sold, but an increase in the value of the output, chiefly of that sold for table use. The total sales in 1914 were 100,700 gallons, valued at $5,555, or at an average price of 6 cents a gallon, whereas 180,200 gallons was sold in 1913 for $3,246, or at an average price of 2 cents. The change in average price is traceable to increased sales of a relatively high-priced water. Bathing establishments were maintained at 2 of these springs, and a small resort at 1. Practically all the water was sold for table use. No new spring was reported. The 3 springs reporting are as follows:

Lissner Mineral Spring, Helena, Lewis and Clark County.
Rock Creek Spring, Red Lodge, Carbon County.
White Sulphur Spring, White Sulphur Springs, Meagher County.

NEBRASKA.

Three springs in Nebraska, also active in 1913, reported for 1914 sales of 10,900 gallons of mineral water, valued at $1,490, or at an average price of 14 cents a gallon. The same springs reported in 1913 a total production of 105,985 gallons, valued at $10,599. This decrease of business represents a decrease of 90 per cent in quantity and 86 per cent in value. At 1 spring a small resort and a bathing establishment were maintained. In addition to the quantity reported as sold, about 121,000 gallons of mineral water was used in the manufacture of soft drinks.

The names of the 3 springs reporting are:

Brown Park Mineral Spring, South Omaha, Douglas County.
Curo Mineral Spring, South Omaha, Douglas County.
Shogo Lithia Spring, Milford, Seward County.

NEVADA.

Three mineral springs in Nevada reported a total production in 1914 of 221,942 gallons of table water, valued at $3,191, or at an average price of slightly more than 1 cent a gallon. The same springs reported a total production in 1913 of 4,897 gallons, valued at $1,584, or at an average price of 32 cents a gallon. The great increase in sales is noteworthy; the remarkable drop in average price was caused by increased sales of low-priced table waters. A small quantity of mineral water was used in the manufacture of soft drinks.

Reports were received from the following 3 springs:

Diamond Mineral Spring, Reno, Washoe County.
Ruby Spring, Halleck, Elko County.
Shoshone Spring, Franktown, Washoe County.

NEW HAMPSHIRE.

There was a notable decrease in the mineral-water business in New Hampshire during 1914, the sales reported being 194,418 gallons, practically all table water, valued at $11,731, as compared with 402,355 gallons, valued at $12,707, in 1913. These figures correspond to a decreased production of 52 per cent and a decreased value of 8 per cent, accompanied by an increase in the average price from 3 to 6 cents a gallon. The cause of this marked readjustment of the trade was great decrease in the sales of certain low-priced table waters. Three springs active in 1913 were idle in 1914, but one that had been temporarily inactive reported production in 1914, making in all 7 active springs. A bathing establishment was maintained at 1 spring, and about 280,000 gallons of spring water in addition to that already noted was used in the manufacture of soft drinks.

The 7 springs reporting are:

Cohas Spring, Londonderry, Hillsboro County.
Crystal Spring, East Concord, Merrimack County.
Granite State Springs, Plaistow, Rockingham County.
Laconia Spring, The Weirs, Belknap County.
White Mountain Mineral Spring, Conway, Carroll County.
Willow Spring, South Nashua, Hillsboro County.
Wilton Mineral Spring, near Wilton, Hillsboro County.

NEW JERSEY.

According to the estimates of operators in New Jersey the sales of mineral water in 1914 decreased 17 per cent in quantity and value, a slightly greater decrease than that which occurred in 1913. The total sales reported in 1914 were 1,710,030 gallons, valued at $155,649; the corresponding figures for 1913 were 2,067,277 gallons, valued at $188,546. The average price has been 9 cents a gallon for the last three years.

The following table shows the output for the last five years.

Production and value of mineral waters in New Jersey, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	11	1,583,050	$133,139	8
1911	12	2,233,627	210,123	10
1912	12	2,386,217	209,726	9
1913	14	2,067,277	188,546	9
1914	17	1,710,030	155,649	9

Six new springs were added to the list of active producers and three hitherto active were idle. Practically the entire output was sold for table use. No resorts or mineral-water baths were maintained at springs, but about 34,000 gallons of water was used in the manufacture of soft drinks.

The following 17 springs reported sales:

Alpha Spring, Springfield, Union County.
Belmar Spring, Glen Rock, Bergen County.
Cold Indian Spring, Asbury Park, Monmouth County.
Culm Rock Spring, Pluckemin, Somerset County.
Echo Spring, Ewing (near Trenton), Mercer County.
Englewood Artesian Well, Englewood, Bergen County.
Fairholme Spring, Wenonah, Gloucester County.
Grey Rock Spring, Trenton, Mercer County.
Indian Spring, near Rockaway, Morris County.
Kalium Spring, Collingswood, Camden County.
Kanouse-Oakland Spring, Oakland, Bergen County.
Pilgrim Spring, Ridgefield Park, Bergen County.
Red Rock Spring, Spring Valley, Bergen County.
Rock Spring, West Orange, Essex County.
Sanhican Spring, Wilburtha, Mercer County.
Washington Rock Spring, Plainfield, Union County.
Watchung Spring, North Plainfield, Somerset County.

NEW MEXICO.

Three springs in New Mexico reported sales of mineral water during 1914. The total output was 41,000 gallons, valued at $6,600, or at an average price of 16 cents a gallon. Nearly all the water was sold for table use, and no resorts or bathing establishments were reported. The sales in 1913 amounted to 154,800 gallons, valued at $16,730. The decrease in 1914 was equivalent to 74 per cent in quantity and 61 per cent in value. One spring active in 1913 was idle in 1914.

The 3 reporting springs are:

Aztec Mineral Spring, Taylor Springs, Colfax County.
Coyote Springs, Albuquerque, Bernalillo County.
Ojo Caliente Spring, Ojo Caliente, Taos County.

NEW YORK.

The State of New York ranked first in 1914 in production and value of mineral water and in number of active springs. The total output was 8,201,202 gallons, valued at $672,913, or at an average price of 8 cents a gallon. The sales for 1913 were 9,801,255 gallons, valued at $871,601, or at an average price of 9 cents a gallon. Comparison of these figures shows a decrease of 16 per cent in quantity and of 23 per cent in value.

The following record for the last five years indicates a decline in production since 1911:

Production and value of mineral waters in New York, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	46	8,780,903	$858,635	10
1911	51	10,245,261	939,003	9
1912	57	10,008,801	1,034,477	10
1913	64	9,801,255	871,601	9
1914	69	8,201,202	672,913	8

Ten new springs were added to the list of producers. Four springs hitherto active were reported idle and three others from which no reports could be obtained have been considered idle in 1914. The number of active springs during 1914 was 69. Less than one-tenth of the water was sold for medicinal use. Five resorts, exclusive of those at Saratoga Springs, accommodated 3,700 guests, and mineral-water baths were operated at 3 springs during 1914. In addition to this business about 223,000 gallons of mineral water was used in the manufacture of soft drinks.

The list of 69 commercial springs in 1914 is as follows:

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 Spring, Rensselaer, Rensselaer County.
Breesport Oxygenated Mineral Spring, Breesport, Chemung County.
Briarcliff Spring, Briarcliff Manor, Westchester County.
Cascadian Spring, Nyack, Rockland County.
Cassadaga Spring, Lilly Dale, Chautauqua County.
Cassier Spring, Potsdam, St. Lawrence County.
Chemung Spring, Chemung, Chemung County.
Clinton Lithia Spring, Franklin Springs, Oneida County.
Coesa Spring, Saratoga Springs, Saratoga County.
Cold Springs, Whitesboro, Oneida County.
Comstock Mineral Spring, Ballston Spa, Saratoga County.
Crystal Spring, Crystal Dale, Lewis County.
Crystal Springs, near Oswego, Oswego County.
Deep Rock Spring, Oswego, Oswego County.
Diamond Rock Spring, Lancaster, Erie County.
Dietade Mineral Spring, Keeseville, Essex County.
Eagle Spring, Edgewood, Greene County.
Elixir Spring, Clintondale, Ulster County.
Elk Spring, Lancaster, Erie County.
Flint Spring, West Sand Lake, Rensselaer County.
Franklin Lithia Spring, Franklin Springs, Oneida County.
Garden City Well, Garden City, Nassau County.
Garden White Sulphur Spring, Sharon Springs, Schoharie County.
Geneva Mineral Spring, Geneva, Ontario County.
Geyser Spring, Saratoga Springs, Saratoga County.
Glen Alex Spring, Washington Mills, Oneida County.
Gramatan Spring, Bronxville, Westchester County.
Great Bear Spring, near Fulton, Oswego County.
Greendale Crystal Spring, Hudson, Columbia County.
Hathorn No. 1 Spring, Saratoga Springs, Saratoga County.
Hathorn No. 2 Spring, Saratoga Springs, Saratoga County.
Kirkland Mineral Spring, Franklin Springs, Oneida County.
Lithia Polaris Spring, near Boonville, Oneida County.
Madrid Indian Mineral Spring, Madrid Springs, St. Lawrence County.
Mammoth and Ideal springs, North Greenbush, Rensselaer County.
Minnonebe Spring, Saratoga Springs, Saratoga County.
Mohawk Springs, Amsterdam, Montgomery County.
Mohican Spring, Ballston Spa, Saratoga County.
Mokobo Spring, Mount Kisco, Westchester County.
Monarch Spring, Matteawan, Dutchess County.
Mount Beacon Spring, Beacon, Dutchess County.
Mount View Spring, Poughkeepsie, Dutchess County.
Oasis Cold Spring, Bergen, Genesee County.
Plymouth Spring, North Greenbush, Rensselaer County.
Real Rock Spring, Breesport, Chemung County.
Red Rock Spring, Fine View, Jefferson County.
Sagamore Spring, Oyster Bay, Nassau County.
Saratoga Gurn Spring, Saratoga Springs, Saratoga County.
Saratoga Vichy and Victoria No. 2 springs, Saratoga Springs, Saratoga County.
Setauket Spring, Setauket, Suffolk County.

Shell Rock Spring, near Rensselaer, Rensselaer County.
Shenorock Spring, Baldwin Place, Westchester 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.
Table Rock Mineral Spring, Honeoye Falls, Monroe County.
Trespur Spring, McGraw, Cortland County.
Valley Spring, Omar, Jefferson County.
Vermont Mineral Spring, Granville, Washington County.
Vita Spring, Fort Edward, Washington County.
Westmoreland Mineral Spring, Westmoreland, Oneida County.
White's Spring, Norwich, Chenango County.

NORTH CAROLINA.

The sales of mineral water in North Carolina in 1914 amounted to 158,226 gallons, valued at $21,964, as compared with 176,068 gallons, valued at $23,877, in 1913, a decrease of 10 per cent in quantity and of 8 per cent in value. The average price per gallon remained 14 cents, as in 1913. Ten resorts, accommodating 1,650 guests, and 3 establishments for bathing in mineral water were maintained at springs. A small quantity of water also was used in the manufacture of soft drinks.

The same springs, 17 in number, were active during 1913, and the names and locations of them follow:

All Healing Spring, Taylorsville, Alexander County.
Barium Rock Spring, Barium Springs, Iredell County.
Buckhorn Lithia Spring, Bullock, Granville County.
Connelly Springs, Connellys Springs, Burke County.
Derita Mineral Spring, Derita, Mecklenburg County.
Haywood White Sulphur Spring, Waynesville, Haywood County.
Huckleberry Spring, Durham, Durham County.
Jackson Springs, Jackson Springs, Moore County.
Midas Spring, near Huntersville, Mecklenburg County.
Moores Springs, Moores Springs, Stokes County.
Mount Vernon Springs, Mount Vernon Springs, Chatham County.
Panacea Spring, Warren County, near Littleton.
Parks Springs, Caswell County, near Danville, Va.
Seven Springs, Sevensprings, Wayne County.
Shelby Lithia Spring, Shelby, Cleveland County.
Smith Lithia Spring, Oxford, Granville County.
Vade Mecum Spring, Vade Mecum, Stokes County.

NORTH DAKOTA.

Four springs in North Dakota reported total sales of mineral water during 1914, amounting to 408,000 gallons, valued at $8,150, as compared with 582,356 gallons, valued at $14,403, in 1913. One spring active in 1913 was reported idle in 1914. Though there was a decrease of 30 per cent in the quantity of natural water bottled and sold, the consumption of mineral water in the manufacture of soft drinks increased from 42,000 gallons in 1913 to 190,000 gallons in 1914.

The names and locations of the 4 active springs are as follows:

Granite Spring, Minot, Ward County.
Kenmare Spring, Kenmare, Ward County.
Sakakawea Spring, Northwood, Grand Forks County.
Williston Medicinal Spring, Williston, Williams County.

OHIO.

The mineral-water trade of Ohio made a decided gain in 1914, the sales rising from 3,317,639 gallons in 1913 to 3,558,413 gallons in 1914, and the total value increasing from $125,084 in 1913 to $145,586 in 1914. The increase in quantity was 7 per cent and in value 16 per cent. The greater increase was in the sales of table waters. The average price remained 4 cents a gallon, at which value it has stood for the last five years.

The following table of sales during the last five years shows, contrary to conditions in most other States, a general increase in the mineral-water business since 1911:

Production and value of mineral waters in Ohio, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	30	2,226,188	$95,989	4
1911	28	1,958,547	86,478	4
1912	30	2,709,745	117,287	4
1913	33	3,317,639	125,084	4
1914	35	3,558,413	145,586	4

Three new springs reported production for the first time, and one spring active in 1913 was idle in 1914; the number of active springs was thus increased to 35. As during 1913, nearly nine-tenths of the water was sold for table use. Five resorts accommodating nearly 500 guests and 1 bathing establishment were operated during the year. In addition more than 357,000 gallons of water was used in the manufacture of soft drinks.

The 35 springs reporting sales are as follows:

Alba Spring, Rockport, Cuyahoga County.
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 Fountain Springs, Plainville, Hamilton County.
Crystal Spring, Newark, Licking 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.
Greenspring, Sandusky County, near Greenspring.
Highland Springs, Akron, Summit County.
Maple Grove Mineral Spring, near Chillicothe, Ross County.
Minnehaha Spring, Rockport, Cuyahoga County.
Oak Place Spring, Akron, Summit County.
Oak Ridge Mineral Springs, Sandusky County, near Greenspring.
Painesville Mineral Spring, Painesville, Lake County.
Partagas Natural Water, Cincinnati, Hamilton County.
Peerless and Puritas springs, West Park, Cuyahoga County.
Pine Tree Spring, Willoughby, Lake County.
Puritas Spring, West Park, Cuyahoga County.
Purity Spring, South Euclid, Cuyahoga County.
Quakerdale Spring, Colerain, Belmont County.
Ripley Bromo Lithia Spring, Ripley, Brown County.

Rock Spring, Wickliffe, Lake County.
Sand Rock Mineral Spring, Canton, Stark County.
Spring Grove Lithia Spring, Springfield, Clark County.
Sulphur Lick Spring, Chillicothe, Ross County.
Tallewanda Springs, Preble County, near College Corner.
Wheeler Mineral Spring, Youngstown, Mahoning County.
Woods Lithia Spring, Bridgeport, Belmont County.

OKLAHOMA.

According to returns from Oklahoma the output of mineral water during 1914 was 804,675 gallons, valued at $26,906, as compared with 502,439 gallons, valued at $26,231, in 1913. The increase in quantity sold is equivalent to 60 per cent and the increase in value is equivalent to 3 per cent, the apparent discordance of these figures being caused by a decrease in the average price from 5 to 3 cents a gallon. Mineral-water baths were operated at 2 springs, and 1 resort accommodating 300 guests was maintained. In addition to the consumption above reported, nearly 24,000 gallons of spring water was used in the manufacture of soft drinks.

Everpure Well and Sulphur Spring reported production for the first time. Two springs hitherto active were idle.

The 12 springs reporting sales are as follows:

Bromide Spring, Sulphur, Murray County.
Comanche Mineral Wells, Comanche, Stephens County.
Everpure Well, Oklahoma City, Oklahoma County.
Excelsior Well, Oklahoma City, Oklahoma County.
Kalium Wells, Faxon, Comanche County.
Lewis Lithia Wells, Oklahoma City, Oklahoma County.
Living Spring, Oklahoma City, Oklahoma County.
Shanoan Spring, Chickasha, Grady County.
Snow Mineral Well, Oklahoma City, Oklahoma County.
Standard Wells, Tulsa, Tulsa County.
White Sulphur Spring, Sapulpa, Creek County.
Works Excelsior Mineral Wells, Comanche, Stephens County.

OREGON.

Sales of mineral water in Oregon amounted in 1914 to 57,800 gallons, valued at $12,810, as compared with 68,413 gallons, valued at $19,409, in 1913, a decrease of 16 per cent in quantity and of 34 per cent in value. The average price decreased from 28 to 22 cents a gallon. One spring active in 1913 was idle in 1914. Four resorts accommodating 1,575 guests and 4 bathing establishments were operated. In addition to the business above reported, about 11,000 gallons was used in the manufacture of soft drinks.

The names of the 7 active springs are:

Calapooya Spring, London, Lane County.
Cascade Mineral Spring, Cascadia, Linn County.
Colestin Spring, Colestin, Jackson County.
Sam-O Springs, Baker, Baker County.
Selah Spring, Silverton, Marion County.
Siskiyou Spring, Soda Springs, Jackson County.
Wilhoit Spring, Wilhoit, Clackamas County.

PENNSYLVANIA.

Returns from Pennsylvania show a marked increase in the mineral-water trade during 1914. The output amounted to 2,457,626 gallons, valued at $213,752, as compared with 2,163,931 gallons, valued at

$190,459, in 1913. These figures correspond to an increase of 14 per cent in quantity and of 12 per cent in value of waters sold. The average price remained 9 cents a gallon.

The following table shows the record of sales during the last five years:

Production and value of mineral waters in Pennsylvania, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	44	2,536,337	$221,685	9
1911	41	2,327,732	216,819	9
1912	41	2,192,106	204,906	9
1913	43	2,163,931	190,459	9
1914	47	2,457,626	213,752	9

Four new springs were added to the list as follows: Blue Mountain, Dark Hollow, Diamond, and Elkoro. The output of four springs that failed to report production was estimated from previous reports; five springs concerning which no information could be obtained have been considered idle; five springs active in 1913 were reported idle in 1914; and five springs temporarily idle in 1913 reported production in 1914; so that 47 represents the number of commercial springs in 1914. Nine resorts accommodating 1,270 guests were operated, and 4 establishments for giving mineral-water baths also were maintained. In addition to the water sold, about 275,000 gallons was used in the manufacture of soft drinks.

The following 43 springs reported sales in 1914:

Bartlett Spring, Cambridge Springs, Crawford County.
Battering Ram Spring, Beach Haven, Luzerne County.
Blue Mountain Spring, West Nanticoke, Luzerne County.
Brookside Spring, Wilkinsburg, Allegheny County.
Carnegie Alkaline and Lithia Mineral Springs, Carnegie, Allegheny County.
Chadwick Mineral Spring, Cambridge Springs, Crawford County.
Cold Spring, Lotell, Lebanon County.
Colonial Spring, Valley Forge, Chester County.
Crystal-Cray Spring, Warren, Warren County.
Dark Hollow Spring, Oakmont, Allegheny County.
De Profundus Spring, Saegerstown, Crawford County.
Diamond Spring, Sayre, Bradford County.
Elkoro Spring, Girard, Erie County.
Ephrata Mountain Crystal Spring, near Ephrata, Lancaster County.
Franklin Lithia Spring, Cambridge Springs, Crawford County.
Glen Summit Spring, Glen Summit, Luzerne County.
Gray Mineral Spring, Cambridge Springs, Crawford County.
Harrison Valley Mineral Spring, Harrison Valley, Potter County.
Hurlburt Spring, Cambridge Springs, Crawford County.
Hutchinson's Spring, East Brook, Lawrence County.
Jeny-See Spring, Genesee, Potter County.
Kecksburg Artesian Mineral Spring, Kecksburg, Westmoreland County.
Keystone Spring, near Taylorsville, Bucks County.
Liposo Spring, near Factoryville, Wyoming County.
Magnetic Mineral Spring, Sizerville, Cameron County.
Massassauga Mineral Spring, Erie, Erie County.
Minnequa Spring, Canton, Bradford County.
Mount Laurel Spring, Temple, Berks County.
Original Magnesia Springs, Cambridge Springs, Crawford County.
Pavilion Spring, Wernersville, Berks County.
Petticord Spring, Cambridge Springs, Crawford County.

Plymouth Crystal Spring, Plymouth, Luzerne County.
Polar Springs, Morrisville, Bucks County.
Prospect Rock Spring, Laurel Run, Luzerne County.
Puritas Spring, near Erie, Erie County.
Quaill Farm Spring, Bellevue, Allegheny County.
Ross Common Spring, Ross Common, Monroe County.
Springfield Spring, Springfield Township, Delaware County.
Summer Hill Spring, Pittsburgh, Allegheny County.
Thurston's Carbonate Spring, Meadville, Crawford County.
Tuckahoe Mineral Spring, near Northumberland, Northumberland County.
Unamis Lithia Spring, Unamis, Somerset County.
Whann Lithia Spring, Franklin, Venango County.

RHODE ISLAND.

The mineral-water trade in Rhode Island during 1914 was nearly the same as in 1913. Six springs reported a production of 438,702 gallons, valued at $29,639, as compared with 444,036 gallons, valued at $28,535, in 1913. The average price per gallon was 7 cents. The water was sold exclusively for table use, and no resorts or bathing establishments were maintained. One spring active in 1913 was reported out of business in 1914.

The names of the 6 commercial springs are as follows:

Berry Spring, Pawtucket, Providence County.
Girard Spring, North Providence, Providence County.
Gladstone Spring, Narragansett Pier, Washington County.
Holley Mineral Spring, East Woonsocket, Providence County.
Ochee Spring, Providence, Providence County.
Prophet Spring, Providence, Providence County.

SOUTH CAROLINA.

The returns from South Carolina indicate an increase in the quantity of mineral water sold during 1914. The total sales were 293,949 gallons, valued at $48,071; the total sales in 1913 were 261,412 gallons, valued at $49,199—an increase of 12 per cent in quantity but a decrease of 2 per cent in value in 1914. The average price per gallon dropped from 19 to 16 cents. The sales of table water decreased to half those in 1913, nearly seven-eighths of the water having been reported sold for medicinal use. Glendale Springs have been added to the list, but three springs active in 1913 were idle in 1914, so that the number of commercial springs was 13. Piedmont Spring is now known as White Diamond Lithia Spring. Five resorts, accommodating nearly 1,400 guests, and 2 bathing establishments were maintained. Nearly 200,000 gallons of mineral water also was used in the manufacture of soft drinks.

The following 13 springs reported sales:

Big Springs, Bethune, Kershaw County.
Buffalo Lick Springs, Carlisle, Union County.
Chick Springs, Chick Springs, Greenville County.
Clementia Mineral Spring, Clementia, Colleton County.
Crystal Carbon Spring, Spartanburg, Spartanburg County.
Glendale Mineral Springs, Bamberg, Bamberg County.
Glenn Spring, Glenn Springs, Spartanburg County.
Harris Lithia Well, Harris Springs, Laurens County.
Moseby Spring, Loris, Horry County.
Shelton Mineral Spring, near Shelton, Fairfield County.
Shivar Spring, Shelton, Fairfield County.
Steele Mineral Spring, Rockhill, York County.
White Diamond Lithia Springs, York County, near Kings Creek.

SOUTH DAKOTA.

South Dakota reported in 1914 sales from 3 springs amounting to 145,647 gallons, valued at $8,999, or at 6 cents a gallon. The water was sold chiefly for table use and about 20,000 gallons in addition was consumed in the manufacture of soft drinks. Kampeskee Spring reported production for the first time. A bathing establishment was maintained at one spring. Heretofore the details of production in South Dakota have been included in those of other States having less than three active springs.

The names of the 3 springs reporting are:

Culbert Spring, Aberdeen, Brown County.
Kampeskee Spring, Watertown, Codington County.
Minnehaha Springs, Sioux Falls, Minnehaha County.

TENNESSEE.

Returns from Tennessee show a decrease in the mineral-water trade in 1914 as compared with 1913. The sales amounted to 943,502 gallons, valued at $56,741, as compared with 1,088,034 gallons, valued at $64,905, in 1913. These figures correspond to a decrease of 13 per cent in quantity and in value. The price remained 6 cents a gallon.

The following table is the record of sales during the last five years:

Production and value of mineral waters in Tennessee, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	18	950,511	$71,129	8
1911	19	1,073,115	72,475	7
1912	21	796,568	53,560	7
1913	23	1,088,034	64,905	6
1914	23	943,502	56,741	6

Darnell Well reported production for the first time; two springs temporarily idle in 1913 were active in 1914; and three springs active in 1913 were idle in 1914. Thus the total number of commercial springs was 23, as in 1913. Fourteen resorts accommodating 2,400 guests were operated, and the water at 4 springs is reported to have been used for bathing.

The following 23 springs reported sales:

Bright Sunrise Spring, near Ashland City, Cheatham County.
Bush Epsom Lithia Spring, Davidson County, near Nolensville.
Darnell Well, Clarksville, Montgomery County.
Eastbrook Spring, Eastbrook, Franklin County.
Epperson Spring, Macon County, near Westmoreland.
Faulkner Springs, near McMinnville, Warren County.
Galbraith Epsom Lithia Springs, Mooresburg, Hawkins County.
Hamilton Spring, near Lebanon, Wilson County.
Horn Spiings, Horn Springs, Wilson County.
Idaho Springs, near Clarksville, Montgomery County.
Larkin Spring, Madison, Davidson County.
Montvale Spring, Maryville, Blount County.
Neubert Spring, Neubert, Knox 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.
Whittle Spring, Whittle Springs, Knox County.
Willow Brook Spring, Craggie Hope, Cheatham County.
Winchester Spring, Estill Springs, Franklin County.
Wright's Epsom-Lithia Spring, Mooresburg, Hawkins County.

TEXAS.

Returns from Texas indicate a decline in 1914 of 35 per cent in quantity and of 30 per cent in value of mineral water sold. The output reported was 766,597 gallons, valued at $93,014, as compared with 1,187,612 gallons, valued at $132,488, in 1913. The average price per gallon rose from 11 to 12 cents.

The following table of production during the last five years shows a decline in trade since 1911:

Production and value of mineral waters in Texas, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	31	1,241,248	$128,549	10
1911	40	1,637,932	158,367	10
1912	34	1,292,992	151,395	12
1913	38	1,187,612	132,488	11
1914	31	766,597	93,014	12

Statistics are included for 31 commercial springs. Four springs from which no reports could be obtained have been considered idle and several others active in 1913 were reported idle in 1914. Practically the entire output is said to be used medicinally.

Six resorts accommodating 970 guests were operated, exclusive of those at Mineral Wells, and the water of 4 springs was used for bathing. Besides this consumption about 24,000 gallons of mineral water was used in the manufacture of soft drinks.

The following is the list of the 31 springs reporting sales during 1914:

Aqua Vitae Wells, Nacogdoches, Nacogdoches County.
Austin Well, Mineral Wells, Palo Pinto County.
Beauchamp's Well, Blossom, Lamar County.
Brock Mineral Well, near Denton, Denton County.
Capp's Wells, Longview, Gregg County.
Carlsbad Well, Blossom, Lamar County.
Crazy and Gibson wells, Mineral Wells, Palo Pinto County.
Dalby Spring, Dalby Springs, Bowie County.
Georgetown Mineral Wells, Georgetown, Williamson County.
Hanna Springs, Lampasas, Lampasas County.
Hefner Well, Blossom, Lamar County.
High Island Mineral Well, High Island, Galveston County.
Hubbard Hot Well, Hubbard, Hill County.
Lamar Wells, Mineral Wells, Palo Pinto County.
Lonestar Mineral Well, Texarkana, Bowie County.
Mangum Wells, Mangum, Eastland County.
Marlin Hot Wells, Marlin, Falls County.
Maurice Wells, Mangum, Eastland County.
Olympia Well, Mineral Wells, Palo Pinto County.
Putnam Mineral Well, Putnam, Callahan County.
Riviere Wells, Tyler, Smith County.

Roach Well, near Mount Pleasant, Titus County.
Rock Bottom Well, Mineral Wells, Palo Pinto County.
St. Mary's Mineral Well, near Hallettsville, Lavaca County.
Sour Wells, Sulphur Springs, Hopkins County.
Southland Spring, Duffau, Erath County.
Star Well, Mineral Wells, Palo Pinto County.
Texas Carlsbad Spring, Mineral Wells, Palo Pinto County.
Tioga Mineral Wells, Tioga, Grayson County.
Weatherby Wells, Garrison, Nacogdoches County.
Wootan Wells, Wootan Wells, Robertson County.

UTAH.

Only 1 mineral spring in Utah reported production in 1914, and statistics regarding it are included with those of other States having less than three operating springs.

The name and location of the spring reporting is:

Deseret Lithia Spring, Deseret, Millard County.

VERMONT.

Returns from Vermont indicate an increase in the mineral-water trade during 1914 of 189 per cent in quantity and of 22 per cent in value. The output was 51,151 gallons, valued at $8,600, as compared with 17,725 gallons, valued at $7,068, in 1913, the average price having decreased from 40 to 17 cents a gallon. The big increase in trade and the drop in price are due chiefly to increased sales of low-priced table water. Most of the water was sold for table use, and in addition to the reported sales 16,000 gallons was used in the manufacture of soft drinks. Resorts for 640 guests were operated at 4 springs and the water of 2 springs was used for bathing. The same 4 springs reported sales in 1913 and are as follows:

Alburg Spring, Alburg Springs, Grand Isle County.
Brunswick Springs, Brunswick, Essex County.
Clarendon Spring, Clarendon, Rutland County.
Equinox Spring, Manchester, Bennington County.

VIRGINIA.

Virginia's output of mineral water in 1914 was about the same as that during 1913. Reports from operators showed a total output of 2,906,976 gallons, valued at $293,512, as compared with an output of 2,873,288 gallons, valued at $298,473, in 1913. In other words, there was an increase of 1 per cent in quantity but a decrease of 2 per cent in value. The average price remained 10 cents a gallon.

The following record of the trade during the last five years shows a steady increase in production.

Production and value of mineral waters in Virginia, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	40	2,441,923	$301,523	12
1911	43	2,474,918	298,701	12
1912	45	2,762,319	349,255	13
1913	49	2,873,288	298,473	10
1914	50	2,906,976	293,512	10

Two new springs, Chlorinated Calcic Spring and Victoria Alka-Lithia Well, were added to the list of producers. Two springs active in 1913 were idle in 1914, and another temporarily idle in 1913 was active in 1914; thus the number of springs reporting production was increased to 50. Resorts accommodating more than 2,000 guests were reported at 13 springs, and the water at 4 springs was used for bathing. In addition to the quantity reported sold, about 99,000 gallons was used in the manufacture of soft drinks.

The 50 springs reporting sales are as follows:

Abbevanna Ponce de Leon Spring, Fluvanna County, near Scottsville.
Alkaline Lithia Spring, near Staunton, Augusta County.
Alleghany Spring, Alleghany Spring, Montgomery County.
Bear Lithia Spring, near Elkton, Rockingham County.
Beaufont Spring, Chesterfield County, near Richmond.
Berry Hill Mineral Spring, Elkwood, Culpeper County.
Blue Ridge Springs, near Blue Ridge Springs, Botetourt County.
Broad Rock Mineral Spring, Chesterfield County, near Richmond.
Brugh Spring, Nace, Botetourt County.
Buckhead Spring, Buckhead Springs, Chesterfield County.
Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg County.
Burnett Mineral Spring, Culpeper, Culpeper County.
Campfield Lithia Springs, Chesterfield County, near Richmond.
Carper Lithia Springs, Radford, Montgomery County.
Carter Springs, Danville, Pittsylvania County.
Chlorinated Calcic Spring, Norfolk, Norfolk County.
Como Lithia Spring, East Richmond, Henrico County.
Coppahaunk Mineral Springs, Waverly, Sussex County.
Crockett Arsenic Lithia Spring, Crockett Springs, Montgomery County.
Eaglewood Spring, near Danville, Pittsylvania County.
Farmville Lithia Springs, Cumberland County, near Farmville.
Fonticello Mineral Spring, Chesterfield County, near Richmond.
Granite Mineral Spring, Chesterfield County, near Richmond.
Harris Anti-Dyspeptic Spring, Burkeville, Nottoway County.
Healing Springs, Healing Springs, Bath County.
Jeffress Lithia Spring, Jeffress, Mecklenburg County.
Jordan's White Sulphur Spring, Stephenson, Frederick County.
Kayser Lithia Springs, Staunton, Augusta County.
Landale Spring, Norfolk, Norfolk County.
Lithia Magnesia Spring, Rockymount, Franklin County.
Magee Chlorinated Lithia Springs, Clarksville, Mecklenburg County.
Massanetta Spring, near Harrisonburg, Rockingham County.
Mecklenburg Springs, Chase City, Mecklenburg County.
Mico Well, Alexandria, Alexandria County.
Mulberry Island Lithia Well, Mulberry Island, Warwick County.
Nye Lithia Springs, Wytheville, Wythe County.
Otterburn Lithia Spring, Amelia C. H., Amelia County.
Paeonian Spring, Paeonian Springs, Loudoun County.
Pickett Spring, Worsham, Prince Edward County.
Rockbridge Alum Springs, Rockbridge Alum Springs, Rockbridge County.
Rubino Healing Springs, Healing Springs, Bath County.
Seawright Magnesian Lithia Spring, near Staunton, Augusta County.
Stribling Springs, Mount Solon, Augusta County.
Trepho Mineral Spring, Claremont, Surry County.
Victoria Alka-Lithia Well, Victoria, Lunenburg County.
Virginia Etna Springs, Vinton, Roanoke County.
Virginia Lithia Spring, Chesterfield, 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 a marked increase in the mineral-water business during 1914. The sales amounted to 180,787 gallons, valued at $28,777, whereas the sales in 1913 amounted to 150,498 gallons, valued at $18,834, the figures representing an increase of 20 per cent in quantity and of 53 per cent in value. The average price increased from 13 to 16 cents a gallon. About two-thirds of the water was reported as having been sold for medicinal use. Private hotels and bathing establishments were maintained at 2 springs, and about 18,000 gallons of water was used in the manufacture of soft drinks.

The names of the 6 reporting springs are:

Ahtanum Soda Springs, near Tampico, Yakima County.
Diamond Mineral Spring, Auburn, King County.
Klickitat Mineral Springs, Klickitat, Klickitat County.
Olympia Hygeian Spring, Tumwater, Thurston County.
Solduc Hot Springs, Solduc, Callam County.
Yakima Artesian Mineral Spring, North Yakima, Yakima County.

WEST VIRGINIA.

There was a slight decrease in the mineral-water trade of West Virginia in 1914. The total sales were 307,890 gallons, as compared with 316,749 gallons in 1913, a decrease of 3 per cent; the value of the production in 1914 was $49,129, as compared with $52,259 in 1913, a decrease of 6 per cent. The average price decreased from 17 to 16 cents a gallon. About 60 per cent of the output was table water. Sales were reported from no new springs. Resorts that accommodated 2,250 guests were maintained at 5 springs, and the water of 3 springs was used for bathing, in addition to which a small quantity was used in the manufacture of soft drinks.

The following are the names of the 10 commercial springs reporting in 1914:

Barilithic Spring, Webster Springs, Webster County.
Borland Springs, Borland, Pleasants County.
Madeira Well, Morgantown, Monongalia County.
Manacea Irondale Spring, Independence, Preston County.
Pence Spring, Pence Springs, Summers County.
Saline Chalybeate and Vigora springs, Woodsdale, Ohio County.
Walnut Hill Lithia Spring, near Charleston, Kanawha County.
Webster Springs, Webster Springs, Webster County.
White Sulphur Springs, White Sulphur Springs, Greenbrier County.

WISCONSIN.

Wisconsin was second in value of mineral waters sold in 1914 and third in quantity of output. The total sales were 5,145,452 gallons, valued at $588,373, and nine-tenths of the output was sold for table use. The sales in 1913 amounted to 6,326,533 gallons, valued at $872,518; thus there was in 1914 a decrease of 19 per cent in quantity and of 33 per cent in value. The average price decreased from 14 to 11 cents a gallon. The chief cause of this readjustment was decreased output of several widely sold table waters. The average price of several waters also was lowered.

The following table gives the records of sales for the last five years:

Production and value of mineral waters in Wisconsin, 1910–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1910	36	6,400,812	$974,366	15
1911	31	5,716,162	955,988	17
1912	31	6,045,719	869,495	14
1913	34	6,326,533	872,518	14
1914	35	5,145,452	588,373	11

Resorts accommodating about 300 guests were operated at 2 springs, and the water of 1 spring was reported to have been used for bathing. In addition to the quantity reported as sold, 722,659 gallons was used in the manufacture of soft drinks.

Three new springs were added to the list during 1914—Soda-Lithia, Sulphur Mineral, and Waukesha AAAA. Four springs active in 1913 were reported idle in 1914, and two others that were temporarily idle in 1913 reported production in 1914; thus the total number of active springs was increased to 35, as follows:

Allouez Mineral Spring, Green Bay, Brown County.
Anderson Waukesha Spring, Waukesha, Waukesha County.
Arbutus Mineral Spring, Oconto, Oconto County.
Arcadian Spring, Waukesha, Waukesha County.
Bay City Spring, Ashland, Ashland County.
Bethania Spring, Osceola, Polk County.
Bethesda Spring, Waukesha, Waukesha County.
Castalia Spring, Wauwatosa, Milwaukee County.
Chippewa Spring, Chippewa Falls, Chippewa County.
Clysmic Spring, Waukesha, Waukesha County.
Crystal Spring, Sheboygan, Sheboygan County.
Crystal Springs, Waupaca, Waupaca County.
Darlington Mineral Springs, Darlington, Lafayette County.
Deep Rock Spring, Palmyra, Jefferson County.
Elysian Spring, Prairie du Chien, Crawford County.
Famous Springs, Menominee Falls, Waukesha County.
Fontana Lithia Spring, Fontana, Walworth County.
Glenn Rock Spring, Waukesha, Waukesha County.
Kusche Spring, Oshkosh, Winnebago County.
Lebenswasser Spring, Green Bay, Brown County.
Maribel Mineral Spring, Maribel, Manitowoc County.
Nee-Ska-Ra Spring, Wauwatosa, Milwaukee County.
Rainbow Spring, Wautoma, Waushara County.
Salvator Mineral Spring, Green Bay, Brown County.
Sheboygan Spring, Sheboygan, Sheboygan County.
Sheridan Mineral Springs, near Lake Geneva, Walworth County.
Silurian Spring, Waukesha, Waukesha County.
Silver Spring, Madison, Dane County.
Soda-Lithia Spring, Fussville, near Menominee Falls, Waukesha County.
Sulphur Mineral Springs, Oshkosh, Winnebago County.
Waukesha AAAA Spring, Waukesha, Waukesha County.
Waukesha Fox Head Spring, Waukesha, Waukesha County.
Waukesha Roxo Spring, Waukesha, Waukesha County.
White Rock Spring, Waukesha, Waukesha County.
Willnette Spring, Cooper Station, Racine County.

WYOMING.

Three mineral springs in Wyoming reported sales during 1914 amounting to 69,658 gallons, valued at $8,802. This was a great increase over the sales in 1913, which amounted to 16,200 gallons, valued at $3,610, or at 22 cents a gallon. The average price per gallon in 1914 was 13 cents. A bathing establishment and a small resort were operated at 1 spring. Rocky Mountain Spring reported production for the first time.

The names of the 3 reporting springs are as follows:

De Maris Spring, Cody, Park County.
Paulson Well, Saratoga, Carbon County.
Rocky Mountain Spring, Granite Canon, Laramie County.

HISTORICAL SKETCH.

DOMESTIC PRODUCTION, 1883-1914.

The following table gives the number of commercial springs, the annual production, value, and average price per gallon of mineral waters from 1883 to 1914, inclusive. The same data are graphically presented in figure 5. The statistics have been compiled from the annual reports on the production of mineral waters, the first of which covered the calendar year 1883, and all differences between these figures and the data in the annual reports or in the summary for 1913 are fully explained by footnotes. The figures showing production and value before 1901 include the estimated sales from springs whose owners failed to report. The custom of estimating a lump production and value for the trade of delinquents was continued through 1906, but those estimates have been omitted from the table for the years 1901 to 1906, inclusive, as they are doubtful and are probably excessive. Since 1906 increased facilities for collecting statistics and for keeping in closer touch with the trade have made it possible to reduce the proportion of delinquents and to estimate with greater accuracy, for inclusion in the State totals, the output of springs not reported. The average price per gallon has, however, been computed throughout the table from the production and value of waters actually reported.

These statistics, with one or two exceptions, indicate a normal growth of the trade slightly faster than the increase of population of the United States. The number of commercial springs has increased from 189 in 1883 to 829 in 1914 and the production from 7,529,423 gallons, valued at $1,119,603, in 1883 to 54,358,466 gallons, valued at $4,892,328, in 1914. The greatest recorded production is 64,674,486 gallons in 1909, to which the production of 63,788,552 gallons in 1911 is a close second. The greatest recorded value of the output is $8,634,179 in 1902. Some of the marked increases in production have been caused by active local sales of bottled table waters in cities having polluted municipal supplies; likewise some of the marked decreases have been caused by the decline in local trade when large cities have put filtration plants into operation.

The average price per gallon was higher and the activity of the mineral-water business was greater during the nineties than before or since. The highest recorded average price, 29 cents a gallon in 1898, is believed to have been due to excessive valuation of large productions from a few springs in Virginia during that year, for the valuation of the waters bottled in that State in 1898 is much higher than in the years immediately preceding and following. The marked decrease of the average price since 1906 has been attributed by several statisticians with good reason not to decrease of price of individual waters, but to increased sales of low-priced table waters unaccompanied by correspondingly increased sales of high-priced medicinal waters. Comparison of the reports of spring owners for several years shows that the price of few waters has been lowered, but that some springs once famous have fallen into desuetude, while others formerly small producers have become leaders inth e trade.

The production by States has been recorded since 1889. The leaders approximately in order of total quantity sold have been New York, Wisconsin, Minnesota, and Massachusetts, followed at some distance by Michigan, Texas, Ohio, Virginia, Pennsylvania, and California. During the last five years all those States, except Michigan, and in addition Colorado, Connecticut, Illinois, Maine, Maryland, and New Jersey, have produced annually more than 1,000,000 gallons. Production was heavy in New Hampshire and Kansas during the nineties, but since then it has fallen off in both States. Production was especially heavy in Minnesota from 1905 to 1912 while the filtration plant at Minneapolis was being constructed and put into effective operation. The production in the States of New York, New Jersey, and Connecticut in the vicinity of Greater New York has been notably high during the last six years.

Mineral water sold for medicinal use has been distinguished from that sold for table use during the decade 1905 to 1914, inclusive. The only basis for the differentiation is the individual reports of spring owners, who rely on their personal acquaintance with their trade for making such estimates. Many waters, especially those that induce a laxative action and those that are strongly sulphuretted, are sold exclusively as medicinal waters, and many that are very low in mineral content are sold exclusively as table waters; yet the majority are sold for both uses and it is impracticable to differentiate the classes either through the channels of trade or by the chemical composition of the supplies. Consequently the distinction between medicinal and table waters is not exact but approximate. According to the records of the last decade the value of the water sold for medicinal use has gradually decreased from \$3,133,542, or 48 per cent of the total value, in 1905, to \$1,298,437, or 27 per cent of the total value, in 1914. This decline may be attributed partly to decrease in the sale of certain waters formerly prized for their medicinal value, but chiefly to increased inclination on the part of spring operators to advertise their products as hygienically pure drinking waters and not as natural solutions having exceptional therapeutic properties, and also to gradual elimination of statistics regarding high-priced artificial water sold almost exclusively for medicinal use.

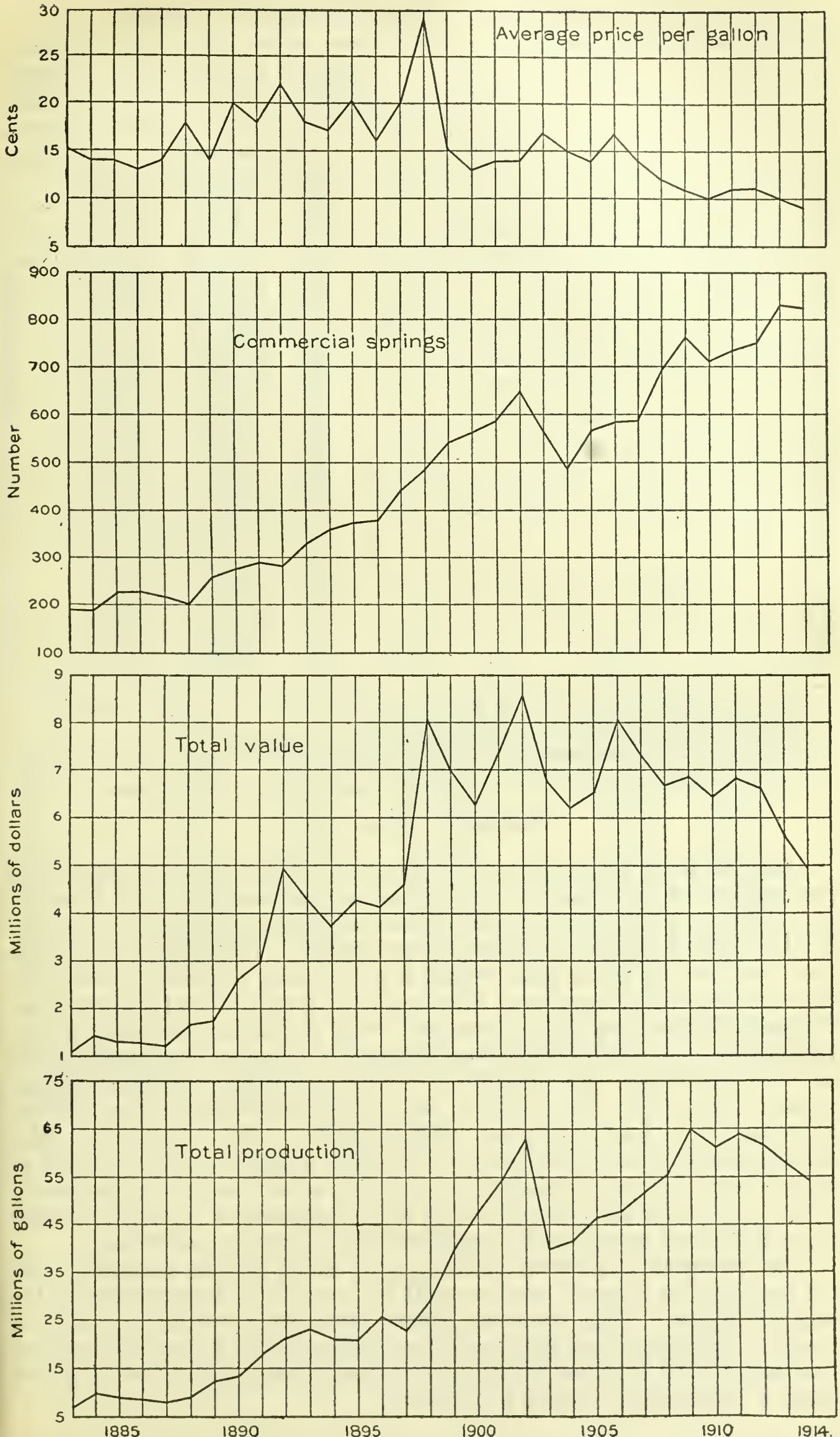

FIGURE 5.—Diagram showing annual production, value, and average price per gallon of mineral waters and number of commercial springs in the United States, 1883 to 1914, inclusive.

Production of mineral water in the United States, 1883–1914.

Year.	Commercial springs.	Quantity sold.	Value.	Average price per gallon.
		Gallons.		*Cents.*
1883	189	[a] 7,529,423	[a] $1,119,603	15
1884	189	[a] 10,215,328	[a] 1,459,143	14
1885	224	9,148,401	1,312,845	14
1886	225	8,950,317	1,284,070	13
1887	215	8,259,609	[b] 1,261,463	14
1888	198	9,578,648	1,679,302	18
1889	258	12,780,471	1,748,458	14
1890	273	13,907,418	2,600,750	20
1891	288	18,392,732	2,996,259	18
1892	283	21,876,604	4,905,970	22
1893	330	23,544,495	4,246,734	18
1894	357	[c] 21,649,608	3,741,846	17
1895	370	21,463,543	4,254,237	20
1896	377	25,795,312	4,136,192	16
1897	441	23,255,911	4,599,106	20
1898	484	28,853,464	8,051,833	29
1899	541	39,562,136	6,948,030	15
1900	561	47,558,784	6,245,172	13
1901	582	54,733,661	7,443,904	14
1902	649	63,174,552	8,634,179	14
1903	560	40,107,147	6,788,426	17
1904	484	[a] 41,969,145	[a] 6,218,873	15
1905	564	46,544,361	6,491,251	14
1906	582	[a] 48,108,580	[a] 8,028,387	17
1907	584	52,060,520	7,331,503	14
1908	695	[a] 55,868,820	[a] 6,712,680	12
1909	760	64,674,486	6,894,134	11
1910	709	62,030,125	6,357,590	10
1911	732	[d] 63,788,552	6,837,888	11
1912	746	62,281,201	6,615,671	11
1913	838	57,867,399	5,631,391	10
1914	829	54,358,466	4,892,328	9

[a] Figures as corrected in reports for 1885, 1905, 1907, and 1909 by excluding statistics regarding waters not classifiable as mineral waters as defined on page 175.
[b] The value $1,261,473, given in report for 1887, was changed in report for 1888.
[c] The production 21,569,608 gallons, given in report for 1894 and in summary for that and succeeding years, has been corrected to make consistent with State totals.
[d] Figures as corrected in report for 1912 by adjusting inconsistencies in producers' reports.

IMPORTS, 1883–1914.

The following table shows the quantity, value, and average price per gallon of mineral waters imported for consumption into the United States from 1883 to 1914, inclusive, according to the records of the United States Treasury Department. The figures for 1883–1885 are for the fiscal year ended June 30, but those for later years are for the calendar year. During 1883 artificial waters were distinguished from natural waters and were classified according to the receptacles in which they were imported. During the period 1884 to 1896, inclusive, this classification was not made, though artificial waters were still distinguished from natural waters. Since 1896, however, they have not been differentiated. The statistics in this table include natural and artificial waters and prepared mixtures of waters from different springs. Since 1908, according to the provisions of the pure-food law, the labels on the containers of imported waters have indicated whether the contents are natural or artificial.

The quantity imported has increased more or less regularly year by year till the imports now brought in are double the quantity in the early eighties. This increase corresponds to a normal growth of trade. During the last five years the consumption of imported waters has been only 5 to 6 per cent of the domestic production, yet it represents a valuation of about $1,000,000.

The value of the imported waters is that appraised by the customs officials. Between 1884 and 1897 the average price per gallon ranged from 17 to 24 cents. In 1898, however, it increased 10 cents, and since that year it has ranged from 27 to 36 cents. Though the average price of imported waters is three times that of domestic waters, this disparity is more apparent than real for several reasons; the price of imported waters includes a large charge for transportation, whereas the price of domestic waters is net at the spring without charges for freight or for returnable containers; most of the imported waters are used for their reputed therapeutic effect, whereas four-fifths of the domestic water was sold in 1914 at prices ranging from half a cent to 10 cents a gallon and chiefly as pure table water; finally, 4 per cent of the domestic water was sold in 1914 at prices greater than 30 cents a gallon, a condition that indicates the production in the United States of waters just as highly prized for their therapeutic effect as those imported from abroad.

The distinction between natural and artificial imported waters, which was made till 1896, indicates that 6,000 to 100,000 gallons of artificial water, equivalent to 1 to 4 per cent of the total, was annually imported. It is not known what proportion of the water now imported is artificial.

Imports of mineral waters into the United States, 1883–1914.

Year.[a]	Quantity imported.	Value.	Price per gallon.	Year.[a]	Quantity imported.	Value.	Price per gallon.
	Gallons.		Cents.		Gallons.		Cents.
1883	[b] 1,714,085	$448,493	....	1899	2,382,410	$663,803	28
1884	1,534,664	367,242	24	1900	2,485,042	687,874	28
1885	1,668,044	400,032	24	1901	2,567,323	744,392	29
1886	[c] 1,681,424	[c] 371,057	22	1902	[d] 2,461,830	[d] 712,827	29
1887	[c] 1,929,396	[c] 390,757	20	1903	[d] 2,851,964	846,294	30
1888	1,729,213	346,106	20	1904	2,901,828	868,262	30
1889	1,595,462	377,432	24	1905	3,150,030	926,357	29
1890	2,344,336	440,414	19	1906	3,157,609	1,012,333	32
1891	2,046,533	401,594	20	1907	3,497,239	1,165,555	33
1892	2,282,175	506,749	22	1908	2,912,398	1,033,047	36
1893	2,327,167	509,858	22	1909	3,464,524	1,085,177	31
1894	1,899,717	420,547	22	1910	3,306,303	983,136	30
1895	2,205,926	525,535	24	1911	3,604,703	1,037,485	29
1896	2,324,501	562,836	24	1912	3,499,497	930,091	27
1897	2,942,200	501,684	17	1913	3,364,676	955,788	28
1898	1,955,723	526,071	27	1914	2,786,142	857,707	31

[a] Figures for 1883, 1884, and 1885 are for the fiscal year ended June 30; later figures for calendar year, ended Dec. 31.
[b] Does not include an unknown quantity of artificial water valued at $7,054.
[c] Figures in reports for 1886 and 1887 are for fiscal year; figures revised for calendar year and given above were first entered in report for 1888.
[d] Figures as corrected in 1904 and later reports.

CEMENT.

By Ernest F. Burchard.

INTRODUCTION.

The most noteworthy feature of the cement industry in 1914 was the fact that the first recorded decrease in annual production of Portland cement took place then. That the production should have shown a decrease just at this particular time occasions no surprise; the surprising fact is that it did not occur sooner. The phenomenal growth of the Portland cement industry in the last 10 years brought forth many prophesies of probable checks, all of which failed to materialize, until finally the large increase in production and stocks in 1913 seemed certain to foreshadow a necessary curtailment of output. Coincident with the decrease in production of Portland cement the output of natural cement showed a slight increase—the first increase that has been recorded in the production of that type of cement since 1902, shortly after it yielded its supremacy in the cement field. The increase in production of natural cement was not sufficient to carry the total for all hydraulic cements beyond the record mark of 1913, yet it is gratifying to note that the total for 1914 is second only to that of 1913 and is well above that of all preceding years. The price of Portland cement decreased 7.8 cents a barrel, but the prices of natural and puzzolan cements increased only 0.4 cent and 1.7 cents a barrel, respectively.

Through the prompt and courteous response of nearly all the manufacturers of Portland cement it was possible to release to the press, on January 4, 1915, an estimate of the production, shipments, and stocks of Portland cement in the United States by districts in 1914. The estimated production and shipments were each three-tenths of 1 per cent higher than the final figures, and the estimated stocks were six-tenths of 1 per cent lower than those shown by the final returns.

In the present chapter, in consideration of the fact that this volume of Mineral Resources completes the publication of the statistics of mineral production of the United States for a series of 35 years, a historical table has been prepared of the production and value of the three principal types of hydraulic cement—natural, Portland, and puzzolan—since the beginning of their manufacture, together with brief notes on the development and character of these cements. A map (Pl. II) showing the location of all the cement plants accompanies this chapter.

The unusual situation developed by the war in Europe and its possible bearing on the extension of foreign trade in cement has seemed to merit a brief discussion at this time and also the insertion of a table showing by countries the quantity and value of the exports of cement.

In the canvass for statistics of output of Portland cement a special statistical compilation of shipments into the various States during 1914 was requested, and the returns have been compiled in a table together with the population of the States for that year and the apparent per capita consumption of Portland cement. The response to this request, which involved much extra work on the part of officials of cement companies, was most gratifying, as it was necessary for the writer to estimate the data for only 2 mills in the United States out of 111 which made shipments.

NOTES ON DEVELOPMENT OF PRINCIPAL HYDRAULIC CEMENTS.

The principal hydraulic cements are termed natural cements, Portland cements, and puzzolan cements.

NATURAL CEMENTS.

Natural cement, sometimes, especially in Europe, called Roman cement, is the product obtained by calcining an argillaceous limestone, without pulverization or admixture of other materials, at a temperature only slightly above that usual for burning lime, and by finely grinding the burned mass. The limestone is calcined in small lumps with coal in stationary kilns. Natural cements similar to those now in use were first manufactured in England in 1796, and in France a few years later; in the United States natural "cement rock" was discovered during the building of the Erie Canal in New York in 1818, and cement manufactured from it was used in the construction of the locks and walls of that canal. A large proportion of the cement made in Belgium and France is still of the natural type. The principal centers of natural-cement manufacture in the United States at present are the Rosendale district, Ulster County, N. Y.; the Lehigh Valley, Pa.; the Ohio River Valley, near Louisville, Ky.; the vicinities of Mankato and Austin, Minn., and of Utica, Ill. Natural cements set more rapidly, but possess less initial strength than Portland cement. They are slow in gaining strength subsequently, but some of them have attained after periods of many years equal or even greater tensile strength than Portland cement. On account of their derivation from natural rock the composition of natural cements made in different localities may vary greatly. Natural cements are yellow to brown in color and have a lower specific gravity than Portland cement.

PORTLAND CEMENT.

Portland cement was invented by Joseph Aspdin, of Leeds, England, and was thus named from its fancied resemblance, when set, to the well-known oolitic limestone of Jurassic age quarried for building purposes on Portland Isle, Dorsetshire, England. Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate mixture of properly proportioned argillaceous and calcareous substances, with only such additions subsequent to calcining as may be necessary to control certain properties. Such additions shall not exceed 3 per cent by weight of the calcined product. Chemically, Portland cement is a combination consisting principally of silicates and aluminates of lime, and the raw materials must necessarily contain silica, alumina, and lime.

MAP OF UNITED STATES SHOWING DISTRIBUTION OF PORTLAND, NATURAL, AND PUZZOLAN CEMENT PLANTS AND OUTLINES OF PORTLAND CEMENT COMMERCIAL DISTRICTS

Prepared by Ernest F. Burchard

1915

• Portland cement plant ▪ Natural cement plant ▲ Puzzolan cement plant

THE FOLLOWING ARE ALL PORTLAND CEMENT COMPANIES UNLESS OTHERWISE SPECIFIED.
N = NATURAL CEMENT PZ = PUZZOLAN CEMENT

1.	Glens Falls	Glens Falls	N. Y.
2.	Knickerbecker Atlas	Hudson	N. Y.
3.	Alsen	Catskill	N. Y.
4	Alpha	Cementon	N. Y.
5.	Rosendale (N)	Rosendale	N. Y.
6.	Helderberg	Howes Cave	N. Y.
7.	Bangs-Gayner (N) Sheedy (N)	Fayetteville	N. Y.
8.	Alvord (N) Thomas Millon	Jamesville	N. Y.
9.	Cayuga Lake	Portland Point	N. Y.
10.	Colloseus (Slag)	Buffalo	N. Y.
11.	Vulcanite Edison Alpha Allentown Alpha Atlas Bath Coplay Dexter Giant Lawrence (also N) Lehigh Nazareth Northampton Penn-Allen Pennsylvania Pheonix Whitehall	Lehigh District	N. J.-Pa.
12.	Sandusky	York	Pa
13.	Stewart (Pz)	Sharon	Pa.
14.	Lehigh	New Castle	Pa.
15.	Crescent	Wampum	Pa.
16.	Universal	Pittsburgh	Pa.
17.	Security	Security	Md.
18.	Tidewater	Union Bridge	Md.
19.	Alpha	Manheim	W. Va
20.	Virginia	Fordwick	Va.
21.	Giant	Norfolk	Va.
22.	Clinchfield	Kingsport	Tenn
23.	Dixie	Richard City	Tenn.
24.	Southern States	Rockmart	Ga.
25.	Coosa	Ragland	Ala.
26.	Standard	Leeds	Ala.
27.	Southern (Pz)	Birmingham	Ala.
28.	Kosmos	Kosmosdale	Ky.
29.	Ironton	Ironton	Ohio.
30.	Superior	Superior	Ohio.
31.	Struthers (Pz)	Struthers	Ohio.
32.	Lisbon (N) Ohio (N)	Lisbon	Ohio.
33.	Diamond	Middle Branch	Ohio.
34	Castalia	Castalia	Ohio.
35.	Sandusky	Baybridge	Ohio.
36	Huron	Alpena	Mich.
37.	Newaygo	Newaygo	Mich.
38.	New Aetna	Fenton	Mich.
39.	Burt	Bellevue	Mich.
40.	Wyandotte	Wyandotte	Mich.
41.	Michigan	Chelsea	Mich.
42.	Peninsular	Cement City	Mich.
43.	Omega	Mosherville	Mich.
44.	Wolverine	Coldwater and Quincy	Mich.
45.	Peerless	Union City	Mich.
46.	Wabash	Stroh	Ind.
47.	Sandusky	Syracuse	Ind.
48.	Lehigh	Mitchell	Ind.
49.	Louisville (N)	Sellersburg	Ind.
50.	Louisville	Speeds	Ind.
51.	Universal	Buffington	Ind.
52.	Universal	South Chicago	Ill.
53.	Utica (N)	Utica	Ill.
54.	German American Marquette	La Salle	Ill.
55.	Chicago	Oglesby	Ill.
56.	Sandusky	Dixon	Ill.
57.	Carney (N)	Mankato	Minn.
58.	Austin (N)	Austin	Minn.
59.	Lehigh Northwestern States	Mason City	Iowa.
60.	Iowa	Des Moines	Iowa.
61.	Atlas	Hannibal	Mo.
62.	Union Sand & Material	Prospect Hill	Mo.
63.	Continental	Continental	Mo.
64.	Cape Girardeau	Cape Girardeau	Mo.
65.	Union Sand & Material	Sugar Creek	Mo.
66.	Bonner	Bonner Springs	Kans.
67.	Nebraska	Superior	Nebr.
68.	Uncle Sam	Yocemento	Nebr.
69	Great Western	Mildred	Kans.
70.	Iola United Kansas	Iola	Kans.
71.	Ash Grove Chanute	Chanute	Kans.
72.	Fort Scott (N)	Fort Scott	Kans.
73.	Altoona	Altoona	Kans.
74.	Fredonia	Fredonia	Kans.
75.	Western States	Independence	Kans.
76.	Dewey	Dewey	Okla.
77.	Oklahoma	Ada	Okla.
78.	Trinity Texas	Eagle Ford and Cement	Tex.
79.	San Antonio	San Antonio	Tex.
80.	United States	Concrete	Colo.
81.	Colorado	Portland	Colo.
82.	Southwestern	El Paso	Tex.
83.	Three Forks	Trident	Mont.
84	Ogden	Bakers	Utah
85.	Union	Devils Slide	Utah.
86.	Utah	Salt Lake City	Utah.
87.	Pheonix	Phoenix	Ariz.
88.	Riverside	Riverside	Cal.
89.	California	Colton	Cal.
90.	Golden State	Oro Grande	Cal.
91.	Santa Cruz	Davenport	Cal.
92.	Cowell	Cowell	Cal.
93.	Standard	Napa Junction	Cal.
94.	Pacific	Cement	Cal.
95.	Olympic	Bellingham	Wash.
96.	Superior Washington	Concrete	Wash.
97.	International	Irvin	Wash.
98.	Lehigh	Metaline Falls	Wash.

Therefore, within these limitations, various raw materials are capable of being utilized for the manufacture of Portland cement. In England chalk and clay, and in Germany and France, marl and clay, and limestone and slate are employed. In the United States limestone and clay or shale, marl and clay, argillaceous limestone and purer limestone, as well as blast-furnace slag and limestone are used.

The first process in the manufacture of Portland cement is the mixing of the raw materials. In order that this mixture may be uniform and homogeneous and the respective ingredients properly proportioned, they must be reduced to a fine powder. The method of reduction depends to some extent, although less now than formerly, upon the character of the raw materials; when readily disintegrable in water they are often reduced by one of the wet processes. One wet process, formerly extensively used in England, consists in applying an excess of water to the clay and chalk, mixing them in a pug mill to a thin paste, which is run into settling basins, where the water is drained off until the mixture is dry enough to be cut into blocks or bricks. In the semiwet process only enough water is added to reduce the mixture to a plastic condition in the pug mill. In these processes the brick or blocks are dried and then burned in kilns, of which there are several varieties.

When hard materials incapable of disintegration by water are employed, they are ground dry, the powder being then either slightly moistened and made into bricks, or, when the rotary kiln is used, stored in powdered form. In the dry process, drying preliminary to burning is unnecessary. In the United States, where only the rotary kiln is now used, the dry powder or the wet paste is run directly into the kiln without being previously made into bricks or dried. Powdered coal is the kiln fuel at more than 80 per cent of the Portland cement mills in the United States, and the fuels at the remaining plants consist of crude petroleum, natural gas, and producer gas. The powdered coal is blown through a tube into the lower end of the inclined rotating kiln, and the incandescent particles of coal constitute a long flame which heats the mixture as it travels slowly through the kiln toward the flame. The burning or calcination is continued until incipient fusion of the raw mixture occurs, the resulting clinker being grayish or greenish black in color. To the clinker is usually added less than 3 per cent by weight of gypsum to serve as a retarder. The mixture is next ground to an impalpable powder, and then after a period of curing, it is ready for use. Extreme fineness of grinding is a prime essential of good Portland cement, many brands of which are ground so fine that from 92 to 96 per cent of the powder will pass through a sieve having 10,000 meshes per square inch and 75 per cent will pass through a sieve having 40,000 meshes per square inch. Portland cement sets slower than natural cement, but attains its maximum strength more quickly. The finished cement is of various shades of gray; some of it is white.

PUZZOLAN CEMENT.

Puzzolan cement is a term applied to a mixture of siliceous and aluminous materials, such as powdered blast-furnace slag or volcanic ash and powdered slaked lime. The mixture is not burned at any stage of the process of manufacture. When made into mortar it has the property of hardening under water. Natural puzzolan cements have been used in Italy and other parts of Europe since very early times, and are made by grinding certain volcanic tuffs and mixing the powder with slaked lime. In the United States puzzolan cement is most commonly made from blast-furnace slag and lime. The hot slag, as it comes from the furnace, is granulated in cold water, dried, and the dry, granulated slag is ground with slaked lime. Puzzolan cements are usually light bluish, of lower specific gravity and less tensile strength than Portland cement,[1] and are considered to be better adapted to use under water than in air.

MARKETED PRODUCTION OF PRINCIPAL HYDRAULIC CEMENTS.

The total quantity of Portland, natural, and puzzolan cement marketed, or shipped from the mills in the United States, in 1914 was 87,257,552 barrels, valued at $80,533,203, as compared with 89,541,348 barrels, valued at $89,550,527, in 1913. This represents a decrease in quantity of 2,283,796 barrels, or nearly 2.6 per cent, and in value of $9,017,324, or 10.1 per cent. The basis formerly used for the statement of this table has been changed in this chapter from that of actual production to that of marketed production in the belief that the marketed production, or shipments of cement, represent more truly the commercial output of the industry than the actual production. It should be noted here that any table in which the statistics of these three kinds of cement are combined to form a total of barrels is necessarily slightly inconsistent, for the weights per barrel of each kind of cement are different. A barrel of Portland cement is considered to weigh 380 pounds net, but the weights of barrels of the other two classes of cement are not uniform. Natural cement is sold in barrels variously containing 240 to 285 pounds and generally considered to contain 265 pounds; puzzolan cement has been considered to weigh 330 pounds to the barrel, but weights varying from 240 to 380 pounds have been reported, depending upon the specific gravity of the cement, the fineness, and the number of sacks constituting a barrel.

The distribution of the total marketed production of the three main classes of cement is shown in the following table for the years 1912, 1913, and 1914:

Marketed production of principal hydraulic cements in the United States in 1912, 1913, and 1914.

Class.	1912		1913		1914	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.	Quantity (barrels).	Value.
Portland	85,012,556	$69,109,800	88,689,377	$89,106,975	86,437,956	$80,118,475
Natural	821,231	367,222	744,658	345,889	751,285	351,370
Puzzolan	91,864	77,363	107,313	97,663	68,311	63,358
Total	85,925,651	69,554,385	89,541,348	89,550,527	87,257,552	80,533,203

The following table shows the total recorded production of cement in the United States, 1818–1914:

[1] Eckel, E. C., Portland cement materials and industry of the United States: U. S. Geol. Survey Bull. 522, p. 18, 1913.

Total recorded production of principal hydraulic cements in the United States, 1818 to 1914, inclusive, in barrels.

Year.	Natural cement.		Portland cement.		Puzzolan cement.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1818-1829	300,000	$246,000					300,000	$246,000
1830-1839	1,000,000	850,000					1,000,000	850,000
1840-1849	4,250,000	3,612,500					4,250,000	3,612,500
1850-1859	11,000,000	9,350,000					11,000,000	9,350,000
1860-1869	16,420,000	13,957,000					16,420,000	13,957,000
1870-1879	22,000,000	18,700,000	82,000	$246,000			22,082,000	18,946,000
1880	2,030,943	1,726,707	42,000	126,000			2,072,943	1,852,707
1881	2,440,000	2,379,000	60,000	150,000			2,500,000	2,529,000
1882	3,165,000	3,481,500	85,000	191,250			3,250,000	3,672,750
1883	4,000,000	4,100,000	90,000	193,500			4,090,000	4,293,500
1884	3,900,000	3,510,000	100,000	210,000			4,000,000	3,720,000
1885	4,000,000	3,200,000	150,000	292,500			4,150,000	3,492,500
1886	4,350,000	3,697,500	150,000	292,500			4,500,000	3,990,000
1887	6,692,744	5,186,877	250,000	487,500			6,942,744	5,674,377
1888	6,253,395	4,533,639	250,000	487,500			6,503,395	5,021,139
1889	6,531,876	4,702,951	300,000	500,000			6,831,876	5,202,951
1890	7,441,116	3,822,501	335,500	704,050			7,776,616	4,526,551
1891 [a]	7,767,979	3,671,147	454,813	967,467			8,222,792	4,638,614
1892	8,211,181	3,991,455	547,440	1,152,600			8,758,621	5,144,055
1893	7,411,815	3,251,757	590,652	1,158,138			8,002,467	4,409,895
1894	7,563,488	3,635,731	798,757	1,383,473			8,362,245	5,019,204
1895	7,741,077	3,895,424	990,324	1,586,830			8,731,401	5,482,254
1896	7,790,450	4,049,202	1,543,023	2,424,011	12,265	$12,250	9,345,738	6,485,463
1897	8,311,688	3,862,392	2,677,775	4,315,891	48,329	48,500	11,037,792	8,226,783
1898	8,418,924	3,888,728	3,692,284	5,970,773	233,000	198,050	12,344,208	10,057,551
1899	9,868,179	4,814,771	5,652,266	8,074,371	335,000	268,000	15,855,445	13,157,142
1900	8,383,519	3,728,848	8,482,020	9,280,525	365,611	274,208	17,231,150	13,283,581
1901	7,084,823	3,056,278	12,711,225	12,532,360	272,689	198,151	20,068,737	15,786,789
1902	8,044,305	4,076,630	17,230,644	20,864,078	478,555	425,672	25,753,504	25,366,380
1903	7,030,271	3,675,520	22,342,973	27,713,319	525,896	542,502	29,899,140	31,931,341
1904	4,866,331	2,450,150	26,505,881	23,355,119	303,045	226,651	31,675,257	26,031,920
1905	4,473,049	2,413,052	35,246,812	33,245,867	382,447	272,614	40,102,308	35,931,533
1906	4,055,797	2,423,170	46,463,424	52,466,186	481,224	412,921	51,000,445	55,302,277
1907	2,887,700	1,467,302	48,785,390	53,992,551	557,252	443,998	52,230,342	55,903,851
1908	1,686,862	834,509	51,072,612	43,547,679	151,451	95,468	52,910,925	44,477,656
1909	1,537,638	652,756	64,991,431	52,858,354	160,646	99,453	66,689,715	53,610,563
1910	1,139,239	483,006	76,549,951	68,205,800	95,951	63,286	77,785,141	68,752,092
1911	926,091	378,533	78,528,637	66,248,817	93,230	77,786	79,547,958	66,705,136
1912	821,231	367,222	82,438,096	67,016,928	91,864	77,363	83,351,191	67,461,513
1913	744,658	345,889	92,097,131	92,557,617	107,313	97,663	92,949,102	93,001,169
1914	751,285	351,370	88,230,170	81,789,368	68,311	63,358	89,049,766	82,204,096
Total	233,292,654	148,821,017	770,518,231	736,588,922	4,764,079	3,897,894	1,008,574,964	889,307,833

[a] The figures for 1890 and previous years are estimates made at the close of each year and are believed to be substantially correct. Since 1890 the official figures are based on practically complete returns from all producers.

PORTLAND CEMENT.

PRODUCTION AND SHIPMENTS.

The total production of Portland cement in the United States in 1914, as reported to the United States Geological Survey, was 88,230,170 barrels, valued at $81,789,368; the production for 1913 was 92,097,131 barrels, valued at $92,557,617. The output for 1914 represents a decrease in quantity of 3,866,961 barrels, or 4.20 per cent, and a decrease in value of $10,768,249, or 11.63 per cent. The value assigned to the production is computed on the basis of 92.7 cents a barrel, or the average price of the Portland cement shipped in 1914.

The shipments of Portland cement from the mills in the United States in 1914 were, according to reports received by the Survey, 86,437,956 barrels, valued at $80,118,475, compared with 88,689,377 barrels, valued at $89,106,975, shipped in 1913. The shipments, therefore, represent a decrease in quantity of 2,251,421 barrels, or 2.54 per cent, and in value of $8,988,500, or 10.09 per cent. The average price per barrel for the whole country in 1914, according to these figures, was 92.7 cents, compared with $1.005 in 1913, a decrease of 7.8 cents a barrel, or about 7.76 per cent. This represents the selling price of cement in bulk at the mills, including cost of labor and packing, but not the value of the sacks or barrels. The average price per barrel for the country is about 11.8 cents higher than the average price received for Portland cement in the Lehigh district, and is near the average price received in New York, Illinois, Iowa, the Southeastern States, and the Plains States, but falls 42.5 cents below the average price received in Utah, where Portland cement brought the highest price of the year.

The quantity of Portland cement produced—88,230,170 barrels, of 380 pounds—is equivalent to 14,967,618 long tons, and the value per long ton is $5.46. Compared with the production, in 1914, of pig iron, 23,332,244 long tons,[1] the production of Portland cement was more than 64 per cent of the quantity of pig iron, but the total value of the cement was only about 20 per cent of the value of the pig iron. The value of the cement per ton was between 35 and 40 per cent of that of pig iron.

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 total shipments of 159,117 barrels of white Portland cement, with a reported average value of $2.25 a barrel. The greater part of this white cement 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. Two mills in Pennsylvania reported the production of white Portland cement in 1914, one of which produced white cement exclusively.

PRODUCTION AND SHIPMENTS BY STATES.

In the following table the production and shipments and the corresponding values of Portland cement for 1913 and 1914, by States, are arranged in the order of rank for 1914, provided there are three

[1] Am. Iron and Steel Inst. Special Statist. Bull. 1, Feb. 25, 1915.

or more producers or shippers 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. There were producing plants in 25 States in 1913, and in 26 States in 1914, but only 14 of these States contained three or more plants; therefore it has been necessary to group together in the table a number of States not closely related geographically. This disadvantage is, however, compensated for in the table "Production and shipments of Portland cement by commercial districts," in which statistics are given for groups, not generally exceeding three in number, of States geographically related.

Production and shipments of Portland cement in 1913 and 1914, by States.

[Figures opposite P relate to production; those opposite S to shipments.]

State.		Active plants.		1913.		1914.		Per-cent age of change in quantity, 1914.	Average factory price per barrel.	
		1913	1914	Quantity.	Value.	Quantity.	Value.		1913	1914
				Barrels.		*Barrels.*				
Pennsylvania	P	23	20	28,701,845	$28,845,355	26,570,151	$24,630,529	− 7.43		
	S	23	20	28,060,495	24,268,800	25,985,106	20,944,787	− 7.40	$0.865	$0.806
Indiana	P	5	5	10,872,574	10,926,937	9,595,923	8,895,421	−11.74		
	S	5	5	10,219,492	10,218,867	9,540,288	8,342,164	− 6.65	1.000	.874
New York	P	8	8	5,208,020	5,234,060	5,886,124	5,456,437	+13.02		
	S	8	8	5,136,334	4,801,607	5,474,191	5,020,720	+ 6.58	.935	.917
Illinois	P	5	5	5,083,799	5,109,218	5,401,605	5,007,288	+ 6.25		
	S	5	5	4,734,540	4,784,696	5,284,022	4,848,522	+11.61	1.011	.918
California	P	7	7	6,159,182	6,189,978	5,075,114	4,704,631	−17.60		
	S	7	7	6,018,262	8,896,734	5,004,633	6,698,905	−16.84	1.478	1.339
Missouri	P	5	5	4,803,338	4,827,355	4,723,906	4,379,061	− 1.65		
	S	5	5	4,485,820	4,556,822	4,706,389	4,485,744	+ 4.92	1.016	.953
Michigan	P	11	11	4,186,236	4,207,167	4,285,345	3,972,515	+ 2.37		
	S	11	11	4,081,281	4,228,879	4,218,429	4,064,781	+ 3.36	1.036	.964
Iowa	P	3	3	3,623,674	3,641,792	4,233,707	3,924,646	+16.83		
	S	3	3	3,455,800	3,972,876	4,224,076	4,008,915	+22.23	1.150	.949
New Jersey	P	3	3	4,460,027	4,482,327	3,674,800	3,406,540	−17.61		
	S	3	3	4,255,015	3,638,755	3,530,476	3,081,205	−17.03	.855	.873
Kansas	P	10	9	3,374,836	3,391,710	3,431,142	3,180,669	+ 1.67		
	S	10	10	3,291,818	3,286,861	3,237,906	2,643,415	− 1.64	.998	.816
Texas	P	4	4	2,117,142	2,127,728	2,100,341	1,947,016	− .79		
	S	4	4	2,108,737	2,663,063	2,096,140	2,686,653	− .60	1.263	1.282
Washington	P	5	5	2,339,202	2,350,898	2,017,344	1,870,078	−13.76		
	S	5	5	2,023,172	2,853,260	2,045,465	2,303,433	+ 1.10	1.410	1.126
Ohio	P	5	5	1,667,739	1,676,078	1,962,047	1,818,817	+17.65		
	S	5	5	1,631,055	1,721,423	1,919,859	1,913,797	+17.71	1.055	.997
Utah	P	3	3	867,433	871,770	981,100	909,480	+13.10		
	S	3	3	950,469	1,233,421	974,723	1,317,575	+ 2.55	1.298	1.352
Other States[a]	P	16	17	8,632,084	8,675,244	8,291,521	7,686,240	− 3.95		
	S	16	17	8,237,087	7,980,911	8,196,253	7,757,859	− .50	.969	.947
Total	P	113	110	92,097,131	92,557,617	88,230,170	81,789,368	− 4.20		
	S	113	111	88,689,377	89,106,975	86,437,956	80,118,475	− 2.54	1.005	.927

[a] Alabama, Arizona, Colorado, Georgia, Kentucky, Maryland, Montana, Oklahoma, Tennessee, Virginia, and West Virginia in 1913; Nebraska in addition in 1914.

According to this table there were unimportant changes in the rank of certain States as cement producers. In 1913 the output of California exceeded that of New York and Illinois, but in 1914 this State dropped from third to fifth place, New Jersey dropped from seventh to ninth place, having been passed by both Michigan and Iowa in 1914. Pennsylvania and Indiana held first and second places, respectively, as for many years, but both of these large cement-producing States suffered an appreciable reduction of output. The State of Kansas, which has attracted considerable attention in the cement world, first, because of the rapid development of the industry within its borders on account of the proximity of abundant supplies of suitable raw material and cheap natural gas, and later because of the waning of the gas supply and the consequent increase in cost of manufacture of cement which resulted in curtailment of output, maintained its rank of tenth among cement producers and suffered but little reduction of output, although the price of cement fell considerably below the average. Iowa and Ohio both showed gratifying increases in output, and appear also to have kept prices up more successfully than many other States. In the far West, in Washington, conditions have been brought into a better balanced state by a considerable curtailment of production with an increase in shipments, although prices fell heavily. In Utah production was largely and shipments slightly increased, and what is of considerable interest, prices were also increased. The only other States showing increase of prices are New Jersey and Texas.

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 was followed in both the 1911 and the 1912 reports, but it appeared advisable that the Southeastern States should be subdivided, and this was first done in the report for 1913.

The following table summarizes, by commercial districts for 1913 and 1914, the number of active plants producing and shipping Portland cement, the production and shipments, with percentage of change in 1914, and the average factory prices per barrel in bulk, with the percentage of change in price in 1914:

Production and shipments of Portland cement in 1913 and 1914, by commercial districts.

[Figures opposite P relate to production; those opposite S to shipments.]

District.		Active plants. 1913	Active plants. 1914	Production and shipments (barrels). 1913	Production and shipments (barrels). 1914	Production and shipments (barrels). Percentage of change, 1914.	Average factory price per barrel. 1913	Average factory price per barrel. 1914	Average factory price per barrel. Percentage of change, 1914.
Lehigh district (New Jersey and eastern Pennsylvania)	P..	22	20	27,139,601	24,614,933	− 9.30	......	......	......
	S..	22	20	26,659,537	23,968,554	−10.09	$0.838	$0.809	− 3.46
New York	P..	8	8	5,208,020	5,886,124	+13.02	......	......	......
	S..	8	8	5,136,334	5,474,191	+ 6.57	.934	.917	− 1.82
Ohio and western Pennsylvania	P..	9	8	7,690,010	7,592,065	− 1.27	......	......	......
	S..	9	8	7,287,028	7,466,887	+ 2.46	1.000	.876	−12.50
Michigan and northeastern Indiana	P..	13	13	5,057,199	5,214,557	+ 3.11	......	......	......
	S..	13	13	4,960,891	5,157,613	+ 3.96	1.030	.960	− 6.79
Kentucky and southern Indiana	P..	3	3	3,005,417	2,930,735	− 2.48	......	......	......
	S..	3	3	2,861,624	2,932,003	+ 2.45	1.008	.717	−28.96
Illinois and northwestern Indiana	P..	6	6	12,423,799	11,532,605	− 7.17	......	......	......
	S..	6	6	11,576,938	11,316,645	− 2.24	1.002	.932	− 6.98
Maryland, Virginia, and West Virginia	P..	4	4	2,668,338	2,784,988	+ 4.37	......	......	......
	S..	4	4	2,529,629	2,793,036	+10.41	.865	.877	+ 1.27
Tennessee, Alabama, and Georgia	P..	5	5	3,082,623	2,672,210	−13.31	......	......	......
	S..	5	5	2,958,829	2,577,099	−12.90	.899	.935	+ 3.89
Iowa and Missouri	P..	8	8	8,427,012	8,957,613	+ 6.29	......	......	......
	S..	8	8	7,941,620	8,930,465	+12.45	1.074	.940	−11.45
Great Plains States (Kansas, Nebraska, Oklahoma, and central Texas)	P..	15	15	6,350,646	6,253,731	− 1.52	......	......	......
	S..	15	16	6,190,040	6,016,774	− 2.79	1.063	.930	−12.51
Rocky Mountain States (Arizona, Colorado, Utah, Montana, and western Texas)	P..	8	8	2,546,082	2,698,151	+ 5.97	......	......	......
	S..	8	8	2,545,473	2,754,591	+ 8.21	1.319	1.306	− .99
Pacific coast States (California and Washington)	P..	12	12	8,498,384	7,092,458	−16.54	......	......	......
	S..	12	12	8,041,434	7,050,098	−12.32	1.461	1.277	−12.66
Total	P..	113	110	92,097,131	88,230,170	− 4.20	......	......	......
	S..	113	111	88,689,377	86,437,956	− 2.54	1.005	.927	− 7.76

According to this table there was in 1914, compared with 1913, in the 12 districts into which the United States is divided, an increase in production in 5 districts: New York, Michigan-northeastern Indiana, Maryland-Virginia-West Virginia, Iowa-Missouri, and the Rocky Mountain States; and an increase in shipments in 7 districts: New York, Ohio-western Pennsylvania, Michigan-northeastern Indiana, Kentucky-southern Indiana, Maryland-Virginia-West Virginia, Iowa-Missouri, and the Rocky Mountain States. There was a decrease in production in 7 districts: Lehigh, Ohio-western Pennsylvania, Kentucky-southern Indiana, Illinois-northwestern Indiana, Tennessee-Alabama-Georgia, Great Plains, and Pacific coast; and a decrease in shipments in 5 districts: Lehigh, Illinois-northwestern Indiana, Tennessee-Alabama-Georgia, Great Plains, and Pacific coast. The largest percentage of increase of production was reported from New York, the increase being 13.02 per cent, but the increase in shipments in that district was only half as great. The districts that showed the heaviest percentages of decrease in both production and shipments were the Tennessee-Alabama-Georgia district, and the Pacific coast district.

The net change for the country at large was a decrease in both production and shipments, amounting to 3,866,961 barrels, or 4.20 per cent, in production, and to 2,251,421 barrels, or 2.54 per cent, in shipments. In 1914 the production exceeded the shipments by 1,792,214 barrels, or about 2 per cent of the production. This relation was similar to conditions in 1913.

LEHIGH DISTRICT.

The production of Portland cement in the Lehigh district of eastern Pennsylvania and western New Jersey in 1914 was 24,614,933 barrels, as compared with 27,139,601 barrels in 1913, a decrease of 2,524,668 barrels or 9.30 per cent. The shipments from mills in this district amounted in 1914 to 23,968,554 barrels, as compared with 26,659,537 barrels in 1913, a decrease of 2,690,983 barrels, or 10.09 per cent. The

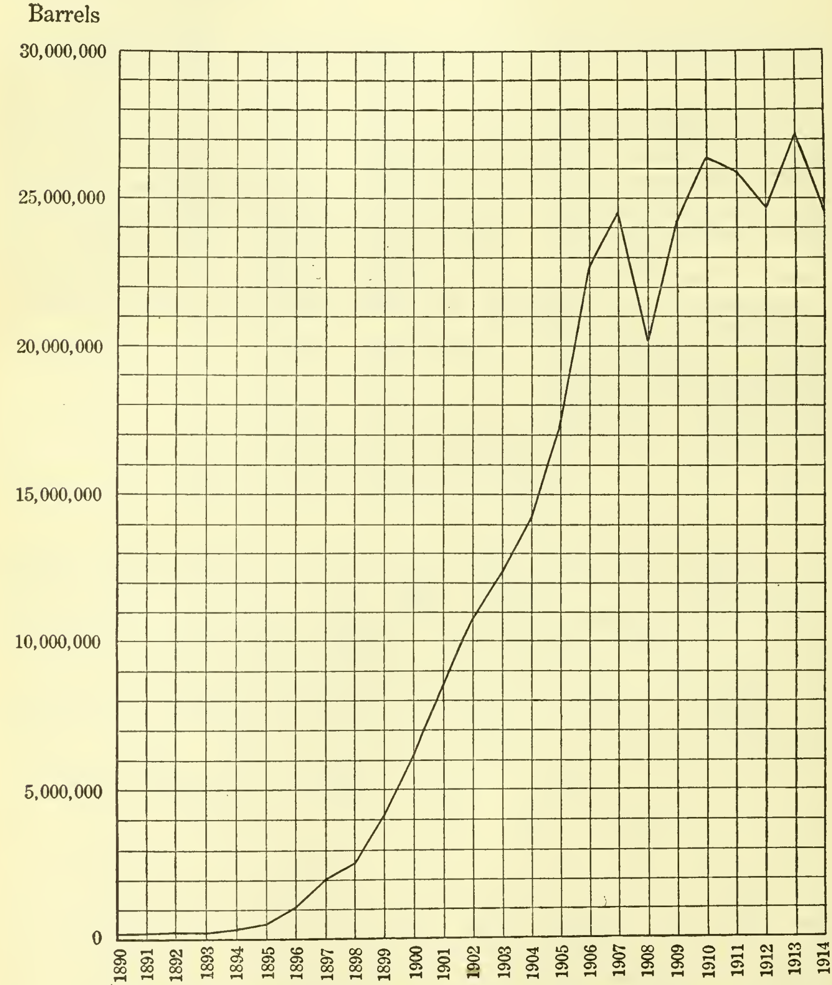

FIGURE 6.—Production of Portland cement in the Lehigh district, 1890-1914.

total value of the Portland cement shipped from this district in 1914 was reported as $19,401,780, at an average price of 80.9 cents a barrel in bulk at the mills, as compared with $22,342,102, or 83.8 cents a barrel, in 1913. The production of white Portland cement from two plants in this district is included in the figures for 1914. As the average price reported for the white cement was considerably higher than that reported for ordinary gray cement, the average price for the district is slightly higher than if it represented gray Portland cement alone.

Twenty plants produced and shipped Portland cement from the Lehigh district in 1914, as compared with 22 producers and shippers in 1913. This is, however, an actual decrease of only one plant, as is explained on page 241.

The Lehigh district of eastern Pennsylvania and western New Jersey has, except in five years, shown a steady increase in production of Portland cement from 1890 to the present time. The years prior to 1914 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 percentage which the Lehigh total bears to the total for the United States is slowly but steadily decreasing.

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, and the curve (fig. 6) illustrates graphically the trend of production during the same period:

Portland cement production in the Lehigh district and in the United States, 1890–1914, 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	1903	12,324,922	22,342,973	55.2
1891	248,500	454,813	54.7	1904	14,211,039	26,505,881	53.7
1892	280,840	547,440	51.3	1905	17,368,687	35,246,812	49.3
1893	265,317	590,652	44.9	1906	22,784,613	46,463,424	49.0
1894	485,329	798,757	60.8	1907	24,417,686	48,785,390	50.0
1895	634,276	990,324	64.0	1908	20,200,387	51,072,612	39.6
1896	1,048,154	1,543,023	68.1	1909	24,246,706	64,991,431	37.3
1897	2,002,059	2,677,775	74.8	1910	26,315,359	76,549,951	34.4
1898	2,674,304	3,692,284	72.4	1911	25,972,108	78,528,637	33.1
1899	4,110,132	5,652,266	72.7	1912	24,762,083	82,438,096	30.0
1900	6,153,629	8,482,020	72.6	1913	27,139,601	92,097,131	29.5
1901	8,595,340	12,711,225	67.7	1914	24,614,933	88,230,170	27.9
1902	10,829,922	17,230,644	62.8				

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, generally, a decrease in the relative production from cement rock (type 1) and from marl (type 3), and a corresponding increase in the production from limestone (type 2) and from blast-furnace slag (type 4).

Production, in barrels, and percentage of total output of Portland cement in the United States according to type of material used, 1898–1914.

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
1913	29,333,490	31.8	47,831,863	51.9	3,734,778	4.1	11,197,000	12.2
1914	24,907,047	28.2	50,168,813	56.9	4,038,310	4.6	9,116,000	10.3

The following table summarizes the shipments of Portland cement and their value during the four years that data on this subject have been gathered by the United States Geological Survey:

Shipments of Portland cement in the United States, 1911–1914, in barrels.

Year.	Quantity.	Value.
1911	75,547,829	$63,762,368
1912	85,012,556	69,109,800
1913	88,689,377	89,106,975
1914	86,437,956	80,118,475

STOCKS AT MILLS.

The stock of Portland cement on hand at the various mills at the end of 1914, according to reports, amounted to 12,893,863 barrels, compared with 11,220,328 barrels on hand at the close of 1913, an increase in stock of 1,673,535 barrels, or 14.91 per cent, during 1914. The stock reported for 1914 checks within 0.9 per cent of the calculated stock obtained by balancing the shipments for 1914 against the production of 1914 plus the stock at the close of 1913, and it is believed that this is as close as can be expected, since the reports of the majority of producers fail to balance from year to year, owing, no doubt, to revisions in estimates of stock from time to time

The two tables following give the stocks on hand by States and by districts at the close of 1913 and 1914 and the percentage of change in 1914.

Stocks of Portland cement Dec. 31, 1913, and Dec. 31, 1914, by States, in barrels.

States.	Quantity.		Percentage of change, 1914.
	1913	1914	
California	651,101	624,162	− 4.13
Illinois	641,334	730,424	+13.88
Indiana	1,888,543	1,947,573	+ 3.12
Iowa	542,575	609,293	+12.29
Kansas	520,917	674,903	+29.56
Michigan	473,563	538,846	+13.78
Missouri	855,272	863,435	+ .95
New Jersey	415,799	559,557	+34.57
New York	556,557	972,082	+74.66
Ohio	228,548	248,628	+ 8.78
Pennsylvania	2,835,945	3,442,913	+21.40
Texas	257,837	254,413	− 1.32
Utah	94,914	104,204	+ 9.78
Washington	406,081	364,267	−10.29
Other States [a]	851,342	959,163	+12.66
Total	11,220,328	12,893,863	+14.91

[a] Alabama, Arizona, Colorado, Georgia, Kentucky, Maryland, Montana, Oklahoma, Tennessee, Virginia, and West Virginia in 1913; Nebraska in addition in 1914.

Stocks of Portland cement, Dec. 31, 1913, and Dec. 31, 1914, by districts, in barrels.

District.	Quantity.		Percentage of change, 1914.
	1913	1914	
Lehigh district (New Jersey and eastern Pennsylvania)	2,448,400	3,118,958	+27.38
New York	556,557	972,082	+74.66
Ohio and western Pennsylvania	1,031,892	1,132,140	+ 9.71
Michigan and northeastern Indiana	643,770	678,980	+ 5.46
Kentucky and southern Indiana	436,703	435,742	− .22
Illinois and northwestern Indiana	1,924,367	2,135,023	+10.94
Maryland, Virginia, and West Virginia	341,120	332,695	− 2.47
Tennessee, Alabama, and Georgia	287,300	383,507	+33.48
Iowa and Missouri	1,397,847	1,472,728	+ 5.35
Great Plains States [a] (Kansas, Oklahoma, and central Texas)	848,949	1,033,002	+21.68
Rocky Mountain States (Colorado, Utah, Montana, western Texas, and Arizona)	246,241	210,577	−14.40
Pacific coast States (California and Washington)	1,057,182	988,429	− 6.50
Total	11,220,328	12,893,863	+14.91

[a] Nebraska in addition in 1914.

The next table gives the total stocks of Portland cement on hand at the mills in the United States at the close of each of the last four years, covering the period in which data have been gathered on this subject by the Survey:

Stocks of Portland cement at the close of 1911, 1912, 1913, and 1914.

	Barrels.
1911	10,385,789
1912	7,811,329
1913	11,220,328
1914	12,893,863

QUANTITY CONSUMED PER CAPITA.

In recent years many inquiries have been received by the United States Geological Survey for more detailed information regarding the consumption of Portland cement. Among the interesting questions that it would be desirable to answer, if possible, are: What quantity of Portland cement is consumed in structural work, in roads, in sidewalks, in concrete pipe, in concrete blocks? How much Portland cement is used by the railroads, by the farmer, by the contracting builder, by the Government? How much is used in Florida, in Montana, in Hawaii?

In the chapter on the cement industry in Mineral Resources for 1911 some data were given with regard to the consumption of Portland cement in Government work for that year. In the present chapter an attempt is made to work out an index of the consumption of Portland cement in the various States and dependencies of the United States. For this purpose it was necessary to obtain from manufacturers (who were willing to take the additional trouble) statements of their shipments of Portland cement into the various States and to make estimates of these shipments for two companies that were too busy to furnish the facts. The consumption in the outlying possessions of the United States is represented simply by the official statistics of exports to those countries. It is, of course, realized that the shipments of cement into a State do not equal the consumption during the same period, but, taken altogether, they should afford a very fair index to that consumption. The estimated consumption per capita appears to be the simplest available common index, and this has been obtained by comparing the shipments into States, etc., with the estimated population for the States and other possessions for the year 1914 prepared by the Bureau of the Census.[1] Perhaps a truer index to the market possibilities of a State would be one which should take account not only of the population but also of the per capita wealth of that population, the derivation of the population and its main occupations, the proportion between urban and rural population, the geographic situation of the Commonwealth, its assessed valuation and indebtedness, its transportation service, the public works in progress or in prospect, and many other important factors. However, the data in the accompanying table are presented in the hope that they may be of interest and service to the cement industry, and with no idea that any business man will arrive at unwarranted conclusions from them. For instance, although Mississippi and South Carolina each show a per capita consumption of Portland cement for 1914 of only 0.11 barrel—the lowest for the United States and her outlying possessions—no one would for a moment believe that these States offer the most inviting field for a cement salesman. It might be admitted, however, by the most pessimistic that in such fields there is room for more missionary work in spreading the gospel of cement and concrete.

The table of per capita consumption necessarily falls short of the total apparent consumption by the quantity of the imports. These, fortunately, are small, only 120,906 barrels; but there are no data to show just what States consumed the imported cement. The highest per capita consumption—the Panama Canal Zone (9.30) excepted—is

[1] Estimates of population, 1910, 1911, 1912, 1913, 1914: Bur. Census Bull, 122, 1914.

that of California (1.70), Montana (1.68), and Iowa (1.64) following closely. Fifteen States, as well as Alaska and the Canal Zone, have a per capita consumption of more than 1 barrel; 9 of these divisions lie west of Mississippi River and 7 of them are west of the Rocky Mountains. The expositions at San Francisco and San Diego have recently consumed much cement in California; irrigation works have taken much cement in the intermountain States; concrete roads and farms have consumed large quantities in the Pacific coast States and in Minnesota, Iowa, Wisconsin, Illinois, Michigan, Indiana, New York, and Maryland. In fact, it is much easier to explain how some States have used large quantities of cement than it is to explain why other States, equally favored, have used less than the average per capita. The table of per capita consumption follows:

Estimated per capita consumption of Portland cement in the United States and outlying possessions in 1914, by States, in barrels.[a]

State.	Population (estimated).	Consumption (shipments to States).	Estimated consumption per capita.	State.	Population (estimated).	Consumption (shipments to States).	Estimated consumption per capita.
		Barrels.	*Barrels.*			*Barrels.*	*Barrels.*
Alabama	2,269,945	517,465	0.23	New Jersey	2,815,663	2,779,819	.99
Alaska	64,680	83,567	1.29	New Mexico	383,551	262,410	.68
Arizona	239,053	286,380	1.20	New York	9,899,761	11,582,337	1.17
Arkansas	1,686,480	400,607	.24	North Carolina	2,339,452	529,643	.23
California	2,757,895	4,678,493	1.70	North Dakota	686,966	175,844	.26
Colorado	909,537	176,035	.19	Ohio	5,026,898	6,735,027	1.34
Connecticut	1,202,688	1,172,095	.97	Oklahoma	2,026,534	508,233	.25
Delaware	209,817	116,029	.55	Oregon	783,239	733,316	.94
District of Columbia	353,378	341,227	.97	Panama Canal Zone	57,400	533,975	9.30
Florida	848,111	460,974	.54	Pennsylvania	8,245,967	7,200,703	.87
Georgia	2,776,513	511,385	.18				
Hawaii	208,063	96,775	.47	Philippine Islands	8,650,937	392	....
Idaho	395,407	473,206	1.19	Porto Rico	1,184,489	232,117	.20
Illinois	5,986,781	6,760,054	1.13	Rhode Island	591,215	316,374	.54
Indiana	2,779,467	3,028,663	1.08	South Carolina	1,590,015	176,693	.11
Iowa	2,221,755	3,641,953	1.64	South Dakota	661,583	428,002	.65
Kansas	1,784,897	1,450,882	.81	Tennessee	2,254,754	802,711	.36
Kentucky	2,350,731	874,538	.37	Texas	4,257,854	1,821,628	.43
Louisiana	1,773,482	583,159	.33	Utah	414,518	442,400	1.07
Maine	762,787	347,866	.46	Vermont	361,205	192,912	.53
Maryland	1,341,075	1,624,180	1.21	Virginia	2,150,009	1,008,492	.47
Massachusetts	3,605,522	2,618,421	.73	Washington	1,407,865	1,557,263	1.11
Michigan	2,976,030	3,664,149	1.24	West Virginia	1,332,910	1,250,557	.94
Minnesota	2,213,919	3,125,930	1.41	Wisconsin	2,446,716	3,134,920	1.28
Mississippi	1,901,882	206,782	.11	Wyoming	168,736	92,693	.55
Missouri	3,372,886	2,940,638	.87				
Montana	432,614	726,245	1.68	Exports, not included above	....	1,605,830	....
Nebraska	1,245,873	1,057,970	.85	Unspecified	....	97,026	....
Nevada	98,726	56,034	.57				
New Hampshire	438,662	214,997	.49	Total	108,946,893	86,437,956	.79

[a] It is not proposed to prepare this table every year unless there is a demand for it on the part of a large majority of cement manufacturers. It is realized that a serious burden is already placed upon manufacturers through the manifold inquiries from Government, State, and commercial organizations; and it is the belief of the writer that only such statistics relating to an industry as are of actual interest and of permanent or temporary value should be collected. Some of the other lines of inquiry suggested above with regard to statistics of consumption of cement are also of interest, but to follow them out would require a much larger statistical force than the Survey can at present assign to the work on cement.

TOTAL QUANTITY CONSUMED.

An approximate estimate of the total consumption of Portland cement in the United States might be made as follows: To the shipments add the imports and from the sum, which represents the total available supply, substract the exports. which leaves the total apparent consumption. Of course, there is at all times a variable but considerable stock of cement in transit, in warehouses at distributing points, and awaiting use on the ground at large jobs; so that at best the data in this form furnish only a rough approximation. Still another uncertain element in this estimate is the fact that imports and exports are classed as hydraulic cement, and the records do not discriminate between Portland and other cements. Portland cement, however, constitutes by far the greater portion of the exports, and, as is shown by the tables, the imports are small. As compared with the apparent consumption in 1913, which amounted to 85,809,649 barrels, the domestic consumption in 1914, which approximated 84,418,665 barrels, decreased 1,390,984 barrels, or 1.6 per cent, as compared with an increase of 6.1 per cent in 1913.

The following tabulation gives the figures necessary for estimates of consumption so far as available, since prior to 1911 no records are at hand for stocks:

Apparent consumption of Portland cement, 1911–1914, in barrels.

Year.	Shipments.	Imports.	Exports.	Apparent consumption.
1911	75,547,829	164,670	3,135,409	72,577,090
1912	85,012,556	68,503	4,215,532	80,865,527
1913	88,689,377	84,630	2,964,358	85,809,649
1914	86,437,956	120,906	2,140,197	84,418,665

GROWTH OF PORTLAND-CEMENT PRODUCTION, 1890–1914.

The growth of the production of Portland cement and its annual value for the years 1890 to 1914, inclusive, also the shipments of Portland cement from 1911 to 1914, are illustrated graphically in the curve (fig. 7). For comparison the course of production of natural cement is plotted on the same diagram. In the historical table on page 225, showing the total production of the principal types of hydraulic cement, will be found statistics of the annual production and value of Portland cement in the United States from the beginning of the industry in the early seventies to the present time.

The table and the curve of production indicate that the Portland-cement industry showed a fair rate of growth from the beginning in the seventies until 1895. At the latter date, however, a rapid development began, coincident with the burning of powdered coal 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 before, which was checked in 1911 by a combination of factors, the most important being 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. In 1913, encouraged by better prices and an increased demand, the output of Portland cement was pushed up to a total far above that anticipated by the most optimistic manufacturers. The demand, however, did not keep

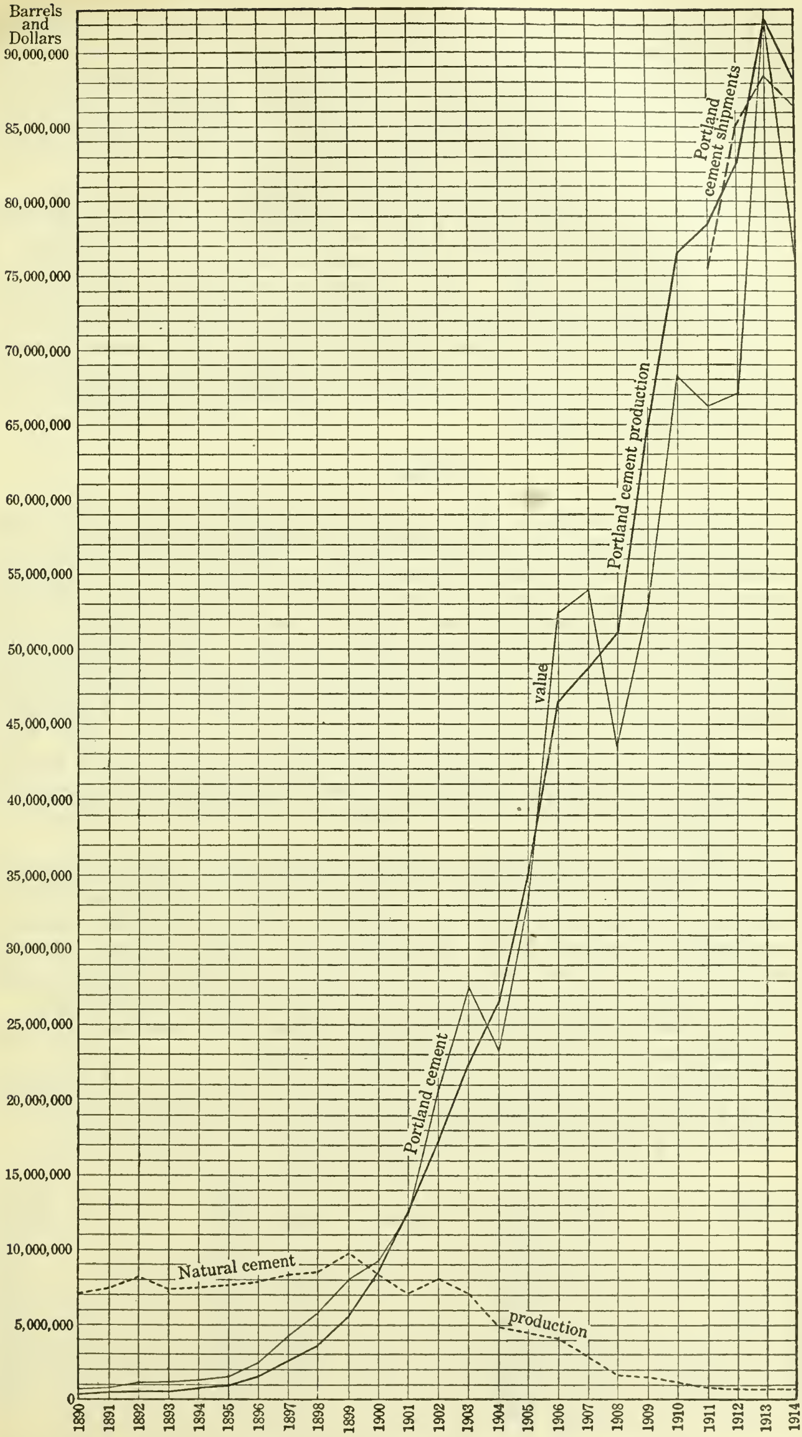

FIGURE 7.—Production of Portland and natural cements, and value of Portland cement, 1890-1914, and shipments of Portland cement, 1911-1914.

pace with the production, and the year closed with large stocks on hand and diminishing kiln activity. The course of the industry in 1914 was, therefore, foreshadowed in 1913, and it is a matter of satisfaction that the showing for 1914 was so good. Both the production and the shipments were greater than those of any previous year except 1913, and the average price per barrel was higher than that for any year since 1907, with the exception of 1913.

The output of Portland cement has, until 1914, 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 a record production of 92,097,131 barrels in 1913. 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 the production is only about three-quarters of a million barrels, and natural cement is a relatively unimportant factor in the cement market.

PRICES.

Average prices of Portland cement per barrel in bulk at the mills are shown in the tables of shipments by States and districts during 1913 and 1914. According to these figures the price in 1914 ranged between 71.7 cents in the Kentucky-southern Indiana district and $1.352 in Utah, as compared with 83.8 cents in the Lehigh district and $1.478 in California, respectively, in 1913. The average price for the whole country was 92.7 cents in 1914, as compared with $1.005 in 1913, a decrease of 7.8 cents per barrel, or 7.7 per cent. This represents the highest price since 1907, with the exception of 1913. Inspection of the State and district tables shows that in New Jersey, Texas, and Utah there were slight increases in average price, as well as in the Maryland-Virginia-West Virginia and the Tennessee-Alabama-Georgia districts.

The decreases in average price in the Lehigh, New York, and Rocky Mountain districts were slight; those in Michigan-northeastern Indiana and Illinois-northwestern Indiana were moderate; and in Ohio-western Pennsylvania, Iowa-Missouri, Great Plains, Pacific coast, and Kentucky-southern Indiana they were above the average, the last being the largest decrease recorded for all the divisions.

Figure 8 illustrates graphically the rapid early decline and the recent fluctuations in prices of Portland cement.

The following table gives the average factory price of Portland cement per barrel in bulk from 1870 to 1914:

Average price per barrel of Portland cement, 1870–1914.

1870–1880	$3.00	1894	$1.73	1905	$0.94
1881	2.50	1895	1.60	1906	1.13
1882	2.01	1896	1.57	1907	1.11
1883	2.15	1897	1.61	1908	.85
1884	2.10	1898	1.62	1909	.813
1885–1888	1.95	1899	1.43	1910	.891
1889	1.67	1900	1.09	1911	.844
1890	2.09	1901	.99	1912	.813
1891	2.13	1902	1.21	1913	1.005
1892	2.11	1903	1.24	1914	.927
1893	1.91	1904	.88		

FIGURE 8.—Range in average price per barrel of Portland cement, 1880-1914.

PORTLAND CEMENT INDUSTRY.

INDUSTRY INDEPENDENT OF EUROPEAN SUPPLIES.

Shortly after the beginning of the present European war the United States Geological Survey issued Bulletin 599, by the Director of the Survey, entitled "Our mineral reserves—How to make America industrially independent." With regard to imports of cement the following statement was made in this bulletin:

> The United States imports relatively little hydraulic cement, only 84,630 barrels having been imported in 1913, whereas the domestic production in that year was nearly 93,000,000 barrels. There is little or no need to import any cement, for all parts of the country are now fairly well supplied with mills for the manufacture of Portland cement, and the supply of raw materials is practically inexhaustible.

American cement manufacturers will readily agree that the domestic cement industry is now practically independent of foreign countries and, if necessary, can easily be made absolutely so. The raw materials, with the exception of cryolite, which is used to a small extent in the manufacture of white cement, are all abundant in the United States. To be sure, some gypsum is doubtless most conveniently imported from Canada by plants near the Atlantic seaboard, but there is little advantage in this, since both New York and Virginia contain large productive deposits of gypsum. As for machinery, everything needed by a fully equipped modern cement mill may be obtained in the United States. Certain pulverizing machinery has been purchased abroad, pebbles for use in tube mills have been imported, and possibly some of the fire clay used in the manufacture of kiln linings may have been imported; but this is no longer necessary. Of all these supplies substitutes for flint pebbles are the least easily procured, but, thanks to the threatened interruption of the supply from Denmark and France, attention has been directed to several possible domestic sources of supply. In the States of Arkansas, Mississippi, and Texas chert gravels occur in abundance at many localities.[1] Local pebbles have been used in tube mills of Portland cement plants in Colorado and Montana for several years. The deposits in Colorado are found in the bed of Arkansas River, east of the Rocky Mountain front.

An interesting discussion of the relative values of pebbles for the fine grinding of metalliferous ores in tube mills appeared early in 1915,[2] in which the discovery, near Manhattan, Nev., of an exceedingly durable material termed a "banded onyx" and its successful use in mills at Tonopah and Goldfield were described. Whether pebbles produced by rolling angular fragments of this particular type of rock about in a dry state in a tumbling mill can be used at a distance from their source is a question, since freight rates rapidly overbalance any advantage in cost these pebbles have locally over the Danish pebbles. However, the fact that this type of material may be used is encouraging, since it is entirely possible that similar deposits may be found in localities nearer to cement-manufacturing centers in the Mountain States and on the Pacific coast.

MANUFACTURING CONDITIONS.

One new plant, that of the Nebraska Portland Cement Co., at Superior, Nebr., produced Portland cement in 1914. The plant was not completed until the latter part of the year, and reported only a small production, little of which was marketed. This plant was built

[1] U. S. Geol. Survey Bull. 599, pp. 38-40, 1914.

[2] Carpenter, J. A., Danish tube-mill pebbles and substitutes: Min. Press [Min. and Sci. Press], Jan. 23, 1915, pp. 139-142.

to utilize Cretaceous limestone and shale, which is exposed along the valley of Republican River, and to use coal as kiln fuel. The limestone and shale are reported to be quarried just across the line in the State of Kansas. The plant near Phoenix, Ariz., consisting in part of the plant formerly operated by the United States Reclamation Service at the Roosevelt Dam, was put in operation in 1913, but produced only a small quantity of cement in 1914. One plant in Pennsylvania, active in 1913, reported no output in 1914; and one plant in Kansas reported only shipments from stock in 1914. In Pennsylvania two plants that were counted as separate establishments in 1913, although active in 1914, are not counted as separate plants, as they have been purchased by Portland cement companies having other mills in the same towns. According to the definition of "producing plant," which has been adhered to for many years in these reports, a mill or group of mills located at one place and operated by one company is regarded as a plant.

There was, therefore, an apparent net loss of 3 producing plants and of 2 shipping plants in 1914, although actually the changes involved only a decrease of 1 producing plant, as compared with the total number of operating establishments in 1913.

Progress was reported on the construction of new Portland cement plants in Iowa and Oregon.

In 1914 there were 110 plants reported as having produced Portland cement, as compared with 113 plants in 1913. The total number of rotary kilns reported as producing in 1914 was 839, as compared with 873 in 1913. 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, 1912, 1913, and 1914.

Length.	Number of kilns.			Length.	Number of kilns.		
	1912	1913	1914		1912	1913	1914
Feet.				*Feet.*			
40 to 60	173	157	170	125	172	157	157
60 to 90	135	145	133	125 to 140	63	63	63
100	103	93	94	150 or more	29	38	46
110	106	117	76				
120	86	103	100	Total	867	873	839

There was a gain in the number of operating kilns 40 to 60 feet, 100 feet, and over 150 feet in length, but a decrease in the number of kilns 60 to 90 feet, 110 feet, and 120 feet in length. There was a net decrease of 34 kilns; and the total number of kilns 100 feet or more in length was 536, as compared with 571 in 1913.

The apparent total annual kiln capacity in 1914 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 115,000,000 barrels of Portland cement, which is about the same as the total capacity for 1913, estimated on the same basis. The total production for 1914 (88,230,170 barrels) was, according to these figures about 76 per cent of the normal cement-producing capacity of the country, as compared with 80 per cent employed in 1913. The apparent average output per kiln in 1914 was about 105,000 barrels, as compared with 105,500 barrels in 1913.

A summary of kiln fuels as reported in 1914 shows that 88 plants, employing a total of 669 kilns, operated with powdered coal as a kiln fuel; 14 plants, with 107 kilns, burned oil; and 1 plant, with 4 kilns, burned natural gas. As compared with 1913, this shows the same number of coal-burning plants, but a decrease of 26 kilns; a decrease of 4 plants and 12 kilns using oil as fuel; and a decrease of 6 plants and 55 kilns burning natural gas. Certain of these apparent decreases are, however, accounted for by the more definite information of several of the reports on fuel consumption made to the Survey, which show that more than one fuel is used at certain plants. For instance, one plant reports coal and oil; another, coal, oil, and gas; two plants report coal and gas; two, oil and gas; and one, producer gas.

The following table summarizes these data for 1913 and 1914, together with the quantities and percentages of Portland cement produced with coal, oil, and gas, and with two or more of these fuels:

Summary of Portland cement kiln fuels in 1913 and 1914.

Fuel.	1913				1914			
	Number of plants.	Number of kilns.	Barrels.	Percentage of total.	Number of plants.	Number of kilns.	Barrels.	Percentage of total.
Coal	88	695	78,508,891	85.2	88	669	72,471,772	82.1
Coal and oil					1	24	4,183,842	4.7
Coal, oil, and gas					1	5	712,314	.8
Coal and gas					2	14	1,564,113	1.8
Oil	18	119	10,013,206	10.9	14	107	7,698,720	8.7
Oil and gas					2	15	1,292,578	1.5
Producer gas					1	1	65,420	.1
Natural gas	7	59	3,575,034	3.9	1	4	241,411	.3
Total	113	873	92,097,131	100.0	110	839	88,230,170	100.0

INVESTIGATIONS OF CEMENT AND CONCRETE.

CONSTITUTION OF PORTLAND CEMENT.

Four papers have now been published from the Geophysical Laboratory of the Carnegie Institution of Washington dealing with compounds of CaO, Al_2O_3, and SiO_2, both binary and ternary.[1] The first two dealt with binary systems; the third assigned provisional locations to ternary quintuple points and boundary curves and applied the relations discovered in a discussion of the constitution of Portland cement clinker; the fourth paper gives more exactly the location of eutectics, quintuple points, and boundary curves, together with the corresponding temperatures. Some of the conclusions pub-

[1] Day, A. L., Shepherd, E. S., and Wright, F. E., The lime silica series of minerals: Am. Jour. Sci., 4th ser., vol. 22, pp. 265–302, October, 1906.
Shepherd, E. S., Rankin, G. A., and Wright, F. E., The binary systems of alumina, with silica, lime, and magnesia: Am. Jour. Sci., 4th ser., vol. 28, pp. 293–333, October, 1909.
Shepherd, E. S. and Rankin, G. A., Preliminary report on the ternary system CaO—Al_2O_3—SiO_2, a study of the constitution of Portland cement clinker, with optical study by F. E. Wright: Jour. Ind. and Eng. Chemistry, April, 1911, pp. 211–227.
Rankin, G. A., The ternary system CaO—Al_2O_3—SiO_2, with optical study by F. E. Wright: Am. Jour. Sci., 4th ser., vol. 39, pp. 1–79, January, 1915.

lished in the first three papers were briefly outlined in the chapter on the cement industry in Mineral Resources for 1910, and in the corresponding chapter for 1913 an outline was given of the more recent work by Bates and Klein.[1]

The conclusions with regard to the application of the latest studies by Rankin and Wright to Portland cement clinker are given below, although it is realized that in the absence of the supporting details and diagrams these conclusions will not convey the significance that they do in the complete paper.

Application to Portland cement clinker.—It is a well-known fact that Portland cement can be made from the pure oxides CaO, Al_2O_3, and SiO_2. According to Richardson's data, cement clinker can be made from mixtures of these three oxides * * *. A cement clinker made from pure CaO, Al_2O_3, and SiO_2, burned at a high enough temperature for a sufficiently long time, would consist of the three compounds $2Ca.SiO_2$, $3CaO.SiO_2$, and $3CaO.Al_2O_3$. If, however, equilibrium was approached but not reached, we would expect to find, in addition to these three compounds, either free CaO or the compound $5CaO.3Al_2O_3$ or both.

Commercial Portland cement clinker has a CaO, Al_2O_3, SiO_2 content of over 90 per cent and is manufactured by methods which one would expect to produce a condition approaching equilibrium, so that it would seem possible to predict * * * what compounds of CaO, Al_2O_3, and SiO_2 are formed when the raw material for Portland cement is burned. From these data we made the prediction that Portland cement clinker consists largely of $3CaO.SiO_2$, $2CaO.SiO_2$, $3CaO.Al_2O_3$, $5CaO.3Al_2O_3$, with possibly a small amount of free lime; and the subsequent work (by Bates and Klein) of the Bureau of Standards at Pittsburgh has demonstrated the applicability of these criteria to commercial clinkers and has completely borne out this prediction. In making this prediction as to the probable constitution of Portland cement clinker we believed (and it subsequently proved to be so) that the components other than $CaO.Al_2O_3$ and SiO_2 were practically negligible. We do not mean by this that the other components such as MgO, Fe_2O_3, etc., may not be important in cement as cementing material, but that the MgO, Fe_2O_3, etc., are present in such small quantities in the raw cement material that it seems probable that the clinker would consist largely of compounds of pure lime, alumina, and silica.

Data on an interesting special investigation, also bearing on the constitution of Portland cement clinker, carried on by Campbell have been published.[2]

HYDRATION OF PORTLAND CEMENT.

The subject of hydration of Portland cement is under critical investigation by the United States Bureau of Standards, and several notes on the work have been published.[3]

In this investigation hydration experiments were made on monocalcium aluminate ($CaO.Al_2O_3$), 5: 3 calcium aluminate ($5CaO.3Al_2O_3$), tricalcium aluminate ($3CaO.Al_2O_3$), monocalcium silicate ($CaO.SiO_2$), beta-orthosilicate ($2CaO.SiO_2$), gamma-orthosilicate ($2CaO.SiO_2$), and tricalcium silicate ($3CaO.SiO_2$); on lime burned at different temperatures and ground to various degrees of fineness; and on a high-silica, a low-silica, a high-iron, and a high-magnesia commercial cement. The tests comprised hydration on slides under the microscope with water, without access of air; hydration in a cylinder with super-

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[1] Bates, P. H., The constitution of Portland cement: Concrete-Cement Age, Cement Mill section, January 1913, pp. 3–7.

[2] Campbell, E. D., Synthetic celite and large crystals of tricalcic silicate: Jour. Ind. and Eng. Chemistry, September, 1914, pp. 706–710.

See also Concrete-Cement Age, Cement mill section, January, 1915, pp. 4–7.

[3] Klein, A. A., and Phillips, A. J., Hydration of Portland cement: U. S. Bur. Standards Tech. Paper 43, Apr. 18, 1914.

See also Notes: Franklin Inst. Jour., November, 1914; The Cement Era, December, 1914, p. 58; and Concrete-Cement Age, Cement mill section, March, 1915, pp. 30–31.

heated steam; hydration in an autoclave; and molding with small quantities of water, approximating those used in normal consistency mixes.

Lack of space prevents the publication here of the full notes, which include data on which is based an interpretation of the failure of cement in the autoclave or high-pressure accelerated test of the soundness of cement. With regard to this phase of the subject it is concluded:[1]

> Failure of cement in accelerated tests is due to the growth of large lime hydrate crystals. The disrupting action results from the pressure caused by growing crystals. Cement will fail in the boiling test which contains lime sufficiently fine and high burned, so that during boiling it hydrates and crystallizes. The growth of fine crystals is sufficient to cause disintegration. When a cement passes the boiling test but not the autoclave test, it contains lime so coarse or high burned as not to hydrate in the boiling test, but only in the autoclave, due to high temperature and pressure employed. Some cements will pass either test only after aging. In this case aeration with sufficient water to allow solution and crystallization causes the lime to hydrate as amorphous hydrate, and in the accelerated tests there is no crystallization and no disintegration.
>
> The reactions when cement is subjected to the autoclave test are not abnormal. The disintegration action attributed to the crystallization of the sulpho-aluminate has been greatly exaggerated.

An illustrated translation by Michaelis of a paper by F. Blumenthal on hydration of hydraulic cements has been published recently in which the following conclusions were stated:[2]

> The foregoing research work leads to the conclusion that in the course of the process of hydration of the various hydraulic cements the same products are formed, namely:
>
> (*a*) Small hexagonal plate crystals composed of tricalcium aluminate. (*b*) Fine needle crystals of monocalcium silicate. (*c*) A colloidal mass of monocalcium silicate. (*d*) Large hexagonal crystals of calcium hydrate. These, however, contribute only indirectly to the hardening.
>
> Iron may take a part in the process of hydration by forming with silica ferrous silicate, or with calcium tricalcium ferrite.
>
> The products of hydration are not merely hydrated compounds already existing in the calcined product, but are formed after previous decomposition of the compounds of the clinker under the influence of water.
>
> The setting of the cement is a process of crystallization brought about by the formation of plate crystals of tricalcium aluminate and needle crystals of monocalcium silicate.
>
> The hardening process is due to the formation of a colloidal mass consisting of monocalcium silicate, which cements the crystals. These continue to form as long as calcium oxide, soluble silica, and water are available.

MAGNESIA IN PORTLAND CEMENT.

A question of importance to manufacturers of Portland cement is the maximum permissible quantity of magnesia in the finished cement. If the quantity could be increased beyond the 4 per cent now permissible under the standard specifications for Portland cement without deleterious effects to the cement or concrete, the range of suitable raw materials would be broadened and many quarries might be operated more economically because the stone would not have to be so carefully selected. An important investigation of this subject is now being carried on by the United States

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[1] Concrete-Cement Age, Cement Mill section, March, 1915, p. 31.

[2] The hydration of hydraulic cements: Cement and Eng. News, October, 1914, pp. 270–273; November, 1914, pp. 298–302.

Bureau of Standards, and the following extracts are taken from a progress report:[1]

The attitude of the users of Portland cement in regard to the content of magnesia allowable in this material is rather difficult to understand, in view of the nature of the results upon which this attitude is based. In 1895 Dyckerhoff presented a minority report of a committee to the German Portland Cement Manufacturers in which he gave results showing that a content of magnesia over 4 per cent tended to give poor cements, and in a concrete made from cement with 8 per cent or more magnesia cracking was produced. This minority report has been used as a basis for many of the arguments against a high magnesia cement—the majority report of the committee which considered that magnesia up to 8 per cent was not harmful is seldom or never mentioned.

Since the above results were published there has been some investigative work [2] done on this subject, but invariably the results have been as contradictory as those published by the above-mentioned committee.

The following investigation, together with one not yet completed, was undertaken to throw some light upon the effect of magnesia not only upon the strength of the resulting cement, but also upon the other physical properties, the general appearance of the clinker and its condition in the kiln during burning, and upon the lime, silica, and alumina compounds present in the ordinary cement:

The raw materials used were clay, limestone, dolomite, and feldspar. * * *

In the first burn, limestone, clay, and some feldspar (to increase the silica somewhat without increasing the alumina to too great an extent) were used. In the successive burns, part of the limestone was replaced with dolomite to give increasing amounts of magnesia and decreasing amounts of lime until the next to the last burn was made, when 18.98 per cent MgO was reached. The difficulties encountered in making these high magnesia burns and the resulting clinker were of such a nature that a burn using dolomite and no limestone was not made in this series, though in a later series when the silica content was lower and the iron-alumina higher, such a burn was made.

After grinding the raw material together in a ball mill until 85 per cent passed a 200-mesh sieve, it was burned in the 2-foot by 20-foot rotary gas-fired kiln used by this bureau in its various cement investigations. It was soon found that the increase of magnesia produced quite a difference in the process of sintering within the kiln and in the appearance of the clinker. This was first noticed when the magnesia content had reached 9.50 per cent, when the clinker had a decided tendency to "ring up" in the kiln. The next increase in the magnesia content, which was to 14.07 per cent, caused a very marked change. Unless the clinker was produced in a slightly underburned condition, it began to dust within 24 hours after burning. Furthermore the increase in temperature necessary to pass from the slightly underburned condition to a hard vitreous state was very slight. The clinker produced, therefore, was the hard vitreous material which showed signs of dusting within 24 hours and is still (now almost 8 months old) dusting slowly. The color also was a reddish-brown—decidedly different from the usual black, glistening, cokelike material produced when the magnesia was under 9.50 per cent. The ground cement has a very light reddish-yellow tinge which differentiates it markedly from normal cement. The one burn made in this series which contained most magnesia (18.98 per cent) produced clinker having these characteristics to a very marked degree. The second and the third burns made were somewhat unsatisfactory, since, owing to low gas pressure, a satisfactory temperature could not be reached. * * *

Of special importance is the petrographic analysis, inasmuch as little work has been done in determining what minerals (or compounds) are found in clinker in which lime has been replaced by magnesia. Two very interesting papers have appeared comparatively recently on this subject and in both will be found résumés of previous investigators. Neither of these attempted to correlate the results with the physical properties of their burns. However, Klein and Phillips working in this laboratory found that magnesia could occur in Portland cement up to 7.5 per cent before it would appear as a new compound not ordinarily present, that is, below this percentage it would form homogenous compounds with the lime in either the β orthosilicate or 3:1 aluminate.

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[1] Bates, P. H., The properties of Portland cement having a high magnesia content: Concrete-Cement Age, Cement Mill section, March, 1914, pp. 29–33, 38. (A paper delivered before the 10th Ann. Convention Am. Concrete Inst., Feb. 18, 1914.) See also Cement Era, March, 1914, pp. 76–80.

[2] Campbell, Am. Chem. Soc. Jour., vol. 24, pp. 969–992, 1902. Michaelis, German Portland Cement Mfrs. Assoc., 1906. Jesser, Zement Zentralb., vol. 1, No. 3, p. 41. Also any of the standard works on Portland cement, as Meade's, Butler's, Candlot's, Spalding's.

In this investigation no new compounds were found until burn 30 was reached (9.5 per cent MgO) when "monticellite" ($MgO.CaO.SiO_2$) was noticed in very small quantities. Burn 31 showed a much larger amount of this compound and in addition spinel ($MgO.Al_2O_3$) was noticed in a small amount. Burn 32 contained these in still larger amounts. It should be noted also that the "monticellite" is colored by iron oxide, whereas the spinel is not.

Both of these compounds are found in nature and are usually considered to weather very slowly; they therefore do not hydrate (except possibly after very long periods). Further they are considered insoluble in dilute and concentrated hydrochloric acid, and it was found that these high magnesia cements contained a considerable amount of insoluble residue—in fact in making the analyses, the concrete was first fused with sodium carbonate. * * *

Summary.—1. Cement can be readily burned in a rotary kiln with a magnesia content of about 9.5 per cent before the resulting clinker will be materially different from that of a cement containing 3 per cent or less. Very high magnesia clinker (over 14 per cent) is very vitreous and dusts slowly, starting within 24 hours.

2. Petrographically no new constituents are present until about 9 per cent MgO is reached, when small quantities of "monticellite" are noticed; with still increasing amounts, spinel occurs. Both of these are nonhydraulic and, if the cement is treated with dilute or concentrated hydrochloric acid, are largely insoluble.

3. Pats made of a cement as high in magnesia as 18.98 per cent were sound after 28 days in air and in water; when placed in boiling water or steam at the end of 24 hours they cracked slighly but were no softer than when removed from the molds. Pats made from cement with lower percentages of magnesia remained in excellent condition after all tests.

4. Cements containing up to 9.5 per cent magnesia showed normal set with a slight tendency toward slower final set. With a greater content, there was a quick initial set accompanied by a very marked rise of the temperature; with the highest magnesia cement made, the initial set determined with the Vicat needle was quick, accompanied by a rather marked evolution of heat, this heat being rapidly dissipated in the smaller, less insulated pat, gave a slow initial set with the Gilmore needle. The final set was very slow.

5. The strength developed either by the neat cement or 1:3 mortars or 1:6 concrete up to periods of half a year shows that cements containing as much as 7.5 per cent magnesia are satisfactory. Further, the increasing magnesia reduces the rate of hardening, so that at the late periods cements with a higher content have rather commendable strengths. Up to this period a 2 per cent solution of equal parts sodium chloride, sodium sulphate, magnesium chloride, and magnesium sulphate has no injurious effect.

ADEQUATE CEMENT IN CONCRETE.

The question of durability of concrete is one that is becoming increasingly important as the years pass and the results of weathering of concrete for a decade or more become evident. It is admitted that many of the exposed concrete structures, such as retaining walls, sea walls, dry docks, abutments, and piers, laid during the last 10 years have suffered deterioration and that this deterioration may be ascribed to the fact that the concrete is too porous. Geologists have long recognized that rock disintegration is largely affected by the porosity of the rock. Porous rocks do not weather well in moist climates when subjected to alternate freezing and thawing, and architects have learned that the porosity and absorption of a building stone are among the most important factors to be considered in connection with the stone specifications. One advantage that concrete possesses over stone is that the porosity of concrete can be to a certain extent controlled, although engineers are far from agreed on the best methods of control. There are advocates of the use of various materials to fill the pores of concrete in order to render it waterproof, but it is significant that committees of engineers have reported that about the best method of waterproofing concrete is to make it rich in cement, and that cement is a cheaper reinforcing material for concrete compression members than steel up to the limit of strength which can be obtained by merely enriching the mixture.[1]

Tests made by the laboratories of the United States Geological Survey and the United States Bureau of Standards of the permeability and absorption of Portland cement mortars and concretes, together with investigations of the value of so-called waterproofing and damp-proofing mediums reviewed in the chapter on the cement industry in Mineral Resources for 1913, have a bearing of interest in the present connection.[2] From these tests it was concluded that the richer the mixture in cement the less permeable and the less absorptive were the mortar and concrete.

In view of these and kindred facts the question has been raised as to whether too little cement is not being used in mixing concrete. There are several reasons why cement has not been more liberally used, among them the desire for economy and the belief that the mixtures commonly in use would prove satisfactory. The special considerations of economy probably are a survival of the period when cement sold much higher than now; the fancied security in lean mixtures may have been influenced by results of tests of laboratory-made concrete when strength rather than durability has been the criterion.

Considering the cost the Engineering News says:

We believe that engineers, at least, will do well to sit down and reflect whether the use of lean mixtures of concrete is not a case of saving at the spigot and wasting at the bunghole. Do most engineers and contractors fully realize how very little more it costs per cubic yard to make a very rich concrete instead of a good concrete? In order to demonstrate this we have compiled the accompanying little table showing the actual cost of the material required for making one cubic yard of concrete of three different grades, a 1:3:5, a 1:2:4, and a 1:1½:3 mixture.

Quantities and cost of materials in 1 cubic yard of rammed concrete, using stone with 45 per cent voids, and assuming cement costing $1.20 per barrel of 4 cubic feet, and sand and stone each costing $1 per cubic yard.

	Cement.	Sand.	Stone.	Concrete.
Proportions by parts	1	3	5	....
Amount required for 1 cubic yard	1.16 bbl.	0.52 cu. yd.	0.86 cu. yd.	....
Cost per cubic yard for	$1.39	$0.52	$0.86	$2.77
Proportions by parts	1	2	4	....
Amount required for 1 cubic yard	1.51 bbl.	0.45 cu. yd.	0.89 cu. yd.	....
Cost per cubic yard for	$1.81	$0.45	$0.89	$3.15
Proportions by parts	1	1½	3	....
Amount required for 1 cubic yard	1.91 bbl.	0.42 cu. yd.	0.85 cu. yd.	....
Cost per cubic yard for	$2.29	$0.42	$0.85	$3.56

We presume most engineers will agree that a 1:3:5 mixture is to be considered first-class concrete. It is doubtful whether as much as 5 per cent of the mass concrete used by engineers is mixed with any larger proportion of cement. The 1:2:4 mixture is at present limited to reinforced-concrete work and to other places where an engineer desires a specially dense and firm concrete for waterproofing or other reasons. The use of a 1:1½:3 mixture is limited, as far as we recall, to concrete paving specifications and some few users of reinforced-concrete columns.

In the compilation of this table we have taken the quantities of material required in making the different concrete mixtures from the table on page 232 of Taylor and

[1] Why not use more cement in concrete? Eng. News, Oct. 30, 1913, pp. 879–880.

[2] Wig, R. J., and Bates, P. H., Tests of absorptive and permeable properties of Portland cement mortars and concretes, together with tests of damp-proofing and waterproofing compounds and materials: U. S. Bur. Standards Tech. Paper 3, 1912.

Thompson's treatise on "Concrete," the percentage of voids in the coarse aggregate used being assumed at 45 per cent. The cost of cement is taken at $1.20 per barrel of 4 cubic feet; the cost of sand and stone is assumed at $1 per cubic yard for each. What we wish to show, however, is the small effect which the increased richness of the concrete has upon its cost per cubic yard, and the difference in cost between the different grades of concrete will be affected very slightly by variations in the cost of sand and stone. As the figures in the table show, the additional cost of a cubic yard of 1:2:4 concrete as compared with a 1:3:5 concrete is only 38 cents. To transform a 1:3:5 concrete into the very rich 1:1½:3 mixture costs only 79 cents per cubic yard for the additional cement.

It may be said that where the 1 : 3 : 5 mixture gives a mixture sufficiently strong, it is adding needless expense to put in the extra cement. This may be true where the material is put in as a foundation footing, for example, and is not exposed to deteriorating influences nor subjected to extraordinary loading. But where the structure is a bridge through which water from the roadway will continually be percolating, or where the structure is a retaining wall whose face might suffer from the weather and the percolating ground water—in these and numerous other places it would seem worth while to spend from 40 to 80 cents per cubic yard additional for the sake of obtaining a solid, dense, water-resisting material instead of a more or less porous one.

When one considers that the average contract price of concrete per cubic yard in a finished work ranges from $4 or $5 up to $10 or $12 and even $20 or more on work involving difficult form construction, one can appreciate all the better how well worth while it is to spend the small amount which the above table indicates is necessary to transform the ordinary concrete to the most dense, hard, and waterproof mixture that can be obtained. * * *

It will be evident, of course, that the figures we have given above are to be modified in any particular case according to variations in the cost of cement from that above assumed of $1.20 per barrel. The enormous productive capacity of the cement mills, however, is pretty fair assurance that the engineer can rely on generally moderate prices for cement prevailing in the future. He will do well to use the material liberally in his work and not to risk its durability by any attempt to save a trifling amount in first cost.

Not all engineers are willing to agree with the suggestions outlined above. Under the caption, "Excess cement in concrete," W. A. Aiken,[1] while admitting that the porosity of concrete is often a pronounced factor in its deterioration, questions whether there is not danger in the introduction of an excess of cement through the factor that not all of the cement may be fine enough to become promptly hydrated and immediately effective but in time when acted upon may cause expansion and deterioration of the concrete. More care in mixing and handling the concrete is also advocated by Aiken. In the same discussion W. R. Mason[2] says that the query as stated suggests the wrong answer to the question, which should have read, "How are we to lengthen the life of concrete structures?" Mason's idea is that the answer to the problem is not more cement but better cement or better methods of mixing the ingredients. In the opinion of the writer these points are all of importance, but at the same time the basal necessity for adequate cement must not be overlooked or ignored.

PAPERS BY AMERICAN SOCIETY FOR TESTING MATERIALS.

Investigations of cement and concrete are becoming an important part of the work of the American Society for Testing Materials, and in former chapters on the cement industry in Mineral Resources the writer has had occasion to refer to important papers published by the society. There is neither time nor space available for a review of any of the recent papers, but the titles of papers presented at the last meeting of the society are reproduced for the benefit of those who may wish to look further into the literature of the subject.

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[1] Eng. News, Nov. 20, 1913, p. 1043. [2] Idem, pp. 1043–1044.

PAPERS ON CEMENT AND CONCRETE PUBLISHED IN PROCEEDINGS OF AMERICAN SOCIETY FOR TESTING MATERIALS, VOL. 14, 1914.

Aiken, W. A., Blast-furnace slag as aggregate in concrete (with discussion), pp. 280–297.
Chapman, Cloyd M., Testing concrete aggregates (with discussion), pp. 298–309.
Force, H. J., Additional results obtained with the autoclave test for Portland cement (with discussion), pp. 246–254.
Gardner, H. A., Paint protection for Portland cement surfaces (with discussion), pp. 482–501.
Greenman, R. S., Examination of concrete failures for their determining causes (with discussion), pp. 321–337.
Maney, G. A., Relations between deformation and deflection in reinforced-concrete beams, pp. 310–320.
Moyer, Albert, Proportioning aggregates for Portland-cement concrete (with discussion), pp. 255–279.
White, A. H., Volume changes in Portland cement and concrete (with discussion), pp. 203–245.
Williams, G. M., Errors in the methods of determining the time of setting of cement (with discussion), pp. 172–202.

FOREIGN TRADE IN CEMENT.

EXPORTS.

With regard to the possibility of building up a larger export trade in cement the following statement was made in Bulletin 599, already cited, on pages 30–31:

A significant feature of the cement industry, however, is the fact that, though only about 80 per cent of the normal cement-producing capacity of the country is employed at the maximum, there is often an overproduction; yet the exports of hydraulic cement have scarcely exceeded 4,200,000 barrels in any year, this amount being only about 5 per cent of the total output—not sufficient to take care of the surplus production in a year of great activity.

There seem to be excellent reasons for stimulating the export trade in cement as rapidly as possible, for, although the export of a relatively bulky and low-priced material such as cement does not promise large direct profits to an individual producer, indirectly the creation and maintenance of an export trade should benefit the industry at large through the opportunity afforded of disposing of surplus stocks and thereby tending to maintain steadier prices.

American manufacturers have not yet made the most of their opportunities to establish greater export trade. Statistics show that the exports of cement from England, Germany, Belgium, and France not only have been considerably greater than those from the United States, but have borne a much higher ratio to the production in these countries. The quantity of cement exported by France in recent years is estimated to have reached at least 23 per cent of her production and that of Germany about 17 per cent. There are few cement plants in South American countries, and in the past these countries have been supplied mainly from Europe. There is evidently an opportunity now for the cement industry of the United States to secure this trade.

Some of the Lehigh Valley plants are already cultivating trade relations with South American and Central American markets, and important shipments have been made recently from southern plants to South America. In order to acquaint builders in South America with the character and possible uses of its white cement, one well-known company has issued a booklet in Spanish, describing and illustrating its product. It seems to be generally acknowledged, however, that there are several serious problems which must be solved before the cement producers of the United States can permanently annex the South American markets. Education of the cement user to a full appreciation of the superiority of American cement is one of the first steps, in order that he may be willing to pay the necessary price. The prices paid for Belgian cements (reported to about correspond to American natural cement) have been so low that American producers can not be tempted to meet them, and the prices paid for German Portland cement have been lower than could well be met by producers in the United States. European cement sent to South America has been shipped mainly in barrels in order that it may be delivered in good condition, and the barrel has become the favorite form of package with South American consumers. Obviously, then, some concessions along this line must be made by manufacturers in the United States or else an equally satisfactory and cheaper form of package must be devised and introduced. Cooperage plants were once part of the equipment at the older cement mills, but they have long since been abandoned, and it is questionable whether individual cooperage plants could profitably be maintained by any mills unless they were occupied exclusively with export business. Here is evidently an opportunity for a waterproof package—possibly an oilcloth sack—and a little educational work to demonstrate that a sack is really much more conveniently handled than a barrel.

Another apparent obstacle to steady export trade with South America is the reported lack of ships engaged in the carrying trade, especially to Brazil and Argentina. Finally, a better basis of exchange of commodities between North America and South America through American banking houses is needed in order that trade may be expanded. South American consumers have been granted long-time credits by European manufacturers, especially by the Germans, and unless equally favorable terms can be granted by manufacturers in the United States it is difficult to see how South American trade can be held after normal conditions are restored in Europe. So long as European shipments are prevented the cement that is absolutely needed in South America may largely be purchased in the United States, but since large construction operations have been customarily financed in Europe consumption probably will be greatly curtailed.

Some cement is already manufactured in South America, the annual output of two plants at Calera, Chile, having reached 120,000 barrels of 397 pounds,[1] and it is to be expected that cement manufacturing will continue to be developed slowly in localities where fuel supplies are accessible in connection with raw materials.

The present opportunities for foreign trade are, of course, not limited to Latin American countries. The Canadian output, under normal conditions, is not yet sufficient to supply the needs of that growing country, but during the European war conditions there are apt to be depressed, with considerable curtailment of municipal and private construction work. If cement production is practically suspended beyond the middle of 1915, as now appears probable, in England, Belgium, France, Denmark, and Germany,[2] then there should be a market for American cement in those European countries with which commerce is open.

The following table, showing, by countries, the quantity and value of cement shipped outside of the United States, is of interest. If the shipments to Alaska, Hawaii, and Porto Rico be deducted, the remainder (2,140,197 barrels) will be found to agree with the total exports to foreign countries given in a succeeding table (p. 251).

[1] Manufacture of cement and its uses in Chile: Min. and Eng. World, Apr. 3, 1915, pp. 646–647.
[2] American cement for Europe: Concrete-Cement Age, March, 1915, p. 32.

Exports of cement from the United States in 1914, and countries to which exported.

Country.	Quantity.	Value.	Country.	Quantity.	Value.
	Barrels.			*Barrels.*	
Alaska	83,567	$194,484	French West Indies	5,033	$7,789
Argentina	121,128	161,788	Germany	633	1,850
Australia and Tasmania	1,206	3,682	Guatemala	8,641	13,872
Azores and Madeira Islands	22	65	Haiti	15,805	21,631
Belgium	160	542	Hawaii	96,775	203,468
Bermuda	5,153	6,782	Honduras	25,155	50,838
Brazil	165,001	202,727	Hongkong	25	33
British Guiana	5,005	7,120	Ireland	120	340
British Honduras	2,460	4,018	Japan	1,032	1,380
British India	186	446	Liberia	1,106	1,450
British South Africa	10	33	Mexico	87,460	155,657
British West Africa	1,490	2,163	Miquelon, Langley, etc	10	20
British West Indies:			Newfoundland	383	567
Barbados	380	532	New Zealand	285	1,140
Jamaica	12,288	17,865	Nicaragua	4,828	8,610
Trinidad and Tobago Islands	9,905	14,077	Norway	2,500	3,800
			Panama	119,550	173,652
Other British West Indies	4,412	6,481	Panama Canal Zone	533,975	779,604
			Peru	60,413	83,200
Canada	73,036	131,036	Philippine Islands	392	504
Chile	32,411	43,099	Porto Rico	232,117	274,159
Colombia	60,512	82,335	Portugal	40	80
Costa Rica	13,917	22,452	Portuguese Africa	5	11
Cuba	663,792	933,424	Salvador	7,167	12,321
Danish West Indies	303	635	Santo Domingo	40,482	55,503
Dutch West Indies	3,953	6,440	Turkey in Asia	135	432
Ecuador	9,821	12,327	Uruguay	5,811	7,493
England	2,023	5,630	Venezuela	30,618	41,304
Egypt	7	11			
French Guiana	12	18	Total	2,552,656	3,760,920

In 1914 the total quantity of hydraulic cement exported[1] to foreign countries, including the Philippines and the Panama Canal Zone, was only 2,140,197 barrels, most of which was Portland cement, valued at $3,088,809, or approximately $1.44 a barrel, as compared with 2,964,358 barrels, valued at $4,270,666, or about $1.44 a barrel, in 1913. The quantity exported in 1914 was only about 2.4 per cent of the total production of hydraulic cements, as compared with 3.2 per cent in 1913. The exports in 1910, 1911, and 1912 showed increases, respectively, of 135 per cent, 27 per cent, and 34 per cent over those of each preceding year; but the exports decreased 29.7 per cent in 1913 as compared with 1912 and 27.8 per cent in 1914 as compared with 1913.

The following table gives the quantity and value of all classes of hydraulic cement exported during the years 1900–1914, 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, 1900–1914, in barrels.

Year.	Quantity.	Value.	Percentage of total quantity.	Year.	Quantity.	Value.	Percentage of total quantity.
1900	100,400	$225,306	0.6	1908	846,528	$1,249,229	1.6
1901	373,934	679,296	1.9	1909	1,056,922	1,417,534	1.6
1902	340,821	526,471	1.3	1910	2,475,957	3,477,981	3.2
1903	285,463	433,984	.95	1911	3,135,409	4,632,215	3.9
1904	774,940	1,104,086	2.4	1912	4,215,532	6,160,341	5.1
1905	897,686	1,387,906	2.2	1913	2,964,358	4,270,666	3.2
1906	583,299	944,886	1.1	1914	2,140,197	3,088,809	2.4
1907	900,550	1,450,841	1.7				

[1] Statistics according to Bureau of Foreign and Domestic Commerce, Department of Commerce.

MARKET FOR CEMENT IN THE AZORES.[1]

In view of the small quantity of cement shown in the preceding table to have been exported to the Azores, the following letter may be of interest to cement manufacturers:

American manufacturers of Portland cement now have an excellent opportunity to enter the market here and to build up a good business which can be retained. This island requires about 6,000 barrels of cement annually, in addition to 2,000 or 2,500 a year, for several years, which will be required for the breakwater. A large theater is being built and will require a heavy supply of cement within a few months. The exact amount is not known now. In addition, the cement trade of the other eight islands of the Azores can be handled through a general agency in this city.

In order to get this business American firms will have to land cement in the Azores at a price that will compete with prices asked by European firms. Most of the cement now being used here is English and is either a "Robbins" brand, sold by a cement society of London, or the product of G. B. White & Co. This cement averages 396 pounds to a barrel and is now quoted at $1.46 (6 shillings 3 pence) f. o. b. London. The freight from London now is 75 cents (3 shillings 9 pence) a barrel, plus a war risk of about 5 per cent. Before the war this cement was sold at $1.23 to $1.45 (5 shillings 8 pence to 6 shillings) and the freight was 73 cents (3 shillings).

Both German and English firms sell cement here on three and four months' credit and pay an agent's commission of 3 per cent.

As soon as satisfactory prices are obtained 200 barrels will be ordered. About 12 other shipments of 500 barrels will be ordered each year.

In quoting prices it must be understood that these people do not want an inferior grade of cement. The quality must be equal to that now used, or construction will be held in abeyance for English supply. This consulate has not been able to obtain an analysis of this European cement, but is sending a sample to the Department of Commerce for the convenience of firms which care to inform themselves as to the quality desired.

The principal impediment for American firms will be high freights, which curtail American trade with these islands even in time of peace. However, this consulate believes the cement trade of the Azores is worth working for, and is ready at all times to conduct any inquiry which will assist firms who care to enter the market.

Samples, prices, and all other information should be sent as soon as possible to Cesar d'Oliveira, St. Michaels, Azores. Correspondence may be in English, but letters written in Portuguese will receive preference.

IMPORTS.

The following table shows the quantities of foreign cement imported for consumption into the United States during the years 1878 to 1914, 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 95 per cent of the total in each year.

The imports in 1914 were approximately 120,906 barrels, of 380 pounds, valued at $194,053, or about $1.60 a barrel, as compared with 85,470 barrels, valued at $139,416, or $1.63 a barrel, in 1913. 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 decline in the imports of foreign cement for the six years ending with 1912, with slight increases in 1913 and 1914.

[1] Report from American Vice Consul J. W. White, jr., dated consulate, St. Michaels, Azores, Apr. 5, 1915. Transmitted by the Secretary of State to the Secretary of the Interior.

Imports of foreign cement, 1878–1914, in barrels of 380 pounds.[1]

1878	92,000	1891	2,988,313	1903	2,251,969
1879	106,000	1892	2,440,654	1904	968,409
1880	187,000	1893	2,674,149	1905	896,845
1881	221,000	1894	2,638,107	1906	2,273,493
1882	370,406	1895	2,997,395	1907	2,033,438
1883	456,418	1896	2,989,597	1908	842,121
1884	585,768	1897	2,090,924	1909	443,888
1885	554,396	1898	1,152,861	1910	306,863
1886	915,255	1899	2,108,388	1911	164,670
1887	1,514,095	1900	2,386,683	1912	68,503
1888	1,835,504	1901	939,330	1913	85,470
1889	1,740,356	1902	1,963,023	1914	120,906
1890	1,940,186				

PORTLAND CEMENT IN CANADA.

The following extract is quoted from the preliminary report on the mineral production in Canada during the calendar year 1914, issued by the Canada department of mines, mines branch, February 24, 1915, pages 21–22:

The year 1914 has witnessed a very large falling off in the production of nearly all materials of construction. This situation, while possibly aggravated by the war, was due primarily to conditions which had already begun to show their effects during the latter part of 1913.

The total quantity of Portland cement, including slag cement and natural Portland, made in 1914 was 8,727,269 barrels of 350 net pounds each, as compared with 8,886,333 barrels made in 1913, a decrease of 159,064 barrels, or about 2 per cent.

The total quantity of Canadian Portland cement sold or used during 1914 was 7,172,480 barrels, valued at $9,187,924, or an average of $1.28 per barrel, as compared with 8,658,805 barrels, valued at $11,019,418, or an average of $1.27 per barrel in 1913, showing a decrease of 1,486,325 barrels, or 17 per cent.

The total imports of cement in 1914 were 343,076 hundredweight, equivalent to 98,022 barrels of 350 pounds, valued at $147,158, or an average of $1.50 per barrel, as compared with imports of 254,093 barrels, valued at $409,303, or an average of $1.61, in 1913.

The total consumption of cement therefore, neglecting a small export, was 7,270,502 barrels, as compared with a consumption of 8,912,898 barrels in 1913, a decrease of 1,642,396 barrels, or 18.4 per cent.

The average price per barrel at the works in 1914 was $1.28, as compared with $1.27 in 1913, $1.28 in 1912, and $1.34 during 1911 and 1910.

The imports of cement in 1914 included 26,774 barrels, valued at $35,517, from Great Britain; 69,117 barrels, valued at $108,487, from the United States; and 2,131 barrels, valued at $3,154, from other countries.

NATURAL CEMENT.

PRODUCTION.

The marketed production of natural cement, including bricklayer's cement, in the United States during 1914 amounted to 751,285 barrels, valued at $351,370, as compared with an output of 744,658 barrels, valued at $345,889, in 1913, an increase in 1914 of 6,627 barrels, or 0.9 per cent, in quantity and of $5,481, or about 1.6 per cent, in value. The average price of the natural cement per barrel at the mills in 1914 was 46.8 cents, as compared with 46.4 cents, in 1913.

The natural cement plants which reported shipments in 1914 were located at Rosendale, Jamesville, and Fayetteville, N. Y.; Northampton, Pa.; Lisbon, Ohio; Sellersburg, Ind.; Utica, Ill.; Fort Scott,

[1] Statistics according to the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Kans., and Austin and Mankato, Minn. At the last place a cement is produced, called "bricklayer's cement" and reported to be higher in lime than most varieties of natural cement.

Natural cement was produced in 1914 in 12 plants distributed in 7 States, as compared with 13 plants in 8 States in 1913—1 plant in Georgia, active in 1913, having reported no production in 1914. In the following table the marketed production of natural cement in 1913 and 1914 is outlined by groups of States:

Marketed production of natural cement in 1913–14, by States.

State.	1913			1914		
	Producing plants.	Quantity (barrels).	Value.	Producing plants.	Quantity (barrels).	Value.
New York	4	255,709	$114,067	4	287,714	$131,593
Pennsylvania	1			1		
Illinois	1			1		
Indiana	1	266,949	121,422	1	197,071	90,852
Ohio	2			2		
Georgia	1			(a)	....	....
Minnesota	2	222,000	110,400	2	266,500	128,925
Kansas	1			1	....	....
Total	13	744,658	345,889	12	751,285	351,370

a In 1914 no production was reported from Georgia.

THE NATURAL CEMENT INDUSTRY, 1818–1914.

The historical table, on page 225, contains statistics of production and value 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 until 1913, and its production for that year is the lowest on record since before 1880. The slight revival in 1914, the year in which the first decrease in Portland cement production was recorded, is of interest. See also the curve of production (fig. 7).

In the table on page 225 the values prior to 1880 have been estimated, those of the earlier years on the basis of prices that prevailed during the construction of the Erie Canal. It is of interest to note that the price of natural cement has rarely exceeded $1 a barrel, and that it has seldom exceeded one-half the price of Portland cement, but it must be borne in mind that the weight of a barrel of natural cement is only about three-fourths that of a barrel of Portland cement. Prices of all cements might well be quoted by the hundredweight for the sake of simplicity.

PUZZOLAN AND OTHER SLAG CEMENTS.

Puzzolan cement was shipped during 1914 from three plants in the United States—at North Birmingham, Ala., Struthers, Ohio, and Sharon, Pa., besides a very small quantity reported to have been made at a natural cement plant in Indiana—and Collos cement was shipped from Buffalo, N. Y. The output of puzzolan and Collos cements in 1914 was 68,311 barrels, valued at $63,358, compared with 107,313 barrels, valued at $97,663, in 1913. This represents a decrease in quantity of 39,002 barrels, or more than 36 per cent, and in value of $34,305, or more than 35 per cent. The average price per barrel of these slag cements in 1913 was 91 cents, and in 1914 it was 92.6 cents, an increase in 1914 of 1.6 cents a barrel. In 1914, therefore, the price of slag cement was practically the same as that of Portland cement. A good average price should be commanded by puzzolan cement, since a considerable proportion of this product is of a light color and is considered to be nonstaining.

The following table summarizes the number of active plants and the production of puzzolan cement during the last five years. Since 1912, inclusive, the quantities represent marketed production or shipments.

Statistics of the puzzolan cement industry, 1910–1914.

	1910	1911	1912	1913	1914
Number of plants reporting production:					
Alabama	1	1	1	1	1
New York[a]	....	1	1	1	1
Ohio	2	1	1	1	1
Pennsylvania	1	1	1	1	1
Total	4	4	4	4	4
Production in barrels	95,951	93,230	91,864	107,313	68,311
Total value	$63,286	$77,786	$77,363	$97,663	$63,358

[a] Includes production of Collos cement, 1911–1914.

GOVERNMENT AND STATE PUBLICATIONS ON CEMENT MATERIALS, CEMENT, AND CONCRETE.

UNITED STATES GEOLOGICAL SURVEY.

The following list includes the principal publications on cement and concrete materials by the United States Geological Survey. These Survey 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 Survey does not distribute any other than its own publications.

Adams, G. I., and others, Stratigraphy and paleontology of the upper Carboniferous rocks of the Kansas section: Bull. 211, 123 pp., 1903. 20c.

——— Economic geology of the Iola quadrangle, Kansas: Bull. 238, 80 pp., 1904.

Ball, S. H., Portland cement materials in eastern Wyoming: Bull. 315, pp. 232–244, 1907. 50c.

Bassler, R. S., Cement materials of the Valley of Virginia: Bull. 260, pp. 531–544, 1905. 40c.

Bastin, E. S., The lime industry of Knox County, Maine: Bull. 285, pp. 393–400, 1906. Edition exhausted.

——— Clays of the Penobscot Bay region, Maine: Bull. 285, pp. 428–431, 1906. Edition exhausted.

Branner, J. C., Clays of Arkansas: Bull. 351, 247 pp., 1908.

Burchard, E. F., Portland cement materials near Dubuque, Iowa: Bull. 315, pp. 225–231, 1907. 50c.

——— Concrete materials produced in the Chicago district: Bull. 340, pp. 383–410, 1908. 30c.

Burchard, E. F., Structural materials available in the vicinity of Austin, Tex.: Bull. 430, pp. 292–316, 1910.
——— Cement: Mineral Resources U. S. for 1909, pt. 2, pp. 433–452, 1911. 75c.
——— Cement: Mineral Resources U. S. for 1910, pt. 2, pp. 469–535, 1911
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——— (See also Eckel, E. C.)
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Darton, N. H., Geology and water resources of the northern portion of the Black Hills and adjoining regions in South Dakota and Wyoming: Prof. Paper 65, 104 pp., 1909.
——— Structural materials in parts of Oregon and Washington: Bull. 387, 36 pp., 1909.
——— Cement materials in Republican Valley, Nebr.: Bull. 430, pp. 381–387, 1910.
——— and Siebenthal, C. E., Geology and mineral resources of the Laramie Basin, Wyo.: Bull. 364, 81 pp., 1908.
Diller, J. S., Limestone of the Redding district, Cal.: Bull. 213, 1903. 25c.
Duryee, E., Tests of cement materials from Gila River, Ariz.: Water-Supply Paper 33, pp. 82–90, 1900. 15c.
——— Cement investigations in Arizona: Bull. 213, pp. 372–380, 1903. 25c.
Eckel, E. C., The materials and manufacture of Portland cement: Senate Doc. 19, 58th Cong., 1st sess., pp. 2–11, 1903.
——— Cement-rock deposits of the Lehigh district: Bull. 225, pp. 448–450, 1904. 35c.
——— Cement materials and cement industries of the United States: Bull. 243, 395 pp., 1905. Edition exhausted. Available in libraries of cities and educational institutions.
——— The American cement industry: Bull. 260, pp. 496–505, 1905. 40c.
——— Portland cement resources of New York: Bull. 260, pp. 522–530, 1905. 40c.
——— Cement resources of the Cumberland Gap district, Tenn.-Va.: Bull. 285, pp. 374–376, 1906. Edition exhausted.
——— Portland cement materials and industry of the United States, with contributions by E. F. Burchard and others: Bull. 522, 401 pp., 1913. 65c.
——— and Crider, A. F., Geology and cement resources of the Tombigbee River district, Miss.-Ala.: Senate Doc. 165, 58th Cong., 3d sess., 21 pp., 1905.
Fenneman, N. M., Geology and mineral resources of the St. Louis quadrangle, Mo.-Ill.: Bull. 438, 73 pp., 1911.
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Humphrey, R. L., The effects of the San Francisco earthquake and fire on various structures and structural materials: Bull. 324, pp. 14–61, 1907. 50c.
——— Organization, equipment, and operation of the structural-materials testing laboratories at St. Louis, Mo.: Bull. 329, 85 pp., 1908. 20c.
——— Portland cement mortars and their constituent materials: Results of tests, 1905 to 1907: Bull. 331, 130 pp., 1908. 25c.
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——— The fire-resistive properties of various building materials: Bull. 370, 99 p., 1909. 30c.
Landes, H., Cement resources of Washington: Bull. 285, pp. 377–383, 1906. Edition exhausted.
Lippincott, J. B., Manufacture of Portland cement in southern California: Water-Supply Paper 60, pp. 135–137, 1902. 15c.
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Pepperberg, L. J., Cement material near Havre, Mont.: Bull. 380, pp. 327–336, 1909.
Richardson, G. B., Portland cement materials near El Paso, Tex.: Bull. 340, pp. 411–414, 1908. 30c.
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——— and Pearson, J. C., Standardization of No. 200 cement sieves: U. S. Bur. Standards Tech. Paper 42, 51 pp., 1914.
——— The suitability of cement drain tile in alkali soils: U. S. Bur. Standards Tech. Paper 44. (In press.)
——— Value of the high pressure steam test for Portland cement: U. S. Bur. Standards Tech. Paper 47. (In press.)
Wormley, P. L., Jr., Cement mortars and concrete—preparation and use for farm purposes: U. S. Dept. Agr. Farmers' Bull. 235, 32 pp., 1905.

STATE GEOLOGICAL SURVEYS.

From time to time investigative work is done by certain of the State geological surveys, and many detailed reports have been published on important local deposits. The surveys of the following States have made special studies of local cement resources: Alabama, Arkansas, California, Georgia, Illinois, Indiana, Iowa, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, North Dakota, Ohio, Oklahoma, South Dakota, Vermont, Virginia, Washington, and West Virginia. Certain other States have done a little work on their cement materials.

The most important of the State reports are listed below:

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GYPSUM.

By G. F. Loughlin.

PRODUCTION.

HISTORICAL REVIEW.

The development of the gypsum industry during the 35 years, 1880 to 1914, inclusive, so far as represented by statistics of the United States Geological Survey, is shown in the following tables and in the accompanying diagram (fig. 9):

Crude gypsum mined in the United States, 1880–1914.

	Short tons.		Short tons.		Short tons.
1880	90,000	1892	256,259	1904	940,917
1881	85,000	1893	253,615	1905	1,043,202
1882	100,000	1894	239,312	1906	1,540,585
1883	90,000	1895	265,503	1907	1,751,748
1884	90,000	1896	224,254	1908	1,721,829
1885	90,405	1897	288,982	1909	2,252,785
1886	95,250	1898	291,638	1910	2,379,057
1887	95,000	1899	486,235	1911	2,323,970
1888	110,000	1900	594,462	1912	2,500,757
1889	267,769	1901	633,791	1913	2,599,508
1890	182,995	1902	816,478	1914	2,476,465
1891	208,126	1903	1,041,704		

Total value of crude and calcined gypsum, 1889–1914.

1889	$764,118	1898	$755,280	1907	$4,942,264
1890	574,523	1899	1,287,080	1908	4,075,824
1891	628,051	1900	1,627,203	1909	5,906,738
1892	695,492	1901	1,506,641	1910	6,523,029
1893	696,615	1902	2,089,341	1911	6,462,035
1894	761,719	1903	3,792,943	1912	6,563,908
1895	797,447	1904	2,784,325	1913	6,774,822
1896	573,344	1905	3,029,227	1914	6,895,989
1897	755,864	1906	3,837,975		

From 1880 to 1887, inclusive, the production remained nearly stationary and averaged a little less than 92,000 short tons annually. Reliable data on the value of production during these years are not available. From 1888 to 1898 the production, as a whole, increased slowly, both in quantity and in value, although certain years, especially 1890 and 1896, were marked by decreases. The panic of 1893 evidently had no material effect upon the industry as a whole. From 1899 to 1910 there was a marked general increase, both in the quantity of crude gypsum and in the value of the marketed product, with occasional years of increase and decrease, the most pronounced of which were 1903 and 1908, the increase in 1903 being due to the use of large quantities of "staff" in the construction of exposition buildings in St. Louis, and the decrease in 1908 being a result of the financial depression which began late in 1907 and which affected the gypsum industry along with most other industries. The quantity produced in 1908, however, decreased only slightly, and the marked drop in value was largely due to keen competition. From 1911 to 1913 quantity and value increased, but at a less pronounced rate than during the period from 1899 to 1910.

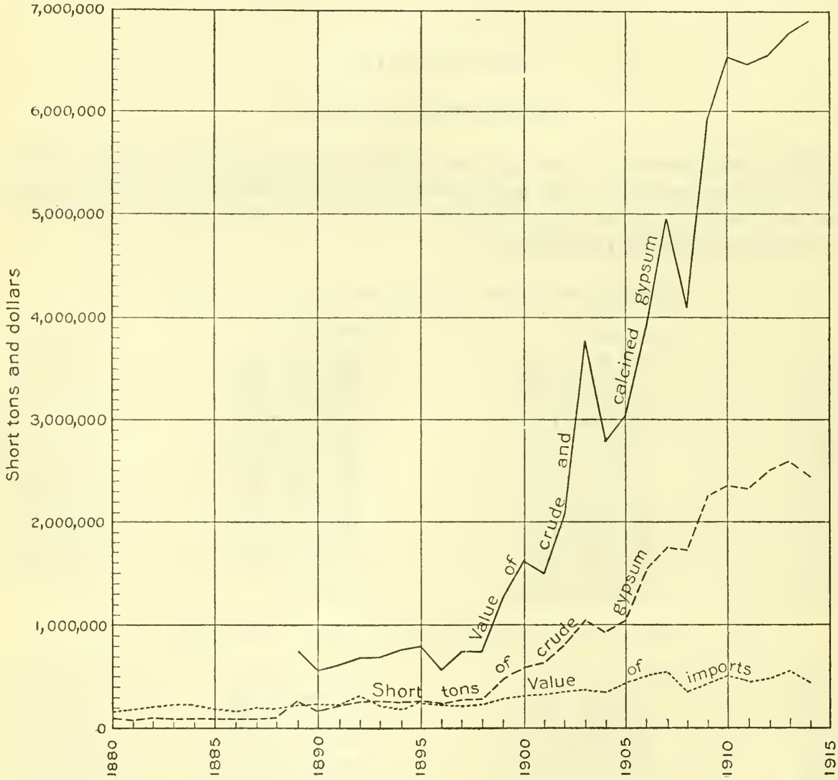

FIGURE 9.—Production of crude gypsum, and value of output and of imports of crude and calcined gypsum, 1880–1914.

Comparison of the curves indicating quantity and value (fig. 9) shows that, on the whole, a uniform ratio was maintained until 1898, with a temporary lowering of prices in 1896. After 1898 the value greatly increased in spite of the fact that the price per ton for different grades decreased in certain years. This proportionate increase has been due to a continual growth of the production of calcined plaster and a decrease in the production of land plaster. The increase in calcined plaster was due to the growing demand for wall plaster and especially to the demand in certain years for "staff," used in the construction of temporary buildings. The great increases for 1902 and 1903 were largely due to the production of staff for buildings at the Louisiana

Purchase Exposition at St. Louis, and the decrease for 1904 represents a return to normal production. The percentage of production of land plaster has been decreasing since 1880, when it comprised about 50 per cent of the total; in 1904, 10 years ago, it amounted to less than 10 per cent, and in 1913, the latest normal year, to less than 2.5 per cent.

The bulk of crude gypsum in recent years has been used in the manufacture of Portland cement. In 1913 about 88 per cent of the total crude gypsum, representing 86 per cent of the value, was used for this purpose.

The decrease in 1911 accompanied a readjustment of the industry, during which several old mills were replaced by newer ones and a number of commercial centers were established remote from deposits, at which ingredients were assembled for the manufacture of finished products.

The prices of crude gypsum for land plaster and other uses and of calcined plaster have fluctuated considerably, but on the whole have not increased. This is especially true of calcined plaster which was lower in 1912 and 1913 than in any of the 10 preceding years, except 1908, when, as already explained, prices were abnormally low. The price in 1914, however, made a marked advance and was the highest in seven years.

Average prices per short ton of crude and calcined gypsum, 1902–1914.

Year.	Crude (excluding land plaster).	Land plaster.	Calcined.	Year.	Crude (excluding land plaster).	Land plaster.	Calcined.
1902	$1.15	$1.75	$3.50	1909	$1.54	$2.09	$3.54
1903	1.19	2.08	4.63	1910	1.52	2.05	3.70
1904	1.09	2.03	3.88	1911	1.47	1.85	3.67
1905	1.58	1.85	3.87	1912	1.33	2.02	3.43
1906	2.46	2.50	3.58	1913	1.47	1.75	3.43
1907	1.82	2.47	3.91	1914	1.41	1.85	3.77
1908	1.75	2.43	3.24				

PRODUCTION IN 1914.

The production of gypsum in 1914 was marked by a decrease in quantity but an increase in value, the latter due to a strong advance in the price of calcined gypsum which more than offset a decline in price of crude gypsum, so that the total value broke all previous records. Considerable quantities of gypsum plaster, or "staff," were used in the Panama-Pacific Exposition buildings at San Francisco and in the Panama-California Exposition buildings at San Diego, but were insufficient to offset the general decrease in quantity. All the gypsum for the Panama-California buildings and at least 80 per cent of that for the Panama-Pacific buildings was quarried near Nephi, Utah.

The number of short tons of raw gypsum mined in 1914 was 2,476,465, a decrease of 123,043 tons from the 2,599,508 tons mined in 1913. The gypsum sold without calcining and used principally as an ingredient in Portland cement, in paint, and as land plaster, amounting to 443,687 short tons and valued at $646,799, showed a decrease in quantity of 19,449 tons and in value of $50,267, as compared with 463,136 short tons, valued at $697,066, in 1913. The material calcined for plaster decreased in quantity 117,783 short tons, but increased in value $171,434. The total value of gypsum and gypsum products produced in 1914 was $6,895,989, as compared with $6,774,822 in 1913, an increase of $121,167.

Gypsum was produced in 18 States and in Alaska, the same States producing in 1914 as in 1913. Seventy-eight quarries or mines were worked. The total number of mills reporting in 1914 was 68, or 1 more than in 1913. This includes mills using domestic material that was calcined for wall plaster as well as those that ground raw gypsum for land plaster and for other purposes. New York was the largest producer of raw gypsum, Iowa ranked second, and Michigan was third. Sales of gypsum products are credited to Illinois, Minnesota, Washington, and Wisconsin, although these States are not producers. This is the necessary result of the 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 quantity of raw gypsum ground and sold for land plaster amounted to 52,945 short tons, valued at $97,716, in 1914, compared with 54,815 tons, valued at $95,953, in 1913, a decrease in quantity of 1,870 short tons and an increase in value of $1,763. The average price per ton at the mills received for land plaster was reported to be $1.85 in 1914, compared with $1.75 in 1913, $2.02 in 1912, $1.85 in 1911, and $2.05 in 1910. The quantity of raw gypsum sold for the manufacture of paint, for Portland cement, for bedding plate glass, and for various other purposes, amounted to 390,742 short tons, valued at $549,083, in 1914, compared with 408,321 short tons, valued at $601,113, in 1913, a decrease in quantity of 17,579 tons and in value of $52,030. The average price of this class of gypsum in 1914 was $1.41 a ton, compared with $1.47 in 1913, $1.33 in 1912, and $1.47 in 1911. The average price of calcined gypsum products, including wall plasters, plaster of Paris, Keenes cement, and dental plaster was $3.77 a ton, compared with $3.43 in both 1913 and 1912.

The following table gives the statistical data regarding the gypsum industry in 1913 and 1914 by States:

Marketed production of gypsum in the United States, 1913 and 1914, by States and uses, in short tons.

1913.

State.	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.	
Alaska, Arizona, Colorado, Illinois,[a] Minnesota,[a] Montana, Nevada, Oregon, South Dakota, Utah, Virginia, Washington,[a] Wisconsin [a]	16	392,788	17,120	$35,624	54,839	$156,177	285,790	$1,335,074	$1,526,875
California	5	49,015	6,209	15,700	18,211	47,166	29,690	168,070	230,936
Iowa	5	456,031	8,757	10,266	43,300	35,285	333,357	1,112,388	1,157,939
Kansas	4	110,510	(b)	(b)	[c] 32,696	26,992	64,236	281,316	308,308
Michigan	8	423,896	9,604	10,222	51,102	45,747	278,368	665,356	721,325
New Mexico	3	43,180	....	....	(d)	(d)	[e] 39,532	102,564	102,564
New York	7	529,627	9,418	17,232	179,064	259,723	282,187	1,003,744	1,280,699
Ohio	4	254,863	(b)	(b)	[c] 7,174	11,793	208,421	683,356	695,149
Oklahoma	8	147,876	(b)	(b)	[c] 12,093	10,723	110,418	319,693	330,416
Texas	4	161,090	(d)	(d)	(d)	(d)	[e] 133,946	345,749	345,749
Wyoming	3	30,632	....	....	....	....	21,453	74,862	74,862
Total	67	2,599,508	54,815	95,953	408,321	601,113	1,773,849	6,077,756	6,774,822

1914.

State.	Number of mills reporting.	Total mined.	Ground for land plaster: Quantity.	Ground for land plaster: Value.	For Portland cement, etc.: Quantity.	For Portland cement, etc.: Value.	Calcined plaster: Quantity.	Calcined plaster: Value.	Total value.
Alaska, Arizona, Colorado, Illinois,[a] Minnesota,[a] Montana, Nevada, New Mexico, Oregon, South Dakota, Virginia, Washington,[a] Wisconsin [a]	15	358,363	14,193	$34,922	47,301	$122,741	238,497	$1,162,584	$1,320,247
California	9	27,376	5,199	14,334	12,921	30,710	24,787	139,842	184,886
Iowa	5	480,404	12,251	14,920	52,934	45,566	335,065	1,260,971	1,321,457
Kansas	4	80,774	(b)	(b)	[c] 23,796	22,531	47,877	255,812	278,343
Michigan	8	393,006	9,322	10,761	51,905	40,481	249,648	654,599	705,841
New York	7	523,368	6,540	12,535	172,279	247,307	279,449	977,350	1,237,192
Ohio	4	265,091	(b)	(b)	[c] 8,189	13,156	220,126	760,257	773,413
Oklahoma	6	113,103	(d)	(d)	(d)	(d)	[e] 91,419	312,856	312,856
Texas	4	158,814	....	....	(d)	(d)	[e] 133,478	490,937	490,937
Utah	3	44,950	(b)	(b)	[c] 7,639	14,741	33,401	169,880	184,621
Wyoming	3	31,216	....	....	....	....	21,537	86,196	86,196
Total	68	2,476,465	52,945	97,716	390,742	549,083	1,656,066	6,249,190	6,895,989

[a] Produces no crude gypsum.
[b] Included with crude gypsum for Portland cement, etc.
[c] Includes some land plaster.
[d] Included with calcined gypsum.
[e] Includes some crude gypsum.

The following table showing the marketed production of gypsum, by uses, in the United States from 1910 to 1914 should be of particular interest, as it shows the trend of the trade. An increasing quantity of crude gypsum has been sold for Portland cement manufacture. Its average price per ton has fluctuated, falling off 15 cents in 1912, increasing 14 cents in 1913, and again decreasing 6 cents in 1914. The decrease in 1914 corresponds to a marked decrease in the production of Portland cement.

The quantity sold crude for land plaster has remained nearly the same for five years. The average price per ton, which dropped 27 cents in 1913, or from $2.02 to $1.75, made partial recovery of 10 cents in 1914. As 88 per cent of gypsum sold crude in 1914 was used for Portland cement, the average price per ton of all crude gypsum ($1.46) is close to that of the crude gypsum used for Portland cement ($1.41), and the slight decrease in the average price of the latter accounts for the rather marked decrease in total value of gypsum sold crude.

The total quantity of calcined gypsum sold in 1914 was 117,783 tons less than that sold in 1913, but the total value was $171,434 greater. The average price per ton, which was $3.43 in both 1912 and 1913, increased to $3.77 in 1914, and accounts for the gain in value despite the loss in tonnage. Nearly 95 per cent of the calcined gypsum sold in the United States, or 1,565,937 tons, is used for wall plaster, Keenes cement, plaster of Paris, etc. About 1,250,000 tons of this quantity represents mixed wall plaster.

Marketed production of gypsum in the United States, 1910–1914, 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.
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
1913	408,221	600,913	1.47	54,815	95,953	1.75	(a)	(a)	....	a 100	200	2.00	463,136	697,066	1.51
1914	b 390,742	549,083	1.41	52,945	97,716	1.85	(b)	(b)	....	....	....	....	443,687	646,799	1.46

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.
1910	c 1,483,046	$5,599,353	$3.78	c 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	d 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
1913	1,680,157	5,858,785	3.49	861	4,168	4.84	10,942	21,797	1.99	81,889	193,006	2.36	1,773,849	6,077,756	3.43
1914	1,565,937	6,038,777	3.86	641	3,374	5.26	(e)	(e)	....	e 89,488	207,039	2.31	1,656,066	6,249,190	3.77

a Paint material included under "For other purposes."
b Small quantity of paint material included with gypsum sold for Portland cement.
c Some dental plaster and other gypsum products included with plaster.
d Includes some casting plaster.
e Calcined gypsum sold to glass factories included under "For Portland cement and other purposes."

Marketed production of gypsum in the United States, 1910–1914, 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.	
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
1913	463,136	697,066	1.51	1,773,849	6,077,756	3.43	6,774,822
1914	443,687	646,799	1.46	1,656,066	6,249,190	3.77	6,895,989

IMPORTS.

The value of imports, as shown in the diagram (fig. 9) and in the following table, has fluctuated, but on the whole has gradually risen. The most pronounced rise was from 1905 to 1907, since which year fluctuations have been more marked. The maximum value ($556,922) was for 1913, and was greater by $21,264 than the value for 1907. The value of imports from 1889 to 1898 averaged about one-third of the value of domestic production, but since 1899 the proportionate value of imports has become very small, and in 1913, the last normal year, amounted to less than one-twelfth of the domestic production. The total value of imports in 1914 was $444,841, a little more than one-sixteenth the value of the domestic production.

Total value of gypsum, crude and calcined, imported for consumption, 1880–1914.

1880 [1]	$150,409	1892	$308,011	1904	$356,401
1881 [1]	171,724	1893	211,924	1905	446,152
1882 [1]	200,922	1894	196,060	1906	508,729
1883 [1]	218,969	1895	247,583	1907	535,658
1884 [1]	210,904	1896	227,248	1908	354,403
1885 [1]	173,752	1897	212,429	1909	425,137
1886 [1]	153,338	1898	240,844	1910	502,111
1887 [1]	199,890	1899	297,926	1911	450,806
1888	190,787	1900	315,530	1912	488,481
1889	220,140	1901	326,670	1913	556,922
1890	229,859	1902	360,700	1914	444,841
1891	226,319	1903	378,597		

Gypsum imported into the United States comes 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.

The quantity and value of imports in 1914 suffered a great decrease and were both less than for any year since 1909. There was a decrease of 78,169 tons of unground gypsum as compared with an increase of 34,686 tons in 1913 and of 22,823 tons in 1912, the total imports of unground gypsum in 1914 being 369,214 short tons, valued at $392,118. The figures show an average price per ton of unground gypsum of $1.062, or about four-tenths of a cent a ton higher than in 1913.

The quantity of ground or calcined gypsum imported continues to be very small, and it also decreased in 1914.

[1] For year ended June 30.

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, 1910–1914, in short tons.

Year.	Unground.		Ground or calcined.		Value of manufactured plaster of Paris.	Total value.
	Quantity.	Value.	Quantity.	Value.		
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
1913	447,383	473,594	4,542	31,277	52,051	556,922
1914	369,214	392,118	3,559	27,931	24,792	444,841

PRODUCTION IN OTHER COUNTRIES.

The following table gives the production of gypsum in the principal producing countries from 1911 to 1913, inclusive, so far as the figures are available:

Production of gypsum in principal producing countries, 1911–1913, in short tons.

Country.	1911		1912		1913	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	57,220	$119,264	59,965	$125,064	55,555	(a)
Australia	15,110	37,584	15,767	60,145	(a)	(a)
Canada	518,383	993,394	578,458	1,324,620	636,370	$1,447,739
Cyprus	[b] 9,595	23,247	[b] 5,571	13,685	(a)	(a)
France	1,874,291	3,139,524	1,979,595	3,330,311	1,902,460	(a)
German Empire (Bavaria)	66,568	26,850	62,957	24,683	(a)	(a)
Greece	1,392	3,572	107	530	2,475	(a)
India	10,296	11,237	23,557	(c)	(a)	(a)
United Kingdom	309,886	507,191	319,526	538,191	319,579	440,174
United States	2,323,970	6,462,035	2,500,757	6,563,908	2,599,508	6,774,822

[a] Data not yet available. [b] Exports. [c] Total value not stated.

TRADE AND MANUFACTURING CONDITIONS.

About two-thirds of the active plants reported on business conditions. Of these about half reported business conditions as practically the same in 1914 as in 1913, and half found trade poorer. Four producers considered it better. The average price of raw gypsum throughout the country decreased 5 cents a ton in 1914 from that of 1913, while the average price of calcined material advanced 34 cents. Four new mills were in operation in 1914, 3 in California and 1 in New York, and 1 new mill was reported under construction in Nevada.

There were 78 active gypsum mines, including quarries and pits, in the United States in 1914, 1 being in Alaska. These mines supplied 68 plants in the United States. Of these 68 plants 47 used gypsum, 11 used gypsite, 9 used both gypsum and gypsite, and 1 reported the use of selenite crystals. Thirty-six plants obtained their material from quarries and open beds, 28 from mines, and 4 from quarries and mines. Seven plants produced ground gypsum only, 28 calcined only, and 33 plants ground and calcined their product. Of the 61 calcining plants, 55 were equipped with kettles, 3 with rotary kilns, and 3 with stationary kilns. There were 173 calcining kettles in operation, ranging from 8 to 14 feet in diameter. The total daily capacity of all these kettles as reported was 13,919 short tons, giving an average of 80 tons per kettle.

On comparing these statistics with those of 1913, when there were 67 gypsum plants in operation, 63 of which were calcining plants and 57 of which were equipped with a total of 181 kettles, it is found from the producers' reports that there was a net gain of 1 plant, a loss of 2 calcining plants, and a net loss of 8 kettles. There was an apparent loss of 425 tons in the total daily capacity, but a gain of 1 ton 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., 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, and sand.

The 61 calcining plants reported in 1914 were operated during a total of 13,298 days, and averaged 218 days per plant. Forty-eight plants worked 1 shift, 8 plants worked 2 shifts, and 5 were in continuous operation. The average number of hours per shift as reported by 57 mills was as follows: Eight at 6 mills, 9 at 4 mills, 10 at 33 mills, 11 at 7 mills, and 12 at 7 mills.

Keenes cement was made at 5 of the gypsum plants in 1914, the same number of plants reporting the manufacture of this cement in 1913.

The fuel used at 42 calcining plants was coal; oil was used at 16 plants, coal and oil at 2 plants, and coke at 1 plant. The oil-burning plants are in Arizona, California, Kansas, Nevada, New Mexico, Oklahoma, Oregon, Texas, and Washington.

SAND AND GRAVEL.

By G. F. Loughlin.

PRODUCTION.

HISTORICAL REVIEW.

In 1902 the value of sand crushed from sandstone and used in the manufacture of glass was for the first time separated from the figures given for stone by the United States Geological Survey and was published in a separate report, which included also the value of other sand used for glass. The process of collecting the figures for 1902 and 1903 revealed a considerable quantity of sand used for molding, building, and various other purposes, and in 1904 it was possible to show approximately the total quantity and value of such sand produced for that year. In 1905 more complete statistics of the total production of sand were obtained, and it was also possible to tabulate the approximate production of gravel. The following table shows the total production of sand and gravel, including glass sand, from 1904 to 1914:

Quantity and value of sand and gravel produced in the United States, 1904–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1904	10,679,728	[a] $5,748,099	1910	69,410,436	$21,037,630
1905	23,204,967	11,223,645	1911	66,846,959	21,158,583
1906	32,932,002	12,698,208	1912	68,354,561	23,113,208
1907	41,851,918	14,492,069	1913	79,555,849	24,217,508
1908	37,216,044	13,270,032	1914	79,281,735	23,846,999
1909	59,565,551	18,336,990			

[a] Includes a very small quantity of gravel.

More complete returns account principally for the large apparent increase during recent years as compared with 1904. The large increase in quantity and the small increase in value in 1906 and 1907 were mainly in the production of cheap gravel for filling, road ballast, and other uses. In 1908 there was, as in most other industries, a decrease in both quantity and value of production, owing to unsettled financial conditions, but in 1909 there was a large increase, due to the great activity in the building trades, in railroad building, and in the iron industry. In glass sand, however, there was only a slight increase. The production of glass sand and molding and building sand continued to increase in 1910. In 1911 there was a small decrease in total production, although the production of glass sand continued to increase. In 1912 and 1913 the total production increased, though special conditions caused a decrease in the production of certain kinds of sand.

With the exception of 1908 and 1911 there has been a steady increase in total production in both quantity and value to 1913, inclusive. The production in 1914, however, shows a decrease in quantity and in value.

PRODUCTION IN 1914.

In view of slackened building demand in 1914 the decrease in output of sand and gravel was relatively small. The total production of sand and gravel in the United States in 1914 reported directly to the United States Geological Survey was 79,281,735 short tons, valued at $23,846,999, a decrease in quantity of 277,114 short tons and in value of $370,509 from the production of 1913. It exceeded, however, by 10,927,174 tons in quantity and $733,791 in value the production of 1912, and by 9,871,299 tons in quantity and $2,809,369 in value the production of 1910, when the largest output previous to that of 1913 was recorded.

Notwithstanding the decrease in total production, there was increase in the value of grinding and polishing sand, of paving sand, of sand for railroad ballast, and especially of gravel. The most conspicuous decrease in value was in molding sand and in fire and engine sand.

Trade conditions in most of the States which show large production were not so favorable in 1914 as in 1913. In the important Eastern States most producers reported conditions to be poor, although a small number had increased production, owing to local demand. The same condition prevailed in the Central States, with the exception of Michigan and Iowa, where the producers who reported conditions as about the same as in 1913 were more numerous than those who reported decreased production. In California more than 50 per cent of the producers reported better conditions in 1914 than in 1913.

The following table gives the total production of glass sand in the United States from 1902 to 1914, inclusive:

Quantity and value of glass sand produced in the United States, 1902–1914, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1902	943,135	$807,797	$0.86	1909	1,104,451	$1,163,375	$1.05
1903	823,044	855,828	1.04	1910	1,461,089	1,516,711	1.04
1904	858,719	796,492	.92	1911	1,538,666	1,543,733	1.01
1905	1,060,334	1,107,730	1.04	1912	1,465,386	1,430,471	.97
1906	1,089,430	1,208,788	1.11	1913	1,791,800	1,895,991	1.06
1907	1,187,296	1,250,067	1.05	1914	1,619,649	1,568,030	.97
1908	1,093,553	1,134,599	1.04				

The production of glass sand in 1914 amounted to 1,619,649 short tons, valued at $1,568,030, a decrease of 172,151 tons, or 9.6 per cent, in quantity and of $327,961, or 17.3 per cent, in value from the production of 1913. The average price per ton fell from $1.06 in 1913 to $0.97.

The following table gives the production of molding sand in the United States since 1904, when the first statistics of molding sand were collected:

Quantity and value of molding sand produced in the United States, 1904–1914, in short tons.

Year.	Quantity.	Value.	Average price per ton.	Year.	Quantity.	Value.	Average price per ton.
1904	3,439,214	$2,125,370	$0.62	1910	3,636,167	$2,431,254	$0.67
1905	3,084,098	2,102,423	.68	1911	3,376,717	2,132,469	.63
1906	3,371,103	2,063,151	.61	1912	4,485,380	2,718,726	.61
1907	3,682,494	2,460,754	.67	1913	3,563,583	2,230,217	.63
1908	1,980,677	1,342,802	.67	1914	2,751,209	1,756,383	.64
1909	3,122,806	2,146,220	.68				

The decrease in the production of molding sand in 1914 was 812,374 short tons and $473,834, or 22.7 per cent in quantity and 21.2 per cent in value. The average price increased from 63 cents to 64 cents a ton. The production of molding sand in 1914 was less than in any year since statistics have been collected by the Survey, with the exception of 1908. The decrease in that year was even more than in 1914, but the recovery was rapid and the production two years later, in 1910, was the greatest in quantity that has been recorded. The production of molding sand reflects to a considerable extent the condition of the iron and steel industry.

The following tables give the production of the various kinds of sand and the production of gravel by States in 1913 and 1914:

Production of sand and gravel in the United States in 1913 and 1914, in short tons.

1913.

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire and furnace sand.		Engine sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			57,798	$23,368	288,346	$90,347	25,903	$11,118				
Arizona					(a)	(a)						
Arkansas			1,214	708	42,914	16,272						
California	(a)	(a)	(a)	(a)	321,777	122,278	35,520	8,880	4,958	$3,671	66,396	$13,096
Colorado			12,781	4,454	29,651	10,400	(a)	(a)			6,001	2,996
Connecticut			(a)	(a)	16,578	5,150						
Delaware			(a)	(a)	(a)	(a)			(a)	(a)		
District of Columbia												
Florida			(a)	(a)	(a)	(a)						
Georgia	(a)	(a)	6,500	4,919	355,289	132,381	(a)	(a)	(a)	(a)	2,700	650
Hawaii					(a)	(a)						
Idaho												
Illinois	350,229	$239,227	404,717	181,794	2,299,834	594,687	42,198	23,138	84,801	43,269	79,568	11,166
Indiana	1,842	1,861	189,446	88,140	1,756,596	418,418	43,020	6,008			57,040	9,878
Iowa			2,977	1,500	794,219	231,784			6,000	2,400	15,509	3,162
Kansas			(a)	(a)	649,646	175,387					(a)	(a)
Kentucky	(a)	(a)	32,981	25,316	391,021	187,993	1,131	873	7,679	4,351	4,177	2,785
Louisiana					185,769	29,177					(a)	(a)
Maine					(a)	(a)						
Maryland	(a)	(a)	10,086	5,276	421,538	192,670	(a)	(a)			20,723	18,224
Massachusetts	(a)	(a)	15,236	7,490	123,388	44,738	(a)	(a)	7,800	6,825		
Michigan	2,938	3,020	50,763	17,493	1,326,016	415,737	(a)	(a)	(a)	(a)	4,447	647
Minnesota			15,364	6,249	433,093	113,904	6,217	2,145			2,916	589
Mississippi			4,920	1,115	204,592	70,104					11,642	2,194
Missouri	130,676	91,284	132,415	63,695	1,585,168	526,912	124,583	63,665	34,800	11,076	21,100	3,700
Montana					(a)	(a)						
Nebraska					665,854	118,255					44,743	7,366
Nevada					(a)	(a)					(a)	(a)
New Hampshire												
New Jersey	108,560	82,577	503,648	285,677	1,666,057	369,973	21,379	14,803	95,889	87,580	57,133	22,626
New Mexico			(a)	(a)								
New York	35,514	21,416	507,263	427,721	4,842,073	1,341,257	55,591	22,767	27,596	14,407	19,806	8,358
North Carolina			(a)	(a)	74,650	25,166	(a)	(a)			(a)	(a)
North Dakota					7,815	5,354						
Ohio	73,154	65,892	731,706	494,342	1,771,233	658,227	21,781	25,948	116,563	90,881	73,031	31,731
Oklahoma					81,125	20,578					11,892	2,424
Oregon					232,959	132,407						
Pennsylvania	513,867	674,073	730,224	505,334	2,298,640	987,810	451,711	346,685	115,672	90,687	216,151	127,257
South Carolina	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)				

South Dakota					12,392	6,785					3,248	544
Tennessee	(a)	(a)	20,199	10,278	300,695	137,750	(a)	(a)	(a)	(a)	61,764	15,476
Texas			(a)	(a)	330,407	160,085					(a)	(a)
Utah					6,947	1,687	(a)	(a)	(a)	(a)	(a)	(a)
Vermont			(a)	(a)	(a)	(a)	(a)	(a)				
Virginia	(a)	(a)	21,225	11,350	359,484	112,854			(a)	(a)	18,694	4,355
Washington			(a)	(a)	141,385	57,808						
West Virginia	534,600	668,214	1,918	1,184	195,115	99,950			(a)	(a)	133,390	94,017
Wisconsin			76,537	37,432	985,988	294,349	(a)	(a)	(a)	(a)	51,955	8,597
Wyoming					(a)	(a)					(a)	(a)
Concealed totals	40,420	48,427	33,665	25,322	199,129	99,135	112,339	14,369	17,303	9,216	49,424	9,968
Total	1,791,800	1,895,991	3,563,583	2,230,217	25,397,383	8,007,949	941,373	540,399	519,061	364,363	1,033,450	401,806

a Included in "Concealed totals."

Production of sand and gravel in the United States in 1913 and 1914, in short tons—Continued.

1913—Continued.

State.	Paving sand.		Railroad ballast sand.		Other sands.		Gravel.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	2,750	$1,250			2,000	$400	1,028,271	$271,605	1,405,068	$398,088
Arizona									(a)	(a)
Arkansas	115,319	45,779			128,124	48,169	533,885	209,711	821,456	320,639
California	111,515	34,861			9,480	5,836	1,272,630	237,118	1,836,012	439,009
Colorado							42,043	10,294	90,578	28,306
Connecticut							(a)	(a)	24,252	7,272
Delaware	(a)	(a)							127,875	58,675
District of Columbia	(a)	(a)			(a)	(a)	(a)	(a)	(a)	(a)
Florida	(a)	(a)					66,835	11,104	87,061	21,194
Georgia	17,500	7,500			2,000	1,000	18,792	15,970	407,853	166,798
Hawaii							(a)	(a)	(a)	(a)
Idaho	(a)	(a)							(a)	(a)
Illinois	101,631	30,973	39,841	$10,849	132,057	66,403	4,457,264	868,985	7,992,140	2,070,491
Indiana	256,235	114,356	95,405	17,886	136,963	40,187	2,485,331	563,938	5,021,878	1,260,672
Iowa	153,789	40,519	777,486	44,694	19,183	3,923	928,869	200,024	2,698,032	528,066
Kansas	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	1,119,990	271,509
Kentucky	23,399	9,905	222,122	30,819	(a)	(a)	446,869	155,449	1,137,286	424,049
Louisiana	(a)	(a)	(a)	(a)	22,787	4,123	662,709	228,043	878,943	262,840
Maine							(a)	(a)	48,963	23,575
Maryland	(a)	(a)			(a)	(a)	861,928	281,371	1,821,214	622,567
Massachusetts	9,855	4,150	(a)	(a)	6,175	3,700	124,260	67,011	290,757	149,036
Michigan	533,261	108,328	358,105	33,823	113,318	20,342	3,930,224	915,455	6,424,168	1,529,142
Minnesota	52,286	10,350			133,283	14,680	1,451,751	134,965	2,094,910	282,882
Mississippi	8,100	1,200					1,662,409	345,788	1,891,663	420,401
Missouri	288,067	69,451	425,282	38,679	20,833	7,940	1,363,202	232,831	4,126,126	1,109,233
Montana							(a)	(a)	15,856	7,857
Nebraska	11,540	1,385					110,772	22,280	832,909	149,286
Nevada					(a)	(a)	(a)	(a)	14,905	3,729
New Hampshire							252,000	87,500	252,000	87,500
New Jersey	175,543	59,722			45,608	22,485	1,222,604	216,587	3,896,421	1,162,050
New Mexico							(a)	(a)	(a)	(a)
New York	196,942	66,083			172,210	43,497	2,767,098	1,018,157	8,624,093	2,963,663
North Carolina	(a)	(a)			(a)	(a)	320,534	100,107	400,577	127,574
North Dakota							9,411	5,235	17,226	10,589
Ohio	192,770	57,047	218,586	62,649	123,884	49,473	2,283,059	556,211	5,605,767	2,092,401
Oklahoma	(a)	(a)	(a)	(a)			48,037	13,538	157,628	39,457
Oregon	59,294	36,972	(a)	(a)	(a)	(a)	1,145,984	261,210	1,442,152	432,938
Pennsylvania	283,946	105,498			148,338	115,167	1,943,900	429,081	6,702,449	3,381,692
South Carolina					(a)	(a)	(a)	(a)	39,730	4,958
South Dakota	12,411	4,163	(a)	(a)			1,040,282	77,614	1,068,833	89,306

Tennessee					19,791	8,337	415,641	112,560	828,633	288,900
Texas	(a)	(a)	(a)	(a)			506,645	287,212	870,943	455,908
Utah	(a)	(a)			(a)	(a)	92,562	13,293	108,758	16,481
Vermont					(a)	(a)	(a)	(a)	116,765	15,045
Virginia	44,588	8,835	(a)	(a)	(a)	(a)	325,115	91,705	787,009	239,591
Washington	318,977	82,456	(a)	(a)			836,623	238,117	1,301,771	385,886
West Virginia	9,118	2,955			(a)	(a)	138,739	67,643	1,026,960	939,933
Wisconsin	93,950	27,688	(a)	(a)	218,087	40,123	2,612,020	362,440	4,044,754	772,125
Wyoming							754,829	60,813	771,139	63,577
Concealed totals	262,722	88,963	198,369	27,453	657.876	150,946	363,371	71,846	282,346	92,618
Total	3,335,508	1,020,389	2,335,196	266,852	2,111,997	646,731	38,526,498	8,842,811	79,555,849	24,217,508

a Included in "Concealed totals."

Production of sand and gravel in the United States in 1913 and 1914, in short tons—Continued.

1914

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire and furnace sand.		Engine sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			92,551	$43,702	152,800	$51,792	8,052	$4,104	22,135	$6,450	12,040	$3,127
Arizona					(a)	(a)						
Arkansas			(a)	(a)	90,689	37,625					(a)	(a)
California	(a)	(a)	5,985	5,562	279,723	85,057	196,263	42,701	(a)	(a)	16,951	2,538
Colorado			(a)	(a)	28,275	8,460			(a)	(a)	5,460	2,490
Connecticut			(a)	(a)	22,575	7,825	(a)	(a)				
Delaware			(a)	(a)					(a)	(a)		
District of Columbia					(a)	(a)						
Florida			(a)	(a)	47,572	36,138					(a)	(a)
Georgia	(a)	(a)	10,427	6,247	200,309	51,782	2,230	815	14,600	4,360	5,032	865
Hawaii					(a)	(a)						
Idaho					(a)	(a)						
Illinois	339,551	$246,803	347,543	200,011	1,196,873	383,209	58,351	38,780	60,674	24,569	93,299	12,239
Indiana	36,977	14,138	311,663	83,733	1,873,953	467,691					49,174	9,238
Iowa	(a)	(a)	1,522	2,365	898,561	272,445	(a)	(a)	(a)	(a)	13,119	3,250
Kansas					992,462	310,547	(a)	(a)			29,458	8,631
Kentucky	(a)	(a)	39,493	26,348	435,641	237,639	(a)	(a)	2,294	1,643	11,807	4,315
Louisiana	(a)	(a)			232,874	76,564					5,085	1,730
Maine					(a)	(a)						
Maryland	(a)	(a)	(a)	(a)	445,092	145,827	(a)	(a)			19,484	18,390
Massachusetts	(a)	(a)	12,452	7,487	318,021	162,860	(a)	(a)	(a)	(a)	(a)	(a)
Michigan	26,035	32,593	53,400	36,583	1,088,650	360,152	(a)	(a)			6,357	1,066
Minnesota			26,270	24,291	315,303	116,191	(a)	(a)	(a)	(a)	(a)	(a)
Mississippi			(a)	(a)	92,567	35,428					45,887	9,398
Missouri	160,190	112,484	53,837	26,656	1,788,277	541,741	102,568	54,263	4,486	1,800	43,619	15,872
Montana			(a)	(a)	3,246	4,005						
Nebraska					696,155	113,841					14,069	1,945
Nevada											(a)	(a)
New Hampshire												
New Jersey	83,927	62,595	376,605	237,788	1,704,011	394,092	21,137	23,207	40,454	33,367	62,534	21,849
New Mexico					(a)	(a)					(a)	(a)
New York	(a)	(a)	428,121	308,324	3,887,515	920,909			16,377	7,861	23,649	10,933
North Carolina			(a)	(a)	31,743	15,468						
North Dakota					12,335	5,600						
Ohio	138,565	131,766	547,398	417,314	1,746,457	660,537	24,343	45,193	35,157	30,488	73,255	26,447
Oklahoma	(a)	(a)			898,452	435,313					4,858	1,362
Oregon					120,856	51,809						
Pennsylvania	512,718	611,173	370,915	280,933	2,086,256	857,305	418,072	295,963	91,519	61,085	409,875	109,348

Rhode Island					(a)	(a)						
South Carolina	(a)	(a)	1,066	1,640	1,480	530	(a)	(a)				
South Dakota			(a)	(a)	25,578	10,686					(a)	(a)
Tennessee	(a)	(a)	6,579	4,021	266,719	123,287	5,610	2,527	11,814	2,544	64,707	15,808
Texas	3,500	3,500	5,120	4,785	371,631	158,587	(a)	(a)	1,588	1,088	9,513	4,698
Utah					1,548	666						
Vermont					4,076	1,368	103,461	9,780				
Virginia	(a)	(a)	15,532	11,128	254,414	110,946	(a)	(a)	(a)	(a)	37,035	4,943
Washington					283,188	67,983						
West Virginia	233,024	269,602	(a)	(a)	251,278	108,112	(a)	(a)	(a)	(a)	96,675	46,578
Wisconsin	(a)	(a)	37,528	21,303	760,740	216,915	(a)	(a)			44,660	4,714
Wyoming					(a)	(a)						
Concealed totals	85,162	83,376	7,202	6,162	96,067	41,842	144,784	135,055	17,462	12,212	65,188	25,774
Total	1,619,649	1,568,030	2,751,209	1,756,383	24,003,962	7,688,774	1,084,871	652,388	318,560	187,467	1,262,790	367,548

a Included in "Concealed totals."

Production of sand and gravel in the United States in 1913 and 1914, in short tons—Continued.

1914—Continued.

State.	Paving sand.		Railroad ballast sand.		Other sands.		Gravel.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	5,849	$4,538			10,112	$9,813	527,891	$138,693	831,430	$262,219
Arizona									(a)	(a)
Arkansas	(a)	(a)			(a)	(a)	673,924	278,876	789,371	325,360
California	106,578	26,714			23,234	8,384	3,258,718	595,449	3,900,540	777,334
Colorado							7,610	3,310	41,614	14,781
Connecticut	(a)	(a)			(a)	(a)			24,343	8,128
Delaware									(a)	(a)
District of Columbia							(a)	(a)	(a)	(a)
Florida	29,000	7,000	(a)	(a)			98,435	10,637	177,241	54,120
Georgia	5,610	1,400			4,973	2,286	12,244	7,875	260,425	80,130
Hawaii					(a)	(a)			(a)	(a)
Idaho							(a)	(a)	(a)	(a)
Illinois	121,812	39,851			522,808	120,635	4,955,219	793,422	7,696,130	1,859,519
Indiana	158,443	55,290	77,362	$6,485	119,041	27,930	4,184,093	602,533	6,810,706	1,267,038
Iowa	201,900	64,340	37,749	3,115	6,518	2,444	1,087,967	205,820	2,253,254	556,868
Kansas	137,582	37,206	(a)	(a)	12,497	3,259	160,283	19,512	1,347,394	381,065
Kentucky	21,653	14,272			226,239	36,393	815,796	208,770	1,563,498	539,335
Louisiana	(a)	(a)	29,061	4,250	(a)	(a)	738,510	190,717	1,051,930	284,297
Maine							(a)	(a)	(a)	(a)
Maryland	327,750	76,212			(a)	(a)	760,204	268,338	1,571,124	523,720
Massachusetts	78,380	33,161	(a)	(a)	11,701	3,805	177,642	50,795	645,773	287,218
Michigan	320,322	74,866	7,565	781	10,336	2,437	2,140,359	530,338	3,757,979	1,143,771
Minnesota	36,458	15,666	22,950	14,900	33,344	9,698	637,900	236,704	1,074,436	417,979
Mississippi			(a)	(a)			1,500,291	354,855	2,144,267	499,726
Missouri	30,327	6,485	(a)	(a)	(a)	(a)	1,321,839	257,827	3,528,678	1,020,903
Montana	(a)	(a)					13,310	11,970	17,864	17,075
Nebraska	5,259	610	(a)	(a)	(a)	(a)	88,026	16,435	859,962	141,319
Nevada							(a)	(a)	(a)	(a)
New Hampshire							670,000	112,500	670,000	112,500
New Jersey	110,260	39,902			61,869	59,089	2,204,880	672,433	4,665,677	1,544,322
New Mexico							(a)	(a)	(a)	(a)
New York	82,725	34,148	392,968	46,530	78,555	20,702	2,149,310	891,762	7,070,820	2,250,169
North Carolina			(a)	(a)			311,059	42,438	492,092	72,989
North Dakota							10,875	5,725	23,210	11,325
Ohio	407,025	134,370			120,874	56,183	2,417,805	654,833	5,510,879	2,157,131
Oklahoma			(a)	(a)	35,421	16,083	505,737	225,559	1,477,618	713,117
Oregon	3,368	2,607	(a)	(a)	533,967	197,790	611,821	137,221	1,271,362	390,177
Pennsylvania	625,171	235,326			584,900	98,979	1,766,651	387,845	6,866,077	2,937,957
Rhode Island							(a)	(a)	(a)	(a)

South Carolina	....	....	....	....	(a)	(a)	29,927	4,995	33,788	8,480
South Dakota	(a)	(a)	(a)	(a)	2,026	1,263	196,909	25,603	232,395	40,215
Tennessee	6,489	2,484	238,431	44,419	51,715	21,644	445,504	183,296	1,097,720	400,182
Texas	46,460	14,315	59,583	17,466	....	....	1,183,646	433,399	1,681,379	638,026
Utah	44,445	11,300	5,100	2,500	....	....	184,763	45,162	235,856	59,628
Vermont	....	....	....	....	....	....	822	390	108,359	11,538
Virginia	(a)	(a)	(a)	(a)	(a)	(a)	294,398	87,379	639,382	229,595
Washington	363,745	86,796	(a)	(a)	....	....	457,137	162,183	1,178,330	324,628
West Virginia	44,617	17,819	....	....	....	....	455,804	125,618	1,106,742	590,391
Wisconsin	222,298	71,560	408,378	41,898	825,118	69,080	1,294,893	343,230	3,594,336	768,996
Wyoming	....	....	....	....	....	....	718,441	48,245	718,914	48,595
Concealed totals	36,645	13,761	837,282	140,396	55,988	14,876	142,215	26,205	258,840	75,133
Total	3,580,171	1,121,999	2,116,429	322,740	3,331,236	782,773	39,212,858	9,398,897	79,281,735	23,846,999

a Included in "Concealed totals."

Sand for building purposes constituted, as in previous years, more than one-half of the total sand production. The production in 1914 was 24,003,962 short tons, valued at $7,688,774. This was a decrease of 1,393,421 tons, or 5.4 per cent, in quantity and of $319,275, or 3.9 per cent, in value from the production of 1913. The average price per ton, which increased from 31 cents in 1911 to 33½ cents in 1912 and decreased to 31½ cents in 1913, increased to 32 cents in 1914. Decrease in output and value was not general, as some producers reported an increase both in quantity and in price per ton.

The production of grinding and polishing sand, which decreased in 1913, showed a marked increase in 1914 and was again above 1,000,000 tons. Although the output was 100,000 tons less than in 1912 (the year of highest production), it was more than 200,000 tons greater than in 1911. The production in 1914 was 1,084,871 tons, valued at $652,388, an increase in quantity of 143,498 tons and in value of $111,989 over the production for 1913.

The production of fire sand and furnace sand, like that of molding sand, decreased greatly. The quantity produced in 1914 was 318,560 tons and the value was $187,467, against 519,061 tons, valued at $364,363, in 1913, a decrease of 200,501 tons in quantity and of $176,896 in value.

The production of engine sand increased in quantity from 1,033,450 tons in 1913 to 1,262,790 tons in 1914, but the value decreased from $401,806 to $367,548.

Paving-sand production increased slightly in both quantity and value, from 3,335,508 tons, valued at $1,020,389, in 1913 to 3,580,171 tons, valued at $1,121,999, in 1914.

The production of sand for railroad ballast actually reported to the Survey was 2,116,429 tons, valued at $322,740, in 1914, as against 2,335,196 tons, valued at $266,852, in 1913. The increase in value, notwithstanding a comparatively small decrease in quantity, is notable. The reported production does not represent the total quantity of sand used for ballast by the railroads, for the reason that some railroads keep no record of the quantity of sand produced and used by them in making cuts and in ballasting their roadbeds. With them it is only a matter of moving material from one point on the right of way to another point.

The production of gravel in 1914 exceeded that of building sand by more than 15,000,000 tons, an excess which was 2,000,000 tons more than that in 1913. The total production of gravel in 1914 was 39,212,858 tons, valued at $9,398,897, an increase in quantity of 686,360 tons and in value of $556,086 over the production of 1913. These figures show an average cost per ton of nearly 25 cents, as compared with slightly less than 23 cents in 1913 and about 26 cents in 1912. This large quantity of gravel was used for many purposes, including concrete, paving, filter beds, roofing, road making, and railroad ballast. The total production of all kinds of sand in 1914 was 40,068,877 short tons, valued at $14,448,102, an excess of 856,019 tons in quantity and of $5,049,205 in value over the production and value of gravel during that year.

The entire report of the production of sand and gravel is necessarily incomplete, because it is impracticable to attempt to get reports or to estimate the quantity of sand produced by the thousands of individuals who each year dig a small quantity for their own use. This production, of which there is no count or accounting, may average less than a ton for the individual producer, but the aggregate may be hundreds of thousands of tons. The figures each succeeding year should be nearer the actual production, as the list of producers is added to annually.

The gravel figures for 1914 do not include a considerable quantity of chats or tailings from the Missouri zinc mines. The production of chats in Missouri in 1914 was 2,270,771 tons, valued at $340,616.

The unit of measurement given in the 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, to the material of which the gravel is composed, and 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.

IMPORTS.

Sand valued at $139,675 was imported into the United States in 1914, as compared with imports valued at $172,257 in 1913, $141,690 in 1912, and $147,268 in 1911. This is largely building sand brought to the United States as ballast, or from Canada as a near source of supply; but it includes a small quantity of French molding sand which comes to this country barreled in lump and is here ground and pulverized before marketing.

BORAX.

By Charles G. Yale and Hoyt S. Gale.

PRODUCTION.

In 1914 the production of crude borate materials in the United States was 62,400 short tons, valued at $1,464,400, as compared with 58,051 short tons in 1913, valued at $1,491,530, an increase of 7.49 per cent in quantity and a decrease of 1.82 per cent in value. All of the crude borate material now used in this country is the mineral colemanite (calcium borate), and the output in 1914 was from three mines in southern and southeastern California. The value of the product given is estimated on a basis of $1 per unit per cent of anhydrous boric acid (boron trioxide, B_2O_3) in the raw material, which basis is believed to approximate very closely the price of the ore at the mine or point of shipment.

A statement of the production of borax and borate materials in the United States (altogether from California and Nevada), compiled from the most authentic sources available, is given below:

Production of borate materials in the United States, 1864–1914, in short tons.

Year.	Crude.	Refined.	Value.	Year.	Crude.	Refined.	Value.
1864		12	$9,478	1891		6,690	$869,700
1865		125	94,099	1892		6,750	900,000
1866		201	132,538	1893		4,350	652,425
1867		220	156,137	1894		7,340	974,445
1868		32	22,384	1895		5,959	595,900
1869		0	0	1896		6,754	675,400
1870		0	0	1897		8,000	1,080,000
1871		0	0	1898		8,000	1,120,000
1872		140	89,000	1899		20,357	1,139,882
1873		1,000	496,000	1900	24,235	1,602	1,018,251
1874		2,000	567,000	1901	17,887	5,344	1,012,118
1875		2,717	672,000	1902	2,600	17,404	2,538,614
1876		2,590	563,000	1903	34,430		661,400
1877		1,864	364,000	1904	45,647		698,810
1878		1,401	249,000	1905	46,334		1,019,154
1879		792	143,000	1906	58,173		1,182,410
1880		1,846	277,233	1907	52,850		1,121,520
1881		2,023	304,461	1908	25,000		975,000
1882		2,118	338,903	1909	41,434		1,534,365
1883		3,250	585,000	1910	42,357		1,201,842
1884		3,500	490,000	1911	53,330		1,569,151
1885		4,000	480,000	1912	42,315		1,127,813
1886		4,889	488,915	1913	58,051		1,491,530
1887		5,500	550,000	1914	62,400		1,464,400
1888		3,795	455,340				
1889		4,000	500,000	Total	607,043	151,315	35,269,118
1890		4,750	617,500				

Note.—Prior to production from Nevada, prices ranged from 28 to 35 cents a pound for the refined borax extracted from the California lake waters. After 1872 the price dropped during the next two years to $6\frac{1}{2}$ cents a pound; it then advanced slowly to 11 to 13 cents, but again fell off. In 1885 borax sold in San Francisco for 6 to 8 cents a pound; a further decline followed. From 1882 to 1903, inclusive, the refined product was used as a basis for estimating the value; but since 1904 the value has been estimated on a basis of unit values assigned to the boric acid in the crude product.

As shown in the foregoing table, the production of borax in the United States began about 1864 and consisted of natural borax crystals which were found in California in the muds on the bottom of two small lakes in Lake County. These crystals were purified by washing, solution, and recrystallization. The product in the early stages of the industry must, therefore, be reported as the refined material and the valuation is based on prices ranging from 28 to 35 cents a pound.

In the late seventies came the development of native borax and of the mineral ulexite ("cotton ball" or boronatrocalcite) from marsh deposits in Nevada and California, which resulted in lowering considerably the price of the refined product, which was reported as refined borax, as this was the form in which it was shipped from the places where it was mined.

During the eighties, however, a new source of borax and boric acid was discovered in the mineral colemanite (a calcium borate), which was contained in vein deposits in the Tertiary formations. This revolutionized the borax industry, once more entirely shifting the basis of production. The raw material as mined was a compact ore mineral, which was submitted to a process of manufacture in factories erected for the purpose. Reports of this production were then stated in terms of the crude colemanite or calcium borate as mined, and for a time production from both the old marsh deposits and the new vein sources gave statistics and prices which were difficult to combine into a single total. This condition led to an apparent confusion in the quotation of borax statistics, which, however, is explained by the conditions of production.

The borax deposits are shown on the accompanying map (Pl. III).

REVIEW OF CONDITIONS OF INDUSTRY.

SOURCES OF DOMESTIC BORAX.

The production of borax in the United States continues to be derived entirely from California colemanite ores and from 3 mines only, 1 in Inyo County, 1 in Los Angeles County, and 1 in Ventura County. The larger portion of the output of the year 1914 came, as usual, from the Lila C. mine of the Pacific Coast Borax Co., in the mountains of the Death Valley region of Inyo County. A reorganization of this company has been effected and it is now known as The Pacific Coast Borax Co. The general office of this company has been removed from Oakland, Cal., to New York City. During 1914 the company completed a calcining plant at Death Valley Junction to roast the ores of low grade before shipping them to New Jersey to be refined. It also completed a narrow-gage railroad from the Tonopah & Tidewater Railroad at Death Valley Junction to the Biddy McCarthy and Monte Blanco mines of the company in the Furnace Creek region, which have not previously been operated owing to lack of transportation facilities.

The Sterling Borax Co., operating colemanite deposits 6 miles from Lang, in Los Angeles County, maintained a production second in importance to that of The Pacific Coast Borax Co. Two grades of ore are mined, which vary in percentage of anhydrous boric acid, and both are roasted at the mine, thereby eliminating impurities which consist mainly of pandermite, clay, and water. Upon calcination the colemanite content of the ore is dehydrated and becomes a fine

MAP SHOWING BORAX DEPOSITS IN THE WESTERN UNITED STATES.

powder which is easily screened from the pandermite and clay, the latter substances retaining their coherence.

The Stauffer Chemical Co., of San Francisco, formerly interested in the operations of the borax mines at Lang, Los Angeles County, has secured the controlling interest in the Russell Borate Co. in the Ventura district. Since making the purchase this company has been operating the property and shipping the ore to San Francisco for refining. The ore is hauled 35 miles to the railroad and the operating season is thus limited to about seven months in each year on account of heavy roads in winter.

Colemanite has been discovered in a well on a ranch 4 miles from Rich station, in the Kramer district, San Bernardino County (sec. 22, T. 11 N., R. 8 W. San Bernardino meridian). The testimony on behalf of the mineral claimants in a contest before the United States Land Office involving the character of the land shows clearly that a bona fide discovery has been made. According to the testimony of L. M. Griffin, the well driller, the well was already 330 feet deep and contained some water when he began drilling. From 331 feet to 369 feet he encountered blue shale; from 369 to 410 feet, "borax;" from 410 to 435 feet, blue shale; from 435 to 445 feet, gypsum; from 445 to 450 feet, "rock formation."

This log shows that the colemanite was met with at a depth of 370 feet and continued apparently for 40 feet. John Ryan, manager of The Pacific Coast Borax Co., testified that the samples analyzed by by the company's chemists showed that they were high-grade colemanite, as good as any yet found on the Pacific coast. The mine has been bonded and part payments have been made on it with a view to further examination. Direct report from the locality at the end of May, 1915, is to the effect that no attempt, with the exception of a small shaft, has yet been made to develop the deposit.

PRICES.

According to quotations in the trade journals [1] the prices of borax and boric acid have fluctuated but little during late years. The price of borax crystals was quoted as $3\frac{3}{4}$ to 4 cents a pound with a slight rise to $4\frac{1}{4}$ to $4\frac{3}{4}$ cents at the close of 1914; and for boric-acid crystals the usual price of 7 to $7\frac{1}{2}$ cents a pound was given as slightly advanced to $7\frac{3}{4}$ to $8\frac{1}{2}$ cents at the close of the year. The closing of some foreign sources of supply, as for instance the mines near the Sea of Marmora, and the interruption of foreign business conditions has created a somewhat larger demand than usual for American products, and a slight rise in price may be expected from the stimulation of the export business.

TARIFF.

The tariff on imported borate materials as fixed by the act of October 3, 1913, is as follows:

Dutiable list: Schedule A, Chemicals, oils, and paints:
- Boracic (boric) acid,[2] $\frac{3}{4}$ cent per pound.
- Soda, borate of, or borax refined, $\frac{1}{8}$ cent per pound.

Free list: Borax, crude and unmanufactured, and borate of lime, soda, and other berate material, crude and unmanufactured, not otherwise provided for in this section.

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[1] Journal of Industrial and Engineering Chemistry; Oil, Paint, and Drug Reporter; Mining and Scientific Press; and others.

[2] The terms boracic acid and boric acid are used interchangeably.

IMPORTS.

The following table, from figures furnished by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, shows the imports of borax and borates into the United States from 1902 to 1914, inclusive:

Imports for consumption of borax and borates into the United States, 1902–1914, 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
1913	4,215	477	7,900	1,125	423,215	16,932
1914	220	29	3,862	546	425,241	18,837

WORLD'S PRODUCTION.

According to the available statistics concerning the world's propuction of borates, or boric acid and borax, prior to 1914, it appears that Chile and the United States lead the industry with approximately equal output of these materials, each producing in recent years in round numbers 40,000 to 50,000 metric tons of crude ores, mainly calcium borates. Turkey probably stands third in rank of production, with a reported average production of 14,000 tons of boracite (a borate and chloride of magnesium), quoted as equivalent to 47.6 per cent boric acid, and so comparable to the calcium borates as ores. Peru, Bolivia, and Italy come next, with a production of 2,000 to 3,000 tons each, and possibly also, although no recent record is at hand, Argentina, with a production of about 1,000 tons. India has a small production of 200 to 300 tons, and Germany a still smaller production of about 150 tons from the boracite of the potash salts deposits.

The total world's production of borax may be stated in general terms as 100,000 metric tons of crude materials, a summation which includes various grades ranging from the relatively pure boric acid from the Italian fumaroles to the crude calcium borate ores containing 25 to 40 per cent of anhydrous boric acid.

The table of the world's production of borates has been taken from published records, including the following official publications:

Chile: Estadística minera de Chile.

Bolivia: Comercio especial de Bolivia, publicación oficial de la Dirección general de aduanas.

Peru: Boletines del Cuerpo de ingenieros de minas del Perú.

Argentina: Anales del Ministerio de agricultura, Sección de geología, mineralogía minería.

Germany: Vierteljahrshefte zur Statistik des Deutschen Reichs.

Italy: Rivista del Servizio minerario.
Turkey: Mining statistics published by the Department of Mines, Forests, and Agriculture, Constantinople.
India: Records of the Geological Survey of India, and Reports of the chief inspector of mines in India.
Great Britain: Mines and Quarries: General report and statistics, Part IV, Colonial and foreign statistics.

The world's production of borax and borates, 1900–1913, in metric tons.

Year.	Calcium borate (colemanite).	Boronatrocalcite (ulexite).				Magnesium borate and chloride (boracite).		Boric acid, crude.	Boracite.[a]	Borax, crude (tincal).[b]
	United States.	Chile.	Bolivia.	Peru.	Argentina.	Prussia.	German Empire.	Italy.	Turkey.	India.
1900	23,439	13,177	....	7,080	....	217	232	2,491	....	224
1901	21,075	11,547	3,065	4,156	....	164	184	2,558	(c)	162
1902	18,148	14,327	593	5,055	....	172	196	2,763	(c)	....
1903	31,235	16,879	1,206	2,466	....	135	159	2,583	(c)	....
1904	41,411	16,733	1,196	2,675	....	115	135	2,624	(c)	271
1905	42,034	19,612	2,146	1,954	....	151	183	2,700	(c)	226
1906	52,774	28,996	....	2,598	....	124	161	2,561	(c)	210
1907	47,945	28,374	....	2,451	....	90	114	2,305	[d] 13,714	285
1908	22,680	35,039	....	2,870	....	105	128	2,520	[d] 11,221	267
1909	37,589	32,218	....	2,715	[e] 805	123	149	2,431	(f)	257
1910	38,426	35,192	....	2,351	[e] 571	138	167	2,502	....	319
1911	48,381	45,558	....	1,923	....	147	160	2,648	....	165
1912	38,388	43,356	....	1,674	....	....	224	2,309	....	....
1913	52,658	....	....	....	....	....	....	[g] 2,410	....	....

[a] Reported boracite, but may be pandermite, a calcium borate.
[b] Produced in Tibet, but exported from India.
[c] Annual output of about 9,000 tons.
[d] Years ending March, 1908, and March, 1909.
[e] Exports.
[f] Annual output of 10,000 to 11,000 tons.
[g] The crude acid is manufactured into refined acid and borax, for which forms of production statistics are quoted.

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SALT, BROMINE, AND CALCIUM CHLORIDE.

By W. C. PHALEN.

SALT.

PRODUCTION.[1]

The marketed production of salt in the United States in 1914, including Porto Rico, was 34,804,683 barrels of 280 pounds each, or 4,872,656 short tons, valued at $10,271,358. In 1913 the marketed

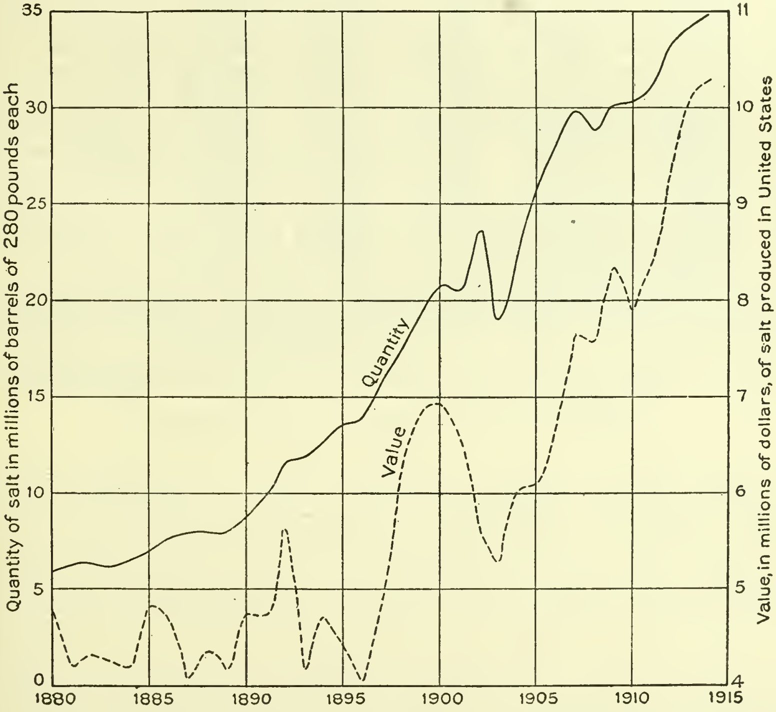

FIGURE 10.—Curves showing growth in quantity and value of salt produced in the United States, 1880–1914.

production was 34,399,298 barrels, or 4,815,902 short tons, valued at $10,123,139, an increase in 1914 of 405,385 barrels or 56,754 short tons, or 1.18 per cent, in quantity and of $148,219, or 1.46 per cent,

[1] The tables in this report were prepared by Miss A. T. Coons, statistical clerk.

in value. Since 1909 the production of Hawaii has been included in this total production for the country, but no returns were received for the island in 1914. Such returns, if received, would probably make no difference in the general statements which follow, since in 1912 and 1913 the Hawaii production was only 0.02 per cent of the total of the country. The average price of salt per barrel in 1914 was 29.511 cents, or $2.11 a short ton, as compared with 29.428 cents a barrel, or $2.10 a short ton in 1913. During the last four years the price of salt as well as the marketed production has been slowly increasing.[1]

As Mineral Resources of the United States completes its thirty-fifth annual statistical record with the volume for 1914 it has been thought well to give the production of salt for this 35-year period, though figures of production for this commodity are available for many years preceding and will be published later in a Survey publication dealing in a comprehensive manner with the salt industry of the United States. From the table and the curves in figure 10 it will be observed that the growth in the salt production of the United States has been fairly consistent and steady and has tended more and more to supply the entire demand of the United States, except in those parts of the Atlantic coast where foreign salt can compete. Thus salt from the West Indies and the Mediterranean countries has been a competitor with New York salt for the trade of the New England seaboard towns for some years. In spite of this, as will be observed later on, the United States in 1914 supplied nearly all the salt used at home. Another interesting point brought out in the table is the downward trend in the price of salt to the year 1905, when the lowest price of 23 cents a barrel was reached. Since that year the price has gradually risen to 29½ cents a barrel in 1914.

In the table following are given the quantity and value of the three basic grades of salt which either entered into the chemical industries or were sold in the United States from 1880 to 1914.

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[1] The barrel containing 280 pounds and the short ton are the units of measure chiefly used in the salt industry.

Marketed production of the three main grades of salt and their value in the United States, 1880–1914, in barrels of 280 pounds.

Year.	Quantity manufactured (evaporated).	Quantity of brine (sold as such or used by chemical works).	Quantity of rock salt.	Total quantity.	Total value.[a]	Average price per barrel.
1880	5,898,660		62,400	5,961,060	$4,829,566	$0.81
1881	6,200,000		....	6,200,000	4,200,000	.68
1882	6,229,873		182,500	6,412,373	4,320,140	.67
1883	5,927,016		265,215	6,192,231	4,251,042	.69
1884	6,290,973		223,964	6,514,937	4,197,734	.64
1885	6,739,382		299,271	7,038,653	4,825,345	.69
1886	7,304,117		402,964	7,707,081	4,736,585	.61
1887	7,231,648		772,314	8,003,962	4,093,846	.51
1888	7,122,281		933,600	8,055,881	4,374,203	.54
1889	6,768,386		1,237,179	8,005,565	4,195,412	.52
1890	7,486,713		1,390,278	8,876,991	4,752,286	.54
1891	8,849,017		1,138,928	9,987,945	4,716,121	.47
1892	10,564,047		1,134,843	11,698,890	5,654,915	.48
1893	7,902,776	[b] 2,110,287	1,884,145	11,897,208	4,154,668	.35
1894	9,344,935	[b] 1,356,876	2,266,606	12,968,417	4,739,285	.37
1895	9,695,665	[b] 1,884,221	2,089,763	13,669,649	4,423,084	.32
1896	9,535,754	[b] 2,531,086	1,783,886	13,850,726	4,040,839	.29
1897	10,709,252	[b] 3,614,491	1,649,459	15,973,202	4,920,020	.31
1898	12,351,809	[b] 3,077,024	2,183,801	17,612,634	6,212,554	.35
1899	13,680,720	[b] 3,483,858	2,544,036	19,708,614	6,867,467	.35
1900	12,324,246	[b] 5,571,063	2,974,033	20,869,342	6,944,603	.33
1901	12,325,197	[b] 5,003,526	3,237,938	20,566,661	6,617,449	.32
1902	12,058,514	[b] 8,900,881	2,889,836	23,849,231	5,668,636	.24
1903	12,674,151	[b] 3,118,417	3,175,521	18,968,089	5,286,988	.28
1904	13,653,911	4,006,950	4,369,141	22,030,002	6,021,222	.27
1905	13,362,426	7,869,931	4,733,765	25,966,122	6,095,922	.23
1906	13,725,174	9,573,680	4,873,526	28,172,380	6,658,350	.24
1907	14,672,329	9,222,471	5,809,328	29,704,128	7,608,323	.26
1908	14,791,635	8,869,216	5,161,211	28,822,062	7,553,632	.26
1909	15,398,118	8,770,807	5,938,721	[c] 30,107,646	8,343,831	.28
1910	13,950,492	9,389,226	6,965,938	[c] 30,305,656	7,900,344	.26
1911	14,924,350	10,027,411	6,232,207	[c] 31,183,968	8,345,692	.27
1912	14,824,428	11,408,623	7,091,757	[c] 33,324,808	9,402,772	.28
1913	15,223,063	11,588,444	7,587,791	[c] 34,399,298	10,123,139	.294
1914	15,422,097	11,805,414	7,577,172	[c] 34,804,683	10,271,358	.295

[a] Prior to 1893 the value includes cost of wrapper in which some of the salt was sold; after 1893 the value is for bulk salt f. o. b. at point of shipment.
[b] Includes a small quantity of manufactured salt.
[c] Includes production of Hawaii and Porto Rico, 1909–1913, and of Porto Rico, 1914.

PRODUCTION, BY GRADES AND STATES.

Salt is prepared for market in various ways, the methods of production being divided into two distinct classes. This is owing in part to the fact that salt itself occurs naturally in two very distinct ways—(1) as rock salt in beds or associated with bedded or sedimentary deposits, and (2) as natural brines or bitterns. The larger part of our salt production is derived by converting the rock salt into artificial brines, which are pumped to the surface and there evaporated.

The two methods of production referred to above are (1) the mining of rock salt and its purification and separation into marketable sizes and (2) the production of salt by evaporation of the artificial or natural brines, bitterns, and sea water.

The principal processes hitherto employed in the manufacture of salt by evaporation are (1) Solar evaporation; (2) direct heat evaporation, (*a*) in open kettles, (*b*) in open pans; (3) steam evaporation, (*a*) in jacketed kettles, (*b*) in grainers; (4) vacuum pan evaporation. Of the classes enumerated, direct heat evaporation in open kettles and steam evaporation in jacketed kettles have become practically obsolete.

In addition to the marketable salt thus produced, a very considerable quantity of salt does not enter the market as such but is converted directly into sodium carbonate or bicarbonate or other sodium salts and is sold in these forms.

PRODUCTION BY GRADES.

By the processes mentioned above are produced the different grades of salt made from brine, together with many modifications of them put on the market under different trade and proprietary names. The production of brine salt for the last five years is shown in the following table:

Marketed production of brine salt in the United States, 1910–1914, by grades, in barrels.

Year.	Table and dairy.		Packers' salt.					
			Common fine.		Common coarse.		Packers'.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	3,881,387	3,223,836	6,521,058	2,423,012	3,464,978	1,414,760	(a)	(a)
1914	4,121,574	3,258,266	6,237,860	2,283,588	3,789,163	1,484,218	....	....

Year.	Coarse solar.		Other grades.		Brine.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	1,161,649	446,342	193,991	67,608	11,588,444	579,014	26,811,507	8,154,572
1914	1,080,199	457,154	193,301	73,715	11,805,414	589,519	27,227,511	8,246,460

[a] A small output reported directly as packers' is included under common coarse.

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 table following is added, giving the quantity and value of the rock salt mined in the United States during the last five years.

Marketed production of rock salt in the United States, 1910–1914, in short tons.

Year.	Rock salt.	
	Quantity.	Value.
1910	a 975,231	$1,613,113
1911	a 872,509	1,578,016
1912	b 992,846	1,697,829
1913	b 1,062,291	1,968,567
1914	b 1,060,804	2,024,898

a Includes California, Idaho, Kansas, Louisiana, Michigan, New York, and Utah.
b Includes California, Kansas, Louisiana, Michigan, New York, and Utah.

Rock salt is produced by deep-shaft mining in the eastern, central, and southern parts of the United States. The 9 active mines are located, respectively, at Retsof and at Halite, Livingston County, N. Y.; 1 near Detroit, Mich.; 3 at Kanopolis, Ellsworth County, and 1 at Lyons, Rice County, Kans.; and 1 each at Weeks and Avery islands, Iberia Parish, southern Louisiana.

Rock salt occurs near the surface in consequence of the dry climate, and is mined in open cuts or pits in Sevier Valley, Utah, and near Redmond, in both Sevier and Sanpete counties. A small production of rock salt from near the surface is also reported near Ward, San Bernardino County, Cal.

PRODUCTION BY STATES.

The following table gives the production and value of the salt produced in the United States from 1911 to 1914, inclusive, by States:

Marketed production and value of salt, 1911–1914, by States, in barrels.

State.	1911		1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Michigan	10,320,074	$2,633,155	10,946,739	$2,974,429	11,528,800	$3,293,032	11,670,976	$3,299,005
New York	a 11,234,928	a 2,538,151	10,527,221	2,615,334	10,780,514	2,865,187	10,389,314	2,824,733
Ohio	4,302,507	1,100,453	5,269,179	1,364,136	5,310,135	1,318,156	5,482,836	1,320,554
Kansas	2,159,859	806,027	2,573,626	844,292	2,698,079	860,404	2,967,864	924,550
Louisiana	(b)	(b)	(c)	(c)	(c)	(c)	(c)	(c)
California	1,086,163	555,359	1,090,000	620,196	1,082,993	759,485	1,100,443	856,861
West Virginia	183,379	78,805	139,121	66,023	113,921	63,803	145,429	78,036
Texas	385,200	299,537	373,064	290,328	355,529	278,008	334,979	251,493
Utah	272,420	171,268	283,293	154,734	330,443	191,686	375,457	231,512
Hawaii	8,463	11,850	8,286	9,180	6,071	5,950	....	....
Idaho	314	532	(c)	(c)	(c)	(c)	300	520
Porto Rico	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Nevada	12,856	16,952	12,536	15,752	8,971	7,947	4,436	2,448
Oklahoma	500	431	(c)	(c)	(c)	(c)	(c)	(c)
Other States	d 1,217,305	133,172	e 2,101,743	448,368	e 2,183,842	479,481	f 2,332,649	481,646
Total	31,183,968	8,345,692	33,324,808	9,402,772	34,399,298	10,123,139	34,804,683	10,271,358

a Includes Louisiana.
b Included in New York.
c Included in "Other States."
d Includes New Mexico, Pennsylvania, Porto Rico, and Virginia.
e Includes Idaho, Louisiana, New Mexico, Oklahoma, Pennsylvania, Porto Rico, and Virginia.
f Includes Louisiana, New Mexico, Oklahoma, Pennsylvania, Porto Rico, and Virginia.

The following table presents in concise form general information of interest to the salt trade. It gives for the two years 1913 and 1914 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 in both quantity and value of salt produced.

Number of operating plants, rank of States, average price per ton in 1913 and 1914, and percentage of increase or decrease in 1914.

State.	1913				1914				Percentage of increase (+) or decrease (−).	
	Number of operating plants.	Rank of State by—		Average price per ton.	Number of operating plants.	Rank of State by—		Average price per ton.	Quantity.	Value.
		Total quantity.	Total value.			Total quantity.	Total value.			
California	[a]24	6	5	[b]$3.00 [c]5.07	[a]24	6	5	[b]$7.00 [c]5.56	+ 1.61	+ 12.82
Hawaii	[c]5	14	14	[c]7.00	....	....	....	....	....	....
Idaho	[c]2	17	16	[c]12.79	[c]3	16	15	[c]12.38	+50.00	+ 45.25
Kansas	[a]10	4	4	[b]1.24 [c]3.32	[a]10	4	4	[b]1.29 [c]3.24	+10.00	+ 7.46
Louisiana	[b]2	5	6	[b]2.10	[b]2	5	6	[b]2.29	− 5.53	+ 2.82
Michigan	[a]26	1	1	[b]2.44 [c]2.01	[a]26	1	1	[b]2.56 [c]1.99	+ 1.23	+ .18
Nevada	[c]3	13	13	[c]6.33	[c]3	14	14	[b]2.50 [c]5.29	−50.56	− 69.20
New Mexico	[c]1	15	15	[c]4.00	[c]1	13	13	[c]7.00	+75.00	+206.25
New York	[a]28	2	2	[b]1.86 [c]1.92	[a]27	2	2	[b]1.91 [c]1.96	− 3.63	− 1.41
Ohio	[c]10	3	3	[c]1.77	[c]10	3	3	[c]1.72	+ 3.25	+ .18
Oklahoma	[c]2	16	17	[c]3.50	[c]2	15	16	[c]3.69	+22.97	+ 29.73
Pennsylvania	[c]1	11	11	[c]5.25	[c]1	12	12	[c]5.25	−75.01	− 75.00
Porto Rico	[c]2	12	12	[c]2.90	[c]2	11	11	[c]2.89	+28.00	+ 27.59
Texas	[c]3	8	7	[c]5.59	[c]3	9	7	[c]5.36	− 5.78	− 9.54
Utah	[a]6	9	8	[b]2.97 [c]4.25	[a]6	8	8	[b]2.81 [c]4.61	+13.62	+ 20.78
Virginia	[c]1	7	10	[c][d].36	[c]1	7	10	[c][d].36	+31.75	+ 31.75
West Virginia	[c]3	10	9	[c]4.00	[c]3	10	9	[c]3.83	+27.66	+ 22.31
Total brine and rock salt	129	....	....	[b]1.85 [c]2.17	124	....	....	[b]1.91 [c]2.16	[b]− 0.14 [c]+ 1.55	+ 2.86 + 1.13
Total United States	....	....	....	2.10	....	....	....	2.11	+ 1.18	+ 1.46

[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.

The following table gives the consumption of salt in the United States during 1914. The marketed production of domestic salt was 34,804,683 barrels; the imports were 934,319, the sum of the two quantities being 35,739,002 barrels. The last figure does not represent the quantity of salt consumed, as 587,818 barrels were exported, leaving for home use 35,151,184 barrels, an increase of 148,485 barrels compared with the consumption of 1913. The imports declined appreciably, namely, by 171,147 barrels, compared with 1913; but exports increased 85,753 barrels. The imported salt constituted 2.7 per cent of the domestic consumption or 0.5 per cent less than in the preceding year.

The figures given above indicate that the United States furnished very nearly all the salt consumed by its people during 1914. For many years the country has been able to supply the domestic demand, as the capacity of both salt mines and manufacturing plants is considerably in excess of the present output. Many plants that have been running at fractional capacity or have been entirely inactive could easily resume full operation should trade conditions warrant.

Supply of salt for domestic consumption, 1890–1914, in barrels.

Source.	1890	1900	1910	1912	1913	1914
Domestic production	8,876,991	20,869,342	30,305,656	33,324,808	34,399,298	34,804,683
Imports	1,838,024	1,427,921	979,305	998,664	1,105,466	934,319
Total	10,715,015	22,297,263	31,284,961	34,323,472	35,504,764	35,739,002
Exports	17,597	53,650	350,094	445,785	502,065	587,818
Domestic consumption	10,697,418	22,243,613	30,934,867	33,877,687	35,002,699	35,151,184
Comparison with preceding year	+877,610	+1,274,634	+46,032	+2,027,885	+1,125,012	+148,485
Percentage of imports to total consumption	17.2	6.4	3.2	2.9	3.2	+2.7

IMPORTS.

In 1914 the imports of salt into the United States were 261,609,200 pounds (934,319 barrels), valued at $380,803; corresponding imports in 1913 were 309,530,500 pounds (1,105,466 barrels), a decrease in 1914 amounting to 47,921,300 pounds (171,147 barrels).

Prior to the tariff act of October 3, 1913, salt imported into the United States for curing fish was admitted free of duty, but not salt imported for other purposes. As that act removes the duty from all salt, the salt imported for curing fish is no longer separately recorded, so that a comparison of the salt imported by grades since 1912 can not be made.

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 are as follows:

Salt imported and entered for consumption in the United States, 1910–1914, 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.		
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
1913	70,433,300	209,752	185,743,900	160,400	[a] 53,353,300	[a] 51,593	309,530,500	421,745
1914	65,614,400	212,349	195,994,800	168,454			261,609,200	380,803

[a] This class was not carried separately after Oct. 3, 1913.

EXPORTS.

The exports of salt in 1914 were 164,589,012 pounds (587,818 barrels), valued at $586,055. Compared with the exports in 1913, which were 140,578,092 pounds (502,065 barrels), valued at $515,194, this was an increase of 24,010,920 pounds (85,753 barrels) in quantity and of $70,861 in value. Both the quantity and the value of the salt exported are the largest in the history of salt exportation from the United States. Exports of domestic salt for the five-year period, 1910–1914, are given in the following table:

Salt of domestic production exported from the United States, 1910–1914.

Year.	Quantity.	Value.
	Pounds.	
1910	98,026,369	$320,926
1911	97,745,833	335,285
1912	124,819,713	418,525
1913	140,578,092	515,194
1914	164,589,012	586,055

SALT INDUSTRY, BY STATES.

CALIFORNIA.

California ranked sixth among the States in quantity and fifth in value of the salt produced in 1914. Twenty-four operators reported a production, amounting to 1,100,443 barrels (of 280 pounds), or 154,062 short tons, valued at $856,861. The production of the State in 1913 was 1,082,993 barrels, or 151,619 tons, valued at $759,485. Thus the production in 1914 exceeded that of the preceding year by 17,450 barrels, or 2,443 tons, in quantity and by $97,376 in value. The total value of California salt in 1914 represents an average of nearly 78 cents a barrel, or $5.56 a ton, compared with 70 cents a barrel, or $5.01 a ton, in 1913. These figures are very much higher than the averages for the United States, which are, respectively, 29.511 cents a barrel and $2.11 a ton.

There is little of special interest to be recorded of the California salt industry in 1914. The absence of unfavorable comment in the returns of the producers may be considered a reasonably safe criterion that the year was a prosperous one in the industry. An occasional producer reported a light crop of salt, but this was not general.

The salt industry in California is different from that in the other parts of the country. The great bulk of the salt produced in this State comes from sea water and is produced by solar evaporation along the shores of San Francisco Bay, in Alameda and San Mateo counties; near Long Beach, in Los Angeles County; and on San Diego Bay, San Diego County. The salt crop, so called, is harvested chiefly in the fall, and its size depends to a large extent on the weather.

The basic salt output in California is therefore chiefly solar salt, and its sale, either in the harvested form or after it has been crushed (half ground) or washed and ground for table and dairy use and is known as granulated, constitutes about 80 per cent of the trade. Three firms on the coast recrystallize their product. The cost of crude solar salt in the stack is fairly well established at $2.50 a ton. The price received f. o. b. shipping point will vary with the varying demands of the industries supplied. The highest grades of salt, such as table and dairy, have practically a uniform market at all times and are not subject to the fluctuation of the crude solar article. The other grades marketed for curing hides, hay, fish, and for making ice cream, have varying prices, according to the work necessary to get them into shape for the market.

About 75 per cent of the salt made on San Francisco Bay is made on the east shore, and the salt companies there forward their product to San Francisco on their own barges or lighters and make all their prices and costs f. o. b. San Francisco. Salt from the plants on the west shore of the bay is shipped to San Francisco by rail.

The headquarters of the salt industry are at Alvarado, Newark, Mount Eden, Russell, and Arffs, in Alameda County, on the east shore of San Francisco Bay, and at Redwood City and San Mateo, in San Mateo County, on the west shore of the bay. In the southern part of the State solar salt is made near Long Beach, in Los Angeles County, and on San Diego Bay, San Diego County.

In addition to the output by solar evaporation, salt is also produced in small quantity at inland points, as follows: Tramway (Keeler post office), Inyo County; Ward, San Bernardino County; Saltdale, Kern County; and near Cedarville, Modoc County.

IDAHO.

Salt was made by 3 operators in Idaho in 1914, the work having been carried on in the vicinity of Stump Creek and Tygee Valley, Bannock County, in the southeastern part of the State. The address of the operators is at Auburn, Wyo. The salt industry in this part of Idaho is of slight importance, a considerable part of the production being cattle salt. The requirements of this section of the country are supplied in large part by the salt made at Saltair, Utah, near Salt Lake City, on the shores of Great Salt Lake.

KANSAS.

Ten companies operated salt plants and salt mines in Kansas in 1914. Four companies mined rock salt, 3 mines being located at Kanopolis, Ellsworth County, and 1 at Lyons, Rice County. A new company, the Independent Salt Co., began operations at Kanopolis and worked about half of the year. The Lyons Salt Co., which has been in operation at Lyons about four years, sold its plant and property to the American Salt & Coal Co., of Kansas City, Mo.

Evaporated salt, that is, salt made in open pans, grainers, or vacuum pans, was produced by 6 operators, located at Hutchinson, Reno County, which may be considered the main headquarters of this branch of the industry, at Anthony, Harper County, and at Sterling, Rice County. The Ellsworth Salt Co., which for many years operated at Ellsworth, Ellsworth County, reported no sales of salt in 1914.

Kansas ranked fourth among the States in both quantity and value of the output of salt in 1914. The quantity produced was 2,967,864 barrels (415,501 tons), valued at $924,550, an increase of 269,785 barrels (37,770 tons) in quantity and of $64,146 in value, compared with 1913.

LOUISIANA.

Louisiana ranked fifth among the States in quantity and sixth in value of the salt produced in 1914. The figures of production and value can not be given, however, as only two companies operated.

The most important salt deposits of the State are located on the Five Islands, so called, located near the southern coast. From two of the islands—Weeks Island (Grand Côte) and Averys Island (Petite Anse)—a large quantity of rock salt is produced.

MICHIGAN.

Michigan ranked first among the States in both quantity and value of the salt produced in 1914. The output of the State was 11,670,976 barrels (1,633,937 tons), valued at $3,299,005. Compared with the production of 1913, this was a gain in quantity of 142,176 barrels (19,905 tons) and in value of $5,973.

The salt produced in Michigan is obtained from two distinct sources: (1) From rock salt and (2) from natural brines.

The rock-salt deposits now worked are in the southeastern and the western parts of the Lower Peninsula and are exploited in two ways: (1) Rock salt itself is actually mined from the deposits, and (2) water is allowed to come into contact with the salt and the brine thus formed, which may be considered artificial, is forced to the surface and there evaporated.

The salt industry of Michigan dependent on the natural brines is confined to the Saginaw Valley. The brine is entirely distinct, not only in its geographic but also in its geologic relations from the salt in the southeastern and the western parts of the Lower Peninsula. With the salt production in the Saginaw Valley are connected the bromine and the calcium chloride industries. The manufacture of salt in Saginaw Valley is not so important as it is in the other parts of the Lower Peninsula.

Rock salt is mined at Oakwood, near Detroit, Wayne County. In the southeastern part of the State evaporated salt is made at Marine City, Port Huron, and St. Clair, in St. Clair County; at Oakwood, in the suburbs of Detroit; and at Delray, Ecorse, and Wyandotte, in Wayne County. In the western part of the State evaporated salt is made at East Lake, Filer City, and Manistee, in Manistee County, and at Ludington, in Mason County. The R. G. Peter Salt & Lumber Co., which has operated for many years at Eastlake, near Manistee, reported no sales of salt during 1914. In the Saginaw Valley salt is made at Bay City, Bay County; Mount Pleasant, Isabella County; and at Carrolton, Saginaw, Saginawtown, and St. Charles, in Saginaw County. The Strubel Manufacturing Co. is reported to have begun to manufacture salt by the grainer process at Saginaw in 1914. Calcium chloride was also made at Mount Pleasant and Saginawtown, and bromine at Midland and Mount Pleasant, though no bromine is made for sale direct. The bromine manufactured in Michigan is placed on the market in the form of bromides and other salts containing bromine.

NEVADA.

The production of salt in Nevada in 1914 amounted approximately to 4,436 barrels (621 tons), valued at $2,448. This small production was reported from Sand Springs, near Fallon, Churchill County, from the Desert Crystal Salt Co., White Plains, Churchill County, and from the Buffalo Salt Works, near Sheepshead post office, Washoe County. The salt properties in Washoe County are known as Salt

Marsh and are located in T. 31 N., R. 20 E. Mount Diablo meridian. No production was reported by the Eagle Salt Works, at Leete, Churchill County, nor from the International Salt Co., at Parran, Churchill County.

NEW MEXICO.

A small production of salt was reported from Crater Salt Lake, Socorro County, western New Mexico, in 1914.

NEW YORK.

New York ranked second among the States in 1914 in both quantity and value of the salt produced. The output of the State was 10,389,314 barrels (1,454,504 tons), valued at $2,824,733. Compared with the production of 1913, which was 10,780,514 barrels (1,509,272 tons), valued at $2,865,187, this was a decrease amounting to 391,200 barrels (54,768 tons) in quantity and $40,454 in value. The output of the State falls into the several usual classes: Rock salt was mined at Halite (Cuylerville post office) and at Retsof, Livingston County. Solar salt was produced in the vicinity of Syracuse, Onondaga County, and brine utilized in the manufacture of soda products came from Tully, Onondaga County. Evaporated salt, or salt made by artificial evaporation in open pans, grainers, or vacuum pans, from brines obtained by allowing water to come into contact with the rock salt in place, is the most important class made in the State. Salt thus produced was made at Le Roy, Genesee County; Piffard, Livingston County; Watkins and Reading, Schuyler County; Ithaca and Myers, Tompkins County; and at Rock Glen, Silver Springs, and Saltvale, Wyoming County.

OHIO.

Ohio ranked third among the States in 1914 in both quantity and value of the salt produced. The State's production was 5,482,836 barrels (767,597 tons), valued at $1,320,554. Compared with the production in 1913, which was 5,310,135 barrels (743,419 tons), valued at $1,318,156, this was an increase in quantity of 172,701 barrels (24,178 tons) and in value of $2,398.

Ohio salt came from two districts, the one located in the northeastern part of the State and the other in the southeastern. In northeastern Ohio the salt produced came from Cleveland, Cuyahoga County; Wadsworth, Medina County; Akron, Summit County, and Rittman, Wayne County. Brine is pumped at Fairport Harbor, Lake County, and at Barberton, Summit County, and is used directly in the manufacture of soda. The brine utilized in making salt and soda is obtained by allowing water to come into contact with beds of salt. In the southeastern part of the State, Pomeroy, Meigs County, is the center of the industry, and in addition to the salt, bromine and calcium chloride are also produced from the natural brines there occurring.

OKLAHOMA.

The small production of salt in Oklahoma in 1914 came from Harmon County. The salt plains of Harmon County are 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 line of the county. The plains are known locally as the Chaney or Salton salt plain and the Kiser salt plain. They 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. The springs farther west, and now known as the Salton salt beds, were worked in 1911, 1912, 1913, and 1914. The old Kiser salt beds were worked in 1914 by W. H. Stockman. Salt for stock is produced at both plains.

PENNSYLVANIA.

The John A. Beck Salt Co., which for many years made salt in Pittsburgh, discontinued the manufacture of salt there in April, 1914, because of the weakening of the brine to the point at which the business could not profitably be continued.

TEXAS.

The production of salt in Texas in 1914 was 334,979 barrels (46,897 tons), valued at $251,493. The output in 1913 was 355,529 barrels (49,774 tons), valued at $278,008, a falling off in production in 1914 of 20,550 barrels (2,877 tons) and in value of $26,515, compared with 1913. The production came as usual from Grand Saline, Van Zandt County, and Palestine (Salt City), Anderson County. Part of the evaporated salt now made in Texas is made by the vacuum pan process.

UTAH.

The production of salt in Utah in 1914 was 375,457 barrels (52,564 short tons), valued at $231,512. Compared with the production of 1913, which was 330,443 barrels (46,262 short tons), valued at $191,686, this was an increase in quantity of 45,014 barrels (6,302 tons) and in value of $39,826. The salt produced in Utah came from the shores of Great Salt Lake at Garfield and Saltair. Rock salt was produced in the Sevier Valley near Redmond, in Sevier and Sanpete counties. Though the salt is obtained in the form of rock salt and is sold in part as such, some of it is dissolved, recrystallized, and retailed in the refined form as table and dairy, packers' salt, etc. It is reported that a salt plant is being erected at Saldura, Tooele County.

VIRGINIA.

Deposits of salt and gypsum occur in Washington and Smyth counties, Va., in a belt of country 20 miles long, running northeast from the village of Plasterco. The Saltville branch of the Norfolk & Western Railway, which joins the main line at Glade Spring, renders the region accessible. The rocks in which the deposits occur are of Mississippian age.

Two gypsum and one salt or alkali works are in operation in the region. Since 1895, when the Mathieson Alkali Works came into control of the property, the brine has been converted into soda products. Over 50 wells have been drilled near Saltville and Plasterco, about 25 of which are now in operation. They range in depth from a few hundred to 2,280 feet, the average depth being about 1,000 feet. The shallower wells are dry and have to be flushed with water through the outer casing. The deeper wells are wet and brine flows into them as fast as it is pumped out.

WEST VIRGINIA.

The production of salt in West Virginia in 1914 was 145,429 barrels (20,360 tons), valued at $78,036. The corresponding figures for 1913 were 113,921 barrels (15,949 tons), valued at $63,803. Thus in 1914 there was an increase in quantity of 31,508 barrels (4,411 tons) and in value of $14,233. The salt was reported from Malden, Kanawha County, and from Hartford, Mason County. A new salt company, the Ohio River Salt Co., finished rebuilding the old Hope or Dixie plant at Mason, opposite Pomeroy, Meigs County, Ohio, and began operations at the beginning of 1915.

PORTO RICO.

Both the quantity and the value of the salt produced in Porto Rico in 1914 were greater than in 1913. The salt came from near San Juan and Cabo Rojo. The salt is made by solar evaporation, and the reports indicate that, owing to unfavorable weather conditions, the production was less than it would have been otherwise. Exports to the United States from Porto Rico are reported to have practically stopped since salt has been admitted to the United States duty free. Competing imports from Curaçao constitute another factor which has tended to retard the salt production of Porto Rico, because, it is said, both wages and living expenses are less in Curaçao than in Porto Rico.

BROMINE.

PRODUCTION.

The following table gives the production of the bromine produced in the United States since 1880:

Marketed production and value of bromine, 1880–1914.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1880	404,690	....	1899	433,004	$108,251
1883	301,000	....	1900	521,444	140,790
1884	281,100	$67,464	1901	552,043	154,572
1885	310,000	89,900	1902	513,893	128,472
1886	428,334	141,350	1903	598,500	167,580
1887	199,087	61,717	1904	897,100	269,130
1888	307,386	95,290	1905	1,192,758	178,914
1889	418,891	125,667	1906	1,283,250	165,204
1890	387,847	104,719	1907	1,379,496	195,281
1891	343,000	54,880	1908	760,023	73,783
1892	379,480	64,502	1909	569,725	57,600
1893	348,399	104,520	1910	245,437	31,684
1894	379,444	102,450	1911	651,541	110,902
1895	517,421	134,343	1912	647,200	145,805
1896	546,580	144,501	1913	572,400	115,436
1897	487,149	129,094	1914	576,991	203,094
1898	486,979	126,614			

CALCIUM CHLORIDE.

PRODUCTION.

In connection with the salt and bromine industry in Michigan, Ohio, and West Virginia, a considerable quantity of the calcuim chloride contained in the natural brines is recovered. Statistics for calcium chloride that is contained in these natural brines have been collected since 1909. It will be understood that the figures given below do not include the calcium chloride obtained in connection with the manufacture of soda, since such calcium chloride is not an original constituent of the brine. The following table shows the quantity and value of the output of calcium chloride from 1909 to 1914, inclusive:

Quantity and value of calcium chloride marketed in the United States, 1909–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1909	12,853	$63,198	1912	18,550	$117,272
1910	10,971	74,713	1913	19,611	130,030
1911	14,606	91,215	1914	19,403	121,766

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GEMS AND PRECIOUS STONES.

By Douglas B. Sterrett.

INTRODUCTION.

There was a large decline in the industry of mining precious and semiprecious stones in the United States in 1914. This is in accord with the usual conditions in the gem trade during times of stress. The greatest decrease was in the production of sapphire in Montana, due to the fact that one of the larger placer mines of variegated sapphire was not operated during the year and that the deposits of blue sapphire in matrix, now owned entirely by an English company, were closed in August. The greatly increased demand for native gem minerals that was expected to arise from dealers preparing for the tourist trade at the Panama-Pacific International Exposition at San Francisco and the Panama-California Exposition at San Diego did not materialize. Only small quantities of these gems were mined in the West, and the demand in the East fell off greatly. Among other minerals in which a large decline of production was reported to the Survey was opal, the claims in the northern part of Humboldt County, Nev., not being so actively worked as in 1913. A comparison of the figures in the table of production for 1913 and 1914 shows decreases in 1914 in most of the gem minerals, slight increases in a few, and a decided increase in turquoise.

Acknowledgment is gladly made of assistance rendered by many persons in the preparation of this report by furnishing statistics and information on gem occurrences and by supplying specimens for examination. It is not possible to name individually all who have assisted in this way, but some are mentioned in the following pages.

This report does not deal with the gem-mining industry of the United States during 1914 alone, but follows a plan adopted several years ago by which as many different gem localities as possible are examined and described each year, regardless of whether or not they are worked that year. The aim of this plan is the collection of information for a more complete report on the occurrence of precious stones in the United States at some future date.

AGATE.

ALABAMA.

Mr. J. H. Watkins, geologist for the Southern Railway, presented to the Survey specimens of chalcedonic chert from a small mountain southeast of Gurley, Ala. The material is in lumps measuring as much as 2½ inches across and shows a variety of colors, chiefly in red and yellow mixed through gray. The color is evenly distributed in some parts and grades from one to the other in other parts. The material has a dense texture very closely resembling the novaculites of Arkansas. Some of it would pass as chalcedony and some has so much impurity in the nature of iron oxide as to resemble jasper. None of it has been cut for ornamental purposes, but the colors would prove attractive.

ARKANSAS.

Mr. F. Holstein, of De Roche, Ark., mentions the occurrence of a bed of brecciated agate-like rock found along the southern border of the Novaculite Mountains, in the northern part of Hot Springs County, Ark., which has many of the qualities desirable in an ornamental stone. When polished the stone shows a brecciated structure with various colors exhibited by the different pebbles and fragments. These fragments are inclosed in a cement of chalcedonic material. It is possible that this bed is a phase of the novaculite, which, as is well known, grades into material indistinguishable from ordinary chalcedony. Some of the novaculites of Arkansas have an exceedingly dense grain, a waxy luster resembling chalcedony, and various bright colors. Prominent among these colors are different shades of pink, red, brown, and yellow scattered in various patterns through gray and white matrix. The color and texture of such novaculites render them quite suitable for ornamental purposes.

COLORADO.

Specimens of agate received from Mr. J. D. Endicott, of Canon City, Colo., were found by him at a new locality in Pueblo County, the exact location of which is not given.

These agates are very delicately banded, showing bright and dull red and brown layers interbanded with gray and white chalcedony. Some of the specimens show a fortification structure and others a concretionary or spherical structure. In some of the translucent gray bands there are small rounded red spots as in the St. Stephen stone variety of agate. The texture is very close-grained and the stones would take a fine polish. The coloring is sufficiently rich without artificial intensifying to make a good grade of agate jewelry.

MONTANA.

Mr. Paul E. Hanson, of Billings, Mont., forwarded to the Survey various specimens of agate, chalcedony, and associated minerals that have been gathered from the gravel deposits lying along Yellowstone River and covering much of the adjacent country. In this report for 1913, specimens of moss agate from the same region, also loaned by Mr. Hanson, were described, and the present notes cover certain associated varieties of agate. Among these is a slice from a cobble 3¾ inches long and 2 inches thick which shows a streak of wavy banded agate surrounded by dark-green mottled prase. This streak of wavy agate also contains a large proportion of green intermixed, resulting from the presence of minute particles or scales probably of an iron silicate mineral, such as chlorite. Another specimen consists of banded bluish-gray, brownish, and white agate crusted over with quartz crystals, the tips of which show a pale amethystine color.

Another specimen is a cream-yellow piece of chert which shows black dendritic markings similar to those occurring in moss agate, and still another is a slice of translucent chalcedony with inclusions of tufts or globules of white chalcedony, which, in turn, inclose small spots of green prase.

WYOMING.

The following notes on the occurrence of moss agate in Fremont County, Wyo., along the Sweetwater Valley, have been supplied by C. J. Hares, of the United States Geological Survey. The agate deposits are scattered over several townships, including Tps. 30 and 31 N., Rs. 89, 90, and 91 W., mostly north of Sweetwater River, and among the isolated granitic masses of the Granite Mountains. The locality is about 35 miles west of the Pathfinder Dam and 60 miles west of Casper. Occasionally a few agates are found farther down Sweetwater River, but the best agate beds are limited to from 1 mile to 3 miles north of the McIntosh ranch, located on Sage Hen Creek, in sec. 15, T. 30 N., R. 90 W., and north of the granite in that vicinity.

The agates occur as pebbles scattered over the surface of the ground on terracelike slopes or in valleys. As they are gathered up from the surface a fresh supply is uncovered among the grass, sagebrush, cacti, and soil by hard showers or by the almost daily heavy winds. They apparently represent residual wind-swept gravel from the disintegration of the flat-lying White River formation, of Oligocene age.

The White River formation in this area is composed of a great variety of rocks—very coarse granitic conglomerate, agglomerate containing fragments of Tertiary eruptive rocks, grits, arkosic sandstone, shale, fine volcanic tuffs containing rhyolitic bombs, opalized quartz, opal containing mossy markings in limestone, much unindurated volcanic ash, and clay. In the vicinity of the agate beds the formation lies unconformably on and fills in around the old irregular bald masses of pre-Cambrian granite. The formation is flat lying and, as far as ascertained, has not been materially deformed since its deposition.[1]

The present altitude of the agate beds is about 6,400 feet above sea level, which is approximately 1,000 feet below the highest White River beds in near-by localities—along the northern edge of the Sweetwater escarpment and about 200 feet above Sweetwater River. The crest of the Sweetwater escarpment, composed of the White River formation, about 25 miles to the west of the agate beds, is composed of limestones which, in places, contain opal with mosslike markings. These opalized limestone beds possibly represent the last stages in the deposition of the White River formation. It is probable that the agates are derived from the disintegration of the White River beds and now remain on the surface, from which the finer and softer material has been blown and washed away.

The agate pebbles range in size up to 2 inches or more in diameter, and are usually well rounded and some are partly polished. Many of the agates have the dreikanter shape and the wind-blown facets characteristic of wind action. Some are elongated and others are flattened or lens shaped. The good specimens are uncommon, being

[1] For a fuller description of the geology of this region, see Hares, C. J., The anticlines in central Wyoming. [In preparation.]

associated with a great many worthless pebbles, such as black and red jasper, quartzite, white milky quartz or chalcedony, and waxy gray chalcedony. A quantity of the waxy chalcedony is found in place and loose on the surface between the McIntosh ranch and Lankin Pass.

The agates range from opaque white and gray to highly translucent gray with black, dark brown, reddish to yellowish-brown dendritic markings. Those with the black and dark-brown markings are most common. The dendrites consist of tufts or patches of oxides of manganese and iron. They show great variations in size and in delicacy of pattern. Some are small rounded tufts too dense to show individual lines, and others are as much as 2 or 3 millimeters across, exhibiting very delicate, mosslike or seaweed-like markings. The black dendrites furnish the prettiest gems. Groupings of the dendrites in such manner as to show complex landscapes, as in the Montana moss agate, apparently do not occur, and the gems depend on the perfection of the individual dendrites for their beauty.

The agate beds have not been exploited commercially to the present time. Most of the specimens have been collected by occasional visitors who have not placed the stones in the regular gem market.

AMETHYST.

PENNSYLVANIA.

The occurrence of amethyst at many localities in Chester and Delaware counties, in southeastern Pennsylvania, have been mentioned by Kunz [1] and Dana.[2] The localities given include, in Chester County, several places in east Bradford, Pocopson, Birmingham, and Newlin townships; and in Delaware County, Aston, Birmingham, Chester, upper Chichester, Concord, Edgemont, Marple, Middletown, upper Providence, and lower Providence townships. Most of these discoveries were made before 1890, and since that time only occasional amethysts have been found. The majority of the amethysts have not been of fine quality, but a few specimens of fine crystals capable of yielding beautiful gems have been obtained.

At present very few persons in the region take an interest in these minerals or know of the localities, and since much of the land has grown up in brush or been turned into meadow, there are few opportunities for the further discovery of amethyst. An examination was made of one of the old localities near Village Green, in Aston township, now owned by G. L. Mills. Some pits in a field on this place where good amethyst was obtained, are now filled up. A careful search on the ground near the pits yielded only a few colorless quartz crystals. No rock crops out around these amethyst pits, but the area is mapped as Wissahickon gneiss by F. Bascom.[3]

Mr. John H. Smedley, of Media, who was formerly much interested in the minerals of this region, knows the location of many of the amethyst deposits. He states that few finds of value are now made and that under the present conditions much prospecting and digging will be necessary to uncover gem material at many of the places.

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[1] Kunz, G. F., Gems and precious stones, pp. 112–115, Scientific Publishing Co., New York, 1890.
[2] Dana, J. D., System of mineralogy, 6th ed., pp. 1067–1068, 1909.
[3] U. S. Geol. Survey Geol. Atlas, Philadelphia folio (No. 162), 1909.

VIRGINIA.

A specimen of amethyst from a locality 1 mile west of Minnieville, Prince William County, Va., has recently been acquired by the United States National Museum. This amethyst was found in 1902 in a cultivated field, and was recently brought to the attention of Farnham E. Briggs, of Minnieville. Mr. Briggs has prospected around the locality, but only found a few colorless quartz crystals and failed to find other amethyst. The specimen weighs over 3 pounds, measures 6 inches across the prism zone, and is 5 inches high. The crystal has been split so that a thickness of 3 inches only remains. The whole specimen is not amethyst; the interior consists of colorless to partly fractured quartz crystal nearly 4 inches in diameter, incrusted with groups of amethyst crystals from half an inch to $1\frac{1}{4}$ inches thick. On one side these groups of crystals have grown into one larger amethyst crystal with a face 3 inches across around the prism zone, but terminated by several pyramidal points. The faces of the amethyst crystals are somewhat dimmed by etching or wear, and part of the crystals are rather badly flawed. Most of the amethyst crystals have a beautiful bright purple color, grading from dark to pale. As usual the color is darkest near the points of the separate crystals. This amethyst is of interest chiefly as a specimen and would yield only small flawless gems. The richness of the color and the size of the crystals, however, are sufficient to justify further efforts to locate the deposit from which the specimen has been obtained.

Amethyst has been found in the region of Trevilians, Louisa County, Va. One of the prospects, on the land of A. J. Rudinger, 4 miles southwest of Trevilians, was visited. Crystals are also reported on the places of Capt. William Overton and J. J. Boxley in the same general region. On the Rudinger land amethyst crystals have been found at two places loose in the soil of cultivated fields about a quarter of a mile north of the house. At one of these places the crystals were found in an area about 40 feet in diameter. The soil at this place is reddish and sandy, resulting from the decomposition of a granitic rock inclosing diorite. An outcrop of quartz has covered the surface with massive quartz débris for a distance of nearly 100 feet in a S. 60° W. direction beginning a few yards southwest of where the amethysts were found. Soapstone borders the granite and diorite on the southeast. About two quarts of crystals have been picked up at this locality, ten or a dozen of which have good color. The others range from paler purple to almost colorless quartz. The crystals are mostly small, not many measuring over an inch thick. The best ones have a fine dark purple color, which is not evenly distributed or clear through the whole crystal.

During July, 1915, Mr. Rudinger dug a trench 12 feet long and 5 feet deep at this prospect. The amethyst vein was located and about half a bushel of crystals are reported to have been taken out. Seven of these crystals were sent to the Survey for examination. They were of about the same size as those found on the surface, but were of better color and quality. Most of them were not perfectly clear or flawless, but would cut into beautiful beads. One or two of the crystals would yield small flawless gems of rich purple color.

The other prospect is about 150 yards N. 15° W. of this place and is less promising. About two dozen crystals have been picked up in an area about 50 feet in diameter. The soil is dark greenish, resulting from disintegrated coarse and medium-grained diorite, and contains many blocks of this rock. Some of these amethysts have fairly good purple color.

BERYL.

ALABAMA.

Golden beryl crystals have been reported from the region of Hissop, Coosa County, Ala., by George F. Kunz.[1] This beryl is described as being light golden yellow and clear enough to cut into small gems.

Two localities were examined, one on the Eliza Goggans place, three-fourths of a mile southwest of Hissop, and the other on John H. Thomas's place, 1 mile northeast of Hissop. The prospects consist of small pits opened by F. M. Dorsey a number of years ago. On the Goggans place the beryl was found in a large outcrop of massive quartz, forming part of a pegmatite ledge. Associated with the quartz is mica in rough fishbone-shaped crystals 3 or 4 inches across, and decomposed feldspar. Most of the beryls were found in the quartz. Two crystals of about 1 inch in diameter were observed at the time of examination. These have a pale yellowish-green to pale aquamarine color. They were so fractured that they would not yield gems over one-third of a carat in weight. Similar outcrops of quartz were observed on the S. Wade place adjoining the Goggans place on the north, and beryl crystals were reported to have been found here also. On the Thomas place the prospect was opened for mica, but a few beryl crystals are reported to have been found. Only yellowish-gray opaque crystals were seen. The country rock around Hissop consists chiefly of biotite granite gneiss, with occasional inclusions of mica schist. Outcrops of massive quartz, similar to those found at the beryl localities, were observed at many places along the road, and Mr. Thomas states that occasional beryl crystals have been found in some of them.

CALIFORNIA.

Mr. Joseph Ward, with headquarters at Barstow and Lone Pine, Cal., who has prospected large areas of the desert between those places for gem and other minerals, has submitted a number of rough beryl crystals to the Survey. These consist of rough, hexagonal crystals ranging from small size to over half an inch in diameter. They are pale to quite dark blue, some of the darkest nearly resembling sapphire in color. All of the specimens found at the time of discovery are opaque, but Mr. Ward expects to prospect the locality more closely for gem varieties. The beryl crystals are associated with such minerals as are found in pegmatite or lining the walls of miarolitic cavities. The associated rock is fine-grained biotite granite, and one specimen contains a vein of the beryl crystals with intermixed quartz and feldspar about half an inch thick. Another

[1] Precious stones: U. S. Geol. Survey Mineral Resources U. S., 1887, p. 59, 1888.

specimen is an inch and a half thick, showing two surfaces which have evidently come from the walls of a vein. The color and association of the beryls are similar to those on Mount Antero, Colo., but so far the California locality has not yielded crystals of gem quality.

CONNECTICUT.

The beryl locality near Merryall, Litchfield County, Conn., has been mentioned by George F. Kunz in these reports for the years 1885, 1892, 1898, and 1899. The beryls were obtained as an important by-product from a quarry worked for feldspar and mica. The deposit has been idle since about 1900, and the workings are now in an overgrown condition. Formerly the mine was owned by two parties, S. L. Wilson and George Roebling, but the whole property is now held by Mr. Roebling, of Northville, Conn. An examination of the deposit was made in October, 1914, at which time the following notes were taken:

The deposit is located 5½ miles N. 12° W. of New Milford, or 3 miles east of Kent, a station on the New York, New Haven & Hartford Railroad. The workings consist of an open cut about 120 yards long driven southwest into a hillside. The cut varies from 10 to 50 feet deep in the deepest part and is 30 to 40 feet wide in the northeast half. The northwest wall overhangs the workings, and the southeast wall dips northwest at varying angles. A little tunnel work has been carried on along the hanging wall. The open cut was originally 65 feet deep toward the northeast end, but this part has been partly filled up by the caving of wall rock. The country rock is biotite gneiss, highly schistose near the vein and has been mapped as Becket gneiss by Rice and Gregory.[1] Immediately around the mine the gneiss has a due northeast strike with a vertical to high northwest dip. The vein rock is pegmatite, which varies from 20 to 40 feet thick. It strikes about parallel with the country rock, but cuts across the schistosity of the latter with a lower dip to the northwest. The pegmatite pinches and swells in different parts and is reported to have been thinner near the bottom of the cut than at the surface. The texture of the pegmatite is extremely coarse grained. Gray quartz occurs in large massive streaks several feet in thickness, lying roughly parallel with the walls of the pegmatite, orthoclase feldspar in crystals and masses several feet across, and mica in bunches and pockets in various parts of the vein. The best mica and feldspar is reported to have come from the northeast half of the open cut and the best beryl from the southwest half. Near the southwest end of the cut there are outcrops of quartz streaks 2 to 3 feet thick and masses of solid mica of even greater thickness, and one 50 feet long. This solid mica is composed of rough "A" and "wedge-shaped" crystals, 1 to 4 inches across, bunched closely together, with a little impurity such as quartz and feldspar mixed with it. One block of solid mica blasted loose from this vein measured 4 feet thick and 8 feet long. Such mica would only be valuable as scrap for grinding, but it is probable there are at least 50 tons in sight. The mica from the northeast end of the cut was suitable for glazing, yielding clear sheets several inches across. Large quantities of

[1] Rice, W. N., and Gregory, H. E., Manual of the geology of Connecticut: Connecticut State Geol. and Nat. Hist. Survey Bull. 6, 1906.

feldspar were shipped for pottery purposes and paid most of the expenses of mining. Among associated minerals are a few dark red opaque garnet crystals, a little biotite mica, and black tourmaline.

Beryl crystals have been found abundantly in some parts of the quarry. These crystals range from small size up to more than a foot in diameter, and one block was seen on the dump which weighed about 50 pounds. The majority of this beryl is opaque or only partly translucent, and is variously colored bluish green, yellowish green, and yellow. In some of the large crystals there are translucent and clear portions from which gems can be cut. In other specimens the gems are obtained from small crystals which are nearly transparent throughout. At one place several fractured crystals are exposed in a streak of granular gray quartz along the southwest wall. These crystals are translucent with a few transparent parts, and are golden yellow to yellowish green in color.

The gem beryls are quite clear and brilliant, with a wide range in colors, from pale to dark golden yellow and almost topaz brown, pale to dark blue and bluish green, and some are yellowish green. Kunz mentions several that were white or colorless.

The production of beryl from this mine has been large, and in four years $17,000 worth of gems are reported to have been sold. Mr. Roebling still has a few specimens showing the quality of the gem material obtained from the mine. This deposit of pegmatite or another in the same lead has been traced for several hundred yards across the hill to the southwest of the mine, and at a few small openings made there showed large pure crystals of orthoclase feldspar. Whether gem beryls would be found by opening this portion of the deposit can not be determined without further excavation.

A number of beryl crystals have been found in the feldspar quarry of Joseph Halberg, 2½ miles S. 25° E., of Middle Haddam. This quarry consists of a cut about 35 feet square and 18 feet deep on the inner side, made in a pegmatite outcrop forming a small steep hill. Besides feldspar the pegmatite contains much quartz, a quantity of biotite mica, some muscovite, large black tourmaline crystals, many beryls, opaque red garnet crystals up to 3 inches in diameter, and columbite in fractured crystals up to several pounds in weight. The beryl occurs in crystals ranging from small ones up to those an inch in diameter and several inches long. In places they are arranged in radial groups in masses of quartz. Most of the crystals are opaque pale yellowish and greenish, but a few contain transparent portions that might yield small gems.

GEORGIA.

Specimens of cut beryl gems found on the farm of T. J. Allen, about 2 miles east of Vaughn, Spaulding County, Ga., were kindly loaned by Mr. John L. Davidson, formerly of Griffin, Ga., now of Chester, S. C. The rough stones from which these gems were cut were found loose in the surface soil several years ago. On the same hill with the beryls black tourmaline, rose quartz, smoky quartz, a few garnets, and mica were found. Mr. Davidson and Mr. Allen sank a shaft nearly 60 feet deep on what appeared to be the beryl vein, but no crystals were found. On the same hill are other deposits of pegmatite and it is possible the beryls were set free by the weathering of some of these. Among the specimens submitted by Mr. Davidson were two blue beryl gems of fine, light sky-blue color, weighing from 1½ to 2 carats each. These gems contained a few flaws but have the color characteristic of fine gems. A third gem was pale blue with a slight greenish cast, weighed over 1 carat, and was almost flawless; and a fourth was of about the same weight, of yellowish-green color, and slightly flawed. There was one pale translucent rose quartz gem cut in elongated "en cabochon" shape. This gem shows an asterism which would probably be more pronounced in a hemispherical stone cut en cabochon. The fine color of the blue beryl gems and the fact that portions of them are perfectly clear make this locality of interest as a possible source of valuable gem material.

MAINE.

During operations for feldspar in the Mount Apatite region, near Auburn, Me., in 1914, a few finds were made of minerals of value as gems or of interest as specimens. Among these was a beryl crystal 12 inches in diameter and 22 inches long, with a light pink color. Much of this crystal was opaque or only translucent, but in some parts it was clear enough to cut into gems. This beryl was found in a quarry of the Maine Feldspar Co., and a specimen of the cut gem was kindly given to the Survey by Mr. N. G. Smith, of the Maine Feldspar Co., and Mr. M. L. Keith, lapidary, of Auburn, Me. The cut gem weighs 1.2 carats, is perfectly clear and flawless, shows a very light pink color, and has great brilliance. In some lights the pink is not especially noticeable and the beryl resembles the caesium beryl found at many localities in Maine. Larger gems showing deeper color were also cut from the crystal.

MASSACHUSETTS.

In the region of variegated tourmalines around Goshen and Chesterfield, Hampshire County, Mass., many beryls are found. A few occurrences are mentioned in this report under tourmaline. Some of these occurrences have been known for a century, and certain beryls from the Goshen region have been called goshenite. Dana [1] calls the white or colorless variety goshenite, but Kunz [2] describes it as blue beryl. Both varieties occur, and specimens suitable for gems have been obtained. A locality 1½ miles N. 80° W. of Goshen, about 300 yards north of the north end of Lily Pond, was visited. This place is overgrown with heavy brush and showed but little evidence of having been worked. As it was found without the services of a guide, the writer does not know whether it is the usual locality mentioned as near the Lily Pond.

At the locality examined a ledge of mixed granite and pegmatite 30 feet thick standing several feet above the surface outcrops up a hill slope in a due west direction for a distance of about 100 yards. The country rock is fine garnet schist cut by medium-grained gray granite. The pegmatite incloses irregular streaks or veins of white quartz which pinch and swell along their course. A prominent one of these quartz veins is inclosed in the pegmatite at the east end of the outcrop.

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[1] Dana, E. S., System of mineralogy, 6th ed., p. 407, 1909.
[2] Kunz, G. F., Gems and precious stones of North America, p. 95, 1890.

Quartz also occurs in smaller masses scattered through the pegmatites. Some of this quartz is highly translucent to almost clear, and some is smoky. Mica occurs in yellowish-green crystals 2 to 3 inches across. Beryl is abundant in crystals ranging from less than an inch to 15 inches in diameter. They occur mostly along the quartz veins, some of the larger ones displacing the quartz. The beryls exposed at the surface are mostly opaque, but some contain translucent portions. They range from nearly white to yellowish, to bluish green and to greenish blue in color.

NEW HAMPSHIRE.

Beryl crystals, some suitable for gems, have been found at several places in the town of Roxbury, a few miles east of Keene, N. H. A number of these have been cut by Leon Allen, a lapidary of Keene, with very good results. Among localities where the crystals occur are Bassett Hill, 5 miles north of east of Keene; Horse Hill, 4½ miles east of Keene; and the Keene granite quarry, on a hill 3 miles south of east of Keene. Still other localities have been found but were not visited. At all of the prospects the beryls have been found in pegmatite.

The surface of Bassett Hill is rolling and stands 200 to 300 feet above the surrounding country or over 1,600 feet above sea level. It is covered with overgrown fields and small pine thickets on the summit and east side and with woods on the west side. The country rock is granite gneiss over most of the hill. Beryl crystals have been found in two ledges of pegmatite on the east side of the hill and in one on the west side. On the east side the outcrop of the lower ledge is exposed for a distance of over 100 yards in a north and south direction. At three places beryl crystals have been found in small openings blasted or cut into the pegmatite outcrop. The vein is about 10 feet thick. It contains smoky and translucent gray quartz, gray orthoclase crystals, plates of greenish muscovite, and beryl crystals. One beryl crystal found at the time of visit was opaque and gray on the outside and pale yellow with clear portions between fractures in the interior. The upper pegmatite ledge on the east side of the hill outcrops with a strike of N. 10° E. and a dip of about 20° W. It is several feet thick, with a zone of coarse-grained rock 2 feet thick next to the hanging wall. There are a few small pockets 1 to 3 inches in diameter at the base of this rock. Among minerals observed in the pegmatite are gray orthoclase crystals, quartz in small masses and graphically intergrown with feldspar and mica, black tourmaline crystals, some arranged in rosettes, and colorless but more or less fractured beryl crystals up to 2 inches in diameter.

Pale-colored beryl crystals have been found in the pegmatite outcrop on the west side of the hill. The pegmatite at this prospect is coarse-grained, containing orthoclase crystals up to 10 inches thick, segregations of quartz over a foot thick, and crude mica crystals 2 to 3 inches across.

Most of the gems that have been cut from beryl crystals from Bassett Hill are colorless or only slightly colored, but quite brilliant, rivaling the cæsium beryl of Maine in luster.

Horse Hill is mostly stripped pasture land with a generous proportion of rock outcrops. Three prospects have been found at the south end of the hill, one in flat ground to the west and at the foot of the hill slope, another 100 yards northeast on the hill slope, and the third about 200 yards east also on the hillside. Horse Hill is composed of granite gneiss inclosing beds of mica gneiss, both of which are cut by pegmatite. The lower prospect to the west consists of an exposure of pegmatite 75 feet across, outcropping somewhat like a floor. Only the southeast wall is exposed, and this strikes N. 35° E. with a northwest dip. The pegmatite contains irregular quartz segregations, orthoclase crystals 1 foot across, greenish muscovite, and beryl crystals. The beryls range up to 2 inches in diameter and are mostly opaque. Some of the beryl is transparent and rather pale aquamarine green.

At the prospect 100 yards to the northeast a pegmatite vein 18 inches to 3 feet thick crops out in a direction S. 60° E. around the end of the hill for a distance of nearly 100 yards. The vein cuts the bedding of the granite and inclosed gneiss which strike N. 30° E., with a high west dip. Beryl crystals are plentiful in the northwest end of the outcrop.

At the east prospect a pegmatite ledge 2 to 6 feet thick with a low northwest dip outcrops in a northeast direction around the hillside. Many loose blocks of pegmatite and quartz have rolled down the hill slope below. Good beryl crystals have been found at this locality, some being of clear aquamarine color. One rough crystal was found which would cut into a gem weighing possibly 10 carats.

At the Keene granite quarry rock has been quarried over an area about 150 yards long in a northeast direction and about 100 yards wide. The granite is a fine to medium grained gray muscovite-biotite variety. On the southeast side of the quarry a vein of pegmatite cuts the granite with a strike of N. 55° E. and a vertical dip. The pegmatite forks into streaks, which pinch out or enlarge irregularly. The pegmatite contains gray to smoky quartz segregations, crystals of microcline or anorthoclase 2 or 3 inches thick, muscovite crystals 1 to 2 inches across, black tourmaline thickly intergrown with quartz, a little biotite, and beryl crystals. The beryls range from dark to pale golden to greenish yellow to yellowish green in color. Most of them are small, but a large proportion contains parts clear enough to cut. The cut gems are very brilliant, and some of the greenish-yellow stones are unusually pretty.

A deposit was operated for mica and gem beryl several years ago by Franklin Playter, of Boston, in the town of Springfield, Sullivan County, N. H. It is on one of the higher summits of Springfield Mountain (called Melvin Hill on Hitchcock's Atlas of New Hampshire), 3 miles S. 40° W. of Grafton, at an elevation of 2,100 feet above sea level. The workings consist of four open cuts along a small ridge. Three of the openings fall in a line of about N. 55° E., within a distance of 150 feet on the northwest side of the ridge, and the fourth is about 100 feet southeast on the opposite side of the small ridge. Two of the open cuts are 25 feet across and are connected by a passage 6 feet wide. The different openings vary from 8 to 25 feet deep.

The country rock is muscovite-biotite gneiss, which has a general northeast strike and high southeast to vertical dip. The pegmatite cuts the gneiss irregularly with its greatest length corresponding approximately to the schistosity of the gneiss. By pinching and swelling the deposit cuts the schistosity of the inclosing rock in one place and is conformable with it in another. In the two connected open cuts the pegmatite is over 20 feet wide, but pinches down to 6 feet at the surface in the passage between the two cuts and widens to 10 feet at a depth of about 10 feet below the surface. Where the pegmatite pinches down in this passage it cuts across the bedding of the gneiss in part, and in part the gneiss bends around the bulging shape.

The texture of the "vein" rock is variable, but chiefly rather coarse. The quartz occurs in large segregations of coarse smoky to gray grains. In places it occurs in translucent to nearly clear masses several inches across. Two varieties of feldspar were observed, gray orthoclase or microcline crystals 2 feet thick and smaller masses of albite 3 to 4 inches across. Black tourmaline crystals are plentiful, some with good crystal form. Biotite is present in quantity, and some of it is intergrown with the muscovite. The muscovite is of good quality, splitting well and having a fine clear rum color. Crystals were seen around the workings which would yield perfect plates $2\frac{1}{2}$ by 3 inches and 2 by 4 inches. Beryl occurs rather plentifully, the greater part being opaque, but some is clear with fairly good colors. It is not possible to judge what quantity and quality of beryl were obtained when the mine was in operation, but the following material was found on the dumps and in the pegmatite: Well-formed opaque to translucent pale yellowish-green and bluish-green crystals as much as 2 inches thick, a few crystals with transparent portions showing the same colors that would cut into small gems. The character of this material would indicate that much larger clear beryl may be expected.

Another prospect for gem beryl and mica was opened by the Columbian Gem Mining Co., on one of the summits of the northern part of Springfield Mountain, about half a mile northeast of the Franklin Playter mine, $2\frac{1}{2}$ miles S. 40° W. of Grafton. Over 200 feet of open-cut and trench work with a shaft and considerable stripping of vein outcrop have been made on the summit of the mountain at an elevation of 1,750 feet above sea level. The open cuts range from 10 to 25 feet wide and 5 to 15 feet deep. The shaft is filled with water. No work has been done for a few years, but at the time of examination (October, 1914), four buildings, in good repair, a quantity of material suitable for punch and scrap mica, and a few rough beryl crystals had been left at the mine.

The country rock is quartz-mica gneiss in which the mica consists of both biotite and muscovite. The gneiss is strongly banded and has been much folded and crumpled so that definite strikes and dip could not be measured. It has been cut by pegmatite and associated granite in several directions, some of the pegmatites showing steep to nearly vertical walls and others apparently lying nearly flat or with low dips. The relations seem to be those of the nearly vertical dikes acting as feed channels for the flatter beds. The granite associated with the pegmatite is chiefly fine-grained biotite granite and merges into the pegmatite. The texture of the pegmatite is variable, ranging from a granite-like rock to masses in which there are orthoclase crystals a foot thick, quartz segregations 3 feet across, and mica crystals 8 to 10 inches in diameter. The arrangement and position of the different minerals in the pegmatite is very irregular.

The quartz of the pegmatite is white, gray, or smoky, mostly opaque, but some is translucent and nearly clear. The muscovite is clear rum-colored and part has a good cleavage. Biotite is plentiful; some of it is intergrown with the muscovite. Black tourmaline is present in some places in crystals up to 2½ inches thick. Opaque dull-red garnet crystals half an inch to 2 inches in diameter are scattered through the pegmatite, and a few small pink garnets were observed in one specimen on the dump. Only a few beryl crystals were seen in the rock. These were yellowish green to pale aquamarine-green and mostly opaque. Little could be learned of the quality of the gem material found during mining.

New prospects for mica and beryl were opened during 1914 by Charles Murphy, of Wilmot, on the old Underhill place, about 1¾ miles N. 75° E. of Springfield in Sullivan County. Only one of these was of interest for its possible gem minerals. This consisted of an open cut 20 feet square and 12 feet deep in a large pegmatite outcrop. Much of the rock exposed in the working is graphic granite of both coarse and fine grain. In places there are small segregations of quartz and orthoclase crystals measuring from a few inches to 1 foot thick. About 4 tons of small mica crystals suitable for cutting into small sheets and for punching were taken from this opening. A great many beryl crystals were found. These range from one-sixteenth of an inch to 1½ inches in diameter. They are well-formed simple hexagonal prisims occurring separately in parallel growths, and in radialg roups. Most of them are opaque or only translucent and have pale-greenish aquamarine color. Up to the time of examination no beryl of gem quality had been found. Among associated minerals are biotite, black tourmaline, opaque red garnet up to 2 inches in diameter, triphyllite in masses up to 8 inches thick, löllingite or arsenopyrite, and apatite.

PENNSYLVANIA.

Beryl crystals occur at many localities in Chester and Delaware counties, Pa., and occasionally one of sufficiently good color and quality for cutting into gems is found. Many of the crystals are obtained from the pegmatite deposits worked for feldspar, but a few have been found in small veins or deposits or pegmatite inclosed in other rocks. One of the best-known localities of this type is in the C. F. Leiper quarry at Avondale, Delaware County. This quarry has been opened by a cut nearly a quarter of a mile long in a north and south direction, 100 to 250 feet wide and 40 to 80 feet deep. The rock quarried is a muscovite-biotite granite gneiss, strongly schistose in some phases. A few streaks or veins of quartz and pegmatite are inclosed approximately conformably with the gneiss, that is, striking north and south with nearly vertical dip. The pegmatite veins examined vary from 1 inch to 2 feet in thickness, pinching and swelling along the strike. They contain flesh-colored potash feldspar, opaque brownish-red garnet up to 2½ inches in diameter, black tourmaline, masses of gray quartz, and muscovite up to 1½ inches in diameter. Fragments of golden beryl crystals were observed at two places in one of these pegmatite veins, but the better part of the crystals had been broken away by mineral collectors. One of these crystals measured about an inch in diameter but was somewhat flawed. Little attention is paid to such minerals by the quarrymen, and most of the best specimens are found by collectors. Most of the beryls obtained are kept as cabinet specimens, but occasional gems are cut from some of the crystals.

CHRYSOPRASE.

CALIFORNIA.

Two specimens of chrysoprase were received from Messrs. L. H. and H. H. Rhodes, Oakland, Cal., which had been found about 15 miles northwest of Coalinga, in Fresno County. This material was obtained from a prospect being developed for cinnabar, and if mining for that mineral is continued, further prospecting for the chrysoprase will be carried on. The specimens consist of fragments from a vein about half an inch thick. They have a dark-green color, but not so bright as that exhibited by the best chrysoprase.

DIAMONDS.

ARKANSAS.

In the Arkansas diamond field prospecting was continued by the Kimberlite Diamond Mining & Washing Co. whenever funds were available. Very little work was done by the Arkansas Diamond Co., and a few stones reported found by that company were picked up from the surface or from concentrates obtained during previous washing. No work was done by the Ozark Diamond Mining Corporation, and in December, 1914, the mill and property of this company were sold by a receiver to the Kimberlite Co. The property of the American Diamond Mining Co. was idle during the year and also sold by a receiver. The work of the Kimberlite Co. consisted in some mining at its workings on the original peridotite area in which diamonds were found and in washing of blue earth in the mill. Outside reports state that a number of diamonds were found, but the policy of the company at present is to withhold information on this subject. Accordingly, in the table of production giving the output of diamonds the output of this company is not included, but will be given in whatever year the company sees fit to furnish this information.

CALIFORNIA.

Information regarding the diamonds found in Butte County, Cal., during 1914 has been furnished by Messrs. M. J. Cooney and William Fliedner, of Oroville, Cal. Ten to a dozen diamonds were found by different parties operating sluice boxes in the old placer ground at Cherokee Flats. Five of these stones are reported to be white or colorless and flawless, ranging from half a carat to $1\frac{1}{4}$ carats. The weights of the three larger stones are given as 1.29, 1.25, and 1.11 metric carats, respectively. Some of the diamonds found during 1914 along with others found in previous years have been placed on exhibition at the Panama-Pacific International Exposition by the Sacramento Valley Association.

FELDSPAR GEMS.

AMAZON STONE.

CALIFORNIA.

Mr. Joseph Ward, with headquarters at both Barstow and Lone Pine, Cal., sent to the Survey a number of specimens of amazon stone which he had collected in the deserts of California somewhere between those two places. The material consists of many fragments and crystals which range from small sizes to an inch in thickness. A few of the specimens show especially good shades of bluish green and greenish blue, with fairly smooth, fine texture. The associated rock sent with the amazon stone consists of pegmatitic granite such as is found around the walls of miarolitic cavities in granite. If crystals of larger size and of the same good color can be obtained in quantity, the locality should prove of value.

MAINE.

Specimens of amazon stone were received from Mr. F. H. C. Reynolds, of Boston, Mass., which had been found during 1914 along the coast of Maine. The exact locality from which these were obtained has not yet been made public by Mr. Reynolds. The discovery was made late in the fall, so that little prospecting was possible and only about a pound of crystals was obtained. The material sent to the Survey contains a specimen of biotite granite grading into pegmatitic material, such as is commonly found lining the walls of a miarolitic cavity in granite. The feldspar grades from white or gray where it is attached to the granite into bright bluish-green and greenish-blue amazon stone. The specimens submitted are rather small, but would cut into cabochon gems of pleasing color, and if larger masses of equally good quality are obtained, the deposit will be of interest to the New England semiprecious stone trade.

NEW YORK.

Prof. Freeman F. Burr, of Barnard College, New York City, submitted to the United States Geological Survey several crystals of amazon stone which he had collected in a quarry 2 miles northeast of White Plains, N. Y., along with information regarding the locality. The quarry is worked for materials for use in the construction of Kensico dam for the New York City water supply. Prof. Burr states that about 100 pounds of specimens have been carried away from the quarry and that probably a large quantity of equally good material has been sent through the crushers, along with other rock, for use on the dam. The crystals are described as varying from less than an inch in thickness to one which measured 7 by 7 by 5 inches. This crystal has been placed in the collection of Columbia University. Some of the crystals are fairly well developed; others have but few faces. The quarry is in the Yonkers gneiss, of pre-Cambrian age. This gneiss is a foliated granitic rock which contains pegmatite injections. The amazon stone crystals have evidently come from miarolitic pockets in this gneiss with pegmatite lining their walls. The crystals are microcline, grading from flesh-colored bases or interior through pale bluish-green to bright bluish-green exteriors. Some of them are associated with smoky quartz in rude crystals and rough tabular albite crystals. Plates of biotite occur with these minerals. Much of the amazon stone is striped with gray to white perthitic markings, but a few specimens do not show more of these markings than is ordinarily present in amazon stone used for gems. The best specimen submitted to the Survey showed a bright translucent bluish-green color. This specimen could not be cut into a pure gem, but would contain some perthitic markings. A few of the amazon stones have been cut as gems, but none have been regularly placed on the market.

SUNSTONE.

ARIZONA.

Specimens of andesine feldspar, some of which showed the characters of sunstone, were received from Dr. H. P. Wightman, of Globe, Ariz. Dr. Wightman states that these were collected by the Apache Indians from their reservation not far from Globe. The specimens resemble the sunstone from Modoc County, Cal., cut by the Pacific Gem Co., of Los Angeles, mentioned in this report for 1913. Microscopic examination shows it to be andesine with a refractive index of 1.550. All of the andesine is clear, one piece showing a pale-yellowish color and the other bright copper-colored reflections from inclusions along certain lines of crystallization parallel to one of the cleavages.

GARNET.

ALASKA.

A deposit of garnet about 7½ miles north of Wrangell, Alaska, from which many fine specimens have been obtained during the last 15 years, is being developed by the Alaska Garnet Mining & Manufacturing Co., of Minneapolis, Minn. The bulk of the garnet taken from this deposit is used for a special foundry powder, but many of the fine crystals, with their associated mica schist matrix, are sold for cabinet specimens, and gems are reported to be cut from occasional fine specimens. A good exhibit of the garnets is being made at the Panama-Pacific International Exposition. The crystals range from small size up to more than an inch in diameter. They show face developments of the rhombic dodecahedron and trapezohedron faces. The small faces are fairly sharp, and where they meet at the dodecahedron points show a dark-red color tinged with violet, characteristic of almandine garnet.

JADE.

ALASKA.

Some of the jade from the Shungnak region north of Kobuk, Alaska, was cut by lapidaries of San Francisco during 1914 in preparation for the expected increase of trade in souvenir gems among visitors to the Exposition. This jade is the dull dark-green variety of nephrite.

JASPER.

CALIFORNIA.

Mr. M. J. Cooney, of Oroville, Cal., states that various types of jasper pebbles and bowlders were found in the old gold placer workings near Oroville when these were prospected for diamonds about four years ago. Among these jaspers was one bowlder of the bloodstone variety.

OREGON.

Mr. Don Maguire mentions a new discovery of a jasper-like mineral found along Crooked River, in Crook County, Oreg., in September, 1914. Only a small quantity was collected, but test specimens cut for gems proved to be unusually pretty for jasper. Mr. Maguire will place the stone on the gem market under the name of "iolanthite."

PERIDOT.

CALIFORNIA.

Mr. Joseph Ward, of Barstow and Lone Pine, Cal., submitted to the Survey specimens of peridot which he has found while prospecting between those places. This peridot resembles very much that found near Rice, Ariz., but among the specimens sent in none was clear or large enough for cutting into gems. The material is in granular masses with grains as coarse as wheat. Mr. Ward reports that the stones were obtained from inclusions in basalt, and a specimen showing this relation was submitted. Further prospecting will be required to learn whether larger peridot suitable for cutting is associated with the deposit.

QUARTZ.

ASTERIATED QUARTZ.

Notes on asteriated quartz have been given by Frank B. Wade.[1] The immediate cause of this investigation is the appearance of the new star stone or asteriated quartz placed on the market by Bell & Birkner, of New York City. No statement has been given of the locality from which this gem is obtained other than that it is an American stone. This quartz has a highly translucent or opalescent appearance, and when cut in hemispherical form in the proper direction with relation to the crystal structure it shows a six-ray star by reflection of sunlight or light derived from a single source. If the same stone is cut into a sphere, the star is seen in the stone by looking toward the source of light. In the better gems these rays are particularly bright and noticeable and move across the surface of the cut stone as the observer's relation to the light is shifted. Microscopic examination was undertaken by Prof. Wade with a view to determining the cause of the rays. The quartz was found to be full of minute needlelike inclusions arranged in three sets, needles of each set lying parallel to each other and at angles of 60 degrees to the other two sets. It was not definitely possible to determine

[1] Jewelers' Circular-Weekly, Jan. 20, 1915.

whether these inclusions are solid needles or very fine tubular cavities, but investigation indicated that they are probably elongated cavities with a diameter of about 0.003 millimeters. It is doubtless the reflection of the light from these different sets of rays which makes the six-ray star visible in the cabochon cut gems. The cause of the inclusions being arranged at angles of 60 degrees may be looked for in the hexagonal structure of quartz.

The gems are cut in round cabochon shapes of standard sizes for the trade and mounted in various articles of gold jewelry. They are sold under the trade name starolite (not to be confused with staurolite), as well as by the mineral name asteriated quartz. Messrs. Bell & Birkner have had on exhibition a rough specimen of the asteriated quartz weighing 10 pounds.

ROSE QUARTZ.

CALIFORNIA.

Mr. M. J. Cooney, of Oroville, Cal., reports the discovery of rose quartz by him near Forbestown, in the eastern part of Butte County, Cal. The rose quartz occurs along the Mammoth gold lode. No information is given regarding the quality.

RHODONITE.

MONTANA.

During 1914 a quantity of rhodonite was collected for ornamental use from the dumps of the old Alice silver mine at Butte, Mont. Rhodonite occurs as a gangue mineral at a number of the mines around Butte, and W. H. Weed[1] states that, next to quartz, it is the most common gangue mineral of the silver veins and is found in some of the fault veins of the copper area. The rhodonite occurs with rhodocrosite and ore minerals in parallel banded veins below the oxidized zone. In places veins composed largely of rhodonite and quartz are 1 to 2 feet thick. Rhodonite is found in other mines along the Rainbow lode and in the Allie Brown and Wappello vein in the Lexington mine. During mining for metal ores a quantity of rhodonite, along with other gangue minerals, has been thrown on the dumps at the different mines, and the supply of this material for ornamental purposes is now obtained by working over these old dumps.

The rhodonite forms fine compact even-grained masses of pale to deep pink color. The best quality is bright rose-pink. Some of the massive mineral is stained by seams of black oxides of manganese, which, by their strong contrast with the pink, add to the beauty of the cut gems. The Butte rhodonite is similar in character to that found at several places in California, notably near Happy Camp, Siskiyou County, and in the Indian Valley, Plumas County. During the last few years a quantity of rhodonite from these different localities has been cut and sold in the west largely to the tourist trade, by which it has been very much appreciated.

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[1] Geology and ore deposits of the Butte district, Mont.: U. S. Geol. Survey Prof. Paper 74, p. 84, 1912.

RUBY.

NORTH CAROLINA.

Prospecting at the ruby deposits on Caler Fork of Cowee Creek, in Macon County, N. C., during part of 1914 did not result in a definite determination as to whether or not the property can be profitably worked. Earlier work for rubies a number of years ago in the gravel beds in the bottom land along the creek resulted in the discovery of much red and pink translucent corundum and of some clear stones of value as gems. The best stones had a fine ruby color with silkiness and slight cloudiness in some specimens. Prospecting of the gravel beds carried the work back to a point where the valley narrows below a flat. Here ruby corundum was found in matrix and the hillside was called In Situ Hill. At several different times prospecting has been carried on in this hillside in search of the remaining part of the deposit from which the best rubies of the placer ground have been obtained.

Prospecting work at the In Situ Hill locality was begun in 1913 by the Consolidated Ruby Co., of New York, and was continued in 1914. The new work consisted of a shaft 38 feet deep from the bottom of the open cut at the foot of the hill. From this shaft drifts were run 58 feet west and 80 feet south of east. Several holes were sunk by a churn drill, using chilled-steel shot for cutting edges. One of these holes was 103 feet deep, cutting through all the saprolite or decomposed rock into fresh, unaltered gneiss. The fresh rock from the drill core consists both of garnetiferous diorite and garnetiferous biotite gneiss. The garnetiferous diorite would probably yield yellowish-brown saprolite just like that found in the upper workings of In Situ Hill. No pockets containing ruby corundum were found in the drill holes. In the shaft and the underground workings a vein or seam was followed, in which several small and one large pocket or deposit carrying ruby corundum were found. The largest deposit was a shoot or chimney measuring 6½ feet high by 3½ feet wide, and was nearly 4 feet thick. The material taken from this deposit, when washed, yielded about 20 pounds of translucent pink corundum. These crystals range from small size up to a centimeter in diameter and thickness. None of them has fine red color, and most of them are pink to purplish red. Nearly all of the crystals contained small rust cavities up to 2 millimeters in diameter, formed by the decomposition of minute rhodolite garnets similar to those described by Pratt and Lewis.[1] The corundum crystals are inclosed in whitish kaolin-like deposits, apparently resulting from the decomposition of feldspar or pegmatitic material which originally inclosed the corundum. None of these rubies is of as deep a color or is as clear as those found in the stream gravels below In Situ Hill, but the richness of the pockets adds to the interest of prospecting for stones of better quality.

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[1] Pratt, J. H., and Lewis, J. V., Corundum and the peridotites of western North Carolina: North Carolina Geol. Survey, vol. 1, p. 183, 1905.

SAPPHIRE

IOWA.

The discovery of a sapphire on the shore of Lake Okoboji, Dickinson County, Iowa, is described by G. A. Muilenburg.[1] This sapphire was found in the gravel along the lake shore by Mr. Muilenburg in 1912. It is described as resembling a piece of blue bottle glass worn round and smooth by attrition. Examination showed it to be a sapphire of good quality, and the stone was later cut into a gem weighing 1⅝ carats. It is stated to be the cornflower blue variety, with a good, velvety luster. This gem was probably transported to the Lake Okoboji region by ice during the glacial period along with a large variety of other minerals and rocks. Its original home can only be guessed at, and Mr. Muilenburg suggests possibly either the Yogo region of Fergus County, Mont., or some unknown area to the north in Canada.

MONTANA.

Mining for sapphires was carried on at several localities in Montana, the principal operations being in Fergus County, where the so-called Yogo blue gems are mined. The only mine in operation there was that of the New Mine Sapphire Syndicate, of London, and this company closed down at the beginning of August after the opening of the war in Europe. The mine of the Yogo American Sapphire Co. was purchased by the New Mine Sapphire Syndicate, and for several months preceding this deal the Yogo American mine had been closed.

Operations for the variegated sapphires in Granite and Deerlodge counties consisted of placer work by several smaller producers. The principal yield from these localities is in sapphire suitable for mechanical purposes, such as meter bearings and watch jewels. Large deposits of these sapphires occur along Dry Cottonwood Creek, in Deerlodge County; along the West Fork of Rock Creek, in Granite County; and along Missouri River, to the north and northeast of Helena. These deposits could be made to meet the demands of the American trade arising from the present decreased imports of foreign materials. The small cull sapphires from the Yogo mine are used in the higher grade of watch jewels, and already a shortage of this quality has arisen.

SPODUMENE.

CALIFORNIA.

Mining at the Pala Chief gem mine, near Pala, Cal., resulted in a production of about 20 pounds of fine gem spodumene crystals, along with a quantity of gem tourmaline. The spodumene occurs in magnificent crystals of pink to lilac and violet colors, with beautiful transparency through the whole crystal. Some crystals are colorless in part or throughout. The larger crystals measure several inches in length, 3 or 4 inches in width, and half an inch to 1 inch in thickness. Among the larger crystals that have been found in this mine is one over 11 inches in length and another weighing 47½ ounces.

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[1] Iowa Acad. Sci. Proc., vol. 21, p. 203, 1914.

MAINE.

Mr. N. G. Smith, of the Maine Feldspar Co., submitted a specimen of purplish lilac-colored spodumene found during 1914 in the quarry of that company on Mount Apatite, near Auburn, Me. This spodumene is translucent to opaque. The color is as good as that found in much of the California iris or kunzite; the mineral only lacks transparency to make it a valuable gem. Evidently the specimen was broken from a crystal of some size, and Mr. Smith reports the finding of many pounds of the spodumene. It is probable that some of this material cut en cabochon could be used as an ornamental stone.

TOPAZ.

CALIFORNIA.

Mr. J. W. Ware, of San Diego, Cal., has furnished the following information concerning a large topaz crystal found at his mine in San Diego County. The crystal weighs $3\frac{1}{4}$ pounds, and shows a number of crystal faces, but without a high polish. It has a decided green color. This topaz was found along with other greenish and white topaz crystals in a part of the pegmatite ledge forming the Mountain Lily gem mine on Smith or Aguanga Mountain. Tourmaline is found in pockets in the same ledge, but not in the same pockets as the topaz. A part of this topaz crystal is transparent and will yield good gem material.

WYOMING.

Mr. Paul E. Hanson, of Billings, Mont., kindly gave to the Survey five specimens of topaz, which were obtained from the headwaters of Bighorn River in northern Wyoming. These specimens are all crystals showing a development of a number of faces including prisms, pyramids, domes, pinacoids, and base. They are mostly small, the largest measuring 13 millimeters long, 10 millimeters wide, and 5 millimeters thick. All of the crystals are transparent and colorless, resembling in quality the colorless topaz from the Thomas Range in Utah. The specimens would not have much value as gems, except for the local souvenir trade, but would be of interest as specimens because of their quality and sharp crystal form.

TOURMALINE.

CALIFORNIA.

There was but little increased activity in the tourmaline field of southern California during 1914, to meet the expected demands for this gem at the Panama-Pacific International Exposition and the Panama-California Exposition. The principal output came from the Tourmaline Queen and the Pala Chief mines, near Pala, San Diego County. The Pala Chief mine is worked for both gem spodumene and tourmaline. The tourmaline crystals from these mines show great variations in color and size and have yielded many beautiful gems. Another mine worked for tourmaline was the Mountain Lily mine of J. W. Ware, on Smith or Aguanga Mountain, San Diego County. This mine produced a small quantity of very fine grade of green, bluish-green, and greenish-blue transparent crystals. Mr. Ware has called some of the more beautiful green and bluish-green gems from his mine emeralite, in allusion to their resemblance to emerald. Among other mines the Esmeralda, 1½ miles north of Mesa Grande, was worked a short time and yielded a few gem tourmaline and good pink beryl crystals. This mine has never been a large producer, but good gems and specimens of aquamarine and pink beryl, along with varicolored tourmalines, have been taken from it.

CONNECTICUT.

Tourmaline of value both as gems and specimens has been found at several places in Middlesex County, Conn. Many of the specimens have been obtained from quarries operated for feldspar for pottery, but in a few quarries the mining has been for tourmaline and associated specimen minerals only. A few of the quarries were visited in October, 1914, and are described below.

The M. P. Gillette feldspar quarry, known as the Haddam Neck quarry, is 1 mile N. 22° E. of Haddam, near the east bank of Connecticut River. It is one of the oldest quarries in Connecticut and, besides many gem tourmalines, has yielded a number of fine specimens of other minerals. The deposit has not been worked for several years and the pits were partly filled with water and overgrown with vegetation at the time of examination. Notes taken at that time have been supplemented from E. S. Bastin's description.[1] The quarry consists of one large irregularly shaped open cut about 100 yards long in a north and south direction and 100 feet wide in the widest part, which joins a smaller open cut on the west about 75 feet long in a north and south direction and 35 feet wide. These quarries range from 20 to 30 feet deep and have crosscuts leading out to two large dumps on the river side. One cut extends west from the west quarry and the other west from the south end of the east quarry. According to Bastin, the west quarry was worked chiefly for tourmalines and specimen minerals. The east quarry was worked chiefly for feldspar, also yielding some mica, gem tourmalines, and specimen minerals.

The country rock is dark-gray muscovite-biotite schist or gneiss, which strikes about north with a vertical dip. The pegmatite is large and has been split into several streaks by large inclusions or horses of schist. In the north end of the quarries there are three beds of pegmatite with a total thickness of about 100 feet in a width of 150 feet. In the middle of the quarry on the south side the schist unconformably overlies a rounded boss of pegmatite. This boss pitches to the south and on the north side of the quarry outcrops as a bed nearly 50 feet thick conformably between schist walls. The pegmatite contains large masses of graphic granite, potash feldspar crystals 1 to 3 feet across, generally with a little intermixed albite, albite, muscovite, black and green tourmaline, and pockets or cavities lined with crystals. Some of the mica crystals measure over 1 foot across and are 6 inches thick, but do not split well because of the presence of "wedge" and "A" structures.

Bastin describes the gem pockets in the east cut as averaging—

> 8 or 10 inches in diameter, though there are many smaller ones only 2 to 3 inches across. They are distributed with great irregularity through the pegmatite mass.

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[1] Feldspar deposits of the United States: U. S. Geol. Survey Bull. 420, pp. 48-49, 1910.

Lepidolite in finely granular masses, pale-green albite, and small green tourmalines are abundant near many of the pockets. Muscovite surrounded by a border of lepidolite, or in parallel growth with lepidolite, is also of common occurrence near the pockets. As in most of the gem-bearing pegmatites the tourmalines are seldom in their original positions on the walls of the cavities, but lie embedded in a sandlike mass of quartz fragments, cookeite, and other decomposition products at the bottom of the pockets. They are mainly grass-green to olive-green in color, becoming nearly colorless toward the tip. The exact apex of some of the crystals is pink and many of them show very perfect terminations. Gem tourmalines are not so abundant that it would pay to work the mine for these alone.

Most of the gems found in the feldspar mining were marketed irregularly through local collectors.

The associated minerals and tourmaline from Haddam Neck have been described by H. L. Bowman,[1] as pinkish muscovite, lepidolite, greenish-white muscovite, tourmaline, apatite, microcline, albite, beryl, quartz, cookeite, fluorspar, microlite, and columbite. The tourmaline occurs in beautiful, transparent, striated, curved triangular prismatic crystals of various colors, the most common being light and dark green and pink. A few crystals are almost perfectly colorless. Color variations in the crystals are generally in transverse bands, either with sharp contacts or hazy gradations. In some crystals the color shades are delimited by planes corresponding to crystal terminations, yielding ghost or phantom crystals. Kunz states that crystals showing marked internal striations have been found which yield gems showing cat's-eye effects when cut cabochon across the prism. This property has also been found highly developed in some of the tourmalines from Mesa Grande, Cal.

The feldspar quarry of F. E. Strickland is about 2½ miles northeast of Portland, in the west side of Collins Hill. It is operated by Mr. Strickland under lease to the Eureka Mining & Operating Co., of Trenton, N. J., all of the spar, quartz, and mica going to the company and gems and other minerals being retained by Mr. Strickland. The quarry consists of two joining open cuts with north and south elongation, parallel, and connected at the north end. The east cut is about 300 feet long, 65 feet wide, and 10 to 40 feet deep. The west cut is about 200 feet long, 50 feet wide, and 25 feet deep. A crosscut leads out to the hillside at the north end of the west cut.

The country rock is muscovite-biotite schist containing much black tourmaline near the pegmatite. The schist has a general north strike and a dip of about 20° W. It has been warped, however, to correspond approximately with the contact of the pegmatite. The pegmatite is a large irregular semibedded deposit both parallel with and cutting the schist in different parts. In the east deposit the outcrop was an elongated dome pitching under the schist at each end. That this body of pegmatite joins the one forming the west deposit under the surface is shown where the two open cuts join at the north end.

The pegmatite is coarse-grained containing large bodies of graphic granite, potash feldspar crystals 2 or 3 feet across, irregular quartz segregations several feet thick, and bunches or streaks of mica crystals. Cavities or pockets with crystal-lined walls are found irregularly distributed in parts of the quarry, especially in the east working. These pockets range from small size up to one reported to be 4 feet long by

[1] Mineralog. Mag. and Jour. Mineralog. Soc. Great Britain, vol. 13, pp. 97–121, 1903. Reviewed by G. F. Kunz, U. S. Geol. Survey, Mineral Resources U. S., 1902, pp. 841–842, 1904.

$1\frac{1}{2}$ feet wide and $1\frac{1}{2}$ feet high. Some of them have yielded tourmaline gems of fine quality and specimen minerals of interest. The gem-bearing pockets were found near the middle and in the south half of the east quarry. Work has been abandoned in this part temporarily, but a good working face 20 feet high has been made across the north end of the cut preparatory to removing the spar to that depth southward to the length of the quarry. Mr. Strickland expects to find more gem pockets when this block of pegmatite is quarried.

The tourmalines so far found in the pockets are mostly greenish, showing many variations as olive-green, yellowish green, nearly grass-green, bluish green, and pale greenish blue. They range from small size to large crystals, one of which weighed several pounds. This crystal was badly broken in quarrying, but some beautiful bluish-green and greenish-blue gems were cut from the fragments. Another crystal of transparent green now in the museum of Wesleyan University at Middletown, Conn., is about 7 inches long. Cut gems are of fine quality, show good colors, and are brilliant in the paler varieties. There is little choice between these and the finer gems from Mount Mica and Mount Apatite, Oxford County, Maine. Mr. Berry states that a few pinkish tourmalines have been found along with the green, the pink generally capping a greenish crystal.

Among other minerals adjoining and lining the walls of the pockets are coarse flat albite or clevelandite crystals, granular lepidolite, rough quartz crystals, greenish muscovite crystals, and a little beryl. Much of the beryl is opaque and yellowish green, but in one pocket an irregularly shaped fragment of transparent pale salmon-pink beryl was found. It is $2\frac{1}{2}$ inches long and 1 inch thick, with an exceedingly rough honeycombed and drusy surface. It is evidently the remnant of a much larger crystal, the greater part of which has been dissolved, leaving only a part with a rough etched surface. Parts of this would cut into small gems. In some of the pockets there are mossy tufts or coatings of minute short hairlike tourmaline crystals of dull greenish-gray color. Some of these coatings cover a couple of square inches of the surface of albite crystals and make exceedingly delicate pretty specimens.

Among other minerals found in the quarry are yellowish-green muscovite mica, biotite mica, columbite, and a few garnets. The muscovite occurs in plates up to 12 inches across, but does not have good cleavage. Most of it is injured by "A" lines and tangle sheet structure so as to be suitable only as scrap for grinding.

The Riverside quarry is about $2\frac{1}{2}$ miles east of Middletown on the south side of Connecticut River. It consists of an open cut 30 to 40 feet across made in the steep northwest slope of the river bank above the public road. The country rock is mica schist which strikes north with a variable dip approximating about 20° W. The pegmatite is about 20 feet thick and apparently conformable with the inclosing schist. It contains potash feldspar crystals over 2 feet across, and some albite feldspar, small segregations of gray and smoky quartz, rum-colored mica in crystals up to $2\frac{1}{2}$ inches across, biotite, numerous beryl crystals, garnets, black and colored tourmalines, lepidolite, and, as reported by Bastin,[1] pink to deep salmon-colored fluorite. The

[1] Feldspar deposits of the United States: U. S. Geol. Survey Bull. 420, p. 50, 1910.

beryl crystals range from less than an inch to 6 inches in diameter. Crystals of less than 1½ inches diameter are most plentiful. They are yellowish to aquamarine colored, mostly opaque, with translucent and small transparent portions. Some of the crystals are penetrated by crystals of black tourmaline. Small pockets were observed with pinkish-violet colored lepidolite and variegated tourmaline. The tourmaline occurs in rough triangular-shaped crystals up to an inch in diameter. Some of them have rose-pink exteriors and dull greenish to black cores. Others are solid pink. No transparent tourmalines were observed, but the presence of cavities indicates a possibility of their being found.

MAINE.

At the Mount Mica tourmaline mine, near Paris, Me., work was carried on for nearly 4 months, but Mr. Loren Merrill, the operator, reports that only one small pocket was found, yielding a few green tourmaline crystals. Other products of the quarry are feldspar and a little mica. Work at this locality is becoming more difficult, since there is 25 to 30 feet of overburden to be removed before the gem-bearing portion of the ledge can be quarried, and unless underground mining is adopted it is doubtful whether the deposit can be worked much farther.

On Mount Apatite, near Auburn, Me., a number of achroite, or nearly colorless tourmaline crystals, were obtained from the quarry of P. P. Pulsifer during operations for feldspar.

MASSACHUSETTS.

Colored tourmaline crystals have been found at several localities in the region of Goshen and Chesterfield, Hampshire County, Mass. Some of these localities have been known for many years. An early description of two of the localities was given by George Gibbs [1] in which the minerals and their distinctive characters are discussed. The two localities are probably those called the Clark ledge and the Barrus property below. Shepard [2] speaks of this region as being rich in variegated tourmalines, among which deep indigo-blue crystals were abundant. Other colors, green and rose-red, are also mentioned, and spodumene is reported from the same region. Emerson [3] quotes Alvan Barrus as stating that tests were made by chemists with some of the spodumene with a view to using it as a source of lithia. A number of the spodumene deposits have been located on the geologic atlas of the region by Emerson [4] and colored tourmalines have been found at some of them. So far as known no clear tourmalines suitable for gems have been found in this region, but the deposits are of interest because of mineral associations and the possibility of gem material being found in the future.

A brief visit was made by the writer to the region in October, 1914, and three deposits were examined, one on the George L. Barrus place, 2½ miles northwest of Goshen, another on the summit of a hill 2 miles north of West Chesterfield, and the third, known as the Clark ledge,

[1] Gibbs on tourmaline, etc.: Am. Jour. Sci., 1st ser., vol. 1, pp. 346–351, 1818.
[2] Shepard, C. U., Treatise on mineralogy, 3d ed., p. 220, 1852.
[3] Emerson, B. K., Geology of Hampshire County, Mass.: U. S. Geol. Survey Mon. 19, pp. 760–761, 1898.
[4] Emerson, B. K., U. S. Geol. Survey Geol. Atlas, Holyoke folio (No. 50), 1898.

$1\frac{1}{2}$ miles north of West Chesterfield. All of these localities lie in an area mapped as Conway schist by Emerson. The Conway schist is described as dark graphitic mica schist, containing biotite, garnet, staurolite, and zoisite, and beds of impure limestone and quartzite. In each case pegmatite is the matrix for the tourmaline and other minerals found.

At the Barrus prospect a pegmatite ledge has been traced by outcrop and surface bowlders for a distance of over 200 yards. Starting from the south side of the spring the ledge outcrops in a N. 15° W. direction along the hillside, continuing through a small glacial valley at the north end. The thickness of the pegmatite is not plainly exposed but is probably as much as 8 feet in places. The wall rock is garnet-staurolite schist of the typical Conway schist, striking parallel with the pegmatite and dipping east. The pegmatite is only medium coarse to fine grained. No crystal-lined cavities or pockets were observed. The quartz of the pegmatite occurs in small masses thickly scattered through the rock. The feldspar is chiefly albite, some of the rough crystals measuring nearly 6 inches thick. In places the albite has a slightly tabular development, forming small crystals like clevelandite. The mica is mostly greenish muscovite, but a little pale pink lepidolite was observed associated with clevelandite. Gray to pale yellowish-green translucent spodumene is abundant in crystals ranging up to 2 inches long. One translucent aquamarine-colored beryl crystal was found in the pegmatite in close association with the spodumene. Indigo-blue to bluish-black tourmaline crystals are scattered through much of the pegmatite. These crystals range from minute size up to half an inch thick and several inches long. Most of them have dark-blue to black cores with lighter blue shells. A few crystals with bluish-green shells were observed. All of the tourmalines found are opaque to translucent and no transparent ones were seen. No pink or red crystals were observed, but Gibbs states that they occur, but are rare.

Most of the work done here consists of blasting and breaking of surface bowlders and outcrop. Much of the ledge is concealed by deep humus and leaf mold soil which makes careful prospecting difficult. Before thorough prospecting can be carried on, much of the surface would have to be stripped of the soil covering.

Clark's ledge is a large prominent outcrop of pegmatite, outcropping along an east sloping hillside in a N. 10° W. direction for about 150 yards. The lower side forms a small cliff 30 feet high in places. The pegmatite is inclosed nearly conformably with the garnet-staurolite schist wall rock cutting across the schist with offsets to the southeast at intervals. It is split by a horse of schist into two ledges 6 to 10 feet thick at the north end, and has a thickness of 15 feet toward the south end. Some of the feldspar of this ledge is in rough crystals. Quartz occurs in small irregular masses, some of which have a peculiar translucency. Beryl crystals are rather plentiful, some showing translucent aquamarine colors. Emerson marks this ledge as carrying spodumene, but none was observed in the brief examination made. Mica occurs in yellowish-green plates up to 3 inches in diameter. Opaque red garnets and a little biotite occur in the pegmatite. Only black and bluish-black tourmaline crystals were observed, but evidently the vein described by Gibbs was not found. Gibbs mentions a "false" vein, 6 inches to $1\frac{1}{2}$ feet thick, cutting obliquely across the ledge for a distance of about 20 feet.

This vein carried bluish-white transparent quartz, crude feldspar crystals, and green tourmaline crystals, some inclosing red to violet-colored cores. None of the crystals was transparent, but some were translucent.

At the locality 2 miles north of West Chesterfield, a little blasting and excavation work has been done in an outcrop of pegmatite on the nearly flat summit of the hill. The outcrop is about 100 feet long in a west of north direction and nearly 40 feet wide. Part of it stands a few feet above the ground. The country rock is fine dark-colored garnet schist belonging to the Conway schist. It strikes north with a dip of 70° E. The texture of the pegmatite varies from fine to medium coarse. Microcline feldspar occurs in crystals ranging up to 10 inches across. A little spodumene was found in the massive pegmatite. Small veins carrying yellowish-green mica, in crystals 1 to 2 inches in diameter, with quartz, feldspar, beryl, and black tourmaline cut across the pegmatite with a northwest strike. The beryls are rather plentiful and occur in crystals ranging from small size up to 2 inches thick. They are bluish-green in color but opaque or only translucent. A few of the mica crystals inclose opaque greenish-blue crystals of tourmaline of pencil size. Some of the quartz has a translucent milky color.

The pegmatite carries cavities or pockets, and one that has been opened on the east side of the outcrop is 2 feet across and 1 to 8 inches high. It has been stripped of any good specimens it may have contained, but fragments of the lining left in the pocket consisted of crude crystals of cleavelandite, opaque bluish-green and indigo-blue tourmaline, bunches of greenish mica, and spodumene. The presence of pockets in this ledge makes it a favorable looking place for further prospecting, since gem tourmalines are usually found in pockets and not frozen in the rock.

TURQUOISE.

NEVADA.

Two new turquoise deposits were developed in Nevada in 1914. One of these, owned by J. F. Campbell, of Colusa, Cal., is located in the Hot Springs mining district on the east side of Reese River valley, about 35 miles south of Battle Mountain, Lander County; and the other, owned by the Cortez Turquoise Co., of Pasadena, Cal., is near the old mining camp of Cortez, along the Lander-Eureka County line, about 35 miles south of Beowawe. Information regarding these deposits and the quality of the turquoise was kindly given by Mr. L. A. Dees, of Los Angeles, and the owners of the properties. Mr. Dees has cut and sold some of the turquoise from both mines. The Campbell mine was discovered in October, 1914, and worked only a short time during the winter. About 300 pounds of matrix, including some pure turquoise of good quality, was taken out during this time. The pure turquoise has been selling at $1 a carat in Los Angeles. It is described as having a good blue color, with but little green, and as being hard with smooth texture. Some of the matrix has also yielded attractive gems.

The mine of the Cortez Turquoise Co. was discovered by Johnny Francis, a Shoshone Indian, several years ago. The assessment work was done by the Indian for several years and in 1914 the claim was leased to a miner who is reported to have taken out 500 pounds of turquoise and matrix. Later the property was purchased by Messrs. E. C. Smith & McGaw, of Pasadena, under the name of the Cortez Turquoise Co. A quantity of development work has been done, which shows the presence of turquoise in an area 50 feet wide and several hundred feet long.

So far the best turquoise has been found within 15 feet of the surface, but the mineral has been found to persist much deeper. One nugget taken out by the Cortez Turquoise Co. is reported to have weighed about 5 pounds and to be composed of solid turquoise. Another nodule broken in blasting showed a face 5 inches long and 2½ inches wide. These large nuggets are not of the best grade, but are equal to the average output of the mine. One nugget weighing about half a pound is reported to be hard and of good azure-blue color. A large oval cabochon-shaped gem measuring 43 by 67 millimeters, described by S. B. Clem, of the Redondo Gem Co., of Redondo, Cal., as being cut from a nugget weighing 19 ounces, probably came from the Cortez Turquoise Co.'s mine. This gem is reported to be of good azure-blue color, without matrix or other defect. Some matrix gems are cut showing the turquoise and brownish iron-stained matrix, but part of the matrix is somewhat softer than the turquoise and does not polish so well.

NEW MEXICO.

Mr. L. M. Richard, of Silver City, N. Mex., reports the occurrence of turquoise in the White Signal mining district, Grant County, N. Mex. The prospect is about three-fourths of a mile southeast of the Paddyford mine. It is owned by V. F. Mueller and has been tested to a small extent. The turquoise occurs as thin seams or bands along the contact of fine-grained diorite inclusions in granite. The veinlets are hard, with good color, and, with the associated matrix, might prove of value for cutting into cameo gems.

VARISCITE.

UTAH.

The production of variscite in 1914 came chiefly from Utah. There was very little activity at the numerous deposits that have been prospected and worked in Nevada. In Utah the output came from the chlorutahlite mine of Don Maguire, in Clay Canyon, 1½ miles west of Fairfield, in Utah County, and from the amatrice mine of the Occidental Gem Co., 14 miles southwest of Tooele, in Tooele County. In the mining of the chlorutahlite a quantity of yellowish to greenish banded phosphatic mineral was obtained, which forms deposits similar to the variscite, and in some cases incloses the variscite. Recently a quantity of this material has been cut and sold under the name of "sabalite." It has a dull light greenish-yellow color and shows a banded texture very similar to agate. "Sabalite" has been favorably received as a western gem stone for the souvenir trade.

MISCELLANEOUS.

APATITE.

P. P. Pulsifer, of Auburn, Me., reports the finding during 1914 of the finest crystal of purple apatite that has been taken from his feldspar quarry. This quarry has yielded a large number of exceptionally fine purple and lilac-colored apatite crystals, chiefly suitable for mineral collections but occasionally cut for gems.

BEACH PEBBLES.

An unusual beach pebble found near Redondo, Cal., has been cut as an ornament by the Redondo Gem Co.[1] This stone is shown by photograph to be about 6 inches by 5 inches thick, consisting of a dark-colored matrix, thickly mottled by numerous white to gray flower-like patches. The matrix of the stone is described as brownish-black in color, with a large variety of flower patterns discernible in the white markings, "such as the iris, morning glory, daisy, and lily."

CATLINITE.

Dr. Burt Ogburn, of Prescott, Ariz., submitted a specimen of catlinite or pipestone found near Jerome Junction. This material has a dull dark-red color, with moderately smooth grain. On fractured surfaces the texture looks somewhat gritty, but when carved with a knife it cuts evenly, leaving a smooth surface quite similar to the catlinite of Minnesota. So far the material has only been used locally for ornamental purposes.

ICELAND SPAR.

The occurrence of Iceland spar in Sweet Grass County, Mont., was mentioned in this report for 1913. Prof. J. P. Rowe, of the University of Montana, at Missoula, has furnished further notes on this occurrence. The deposit is located about 9 miles from Gray Cliff and has been traced through the country for several miles. The Iceland spar occurs in a fissure vein from 3 to 8 feet thick, cutting gneiss rock with a northwest strike and almost vertical dip. All of the material mined during 1914 was sold, and large excess orders were received. This Iceland spar may be classed among the best grades of that material, and some of the rhombs obtained measured over 2 inches thick, with perfect transparency and without blemish. This grade is especially suitable for optical work and for specimens. The smaller spar of equally good quality is applied for various uses, and especially for standardizing in chemical work. The present price of the Iceland spar varies from 50 cents to $4 a pound.

PRODUCTION.

The total production of gems and precious stones in the United States in 1914, as reported to the Survey, amounted to $124,651. This is a large decrease from the production reported for 1913, which amounted to $319,454. The principal production of precious stones in the United States consists of the semiprecious and ornamental stones, a large part of which has been cut in Europe, especially in Germany, to which country exports of such minerals have naturally decreased. An important change during the year was the decrease in the production of Montana sapphire, due to the fact that the largest placer mines were not operated and that the mines of matrix deposits, all of which are owned by an English company, were closed

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[1] Jewelers' Circular-Weekly, July 15, 1914.

in August. There was a slight increase in the output of turquoise and turquoise matrix, probably to meet the increased demand for souvenir gems in the western tourist trade. The table of production represents only an approximation of the output of gems in the United States. For many gems the values given in 1914 and in previous years have been estimated from figures showing the quantity produced. That is, the tables give as nearly as possible the first values of the rough minerals. The value of the finished gems is several times greater. The preparation of complete statistics of production of precious stones is practically impossible, owing to the attitude assumed by some of the gem miners and dealers, who hesitate to furnish statements of production. The assistance of those who have kindly furnished such figures is greatly appreciated, and it is hoped that those who have not cooperated in this way in the past will do so in the future, on realizing that statistical information furnished by them will be held confidential.

Under miscellaneous gems in the table of production for 1914 are included obsidian, beach pebbles, fossil coral, apatite, kyanite, and Iceland spar. During other years datolite, natrolite, pectolite, apophyllite, iolite, chondrodite, and various gem minerals with trade names have been included.

Production of precious stones in the United States, 1908–1914.

	1908	1909	1910	1911	1912	1913	1914
Agates, chalcedony, onyx, etc	$1,125	$750	$2,268	$8,128	$9,978	$8,895	$8,312
Amethyst	210	190		725	363	389	255
Benitoite	3,638	500			150		
Beryl, aquamarine, blue, pink, yellow, etc	7,485	1,660	5,545	2,505	1,765	1,615	2,395
Californite		18,000	8,000	150	275	152	1,425
Chiastolite				25			
Chlorastrolite	25	2,400	2,000	1,992	350		
Chrysoprase	48,225	84,800	9,000	13,550	220		75
Copper ore gems, chrysocolla, malachite, etc	6,050	2,300	550	800	1,085	2,350	1,280
Cyanite					10		
Diamond	2,100	2,033	1,400	2,750	1,475	6,315	765
Diopside	120						
Emerald		300	700	9,500	2,375		
Epidote		15			10		
Feldspar, amazonstone, sunstone, etc	2,850	2,700	2,510	175	1,310	1,285	449
Garnet, almandine, pyrope, hyacinth, etc	13,100	1,650	3,100	2,065	860	4,285	1,760
Gold quartz	1,010		1,000	1,700	1,900	300	1,050
Jade							300
Jasper, petrified wood, bloodstone, etc		100	475	2,240	6,005	5,275	4,700
Opal	50	200	270	1,875	10,925	15,130	1,114
Peridot	1,300	300		360	8,100	375	100
Phenacite	95	50	50				
Prase			100			25	
Pyrite					265	50	
Quartz, rock crystal, smoky quartz, rutilated quartz, etc	3,595	2,689	1,335	2,140	2,448	1,640	4,046
Rhodonite	1,250	125	6,200	1,300	550	165	1,050
Rose quartz	568	2,970	2,537	1,744	865	337	400
Ruby				210	2,260	200	100
Rutile		25					
Sapphire	58,397	44,998	52,983	215,313	195,505	238,635	60,932
Smithsonite	1,200	300		25	650	50	50
Spodumene, kunzite, hiddenite	6,000	15,150	33,000	75	18,000	6,520	4,000
Thomsonite	35	100	610	1,500	450		21
Topaz	4,435	512	884	2,675	375	736	1,380
Tourmaline	90,000	133,192	46,500	16,445	28,200	7,630	7,980
Turquoise and matrix	147,950	179,273	85,900	44,751	10,140	8,075	13,370
Variscite, amatrice chlorutahlite, utahlite	14,250	35,938	26,125	5,750	8,450	6,105	5,055
Miscellaneous gems		1,060	2,755	3,224	4,408	2,920	2,287
Total	415,063	534,280	295,797	343,692	319,722	319,454	124,651

IDENTIFICATION OF GEMS BY THE MICROSPECTROSCOPE.

Attention has again been called to the use of the microspectroscope in the identification of gem minerals in a paper by Edgar T. Wherry.[1] Dr. Wherry mentions the discussions of this subject in textbooks and other publications and supplements them with notes on methods of microspectroscopic examination and tables of results on many minerals examined including gem minerals. Of the other articles cited, one by F. J. Keeley[2] contains interesting data on the color and the coloring agents of several gem minerals.

The apparatus used by Dr. Wherry "consists of a Crouch binocular microscope stand fitted with a 37-millimeter objective, an Abbe-Zeiss 'Spectral Ocular' in the right hand tube, and in the other an ordinary low-power eyepiece, marked on the lower lens at the point where the image of the mineral grain falls when it is visible through the spectroscope slit." White light such as is given by a Welsbach burner surrounded by a dark chimney is found preferable to sunlight. For the examination of gems, either loose or set, it is desirable to concentrate the light from the side by means of a lens or parabolic mirror. A gem must be transparent or at least fairly translucent to respond to the test, since it is necessary for the light to penetrate well into the mineral for absorption of color to take place properly.

Colorless gems show a continuous spectrum, but if the mineral is colored by certain elements or chemical substances, light of some color will be absorbed by it and dark bands will appear in the spectrum at places which are learned to be characteristic of such elements. If the coloring agent in different gems is known, a stone in doubt can be examined for the presence of that coloring agent by the microspectroscope. Dr. Wherry has found this method useful in determining the genuineness of rubies, sapphires, and emeralds, and in picking out corundum, zircon, and garnet from gem gravels.

IMPORTS.

The value of the imports of precious stones into the United States during the calendar year 1914, as reported by the Bureau of Foreign and Domestic Commerce, amounted to $19,211,084, the smallest since 1908, when it was $13,700,404. The imports were less by $26,220,914 in 1914 than in 1913, the greatest proportionate decrease occurring in rough or uncut diamonds. Large decreases were also recorded in pearls and cut diamonds, and the only increase in value of imports was in glazier diamonds.

The following table shows the value of the diamonds, pearls, and other precious stones imported into the United States from 1906 to 1914, inclusive:

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[1] The microspectroscope in mineralogy: Smithsonian Misc. Coll., vol. 65, No. 5, Pub. No. 2362, 16 pp., 1915.
[2] Microspectroscopic observations: Acad. Nat. Sci. Philadelphia Proc., pp. 106–116, 1911.

Diamonds and other precious stones imported and entered for consumption in the United States, 1906–1914.

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	[a] 1,051,747	910,699	13,700,404
1909	758,865	50,265	8,471,192	......	27,361,799	[a] 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
1913	471,712	100,704	12,268,543	......	24,812,604	2,775,811	5,002,624	45,431,998
1914	579,332	77,408	2,851,933	......	11,976,871	1,635,522	2,090,018	19,211,084

[a] Including agates. Agates in 1906, $20,130; in 1907, $22,644.

FOREIGN LOCALITIES.

DIAMOND.

AFRICA.

UNION OF SOUTH AFRICA.

The production of diamonds during the fiscal year ending June 30, 1914, by the De Beers Consolidated Mines[1] amounted to 2,081,386 carats, as compared with 2,293,468 carats in 1913. Actual sales of diamonds, plus the increase of stocks taken at the cost of production, amounted to £5,123,336, as compared with £6,297,782 in 1913. The total production of blue ground in 1914 amounted to 7,166,829 loads of 16 cubic feet, as compared with 7,382,216 loads in 1913. The total quantity of blue ground and tailings washed during 1914 was 7,406,278 loads, as compared with 8,702,289 loads in 1913. Stocks of blue ground and lumps on the floors increased from 10,803,054 in 1913 to 11,331,022 in 1914. The yield in carats of diamonds per load of blue ground washed remained at 0.36 at the De Beers mine, increased from 0.27 to 0.28 at the Wesselton mine, and decreased from 0.42 to 0.38 and from 0.23 to 0.21 in the Bultfontein and Dutoitspan mines, respectively. The De Beers mine has not been reopened since it was closed in 1908. Developments at the Kimberly mine consisted chiefly in the removal of mixed reef rock and blue ground formed by mud rushes.

The Premier Diamond Mining Co., of the Transvaal, ceased operations on August 10, 1914. The production of diamonds up to that date is reported[2] as amounting to 1,417,755 carats, a decrease of 211,732 carats, as compared with the corresponding period of 1913, and a total decrease of 690,228 carats, as compared with the financial year to October 31, 1913.

Diamond mining practically ceased in South Africa toward the close of 1914. Consul Edwin N. Gunsaulus,[3] of Johannesburg, reported to the State Department in January, 1915, that all diamond mines in the Cape, Transvaal, and Orange Free State Provinces were closed. Later he comments[4] on the effect the closing of practically

[1] De Beers Consolidated Mines Twenty-sixth Ann. Rpt., for the year ending June 30, 1914.
[2] African World, quoted in Jewelers' Circular-Weekly, Feb. 17, 1915.
[3] Jewelers' Circular-Weekly, Jan. 6, 1915.
[4] Daily Cons. and Trade Repts., June 25, 1915.

the entire diamond producing industry of the Union has necessarily had on the industrial conditions of the country. In this statement the output of diamonds in the Transvaal during 1914 is given as 1,101,264 carats, valued at $4,948,704, as compared with 2,156,897 carats, valued at $13,269,305, in 1913.

KONGO.

Vice Counsl General Harry A. McBride, of Boma,[1] Belgian Kongo, gives the following notes on diamonds of that country: The principal mines are in the Kasai district, near Tshikapa, and are operated by the Belgo-American Co., Société Forestière et Minière du Congo. American prospectors are working in the region and have met with some success. Two of the more important shipments of diamonds have been one of nearly 8,000 carats in November, 1913, sold in Antwerp at an average price of $5.79 per carat and another early in 1914 of 4,884 carats, sold to the same firm at an average price of $5.22 per carat.

The diamonds from the Kasai River district are obtained from river beds, but prospecting is in progress on eight matrix deposits or "pipes" in the Kundelunger region. In the Luanza "pipe," 9,315 loads of ground were washed to the end of December, 1913, and yielded 369 small diamonds weighing about 187 carats.

JADE.

NEW ZEALAND.

According to a correspondent of the Mining Journal [2] there was an active demand, before the European war, for the New Zealand jade or nephrite in Germany. A photograph accompanies the article showing a bowlder of nephrite, weighing about $1\frac{3}{4}$ tons, which had recently been shipped to Germany. Large deposits of the jade have been located, and a company (The New Zealand Greenstone (Ltd.)) has prepared to work them along with the richly colored serpentines in the same region. Both the serpentine and the jade have been called New Zealand greenstone, but the serpentine is used for ornamental building purposes and the jade for smaller ornamental and gem purposes.

[1] Daily Cons. and Trade Repts., Dec. 7 and 8, 1914.

[2] Mining Journal (London), July 25, 1914.

SUMMARY OF THE PRECIOUS-STONES INDUSTRY, 1882-1914.

Mining of precious stones in the United States has been a variable industry since its beginning. Most of the gem minerals have been sporadically mined or found during the course of mining for other minerals and only a few varieties have been systematically mined for periods of years at a time. Among those minerals which have been most persistently produced, and in some quantity at different times, are sapphire, turquoise, tourmaline, spodumene, and chrysoprase. A few other gems such as beryl, garnet, quartz, agate, amazon stone, rose quartz, and variscite, have been produced somewhat regularly, but generally in small quantity.

George F. Kunz,[1] summarizing the production and the localities of the different gem minerals in 1882, mentions the following:

Occasional diamonds had been found in several States. Sapphire was known to occur along Missouri River near Helena, Mont., and both ruby and sapphire at the Jenks corundum mine in Macon County, N. C. Topaz had been found in Maine and Colorado. Emerald and hiddenite had been discovered 16 years before in Alexander County, N. C. Aquamarine and other beryl were obtained from several of the Eastern States. Garnets, called "Arizona ruby," were being collected each year by the Navajo Indians in some quantity. Tourmaline had been mined for many years at Mount Mica, near Paris, Me., and was known to occur at other localities and also in Connecticut. Quartz and rock crystal were obtained from numerous scattered localities, especially fine small crystals coming from Herkimer County, N. Y., and Hot Springs, Ark. Rose quartz was found at several places in New England. Gold quartz from several Western States was made into jewelry. Amethyst had been found in Maine, Pennsylvania, Virginia, and Colorado. Agate was known to occur in many States, and the Wyoming and Montana moss agates were used in large quantities. Jasper and petrified wood were found in many States and used in small quantities. Peridot was gathered by the Navajo Indians of Arizona. Turquoise was known in New Mexico, Arizona, and Nevada. The feldspar gems, labradorite, amazon stone, sunstone, and moonstone were used in small quantities. The amazon stone came from the Pikes Peak region, Colorado. The Lake Superior gem stones, thomsonite and chlorastrolite, were collected for the tourist trade. Numerous lesser gems were known to occur in the United States, but were only sparingly used, such as phenacite, hyacinth garnet, iolite, rutilated quartz, novaculite, rutile, prehnite, obsidian, diopside, chrysoprase, rhodonite, malachite, chiastolite, catlinite, and others.

[1] Precious stones: U. S. Geol. Survey Mineral Resources U. S., 1882, 1883.

The following summary includes only a few of the principal features in the precious stones industry in the United States since 1882:

Diamond.—Only scattered finds were reported in various States, some in river and glacial gravels, and others loose in the soil, until 1906 when diamond was found associated with decomposed peridotite matrix in Arkansas. Since that time 2,000 to 3,000 stones have been found on the surface and by washing the earthy matrix. The value of the Arkansas deposits has yet to be demonstrated.

Sapphire.—A few sapphires were saved from the placer gold mining along Missouri River near Helena, Mont., until about 1890 when active mining for the sapphire was undertaken in connection with mining for gold. In 1891 and for several years following mining was continued successfully. In 1893 placer sapphire deposits were discovered along Rock Creek in Granite County. In 1894 more placer sapphire deposits were found along Dry Cottonwood Creek, in Deerlodge County, and near Yogo Gulch, in Fergus County. The Yogo sapphires are nearly all true sapphire blue and were soon traced to their original matrix, from which they have been mined almost continuously to the present. All of the other placer sapphire deposits produce only varicolored stones, including no pure blue gems. They are used principally for mechanical purposes, such as meter and watch bearings.

Ruby.—Occasional rubies were found in the corundum deposits of North Carolina and Georgia. The best find of ruby was made in 1893 in Cowee Valley of Macon County, N. C., in placer deposits. A few fine gems were found and later the stones were traced to their original matrix, where prospecting has been tried at various times without definite results.

Topaz.—Topaz mining has never reached an important stage in the United States Since 1882 the more important finds have been on Baldface Mountain, near North Chatham, N. H., in 1888; in San Diego County, Cal., about 1903; and in Mason County, Tex., in 1904. These deposits, as well as others in Maine, Colorado, and Utah, are only intermittently worked. The majority of the topaz from the United States is colorless, but some fine blue and bluish-green crystals are found.

Emerald.—The principal emerald localities of the United States are in North Carolina, but a few inferior emeralds have been found in Maine and Connecticut. In North Carolina the emerald-hiddenite mine has already been referred to. After 1891 operations were limited to a little intermittent prospecting, the last of which was in 1907. In 1894 emerald was found on Crabtree Mountain in Mitchell County, N. C., and mining was conducted for a few years. This locality did not produce clear gem emeralds, but a quantity of stones were cut with the white, gray, and black associated matrix and sold under the name of emerald matrix. In the same year, 1894, a stray emerald of good color was found near the North Carolina-South Carolina State line, south of Shelby. This was a forerunner of the discovery of the emerald deposit on the Turner plantation, 5 miles southwest of Shelby, in Cleveland County, N. C., in 1909. This deposit was worked by the Emerald Co. of America and yielded the best colored emeralds so far found in the United States. Work was stopped in 1913.

Aquamarine and other beryl gems.—Beryl gems have been obtained intermittently from many localities, prominent among which are Stoneham and other localities in Maine; Royalston, Mass.; Merryall, Conn.; Alexander, Mitchell, Yancey, and Macon counties, N. C.; Mount Antero, Chaffee County, Colo.; Riverside and San Diego counties, Cal. The localities are scattered and mining and prospecting have been irregular.

Garnet.—The "Arizona ruby" or garnet from the Navajo Indian Reservation has supplied the gem trade with varying quantities of fine garnet to the present time. Mason branch in Macon County, N. C., yielding the rose-pink rhodoite garnet, was an important source of gem garnet from 1897 to 1901. The majority of other gem garnets have been obtained from numerous localities and chiefly during mining for other minerals. Noteworthy among these was the hyacinth or spessartite variety from Amelia, Va., and from San Diego County, Cal.

Tourmaline.—Tourmaline has been obtained intermittently but not in large quantities from several localities in Maine and Connecticut. After 1900 the deposits of southern California became large producers and were actively worked for several years. Since 1911 only a few of these mines have been systematically worked, and the production has not been large. In connection with tourmaline mining in southern California lilac to rose-colored spodumene, called "kunzite" and "California iris," has been obtained in quantity and has taken an important place among American gems.

Chrysoprase.—Chrysoprase was first found near Riddle, Oreg., in 1884. In 1887 deposits were discovered in Tulare County, Cal. There was only a small annual production for a number of years, but between 1901 and 1911 the output was large.

Quartz.—Fine quartz crystals have been obtained from mines worked for tourmaline and other gem minerals in various parts of the country. One of the most important finds was of a lot of large clear crystals on Mokelumne Hill, Calaveras County, Cal., in 1898. One of these crystals yielded a flawless sphere $5\frac{1}{2}$ inches in diameter.

Amethyst.—Amethyst has been mined in some quantity in Georgia, North Carolina, and Virginia, and small outputs have come from numerous other deposits in these and other States.

Agate.—Agate has been obtained from most of the Western States, and in some years the production has been large. The moss agates of Montana and Wyoming continue to be of importance because of their beauty and of the quantity in which they are found.

Jasper.—The varieties of jasper suitable for ornamental purposes known in the United States have increased greatly. Among the promising varieties are bloodstone from the Death Valley region, California, and kinradite or spherulitic quartz and associated jaspers of the San Francisco region.

Peridot.—Peridot has been obtained sporadically and occasionally in some quantities from both the Navajo and the Apache Indian Reservations in Arizona. It is collected chiefly by the Indians.

Turquoise.—Up to 1888 the output of turquoise mining was small, but regular mining was then begun first at Cerrillos, N. Mex., and later in the Burro Mountains, N. Mex., and in Saguache County, Colo. The production rose to $175,000 in 1892. Arizona, California, and Nevada have since entered the list of turquoise-producing States, and have contributed large quantities at different times. The climax in the production of turquoise came in 1909 when more than 17 tons of turquoise and matrix was mined. The value of this rough product was estimated at about $179,000.

Feldspar gems.—Amazon stone is the principal feldspar gem mined in the United States. The Pikes Peak region of Colorado has continued to yield a quantity of this stone nearly every year. Amelia, Va., has been another source of supply of much good grade of amazon stone.

Other semiprecious stones.—The production of numerous other gems has been quite variable. The thomsonite and chlorastrolite beach pebbles of Isle Royale, Lake Superior, have been gathered more or less regularly by tourists each year. Other varieties of beach pebbbles are collected for ornamental purposes along the Pacific coast. Of the numerous other minerals sometimes used for gems or ornaments mentioned as known in 1882, rhodonite, malachite, rose quartz, and catlinite have been used in some quantity.

New gem minerals.—Among new gem minerals may be mentioned californite (massive compact vesuvianite), and benitoite both found in California. Californite has been found in several counties and a quantity has been sold at different times. Benitoite is a barium titanosilicate. It is a new mineral discovered in San Benito County in 1906. Only one deposit, now exhausted, has been found. Benitoite is a blue mineral resembling sapphire in color but much softer. It has a high refractive index and strong dichroism.

Below is given a table of the production of gems and precious stones as recorded in these reports from 1883 to 1914, inclusive. Difficulty was encountered in deciding on the statistics for the earlier years, as there were discrepancies between the tables of production given year by year and those showing the production for periods of years. The figures used are those which seem most reliable.

The tables of production are not given as exact statements, but represent the best estimates that could be made each year. During the last 20 years the statistics include exact figures of production for some minerals and estimates for others. The tables of production for the years 1883 to 1905, inclusive, were prepared by G. F. Kunz. The value of the total production for the years 1883 to 1914 amounts to $7,799,971. Kunz has made an estimate of the total production for the three years preceding 1882 as follows: 1880, $100,000; 1881, $110,000; 1882, $150,000. This makes a grand total of the production of gems and precious stones in the United States from 1880 to 1914 of $8,159,971.

Production of precious stones in the United States, 1883–1914.[a]

	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893
Agate, moss agate, chalcedony, onyx, etc	$4,500	$7,500	$4,500	$3,000	$4,950	$4,950				$3,500	$3,000
Amethyst	2,250	2,250	2,100	2,100	2,100	2,500	$98			200	75
Beryl, aquamarine, blue, pink, golden, etc	500	700	750	5,550	3,500	800	747		$1,000	1,000	500
Catlinite, pipestone	10,000	10,000	10,000	10,000	5,000	5,000	5,000	$5,000	5,000	5,000	5,000
Chlorastrolite	1,500	1,500			800	800	500	400	500	500	500
Chrysoberyl	100	25									
Chrysoprase							200	200		100	
Copper ore gems, chrysocolla, malachite, azurite, etc							6,037	2,000		1,500	
Diamond		800									125
Diopside	300		100	2,000	50					500	105
Emerald	500		3,200	3,200		100	450		1,000		
Feldspar, amazon stone, sunstone, moonstone, oligoclase	4,200	3,200	3,100	3,250	1,850	1,700	500	500		1,000	1,000
Garnet, almandine, pyrope, rhodolite, spessartite, hyacinth, topazolite	6,000	4,000	2,700	3,250	3,500	3,500	2,308	2,308	3,000	5,250	2,000
Gold quartz	115,000	140,000	140,000	40,000	75,000	75,000	9,000	9,000	6,000	15,000	10,000
Jasper	2,500	2,500				100	630				
Opal									5,000	10,000	5,000
Peridot		150	50	50					1,000	1,000	500
Petrified wood	5,000	10,500	6,500	1,500	36,000	16,000	53,175	6,000	2,000	11,000	21,250
Phenacite						650	200				
Prehnite										200	
Pyrite	2,000	3,000	2,000	2,000	2,500	2,500	2,000	2,000	1,500	1,500	1,500
Quartz, crystal, smoky; inclosing rutile and other minerals	23,100	25,100	19,050	20,450	16,100	15,150	18,512	16,475	15,000	15,000	15,000
Rose quartz							600	200		200	100
Ruby											150
Rutile			750	750							
Sapphire	2,200	1,750	500	500	500	500	6,725	6,725	10,000	20,000	10,000
Spodumene, hiddenite, kunzite, California iris	600		2,500	4,500			200				
Thomsonite, mesolite	750	750	750	400	750	500	400	400	200	500	500
Topaz	1,000	500	1,250	1,000	2,000	600	400		100	1,000	100
Tourmaline		2,000	600	6,250	500		2,250	2,250	3,000	3,000	5,000
Turquoise and matrix	2,000	2,000	3,500	3,000	2,500	3,000	23,675	28,675	150,000	175,000	143,136
Miscellaneous gems and ornamental stones [b]	4,750	4,750	6,000	6,000	6,000	6,500	55,200	36,700	31,000	40,100	39,500
Total	188,750	222,975	209,900	118,750	163,600	139,850	188,807	118,833	235,300	312,050	264,041

	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Agate, moss agate, chalcedony, onyx, etc	$12,500	$3,500	$2,000	$2,000	$2,000	$2,000	$2,000	$1,500	$1,500	$3,400	$3,500
Amethyst	500	200	500	200	250	250	500	500	2,000	3,000	3,000
Beryl, aquamarine, blue, pink, golden, etc	1,050	369	700	1,500	2,200	4,000	11,000	5,000	4,000	4,200	5,100
Catlinite, pipestone	3,000	3,000	3,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,500
Chiastolite, andalusite		1,000									
Chlorastrolite	500	500	500	500	5,000	3,000	3,000	3,000	4,000	3,000	2,000
Chrysoprase	100	550	600		100	100	100	1,500	5,000	1,500	6,000
Copper ore gems, chrysocolla, malachite, azurite, etc	1,500					250	200	100			
Diamond	200	250				300	150	100		50	
Diopside	150	200	200	100							
Emerald	250	25		25	50	50	1,000	1,000	1,000	250	
Epidote		75	250								
Feldspar, amazon stone, sunstone, moonstone, oligoclase	1,600	175	1,750	525	510	270	270	200	500	400	500
Garnet, almandine, pyrope, rhodolite, spessartite, hyacinth, topazolite	4,300	2,350	2,600	9,000	7,000	7,000	21,500	22,100	2,500	3,000	3,000
Gold quartz	10,000	10,000	10,000	5,000	5,000	500	2,000	2,000	3,000	3,000	5,000
Opal	500	300	200	200	200				150	200	
Peridot	500	300	500	500	500	500	500	500	500	5,000	5,000
Petrified wood		4,000	4,000	2,000	2,000	3,000	6,000	7,000	7,000	5,000	5,000
Phenacite		1,050									
Prase		100	100								
Prehnite	300	200	100	100	100	50	50				
Pyrite	1,800	1,000	1,000	1,000	1,000	1,000	2,000	3,000	3,000	3,000	3,000
Quartz, crystal, smoky; inclosing rutile and other minerals	7,000	12,660	10,050	13,000	18,100	12,050	11,050	12,050	14,100	11,600	12,000
Rhodonite	100										
Rose quartz	200	1,000	500		100	100	100	150	200	1,500	1,000
Ruby	2,500	2,000	1,000		2,000	3,000	3,000	500			
Rutile		100	100	800	110	200	100				
Sapphire	10,000	9,057	10,000	25,000	55,000	68,000	75,000	90,000	115,000	100,000	100,000
Spodumene, hiddenite, kunzite, California iris											10,000
Thomsonite, mesolite	500	500	500	500	1,000	1,000	1,000	1,000	1,000	500	500
Topaz	1,000	1,000	200		100					200	
Tourmaline	2,300	3,160	3,000	9,125	4,000	2,000	3,500	15,000	30,000	45,000	40,000
Turquoise and matrix	30,000	50,000	40,000	55,000	50,000	72,000	82,000	118,000	130,000	110,000	100,000
Variscite, utahlite, chlorutahlite, amatrice		1,000	500	100	100	100	100	250		100	200
Miscellaneous gems and ornamental stones [b]	16,300	4,000	4,000	2,500	2,500	3,500	3,050	2,600	2,000	2,000	17,000
Total	108,650	113,621	97,850	130,675	160,920	186,220	231,170	289,050	328,450	307,900	324,300

[a] Estimated total production: 1880, $100,000; 1881, $110,000; 1882, $150,000.

[b] Includes anthracite ornaments, arrow points, chondrodite, diaspore, fossil coral, fergusonite, fluorite, gadolinite, iolite, jade, monazite, obsidian, staurolite, titanite (sphene), trilobites, willemite, wooden ornaments decorated with gems, zircon, and gems with trade names.

Production of precious stones in the United States, 1883–1914—Continued.

	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Agate, moss agate, chalcedony, onyx, etc	$3,500	$800	$650	$1,125	$750	$2,268	$8,128	$9,978	$8,895	$8,312
Amethyst	2,000	700	850	210	190		725	363	389	255
Benitoite			1,500	3,638	500			150		
Beryl, aquamarine, blue, pink, golden, etc	7,000	9,000	6,435	7,485	1,660	5,545	2,505	1,765	1,615	2,395
Californite			25,000		18,000	8,000	150	275	152	1,425
Catlinite, pipestone	2,000		25							
Chiastolite, andalusite		25	20				25			
Chlorastrolite	3,000			25	2,400	2,000	1,992	350		
Chrysoprase	5,000	32,470	46,500	48,225	84,800	9,000	13,550	220		75
Copper ore gems, chrysocolla, malachite, azurite, etc	2,000		400	6,050	2,300	550	800	1,085	2,350	1,280
Cyanite			100					10		
Diamond			2,800	2,100	2,033	1,400	2,750	1,475	6,315	765
Diopside		5		120						
Emerald			1,320		300	700	9,500	2,375		
Epidote			60		15			10		
Feldspar, amazon stone, sunstone, moonstone, oligoclase	1,000	100	1,110	2,850	2,700	2,510	175	1,310	1,285	449
Garnet, almandine, pyrope, rhodolite, spessartite, hyacinth, topazolite	5,000	3,000	6,460	13,100	1,650	3,100	2,065	860	4,285	1,760
Gold quartz	5,000		1,000	1,010		1,000	1,700	1,900	300	1,050
Jasper			675		100	475	2,240	6,005	5,275	4,700
Opal			180	50	200	270	1,875	10,925	15,130	1,114
Peridot	10,000	2,400	1,300	1,300	300		360	8,100	375	100
Petrified wood	5,000	150	325							
Phenacite		250	25	95	50	50				
Prase		50				100			25	
Prehnite								20		
Pyrite	2,000		400					265	50	
Quartz, crystal, smoky; inclosing rutile and other minerals	13,100	3,050	2,580	3,595	2,689	1,335	2,140	2,448	1,640	4,046
Rhodocrosite			150							
Rhodonite				1,250	125	6,200	1,300	550	165	1,050
Rose quartz	1,000	4,000	6,375	568	2,970	2,537	1,744	865	337	400
Ruby		600	2,000				210	2,260	200	100
Rutile			200		25					
Sapphire	125,000	39,100	229,800	58,397	44,998	52,983	215,313	195,505	238,635	60,932
Smithsonite			800	1,200	300		25	650	50	50
Spodumene, hiddenite, kunzite, California iris	5,000	14,000	14,500	6,000	15,150	33,000	75	18,000	6,520	4,000
Thomsonite, mesolite	500			35	100	610	1,500	450		21
Topaz	500	1,550	2,300	4,435	512	884	2,675	375	736	1,380
Tourmaline	50,000	72,500	84,120	90,000	133,192	46,500	16,445	28,200	7,630	7,980
Turquoise and matrix	65,000	22,250	23,840	147,950	179,273	85,900	44,751	10,140	8,075	13,370
Variscite, utahlite, chlorutahlite, amatrice	500	2,000	7,500	14,250	35,938	26,125	5,750	8,450	6,105	5,055
Miscellaneous gems and ornamental stones [a]	13,250				1,060	2,755	3,224	4,388	2,920	2,587
Total	326,350	208,000	471,300	415,063	534,280	295,797	343,692	319,722	319,454	124,651

[a] Includes anthracite ornaments, arrow points, chondrodite, diaspore, fossil coral, fergusonite, fluorite, gadolinite, iolite, jade, monazite, obsidian, staurolite, titanite (sphene), trilobites, willemite, wooden ornaments decorated with gems, zircon, and gems with trade names.

ASPHALT.

By John D. Northrop.

INTRODUCTION.

The term natural asphalt is used in this chapter in a generic sense and denotes all commercially utilized types of native bitumens, pyrobitumens, and bitumen impregnated rocks, to which, for statistical convenience, the native paraffin wax, ozokerite, has been added. The term manufactured asphalt is here used to denote only those forms obtained as by-products in the refining of certain asphaltic oils. Mastic, a prepared mixture of bituminous material and mineral matter, and partly treated or refined native bitumens are included under natural asphalt.

The natural asphalts occur in the United States in three principal forms: (1) As viscous, semiliquid substances filling interstices and cavities in rock of almost every type, but found most abundantly in sand, sandstone, and limestone; (2) as viscous and semisolid tenaceous exudations from the earth, either directly from exposed bituminous rocks or from subterranean passages; (3) as solids in the form of veins or irregular bodies, cutting across or lying between layers or masses of rocks. Stratigraphically, the natural asphalts here considered occur in commercial quantities in or associated with sedimentary rocks of all ages from Ordovician to Pleistocene.

The distribution of the natural asphalts in the United States is wide, deposits having been found at numerous localities in fully a dozen States, though commercial production is now limited to only a few localities in five States.

The manufactured or oil asphalt produced in the United States is obtained from certain grades of crude petroleum found in California, Texas, Louisiana, Oklahoma, Kansas, and Illinois, as well as from the heavier grades of Mexican crude, which are imported in ever increasing quantities for the manufacture of asphalt and asphalt products.

GENERAL CONDITIONS.

Since 1907 the output of manufactured asphalt from domestic sources has dominated the asphalt industry in the United States, though it had been recognized as a factor of growing importance for years before. In the year 1907 the output of manufactured asphalt exceeded for the first time the combined output of the natural varieties, and by a margin of 52,035 short tons. In 1908 and 1909 this margin was cut down to some extent, since which time, however, it has greatly increased, attaining a record excess of 343,982 short tons in 1913, though declining to 283,095 short tons in 1914. This increase in output of oil asphalt has been, of course, to some extent at the expense of the natural varieties, but less than might be inferred from the foregoing statement of excess production. The explanation for the increase lies rather in the more extended utilization of asphalt and asphalt products which has characterized the last few years and in the adaptability of the manufactured varieties to many of the newer uses. For example, the demand for certain varieties of natural asphalt for use in paving in 1914 is stated by the producers to have been normal, though the demand for the natural varieties for roofing is reported to have decreased, which indicates an invasion of this particular field by the manufactured substitute.

Within the last two or three years oil asphalt from domestic sources has met a strong competitor for the American markets in a similar product manufactured in this country from heavy asphaltic oils imported from Mexico. Two new plants for the manufacture of asphalt from Mexican petroleum began operations in the United States in 1914, and the output was more than doubled as compared with 1913, reaching a total within 13 per cent of the output of oil asphalt from domestic sources. The higher asphalt content of the Mexican petroleum and the correspondingly lower cost of extraction has already converted certain refiners formerly utilizing petroleum of domestic origin to the exclusive use of the Mexican oil for asphalt manufacture.

That the Mexican product will dominate the market for oil asphalt in the eastern part of the United States in the future appears certain in consideration of the facts that the supply of crude material is abundant and that it can be delivered at Atlantic and Gulf ports at a less cost than suitable crude oils of domestic origin. The abundance of asphaltic oil in California, however, assures local dominance of the oil asphalt markets tributary to the Pacific coast for some time to come. The number of active plants producing oil asphalt in the United States in 1914 was 44, of which number 36 refined exclusively petroleum of domestic origin. In 1913 the active plants producing oil asphalt numbered 36, of which number 26 refined American oil exclusively.

MARKETED PRODUCTION.

NATURAL ASPHALT.

The marketed production of natural asphalt in the United States in 1914 aggregated 77,588 short tons, valued at $630,623, a decline of 15,016 tons in quantity and of $120,090 in value from the output of 1913. This decline may be ascribed in part to the general business depression resulting from the European war, which affected to some extent the paving industry—the principal outlet for the natural asphalts—and in part to the successful invasion by oil asphalt of certain other outlets. Of the production in 1914 of natural asphalt, 48,771 tons, valued at $151,122, or $3.10 a ton, are classed as bituminous rock; 19,148 tons, valued at $405,966, or $21.20 a ton, represent the combined output of gilsonite and wurtzilite (elaterite); and 9,669 tons, valued at $73,535, or $7.60 a ton, are credited to grahamite. No production of natural soft asphalt, known as maltha or brea, was reported for the year.

The number of active producers of natural asphalt in the United States declined from 14 in 1913 to 11 in 1914.

The following table presents the output of natural asphalt entering the market from quarries and mines in the United States by calendar years from 1882 to 1914, inclusive:

Marketed production of natural asphalt and bituminous rock, 1882–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1882	3,000	$10,500	1899	75,085	$553,904
1883	3,000	10,500	1900	54,389	415,958
1884	3,000	10,500	1901	63,134	555,335
1885	3,000	10,500	1902	84,632	461,799
1886	3,500	14,000	1903	55,068	483,282
1887	4,000	16,000	1904	64,167	420,701
1888	50,450	187,500	1905	62,898	305,242
1889	51,735	171,537	1906	73,062	674,934
1890	40,841	190,416	1907	85,913	928,381
1891	45,054	242,264	1908	78,565	517,485
1892	87,680	445,375	1909	99,061	572,846
1893	47,779	372,232	1910	98,893	854,234
1894	60,570	353,400	1911	87,074	817,250
1895	68,163	348,281	1912	95,166	865,225
1896	80,503	577,563	1913	92,604	750,713
1897	75,945	664,632	1914	77,588	630,623
1898	76,337	675,649			

The asphalt industry in the United States is older than the foregoing table would indicate. For nearly half a century before the exploitation of asphalt deposits in other parts of the country the brea deposits of southern California had been industrially utilized. In the Works of De Mofas (vol. 2, p. 337, Paris, 1844) the following statements relating to "tar springs" are found:

Two leagues to the southeast of Los Angeles there are four great sources of asphaltum situated on a level with the prairie. These springs open in the middle of little pools of cold water, while the bitumen possesses a higher temperature. * * * At sunrise the orifices of these springs are covered by enormous bubbles of asphaltum, often being more than a yard high and looking like soap bubbles. * * * The inhabitants collect the solidified asphaltum and use it for covering the roofs of their houses. * * * Vessels carry this bitumen to different parts of the coast.

One branch at least of the asphalt industry appears to have been fairly well established at the time of the visit of De Mofas, but of its earlier history in this country there seems to be no authentic record.

The first use of domestic bituminous rock for paving in the United States is credited to Santa Cruz, Cal., and is said to have been accidental. In the winter of 1868 Mr. Pray, the proprietor of a hotel, put down redwood blocks as a street pavement in front of his hotel. A man was sent to get asphaltum to pour between the blocks. This asphaltum was then known to occur in a wild region about 10 miles north of Santa Cruz. By mistake he went to the wrong place and returned with a wagonload of bituminous sandstone. This was melted and laid over the redwood blocks, and proved satisfactory. The next attempt to use the rock was in 1876, when street cars were introduced into the town, and by 1884 it had become the standard paving material in Santa Cruz.

In 1882, when the Geological Survey began its systematic compilation of statistics on asphalt production, the entire domestic output of about 3,000 tons was from California. As early as 1867, however, imports of asphalt, chiefly from Trinidad, were being regularly made to supply the demand for paving materials in the Eastern States.

In 1888 the asphalt industry became well established in California by a greatly increased utilization of the natural hard asphalts for paving and the natural liquid varieties (maltha) as a base for paints and varnishes. The enormous increase in asphalt output in 1888 over the practically negligible output in 1887 was due to the novelty of the enterprise and the consequent flooding of a very limited market with a great quantity of a new and unproven type of paving material. The market did not respond as promptly as might have been desired by the producers, and a decline in production marked the period of adjustment in 1890 and 1891.

In 1888 about 700 tons of gilsonite were shipped from Utah to St. Louis for use in varnish manufacture; in 1889 Kentucky became a contributor of natural asphalt; in 1894 the bituminous limestone deposits in Texas reported a commercial production; and in 1896 Colorado marketed a small quantity of gilsonite and Oklahoma produced 12 tons of asphaltum.

The industrial depression of 1893 was strongly reflected in the output of asphalt for that year, which decreased 45 per cent from the output of 1892. After this period of depression the output of natural asphalt gradually increased until 1909, when the highest production of 99,061 tons was recorded. By this time, however, manufactured asphalt obtained as a by-product in refining petroleum had begun to invade the markets with such success that from 1910 to 1914 the output of natural asphalt has been gradually diminishing.

MANUFACTURED ASPHALT.

The marketed production of oil asphalt derived from petroleum of domestic origin in 1914 amounted to 360,683 short tons, valued at $3,016,969, or an average of $8.36 a ton, a decrease of 75,903 tons in quantity, of $1,514,688 in value, and of $2.25 a ton, as compared with the output of 1913. The explanation of this condition lies in the competition of the domestic product with that derived from Mexican petroleum. The quantity of this latter type of oil asphalt manufactured wholly within the United States in 1914 was 313,787 short tons, valued at $4,131,153, or an average of $13.16 a ton, as compared with 114,437 short tons, valued at $1,743,749, or an average of $15.23 a ton, produced in 1913.

Of the quantity of oil asphalt produced in 1914 from oils of domestic origin 171,447 tons, valued at an average price of $7.83 a ton, found utilization chiefly as road oils or as fluxes for softening harder bitumens, and 189,236 tons, with an average value of $8.84 a ton, were classed as residual pitches and utilized in the paving industry. Of the quantity produced in this country from oils of Mexican origin 111,058 tons, valued at an average price of $11.10 a ton, were classed as road oils and fluxes and 202,729 tons, valued at an average price of $14.29 a ton, were classed as residual pitches.

The following table shows, by calendar years, the output of oil asphalt derived from petroleum of domestic origin since 1902:

Marketed production of oil asphalt from domestic petroleum, 1902–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1902	20,826	$303,249	1909	129,594	$1,565,427
1903	46,187	522,164	1910	161,187	2,225,833
1904	44,405	459,135	1911	277,192	3,173,859
1905	52,369	452,911	1912	354,344	3,755,506
1906	64,997	615,406	1913	436,586	4,531,657
1907	137,948	1,898,108	1914	360,683	3,016,969
1908	119,817	1,540,396			

The following table shows the production in the United States of oil asphalt from petroleum of Mexican origin for the calendar years 1913 and 1914:

Production of oil asphalt from Mexican petroleum, 1913–14, in short tons.

Year.	Quantity.	Value.
1913	114,437	$1,743,749
1914	313,787	4,131,153

PRODUCTION BY CLASSES AND BY STATES.

The changes in production in the different classes of asphalt are detailed for the last five years in the table which follows:

Marketed production of asphalt, 1910–1914, by varieties, in short tons.

Variety.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous rock	64,554	$400,557	[a] 42,654	[a] $159,670	[a] 54,762	[a] $173,018
Maltha	1,252	12,742	8,574	125,966	474	3,518
Wurtzilite (elaterite)			610	30,500	[b] 8,452	[b] 115,620
Gilsonite	[c] 33,087	[c] 440,935	30,236	486,114	31,478	573,069
Grahamite			5,000	15,000	([d])	([d])
Total	98,893	854,234	87,074	817,250	95,166	865,225
Manufactured or oil asphalt [e]	161,187	2,225,833	277,192	3,173,859	354,344	3,755,506
Total	260,080	3,080,067	364,266	3,991,109	449,510	4,620,731

Variety.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Bituminous rock } Maltha }	57,549	$173,764	48,771	$151,122
Wurtzilite (elaterite) } Gilsonite } Grahamite }	35,055	576,949	(Wurtzilite, Gilsonite) 19,148 (Grahamite) 9,669	405,966 73,535
Total	92,604	750,713	77,588	630,623
Manufactured or oil asphalt [c]	436,586	4,531,657	360,683	3,016,969
Total	529,190	5,282,370	438,271	3,647,69[illegible]

[a] Includes small output of mastic.
[b] Includes grahamite.
[c] Includes gum.
[d] Included in wurtzilite.
[e] This item includes material derived from petroleum of domestic origin only.

The following table shows the output of natural asphalt, by States, from 1910 to 1914, inclusive:

Marketed production of natural asphalt, by States, 1910–1914, in short tons.

State.	1910		1911		1912	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	41,299	$165,954	36,481	$220,580	36,741	$100,481
Kentucky	9,938	53,703	(a)	(a)	b 10,145	b 46,032
Oklahoma	11,959	35,244	c 19,747	c 80,056	15,766	85,643
Texas					(d)	(d)
Utah	35,697	569,333	30,846	516,614	32,514	633,069
Total	98,893	854,234	87,074	817,250	95,166	865,225

State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
California	27,870	$69,825	28,186	$77,810
Kentucky	b 17,465	b 60,131	b 18,935	b 66,298
Oklahoma	16,459	91,416	9,669	73,535
Texas	(d)	(d)	(d)	(d)
Utah	30,810	529,341	20,798	412,980
Total	92,604	750,713	77,588	630,623

a Included in Oklahoma.
b Includes Texas.
c Includes Kentucky.
d Included in Kentucky.

CONDITIONS AND PRODUCTION IN THE PRINCIPAL PRODUCING STATES.

California.—Owing to a marked activity in highway and pavement construction in California in 1914, the year witnessed an increased development of the State's asphalt resources, affecting both natural and manufactured varieties. Compared with 1913, the output of natural asphalt in 1914, which consisted wholly of bituminous sandstone from the well-known localities in Santa Cruz and San Luis Obispo counties, recorded a slight increase, less than 2 per cent. The quantity produced in 1914 amounted to 28,186 short tons, valued at $77,810, or an average of $2.75 a ton, at the quarries.

The output of oil asphalt in California, which in 1914 was distributed among 27 producers, amounted to 259,972 short tons, valued at $2,057,725, or an average of $7.90 a ton, at the refineries. Compared with 204,228 short tons in 1913, the output in 1914 shows a net gain of 55,744 tons, amounting to an increase of 27 per cent. Of this output, 82,513 tons, valued at an average price of $6.10, were marketed for road oil and fluxing purposes and 177,459 tons, average refinery value $8.75 a ton, were marketed as residual pitches for use in highway and pavement construction.

Kentucky.—The quantity of bituminous sandstone produced and marketed in Kentucky in 1914 declined slightly from the output in 1913, the apparent increase credited to the State in the accompanying table belonging in reality to Texas, with which Kentucky has been combined to avoid disclosing individual returns.

Oklahoma.—The marketed production of asphalt in Oklahoma in 1914 comprised chiefly the natural form, grahamite, but included for the first time a small production of oil asphalt, which was refined in another State and was marketed under the road-oil and flux classification. The decrease in output of natural asphalt in the State—that is, 9,669 short tons in 1914, as compared with 16,459 tons in 1913—is ascribed chiefly to the invasion of the markets by manufactured asphalt produced in large quantities at various points along the Gulf coast and marketed at prices precluding competition by the natural sources, many of which have been developed to the depth limit of profitable operation.

Texas.—The output of natural asphalt in Texas is restricted at present to the variety bituminous limestone, quarried in the well-known Uvalde County locality, statistics of which are combined with Kentucky in the accompanying table. The demand for this type of asphalt has been increased somewhat as the result of researches showing[1] that the material, when properly fluxed with a small percentage of maltha (asphalt oil), affords a superior paving material, free from the objectionable lack of ductility and resilience which characterized the results of its earlier use in the natural condition.

The output in 1914 of manufactured asphalt from Texas petroleum amounted to 57,934 short tons, valued at $608,132, at the three contributing refineries. Two additional refineries within the State manufactured more than one and one-half times this quantity of oil asphalt from Mexican petroleum during the year.

Louisiana.—In 1914 Louisiana became enrolled on the list of asphalt-producing States by marketing a small production of manufactured asphalt derived from petroleum produced within its borders.

Utah.—The production in Utah of natural hard asphalts, elaterite, gilsonite, and bituminous sandstone fills a demand for hydrocarbons utilized in the manufacture of japans, varnishes, insulations, and rubber substitutes which is fairly steady, though the quantity entering the trade in 1914 showed a notable decline from that marketed in previous years. An analysis of the returns for 1914 shows the decline in output to lie wholly in the output of gilsonite, the other varieties disclosing substantial increases over the production credited to 1913. The reasons for this decline lie in the invasion of certain gilsonite markets by oil asphalt with which the high-grade natural product is unable to compete, owing to the high costs of transportation necessitated by the location of the mines remote from railway facilities.

Illinois.—This State contributed to the domestic asphalt industry in 1914 as in previous years by supplying crude petroleum for oil asphalt to four refineries having a combined output of 41,553 short tons, valued at $340,862, the entire production being marketed for use as road oil and for flux.

Other States.—In addition to the previously mentioned sources of asphalt the following States, containing no commercially developed sources of raw material, contributed to the output of manufactured

[1] Boorman, T. H., American rock asphalt: The American City, vol. 11, pp. 319–321, 1914.

asphalt in the United States in 1914 through refineries treating asphaltic oils produced in adjacent States or obtained from Mexican sources, namely, Indiana, Maryland, New Jersey, Ohio, and Pennsylvania.

Philippine Islands.—Concerning the asphalt deposits in Leyte, discovery of which was announced in the Survey's report on asphalt production in 1913, Mr. J. F. Boomer, correspondent at Manila, writes in Commerce Reports, issue of July 22, 1914, in part, as follows:

The deposits of asphalt in Leyte have recently been examined by the division of mines of the Philippine Bureau of Science, and the following statement sets forth the principal results of the examination.

It will be recalled that asphalt was first reported from Leyte a little more than a year ago, having been discovered by a Filipino ranger employed by the Bureau of Forestry. The original discovery was made near the head of the Butason River in a region about 6 miles from the barrio of Campocpoc on the northwestern coast of the island.

The outstanding feature of the recent official examination is the discovery of a large deposit of bituminous limestone, or, as it is more commonly called, rock asphalt, near the town of Villaba and at a point very much closer to the seacoast than the original discovery. At the beginning of this year prospectors learned that unimportant quantities of semiliquid asphalt were seeping from small holes in the wall of a canyon near Villaba, but they believed the occurrence to be of little value because of the small quantity of the material found. The fact that the whole rock face was impregnated with asphalt was not detected previous to the official investigation. Although the deposit has not been explored by artificial openings it is well exposed by the deep canyon, and there is little question that the quantity of material present is to be measured in thousands of tons. The upper 20 feet of the rock asphalt, which occurs in thick beds, is a bituminous, sandy limestone, while an equal thickness at the base is bituminous sandstone.

Area of deposits.—Other important discoveries made by prospectors themselves have revealed deposits of greater extent than the original discovery, which consists of only a small pocket. Taking into consideration the first findings and the results of the subsequent prospecting, outcrops of various grades of asphalt, including solid, viscous, and liquid types, together with seeps of the petroleum, from which the asphalt has been derived, are known to occur over an area about 12 miles long. The more important discoveries, however, are limited to an area about 8 miles long.

Paving material.—Some of the deposits of asphalts are in themselves of possible commercial importance. In the first place, it may be possible to use the rock asphalt at Villaba as a paving material. Chemical analyses now being made will throw more light on this possibility, but the question must be determined finally by actually paving a section of some street with this material. There is reason to believe that the Bureau of Public Works, in cooperation with the holders of the mineral claims, will make such an experiment. If the material can be successfully employed for paving, it will undoubtedy find a considerable market in the Philippines themselves, and it might be exported to the China coast and to Japan. Rock asphalt is not extensively used as a paving material in the United States, largely because of the abundance and consequent cheapness of true asphalt. In Europe, however, there are millions of square meters of rock-asphalt pavement. Indeed, in France and Italy rock asphalt is the standard paving material. Italy, for instance, uses annually about 200,000 tons of rock asphalt, valued at more than half a million dollars.

Use of asphalt for paints, paraffin, etc.—In case it develops that the Leyte rock asphalt is not suitable for paving, there is still a possibility of using some of the purer asphalt for the manufacture of paraffin and other products, such as bituminous paints and varnishes. Asphalts which can be used for varnishes are worth about $17.50 a ton in the United States. Ozokerite, from which large proportions of paraffin are obtained, is worth 5 to 7½ cents per pound in the United States. Thus it appears that asphalts high in paraffin command even a better price than true asphalts. Of course, the market for the derived products, such as paraffin and varnishes, would be limited in the Philippine Islands, but exportation to China and Japan is at least a possibility. It is true, also, that more capital would be required to establish an industry if the Leyte asphalt must be refined and manufactured than if it can be sold in the crude state for paving purposes.

Consul General George E. Anderson, at Hongkong, states in Commerce Reports, issue of April 17, 1915, that the commercial development of the asphalt of Leyte is being undertaken by a Philippine corporation, known as the Leyte Asphalt & Mineral Oil Co., with headquarters at Tacloban, near which the deposits lie. The property of this company is said to consist of 656 hectares adjacent to the shore line, and so situated that the material can be loaded directly on lighters at the mines for transportation to the adjacent deep-water port of Tacloban. Asphalt from this property has been put to thorough practical tests, both in the Philippines and in the United States, and has already been purchased by the Philippine government for extensive use on roadways in the Philippines.

IMPORTS.

During the calendar year 1914, the total imports of asphalt for consumption in the United States amounted to 139,057 short tons, valued at $675,618, or an average of $4.85 a ton. The following table, compiled from the records of the Bureau of Foreign and Domestic Commerce, shows for purposes of comparison the imports of asphalt for domestic consumption in the last five years:

Asphalt imported for consumption into the United States, 1910–1914, in short tons.

Year.	Crude.		Dried or advanced.		Bituminous limestone.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	[b] 207,033	738,452	[c] 14,750	133,336	6,395	38,823	228,178	910,611
1914	137,352	664,558	....	....	1,705	11,060	139,057	675,618

[a] Imports for 1910 include $9,752 of manufactures.
[b] Includes dried or advanced asphalt for last three months of 1913.
[c] Last three months of 1913 included in crude asphalt.

In addition to the imports of raw asphalt in 1914, shown in the table, asphalt products aggregating $10,524 in value were imported for consumption during the calendar year.

During the fiscal year ending June 30, 1914, imports of asphalt for consumption in the United States aggregated 180,689 long tons, valued at $918,387, a decrease of 31,184 tons, or nearly 15 per cent, in quantity and of $33,693, or about 3.5 per cent, in value from the receipts for the fiscal year 1913. As usual, the bulk of the imported material came from the well-known Trinidad and Venezuelan sources, though imports from these countries showed a moderate decline. The most conspicuous decrease, however, was in the quantity imported from Italy, which dropped from 4,619 tons in 1913 to only 50 tons in 1914. Imports from Cuba, which amounted to 9,696 tons in 1913, also decreased notably in 1914, only 688 tons being received from that source during the fiscal year. Slight increases were recorded in the small quantities imported from Colombia, Mexico, and Turkey.

The following table, compiled from the published records of the Bureau of Foreign and Domestic Commerce, shows by sources the imports for consumption of asphalt and bitumen for the fiscal years 1910 to 1914, inclusive:

Asphalt imported into the United States during the fiscal years ending June 30, 1910–1914, by countries, in long tons.

Imported from—	1910		1911		1912		1913		1914	
	Quantity	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Europe:										
Belgium	12	$369	364	$5,498	420	$2,914	89	$538		
France	1,648	7,917	119	1,598	248	2,390				
Germany	2,294	18,587	2,091	17,576	2,586	22,111	1,898	16,444	1,311	$10,216
Italy	3,050	8,092	6,099	17,636	5,515	22,873	4,619	18,874	50	294
Netherlands				41			100	598		
Switzerland	1,280	9,184	750	5,783	1,453	9,863	1,235	8,272	785	5,032
United Kingdom	274	6,808	297	6,876	434	5,278	7,721	18,736	5,132	13,128
North America:										
Canada			36	600	94	2,351	1	28	1	20
Mexico	145	2,652	32	457	581	11,089	64	482	109	1,532
West Indies—										
British	89,994	407,325	94,594	405,735	115,884	475,299	108,216	438,362	97,666	444,413
Cuba	13,873	73,455	14,027	73,233	12,405	68,879	9,696	57,804	668	10,866
Danish	200	800								
South America:										
Colombia	1	9	45	1,639	11	1,216			113	6,894
Venezuela	33,503	173,363	34,104	170,683	53,922	260,074	78,221	390,907	74,849	425,060
Asia:										
Turkey	8	554					3	639	5	932
Oceania	89	3,436	10	391	25	967	10	396		
Total	146,371	712,551	152,568	707,746	193,578	885,304	211,873	952,080	180,689	918,387

OZOKERITE.

Despite the fact that ozokerite, or natural mineral wax, occurs in considerable quantity in Utah, the United States has for many years imported practically its entire supply of this mineral from Galicia. This condition is due, in part, to the fact that the Utah deposits are remote from the market, which is principally in the Eastern States, but chiefly to the fact that the Utah mineral occurs in a less concentrated form and requires greater expense for extraction than the Galician wax.

At the outbreak of the European war, in the summer of 1914, shipments of ozokerite to the United States were abruptly terminated, and the wholesale market prices which prevailed in New York at the end of July advanced from 22 cents a pound for prime brown and 30 cents a pound for prime green to 40 cents and 36 cents, respectively, before the end of the year. These advances in the market aroused renewed interest in the latent ozokerite resources of Utah, but to the end of the year this interest had not resulted in any active development in the productive locality other than the nominal assessment work required by law on unpatented mining claims.

During the later part of 1914 the ozokerite area, which lies adjacent to Colton and Soldier Summit, in Utah and Wasatch counties, Utah, was examined by H. M. Robinson, of the United States Geological Survey, and the results of this investigation are contained in a forthcoming Survey bulletin.

The quantity of mineral wax, chiefly ozokerite, imported for consumption in the United States in 1914 amounted to 8,191,529 pounds, valued at $498,655. The import price declined from 7.7 cents a pound in 1913 to 6.1 cents a pound in 1914.

The following table shows the imports by calendar years of mineral wax from 1910 to 1914, inclusive:

Mineral wax, chiefly ozokerite, imported into the United States, 1910–1914, in pounds.

Year.	Quantity.	Declared value.	
		Total.	Per pound.
1910	7,933,377	$606,651	$0.076
1911	4,472,708	388,461	.087
1912	6,352,003	488,894	.077
1913	7,141,514	549,992	.077
1914	8,191,529	498,655	.061

ICHTHYOL.

For years the United States has been a large importer of a peculiar form of asphaltic material which, after appropriate chemical treatment, finds utilization as a medicament under the name ichthyol. The raw material from which it is derived is a bituminous rock filled with fossil fish and found in large quantities near Seefeld, in the Austrian Tyrol. The material mined at this place is carefully selected as to grade and is subjected to dry distillation. The distillate thus obtained—ichthyol oil—is then sulphonated, and the resulting ichthyolsulphonic acid is neutralized with concentrated ammonia and water. After evaporation to the consistency of sirup the product is marketed under the name ichthyol, being employed, both internally and externally, as an alterative and antiseptic, its efficiency for these purposes being ascribed to the sulphur it contains.

At the outbreak of the European war imports of ichthyol, the output of which is controlled by the Ichthyol Co., of Hamburg, were abruptly terminated.

As there are no known deposits in the United States of asphaltic material of the peculiar type from which ichthyol is derived, American chemists were confronted with no easy problem in supplying the insistent demand created by the imported product. Synthetic ichthyol, likewise manufactured abroad and marketed under various trade names, has been available for some time, and synthetic methods have been adopted to provide the means for supplying the domestic requirements. As a result one of the prominent chemical firms in this country was marketing a product favorably recommended as an efficient substitute for ichthyol before the end of the year 1914.

As an indication of the growth and present extent of the ichthyol market in this country the following table has been prepared from the records of the Bureau of Foreign and Domestic Commerce, showing, by calendar years, the imports for consumption of this medicament from 1910 to 1914, inclusive:

Imports for consumption of ichthyol, 1910–1914, by calendar years, in pounds.

Year.	Quantity.	Value.
1910	24,663	$35,111
1911	42,589	65,715
1912	51,502	69,670
1913	58,485	83,034
1914	61,416	56,415

EXPORTS.

The published records of the Bureau of Foreign and Domestic Commerce show that 37,246 long tons of crude asphalt, valued at $845,838, together with asphalt products valued at $401,182, were exported from the United States during the calendar year 1914. Compared with the corresponding period in 1913, these data show a decline of 21,304 tons in the exports of crude asphalt and a decrease of $10,604 in the value of asphalt products sent out. The following table shows by calendar years the exports of domestic asphalt and the value of exported asphalt products for the last three years:

Asphalt exported from the United States in the calendar years 1912 to 1914, in long tons.

Year.	Unmanufactured.		Manufactures of—value.	Total value.
	Quantity.	Value.		
1912	39,915	$886,678	$467,959	$1,354,637
1913	58,550	1,267,625	411,786	1,679,411
1914	37,246	845,838	401,182	1,247,020

During the fiscal year ending June 30, 1914, the exports of crude asphalt, as shown by the records of the Bureau of Foreign and Domestic Commerce, amounted to 49,831 long tons, valued at $1,131,086, and the additional value of the asphalt products exported amounted to $362,347.

The quantity and value of domestic crude asphalt and the value of asphalt products exported during the fiscal years 1913 and 1914, classified by major destinations, are shown in the following table:

Asphalt exported from the United States during the fiscal years 1913 and 1914, by countries, in long tons.

Exported to—	1913				1914			
	Unmanufactured.		Manufactures of.	Total value.	Unmanufactured.		Manufactures of.	Total value.
	Quantity.	Value.	Value.		Quantity.	Value.	Value.	
Europe:								
Austria-Hungary	301	$7,543	$400	$7,943	514	$11,801		$11,801
Belgium	649	14,306	3,297	17,603	745	16,244	$4,361	20,605
Denmark	212	5,280		5,280	99	1,979	20	1,999
Finland					12	235		235
France	893	22,462	2,283	24,745	971	26,119	178	26,297
Germany	8,465	191,892	28,793	220,685	7,969	188,937	25,340	214,277
Italy	115	3,888	1,932	5,820	71	2,083	1,572	3,655
Netherlands	2,456	45,344	2,350	47,694	1,917	49,332		49,332
Portugal			28	28				
Roumania	113	2,026	8,121	10,147			3,151	3,151
Russia in Europe	10	202	385	587	5	101		101
Spain	15	303	2,258	2,561	145	2,923	6,647	9,570
Sweden	50	1,445		1,445				
Switzerland			720	720				
Turkey in Europe			686	686				
British Isles	6,359	174,334	50,880	225,214	4,286	91,138	33,108	124,246
North America:								
Bermuda	2	25		25				
Canada	25,546	448,656	318,477	767,133	19,936	383,977	242,198	626,175
Costa Rica			415	415			118	118
Guatemala			163	163			44	44
Honduras							29	29
Nicaragua			19	19				
Panama	185	8,274	4,885	13,159	705	27,561	3,820	31,381
Mexico	90	1,911	2,740	4,651	36	962	2,795	3,757
Newfoundland and Labrador			846	846			236	236
West Indies	3,626	88,700	1,067	89,767	4,888	119,008	2,177	121,185
South America:								
Argentina	4,198	111,019	2,627	113,646	3,736	90,043	42	90,085
Bolivia					2	40		40
Brazil	415	11,255	16,664	27,919	2,273	73,329	6,962	80,291
Chile	129	4,129	73	4,202	1,158	35,875	14,472	50,347
Colombia			3	3				
Ecuador	10	382		382			10	10
Peru			3,163	3,163			300	300
Uruguay	200	5,979	2,080	8,059			2,619	2,619
Venezuela			49	49			102	102
Asia:								
China	32	1,047	115	1,162	76	1,667	1,338	3,005
Chosen			28	28			110	110
East Indies, Br.			660	660				
British India			1,594	1,594			2,422	2,422
Straits Settlements							97	97
Hongkong	11	363	871	1,234	29	606	124	730
Japan	134	3,024	8,129	11,153	42	834	3,186	4,020
Oceania:								
British—								
Australia and Tasmania	273	8,725	2,052	10,777	151	4,975	1,190	6,165
New Zealand	4	115	724	839	4	151	441	592
French			65	65				
Philippine Islands			5,899	5,899	10	125	3,138	3,263
Africa:								
British—South	67	1,857		1,857	50	1,008		1,008
German					1	33		33
Total	54,560	1,164,486	475,541	1,640,027	49,831	1,131,086	362,347	1,493,433

ASPHALT INDUSTRY IN PRINCIPAL COUNTRIES.

The following table shows the output of natural asphalt (all forms) in the principal producing countries, by calendar years, except as otherwise stated, from 1905 to 1914, inclusive, as far as reliable statistics are available:

Production of asphalt and bituminous rock in the principal producing countries, 1905–1914, in short tons.

Year.	United States.		Trinidad.[a]		Germany.		Cuba.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1905	62,898	$305,242	114,845	$626,293	113,513	$235,620	11,180	$87,505
1906	73,062	674,934	150,373	832,964	129,388	268,631	5,717	26,605
1907	85,913	928,381	171,271	832,274	139,567	264,494	5,571	37,594
1908	78,565	517,485	143,552	403,023	98,088	188,334	6,875	31,574
1909	99,061	572,846	159,416	459,446	85,446	176,897	11,900	48,246
1910	98,893	854,234	157,120	421,419	89,491	152,565	2,320	13,685
1911	87,074	817,250	[b] 201,284	[c] 494,000	90,256	154,938	3,638	21,928
1912	95,166	865,225	[b] 212,236	[c] 521,000	105,950	200,743	17,260	87,500
1913	92,604	750,713	[b] 257,635	[c] 633,000			[d] 10,516	60,924
1914	77,588	630,623	[b] 163,076	[c] 400,411			[d] 903	15,642

Year.	France.		Italy.[e]		Spain.		Japan.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1905	211,043	$325,340	117,929	$298,097	7,135	$14,794	114	$959
1906	216,405	345,599	144,802	349,926	8,587	17,130	43	3,572
1907	195,136	330,065	178,127	442,014	9,057	16,001	644	5,436
1908	188,616	264,188	148,433	368,306	13,635	24,084	2,650	25,564
1909	186,298	269,161	123,361	305,159	5,822	10,282	4,614	45,205
1910	187,085	277,210	179,261	452,911	7,072	18,308	526	29,004
1911			207,926	591,550	[f] 4,124	8,754	1,389	13,728
1912			200,560	581,383	5,938	13,003	3,199	32,518
1913			188,601	521,398				
1914								

Year.	Austria-Hungary.		Russia.		Venezuela.		Mexico.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1905	8,257	$854,197	[g] 23,659	$201,965	[b] 33,803	$258,526	947	$9,008
1906	10,633	778,781	[g] 12,517	110,294	[b] 22,128	98,250	1,531	17,174
1907	11,335	727,892	[g] 14,116	101,705	[b] 37,637	167,938	4,945	182,265
1908	12,239	768,162	[g] 24,961	491,302	[b] 31,539	141,912	5,811	330,903
1909	11,179	663,246	[h] 2,665	4,599	[b] 37,292	180,061	6,031	106,484
1910	9,070	702,022	[h] 27,544	176,518	[b] 31,890	[c] 151,000	3,140	39,681
1911	[h] 8,312	652,603			[b] 50,163	[c] 238,000	8,912	125,322
1912	[h] 11,439	664,778			[b] 65,875	[c] 312,000	33,611	462,230
1913					[b] 83,825	[c] 400,000		
1914								

[a] Includes small quantity of manjak, produced in Barbados.
[b] Exports.
[c] Estimated.
[d] Exports for fiscal year.
[e] Only about 7 per cent of the quantity given represents asphalt, the remainder being bituminous sandstone and limestone.
[f] In addition 6,306 tons of bituminous rock were produced, no value being reported.
[g] Includes mineral pitch.
[h] Includes ozokerite.

TRINIDAD.

As a source of natural asphalt the island of Trinidad has maintained a high rank for many years, owing to the practically unlimited supply of raw material it contains and to the uniform character and high degree of suitability of its product for use in paving. The deposits of commercial importance are situated on La Brea Point, on the western shore of the island, about 30 miles south from Port of Spain, the seat of the local government.

The source of the asphalt exploited in this locality is Pitch Lake, which covers a roughly circular area of about 100 acres, lying at an elevation of 138 feet above sea level. Borings in the central part and near the sides of the lake show that the bitumen fills a bowl-like depression or crater to a depth of more than 135 feet.

The asphalt of Trinidad is described as occurring in two forms, land pitch and lake pitch, the former occurring in sheets or layers—supposed overflows from the lake—and as exudations at the surface of the land from the same source, and the latter, as the name implies, occurring in the lake bed itself. The land pitch seems to have been slightly metamorphosed at the surface by evaporation of the lighter oils and locally hardened by surface fires.

Through the courtesy of the Barber Asphalt Paving Co. the Survey is able to present the following table showing, by calendar years and principal destinations, the exports of asphalt from Trinidad from 1910 to 1914, inclusive:

Total exports of asphalt from Trinidad, 1910–1914, in long tons.

Year.[a]	To United States.			To Europe.			To other countries.			Grand total.
	Lake.	Land.	Total.	Lake.	Land.	Total.	Lake.	Land.	Total.	
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
1913	123,873	1,400	125,273	104,153		104,153	605		605	230,031
1914	67,357	2,950	70,307	75,297		75,297				145,604

[a] Ending Jan. 31 of year succeeding.

CUBA.

According to the official report of the Secretary of Agriculture, Havana, Cuba, the asphalt claims in that country aggregated 7,180 hectares (17,734.6 acres), at the end of June, 1914. The number and distribution of the asphalt workings is given as follows: Pinar del Rio, 34 mines; Havana, 36 mines; Matanzas, 35 mines; Santa Clara, 29 mines; scattered, 11 mines. Total, 145 mines.

BARBADOS.

Commercial exploitation of the deposits of the hydrocarbon manjak on the island of Barbados continued on a small scale in 1914. The quantity of Barbados manjak invoiced at the Georgetown (Venezuela) consulate for shipment to the United States in 1914 amounted to 59 long tons, having a declared value of $6,159, as compared with 112 tons, valued at $9,435 in 1913. The quantity imported by the United States is absorbed by the varnish industry.

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. The libraries of many large cities and educational institutions maintain reference files of the Survey publications.

ANDERSON, ROBERT, An occurrence of asphaltite in northeastern Nevada: Bull. 380, pp. 283–285, 1909. 40 cents.

BOUTWELL, J. M., Oil and asphalt prospects in Salt Lake basin, Utah: Bull. 260, pp. 468–479, 1905. Exhausted.

BRANNER, J. C., NEWSOME, J. F., and ARNOLD, RALPH, Geological Atlas, Santa Cruz folio (No. 163), 1909. Exhausted.

CLARKE, F. W., The data of geochemistry, 3d ed.: Bull. 616 (in press).

DAY, D. T., Asphalt: Mineral Resources, 1909, pt. 2, pp. 731–733 (75 cents), 1910; idem, 1910, pt. 2, pp. 833–839, 1911 ($1.25); idem, 1911, pt. 2, pp. 1003–1021, 1912 (exhausted); idem, 1912, pt. 2, pp. 997–1000, 1913; idem, 1913, pt. 2, pp. 537–544, 1914.

DAY, W. C., The coal and pitch coal of the Newport mine, Oregon: Nineteenth Ann. Rept., pt. 3, pp. 370–376, 1899. Exhausted.

ELDRIDGE, G. H., The uintaite (gilsonite) deposits of Utah: Seventeenth Ann. Rept., pt. 1, pp. 909–949, 1896. $2.

——— The asphalt and bituminous rock deposits of the United States: Twenty-second Ann. Rept., pt. 1, pp. 209–452, 1901. $1.60.

——— Origin and distribution of asphalt and bituminous rock deposits in the United States: Bull. 213, pp. 296–305, 1903. 25 cents.

FAIRBANKS, H. W., Geological Atlas, San Luis folio (No. 101), 1904. 5 cents.

FULLER, M. L., Asphalt, oil, and gas in southwestern Indiana: Bull. 213, pp. 333–335, 1903. 25 cents.

HAYES, C. W., Asphalt deposits of Pike County, Ark.: Bull. 213, pp. 353–355, 1903. 25 cents.

HILGRADE, E. W., The asphaltum deposits of California: Mineral Resources, 1883–84, pp. 938–948, 1885. 60 cents.

HOVEY, E. O., Asphlaltum and bituminous rock: Mineral Resources, 1903, pp. 745–754 (70 cents), 1904; idem, 1904, pp. 789–799 (70 cents), 1905.

RICHARDSON, C., Asphaltum: Mineral Resources, 1893, pp. 626–669, 1894, 50 cents.

ROBINSON, H. M., Ozokerite deposits in Utah: Bull. — (in preparation).

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, pp. 219–224, 1899.

——— Description of the unleased segregated asphalt lands in the Chickasaw Nation, Indian Territory: Circ. No. 6, U. S. Dept. Interior, 14 pp. 1904.

——— Grahamite deposits of southeastern Oklahoma: Bull. 380, pp. 286–297, 1909. 40 cents.

——— Asphalt and bituminous rock: Mineral Resources, 1906, pp. 1131–1137 (50 cents), 1907; idem, 1907, pt. 2, pp. 723–730 ($1), 1908.

TAFF, J. A., and SMITH, C. D., Ozokerite deposits in Utah: Bull. 285, pp. 369–372, 1906. Exhausted.

VAUGHAN, T. W., The asphalt deposits of western Texas: Eighteenth Ann. Rept., pt. 5 (cont.), pp. 930–935, 1897. $1.

——— Geol. Atlas, Uvalde folio (No. 64), 1899. 5 cents.

LIME.

By G. F. Loughlin.

PRODUCTION.

HISTORICAL REVIEW.

Although the statistics of the production of lime collected by the United States Geological Survey date, in one form or another, back to 1880, reliable figures showing the extent and growth of the industry have been available only since 1894. During the years 1880 to 1888 the quantity and value of lime as recorded ranged from 28,000,000 barrels, valued at $19,000,000 in 1880 to 49,087,000 barrels, valued at $24,543,500, in 1888. As the highest value during the last 20 years was only $14,648,362—in 1913—these early figures are obviously much too large; but there is no adequate means of explaining the discrepancy. The statistics are sufficiently consistent to indicate a steady growth in quantity and, with a few exceptions, in value from 1880 to 1888, but in other respects they can not be considered reliable.

During the years 1890 to 1893, inclusive, the production of lime was not separated from that of limestone, but from 1894 to 1903 the value of the lime was indicated in the reports on the stone industry, and in 1904 the quantity of lime produced was recorded in short tons for the first time. In 1905 the lime industry had grown to such proportions that a separate chapter in Mineral Resources was devoted to it and sand-lime brick, and since 1907 the lime industry alone has been the subject of a separate chapter.

The quantity, so far as possible, and the value of lime produced from 1894 to 1914, inclusive, is shown in the following table:

Quantity and value of lime burned and sold in the United States, in short tons, average price per ton, and number of plants in operation, 1894–1914.

	Value.		Quantity.	Value.	Average price per ton.	Number of plants in operation.
1894	$8,287,821	1904	2,707,809	$9,951,456	$3.68	
1895	6,588,822	1905	2,984,100	10,941,680	3.67	
1896	6,327,900	1906	3,198,087	12,480,653	3.90	979
1897	6,390,487	1907	3,092,524	12,656,705	4.09	899
1898	6,886,549	1908	2,766,873	11,091,186	4.01	949
1899	6,983,067	1909	3,484,974	13,846,072	3.98	1,232
1900	6,797,496	1910	3,505,954	14,088,039	4.02	1,125
1901	8,204,054	1911	3,392,915	13,689,054	4.03	1,139
1902	9,335,618	1912	3,529,462	13,970,114	3.96	1,017
1903	9,255,882	1913	3,595,390	14,648,362	4.07	1,023
		1914	3,380,928	13,247,676	3.92	954

These figures show a general increase in quantity and value, interrupted by occasional decreases, most conspicuous of which are those of 1908, 1911, and 1914. The decrease in 1908 was common to nearly all the industries, owing to the unsettled financial conditions which began late in 1907. This disturbance affected the lime industry sufficiently to account for the decrease in quantity in 1907, although the higher price for 1907 than for 1906 caused a slight increase in total value. In 1911 the small decrease was due to the depression that affected building materials in general, but the lime industry was not affected by this cause so much as many other industries, and was reported generally in good condition. The year was marked by a tendency on the part of manufacturers to improve their products and methods of manufacture. In 1912 and 1913 the demand was greater than ever before, and the production for 1913 broke the record in both quantity and value.

The price per ton since 1904 has fluctuated, but on the whole has gradually increased, although the maximum was in 1907. The number of lime burners first recorded in 1906, decreased in 1907, and then rose to a maximum in 1909. The increase was largely among the farmers, especially in Pennsylvania, who burned small quantities of lime for their own use. These, however, have been decreasing in number, especially since 1911, owing largely to the increased cost of fuel, and also to the fact that several of them find it more convenient to purchase fertilizer from large producers.

The most marked feature of the lime industry since 1906 has been the rapid growth in the production of hydrated lime, which in 1913 had increased over 400 per cent in both quantity and value. Its price per ton has fluctuated between \$3.98 and \$4.69, and was highest in 1907. During the last four years, 1911 to 1914, inclusive, its average price has been \$4.43. The production of hydrated lime from 1906 to 1914, the average price per ton, and the total number of manufacturers reporting to the Survey are shown in the table on page 370.

MARKETED PRODUCTION IN 1914.

The lime manufactured and sold in the United States in 1914 amounted to 3,380,928 short tons, valued at \$13,247,676. This was a decrease of 214,462 tons, or 5.96 per cent, in quantity, and of \$1,400,686, or 9.56 per cent, in value, compared with the output for 1913, which was 3,595,390 short tons, valued at \$14,648,362. The value given represents the value of bulk lime f. o. b. at point of shipment, and does not include any weight or cost of barrel or package. Both the quantity and the value for 1914 are less than for any previous year since 1908, and show how severely the lime industry as a whole was affected by the business depression of the year.

The decrease in average price was not general for the entire country. The States with increase and those with decrease in average price were about equally divided, and the amounts of increase and decrease varied greatly from State to State. The Atlantic States as a whole suffered a decrease in price, although Massachusetts, Rhode Island, and Maryland showed slight gains. Pennsylvania, the largest producer, had the same average price as in 1913. The States between Michigan on the north and Alabama on the south showed small to large increases, but the Mississippi River States just west of them suffered considerable decreases. The price also decreased in Texas. There was a prevailing increase in price in the Western States with the exception of Idaho, Nevada, and Utah. The greatest increases in average price were in Arizona (97 cents), and Colorado (94 cents); the greatest decreases were in Utah (56 cents), and Maine (\$1.97).

Analysis of returns from the different States does not point to very definite reasons for the increase and decrease in the average price per ton. In most of the Eastern States, where lime for fertilizer formed a considerable part of the total, there was a decrease in average price in spite of the fact that the average price per ton of lime for fertilizer for the whole country increased from $3.05 to $3.13. In Pennsylvania, however, the decrease in the price of lime for fertilizer was offset by an increase in the price of lime for building. Eastern and Central States, in which lime for building forms a large fraction of the total, were about equally divided as regards increase or decrease in average price per ton. The value of the lime produced for any of the other uses shown in the table on page 368 was not conspicuous in a sufficient number of States to afford definite information. It appears, therefore, that the increase or decrease in average price in different States was largely due to local conditions, especially in the building trades.

Detailed statistics of the production of lime in 1913 and 1914 are given in the following table:

Quantity and value of lime burned and sold in the United States in 1913 and 1914, by States, in short tons, rank of State, average price per ton, and number of plants in operation.

1913.

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	16	75,468	$290,394	16	$3.85	12
Arizona	23	18,292	99,550	22	5.44	3
Arkansas	22	19,391	95,846	23	4.94	5
California	17	73,715	569,874	9	7.73	19
Colorado	29	7,875	46,390	29	5.89	8
Connecticut	15	76,192	382,347	12	5.02	10
Florida	24	16,845	89,973	24	5.34	5
Georgia	37	3,550	13,483	38	3.80	3
Hawaii	34	(a)	(a)	31	8.15	1
Idaho	36	4,133	22,413	35	5.42	4
Illinois	12	95,977	433,331	11	4.51	16
Indiana	11	96,359	323,905	15	3.36	10
Iowa	26	10,015	47,520	28	4.74	3
Kansas	42	(a)	(a)	40	4.95	1
Kentucky	31	6,001	24,313	34	4.05	9
Maine	7	146,970	906,604	4	6.17	5
Maryland	10	108,883	357,392	13	3.28	40
Massachusetts	8	130,365	683,541	8	5.24	10
Michigan	14	77,088	331,852	14	4.30	10
Minnesota	21	22,800	112,300	21	4.93	5
Missouri	6	161,770	734,009	7	4.54	27
Montana	30	(a)	(a)	30	5.84	2
Nevada	44	(a)	(a)	44	6.60	1
New Jersey	25	14,378	55,775	26	3.88	15
New Mexico	41	1,246	8,612	41	6.91	3
New York	9	114,071	503,157	10	4.41	34
North Carolina	27	9,815	47,838	27	4.87	4
Ohio	2	497,693	1,976,316	2	3.97	38
Ohlahoma	39	2,640	12,160	39	4.61	4
Oregon	32	4,747	30,704	32	6.47	5
Pennsylvania	1	852,927	2,743,197	1	3.22	494
Porto Rico	33	4,738	19,707	37	4.16	38
Rhode Island	38	(a)	(a)	36	6.53	1
South Carolina	40	(a)	(a)	42	3.00	1
South Dakota	35	4,217	28,610	33	6.78	5
Tennessee	13	92,427	288,400	17	3.12	15
Texas	18	45,897	255,893	18	5.57	10
Utah	28	8,680	56,704	25	6.53	10
Vermont	19	32,803	171,138	20	5.22	9
Virginia	4	236,665	805,443	5	3.40	48
Washington	20	28,070	178,945	19	6.37	9
West Virginia	5	282,683	789,901	6	3.39	31
Wisconsin	3	243,006	1,005,496	3	4.14	39
Wyoming	43	(a)	(a)	43	12.92	1
Other States [b]	....	16,998	105,329	....	....	....
Total	....	3,595,390	14,648,362	....	4.07	1,023

[a] Included in "Other States."
[b] Includes Hawaii, Kansas, Montana, Nevada, Rhode Island, and Souuth Carolina.

Quantity and value of lime burned and sold in the United States in 1913 and 1914, by States, in short tons, rank of State, average price per ton, and number of plants in operation—Continued.

1914.

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	17	46,966	$199,814	18	$4.25	12
Arizona	23	19,093	122,324	21	6.41	3
Arkansas	22	19,230	92,067	23	4.79	6
California	16	55,492	430,792	9	7.76	16
Colorado	32	5,415	36,996	29	6.83	4
Connecticut	14	70,534	338,601	14	4.80	10
Florida	26	12,376	64,531	25	5.21	5
Georgia	42	(a)	(a)	42	3.50	1
Hawaii	34	(a)	(a)	27	10.00	1
Idaho	33	(a)	(a)	34	5.00	2
Illinois	12	87,603	362,727	12	4.14	16
Indiana	10	99,185	358,738	13	3.62	9
Iowa	25	(a)	(a)	26	4.52	2
Kentucky	29	5,978	26,762	33	4.47	9
Maine	8	122,218	512,842	8	4.20	5
Maryland	9	115,845	390,298	11	3.37	4
Massachusetts	7	124,199	652,067	7	5.25	11
Michigan	15	66,507	287,648	15	4.33	10
Minnesota	21	22,057	104,195	22	4.72	5
Missouri	6	155,680	686,051	5	4.41	21
Montana	31	(a)	(a)	32	5.86	2
Nevada	37	(a)	(a)	36	6.50	1
New Jersey	27	10,953	41,226	28	3.76	10
New Mexico	41	(a)	(a)	40	7.00	2
New York	11	94,009	396,494	10	4.22	26
North Carolina	28	8,098	36,356	31	4.49	3
Ohio	2	480,010	1,880,836	2	3.92	44
Oklahoma	39	2,293	11,130	39	4.77	4
Oregon	36	3,143	21,576	35	6.86	4
Pennsylvania	1	849,963	2,740,238	1	3.22	476
Porto Rico	35	4,231	15,835	38	3.74	36
Rhode Island	38	(a)	(a)	37	7.00	1
South Carolina	40	(a)	(a)	41	2.93	1
South Dakota	30	5,603	36,976	30	6.60	4
Tennessee	13	85,939	266,881	16	3.11	14
Texas	18	37,365	200,788	17	5.37	10
Utah	24	12,425	74,212	24	5.97	11
Vermont	20	28,758	142,034	20	4.94	8
Virginia	3	243,990	763,775	4	3.13	40
Washington	19	29,430	189,260	19	6.43	8
West Virginia	5	192,195	680,065	6	3.54	28
Wisconsin	4	227,469	871,820	3	3.83	36
Other States [b]	....	36,676	211,721	....	....	....
Total	....	3,380,928	13,247,676	....	3.92	954

[a] Included in "Other States."
[b] "Other States" includes Georgia, Hawaii, Idaho, Iowa, Montana, Nevada, New Mexico, Rhode Island, and South Carolina.

The total number of plants reporting operations in 1914 was 954, as compared with 1,023 in 1913, 1,017 in 1912, and 1,139 in 1911. The number operating in 1914 was, with the exception of that in 1908, the smallest since record of them was first made in 1906. The decrease was evidently in part temporary, owing to the unfavorable conditions of the year, but in part it marked a continuance of the tendency of the industry toward combination. In contrast to the decrease in number of plants, the number of kilns in operation increased from 2,203 in 1912 to 2,338 in 1913 and to 2,374 in 1914. This increase, however, was in part due to the more complete returns received in successive years. These figures, furthermore, are not entirely satisfactory, as some operators apparently do not distinguish between the total number of kilns in the plant and the number operated during the year, and several small producers evidently report the number of times a single kiln was operated as the number of kilns operated.

As in 1913, a number of isolated lime manufacturers, operating on a small scale, reported their plants idle on account of cost of production and cost and scarcity of labor, which prevented competition with lime shipped in from the outside.

In 1914, Hawaii and Porto Rico included, 42 States reported a production of lime. In 1913 there were 44 producing States, including Kansas and Wyoming, which were idle in 1914. The five leading States in 1914 were, in order of production, Pennsylvania, Ohio, Virginia, Wisconsin, and West Virginia. In 1913 the order was Pennsylvania, Ohio, Wisconsin, Virginia, and West Virginia. Virginia's large reported production during the last two years has been due to a great quantity of lime burned and used by alkali manufacturers, whose figures were not obtained prior to 1913. Pennsylvania produced 25.1 per cent of the lime output and Ohio 14.2 per cent, but Ohio's production was from 44 plants, while Pennsylvania's output was from 476 operations, mostly the stack kilns of farmers burning lime in small quantities for use as a soil enricher for their own or their neighbor's farms. The decrease in the number of operators in Pennsylvania, which was 494 in 1913, shows that this practice of burning in small quantities is continuing to decline, both on account of the difficulty in obtaining labor and wood for burning and of increased cost of coal. The value of lime burned for use by farmers continues to range from 6 to 12 cents a bushel of 70 to 80 pounds, according to whether the fuel is purchased or obtained on the farm. The average price of this lime has increased slightly, but it is still so low as to decrease considerably the average for the entire State. The use of coal for fuel instead of wood is increasing, especially where the farmers can obtain the coal on their own farms. A considerable quantity of lime is also burned in small quantities for agricultural use in Maryland, Virginia, and West Virginia. A quantity of marl burned or dried and used for agricultural purposes is included in the lime figures for New York, North Carolina, South Carolina, and Wisconsin.

A quantity of limestone is sold each year to various burners of small limekilns and the value of this lime is not included in the lime figures, but is included under the value of limestone in the report on the stone industry. This also applies to a considerable quantity of stone quarried and sold to sugar refiners, smelters, and alkali works and burned by them into lime after the stone leaves the hands of the quarrymen. In a few cases limestone quarried in Ohio is shipped to Wisconsin and Minnesota to be burned into lime, and is necessarily included in the report on the stone industry.

The expression of quantity in tons in the foregoing tables is a recalculation of the quantities by weight reported by producers. Heretofore there has been no standard unit of quantity. Some producers report quantity in bushels which vary in weight from 40 to 80 pounds. In some cases the number of pounds in a bushel depends upon the State in which the lime is sold, and in other cases the weight per bushel may vary within a single State. Where lime is shipped in barrels, the weight per barrel varies from 160 to 300 pounds, and may or may not include the weight of the barrel. This variation, it is hoped, will be largely corrected when the bill recently passed by Congress adopting standard barrels for dry measures becomes effective on July 1, 1916. According to this bill (H. R. 4899, 1st sess. 63d Cong.), the dimensions of the standard barrel will be as follows:

Length of staves, 28½ inches; diameter of heads, 17⅛ inches; distance between heads, 26 inches; circumference at bilge, 64 inches, outside measurement; thickness of staves not greater than four-tenths of an inch. It is further provided that any barrel of different form having a capacity of 7,056 cubic inches shall be a standard barrel.

USES.

Lime is used for a great variety of purposes, which have been given in detail in previous reports on this subject. The principal uses, as far as it is possible to give them, are shown in the following table. Under the head of "Dealers—uses not specified" is included a considerable quantity of lime which would necessarily raise the figures for all the other products, but the manufacturers were not able to classify the figures given under this heading.

Marketed production of lime in the United States in 1913 and 1914, by uses, in short tons

1913.

	Quantity.	Value.	Average price per ton.
Building lime	1,358,099	$6,011,856	$4.43
Chemical works	388,369	1,339,228	3.45
Paper mills	284,090	1,187,154	4.18
Sugar factories	32,236	216,768	6.72
Tanneries	49,591	217,390	4.38
Fertilizer	590,229	1,798,566	3.05
Dealers—uses not specified	692,265	3,153,457	4.56
Other uses [a]	200,511	723,943	3.61
Total	3,595,390	14,648,362	4.07
Hydrated lime, included in total	493,269	2,205,657	4.47

1914.

	Quantity.	Value.	Average price per ton.
Building lime	1,163,433	$5,047,113	$4.34
Chemical works	367,497	1,202,178	3.27
Paper mills	242,998	915,369	3.77
Sugar factories	31,931	187,605	5.88
Tanneries	43,793	190,253	4.34
Fertilizer	689,948	2,161,844	3.13
Dealers—uses not specified	646,490	2,791,139	4.32
Other uses [a]	194,838	752,175	3.86
Total	3,380,928	13,247,676	3.92
Percentage of decrease (−) in 1914	−5.96	−9.56	....
Hydrated lime, included in total	515,121	2,239,916	4.35
Percentage of increase (+) in 1914	+4.43	+1.55	....

[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.

Lime used for building represents more than one-third of the total output, probably one-half if this product were segregated from the quantity sold to dealers. Building lime in 1914 decreased both in quantity and in value in comparison with the production in 1913. The average price per ton also decreased from $4.43 in 1913 to $4.34 in 1914. There has been a general decrease in quantity and value during the last five years, during which the average price per ton has fluctuated from $4.22 (in 1912) to $4.54 (in 1911). The general business depression may account in part for the decrease in production of the last year, but the decrease in quantity in 1914 compared with 1913 is not quite as great as was the decrease in 1913 compared with 1912. Strikes in the building trades at Chicago account for the decreases in Illinois and Wisconsin, and, to a less extent, for those in Minnesota and Iowa.

Lime for chemical works in 1914 showed a decrease in quantity of 20,872 tons from the quantity produced in 1913, and a decrease in value of $137,050, owing to a drop of 18 cents in the average price per ton. Both quantity and value in 1914 exceeded those of 1910, 1911, and 1912.

Lime for paper mills in 1914 decreased both in quantity and in value, as well as in average price per ton, when compared with the production in 1913. The quantity and value produced in 1914 are also less than the corresponding figures for 1910, 1911, and 1912. The average price per ton, $3.77, in 1914 was also less than for these preceding years except 1910, when the average price was $3.76.

Lime for sugar factories in 1914 also decreased in quantity and value when compared with the figures for 1913, but both quantity and value were greater than in 1912, though lower than in 1911. The average price per ton in 1914 was much less than in the four preceding years. The significance of these figures, however, as indicators of conditions in the sugar industry may be somewhat indefinite, as many sugar factories buy limestone and burn their own lime. This limestone is necessarily included in the stone-industry report. The following table shows the value of limestone and lime used by sugar factories as reported to the Survey during the last five years:

Value of limestone and lime used by sugar factories, 1910–1914.

	1910	1911	1912	1913	1914
Limestone	$362,400	$300,717	$335,108	$387,724	$323,796
Lime	239,536	242,344	186,164	216,768	187,605
Total	601,936	543,061	521,272	604,492	511,401

These figures show a general decline in total value except in 1913, when there was a marked increase, which corresponds with a large increase in the average price per ton for lime in that year. The total value in 1914 was less than in any one of the four preceding years, and corresponds to a drop in the average price of lime, which was also lower than in the preceding years.

Lime for tanneries in 1914 decreased both in quantity and in value when compared with the figures for 1913, but both quantity and value were greater than in 1910, 1911, and 1912. The average price per ton, $4.34, was less than in any one of the four preceding years.

Lime for fertilizer, although suffering a decrease in 1913, made a very substantial gain in 1914, both in quantity and in value, over the figures for the four preceding years. The average price per ton also increased 8 cents. This increase is especially noteworthy in view of the fact that agricultural lime is meeting with considerable competition from pulverized limestone.

The quantity of lime produced in 1914 for "other uses" was somewhat less than that produced in 1913, but its total value was greater owing to an increase of 25 cents in the average price per ton.

HYDRATED LIME.

In spite of the decrease in total production of lime, the production of hydrated lime continued to increase in 1914, although the rate of increase was small compared to the increases in the two preceding years. The increase in 1914 was 4.43 per cent in quantity and 1.55 per cent in value; in 1913 it was 18.32 per cent in quantity and 20.59 per cent in value; in 1912 it was 36.87 per cent in quantity and 33.31 per cent in value.

The output in 1914 was 515,121 tons, valued at $2,239,916; for 1913 it was 493,269 tons, valued at $2,205,657, an increase in 1914 of 21,852 tons in quantity and of $34,259 in value. These figures do not represent quite the total quantity of hydrated lime, as some of the lump lime sold by producers was converted into hydrated lime by dealers. Of the total output of hydrated lime 126,136 tons were used in 1914 for fertilizer. The average price per ton, which rose from $4.39 in 1912 to $4.47 in 1913, decreased to $4.35 in 1914.

The number of hydrating plants was increased from 80 in 1913 to 82 in 1914. Twenty-four States reported active hydrating plants in 1914, the same number as in 1913; but the plants in Florida and Georgia, active in 1913, were idle in 1914, while a plant in Connecticut became again active and a new plant was reported active in Rhode Island. The number of plants increased in Alabama, Indiana, Maryland, Missouri, and Ohio, but decreased in California, Michigan, Pennsylvania, and Virginia.

The following table shows the quantity and value of the hydrated lime produced and sold in the United States from 1906 to 1914, inclusive, together with the average price per ton and the total number of manufacturers reporting to the Survey:

Marketed production of hydrated lime in the United States, 1906–1914, 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
1913	493,269	2,205,657	4.47	80
1914	515,121	2,239,916	4.35	82

The following table shows the number of lime-hydrating plants reported to the Survey as operating in the United States during the last nine years, and draws attention to the steady development of this phase of the lime industry:

Number of lime-hydrating plants in operation in 1906–1914, by States.

State or Territory.	1906	1907	1908	1909	1910	1911	1912	1913	1914
Alabama	1	1	1	3	2	2	2	2	3
Arizona	1	1	1	1	1	1	....	....	....
California	....	1	2	2	2	3	3	4	2
Colorado	....	1	....	1	1	....	....	....	....
Connecticut	1	....	....	1	....	....	1	....	1
Florida	....	....	1	....	1	....	....	1	....
Georgia	2	1	1	....	....	1	1	1	....
Hawaii	....	....	....	....	1	....	....	....	....
Idaho	....	....	....	1	1	1	1	....	....
Illinois	....	1	1	2	2	1	1	1	1
Indiana	2	2	2	2	2	2	2	2	3
Iowa	1	....	....	1	....	....	....	1	1
Kansas	1	1	....	1	....	....	....	....	....
Kentucky	....	....	....	....	....	....	....	1	1
Maine	1	1	1	1	1	1	1	1	1
Maryland	....	....	1	1	3	3	3	4	6
Massachusetts	....	....	....	....	1	2	....	1	1
Michigan	1	1	2	1	2	3	1	3	2
Missouri	....	2	2	3	3	3	4	4	6
New Jersey	....	....	1	1	....	2	1	1	1
New York	1	2	2	3	....	2	3	4	4
North Carolina	....	....	....	....	....	1	....	....	....
Ohio	8	9	11	8	11	15	17	19	20
Pennsylvania	8	6	11	9	8	8	15	15	14
Rhode Island	....	....	....	....	....	....	....	....	1
South Dakota	....	....	....	....	1	1	....	1	1
Tennessee	....	....	1	1	1	1	1	2	2
Texas	....	....	1	3	3	3	3	3	3
Virginia	....	....	1	2	....	1	....	2	1
Washington	....	....	....	....	....	1	1	2	2
West Virginia	1	1	1	....	2	1	2	3	3
Wisconsin	1	2	2	2	2	1	1	2	2
Total	30	33	46	50	51	60	64	80	82

IMPORTS.

The imports of lime for consumption in the United States in 1914 were reported by the Bureau of Foreign and Domestic Commerce as 3,455 short tons, valued at $33,670, as compared with 4,139 short tons, valued at $48,538, in 1913, a decrease in quantity of 684 tons and in value of $14,868. The quantity of imports has been steadily decreasing and for some years has been insignificant.

EXPORTS.

Exports of lime steadily increased in recent years, both in quantity and in value, until 1913, when they amounted to 294,746 barrels, valued at $212,345, or 1.45 per cent of the total value of domestic production. In 1914, however, they dropped to 241,406 barrels, valued at $170,744, a decrease in quantity of 53,340 barrels and in value of $41,601. The value of exports in 1914 was 1.29 per cent of the value of domestic production.

FUELS.

The statistical inquiry of the Survey into the efficiency of various fuels in burning lime has yielded some results, though far from what could be wished. Information obtained from operations in 1914 does not alter the data already published. The data is not sufficient to make reliable averages, for many producers have not replied to the inquiry; and although some have given figures evidently based on measurements, others have 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, according to the kind of coal used, from 1.5 to 6 pounds, but the average was about 3.6 pounds. 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 reported as a fuel showed a range from 1,000 to 6,400 pounds of lime burned by a cord of wood. In spite of this wide range, 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, and varies with the kind of wood used.

It is still hoped that in the future more satisfactory data can be obtained on this question of the efficiency of different fuels.

The following tables show the kinds of fuels and number of kilns using the various fuels as reported for 1913 and 1914:

Number of kilns using various kinds of fuel, by States, in 1913 and 1914.

1913.

State or Territory.	Coal.	Wood.	Oil.	Natural gas.	Producer gas.	Coke.	Coal and wood.	Coal and coke.	Total.
Alabama	18						30		48
Arizona		9							9
Arkansas		12							12
California		7	40			5			52
Colorado	9	2				1			12
Connecticut	7	32							39
Florida		18							18
Georgia	2	3							5
Hawaii			2						2
Idaho	1	7				2			10
Illinois	4	24				1			29
Indiana	50	1	2	1	2				56
Iowa		5							5
Kansas	1								1
Kentucky	7	4	1						12
Maine	43	15							58
Maryland	78	6				25	7	5	121
Massachusetts	3	11			3		18		35
Michigan		25							25
Minnesota	9	6							15
Missouri	19	31			2		22		74
Montana		2							2
Nevada			1						1
New Jersey	33	2							35
New Mexico	2	1							3
New York	39	7			1		6		53
North Carolina							4		4
Ohio	190	5		26	53		6		280
Oklahoma		2							2
Oregon		2					2		4
Pennsylvania	701	21			8	19	76	9	834
Rhode Island	2								2
South Dakota	1	7							8
Tennessee	30	4				1	6	1	42
Texas	1	15	8	2	2	4			32
Utah	9	1				5			15
Vermont		13					17		30
Virginia	43	31				18	14		106
Washington		24							24
West Virginia	28	5		1	3	42	7	7	93
Wisconsin	3	119			2		5		129
Wyoming	1								1
Total	1,334	[a] 479	54	30	76	123	220	22	2,338

[a] Includes 19 kilns using shavings.

Number of kilns using various kinds of fuel, by States, in 1913 and 1914—Continued.

1914.

State or Territory.	Coal.	Wood.	Oil.	Natural gas.	Producer gas.	Coke.	Shavings.	Coal and wood.	Coal and coke.	Total.
Alabama	8	10			8			9		35
Arizona	7									7
Arkansas		11						2		13
California		7	36			3				46
Colorado	3	1				1				5
Connecticut	9	26								35
Florida		19								19
Georgia								2		2
Hawaii			2							2
Idaho		5				2				7
Illinois	8	6		1			21	12		48
Indiana	44	1								45
Iowa		5								5
Kentucky	8	4								12
Maine	41	14					5			60
Maryland	87	3				39		7	1	137
Massachusetts	9	9			6			20		44
Michigan		32			1					33
Minnesota	8	6								14
Missouri	28	31			2			23		84
Montana		7								7
Nevada			2							2
New Jersey	19	1								20
New Mexico	1							1		2
New York	39	10			1			8		58
North Carolina	1							4		5
Ohio	206	10		33	55	5		6		315
Oklahoma		4								4
Oregon		2						1		3
Pennsylvania	765	19			2	32	3	20	25	866
Rhode Island	2									2
South Dakota	2	4								6
Tennessee	26	1				1		6	1	35
Texas	1	12	7	2	4	5				31
Utah	7	5				7				19
Vermont		8			4			8		20
Virginia	44	20				29		24		117
Washington		23								23
West Virginia	28	3			3	44		4		82
Wisconsin	3	101								104
Total	1,404	420	47	36	86	168	29	157	27	2,374

PEAT.

By Charles A. Davis.

INTRODUCTION.

Peat is incipient coal. It is made up of the more or less thoroughly decomposed and carbonized remains of plants accumulated under conditions that have prevented their complete transformation into gaseous and mineral matter. In the course of their growth plants segregate carbon dioxide from the gases of the atmosphere and, by the aid of sunlight, decompose it and water in their green tissues and recombine the elements into complicated organic compounds, in which carbon is the characterizing element. If the compounds formed in this way by practically all green plants decay in the air, they are slowly changed back to gases again, chiefly by the activities of plants and animals of low orders, the biochemical agents of decomposition. If, however, the air is excluded from accumulations of plant material, chemical and physical changes of quite a different character take place—and much more slowly than when air is present—by which the vegetable matter loses only a part of its constituents. In the course of such changes and losses two gases—hydrogen and oxygen, the chemical elements that form water—disappear more quickly than carbon, the third important chemical element, which in combination with them forms cellulose and lignin, the compounds of which most plant tissues and organs are composed. The carbon is concentrated as such changes continue, and the original plant material becomes more and more nearly pure carbon. Peat, lignite, coal, anthracite, and graphite, a form of carbon, are successive stages in this process of carbonization as it is represented in nature. Similar changes are made in wood or other plant structures when they are heated in closed vessels, the residue left after heating being charcoal, also a form of nearly pure carbon.

CONDITIONS UNDER WHICH PEAT OCCURS.

The chief agency by which vegetable matter is preserved from the attacks of air-requiring organisms is water. Peat, therefore, is found—if other conditions permit the growth of vegetation—in lakes, swamps, marshes, bogs, and other perennially wet places. Such places are found where the land surface contains many depressions and poorly drained plains, where the temperatures of air and soil are low in summer and the humidity of the air is high, and where precipitation exceeds run-off and evaporation combined.

DISTRIBUTION OF PEAT IN THE UNITED STATES.

In the United States the regions most favorable for the occurrence of deposits of peat are in the States lying east of about the ninetieth meridian and north of an irregular line following the southern margin of the last or Wisconsin glacial drift. This line runs nearly due east across north-central Iowa, Illinois, Indiana, and Ohio, and, after dipping southward a short distance along the Appalachians, turns northeastward across Pennsylvania and New Jersey nearly to the coast. Peat deposits are also of frequent occurrence in the region extending southward from New Jersey along the Coastal Plain to and including Florida. In the regions of heavy rainfall along the Pacific coast peat deposits occur wherever the drainage is sufficiently interrupted to allow the soil to be flooded or permanently saturated by water.

The States known to have the most extensive peat deposits are Florida and those along the northern border as far west as North Dakota. These States, with the exception of Michigan and Ohio, have no known coal deposits and, on account of climatic and industrial conditions, are extensive consumers of fuel, a constantly increasing percentage of which has to be imported from distant mines by rail and water.

USES OF PEAT IN EUROPE.

PEAT AS FUEL.

PRESSING WATER FROM PEAT.

The most serious difficulty in producing peat fuel on a large commercial scale is the necessity of eliminating from the raw material the large percentage of water it contains. This may constitute considerably more than 90 per cent of the weight of the peat in an undrained deposit and is seldom less than 85 per cent in well-drained bogs. This water, because of the mechanical structure of the partly decomposed vegetable matter with which it is associated and the peculiar chemical compounds of which it forms a part, can not be cheaply and quickly pressed out of the peat even by the use of great mechanical force. The mechanical extraction of water from peat has been attempted by inventors and students of peat problems for more than 50 years. Many types of presses have been used, but with no practical success.

RAW PEAT.

For centuries peat has been extensively used for domestic fuel by the peasantry of northern Europe. It has long been the custom there to cut the peat from carefully drained deposits in brick-shaped blocks by means of specially shaped spades and knives and to dry these blocks by exposure to the heat of the sun and air during the short summers. More recently the quantity of peat mined has been increased, and the quality, and therefore the efficiency, of the fuel produced has been greatly improved, so that it can be used to produce power. These results have been attained by the improvement of the machinery for digging and grinding the raw peat, for shaping it into blocks of convenient size, and for spreading out the blocks thus formed to dry on the surface of the bog or on special drying grounds. By far the greater part of the peat fuel used in Europe is produced by some modification of this process of air drying the wet peat. Fuel thus prepared is called "machine peat."

BRIQUETTED PEAT.

Peat is also prepared for fuel by partly air drying it and reducing it to powder. The partly dried powder is then artificially dried to a fixed moisture content and is pressed into briquets of uniform size, shape, density, and weight by a powerful press of special form, called a briquetting press.

Briquetting has proved highly successful in various European countries for increasing the compactness and fuel efficiency of coal fines and of lignite, but for several reasons it has never been wholly satisfactory for peat. The most recent information available from Europe indicates that after many commercial trials, extending over at least a quarter of a century, there was but a single peat-briquetting plant in operation in Europe in 1913. This plant produced only a very small part of the estimated output of that year of more than 15,000,000 metric tons.

POWDERED PEAT.

Powdered peat is made ready for use as fuel by crushing and grinding machine peat blocks after they have been dried down to about 35 or 40 per cent moisture by exposure to sun and wind. The crude powder thus obtained is screened and then heated in rotary driers until the peat contains only about 15 per cent of moisture. After this treatment the powder may be used for firing steam boilers by burning it in blast burners of a design suitable to give the most complete and efficient combustion. Good peat thus treated is reported to give nearly as much energy in the form of live steam as the same weight of good English coal, and in Sweden, where the tests were conducted, at a less cost per ton of fuel.

The production and use of powdered peat for fuel are still in the experimental stage, but, if the reports of officially conducted tests are to be relied on, have very considerable possibilities, not only for boiler firing but for metallurgical work, such as smelting and refining, and also for use in cement and other kinds of kilns, such as have already been successfully fired by burning powdered coal.

PEAT CHARCOAL OR COKE.

When peat is heated in covered heaps or in closed ovens or retorts of iron or masonry, gaseous, liquid, and tarry volatile substances are driven off by the heat. The greater part of the carbon and all the mineral matter of the organic compounds of the peat are left behind as charcoal or coke. The so-called coke obtained from peat is, in reality, only a charcoal, as there is no such fusion of particles by the action of heat as takes place in the coking of coal.

The manufacture of peat coke is expensive unless the volatile matter driven off from the peat can be recovered and used or made into salable products, because only about one-third of the original weight of the peat used is recoverable as coke of the best grade. It is possible to recover this volatile matter, and for more than 60 years experimenters have attempted to utilize in commercial plants the methods used in recovering chemical by-products in plants for the distillation of wood. Many of these attempts have resulted only in technical success, and few such plants have been commercially profitable to their owners.

The chemical by-products to be obtained by distillation of peat are practically the same as those yielded by wood, but in different proportions. Only those having the highest market value and recoverable in the largest percentages are recovered in practice, unless the plants are of unusually large size. The volatile substances driven off during the coking process are converted into gases. The lightest of these compounds do not condense on cooling, and they contain so large a percentage of combustible matter that they can be burned to keep up the heat necessary to carry on distillation. In order to separate such gases from the condensable portions of the distillate they are passed through cooling and washing chambers, in which the less volatile gases are condensed into liquids.

These liquids are of varying density and weight and readily separate by gravity into the heavy, tarry liquids and the lighter watery ones, the tars remaining at the bottom of the condensing chambers and the light, watery solutions rising to the top, whence they may be drawn off. From such solutions the valuable chemical compounds which they contain may be recovered and purified by distillation, by crystallization, or by precipitation in insoluble form, and filtration.

From the watery compounds may be had methyl or wood alcohol, acetic acid or some of its derivatives, and ammonia. Ammonia is the most valuable substance thus obtained. It is usually recovered as ammonium sulphate, a very important constituent of commercial fertilizers. In practice it is usually the only by-product considered worth recovering from the tar water.

The tarry constituents of the distillates may be separated into a variety of compounds of greater or less commercial value by redistillation. In practice, illuminating and lubricating oils and paraffin wax may thus be easily obtained. The heavy tars left after redistillation are asphalt-like substances and may be employed for some of the same uses as asphalt. Another way of utilizing the tars is to saponify them and to use the product as lubricator for wheels of cars and heavy trucks.

The charcoal derived from well-macerated peat in the form of thoroughly dried blocks is hard and tough, and it sustains greater crushing force than the best hardwood charcoal. It contains very low percentages of sulphur and phosphorus and is, therefore, valuable for metallurgical work. Nearly all the peat coke produced in Europe is used in refining metals and in producing the highest grades of steel. The latest reports from European countries indicate that two plants making peat coke are in operation and that they recover the by-products.

WET CARBONIZATION OF PEAT.

Some years ago Ekenberg, a Swedish chemist, announced that he had discovered that by heating raw peat under a pressure of 10 atmospheres to a temperature of about 170° C., the colloidal compound which holds the water in the peat, and which he identified as hydrocellulose, is destroyed. After this heating the water can be quickly and cheaply pressed from the cooked peat and the residue be compressed into firm, very dense briquets, which, on further drying, make excellent fuel. By this process, which was called wet carbonizing by Ekenberg, the peat was blackened and, according to published reports, lost weight, the loss being accompanied by the evolution of heat and gases. Ekenberg died without making his process commercial, but, after several years of experimentation, the company controlling the patents on the process announced the completion of a successful mechanical plant capable of converting raw peat of the best quality into wet-carbonized peat fuel, which, it was claimed, equaled high-grade coal in fuel value. Such plants were being built in at least two European countries in the summer of 1914, when the breaking out of the war caused a total suspension of operations.

The objection to this and to all other processes requiring the repeated handling of large volumes of raw peat by expensive machinery, is that each additional operation adds disproportionately to the costs to be charged against the finished product, because the large quantities of water it contains are handled at a loss, a loss that must be paid out of the selling price of the fuel. The selling price, however, is largely fixed by the market price of coal, which is comparatively stable and low. Therefore, the simpler the process of producing a salable fuel the more likely it is to be financially successful.

PRODUCER GAS FROM PEAT.

Peat consumed in any properly designed gas producer yields producer gas good in quality and abundant in quantity in comparison with the yield from coal. This seems to be the most effective way to use peat fuel for generation of power, because fuel so used does not need as careful preparation nor as thorough drying as when it is to be used under steam boilers. The gas producers can be located at the bogs and the gas generated can be converted into electric energy by the use of gas engines and transmitted to centers of consumption more cheaply than the fuel can be transported. If this procedure does not seem desirable, the producer gas can be piped long distances and used for firing steam boilers, for metallurgical work, for firing kilns, or in gas engines, by means of which the highest efficiency in the use of any given fuel can be attained.

Several European manufactures of gas producers have developed gas-producer plants for using peat fuel that have been in commercial operation long enough to demonstrate their practical value. Such plants have been used successfully in England, Ireland, Germany, Sweden, and Russia for the generation of electricity for light and power and also to furnish power directly for various manufacturing industries.

BY-PRODUCT GAS PRODUCERS.

Peat, in comparison with coal and lignite, contains a large percentage of combined nitrogen in the form of decomposable organic compounds. In much peat this nitrogen exceeds 1.5 per cent of the dry weight of the peat, and in some it is as much as 2.5 or 3 per cent, or in the proportion of 50 to 60 pounds to the ton.

In the early stages of gasification of fuels in gas producers the more volatile substances are given off in large volume from the less strongly heated parts of the fuel. Among these substances is the ammonia generated by the decomposition of the nitrogen compounds. If the ammonia thus liberated is heated too hot, however, it is in turn decomposed into its constituent elements and is lost. By keeping the fuel bed in the gas producer at temperatures so low that the ammonia is not destroyed and yet high enough to decompose the rest of the fuel into burnable gases, at least 75 per cent of the ammonia may be separated from other gases during the purifying process or scrubbing necessary to prepare producer gas for use in gas engines and may be fixed in permanent compounds. The fuel bed is kept at the low temperature necessary for getting a large yield of ammonia by the introduction of steam at proper intervals and the ammonia is made to combine with sulphuric acid by bringing the gases with which it is mixed into contact with the acid in the form of a fine spray. The ammonium sulphate thus formed passes into solution in tanks or receptacles provided for the purpose, from which at intervals it is drawn off, crystalized, filtered, and purified. By-product gas producers are used only in plants in which 2,000 or more horsepower is to be generated, because the returns in ammonia are too small to be remunerative in smaller plants.

Other chemical compounds of value, including tar of good quality, may be recovered in purifying producer gas, but, as in peat-coking plants, the chief by-product sought is the ammonia. The tar is next in value, where a market can be found for it.

The process of recovering ammonia from gas producers using bituminous coal was first developed by Sir Ludwig Mond, in England, and later was extended by the company controlling his patents to the gasification of peat. There are now in operation in England, Germany, and Italy large gas-producer power plants that use peat fuel exclusively and that are reported to pay all operating expenses from the sale of sulphate of ammonia recovered as a by-product, thus obtaining free the gas and the power generated by its use. One plant of this type in Italy makes no use of the gas generated beyond supplying its own requirements for power and heat, but depends entirely on the ammonia recovered for its profits. The statement has frequently been made that peat containing 1.5 per cent or more of nitrogen will yield a good profit from the ammonia which may be recovered by this method of gasification.

PEAT AS A SOURCE OF AMMONIA.

Peat beds are therefore important potential sources of the most costly ingredient of modern chemical fertilizers, sulphate of ammonia. As the peats of the United States show, from carefully made analyses, that they are very rich in combined nitrogen, in comparison with the peats of Europe, many of them exceeding 2 per cent and some containing more than 3 per cent of the total dry weight, it would seem that a highly profitable industry could be based on them, especially when the value of the power gas to be derived from the same sources is taken into consideration.

PEAT AS STABLE LITTER.

During the last few years the lighter and more poorly decomposed kinds of peat, especially that originating from sphagnum moss, has been produced in Europe in rapidly increasing quantity for use as stable bedding for horses, cattle, poultry, and other domestic and farm animals. The method of preparing peat for such use is very simple and requires but small outlay for machinery and plant. The bog is drained, and the upper fibrous layers of peat are cut into blocks, which are laid out to dry on the surface of the bog. When partly dry the blocks are piled in small open stacks for further drying, after which they are stored in large piles until used. The only other treatment given to the raw material thus obtained is to shred the blocks into small pieces by passing them through some form of disintegrating machinery and to remove sticks and other hard foreign matter. The shredded material is then screened and the coarse fragments are baled and sold for stable litter and the finer residue is sold under the name of peat mull, which has a variety of uses, such as for packing fruits and vegetables for shipment, as an absorbent and deodorizer, and for disinfection.

Peat litter, prepared as described, is very absorbent and is much cheaper, more durable, and more satisfactory in every way than straw, shavings, or any of the materials commonly used in the United States for stock bedding. The production of this material, although greatly increasing abroad, has not been attempted in this country for some years past, but as it can easily be prepared for market by inexpensive machinery there is among the possible ways for using peat no more tempting field for investment.

PEAT AS FOOD FOR STOCK.

The peat mull obtained by screening the peat shredded for stable litter has long been used in Europe as the basis of food for stock made by mixing it with refuse molasses, obtainable in large quantities at a low price from beet-sugar factories and cane-sugar refineries. This material makes excellent and fattening food, but is difficult to feed to stock on account of its stickiness and fluidity as well as because of its effects on the digestive organs. When mixed in proper proportions with peat powder, however, it is readily eaten by all kinds of live stock, and beef cattle, hogs, sheep and horses are reported to be greatly improved in condition and weight by its use. In England, Sweden, and Germany, thousands of tons of peat mull are used annually in the preparation of such sweetened cattle foods, but until very recently, possibly on account of the lack of an available supply of peat in the proper form, it has had very slight use in the United States. For the last few years, however, an increasing quantity of mixed stock food containing molasses has been manufactured and sold in this country, and still more recently, powdered black peat has been added to mixed cattle foods in small quantities, with reported beneficial effects.

PEAT FIBER.

In certain localities fine, tough, fibrous masses of sedge remains are obtained from sphagnum peat while the peat is being shredded for making litter. Such fiber, after thorough cleansing by beating and washing, is used either alone or mixed with other fibers, for making fabrics, for paper stock, for insulating material, especially in refrigerating plants, and for filling mattresses and stuffing furniture.

UTILIZATION OF PEAT IN THE UNITED STATES.

In spite of the facts that peat has so many uses in European countries and that the peat deposits of the United States are very extensive, the domestic material has only recently been produced on a commercial scale for any purpose.

PEAT AS FUEL.

Many attempts have been made in this country to manufacture peat fuel, with almost uniform lack of success. The reasons for failure of such enterprises have been manifold, but so far as can be determined by careful inquiry the failure was not caused by inability to sell the product after it was made, but generally by other factors, among which may be mentioned inexperience of operators, impractical machinery, and lack of sufficient capital to carry the plant over critical periods.

In 1914, so far as reported, there were four peat-fuel plants in operation in the entire country, with an estimated production of 1,925 tons of air-dried machine peat. Of these plants, one had been operated more or less regularly for several years, but on a small scale, employing but three men during the working season of 1914. A second plant was wholly experimental and was in operation only occasionally. One of the other plants was not completed until late in the season, and consequently was in operation only a short time and with an unskilled force. The fourth plant reported a prosperous and satisfactory season.

The outbreak of the war in Europe caused an entire suspension of plans for development of large plants for using peat fuel in Florida and Georgia. To the same cause may doubtless be attributed the closing of two very promising peat-fuel factories in Canada before the end of the season.

PEAT AS FERTILIZER AND FERTILIZER FILLER.

The most successful industry based on peat so far attempted in the United States is that of preparing peat for use as a fertilizer or as a filler for chemical fertilizers. Black, thoroughly decomposed peat is most satisfactory for all fertilizer uses, as such peats are generally heavier, more compact, and contain more nitrogen and less fibrous material than the brown types.

The processes of preparing peat for such uses are comparatively simple. The bog is drained thoroughly, and the surface layers are carefully plowed and cultivated for one or more seasons before digging begins. The peat is prepared for sale by reducing it to the state of a powder containing about 10 per cent of moisture. When an area is considered ready for gathering the peat the surface is repeatedly harrowed either by ordinary harrows or by special machinery for the purpose of drying the surface layers as much as possible. When sufficiently dry the harrowed peat is scraped into windrows and loaded on tram cars, which, in the larger plants, are drawn to the drying plant by small locomotives operated by electricity or gasoline. The unloading is done from a trestle over the stock pile, from which the peat is elevated as needed to the inlet hoppers of large rotary cylindrical driers. The driers used are of the directly heated single-tube type—that is, they consist of a single shell of boiler iron, with a large furnace at one end and a settling chamber, from which the smokestack or chimney rises, at the other. The cylinder is slightly inclined from the inlet to the outlet end and is revolved on its long axis by mechanical means. Iron flanges, running spirally the length of the inside of the cylinder, raise the peat to the top of the tube and drop it to the bottom through the heated air and gases, as these pass from furnace to smokestack, and at the same time move it steadily forward to the outlet, where it is automatically discharged. Usually a fan blower or an exhaust fan increases the draft through the drier, and this can be regulated to meet the requirements of the peat. After the peat has passed through the drier it is elevated by mechanical conveyers of considerable length to permit proper cooling, screened to remove coarse and lumpy material that has not been completely disintegrated in drying, and immediately shipped or stored in fireproof storage bins.

The peat that is prepared for fertilizer filler, for stock food, and for certain grades of fertilizers of which the peat powder forms the base is dried to a moisture content of about 10 per cent. When the peat is to be applied directly to the soil as a source of humus and of organic nitrogen, the drying is not carried so far. Considerable quantities of peat are prepared for such use and are sold as "sun-dried," and in that state the material may have a moisture content of 25 to 50 per cent or even more.

Some of the peat sold during 1914 for direct use as fertilizer was enriched by the addition of mineral salts of high fertilizing value, especially compounds of potassium and phosphorus and substances furnishing organic nitrogen to supplement that present in the peat.

The production of peat for fertilizer uses during 1914 as reported was 37,729 short tons, valued at $249,899. The selling prices given varied widely according to the grade of the product, the uses to which it was to be put, the quantity and quality of materials added, and the size of the selling unit. In carload lots the price of sun-dried, untreated peat ranged from $3.50 to $6 a ton. In small lots, shipped in bags or barrels, the prices ran considerably higher. Fertilizer filler, sold at a somewhat uniform price per unit of nitrogen, varied according to the percentage of nitrogen and locality of production from $4.50 to $7.50 a short ton, the average price being $6.02. The quantity of peat sold for fertilizer filler was 22,267 tons and for fertilizer 14.962 tons.

MISCELLANEOUS USES OF PEAT IN 1914.

Three other uses of peat were reported by producers in 1914—for stock food, for mud baths, and for making paper. As the production for each use was reported by a single firm, the whole output is given under a single heading. This total was 7,439 short tons, valued at $53,253. The highest price and the lowest production reported for any peat product was that of peat for paper pulp, as the plant producing it was in operation only a small part of the year.

Food for stock.—The largest quantity of peat reported sold for other than fertilizer uses was sold for use in mixed stock foods containing molasses. The single producer who reported sales for this purpose stated that the results obtained by the use of peat in such foods have proved very satisfactory in practice, the peat acting as a tonic and a corrective. The kind of peat so far used in this country for the purpose is of the black, well-humified type. The method of preparing it is practically the same as for fertilizer filler.

Mud baths.—At several of the famous health resorts of Germany and Austria mud or peat baths have long been used with great success, and during the last few years such baths have been tried in some of the sanitariums of the Middle West and found beneficial in certain cases. Well-decomposed peat, free from coarse or woody material, is the basis of the mixtures used, and the demand for grades of peat suitable for this use is reported to be increasing.

PEAT LITTER IN THE UNITED STATES.

As noted above, no peat litter has been produced in this country for several years. As in previous years, however, a certain quantity was imported into New York City and other coast cities in 1914 from Holland and Germany under the name "peat moss." The entire importation was 8,858 long tons (9,921 short tons), valued at $57,542, or at $5.80 a short ton. No attempt was made to produce this material at home, so far as could be learned.

PRODUCTION OF PEAT IN 1913 AND 1914.

During 1914 no new processes or machinery for preparing peat for fuel were reported to have been given commercial trials in the United States. The whole number of plants reporting production was 14, of which 10 sold peat for fertilizer uses. Two firms that furnished data for 1913 did not cooperate for 1914, and four firms are represented for the first time, having made their initial production during the year.

The 14 plants known to be at work during the year were distributed as follows: Maine, 1; Massachusetts, 1; Connecticut, 2; New York, 1; New Jersey, 3; Pennsylvania, 1; Florida, 1; Michigan, 2; Illinois, 1; Indiana, 1.

The following tables give the quantity of peat products made and used in the United States in 1913 and 1914, so far as these have been reported:

Production, imports, and consumption of peat in the United States in 1913, in short tons.

Use.	Production.		Imports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fertilizer	28,460	$169,600			28,460	$169,600
Stock food	4,800	27,600			4,800	27,600
Stable litter			10,983	$55,719	10,983	55,719
Total	33,260	197,200	10,983	55,719	44,243	252,919

Production, imports, and consumption of peat in the United States in 1914, in short tons.

Use.	Production.		Imports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fertilizer filler	22,767	$136,994			22,767	$136,994
Fertilizer	14,962	112,905			14,962	112,905
Fuel	1,925	6,540			1,925	6,540
Miscellaneous [a]	7,439	53,253			7,439	53,253
Peat moss litter			9,921	$57,542	9,921	57,542
Total	47,093	309,692	9,921	57,542	57,014	367,234

[a] Only 1 producer each of peat for stock food, mud baths, and paper pulp.

COKE.[1]

By C. E. Lesher.

INTRODUCTION.

The condition of the iron trade is the barometer by which we judge the industrial condition of the country; the number of coke ovens going in and out of blast in Pennsylvania is the pulse of the iron and steel trade. By far the greater part of the coke produced in the United States goes into the manufacture of iron, and more than two-thirds of the coke made in 1914 was from ovens owned by companies engaged in the iron business. As is to be expected under these conditions, the rise and fall in the production of coke follows the ups and downs in the output of pig iron year by year. As nearly all the coke is utilized as soon as it is made, comparatively little being held in storage, the curve of production for coke is almost synchronous with that for pig iron. During the last 25 years only once has increase or decrease in the output of iron not been accompanied by a corresponding record for coke. The year 1914 was no exception to the general rule, and the production of coke followed that of pig iron. As compared with 1913, pig iron declined 24.7 per cent and coke fell off 25.4 per cent.

With the advent of the retort oven in the United States in 1893 and the steady growth of this improved method of manufacturing coke, a factor has been introduced which, it is confidently believed, will materially affect the trend of the coke industry in the future. In the older or beehive method of making coke no part of the coal is saved except the coke or carbon, and indeed part of that is nearly always burned in the process of manufacture. In the newer or retort process the gas, tar, ammonia, benzol, and other valuable by-products are saved, and a larger yield of coal in coke is obtained. One effect of the European war has been to throw the United States more completely upon its own resources and has concentrated attention upon the development in this country of industries that utilize the by-products of coke, such as the dyes, organic acids, and other derivatives of coal tar, until now largely imported.

The steadily increasing use of gas as a fuel and a source of power in internal-combustion engines, the growing demand for ammonia as a fertilizer, and for coal tar as a road-making and roofing material, as well as for its chemical and dye derivatives, and, at the present time, the keen demand for some of the products of benzol used in the manufacture of high explosives, all tend to increase the relative

[1] The product obtained from the distillation or partial combustion of bituminous coal in ovens or retorts 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. The statistical data in this report were compiled by Mrs. H. L. Bennit.

importance of the by-product coking industry and forecast a change in economic conditions when all coal will be coked in a manner to save the by-products.

PRODUCTION.

STATISTICS OF PRODUCTION IN 1914.

The production of coke in 1914 was the smallest, except in 1908, in 10 years, or since 1905, and amounted to 34,555,914 short tons, valued at $88,334,217. Compared with 1913, when the production was 46,299,530 short tons, valued at $128,922,273, the output in 1914 decreased 11,743,616 short tons, or 25.4 per cent, in quantity and $40,588,056, or 31.5 per cent, in value. The value of coke has a marked tendency to follow the rate of production, answering in a general way to the law of supply and demand. Prices in 1914 fell gradually, with slackening demand and decline in output, from the beginning of the year to the end, the result being an average value obtained at the ovens of $2.56, as compared with $2.78 in 1913. The decline in value was shared almost equally by beehive and by-product coke, the former declining from $2.39 to $2.15, or 10 per cent, and the latter from $3.82 to $3.39, or 11 per cent.

The cost of coal to the manufactured per ton of coke produced in 1914 was $2.166, or practically the same as in 1913 ($2.169), and this fact, considered with the decrease in average value for the coke, indicates that the actual returns to the producers were relatively less in 1914 than in 1913. Of the 34,555,914 tons of coke made in 1914 in the United States, 23,335,971 tons were beehive or oven coke, valued at $50,254,050, and 11,219,943 tons, valued at $38,080,167, were by-product or retort coke. In 1913 the production of oven coke was 33,584,830 tons, valued at $80,284,421, and that of retort coke was 12,714,700 tons, valued at $48,637,852. From this it appears that only 12.7 per cent of the decrease in quantity was in by-product coke and 87.3 per cent was in oven coke.

The decrease in the production of retort coke in 1914 was 1,494,757 short tons, or 11.8 per cent; the beehive output decreased 10,248,859 tons, or 30.5 per cent. With the exception of two years, 1908 and 1914, the production of by-product coke has increased each year since the first ovens were completed at Syracuse, N. Y., in 1893. Except in 1909 the percentage of by-product coke to the total has increased each year; in 1901 it was 5.4; in 1910 it was 17.1; in 1912 it was 25.3; in 1913 it was 27.5; and in 1914, 32.5. The average value per ton for oven coke in 1914 was $2.15 against $2.39 in 1913. The average value for retort coke was $3.39 in 1914 as compared with $3.82 in 1913. As explained in previous reports, 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 considerable distances from the coal mines and at or near the centers of consumption where markets for the gas and other by-products as well as for the coke are available. Hence the expenses of transportation are borne by the coal and are added to the value of the coal as charged into the ovens. An equivalent value is necessarily added to the coke. The beehive and similar types of ovens are, on the other hand, located in the immediate vicinity of the mines and the expenses of transportation are borne by the coke, and the beehive coke thus costs the ultimate consumer as much as the apparently higher-valued retort coke.

Connellsville coke has for many years been the standard furnace coke of the United States and the Connellsville region is the only one for which weekly reports on the trade conditions are made to the technical journals. The Connellsville Courier presents each week a comprehensive review of conditions affecting the demand and the prices for the commodity which has been the mainstay of the region. From its weekly reviews the following summary of the trade in 1914 has been extracted.

The year opened with production in excess of demand, spot coke selling for $2 a ton. In January a number of operators closed down their plants rather than accept contracts for less than $2. In the second month of the year some spot coke was sold for $1.90, with the production fluctuating up and down from week to week. Early in March severe weather interfered with regular shipments of coke, and when normal conditions were resumed, they rose from 9,000 to 10,000 cars a week, without, however, effecting any increase in the price. Producers held out for $2.10 on additional contracts, and there were some sales at that figure. In April the pig-iron production was curtailed, and coke production decreased 15 per cent in two weeks. An attempt was made to hold coke prices firm at $2 for contracts, and spot furnace dropped to $1.95 to $1.85. A decline set in during May and by the middle of June the production was down to a 50 per cent basis. Contract furnace coke ranged from $1.85 to $2, but furnace coke for prompt delivery was being freely sold at $1.75. During July every effort was made to hold contract furnace coke at $2. By the last of August contract prices for furnace coke had fallen to $1.90, and for foundry to $2.50, with production slowly but steadily declining. Through September the decline was steady, and the coke market was dull and stagnant in sympathy with the condition of the steel trade, which was passing through its dullest period since 1906. Conditions were particularly bad in November and December, each succeeding week showing more ovens put out of blast and prices dropping. Contracts for the first quarter and the first half of 1915 were taken at $1.70, with spot furnace at $1.60—although there were then some signs for betterment of the coke business by reason of orders placed with the iron furnaces and steel mills.

A considerable proportion of the coke produced in the United States is made in ovens or retorts operated by large corporations that not only mine the coal and make the coke but also operate blast furnaces and steel mills, which consume the entire product of the ovens. Under such conditions the fixing of a value upon the coke and upon the coal consumed in its making is purely arbitrary. By some corporations the coke is charged to the furnace department at cost; by others a percentage of profit is added, or the reported value is based on what it would cost if purchased. As the beehive ovens are gradually replaced by the retorts the proportion of the coke upon which the arbitrary values are fixed will increase, because the retort ovens are for the most part constructed by or for furnace operators and the product of the ovens does not go to the general markets. It must not be considered, therefore, that the values as stated in this and other reports of the series represent the actual selling value of all the coke, but they are sufficiently exact for statistical comparison.

The coal consumed in the manufacture of coke in 1914 was 51,623,750 short tons, valued at $74,949,565, as compared with 69,239,190 tons, valued at $100,561,439 in 1913. The value of the coke made in 1914 was $88,334,217, the difference between the cost of the coal and the value of the coke made from it being $13,384,652, which, less the cost of manufacture and expenses of administration, represents the profits on the coke-making operations. In 1913 the value of the coke was $128,922,273, and the difference between that and the cost of the coal was $28,360,834.

In 1913 there was a net increase of 420 in the total number of ovens, although 2,833 ovens, all of the beehive type, were abandoned during that year. At the close of 1914 there were 2,895 less ovens in existence than at the beginning of the year. There were 192 retort ovens constructed during the year, out of a total of 779, so that the new installations of beehive or partial combustion type aggregated 587. The total number of ovens and retorts in operation in the United States decreased in 1914 from 102,650 to 99,755, a net loss of 2,895. As the retort ovens showed an increase of 121, there was a net decrease of 3,016 in the number of beehive ovens in existence in 1914 compared with 1913. In addition to the number of ovens abandoned during 1914 there were 45,117 idle, of which 667 were retorts and 44,450 were beehive ovens. The 44,450 idle beehive ovens included 21,801 which were the entire equipment of 177 idle establishments. The statement regarding the number of idle ovens represents only those which were idle during the entire year and does not include any ovens which were idle during a portion of the time only and which contributed to the output in 1914. The number of ovens and retorts in blast during the whole or a portion of 1914 was 54,638, as compared with 72,008 active ovens and retorts in 1913. The 54,638 active ovens and retorts included 5,142 retorts and 49,496 beehive ovens. As the 5,142 retorts produced a total of 11,219,943 tons of coke, the average production for each retort was nearly 2,200 tons; the 49,496 beehive ovens produced 23,335,971 tons, or an average of a little over 470 tons per oven. In 1913 there were 5,531 retorts which produced an average of 2,300 tons per oven, and 66,477 beehive ovens which produced an average of 505 tons per oven. The new ovens in course of construction at the close of 1914 numbered 1,249, of which 644 were retorts and 605 were beehive ovens.

The tendency to consolidate into large units is exhibited in the manufacture of coke, as in other branches of industry, and the number of coke-making establishments has shown a steady decrease since 1909, when, on December 31, there were 579 coke-making establishments in the United States. At the close of 1910 the number of establishments had decreased to 578, at the close of 1911 to 570, in 1912 to 559, in 1913 to 551, and in 1914 to 536. Although the total number of establishments in the United States decreased 15 in 1914, the number of by-product plants increased 4, whereas the plants using beehive ovens decreased 19. There were 5 establishments with a total of 231 ovens under construction at the close of 1914. Four of the new establishments with a total of 171 ovens were retort oven plants.

The statistics of production of coke in 1913 and 1914 are presented, by States, in the following tables:

Manufacture of coke, by States, in 1913 and 1914.

1913.

State.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke.	Value of coke per ton.
		Built.	Building.					
Alabama	46	10,284	20	5,218,323	63.6	3,323,664	$9,627,170	$2.90
Colorado	15	3,588	0	1,349,743	65.1	879,461	2,815,134	3.20
Georgia	2	251	0	82,871	51.5	42,747	186,304	4.35
Illinois	4	568	53	2,481,198	74.9	1,859,553	8,593,581	4.62
Indiana	5	749	41	3,535,136	77.1	2,727,025	13,182,136	4.83
Kansas	1	2	0	0	0	0	0	0
Kentucky	9	1,049	100	512,245	61.9	317,084	753,897	2.38
Missouri	0	0	56	0	0	0	0	0
Montana	3	351	0	0	0	0	0	0
New Jersey	1	150	0	339,351	75.4	255,792	695,041	2.72
New Mexico	4	1,030	0	788,172	59.4	467,945	1,548,536	3.31
New York	4	555	0	1,067,207	71.1	758,486	3,301,400	4.35
Ohio	7	471	119	507,417	69.3	351,846	1,231,554	3.50
Oklahoma	2	260	0	0	0	0	0	0
Pennsylvania	276	55,058	582	43,195,801	66.6	28,753,444	67,929,864	2.36
Tennessee	15	2,427	0	694,085	52.5	364,578	925,430	2.50
Virginia	18	5,695	100	2,015,259	64.7	1,303,603	2,840,275	2.18
Washington	6	331	0	118,786	64.2	76,221	432,770	5.68
West Virginia	124	17,826	35	4,034,251	61.3	2,472,752	5,504,416	2.23
Maryland, Massachusetts, Michigan, Minnesota, Utah, Wisconsin	9	2,005	210	3,299,345	71.1	2,345,329	9,354,765	3.99
Total	551	102,650	1,321	69,239,190	66.9	46,299,530	128,922,273	2.78

1914.

State.	Establishments.	Built.	Building.	Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke.	Value of coke per ton.
Alabama	38	9,285	0	4,678,196	65.9	3,084,149	$8,408,443	$2.73
Colorado	14	3,573	0	1,048,251	63.5	666,083	2,203,031	3.30
Georgia	2	201	0	45,298	54.1	24,517	100,529	4.10
Illinois	4	586	40	1,932,132	73.8	1,425,168	5,858,700	4.11
Indiana	5	789	33	3,125,207	72.8	2,276,652	9,055,937	3.98
Kansas	1	2	0	0	0	0	0	0
Kentucky	9	1,151	0	672,624	66.0	443,959	971,060	2.19
Missouri	0	0	56	0	0	0	0	0
Montana	3	351	0	0	0	0	0	0
New Jersey	1	150	0	328,921	77.6	255,283	680,972	2.67
New Mexico	4	1,030	0	660,501	54.9	362,572	1,228,045	3.39
New York	4	555	100	659,418	69.0	457,370	1,726,133	3.77
Ohio	8	538	51	745,097	70.0	521,638	1,678,686	3.21
Oklahoma	2	260	0	0	0	0	0	0
Pennsylvania	274	54,075	867	30,286,961	66.9	20,258,393	42,447,886	2.10
Tennessee	14	2,303	12	487,446	54.2	264,127	642,573	2.43
Virginia	18	5,435	0	1,319,901	59.2	780,984	1,582,419	2.02
Washington	7	336	0	133,349	63.7	84,923	472,531	5.56
West Virginia	118	17,120	0	2,316,309	61.6	1,427,962	2,847,284	1.99
Maryland, Massachusetts, Michigan, Minnesota, Utah, Wisconsin	10	2,015	90	3,184,139	69.8	2,222,134	8,429,988	3.79
Total	536	99,755	1,249	51,623,750	66.9	34,555,914	88,334,217	2.56

PRODUCTION IN PREVIOUS YEARS.

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 35 years, which is shown in the following table:

Quantity of coke produced in the United States, 1880–1914, in short tons.

1880	3,338,300	1892	12,010,829	1904	23,661,106
1881	4,113,760	1893	9,477,580	1905	32,231,129
1882	4,793,321	1894	9,203,632	1906	36,401,217
1883	5,464,721	1895	13,333,714	1907	40,779,564
1884	4,873,805	1896	11,788,773	1908	26,033,518
1885	5,106,696	1897	13,288,984	1909	39,315,065
1886	6,845,369	1898	16,047,209	1910	41,708,810
1887	7,611,705	1899	19,668,569	1911	35,551,489
1888	8,540,030	1900	20,533,348	1912	43,983,599
1889	10,258,022	1901	21,795,883	1913	46,299,530
1890	11,508,021	1902	25,401,730	1914	34,555,914
1891	10,352,688	1903	25,274,281		

Of the 15 coke-producing States for which the statistics may be separately published, there were 3 in which the production increased in 1914, and 12 in which the output decreased. More than 70 per cent of the total decrease was in Pennsylvania, which showed a decrease of 8,495,051 short tons out of a total for the United States of 11,743,616 tons. The largest percentage of decrease was in Georgia, which was 18,230 tons, or 42.7 per cent, less than in 1913. Virginia with a decrease of 40.1 per cent and New York with 39.7 per cent followed Georgia in order of percentage of decrease. Ohio with a gain of 169,792 tons, or 48.3 per cent; Kentucky, with 126,875, or 40 per cent; and Washington, with 8,702 tons, or 11.4 per cent, were the only States reported separately that recorded increases in 1914.

In the following table is shown the production of coke by States during the last five years, with the increase and decrease in 1914 as compared with 1913:

Quantity of coke produced in the United States, 1910–1914, by States, in short tons, with increase and decrease in 1914.

State.	1910	1911	1912	1913	1914	Increase (+) or decrease (−) in quantity of coke produced, 1914.	
						Quantity.	Percentage
Alabama	3,249,027	2,761,521	2,975,489	3,323,664	3,084,149	− 239,515	− 7.2
Colorado	[a] 1,346,211	951,748	972,941	879,461	666,083	− 213,378	−24.3
Georgia	43,814	37,553	43,158	42,747	24,517	− 18,230	−42.7
Illinois	1,514,504	1,610,212	1,764,944	1,859,553	1,425,168	− 434,385	−24.5
Indiana	(b)	916,411	2,616,339	2,727,025	2,276,652	− 450,373	−16.5
Kansas	(b)	(b)	(b)	0	0	0	0
Kentucky	53,857	66,099	191,555	317,084	443,959	+ 126,875	+40.0
New Jersey	(b)	(b)	270,429	255,792	255,283	− 509	− 0.02
New Mexico	401,646	381,927	413,906	467,945	362,572	− 105,373	−22.5
New York	652,459	686,172	794,618	758,486	457,370	− 301,116	−39.7
Ohio	282,315	311,382	388,669	351,846	521,638	+ 169,792	+48.3
Pennsylvania	26,315,607	21,923,935	27,438,693	28,753,444	20,258,393	−8,495,051	−29.5
Tennessee	322,756	330,418	370,076	364,578	264,127	− 100,451	−27.6
Utah	(c)	(b)	(b)	(b)	(b)	(b)	(b)
Virginia	1,493,655	910,411	967,947	1,303,603	780,984	− 522,619	−40.1
Washington	59,337	40,180	49,260	76,221	84,923	+ 8,702	+11.4
West Virginia	3,803,850	2,291,049	2,465,986	2,472,752	1,427,962	−1,044,790	−42.3
Other States	2,169,772	2,332,471	2,259,589	2,345,329	2,222,134	− 123,195	− 5.3
Total	41,708,810	35,551,489	43,983,599	46,299,530	34,555,914	−11,743,616	−25.4

[a] Includes Utah.
[b] Included with other States having less than three producers.
[c] Included with Colorado.

In the following table 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 the value of the coke produced, and the average value per ton for the years 1880, 1890, 1900, and from 1910 to 1914, inclusive:

Statistics of the manufacture of coke in the United States in 1880, 1890, 1900, 1910–1914.

Year.	Establishments.	Ovens.		Coal used (short tons).	Percentage yield of coal in coke.	Coke produced (short tons).	Total value of coke at ovens.	Value 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
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	111,805,113	2.54
1913	551	102,650	1,321	69,239,190	66.9	46,299,530	128,922,273	2.78
1914	536	99,755	1,249	51,623,750	66.9	34,555,914	88,334,217	2.56

VALUE OF COKE PRODUCED.

As has already been indicated, the prices for coke during 1914 averaged lower than in 1913, and every State with the exception of Colorado, New Mexico, and Wisconsin, showed a larger percentage of loss or a less percentage of gain in the value than in the quantity of the coke produced. The total value of the coke produced in the United States decreased from $128,922,273 in 1913 to $88,334,217 in 1914, a loss of $40,588,056, or 31.5 per cent. The percentage of decrease in quantity was 25.4 per cent. Nearly two-thirds of the total decrease in value occurred in Pennsylvania, whose production for 1914 was valued at $25,481,978 less than that of 1913. Indiana was second in order of decreased value, with a falling off of $4,126,199 in 1914 as compared with 1913. The value of the output of Illinois and West Virginia decreased more than $2,000,000 each, and that of Alabama, Virginia, and New York more than $1,000,000 each. The value of the retort coke produced was $38,080,167, a loss of $10,557,685, or 21.7 per cent, in 1914 as compared with 1913, and that of oven or beehive coke was $50,254,050, a decline of $30,030,371, or 37.4 per cent. In quantity, retort coke showed a decrease of 11.8 per cent and oven coke of 30.5 per cent.

In the following tables are presented statements showing the value of the coke produced in the several States for the last five years, with the quantity and percentage of increase and decrease in 1914 as compared with 1913, 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, 1910–1914, by States, with increase and decrease in 1914.

State.	1910	1911	1912	1913	1914	Increase (+) or decrease (—) in value of coke produced, 1914.	
						Value.	Percentage.
Alabama	$9,165,821	$7,593,594	$8,098,412	$9,627,170	$8,408,443	—$1,218,727	—12.7
Colorado	a4,273,579	2,903,811	3,043,994	2,815,134	2,203,031	— 612,103	—21.7
Georgia	173,049	135,190	161,842	186,304	100,529	— 85,775	—46.0
Illinois	6,712,550	6,390,257	8,069,903	8,593,581	5,858,700	—2,734,881	—31.8
Indiana	(b)	3,598,195	12,528,685	13,182,136	9,055,937	—4,126,199	—31.3
Kansas	(b)	(b)	(b)				
Kentucky	120,554	134,862	513,734	753,897	971,060	+ 217,163	+27.5
New Jersey	(b)	(b)	690,368	695,041	680,972	— 14,069	— 2.0
New Mexico	1,306,136	1,240,963	1,356,946	1,548,536	1,228,045	— 320,491	—20.7
New York	2,635,873	2,883,990	3,203,133	3,301,400	1,726,133	—1,575,267	—47.7
Ohio	911,987	961,904	1,365,905	1,231,554	1,678,686	+ 447,132	+36.3
Pennsylvania	55,254,599	43,053,367	56,336,255	67,929,864	42,447,886	—25,481,978	—37.5
Tennessee	959,104	797,758	951,853	925,430	642,573	— 282,857	—30.6
Utah	(c)	(b)	(b)	(b)	(b)	(b)	(b)
Virginia	2,731,348	1,615,609	1,815,975	2,840,275	1,582,419	—1,257,856	—44.2
Washington	347,540	216,262	279,105	432,770	472,531	+ 39,761	+ 9.2
West Virginia	7,354,039	4,236,845	4,692,393	5,504,416	2,847,284	—2,657,132	—48.2
Other States	7,796,522	8,368,242	8,696,610	9,354,765	8,429,988	— 924,777	— 9.9
Total	99,742,701	84,130,849	111,805,113	128,922,273	88,334,217	—40,588,056	—31.5

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, 1880–1914.

1880	$6,631,265	1892	$23,536,141	1904	$46,144,941
1881	7,725,175	1893	16,523,714	1905	72,476,196
1882	8,462,167	1894	12,328,856	1906	91,608,034
1883	8,121,607	1895	19,234,319	1907	111,539,126
1884	7,242,878	1896	21,660,729	1908	62,483,983
1885	7,629,118	1897	22,102,514	1909	89,965,483
1886	11,153,366	1898	25,586,699	1910	99,742,701
1887	15,321,116	1899	34,670,417	1911	84,130,849
1888	12,445,963	1900	47,443,331	1912	111,805,113
1889	16,630,301	1901	44,445,923	1913	128,922,273
1890	23,215,302	1902	63,339,167	1914	88,334,217
1891	20,393,216	1903	66,498,664		

In the following table is shown the average value per ton, by States, during the last five years and the general average value per ton in the United States for each year since 1880. These averages are not the averages of the prices themselves, but are obtained by dividing the total quantity of coke produced into the total value in each State, with the same method for the total for the United States. The figures represent closely, therefore, the average values obtained by the producers. As has already been explained, the values of the product as reported to the Survey do not always represent actual cash or its equivalent received by the producers, as some of the largest operations are carried on in connection with blast furnaces or other manufacturing enterprises and the placing of value upon their coke by such producers is purely arbitrary. As the same methods of valuation at any one point are, however, employed each year, they would not affect materially the changes due to market conditions, and the statement of value per ton may be accepted as indicating closely the relations of supply and demand.

The average value per ton of coke, by States, from 1910 to 1914, inclusive, is shown in the following table:

Average value per short ton, at the ovens, of the coke made in the United States, 1910–1914, by States.

State.	1910	1911	1912	1913	1914
Alabama	$2.82	$2.75	$2.72	$2.90	$2.73
Colorado	[a] 3.17	[a] 3.30	3.13	3.20	3.30
Georgia	3.95	3.60	3.75	4.35	4.10
Illinois	4.43	3.97	4.57	4.62	4.11
Indiana	(b)	(b)	4.79	4.83	3.98
Kentucky	2.24	2.04	2.68	2.38	2.19
New Jersey	(b)	(b)	2.55	2.72	2.67
New Mexico	3.25	3.25	3.28	3.31	3.39
New York	4.04	4.20	4.03	4.35	3.77
Ohio	3.23	3.09	3.51	3.50	3.21
Pennsylvania	2.10	1.96	2.05	2.36	2.10
Tennessee	2.97	2.41	2.57	2.50	2.43
Utah	(c)	(c)	(b)	(b)	(b)
Virginia	1.83	1.77	1.88	2.18	2.02
Washington	5.86	5.38	5.67	5.68	5.56
West Virginia	1.93	1.85	1.90	2.23	1.99
Other States	3.53	3.75	3.71	3.99	3.79
Average	2.39	2.37	2.54	2.78	2.56

[a] Includes Utah.
[b] Included in other States having less than 3 producers.
[c] Included with Colorado.

The following table, showing the general average value per ton during a period of 35 years, is of particular interest as indicating the higher values that have obtained since the beginning of the present century. In only three years prior to 1901 did the general average value of coke per ton exceed $2, and one of these was the last year of the nineteenth century. In the other two years, 1887 and 1890, the average value per ton exceeded $2 by 1 cent and 2 cents, respectively. On the other hand, in only one year since and including 1901 has the average value of coke per ton fallen below $2, and in six years it has exceeded $2.50, the maximum being $2.78 in 1913. In 1914 the average value at the ovens was $2.56. From 1880 to 1890 the mean average value of coke per ton was $1.71, from 1891 to 1900 it was $1.76, and from 1901 to 1914 it was $2.43.

Average value per short ton, at the ovens, of the coke made in the United States, 1880–1914.

1880	$1.99	1892	$1.96	1904	$1.95
1881	1.88	1893	1.74	1905	2.25
1882	1.77	1894	1.34	1906	2.52
1883	1.49	1895	1.44	1907	2.74
1884	1.49	1896	1.84	1908	2.40
1885	1.49	1897	1.66	1909	2.29
1886	1.63	1898	1.59	1910	2.39
1887	2.01	1899	1.76	1911	2.37
1888	1.46	1900	2.31	1912	2.54
1889	1.62	1901	2.04	1913	2.78
1890	2.02	1902	2.49	1914	2.56
1891	1.97	1903	2.63		

The higher values shown in the later years were due in part, but not entirely, to the influence exerted by the increasing production of retort coke. The average price of beehive coke, which is more of a commercial product than the retort coke, has been much better maintained in the last few years than in the preceding century, and since 1908 the average value for beehive coke has not fallen below $2. Since 1908 the average value per ton for retort coke has ranged from $1.17 to $1.74 higher than for beehive coke, this difference representing the transportation expenses on the coal from the mines to the ovens. The average value per ton for beehive coke declined in 1914 from $2.39 to $2.15, that of by-product coke from $3.82 to $3.39, and the mean average from $2.78 to $2.56.

Comparative average values of beehive (oven) and by-product (retort) coke, 1908–1914, 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
1913	2.39	3.82	2.78
1914	2.15	3.39	2.56

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 many of 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 1914 the number of establishments and of ovens abandoned greatly exceeded the number of plants and ovens of new construction. There were 22 plants abandoned and 7 new plants built, reducing the total number of plants from 551 to 536. The 22 dismantled plants had a total of 2,359 ovens. In addition to the 2,359 ovens contained in the 22 abandoned plants, there were 1,316 ovens, portions of operating plants, that were dismantled, making a total of 3,675 ovens abandoned during 1914. Of the 22 establishments abandoned 8 were in Alabama, 6 in West Virginia, 5 in Pennsylvania, and 1 each in Colorado, Indiana, and Tennessee. There were 177 establishments with a total of 21,801 ovens idle during the year, and 23,316 ovens, portions of other plants, that were also idle, a total of 45,117 idle ovens. In 1913 there were 107 idle establishments and a total of 30,642 idle ovens. The number of plants in operation in 1914 was 359, as compared with 444 in 1913, and the number of active ovens was 54,638, against 72,008 in 1913. The 359 active establishments in 1914 produced 34,555,914 tons of coke, or an average of a little over 96,000 tons to a plant.

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 the establishment; the average production of each establishment in 1914 was almost six times the average of 1880. In 1880 there were 12,372 ovens in existence, an average of 67 to an establishment; in 1913 and 1914 the average number of ovens to an establishment, including idle as well as active ovens, was 186. If instead of the number of plants the number of operating firms and corporations were considered as the unit, the concentration would appear to be 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 1914 there were 5,142 active retort ovens in operation, with an average of 2,200 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	1890, Dec. 31	253	1912, Dec. 31	559
1860 (census year)	21	1900, Dec. 31	396	1913, Dec. 31	551
1870 (census year)	25	1910, Dec. 31	578	1914, Dec. 31	536
1880, Dec. 31	186	1911, Dec. 31	570		

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, 1910–1914.

State.	1910	1911	1912	1913	1914
Alabama	10,132	10,121	10,208	10,284	9,285
Colorado	3,611	3,606	3,588	3,588	3,573
Georgia	350	225	251	251	201
Illinois	508	506	594	568	586
Indiana	90	586	642	749	789
Kansas	71	53	3	2	2
Kentucky	495	577	1,049	1,049	1,151
Maryland	200	200	200	200	120
Massachusetts	400	400	400	400	400
Michigan	162	162	165	205	205
Minnesota	50	50	50	50	140
Missouri	4	0	0	0	0
Montana	451	451	451	351	351
New Jersey	150	150	150	150	150
New Mexico	1,030	1,030	1,030	1,030	1,030
New York	556	556	555	555	555
Ohio	496	496	471	471	538
Oklahoma	408	410	260	260	260
Pennsylvania	55,656	54,904	53,756	55,058	54,075
Tennessee	2,792	2,547	2,584	2,427	2,303
Utah	854	854	650	726	726
Virginia	5,389	5,496	5,408	5,695	5,435
Washington	285	235	313	331	336
West Virginia	19,912	19,876	19,064	17,826	17,120
Wisconsin	388	388	388	424	424
Total	104,440	103,879	102,230	102,650	99,755

Number of coke ovens in the United States on Dec. 31 of each fifth year, from 1880 to 1910 and from 1911 to 1914.

1880	12,372	1900	58,484	1912	102,230
1885	20,116	1905	87,564	1913	102,650
1890	37,158	1910	104,440	1914	99,755
1895	45,565	1911	103,879		

The following table shows in a succinct statement the number of establishments and ovens idle, the number of establishments and ovens abandoned, and the number of establishments and ovens in course of construction at the end of the year:

Number of coke establishments and ovens idle, abandoned, and in course of construction at the end of 1914, by States.

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	5,015	5,973	8	1,047	1,049	0	0	0
Colorado	6	865	2,142	1	15	15	0	0	0
Georgia	1	50	101	0	0	50	0	0	0
Illinois	0	0	40	0	0	0	0	0	40
Indiana	1	22	22	1	1	1	1	3	33
Kansas	1	2	2	0	0	0	0	0	0
Kentucky	4	324	610	0	0	6	0	0	0
Maryland	0	0	60	0	0	0	0	0	0
Minnesota	1	90	90	0	0	0	0	0	90
Missouri	0	0	0	0	0	0	1	56	56
Montana	3	351	351	0	0	0	0	0	0
New Mexico	1	50	50	0	0	0	0	0	0
New York	0	0	188	0	0	0	1	100	100
Ohio	2	110	110	0	0	1	0	0	51
Oklahoma	2	260	260	0	0	0	0	0	0
Pennsylvania	65	5,281	18,363	5	576	1,307	1	60	867
Tennessee	8	1,098	1,392	1	120	125	1	12	12
Virginia	4	797	3,244	0	0	260	0	0	0
Washington	2	75	90	0	0	0	0	0	0
West Virginia	57	7,183	11,801	6	600	861	0	0	0
Wisconsin	1	228	228	0	0	0	0	0	0
Total	177	21,801	45,117	22	2,359	3,675	5	231	1,249

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, 1907–1914.

1907	2,546	1910	2,567	1913	1,321
1908	2,241	1911	2,254	1914	1,249
1909	2,950	1912	2,783		

RANK OF COKE-PRODUCING STATES.

The record of the production of coke in 1914 effected several changes in relative importance of the States in connection with the industry. Illinois superseded West Virginia as fourth in rank, but with that exception the first seven States held the same position in 1914 as in 1913. Pennsylvania of course stands preeminently first, with Alabama second, and Indiana third. West Virginia was fifth in 1914, but if all of the coke made from West Virginia coal were produced in that State it would be well fixed in second place, as by far the larger part of the coke manufactured in Ohio, Indiana, and

Illinois is from West Virginia coal. As, however, the production of coke in retort ovens at or near the points of consumption is likely to continue to increase in greater proportion and the beehive ovens to disappear gradually from the mining regions, it is not probable that West Virginia will again assume its former importance as a coke-producing State. The quantity of coke made in West Virginia in 1913 was less than one-half of that made from West Virginia coal in ovens outside the State.

Among the less important States Wisconsin moved up from ninth to eighth place, Michigan from eleventh to ninth, Ohio from fourteenth to eleventh, and Tennessee was replaced by Kentucky, which moved from sixteenth to thirteenth place. New York, eighth in rank in 1913, fell to twelfth in 1914. The positions held by the coke-producing States are shown in the following table:

Rank of the States in production of coke, 1910–1914.

State.	1910	1911	1912	1913	1914	State.	1910	1911	1912	1913	1914
Pennsylvania	1	1	1	1	1	Kentucky	20	19	18	16	13
Alabama	3	2	2	2	2	New Mexico	10	11	12	12	14
Indiana	17	6	3	3	3	Utah	16	17	15	15	15
Illinois	4	4	5	5	4	Tennessee	13	14	14	13	16
West Virginia	2	3	4	4	5	New Jersey	15	16	17	17	17
Virginia	5	7	7	6	6	Minnesota	18	18	19	19	18
Colorado	6	5	6	7	7	Maryland	12	13	16	18	19
Wisconsin	8	9	9	9	8	Washington	19	20	20	20	20
Michigan	11	12	11	11	9	Georgia	21	21	21	21	21
Massachusetts	9	10	10	10	10	Kansas	24	22	22	......	......
Ohio	14	15	13	14	11	Montana	22	......	......	......	......
New York	7	8	8	8	12	Oklahoma	23	......	......	......	......

COAL CONSUMED IN THE MANUFACTURE OF COKE.

The following tables present a statement of the quantity of coal consumed in the manufacture of coke in the several States during the last five years and the total quantity used each five years since 1880.

A considerable quantity of the coal which is not run directly from the mines to the ovens is crushed and washed before coking. In such cases it has been the practice to ascertain for this report the quantity of cleaned coal obtained from washing operations, and to consider that as the oven charge. As explained in previous reports of this series, the quantity of coal consumed in making coke reported in this chapter is at considerable variance with the quantity reported as made into coke in the chapter on the production of coal. The reason for this discrepancy is that in the chapter on the production of coal the quantity made into coke takes into account only that coal which is coked at the mines. The coal shipped to ovens at a distance is included in the shipments and not in the quantity made into coke. The total quantity of coal made into coke in 1914 was 51,623,750 short tons. The coal-mine operators reported 34,791,656 tons made into coke at the mines.

The quantity of coal used in the manufacture of coke, as obtained for this report from the several States, from 1910 to 1914, 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, 1910–1914, by States, in short tons.

State.	1910	1911	1912	1913	1914
Alabama	5,272,322	4,411,298	4,585,498	5,218,323	4,678,196
Colorado	[a] 2,069,266	[a] 1,810,335	1,473,112	1,349,743	1,048,251
Georgia	80,019	72,677	87,300	82,871	45,298
Illinois	1,972,955	2,087,870	2,316,307	2,481,198	1,932,132
Indiana	(b)	(b)	3,198,874	3,535,136	3,125,207
Kentucky	104,103	118,255	307,162	512,245	672,624
New Jersey	(b)	(b)	344,749	339,351	328,921
New Mexico	651,494	620,639	679,209	788,172	660,501
New York	910,293	955,067	1,095,198	1,067,207	659,418
Ohio	413,059	456,222	561,426	507,417	745,097
Pennsylvania	39,455,785	32,875,655	41,268,532	43,195,801	30,286,961
Tennessee	597,658	628,118	685,861	694,085	487,446
Utah	(c)	(c)	(b)	(b)	(b)
Virginia	2,310,742	1,425,303	1,555,969	2,015,259	1,319,901
Washington	94,223	60,201	78,693	118,786	133,349
West Virginia	6,226,234	3,754,561	4,061,702	4,034,251	2,316,309
Other States	2,930,174	4,002,047	3,278,270	3,299,345	3,184,139
Total	63,088,327	53,278,248	65,577,862	69,239,190	51,623,750

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 from 1880 to 1910 and from 1911 to 1914.

	Short tons.		Short tons.		Short tons.
1880	5,237,741	1900	32,113,543	1912	65,577,862
1885	8,071,126	1905	49,530,677	1913	69,239,190
1890	18,005,209	1910	63,088,327	1914	51,623,750
1895	20,848,323	1911	53,278,248		

VALUE OF COAL USED IN MANUFACTURE OF COKE.

The quantity of coal consumed in the manufacture of coke in 1914 was 51,623,750 short tons, valued at $74,949,565, as compared with 69,239,190 tons, valued at $100,561,439, in 1913. The average value obtained for the coal used in 1914 was $1.45, the same as in 1913. The cost of coal per ton of coke produced was $2.166 in 1914, compared with $2.169 in 1913. The cost of the coal per ton of coke charged into the ovens in 1914 was therefore practically the same as in 1913, and as the average value per ton of coke produced showed a decrease of 22 cents, a net loss of 22 cents a ton for the product in 1914 is indicated.

The total quantity and value of the coal consumed in the manufacture of coke in 1913 and 1914, with the quantity and value of the coal consumed per ton of coke produced, by States, are shown in the following tables:

Quantity and value of coal used in the manufacture of coke in the United States in 1913 and 1914, and quantity and value of same per ton of coke, by States.

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.
1913.					
Alabama	5,218,323	$7,609,963	$1.46	1.570	$2.292
Colorado	1,349,743	2,158,120	1.60	1.535	2.456
Georgia	82,871	162,439	1.96	1.939	3.800
Illinois	2,481,198	7,225,925	2.91	1.335	3.885
Indiana	3,535,136	11,006,033	3.11	1.296	4.031
Kentucky	512,245	584,684	1.14	1.615	1.841
New Jersey	339,351	868,346	2.03	1.327	2.694
New Mexico	788,172	1,085,239	1.38	1.684	2.324
New York	1,067,207	2,640,679	2.47	1.407	3.475
Ohio	507,417	977,990	1.93	1.442	2.783
Pennsylvania	43,195,801	52,374,986	1.21	1.502	1.817
Tennessee	694,085	668,255	.96	1.904	1.828
Virginia	2,015,259	1,772,837	.88	1.546	1.360
Washington	118,786	295,402	2.40	1.558	3.739
West Virginia	4,034,251	3,615,901	.90	1.631	1.468
Other States [a]	3,299,345	7,514,640	2.28	1.407	3.208
Total	69,239,190	100,561,439	1.45	1.496	2.169
1914.					
Alabama	4,678,196	$6,765,639	$1.45	1.517	$2.200
Colorado	1,048,251	1,874,580	1.79	1.574	2.817
Georgia	45,298	82,260	1.82	1.848	3.363
Illinois	1,932,132	5,455,620	2.82	1.356	3.824
Indiana	3,125,207	8,881,590	2.84	1.373	3.899
Kentucky	672,624	864,071	1.28	1.515	1.939
New Jersey	328,921	841,991	2.56	1.288	3.297
New Mexico	660,501	981,046	1.49	1.822	2.715
New York	659,418	1,657,502	2.51	1.442	3.619
Ohio	745,097	1,438,891	1.93	1.428	2.756
Pennsylvania	30,286,961	34,870,144	1.15	1.495	1.719
Tennessee	487,446	506,643	1.04	1.845	1.919
Virginia	1,319,901	1,022,124	.77	1.690	1.301
Washington	133,349	342,621	2.57	1.570	4.035
West Virginia	2,316,309	1,897,912	.81	1.622	1.314
Other States [a]	3,184,139	7,466,931	2.35	1.433	3.368
Total	51,623,750	74,949,565	1.45	1.494	2.166

[a] Includes Maryland, Massachusetts, Michigan, Minnesota, 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. Up to 1903 the quantity of coal required to produce a ton of coke exceeded 3,100 pounds; from 1904 to 1910, inclusive, it was between 3,000 and 3,100 pounds; and for the last four years it has been less than 3,000 pounds, the lowest figure (2,982 pounds) being 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	1907	1,519	3,038
1890	1.56	3,120	1908	1.515	3,030
1900	1.57	3,140	1909	1.510	3,020
1901	1.57	3,140	1910	1.513	3,026
1902	1.56	3,120	1911	1.499	2,998
1903	1.56	3,120	1912	1.491	2,982
1904	1.544	3,088	1913	1.496	2,992
1905	1.537	3,074	1914	1.494	2,988
1906	1.531	3,062			

YIELD OF COAL IN COKE.

With the decrease since 1903 in the quantity of coal required to produce a ton of coke shown in the preceding table, the yield of coal in coke has correspondingly increased. In present practice the quantity of coal required per ton of coke is about 160 pounds, or 5 per cent, less than was necessary 10 or 12 years ago, before the operations of retort ovens began to exert any marked influence on the coke-making industry. The yield of coal in coke prior to 1902 was generally less than 64 per cent and reached as high as 65 per cent in one year only. From 1902 to 1904, inclusive, the yield of coal in coke was over 64 per cent; in the next three years another 1 per cent was added to the yield; and since 1908 the yield has been 66 per cent or more. In 1912 it reached its maximum of 67.1 per cent, and in 1913 and 1914 it was 66.9 per cent.

The effect produced on the yield of coal in coke by the retort ovens already constructed is clearly shown in the following table. The entire output of coke in Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, and Wisconsin is from retort ovens, and the yield of coal in coke in 1914 ranged from 67.6 per cent in Maryland to 77.6 per cent in New Jersey, whereas the yield in beehive ovens ranged from 54.1 per cent in Georgia to 66.9 per cent in Pennsylvania. The average yield of coke from retort ovens in the United States in 1914 was 72.4 per cent, and of coke from beehive ovens was 64.6 per cent. In 1913 the retort coke yield averaged 74.4 per cent and beehive coke 64.4 per cent.

The following tables show the percentage yield of coal in coke in each State during the last five years, and in the United States in each tenth year since 1880, and annually since 1901:

Percentage yield of coal in coke, 1910–1914, by States.

State.	1910	1911	1912	1913	1914
Alabama	61.6	62.6	64.9	63.6	65.9
Colorado	66.6	66.6	66.0	65.1	63.5
Georgia	54.8	51.7	50.0	51.5	54.1
Illinois	76.8	77.1	76.2	74.9	73.8
Indiana	78.3	80.6	81.8	77.1	72.8
Kansas	75.2	70.0	70.0	0	0
Kentucky	51.7	55.9	62.4	61.9	66.0
Maryland	65.6	66.2	65.8	69.4	67.6
Massachusetts	77.3	77.4	75.5	76.3	76.4
Michigan	75.7	74.2	75.4	76.2	74.1
Minnesota	68.0	67.6	69.6	66.9	68.4
Montana	44.7	0	0	0	0
New Jersey	76.1	76.2	78.4	75.4	77.6
New Mexico	61.6	61.5	60.9	59.4	54.9
New York	71.7	71.8	72.6	71.1	69.0
Ohio	68.3	68.2	69.2	69.3	70.0
Oklahoma	45.0	0	0	0	0
Pennsylvania	66.7	66.7	66.5	66.6	66.9
Tennessee	54.0	52.6	54.0	52.5	54.2
Utah	54.9	59.0	56.8	56.9	55.9
Virginia	64.6	63.9	62.2	64.7	59.2
Washington	63.0	66.6	62.6	64.2	63.7
West Virginia	61.1	60.4	60.7	61.3	61.6
Wisconsin	77.4	74.9	69.6	76.2	70.8
Total average	66.1	66.7	67.1	66.9	66.9

Percentage yield of coal in coke, 1880–1914.

1880	63.0	1904	64.8	1910	66.1
1890	64.0	1905	65.1	1911	66.7
1900	63.9	1906	65.3	1912	67.1
1901	63.7	1907	65.8	1913	66.9
1902	64.1	1908	66.0	1914	66.9
1903	64.1	1909	66.2		

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 charge 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 places 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. Twenty-one per cent of all the coal charged into the coke ovens was washed in 1914, and 79 per cent was used without any preparation except crushing at some of the establishments. 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 greater part of the coal used is unwashed. In West Virginia most of the coal used in making coke is unwashed slack, as the larger number 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 is washed, and about two-thirds of the total coal used in the State is washed slack. All of the coal used in Georgia and practically all of that used in Washington is washed. In Colorado the greater part of the coal used is washed run of mine, and in Illinois, New Jersey, Ohio, and Virginia, no washed coal is used.

In 1914 the total quantity of coal used for manufacture of coke was 51,623,750 tons, of which 42,032,566 tons (36,517,276 tons unwashed and 5,515,290 tons washed) were run of mine, and 9,591,184 tons (4,289,870 unwashed and 5,301,314 washed) were slack. The total quantity of unwashed coal used was 40,807,146 tons and of washed coal was 10,816,604 tons.

The table following shows the quantity of run of mine and slack coal, unwashed and washed, charged into the ovens in 1913 and 1914, by States, with the percentage of each.

Character of coal used in the manufacture of coke, by States, in 1913 and 1914, in short tons.

1913.

State.	Run of mine.		Slack.		Total.			
	Unwashed.	Washed.	Unwashed.	Washed.	Unwashed.	Percentage.	Washed.	Percentage.
Alabama	868,659	684,223	0	3,665,441	868,659	16.6	4,349,664	83.4
Colorado	13,267	1,015,099	48,952	272,425	62,219	4.6	1,287,524	95.4
Georgia	0	0	0	82,871	0	0	82,871	100.0
Illinois	2,348,526	111,762	0	20,910	2,348,526	94.7	132,672	5.3
Indiana	3,485,232	0	49,904	0	3,535,136	100.0	0	0
Kentucky	440,480	0	0	71,765	440,480	86.0	71,765	14.0
New Jersey	339,351	0	0	0	339,351	100.0	0	0
New Mexico	0	0	0	788,172	0	0	788,172	100.0
New York	835,600	222,364	6,259	2,984	841,859	78.9	225,348	21.1
Ohio	479,286	7,726	7,417	12,988	486,703	95.9	20,714	4.1
Pennsylvania	36,621,183	2,191,944	1,199,859	3,182,815	37,821,042	87.6	5,374,759	12.4
Tennessee	0	202,014	24,327	467,744	24,327	3.5	669,758	96.5
Virginia	916,808	0	1,098,451	0	2,015,259	100.0	0	0
Washington	0	118,786	0	0	0	0	118,786	100.0
West Virginia	916,068	239,135	2,525,919	353,129	3,441,987	85.3	592,264	14.7
Wisconsin	847,469	0	0	0	847,469	100.0	0	0
Other States [a]	1,454,791	0	997,085	0	2,451,876	100.0	0	0
Total	49,566,720	4,793,053	5,958,173	8,921,244	55,524,893	80.2	13,714,297	19.8

1914.

State.	Run of mine.		Slack.		Total.			
	Unwashed.	Washed.	Unwashed.	Washed.	Unwashed.	Percentage.	Washed.	Percentage.
Alabama	703,241	2,069,638	0	1,905,317	703,241	15.0	3,974,955	85.0
Colorado	193	890,948	13,976	143,134	14,169	1.4	1,034,082	98.6
Georgia	0	0	0	45,298	0	0	45,298	100.0
Illinois	1,913,648	0	18,484	0	1,932,132	100.0	0	0
Indiana	2,926,637	61,014	137,556	0	3,064,193	98.0	61,014	2.0
Kentucky	632,913	0	0	39,711	632,913	94.1	39,711	5.9
New Jersey	328,921	0	0	0	328,921	100.0	0	0
New Mexico	0	0	249,546	410,955	249,546	37.8	410,955	62.2
New York	503,540	78,499	1,663	75,716	505,203	76.6	154,215	23.4
Ohio	743,549	0	1,548	0	745,097	100.0	0	0
Pennsylvania	25,568,962	2,135,754	465,927	2,116,318	26,034,889	86.0	4,252,072	14.0
Tennessee	6,499	140,500	0	340,447	6,499	1.3	480,947	98.7
Virginia	460,164	0	859,737	0	1,319,901	100.0	0	0
Washington	560	132,789	0	0	560	.4	132,789	99.6
West Virginia	537,613	0	1,554,278	224,418	2,091,891	90.3	224,418	9.7
Other States [b]	2,190,836	6,148	987,155	0	3,177,991	99.8	6,148	.2
Total	36,517,276	5,515,290	4,289.870	5,301,314	40,807,146	79.0	10,816,604	21.0

[a] Includes Maryland, Massachusetts, Michigan, Minnesota, and Utah.
[b] Includes Maryland, Massachusetts, Michigan, Minnesota, Utah, and Wisconsin.

In the following table are given the statistics of the character of the coal used in making coke each fifth year since 1890, and annually from 1910 to 1914, inclusive:

Character of coal used in the manufacture of coke in the United States, 1890–1914, 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
1913	49,566,720	4,793,053	5,958,173	8,921,244	69,239,190
1914	36,517,276	5,515,290	4,289,870	5,301,314	51,623,750

MANUFACTURE OF COKE IN BY-PRODUCT OVENS.

The first ovens of the retort type constructed in this country comprised a plant of 12 Semet-Solvay ovens with recovery apparatus at Syracuse, N. Y., built in 1893, primarily for the recovery of chemical by-products for use in connection with the chemical works of the Solvay Process Co. The second by-product plant constructed was one of 60 Otto-Hoffmann ovens completed the latter part of 1895 at Johnstown, Pa. Since the first installations at Syracuse and Johnstown, the by-product coking industry has grown steadily, the output each year showing gain in its percentage to the total quantity of coke produced, and in only two years—1908 and 1914—showing decrease in quantity. The decrease in the output of retort coke in those years, moreover, was less in proportion than the decrease in the production of beehive coke. At the close of 1914 there were 42 by-product coke-making establishments, distributed among 15 States and having a total equipment of 5,809 retorts. The production of retort coke in 1914 amounted to 11,219,943 short tons, or 32.5 per cent of the total, a decrease of 1,494,757 tons, or 11.8 per cent, as compared with 1913, when the output of retort coke was 12,714,700 short tons, or 27.5 per cent of the total. In addition to the increase in the number of retorts, the installations of the present day are of much larger dimensions and of greater capacity than formerly. The original ovens at Syracuse, N. Y., had a charging capacity of 4.4 tons of coal, and the time required for coking was 74 hours. The present-day by-product ovens have capacities ranging from 10 to 16 tons of coal, and make furnace coke in 16 to 18 hours. These developments have been accompanied by marked improvements in by-product recovery and in the manufacture of ammonia. 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 ranging in quality from crude liquor through the different grades required for the manufacture of flameless powder to almost chemically pure aqua ammonia. Other plants are manufacturing ammonium sulphate either by the old or indirect process or by some of the more direct processes which have lately come into use and in which 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 over 50,000,000 cubic feet of gas a day for domestic purposes. Almost the entire supply of gas in some cities is from retort ovens. Among these cities may be specially mentioned Boston, Mass.; Camden, N. J.; Indianapolis, Ind.; Hamilton, Ohio; Baltimore, Md.; Duluth, Minn.; South Chicago, Ill.; and Milwaukee, Wis.

The 5,809 retorts in existence in the United States at the close of 1914 consisted of 1,957 United-Otto, 1,669 Koppers, 1,598 Semet-Solvay, 281 Rothberg, 232 Didier, 27 Klönne, 27 Gas Machinery, and 18 Wilputte ovens. At the end of 1914 there were 644 retort ovens in course of construction, of which 388 were Koppers, 150 United-Otto, 91 Semet-Solvay, 12 Roberts Flueless, and 3 Gas Machinery.

The Gas Machinery retort is a new type, the first installation being in 1914 at the Cambria Steel Co.'s plant at Johnstown.

Although not a retort oven the Mitchell or rectangular oven has achieved considerable popularity in the Lower Connellsville district of Pennsylvania, where the activity in that kind of construction has been greatest. In the rectangular ovens the process is the same as that of the beehive, but the coking chamber, instead of being round, is, as the name implies, rectangular and oblong, so that the coke may be pushed, as from the retort oven, and does not have to be drawn, as from the beehive. The rectangular oven is, therefore, included with the beehive type.

With the exception of Alabama, which has shown exceptional progress in the substitution of retort for beehive ovens, most of the by-product oven construction has been at points distant from the mines; and if all of the beehive ovens in the Connellsville district were abandoned, the retorts to take their places would be built at the points of consumption and not at Connellsville.

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 10 years, or from 1905 to 1914, the increase in beehive coke has amounted to 11 per cent; that of retort-oven coke has amounted to 330 per cent.

Production of by-product coke, compared with that of beehive coke, with percentage of quantity and value to the total, 1893–1914.

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	38.13	32,868,435	74.73	69,172,183	61.87	43,983,599	111,805,113
1913..	12,714,700	27.46	48,637,852	37.73	33,584,830	72.54	80,284,421	62.27	46,299,530	128,922,273
1914..	11,219,943	32.47	38,080,167	43.11	23,335,971	67.53	50,254,050	56.89	34,555,914	88,334,217

Distributed by States, the production of beehive and retort coke in 1913 and 1914 was as follows:

Statistics of the production of coke in beehive and retort ovens in the United States, 1913 and 1914, by States, in short tons.

1913.

State.	Beehive coke.		By-product coke.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	1,300,705	$4,401,216	2,022,959	$5,225,954	3,323,664	$9,627,170
Illinois	0	0	1,859,553	8,593,581	1,859,553	8,593,581
Indiana	0	0	2,727,025	13,182,136	2,727,025	13,182,136
Kentucky	248,061	589,225	69,023	164,672	317,084	753,897
New Jersey	0	0	255,792	695,041	255,792	695,041
New Mexico	467,945	1,548,536	0	0	467,945	1,548,536
New York	0	0	758,486	3,301,400	758,486	3,301,400
Ohio	115,814	364,124	236,032	867,430	351,846	1,231,554
Pennsylvania	26,124,764	59,690,940	2,628,680	8,238,924	28,753,444	67,929,864
Tennessee	364,578	925,430	0	0	364,578	925,430
Virginia	1,303,603	2,840,275	0	0	1,303,603	2,840,275
Washington	76,221	432,770	0	0	76,221	432,770
West Virginia	2,336,600	5,069,837	136,152	434,579	2,472,752	5,504,416
Colorado, Georgia, Maryland, Massachusetts, Michigan, Minnesota, Utah, Wisconsin	1,246,539	4,422,068	2,020,998	7,934,135	3,267,537	12,356,203
Total	33,584,830	80,284,421	12,714,700	48,637,852	46,299,530	128,922,273

1914.

State.	Beehive coke.		By-product coke.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	1,052,614	$3,329,606	2,031,535	$5,078,837	3,084,149	$8,408,443
Colorado	666,083	2,203,031	0	0	666,083	2,203,031
Georgia	24,517	100,529	0	0	24,517	100,529
Illinois	0	0	1,425,168	5,858,700	1,425,168	5,858,700
Indiana	0	0	2,276,652	9,055,937	2,276,652	9,055,937
Kentucky	247,182	477,301	196,777	493,759	443,959	971,060
New Jersey	0	0	255,283	680,972	255,283	680,972
New Mexico	362,572	1,228,045	0	0	362,572	1,228,045
New York	0	0	457,370	1,726,133	457,370	1,726,133
Ohio	67,838	214,805	453,800	1,463,881	521,638	1,678,686
Pennsylvania	18,074,057	35,877,910	2,184,336	6,569,976	20,258,393	42,447,886
Tennessee	264,127	642,573	0	0	264,127	642,573
Virginia	780,984	1,582,419	0	0	780,984	1,582,419
Washington	(a)	(a)	(a)	(a)	84,923	472,531
West Virginia	1,381,675	2,705,992	46,287	141,292	1,427,962	2,847,284
Maryland, Massachusetts, Michigan, Minnesota, Utah, Wisconsin	[b] 414,322	[b] 1,891,839	[b] 1,892,735	[b] 7,010,680	2,222,134	8,429,988
Total	23,335,971	50,254,050	11,219,943	38,080,167	34,555,914	88,334,217

[a] Included in combined States. [b] Includes also Washington.

The value of the by-product coke produced in 1914 was $38,080,167, or an average value per ton of $3.39. In 1913 the average value per ton of retort coke produced was $3.82. The cost of the coal consumed decreased from $2.43 in 1913 to $2.31 in 1914, and the average value for the coke declined from $3.82 to $3.39. The cost of the coal used per ton of coke produced in retorts in 1914 was $3.19, the difference between that and the value of the coke produced and the coal used being 20 cents. The cost of the coal used in beehive ovens per ton of coke was $1.67 per ton, the difference between that and the value per ton of coke produced being 48 cents. From this it would seem that in 1914 the advantage was with the beehive coke. However, to the value of the coke produced in retort ovens should be added the value of the by-products recovered. In 1914 the value of the by-products amounted to $17,529,088, or an average of $1.13 for each ton of coal used and of $1.56 for each ton of coke produced. The value of the by-products in 1914 was equivalent to 46 per cent of the value of the coke produced, as compared with 35 per cent in 1913 and 34 per cent in 1912. The value of the by-products in 1914 was $1.13 for each ton of coal used, as compared with 99 cents in 1913. The by-products in 1914 consisted of 61,364,375,000 cubic feet of surplus gas, valued at $6,009,583; 109,901,315 gallons of tar, valued at $2,867,274; ammonia in the form of sulphate, ammoniacal liquor, and anhydrous ammonia valued at $7,655,224. In addition there were other by-products, principally benzol, valued at $997,007.

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 by-products obtained in manufacture of coke in retort ovens in 1912, 1913, and 1914.

Product.	1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gas..............M cubic feet..	54,491,248	$4,650,517	64,553,941	$5,694,691	61,364,375	$6,009,583
Tar....................gallons..	94,306,583	2,310,900	115,145,025	2,830,158	109,901,315	2,867,274
Ammonia, sulphate or reduced to equivalent in sulphate, pounds..........	95,275,545	3,649,144	173,342,349	5,324,444	170,763,906	4,696,590
Ammonia liquor.....gallons..	5,502,403	735,120	4,102,448	537,413	5,938,233	658,497
Anhydrous ammonia, pounds..	[a]26,672,474	[a] 2,387,562	[a]28,663,936	[a] 2,135,656	[a]25,370,509	[a] 2,300,137
Other by-products..........	....	610,552	....	403,579	....	[b] 997,007
Total value of by-products..........	....	14,343,795	....	16,925,941	....	17,529,088
Coke..............short tons..	11,115,164	42,632,930	12,714,700	48,637,852	11,219,943	38,080,167
Grand total..........	....	56,976,725	....	65,563,793	....	55,609,255

[a] Mainly ammoniacal liquor sold on pound basis of NH_3. [b] Mainly benzol.

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. At some plants where the surplus gas is consumed by the producing or 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 40 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 2½ cents a thousand cubic feet. The average value of the surplus gas in 1914 was 9.8 cents a thousand cubic feet, against 8.8 cents in 1913.

At the close of 1913 there were 5,688 retort ovens completed and 504 building. At the close of 1914 there were 5,809 retort ovens completed and 644 building. The new construction added in 1914 consisted of 98 Koppers, 61 Semet-Solvay, 18 Willputte, 5 Klönne, and 27 Gas Machinery ovens. There were 71 retort ovens abandoned during 1914—68 Didier ovens, 2 United-Otto, and 1 Roberts-Mass. The ovens building at the end of the year included 388 Koppers, 91 Semet-Solvay, 150 United-Otto, 12 Roberts-Flueless, and 3 Gas Machinery ovens.

The statistical history of by-product manufacture of coke in the United States since the first ovens were completed in 1893 is shown in the table following:

Record of by-product manufacture of coke, 1893–1914.

Year.	Ovens.		Production (short tons).	Year.	Ovens.		Production (short tons).
	Built.	Building.			Built.	Building.	
1893	12	0	12,850	1904	2,910	832	2,608,229
1894	12	60	16,500	1905	3,103	417	3,462,348
1895	72	60	18,521	1906	3,547	112	4,558,127
1896	160	120	83,038	1907	3,684	330	5,607,899
1897	280	240	261,912	1908	3,799	240	4,201,226
1898	520	500	294,445	1909	3,989	949	6,254,644
1899	1,020	65	906,534	1910	4,078	1,200	7,138,734
1900	1,085	1,096	1,075,727	1911	4,624	698	7,847,845
1901	1,165	1,533	1,179,900	1912	5,211	793	11,115,164
1902	1,663	1,346	1,403,588	1913	5,688	504	12,714,700
1903	1,956	1,335	1,882,394	1914	[a] 5,809	[b] 644	11,219,943

[a] Includes 1,598 Semet-Solvay, 1,957 United-Otto, 281 Rothberg, 1,669 Koppers, 232 Didier, 27 Klönne, 27 Gas Machinery, and 18 Willputte ovens.
[b] Includes 388 Koppers, 91 Semet-Solvay, 150 United-Otto, 12 Roberts-Flueless, and 3 Gas Machinery 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, 1910–1914.

State.	Dec. 31, 1910.		Dec. 31, 1911.		Dec. 31, 1912.		Dec. 31, 1913.		Dec. 31, 1914.	
	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.
Alabama	280	340	340	280	620	100	700	20	750	0
Illinois	480	0	480	48	568	40	568	58	586	40
Indiana	50	560	540	70	632	169	749	41	789	33
Kentucky	0	0	0	0	0	41	54	0	54	0
Maryland	200	0	200	0	200	6	[a] 0	120	120	0
Massachusetts	400	0	400	0	400	0	400	0	400	0
Michigan	162	0	162	0	165	40	205	0	205	0
Minnesota	50	0	50	0	50	92	50	90	140	90
Missouri	0	0	0	0	0	0	0	56	0	56
New Jersey	150	0	150	0	150	0	150	0	150	0
New York	556	0	556	0	555	0	555	0	555	100
Ohio	174	0	174	0	149	119	149	119	217	51
Pennsylvania	1,296	300	1,292	300	1,442	150	1,592	0	1,522	262
Tennessee	0	0	0	0	0	0	0	0	0	12
Washington	0	0	0	0	0	0	0	0	5	0
West Virginia	120	0	120	0	120	0	120	0	120	0
Wisconsin	160	0	160	0	160	36	196	0	196	0
Total	4,078	1,200	4,624	698	5,211	793	[a] 5,488	504	5,809	644

[a] At the close of 1913, the 200 ovens at Sparrows Point works of the Maryland Steel Co. that were operated during the year were being torn down to be replaced by 120 ovens of larger dimensions.

The retort ovens under construction at the close of 1914 were as follows:

Retort ovens under construction at the close of 1914, by kinds.

State.	Kind of ovens.				
	Koppers.	United-Otto.	Semet-Solvay.	Roberts-flueless.	Gas machinery.
Illinois	0	0	40	0	0
Indiana	30	0	0	0	3
Minnestoa	90	0	0	0	0
Missouri	56	0	0	0	0
New York	0	100	0	0	0
Ohio	0	0	51	0	0
Pennsylvania	212	50	0	0	0
Tennessee	0	0	0	12	0
Total	388	150	91	12	3

The distribution, by States and by kinds, of by-product ovens built and building in the United States at the close of 1914 is shown in the following table:

Kinds of by-product ovens built and building in the United States, by States, at the close of 1914.

State.	United Otto,[a] built.	Koppers, built.	Semet-Solvay, built.	Didier, built.	Rothberg, built.	Klönne, built.	Gas machinery, built.	Wilputte, built.	Total.	
									Built.	Building.
Alabama	0	450	300	0	0	0	0	0	750	0
Illinois	0	315	253	0	0	0	0	18	586	[b] 40
Indiana	100	626	41	0	0	22	0	0	789	[c] 33
Kentucky	0	0	54	0	0	0	0	0	54	0
Maryland	0	120	0	0	0	0	0	0	120	0
Massachusetts	400	0	0	0	0	0	0	0	400	0
Michigan	30	0	175	0	0	0	0	0	205	0
Minnesota	50	90	0	0	0	0	0	0	140	[c] 90
Missouri	0	0	0	0	0	0	0	0	0	[c] 56
New Jersey	150	0	0	0	0	0	0	0	150	0
New York	188	0	86	0	281	0	0	0	555	[d] 100
Ohio	100	68	49	0	0	0	0	0	217	[b] 51
Pennsylvania	903	0	360	232	0	0	27	0	1,522	[e] 262
Tennessee	0	0	0	0	0	0	0	0	0	[f] 12
Washington	0	0	0	0	0	5	0	0	5	0
West Virginia	0	0	120	0	0	0	0	0	120	0
Wisconsin	36	0	160	0	0	0	0	0	196	0
Total	1,957	1,669	1,598	232	281	27	27	18	5,809	644

[a] Includes the Otto-Hoffmann and Schniewind types.
[b] Semet-Solvay ovens.
[c] Includes 30 Koppers and 3 gas machinery ovens.
[d] United-Otto ovens.
[e] Includes 212 Koppers and 50 United-Otto ovens.
[f] Roberts Flueless ovens.

In the following table is presented a list of the by-product retort oven plants in the United States as they existed on January 1, 1915, with the dates when the plants were put into operation, the number of ovens to each installation, and the uses to which the coke and surplus gas are put.

Complete list of retort coke-oven plants of the United States Jan. 1, 1915, by States.

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	Tennessee Coal, Iron & R. R. Co.	First	Oct., 1898	120	Blast furnace	Fuel	
				Second	Mar., 1902	120	do	do	
	Tuscaloosa	do	Central Iron & Coal Co.	First	Feb., 1906	40	do	do	
	do	do	do	Second	1914	20	do	do	
	Woodward	Koppers	Woodward Iron Co.	First	1911	60	do	Fuel and power	
	do	do	do	Second	1913	80	do	do	
	do	do	do	Third	1914	30	do	do	
	Fairfield	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.	Gas sold to Western United Gas & Electric Co.
	do	Wilputte	do	Second	1914	18			
	do	Koppers	Illinois Steel Co.	First	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	Illuminating and domestic fuel.	
Ind.	Gary	Koppers	Illinois Steel Co.	do	490 completed in 1911.	560	Blast furnace	Fuel	
	Indiana Harbor	do	Inland Steel Co.	do	1913	66	do	do	
	do	do	do	Second	Began construction 1914.	30			
	Muncie	Klönne	Central Indiana Gas Co.	First	1912	22	Domestic and industrial.	Illuminating	
	Gary	Roberts-Mass	American Coal & By-Products Coke Co.	do	1913	1			Experimental plant to test western coals; no by-products obtained. Abandoned at close of 1913.
	Indianapolis	United-Otto	Citizens Gas Co.	do	Completed 1909.	50	Blast furnace, foundry, and domestic.	Fuel and illuminating gas for Indianapolis.	
	do	do	do	Second	1913	50	do	do	

Complete list of retort coke-oven plants of the United States Jan. 1, 1915, by States—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.
Ind	Indianapolis	Semet-Solvay	Indianapolis Gas Co.	First	1914	41	Foundry and domestic.	Illuminating, domestic heating, and industrial.	Leased to Citizens Gas Co.
	Linton	Gas Machinery	Linton Gas Co.	do	Began construction 1914.	3			
Ky	Ashland	Semet-Solvay	Kentucky Solvay Co.	do	1913	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.	Abandoned during 1913. Koppers ovens to be substituted.
	do	Koppers	do	do	1914	120		Illuminating, domestic heating, and industrial.	All completed, but only 60 in blast in 1914.
Mass	Everett	Otto-Hoffmann	New England Gas & Coke Co.	First	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	1913	43			
	Wyandotte	United-Otto	Michigan Alkali Co.	First	Oct., 1902	15	Burning limestone.	Fuel	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 and domestic.	Illuminating gas for Duluth.	
	do	Koppers	Minnesota Steel Co.	do	Completed in 1914 but not in blast.	90	do	Fuel	
	do	do	do	Second	Began construction 1914.	90	do	do	
Mo	St. Louis	do	Laclede Gas Light Co.	First	Began construction 1913.	56			

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.
	do	do	do	Second	1896	13			
	do	do	do	Third	Bet. 1900 and 1903.	15			
	Geneva	do	The Empire Coke Co.	First	Aug., 1904	30	Foundry and domestic.	Illuminating and domestic fuel.	
	do	do	do	Second	1909	16			
	Buffalo	United-Otto	Lackawanna Steel Co.	First	May, 1904	188	Blast furnace	Fuel	First used stamped coal, but changed to top-charging, 1907.
	do	Rothberg	do	do		281	do	do	
	Lackawanna	United-Otto	Niagara Coke Corporation.	do	Began construction 1914.	100	Blast furnace, foundry, and domestic.		
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.	Gas purchased and distributed by Hamilton Utilities Co.
	do	United-Otto	do	Second	1909	50	Blast furnace	do	
	Cleveland	Semet-Solvay	Cleveland Furnace Co.	First	1910	49	do	Illuminating and domestic 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	1914	68	do	Fuel	
Pa	Dunbar	Semet-Solvay	Dunbar Furnace Co.	First	Aug., 1896	50	do	do	
	do	do	do	Second	July, 1903	60	do	do	
	Chester	do	The Philadelphia Suburban Gas & Electric Co.	First	Apr., 1904	40	Blast furnace	Illuminating and domestic fuel.	
	Farrell	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.	

Complete list of retort coke-oven plants of the United States Jan. 1, 1915, by States—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.
Pa	Johnstown	do	Cambria Steel Co	do	Nov., 1895	60	Blast furnace	Fuel and power	
	do	United-Otto	do	Second	Mar., 1899	100	do	do	
	do	United-Otto	Cambria Steel Co	Third	Sept., 1904	100	Blast furnace	Fuel and power	
	do	do	do	Fourth	Feb., 1907	112	do	do	
	do	do	do	Fifth	Began construction 1914.	50	do	do	
	do	Gas Machinery	do	First	1914	27			Originally United-Otto ovens. Includes benzol recovery.
	Lebanon	Semet-Solvay	Pennsylvania Steel Co.	do	July, 1904	90	Blast furnace	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	Returned to top-charging since resumption in September, 1905.
	Steelton	Semet-Solvay	Pennsylvania Steel Co	do	Jan., 1907	120	do	do	
	South Bethlehem.	Didier	Lehigh Coke Co	do	1912	150		do	
	do	do	do	Second	1913	150		do	68 of these ovens abandoned, 1914.
	do	Koppers	do	First	Began construction 1914.	212			
Tenn	Chattanooga	Roberts-Flueless	Chattanooga Gas & Coal Products Co.	do	do	12			Supplies Seattle and suburbs.
Wash	Seattle	Klönne	Seattle Lighting Co	do	1914	5		Illuminating and domestic heating.	
W. Va	Benwood	Semet-Solvay	National Tube Co	do	Oct., 1898	60	Blast furnace	Fuel	
	do	do	do	Second	Mar., 1901	60	do	do	
Wis	Milwaukee	do	Milwaukee Coke & Gas. Co.	First	Mar., 1904	80	Blast furnace, foundry, and domestic.	Illuminating and domestic fuel.	Gas sold to Milwaukee Gas Light Co.
	do	do	do	Second	Mar., 1906	80			
	Mayville	Otto-Hoffmann	Northwestern Iron Co.	First	1914	36			

IMPORTS AND EXPORTS.

IMPORTS.

The following table gives the quantity and value of coke imported and entered for consumption in the United States from 1908 to 1914, 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 United States, 1908–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1908	147,427	$606,294	1912	123,614	$488,398
1909	191,253	736,120	1913	101,212	435,157
1910	172,716	625,130	1914	133,226	551,104
1911	77,923	254,455			

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, although with slight fluctuations it has remained practically stationary during the last six years. The exports in 1914 were the lowest since 1904.

The exports of coke during the last six years are shown in the following table, the quantities being reduced to short tons:

Coke exported from the United States, 1909–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1909	1,002,916	$3,232,673	1912	912,576	$3,002,742
1910	984,618	3,053,293	1913	987,395	3,309,930
1911	1,023,727	3,215,990	1914	663,585	2,233,686

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 the domestic coal tar produced in 1914 from retort coke ovens was $2,867,274. 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. For several years the coal-tar products imported into the United States have amounted approximately to $10,000,000 annually. In 1914 the total value of coal-tar products was $9,646,199, compared with $10,962,828 in 1913, a decrease of 12 per cent. Colors and dyes made up about 84 per cent of the total, compared with 80 per cent in 1913. This decrease in the value of imported coal-tar products, which come mainly from Germany, is probably to be ascribed not so much to decrease in demand as to the restrictions in imports since the beginning of the European war in August, 1914. The unit values have consequently been considerably increased. The kinds of coal-tar products imported, the value thereof, and the amount of duty paid on each during the last six years are shown in the following table:

Coal-tar products imported into the United States, 1909–1914.

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.
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
1913	2,969	613	1,493,840	Free.	323,420	[a]$4,034	7,253,788	2,176,136
1914	9,245	1,051	1,216,907	Free.	180,905	18,091	6,868,818	2,060,629

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.
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	998,767	Free.	10,740,638	2,295,666
1913	702,721	131,268	1,186,090	[b] $11,678	10,962,828	2,323,729
1914	556,614	80,179	813,710	52,964	9,646,199	2,212,914

[a] Dutiable on and after Oct. 4, 1913.
[b] All products in this class became dutiable on Oct. 4, 1913, except naphthaline, phenol, and cresol.

PRODUCTION OF COKE BY STATES.

ALABAMA.

The production of coke in Alabama decreased from 3,323,664 short tons, valued at $9,627,170, in 1913 to 3,084,149 tons, valued at $8,408,443, in 1914. The decrease was 239,515 tons, or 7 per cent, in quantity and $1,218,727, or 12.7 per cent, in value. There were in Alabama 4 retort-oven establishments with a total of 750 ovens, and in 1914 these 4 establishments produced 2,031,535 tons, or nearly 66 per cent of the total output, whereas 16 active beehive plants with an aggregate of 2,562 ovens in blast produced 1,052,614 tons, or a little more than 34 per cent of the total. The average production per oven in the by-product plants was 2,700 tons and the average production from active beehive ovens was 411 tons. The increase in the production of by-product coke in 1914 over 1913 was

8,576 tons, or 0.4 per cent, and the decrease in the production of beehive coke was 248,091 tons, or 18.3 per cent. The value of the by-product coke, however, showed a decrease of $147,117, or 2.8 per cent, a little over 10 per cent of the total decrease in the State. The average yield of coal in coke from the retort ovens was 69.8 per cent, and the average yield in the beehive ovens was 59.5 per cent. There is not the marked difference in the values of retort and beehive cokes (and in favor of the former) in Alabama as is shown in some States, for in Alabama the retort ovens, like the beehive, are located near the mines, and the two in that respect are somewhat on a parity, whereas in most of the States in which retort coke is made the ovens are at considerable distances from the mines, and the transportation charges assessed against the coal appear in the cost of the coke to the consumer. In fact, the Alabama beehive coke had a higher value per ton in 1914 than the retort coke, the averages being $3.16 for beehive and $2.50 for retort coke. The explanation of this seeming inconsistency lies in the fact that all of the retort coke is used by the producers in their own furnaces, and the coke is charged to the furnaces at little more than cost, whereas the greater part of the beehive product is commercial coke, some of it for foundry use, and profits are included in the value.

That the beehive oven has had its day in Alabama and is on the decline is evidenced by the fact that no new ovens of that type have been built in the last five years, and that 18 establishments with a complement of 5,015 ovens out of a total of 34 establishments with 8,535 ovens were idle in 1914, not counting the idle ovens at plants producing some coke in 1914. There were fewer beehive ovens in existence in Alabama in 1914 than in 1908, six years before. The number of retort ovens increased from 620 in 1912 and 700 in 1913 to 750 in 1914. The 750 completed ovens included 300 Semet-Solvay and 450 Koppers ovens. There were no new ovens under construction in Alabama at the close of 1914, and 8 establishments with a total of 1,047 beehive ovens were abandoned during the year.

The production of coke in Alabama in 1880, 1890, 1900, and annually from 1910 to 1914, is shown in the following table:

Statistics of the manufacture of coke in Alabama, 1880–1914.

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
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	10,208	100	4,585,498	64.9	2,975,489	8,098,412	2.72
1913	46	10,284	20	5,218,323	63.6	3,323,664	9,627,170	2.90
1914	38	a 9,285	0	4,678,196	65.9	3,084,149	8,408,443	2.73

a Includes 300 Semet-Solvay and 450 Koppers ovens.

Almost 85 per cent of the coal used in the manufacture of coke in Alabama is washed before being charged into the ovens. In 1914, out of a total of 4,678,196 tons of coal made into coke, 3,974,955 were washed. Of the washed coal used 1,905,317 tons were slack and 2,069,638 were mine run. The unwashed mine-run coal used was 703,241 tons. No unwashed slack was used in 1914.

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, 1890–1914, 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
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
1913	868,659	684,223	0	3,665,441	5,218,323
1914	703,241	2,069,638	0	1,905,317	4,678,196

COLORADO.

The production of coke in Colorado decreased from 879,461 short tons, valued at $2,815,234, in 1913 to 666,083 short tons, valued at $2,203,031, in 1914. The decrease, which amounted to 213,378 tons, or 24 per cent, in quantity and to $612,103, or 22 per cent, in value, was due only in part to lack of demand because of adverse trade conditions. In the struggle to secure recognition of the Mine Workers' Union a strike was called in the latter part of September, 1913, and lasted throughout 1914. The principal disturbances were in Las Animas County, the leading coal-producing and coke-making county, and resulted in a notable decrease in production of coal and output of coke in both 1913 and 1914.

In 1914 there were 2,142 idle ovens, nearly two-thirds of the coking capacity of the State. Of this number 1,704 were reported by the operators as not in use because of the strike. In 1914 there were 14 coke-making establishments in Colorado with a total of 3,573 ovens all of the beehive type. Six of the establishments, with a total of 865 ovens, were idle throughout the year. One plant of 15 ovens was abandoned in 1914. There were no new ovens under construction during the year.

According to returns to the Survey, the average value per ton of Colorado coke advanced from $3.20 in 1913 to $3.30 in 1914. In 1912 the average was $3.13. These fluctuations are, however, more apparent than real. A large proportion of the coke produced in Colorado is made in ovens which are parts of plants including in their operations the mining of coal, the making of coke, and the manufacture of iron and steel or the smelting and refining of the precious and base metals. In such establishments the placing of a value on the coke is an arbitrary matter and does not represent market prices.

The statistics of the manufacture of coke in Colorado and Utah in 1880, 1890, 1900, and from 1910 to 1914, inclusive, are shown in the following table. The statistics for 1912 to 1914 are for Colorado alone.

Statistics of the manufacture of coke in Colorado, 1880–1914.

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 [a]	1	200	50	51,891	49.0	25,568	$145,226	$5.68
1890 [a]	8	916	30	407,023	60.0	245,756	959,246	3.90
1900 [a]	14	1,692	0	997,861	62.0	618,755	1,746,732	2.82
1910 [a]	18	4,465	0	2,069,266	65.1	1,346,211	4,273,579	3.17
1911 [a]	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
1913	15	3,588	0	1,349,743	65.1	879,461	2,815,134	3.20
1914	14	3,573	0	1,048,251	63.5	666,083	2,203,031	3.30

[a] Includes Utah.

The total quantity of coal consumed in the manufacture of coke in Colorado in 1914 was 1,048,251 short tons, of which 891,141 tons were mine run and 157,110 were slack. All but 193 tons of the mine run and 90 per cent of the slack was washed before being charged into the ovens. The character of the coal used in making coke in Colorado in 1890, 1900, and from 1910 to 1914, inclusive, is shown in the following table:

Character of coal used in the manufacture of coke in Colorado, 1890–1914.

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
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
1913	13,267	1,015,099	48,952	272,425	1,349,743
1914	193	890,948	13,976	143,134	1,048,251

[a] Includes Utah.

GEORGIA.

Portions of two counties in the extreme northwest corner of the State, Dade and Walker, are underlain by the coal measures of the Appalachian province. Coal has been mined and coke has been made in both counties, but the Dade County mines and ovens have been idle the last few years and all the production at the present time is from Walker County. The sole operator in that county is the Durham Coal & Coke Co., of Chattanooga, Tenn. The statistics of its production of coke, as of coal, are published with the express permission of the company.

The production of coke at the one plant in Walker County amounted to 24,517 short tons, valued at $100,529, compared with 42,747 short tons, valued at $186,304, in 1913. These figures show a decrease in 1914 of 18,230 tons, or 43 per cent, in quantity and of $85,775, or 46 per cent, in value. The average value per ton declined from $4.35 in 1913 to $4.10 in 1914.

The two coking establishments in Georgia have a total coking equipment of 201 ovens, of which 101 were idle in 1914. All the ovens are of the beehive type, the wasteful character of which is shown in the theoretical and practical yield of the Walker County coal in coke. The mine-run coal has a high content of fixed carbon (80 per cent), whereas the yield during the last few years has averaged less than 55 per cent. The recovery is less than two-thirds of the possible yield.

The statistics of the manufacture of coke in Georgia in 1880, 1890, 1900, and from 1910 to 1914, inclusive, are shown in the following table:

Statistics of the manufacture of coke in Georgia, 1880–1914.

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
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
1913	2	251	0	82,871	51.5	42,747	186,304	4.35
1914	2	201	0	45,298	54.1	24,517	100,529	4.10

ILLINOIS.

All the coke made in Illinois is the product of retort ovens. The retort-oven plants are at South Chicago, Joliet, and Waukegan, but they draw most of their coal from the Pennsylvania and West Virginia mines. The common practice is to mix the West Virginia coal with Illinois coal in the proportion of 4 to 1. The mixture is ground fine and has been found to make an entirely satisfactory coke with a yield of coal in coke of approximately 75 per cent. There are 4 establishments with a total of 586 ovens, 546 of which were in operation during the year. There were 40 Semet-Solvay ovens in course of construction at the end of the year, work on which was begun in 1913. During the year 18 Wilputte ovens, building in 1913, were completed.

The production of coke in Illinois decreased from 1,859,553 short tons, valued at $8,593,581, in 1913, to 1,425,168 short tons, valued at $5,858,700, in 1914. The decrease in quantity amounted to 434,385 tons, or 24.5 per cent, and in value to $2,734,881, or 32 per cent. The decrease in the value of the coke was greater than the decrease in the value of the coal used in its manufacture. In 1913 the coal consumed in the coke ovens of Illinois amounted to 2,481,198 short tons, valued at $7,225,925. In 1914 the coal used was 1,932,132 tons, valued at $5,455,620, the difference being $1,770,305, or $964,576 less than the decrease in the value of the coke made from it. The average value of coke per ton at the ovens declined from $4.62 in 1913 to $4.11 in 1914. In Illinois, as elsewhere, a large part of the byproduct coke is consumed by the producing or allied interests, and the fixing of the values is an arbitrary matter and not indicative of market conditions.

The statistics of the manufacture of coke in Illinois during the last eight years are shown in the following table:

Statistics of the manufacture of coke in Illinois, 1907–1914.

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	594	40	2,316,307	76.2	1,764,944	8,069,903	4.57
1913	4	568	58	2,481,198	74.9	1,859,553	8,593,581	4.62
1914	4	[a] 586	[b] 40	1,932,132	73.8	1,425,168	5,858,700	4.11

[a] Includes 253 Semet-Solvay, 315 Koppers, and 18 Wilputte ovens.
[b] Semet-Solvay ovens.

INDIANA.

As in the neighboring State of Illinois, all the coke made in Indiana is the product of retort ovens, and most of the coal used is brought from West Virginia. The State assumed importance in the manufacture of coke in 1911, when a portion of the United States Steel Corporation plant at Gary was completed and put in blast. The entire plant was completed in 1912, and Indiana, from a relatively low place (seventeenth) in the rank of coke-producing States in 1910 advanced to third place in 1912, which position it has maintained since that time, outranking West Virginia, upon whose mines the ovens in Indiana depend for the greater part of their coal. The United States Steel Corporation's plant at Gary consists of 560 Koppers' ovens, which in 1914 produced 73 per cent of the entire output of the State. The construction of 41 Semet-Solvay ovens begun in 1912 at Indianapolis was completed in 1914. One Roberts-Mass oven, an experimental installation, built at Gary in 1913 by the American Coal & By-Products Coke Co., was torn down. The Inland Steel Co. at Indiana Harbor, with 66 Koppers' ovens, began the construction of 30 additional ovens of the same type in 1914. The Gas Machinery Co. has under construction 3 ovens of special type for the Linton Gas Co., at Linton, Ind. The total number of ovens in the State at the close of 1914 was 789, with 33 under construction.

The production of retort coke in Indiana in 1914 was 2,276,652 short tons, valued at $9,055,937, as compared with 2,727,025 short tons, valued at $13,182,136, in 1913. The decrease in 1914 was 450,373 tons, or 16.5 per cent, in quantity and $4,126,199, or 31 per cent, in value. The average value per ton decreased from $4.83 to to $3.98. The decrease in the value of coke was nearly twice the decrease in the value of the coal used, which in 1914 was $8,881,590 against $11,006,033 in 1913, the difference being $2,124,443. The 767 active ovens had an average production in 1914 of 2,968 tons of coke, and the average yield of coal in coke was 72.8 per cent.

The statistics of the manufacture of coke in Indiana in 1912, 1913, and 1914, are shown in the following table:

Statistics of the manufacture of coke in Indiana, 1912–1914.

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	642	169	3,198,874	81.8	2,616,339	$12,528,685	$4.79
1913	5	749	41	3,535,136	77.1	2,727,025	13,182,136	4.83
1914	5	[a] 789	[b] 33	3,125,207	72.8	2,276,652	9,055,937	3.98

[a] Includes 626 Koppers, 100 United-Otto, 22 Klönne, and 41 Semet-Solvay ovens.
[b] Includes 30 Koppers and 3 Gas Machinery ovens.

KENTUCKY.

Kentucky is one of the three States in which the output of coke increased in 1914 over 1913, the other two States being Ohio and Washington. From sixteenth in the rank of coke-producing States in 1913, Kentucky advanced to thirteenth in 1914. The output in 1914 was 443,959 short tons, valued at $971,060, an increase over 1913 of 126,875 tons, or 40 per cent, in quantity and of $217,163, or 27.5 per cent, in value. The great increase in activity in the coal mining and coking districts of eastern Kentucky is responsible for this increase, as more than 95 per cent of the production in the State was from Pike, Harlan, and Boyd counties. More than 44 per cent of the total output of coke in the State came from 54 Semet-Solvay ovens operated by the Semet-Solvay Co. for the Kentucky Solvay Co., from near Ashland. No ovens were under construction at the close of 1914; 108 ovens were completed and 6 were abandoned during the year. The total number of ovens at the end of 1914 was 1,151, of which 610 were idle throughout the year. The 1,151 ovens were distributed among 9 establishments, 4 of which, with a total of 324 ovens, were idle the entire year.

The quantity of coal used in the manufacture of coke in 1914 was 672,624 short tons, of which 632,913 tons was unwashed run of mine, and 39,711 tons was washed slack. All the latter was used in the western district.

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, 1880–1914.

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
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	291	307,162	62.4	191,555	513,734	2.68
1913	9	1,049	100	512,245	61.9	317,084	753,897	2.38
1914	9	[a] 1,151	0	672,624	66.0	443,959	971,060	2.19

[a] Includes 54 Semet-Solvay and 150 rectangular ovens.

MONTANA.

Some of the coals found in Montana possess coking quality, but so far the attempts to use them for that purpose have not been entirely successful. Four plants, with a total of 451 ovens, have been built, but none of them has been in active operation for the last four years, and one establishment of 100 ovens was abandoned in 1913. All the 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 1910:

Statistics of the manufacture of coke in Montana, 1884–1914.

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
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
1913	3	351	0	0	0	0	0	0
1914	3	351	0	0	0	0	0	0

a Included with other States having less than 3 producers.

NEW JERSEY.

There is but one establishment manufacturing coke in New Jersey, the Camden Coke Co., at Camden. This company has given permission for the publication of its figures of production, which for the years 1913 and 1914 are shown in the following table:

Statistics of the manufacture of coke in New Jersey, 1913 and 1914.

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.					
1913	1	150	0	339,351	75.4	255,792	$695,041	$2.72
1914	1	150	0	328,921	77.6	255,283	680,972	2.67

The Camden Coke Co. has 150 United-Otto by-product coke ovens, the coke output from two-thirds of which is used in blast furnaces. The excess illuminating and fuel gas over the requirements of the company is distributed to a number of points in the surrounding regions, some being piped from 30 to 40 miles. All the coal used in these ovens is unwashed run of mine from West Virginia.

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 Mountains coal region, which consists of the Raton field in northeastern 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. 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 five 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 1914, although 210 were idle for the first five months of the year. There has been no new construction work during the last six years. 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, and the washery, furnishes also steam heat to the offices, commissary, hotel, hospital, and theater, and electric light for the city of Dawson.

The quantity of coke made in New Mexico in 1914 was 362,572 short tons, valued at $1,228,045, a decrease as compared with 1913 of 105,373 tons, or 22.5 per cent, in quantity and of $320,491, or 21 per cent, in value. There were 660,501 tons of slack used in making coke, of which 249,546 tons was unwashed and 410,955 tons was washed. The yield of coal in coke was 54.9 per cent, a decrease of several points over that of 1913.

The statistics of production in 1882, 1890, 1900, and from 1910 to 1914, inclusive, are shown in the following table:

Statistics of the manufacture of coke in New Mexico, 1882–1914.

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
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
1913	4	1,030	0	788,172	59.4	467,945	1,548,536	3.31
1914	4	1,030	0	660,501	54.9	362,572	1,228,045	3.39

NEW YORK.

All of the coke made in New York is from coal mined in Pennsylvania, and it is all made in retort ovens. There are 4 establishments in the State having a total of 555 ovens, of which 188 are United-Otto, 281 Rothberg, and 86 Semet-Solvay. During 1914 the Niagara Coke Co. had under construction 100 United-Otto ovens at

Buffalo. 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 Syracuse. This plant was increased to 25 ovens in 1896 and to 40 ovens in 1903.

The 4 establishments were in operation in 1914, but at one plant 188 ovens were idle. The production decreased from 758,486 tons, valued at $3,301,400, in 1913 to 457,370 tons, valued at $1,726,133, in 1914. The decrease in quantity amounted to 301,116 tons, or 40 per cent, and in value to $1,575,267, or 48 per cent. The quantity of coal used in 1914 was 659,418 tons, valued at $1,657,502, an average of $2.51 a ton. The yield of coal in coke was 69 per cent. Nearly all the coal used for making coke in New York is run of mine. There were 503,540 tons of unwashed run of mine and 78,499 tons of washed run of mine used in 1914, in addition to which 1,663 tons of unwashed slack and 75,716 tons of washed slack were made into coke.

The statistics of the manufacture of coke in New York since 1910 are shown in the following table:

Statistics of the manufacture of coke in New York, 1910–1914.

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	555	0	1,095,198	72.6	794,618	3,203,133	4.03
1913	4	555	0	1,067,207	71.1	758,486	3,301,400	4.35
1914	4	[a] 555	[b] 100	659,418	69.0	457,370	1,726,133	3.77

[a] Includes 188 United-Otto, 281 Rothberg, and 86 Semet-Solvay ovens.
[b] United-Otto ovens.

OHIO.

The production of coke in Ohio in 1914 was 521,638 short tons, valued at $1,678,686, as compared with 351,846 tons, valued at $1,231,554, in 1913, an increase of 169,792 tons, or 48 per cent, in quantity and of $447,132, or 36 per cent, in value. The increase was due to the starting up in 1914 of 68 Koppers ovens at Youngstown. This establishment was the largest producer of coke in the State in 1914. There were 8 establishments in the State in 1914, with 538 ovens completed and 51 building at the end of the year. Two establishments, with 110 ovens, were idle throughout the year. The active ovens consisted of 217 by-product ovens and 211 beehive ovens. The retort-oven coke in 1914 amounted to 453,800 tons, or an average of 2,091 tons per oven; the beehive coke was 67,838 tons, or 322 tons per oven.

The statistics of the production of coke in Ohio in 1880, 1890, 1900, and for the last five years are shown in the following table:

Statistics of the manufacture of coke in Ohio, 1880–1914.

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
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	471	119	561,426	69.2	388,669	1,365,905	3.51
1913	7	471	119	507,417	69.3	351,846	1,231,554	3.50
1914	8	[a] 538	[b] 51	745,097	70.0	521,638	1,678,686	3.21

[a] Includes 100 United-Otto, 49 Semet-Solvay, and 68 Koppers ovens.
[b] Semet-Solvay ovens.

Most of the coal used for making coke in Ohio is unwashed run of mine. In 1914 the total quantity of coal made into coke was 745,097 short tons, of which 743,549 was unwashed run of mine and 1,548 was unwashed slack.

The character of the coal used in the manufacture of coke in Ohio in 1890, 1900, and from 1910 to 1914 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
1910	333,397	0	12,212	67,450	413,059
1911	417,101	16,574	5,504	17,043	456,222
1912	506,883	23,541	15,598	15,404	561,426
1913	479,286	7,726	7,417	12,988	507,417
1914	743,549	0	1,548	0	745,097

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 coking coals of the highest grade in the United States and although those two States are first and second in rank as coal producers, the coals seem to lose their coking qualities as the beds extend westward; hence 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. The principal beehive operations are those of the United Iron & Steel Co. at Cherry Valley, in Columbiana County, and the coal for these ovens is brought from Pennsylvania mines. On the other hand, some of the coal mined in Ohio makes a satisfactory blast-furnace fuel in the raw state, but when so used, at the present time, it is usually mixed with coke. At one time raw bituminous coal was an important factor in the iron industry of Ohio.

Ohio, which normally ranks fourth among the States as a producer of coal, but which in 1914 because of the prolonged strike fell to fifth place, stands somewhat far down in the list of coke producers, being eleventh in 1914 and having moved up from fourteenth place in 1913. Ohio is second among the States in the manufacture of pig iron, and its blast furnaces have been supplied largely by Connellsville coke; but, as in Illinois and Indiana, the future blast-furnace fuel in Ohio will be the product of retort ovens located at or near the points of consumption. The first installation of this kind was a bank of 50 Otto-Hoffmann ovens near Hamilton built in 1901 by the Hamilton Otto Coke Co., and a second installation of the same number of ovens was completed in 1909. Forty-nine Semet-Solvay ovens were completed at Cleveland, in 1910, and this plant is now being increased to 100 ovens, construction of the additional 51 ovens having been begun in 1912 but not completed by the end of 1914. Sixty-eight Koppers ovens using Pennsylvania coal, were completed and put in blast in 1914 at Youngstown for the Republic Iron & Steel Co.

OKLAHOMA.

No coke has been made in Oklahoma since 1910, and of 536 ovens in existence in 1909 more than half (276) have been abandoned.

The following table gives the statistics of the manufacture of coke in Oklahoma (Indian Territory) in 1880, 1890, 1900, and from 1910 to 1914:

Statistics of the manufacture of coke in Oklahoma (Indian Territory), 1880–1914.

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
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
1913	2	260	0	0	0	0	0	0
1914	2	260	0	0	0	0	0	0

a Included with other States having less than 3 producers.

PENNSYLVANIA.

Except in 1908, when the production of coke in Pennsylvania fell to 15,511,634 tons, following the demoralization of business at the end of 1907, the production of coke in 1914 was the lowest since 1904, or for 10 years. The decrease was 8,495,051 tons, or 29.5 per cent, in quantity and $25,481,978, or 37.5 per cent, in value. This decrease occurred simultaneously with the falling off of 24.7 per cent in the production of pig iron in the United States. The decrease in value exceeded the decrease in output, and the average value of coke at the ovens fell from $2.36 in 1913 to $2.10 in 1914. In 1913 both the Connellsville and the Lower Connellsville districts showed a decreased output as compared with 1912, although the output of the State as a whole increased. The Lower Connellsville district, however, the younger of the two, with operations dating from 1900, showed a relative gain in 1913 as compared with the Connellsville, and the relative positions of the two districts did not materially change in 1914, the Lower Connellsville suffering a decrease of 30.7 per cent in output as compared with a decrease of 32.2 per cent in the Connellsville.

In 1912 there was a steady advance in Connellsville coke, with the demand gradually overtaking and finally exceeding the supply, and finally causing almost a famine, particularly in foundry coke. In 1913, on the other hand, with a strong opening in January, there was a somewhat irregular falling off in business, with a gain in supply over demand, culminating in a slump in the iron trade in October; prices declined until in December they were down to the low level of the beginning of 1912. Prices throughout 1914 were lower than in 1912 or 1913. The year opened with quotations about on a par with those at the beginning of 1912; prices steadily declined throughout the year, finally closing at figures comparable to those obtained during parts of the year 1911. A comparison of the table of prices on page 435 with the average price of Connellsville coke for the year indicates that probably more than a normal quantity was sold at spot prices, and, as might be expected on account of the higher prices at the opening, that contract buyers were less anxious to close and less contract coke was sold during the year. The average value obtained for Connellsville coke in 1914 was $1.92, as compared with $2.23 in 1913 and $1.90 in 1912.

Both the number of establishments and the number of ovens decreased in 1914. Five establishments were abandoned during the year and three new ones were completed. The net decrease in the number of ovens in 1914 as compared with 1913 was 983. There were 1,307 ovens abandoned and 324 new ovens constructed. The Lower Connellsville district increased its number of ovens by 301. The number of ovens in the Connellsville district has decreased in each of the last four years, and there were 846 fewer ovens in this district in 1914 than in 1913. As noted in the report for 1912, the period of expansion in the Connellsville coke trade proper is ended and its supersession as the leading coke-producing district in the United States at no late date is to be expected. The area of the Connellsville Basin proper is limited, and the drains upon it during the last three decades of marvelous expansion in our iron and steel industries have exhausted the greater part of the supply of Connellsville coal. By some authorities it is estimated that in another generation the manufacture of coke in the Connellsville district will be largely a matter of history. This reason is assigned as the principal one for the continuance of beehive-oven practice in the district, the expense of substituting retort ovens for beehive ovens not being warranted by the short life of the Connellsville coal field. This, however, was hardly true 20 years ago and is not now true of the Lower Connellsville district, where the beehive and its equally wasteful companion, the rectangular oven, continue to be built. It is indeed to be hoped that with the continued construction of by-product ovens at other places the beehive type of oven will be abandoned in the Connellsville districts more rapidly than the coal is exhausted and that Connellsville coal will become, for a while at least, an important fuel for the retort ovens.

The total number of ovens in Pennsylvania decreased from 55,058 in 1913 to 54,075 in 1914. Of these ovens, 18,363, including 356 ovens at 5 establishments built but not yet operated, were idle throughout the year. Nearly half of them were in the Connellsville district. There were 209 establishments that made coke in 1914, as compared with 257 in 1913. The 209 active establishments had 35,712 ovens in operation during the year and produced 20,258,393 tons of coke, an average of 96,930 tons for each establishment and of 567 tons for each oven. The 35,712 active ovens included 1,255 of the by-product type. The active by-product ovens constituted 3.5 per cent of the total active number and produced 2,184,336 tons of coke, or 10.7 per cent of the total output. The average production for each active retort oven was 1,741 tons of coke, and the yield of coal in coke was 73.7 per cent. The 34,457 active beehive ovens produced an average of 524 tons of coke, and the yield of coal in coke was 66.1 per cent.

At the close of 1914 there were 867 ovens in course of construction, 605 of them beehive and rectangular, and 262 by-product. More than 50 per cent, all of them rectangular, were building in the Lower Connellsville district. The chief advantage possessed by the rectangular oven over the beehive oven 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 from the beehive oven. The process of carbonization is the same—that of partial combustion. There were 212 Koppers ovens being built by the Lehigh Coke Co. at South Bethlehem, and 50 United-Otto ovens were being added to its plant at Johnstown by the Cambria Steel Co., which built and began the operation of 27 Gas Machinery ovens in 1914.

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, 1880–1914.

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
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	53,756	1,887	41,268,532	66.5	27,438,693	56,336,255	2.05
1913	276	55,058	582	43,195,801	66.6	28,753,444	67,929,864	2.36
1914	274	[a]54,075	[b]867	30,286,961	66.9	20,258,393	42,447,886	2.10

[a] Includes 903 United-Otto, 360 Semet-Solvay, 232 Didier, 27 Gas Machinery, and 5,502 rectangular ovens.
[b] Includes 212 Koppers, 50 United-Otto, and 445 rectangualr ovens.

By far the larger part of the coal used in making coke 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 30,286,961 short tons of coal used in 1914 for making coke in Pennsylvania, 25,568,962 tons were unwashed run of mine and

465,927 tons were unwashed slack. The washed coal used consisted of 2,135,754 tons of run of mine coal and 2,116,318 tons of slack.

The character of the coal used in the manufacture of coke in Pennsylvania in 1890, 1895, 1900, 1905, and from 1910 to 1914 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
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
1913	36,621,183	2,191,944	1,199,859	3,182,815	43,195,801
1914	25,568,962	2,135,754	465,927	2,116,318	30,286,961

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 Pennsylvania contributes, anthracite included, less than half the entire output of coal in the United States, nearly two-thirds the total production of coke is made in that State. In 1914 the two principal coking districts of Pennsylvania—the Connellsville and the Lower Connellsville, both included in the two counties of Fayette and Westmoreland—produced 40 per cent of the coke made in the United States. Ever since coke become 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 14 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 Connellvsville 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. In both the Connellsville and the Lower Connellsville districts all but a very small quantity of the coke is made in beehive and rectangular ovens, in which the process is one of partial combustion without recovery of by-products or utilization of the heat generated in the coking process. With the exception of 110 Semet-Solvey ovens in the Connellsville district, all the by-product recovery ovens in Pennsylvania are outside of the coking-coal mining districts.

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, and 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 is combined with that of the Allegheny Mountain district. What was previously known as the Beaver district included the ovens in Beaver and Mercer counties, but all the ovens in Beaver County have been abandoned, those formerly operated by the Semet-Solvay Company in Mercer County have also been abandoned, and the operations of the one establishment of United-Otto ovens at South Sharon are now 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 important 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 Didier ovens at South Bethlehem, and the United-Otto ovens at Lebanon are in what has been designated as the Lebanon-Schuylkill district.

The following tables give the details of coke production in Pennsylvania for 1913 and 1914, by districts:

Production of coke in Pennsylvania in 1913 and 1914, by districts.

1913.

District.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at oven.	Value of coke per ton.
		Built.	Building.					
Allegheny Mountain and Allegheny Valley	27	2,505	0	1,300,110	69.0	897,913	$2,618,932	$2.91
Connellsville	106	22,189	60	17,379,314	66.6	11,566,778	25,830,382	2.23
Lower Connellsville	75	15,736	440	13,498,088	66.5	8,976,781	19,868,322	2.21
Pittsburgh	14	4,554	0	4,258,903	64.7	2,756,954	7,438,745	2.70
Upper Connellsville	21	2,828	82	1,244,230	65.9	820,192	1,811,353	2.21
All other districts	33	7,246	0	5,515,156	68.1	3,734,826	10,362,130	2.77
Total	276	55,058	582	43,195,801	66.6	28,753,444	67,929,864	2.36

1914.

District.	Establishments.	Ovens.		Coal used (short tons).	Yield of coal in coke (per cent).	Coke produced (short tons).	Total value of coke at oven.	Value of coke per ton.
		Built.	Building.					
Allegheny Mountain and Allegheny Valley	26	a 2,470	b 50	917,790	75.0	689,216	$1,993,276	$2.89
Connellsville	106	c 21,343	160	11,789,842	66.6	7,850,813	15,078,667	1.92
Lower Connellsville	76	d 16,037	e 445	9,296,713	65.5	6,224,224	11,557,006	1.86
Pittsburgh	14	f 4,558	0	3,047,241	65.2	1,985,555	4,827,964	2.43
Upper Connellsville	20	g 2,552	0	919,316	65.4	601,448	1,185,138	1.97
Other districts h	32	i 7,115	j 212	4,316,059	67.4	2,907,137	7,805,835	2.68
Total	274	54,075	867	30,286,961	66.9	20,258,393	42,447,886	2.10

a Includes 343 United-Otto and 27 Gas Machinery ovens.
b United-Otto ovens.
c Includes 110 Semet-Solvay and 1,132 rectangular ovens.
d Includes 2,666 rectangular ovens.
e Rectangular ovens.
f Includes 332 United-Otto and 1,135 rectangular ovens.
g Includes 270 rectangular ovens.
h Bedford, Cameron, Clearfield, Dauphin, Delaware, Elk, Huntingdon, Jefferson, Lebanon, Northampton, and a part of Allegheny, Indiana, and Westmoreland counties.
i Includes 250 Semet-Solvay, 228 United-Otto, 232 Didier, and 311 rectangular ovens.
j Koppers ovens.

CONNELLSVILLE DISTRICT.

The Connellsville district of Pennsylvania continues to be the most important coke-producing district of the world, though in the last few years it has been gradually losing its relatively exalted position. This relative retrogression may be expected to continue as this wonderful portion of the great Pittsburgh bed approaches exhaustion, an eventuality which, according to conservative estimates, is only three or four decades distant.

There were fewer ovens in the Connellsville region in 1914 than in any year since 1905, and the number has been decreasing steadily for the last four years from a maximum of 24,481 ovens in 1910. In 1914 there were 21,343 ovens, 846 less than in 1913. There were 60 ovens building at the close of 1913, and 160 at the close of 1914. The number of establishments was 106, the same in 1914 as in 1913. Of the 106 establishments with 21,343 ovens, 19 establishments with 1,015 ovens were idle throughout the year, in addition to which 7,569 ovens were idle at plants portions of which were in operation. Altogether there were 12,759 ovens in the Connellsville district making coke in 1914. They produced a total of 7,850,813 tons of coke, or an average of 615 tons per oven. In 1913 there were 17,883 active ovens that produced 11,566,778 tons of coke, or an average of 647 tons per oven. The average value per ton for coke made in Pennsylvania was \$2.36 in 1913 and \$2.10 in 1914. The average value of Connellsville coke was \$2.23 in 1913 and \$1.92 in 1914. The apparent lower value for Connellsville coke is due to including in the total production for the State the output from a number of by-product plants located at distances from the mines, at which plants the expense of transportation of the coal is added to its cost and is naturally reflected in the higher prices for the coke at the ovens. The total quantity of retort-oven coke in Pennsylvania was 2,184,336 tons, valued at \$6,569,976, or an average of \$3.01 a ton, which had the effect of increasing the average value per ton for all the coke produced in the State.

In the following table are presented the statistics of the manufacture of coke in the Connellsville district in 1880, 1890, 1900, and from 1910 to 1914:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1914.

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
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	22,219	148	17,772,202	66.5	11,814,588	22,463,602	1.90
1913	106	22,189	60	17,379,314	66.6	11,566,778	25,830,382	2.23
1914	106	[a]21,343	160	11,789,842	66.6	7,850,813	15,078,667	1.92

[a] Includes 110 Semet-Solvay and 1,132 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 1914 as 14,075,638 short tons, whereas the combined production of the Connellsville and the Lower Connellsville districts as reported to the Geological Survey amounted to 14,075,037 short tons. It will be noted that, except in March and April, shipments were below those of the lowest month (December) in 1913, and were all lower than in any month in 1912. Beginning in March, 1914, the decline was steady until December, which showed a slight betterment. The average of the daily record of shipments in 1914 was 1,235 cars as compared with 1,872 in 1913. The largest average daily shipments were in March—1,691 cars; the smallest daily car record was made in November—887 cars. The largest shipment of cars in any month during the last three years was in January, 1913—55,148 cars; the smallest was in November, 1914—22,177 cars.

The monthly shipments from this region from 1910 to 1914, inclusive, as reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville and Lower Connellsville regions, 1910–1914, in short tons.

Month.	1910	1911	1912	1913	1914
January	1,952,406	1,194,047	1,546,892	1,868,149	1,222,282
February	1,787,164	1,302,098	1,560,182	1,715,917	1,270,107
March	1,922,575	1,621,301	1,747,959	1,728,709	1,594,267
April	1,754,654	1,419,369	1,697,734	1,730,183	1,423,048
May	1,527,515	1,343,879	1,776,415	1,817,805	1,198,651
June	1,544,964	1,299,295	1,635,824	1,685,635	1,129,821
July	1,446,294	1,257,820	1,564,377	1,710,435	1,189,834
August	1,464,060	1,355,774	1,704,307	1,696,368	1,157,942
September	1,390,140	1,394,752	1,555,483	1,649,368	1,112,653
October	1,450,717	1,424,232	1,782,302	1,719,045	1,028,764
November	1,252,797	1,385,627	1,736,888	1,496,000	823,595
December	1,196,436	1,335,974	1,692,510	1,280,287	924,674
Total	18,689,722	16,334,168	20,000,873	20,097,901	14,075,638

The total shipments in cars for the last 27 years, the total number of cars in 1913 and 1914, the daily car average, and the total number of tons shipped, as reported by the Courier, are shown in the following tables:

Total and daily average shipments of coke in cars, 1888–1914.

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	448,672
1894	900	281,677	1903	1,782	558,738	1912	1,911	595,336
1895	1,410	441,243	1904	1,623	510,759	1913	1,872	582,071
1896	920	289,137	1905	1,886	688,328	1914	1,235	383,961

Shipments of coke from the Connellsville region, including the Lower Connellsville district, in 1913 and 1914, by months.

Month.	1913			1914		
	Cars.	Daily car average.	Short tons.	Cars.	Daily car average.	Short tons.
January	55,148	2,042	1,868,149	33,537	1,249	1,222,282
February	50,736	2,114	1,715,917	34,848	1,452	1,270,107
March	51,454	1,979	1,728,709	43,962	1,691	1,594,267
April	51,026	1,963	1,730,183	39,599	1,523	1,423,048
May	53,287	1,974	1,817,805	32,936	1,267	1,198,651
June	49,144	1,966	1,685,635	30,749	1,183	1,129,821
July	49,223	1,823	1,710,435	32,181	1,238	1,189,834
August	48,730	1,874	1,696,368	31,212	1,200	1,157,942
September	47,150	1,813	1,649,368	30,023	1,155	1,112,653
October	48,695	1,803	1,719,045	27,749	1,028	1,028,764
November	41,972	1,679	1,496,000	22,177	887	823,595
December	35,506	1,365	1,280,287	24,988	976	924,674
Total	582,071	1,872	20,097,901	383,961	1,235	14,075,638

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 1912 to 1914. 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.

During the last three years there seems to have been some disposition to get away from the buying of coke on six months' contract for delivery, and accordingly two sets of statistics for prices have developed, one for spot coke and one for contract, usually made for six months at a time. As a general thing contract prices are higher than spot, the latter being frequently, but not always, made on unsold coke which happens to be thrown upon the market. In the latter part of 1912 and in January of 1913 spot coke was in active demand and famine prices were realized, from $4.25 to $4.50 being obtained for spot foundry coke, while a portion of the deliveries were on contracts made the previous summer, when prices were from $2.40 to $2.50 a ton. The steady advance in prices in 1912 and the almost equally steady decline in 1913 and 1914 are clearly exhibited in this statement. The high average of the spot furnace coke for 1912 was $3.85 to $4 in November; the high average for 1913 was in January, $3.50 to $4.15; and for 1914 it was in March, $1.85 to $2. The average value per ton for Connellsville coke was $2.23 in 1913 and $1.92 in 1914, from which it appears that the price quotations do not exactly harmonize with the actual receipts by the producers.

Prices of Connellsville furnace and foundry coke per short ton at ovens, 1912–1914, by months.

Month.	Furnace.					
	1912		1913		1914	
	Spot.	Contract.	Spot.	Contract.	Spot.	Contract.
January	$1.75 to $1.85	$1.65 to $1.70	$3.50 to $4.15	$3.15 to $3.25	$1.85	$2.00
February	1.75 to 1.80	1.75 to 1.80	2.25 to 3.00	2.50 to 3.00	1.85	2.00
March	1.85 to 2.25	1.75 to 1.80	2.30 to 2.40	2.50	$1.85 to 2.00	2.00
April	2.10 to 2.60	2.15 to 2.25	2.00 to 2.25	2.25	1.85 to 1.90	2.00
May	2.10 to 2.50	2.25 to 2.35	2.00 to 2.20	2.25	1.75 to 1.85	$1.90 to 2.00
June	1.90 to 2.10	2.25 to 2.35	2.10 to 2.15	2.25	1.75	1.85 to 1.90
July	2.15 to 2.25	2.25	2.25 to 2.50	2.25 to 2.50	1.75	1.85 to 1.90
August	2.15 to 2.25	2.25	2.50	2.50	1.70	1.75 to 1.85
September	2.15 to 2.50	2.25 to 2.50	2.15 to 2.50	2.25 to 2.50	1.60 to 1.70	1.75
October	2.65 to 4.00	2.50 to 3.00	2.00 to 2.15	2.10 to 2.25	1.60	1.75
November	3.85 to 4.00	3.00 to 3.25	1.75 to 1.90	1.90 to 2.00	1.50 to 1.60	1.75
December	4.00	3.25	1.75	1.80 to 1.85	1.50	1.75

Month.	Foundry.					
	1912		1913		1914	
	Spot.	Contract.	Spot.	Contract.	Spot.	Contract.
January	$1.90 to $2.00	$2.10 to $2.15	$4.25 to $4.50	$3.60 to $4.00	$2.50	$2.60
February	2.00 to 2.25	2.10 to 2.25	3.00 to 3.50	3.00 to 3.50	2.50	$2.60 to 2.75
March	2.25 to 2.75	2.25 to 2.50	3.00	3.00	$2.40 to 2.50	2.65 to 2.75
April	2.50 to 2.75	2.50 to 2.75	3.00	3.00	2.40	2.50 to 2.55
May	2.50 to 2.75	2.40 to 2.65	2.75 to 3.00	2.90 to 3.00	2.40	2.50
June	2.40	2.40 to 2.60	2.75 to 2.85	3.00	2.30 to 2.40	2.50
July	2.40	2.40 to 2.60	2.75	3.00	2.25 to 2.35	2.35 to 2.50
August	2.40	2.50	2.90	3.00	2.25	2.35
September	2.40 to 2.75	2.50 to 2.75	2.90	3.00	2.00 to 2.20	2.15 to 2.35
October	3.00 to 4.25	3.00 to 3.75	2.75 to 2.90	3.00	2.00	2.15
November	4.25	3.75	2.50 to 2.65	2.75	1.90 to 2.00	2.15
December	4.25 to 4.50	3.75 to 4.00	2.50	2.60 to 2.75	1.90	2.15

LOWER CONNELLSVILLE DISTRICT.

This district is second in importance among the coke-producing districts of the United States. The production in 1914 was 6,224,224 short tons, valued at $11,557,006, a decrease of 2,752,557 tons, or 30.7 per cent in quantity and of $8,311,316, or 41.8 per cent in value, as compared with the production of 1913. The average price obtained in 1913 was $2.21 and in 1914 it was $1.86. There was a gain of 301 in the total number of ovens at the close of the year, as against a decrease of 846 ovens in the Connellsville district, and there were 445 rectangular ovens building at the close of the year as compared with 160 beehive ovens in the Connellsville district. The number of establishments in the lower Connellsville district increased from 75 to 76. There were 17 idle establishments, with a total of 1,129 ovens, and 2,921 additional ovens were idle at plants in partial operation. Rectangular and Mitchell ovens have found their greatest favor in the lower Connellsville district, there being 2,666 of these types in existence at the end of the year and 445 building. 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 1910 to 1914 is as follows:

Statistics of the manufacture of coke in the Lower Connellsville district, Pennsylvania, 1900, 1905, and 1910–1914.

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
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	15,525	422	13,456,074	67.1	9,023,371	17,166,837	1.90
1913	75	15,736	440	13,498,088	66.5	8,976,781	19,868,322	2.21
1914	76	[a]16,037	[b]445	9,296,713	65.5	6,224,224	11,557,006	1.86

[a] Includes 2,666 rectangular ovens. [b] Rectangular ovens.

The combined production of the Connellsville, Upper Connellsville, and Lower Connellsville districts in 1914 amounted to 14,676,485 tons, as compared with 21,363,751 tons in 1913. All the other coke districts in Pennsylvania, including the by-product ovens at Lebanon, Steelton, South Bethlehem, and Chester, produced 5,581,908 short tons, valued at $14,627,075. The three Connellsville districts produced 72 per cent of the total for Pennsylvania.

TENNESSEE.

The production of coke in Tennessee in 1914 amounted to 264,127 short tons, valued at $642,573, a decrease of 100,451 tons, or 27.6 per cent, in quantity and of $282,857, or 30.6 per cent, in value, as compared with 1913. There were 14 establishments in the State with a total of 2,303 ovens, or 124 less than in 1913, of which establishments 8, with a total of 1,098 ovens, were idle. In addition to the idle plants there were 294 ovens idle at plants which operated some of their ovens during the year. The 911 active ovens, all of which are of the beehive type, produced 264,127 tons, or an average of 290 tons per oven. One establishment with 120 ovens was abandoned during 1914, and the Durham Coal & Iron Co. had 12 Roberts-Flueless ovens under construction at Chattanooga at the end of the year.

The statistics of the manufacture of coke in Tennessee in 1880, 1890, 1900, and from 1910 to 1914, are shown in the following table:

Statistics of the manufacture of coke in Tennessee, 1880–1914.

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	609,387	58.0	348,728	684,116	1.96
1900	14	2,107	340	854,789	55.6	475,432	1,269,555	2.67
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
1913	15	2,427	0	694,085	52.5	364,578	925,430	2.50
1914	14	2,303	[a] 12	487,446	54.2	264,127	642,573	2.43

[a] Roberts Flueless ovens.

Nearly all of the coal used for making coke in Tennessee is washed before being charged into the ovens. In 1914 the total quantity of coal used was 487,446, of which 480,947 tons (140,500 of mine-run and 340,447 tons of slack) were washed. The unwashed coal consisted of 6,499 tons of mine-run.

Character of coal used in the manufacture of coke in Tennessee, 1890, 1900, and 1910–1914, 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
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
1913	0	202,014	24,327	467,744	694,085
1914	6,499	140,500	0	340,447	487,446

VIRGINIA.

There are 18 coke-making establishments in Virginia, with a total of 5,435 ovens, of which 4, with 797 ovens, were idle in 1914. The production of these 14 establishments was 780,984 short tons, valued at $1,582,419, a decrease as compared with 1913, of 522,619 tons, or 40 per cent, in quantity, and of $1,257,856, or 44 per cent, in value. Fifty-three per cent of the ovens at the 14 active establishments were idle during the year, and there were only 2 small plants, with a total of 101 ovens, not reporting some idle ovens during the year. In the 14 years since 1901 the coke production of Virginia has fallen below the million-ton mark only four times, in 1901, 1911, 1912, and 1914, and the output of 1914 was the lowest of that period.

All of the ovens in Virginia are of the beehive type. There were 260 abandoned ovens and none were building at the close of 1914. The principal manufacture of coke is in Wise County, which in 1914 produced over 90 per cent of the total output of the State.

The statistics of the manufacture of coke in Virginia in 1883, when the first operations were begun, and in 1890, 1900, and from 1910 to 1914, are shown in the following table:

Statistics of the manufacture of coke in Virginia, 1883–1914.

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
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
1913	18	5,695	100	2,015,259	64.7	1,303,603	2,840,275	2.18
1914	18	5,435	0	1,319,901	59.2	780,984	1,582,419	2.02

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 ovens. The total quantity of coal consumed in the manufacture of coke in 1914 was 1,319,901 tons, of which 859,737 tons was slack and 460,164 tons was mine-run, all unwashed

The following table shows the character of the coal used in coke making in Virginia in 1890, 1900, and from 1910 to 1914:

Character of coal used in the manufacture of coke in Virginia, 1890–1914, 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
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
1913	916,808	0	1,098,451	0	2,015,259
1914	460,164	0	859,737	0	1,319,901

WASHINGTON.

Washington is the only Pacific coast State in which coal is coked. A newly discovered field in the south end of Coos County, Oreg. (T. 33 S., R. 11 W.), is said to possess coal of coking quality, but there has been no development to date and it is not now known whether the coal will coke commercially. The coking industry in Washington is restricted to a limited area in Pierce and King counties, although the coal mined in the northern part of the Roslyn field in Kittitas County is of coking grade.

There are 7 establishments in Washington, with a total of 336 ovens. Two of the establishments, 1 of 50 ovens and 1 of 25 ovens, have been idle for several years. The entire production in 1914 was from 5 establishments in the Wilkeson-Carbonado field of Pierce County and at Seattle, in King County. The production in 1914 was the largest in the history of the State, amounting to 84,923 short tons, valued at $472,531, exceeding that of 1913 by 8,702 tons, or 11.4 per cent, in quantity and $39,761, or 9.2 per cent, in value. The increase is due in large part to the installation during the year of 5 Klönne by-product ovens constructed for the Seattle Lighting Co. at Seattle. All of the coal used for making coke in 1914 was run of mine, nearly all of which was washed.

The first ovens were built in Washington in 1885, but 400 tons of coke were made in pits the preceding year.

The statistics of production in 1884, 1890, 1900, and from 1910 to 1914 are as follows:

Statistics of the manufacture of coke in Washington, 1884–1914.

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
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
1913	6	331	0	118,786	64.2	76,221	432,770	5.68
1914	7	[a] 336	0	133,349	63.7	84,923	472,531	5.56

[a] Includes 5 Klönne ovens.

WEST VIRGINIA.

The quantity of coke made in West Virginia in 1914 was 1,427,962 short tons, valued at $2,847,284, a decrease as compared with 1913, of 1,044,790 tons, or 42.3 per cent, in quantity and of $2,657,132, or 48.2 per cent, in value.

With the exception of 120 Semet-Solvay ovens at Benwood, near Wheeling, all 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, notwithsatnding the fact that a large part of the coal used for making coke in the State contains only 15 to 20 per cent of moisture and volatile matter. Theoretically 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 coke-making establishments decreased from 124 in 1913 to 118 in 1914. Six plants, with 600 ovens, were abandoned. The total number of ovens abandoned in 1914 was 861, and the net decrease in the number of ovens in the State was 706, reducing the total from 17,826 in 1913 to 17,120 in 1914. Of the 861 ovens abandoned, 478 were in the Flat Top district, 175 in the Kanawha, 134 in the New River, and 74 in the Upper Monongahela and Upper Potomac districts. Of the 17,120 ovens in existence, 11,801, or 69 per cent, were idle; this includes all the ovens in the Tug River district, nearly 72 per cent of those in the Upper Monongahela, and 66 per cent of those in the Flat Top district.

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, 1880–1914.

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
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	19,064	0	4,061,702	60.7	2,465,986	4,692,393	1.90
1913	124	17,826	35	4,034,251	61.3	2,472,752	5,504,416	2.23
1914	118	[a]17,120	0	2,316,309	61.6	1,427,962	2,847,284	1.99

[a] Includes 120 Semet-Solvay ovens.

The larger part of the coal used in making coke in West Virginia (in 1914 over 76 per cent) is slack. In 1914 out of a total of 2,316,309 short tons of coal consumed in the coke-making operations, 1,554,278 tons were unwashed slack, and 224,118 tons were washed slack. In addition to the slack coal, 537,613 tons of unwashed run of mine coal were used.

The character of the coal used in the manufacture of coke in West Virginia in 1890, 1900, and from 1910 to 1914 is shown in the following table:

Character of coal used in the manufacture of coke in West Virginia, 1890–1914, 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
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
1913	916,068	239,135	2,525,919	353,129	4,034,251
1914	537,613	0	1,554,278	224,418	2,316,309

PRODUCTION BY DISTRICTS.

It has been customary in the preceding reports of this series to consider the production of coke by the districts into which West Virginia has been divided. These districts are known 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 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 the coals of the New River region go below water level. The Kanawha district embraces all 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; it 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 production of coke in the State.

The statistics of the production of coke in West Virginia, by districts, in 1913 and 1914 are shown in the following tables:

Production of coke in West Virginia in 1913 and 1914, by districts.

1913.

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]	52	10,952	0	2,047,926	58.8	1,203,690	$2,543,953	$2.11
Kanawha	10	1,628	0	533,035	61.8	329,618	700,559	2.12
New River	19	1,561	0	322,070	60.1	193,418	489,071	2.53
Upper Monongahela	34	[b] 2,918	0	793,508	64.9	515,189	1,279,614	2.48
Upper Potomac and Tygarts Valley	9	767	35	337,712	68.4	230,837	491,219	2.12
Total	124	17,826	35	4,034,251	61.3	2,472,752	5,504,416	2.23

[a] Includes Tug River district. [b] Includes 120 Semet-Solvay ovens.

1914.

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]	51	10,584	0	1,246,917	59.4	741,108	$1,396,501	$1.88
Kanawha	8	1,453	0	204,631	61.8	126,422	258,214	2.04
New River	18	1,437	0	195,109	59.9	116,865	321,624	2.75
Upper Monongahela	33	[b] 2,868	0	472,933	64.9	306,833	663,632	2.16
Upper Potomac and Tygarts Valley	8	778	0	196,719	69.5	136,734	207,313	1.52
Total	118	17,120	0	2,316,309	61.6	1,427,962	2,847,284	1.99

[a] Includes Tug River district, which was idle in 1914.
[b] Includes 120 Semet-Solvay ovens.

OTHER STATES.

In the following table are presented statistics of the production of coke in those States in which there are three or less establishments, of whose output permission to make separate publication has not been granted. Permission has been granted to make separate publication of the operations of the Camden Coke Co.'s plant, and New Jersey, therefore, is discussed separately on a preceding page. The 6 States included are Maryland, Massachusetts, Michigan, Minnesota, Utah, and Wisconsin. These 6 states have 10 establishments, with a total of 2,015 ovens, all but those of Utah being of the by-product-recovery type. The total production in 1914 of the 6 States included in this table was 2,222,134 short tons, valued at $8,429,988, or an average of $3.79 a ton. Of the 6 States, Maryland, Michigan, Minnesota, and Wisconsin obtain their coal from mines in other States; Massachusetts obtains its supply from Nova Scotia and West Virginia; the Utah ovens are supplied from mines within the State.

Statistics of coke production in 1900, 1905, and from 1910 to 1914 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
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	2,006	174	3,623,019	69.8	2,530,018	9,386,978	3.71
1913	9	2,005	210	3,299,345	71.1	2,345,329	9,354,765	3.99
1914	10	[a] 2,015	[b] 90	3,184,139	69.8	2,222,134	8,429,988	3.79

[a] Includes 335 Semet-Solvay, 516 United-Otto ovens, and 210 Koppers ovens.
[b] All Koppers ovens.

SILICA (QUARTZ).

By Frank J. Katz.

INTRODUCTION.

Silica, the oxide of silicon (SiO_2), which has been treated in these reports under the heading "Quartz" (including flint), is the most abundant of mineral substances. It occurs in deposits of commercial importance in many different forms, such as vein quartz, as a constituent of pegmatites, as sand, sandstone, quartzite, or flint, as tripoli, and as diatomaceous (infusorial) earth. In some forms, such as rose, smoky, and amethystine quartz, it has value as gems. This chapter deals with silica of all kinds except gem quartz, silica used for making glass, and silica used in the form of sand, gravel, and crushed material for building, for concrete and mortar, for foundry and furnace work, and for cutting and grinding stone. Such material as is not here reported on is either gem material or sand, and is commercially so designated, and is therefore considered in other chapters of Mineral Resources. Tripoli and diatomaceous (infusorial) earth have heretofore been dealt with as abrasive materials, and as they are to a large extent consumed as abrasives they also are considered in the chapter on abrasive materials.

USES.

Silica (quartz) as reported on in this chapter is used for many purposes, principally in the manufacture of pottery, paints, and scouring soaps, as a wood filler, and as a polisher. In the pottery industry, where it is generally called flint, silica is used in the body of the ware to diminish shrinkage and is also used in glazes. Silica for use in pottery should contain less than 0.5 per cent of iron-bearing minerals. Manufacturers of paint use considerable quantities of very finely ground silica, which forms as much as one-third of the total pigment in some paints. For this purpose finely ground crystalline material is superior to natural sand because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear affords a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. For soaps and polishing powders ground material is preferred to natural sand on account of its whiteness and angularity. For all these purposes large quantities of pure quartz sand and sandstone are finely ground and yield a product fully equal to that obtained by grinding massive crystalline quartz.

The material known commercially in the United States as tripoli, which is the siliceous residue of decomposed limestones, also yields an excellent grade of pulverized silica, which is used for the same purpose as silica powder obtained from massive crystalline quartz and from sands and standstones. Diatomaceous (infusorial) earth is also used to make polishing powder that is employed for similar uses to those for which quartz, sand, and tripoli powders are employed, but diatomaceous earth has somewhat different properties and most of it finds different application.

Quartz crushed and graded to various sizes is used in making sandpaper and sand belts, as a scouring agent, for "frosting" glass with sand-blast apparatus, and for other purposes. Blocks of massive quartz and quarzite 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.

Sand and crystalline quartz have been used in making silicon and alloys of silicon with iron, copper, and other metals in the electric furnace. Quartz may be fused in the electic furnace to make chemical apparatus, such as tubes, crucibles, and dishes.

MARKETED PRODUCTION.

The marketed production of silica in 1914 for the uses considered in this chapter, as reported to the United States Geological Survey, was 181,731 short tons, valued at $612,829. In the preparation of this report on silica in 1913 the attempt was made to collect statistics of production of silica of all kinds used as indicated above. Sources were considered which had not been included in previous compilations. In particular, the grinders and crushers of sand and sandstone were canvassed in order to determine, so far as was then possible, the quantity of material produced by them which competed in the market with vein quartz, tripoli, and like products. The results of this canvass in 1913 were unsatisfactory; they were even more so in 1914. The present report, therefore, gives only the production of silica from vein quartz, pegmatite, and quartzite, and only recapitulates the data on tripoli and diatomaceous earth, which are more fully considered in the chapter on abrasive materials. The following table summarizes the available information on the production of silica from various sources:

Marketed production of silica for pottery, paints, fillers, polishers, abrasives, and other uses in 1913 and 1914, in short tons.

Material.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Quartz (vein quartz,[a] pegmatite, and quartzite)	97,902	$201,488	153,401	$360,502
Sand and sandstone [e]	106,857	466,523		
Tripoli	20,831	216,517	17,218	142,428
Diatomaceous earth	6,602	69,304	11,012	109,899
Total	232,192	953,832	181,731	612,829

[a] Includes only finely ground material. Figures probably incomplete.

QUARTZ.

MARKETED PRODUCTION.

The marketed production of silica from quartz veins, pegmatites, and quartzite in 1914 was 153,401 short tons, valued at $360,502, against 97,902 short tons, valued at $201,488 in 1913. This was an increase of 55,499 short tons, or 57 per cent, in quantity and of $159,014, or 79 per cent, in value.

Increase in sales of crude quartz in 1914 as compared with 1913 was 49,332 short tons, or 65 per cent, in quantity and $34,378, or 63 per cent, in value. The sales of ground quartz increased 6,167 short tons, or 26 per cent, in quantity and $124,636, or 85 per cent, in value. The average price per ton for crude was 72 cents in 1914; in 1913 it was 73 cents; in 1912, 82 cents; and in 1911, 91 cents. This decline in average price is due to the increased sales of quartz for smelting. Quartz, which was ground for pottery, paints, and fillers, was purchasable crude for about $2 a ton in Maine, Connecticut, and Maryland. The average price per ton for ground quartz was $9.09; in 1913 it was $6.23; in 1912, $7.94; and in 1911, $8.30. In 1914, of the total quantity here recorded, 80.51 per cent was marketed in crude form and 19.49 per cent as ground, and of the total value received, 75.36 per cent was for ground quartz and 24.64 per cent was for crude.

The following tables show the marketed production of quartz in 1913 and 1914, classified as to crude and ground, by States, and from 1910 to 1914 classified as to crude and ground:

Marketed production of quartz in the United States, 1913–14, by States, in short tons.

1913.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Connecticut, Massachusetts, and New York	8,153	$18,711	1,190	$20,674	9,343	$39,385
Maryland	194	565	7,664	54,877	7,858	55,442
North Carolina, Pennsylvania, and Tennessee	65,829	35,166	1,210	7,260	67,039	42,426
Other States [a]			13,662	64,235	13,662	64,235
Total	74,176	54,442	23,726	147,046	97,902	201,488

1914.

State.	Crude Quantity.	Crude Value.	Ground Quantity.	Ground Value.	Total Quantity.	Total Value.
Arizona, Michigan, South Dakota, and Wisconsin	5,163	$5,909	5,418	$46,687	10,581	$52,596
California	2,100	3,900	335	3,903	2,435	7,803
Maryland	4,046	8,229	8,011	59,405	12,057	67,634
Connecticut, Maine, Massachusetts, and Pennsylvania	4,249	12,160	7,335	124,380	11,584	136,540
North Carolina, Tennessee, and West Virginia	107,950	58,622	8,794	37,307	116,744	95,929
Total	123,508	88,820	29,893	271,682	153,401	360,502

[a] Includes Arizona, Michigan, and Wisconsin.

Marketed production of quartz in the United States, 1910–1914, in short tons.

Years.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	74,176	54,442	23,726	147,046	97,902	201,488
1914	123,508	88,820	29,893	271,682	153,401	360,502

REVIEW OF PRODUCTION OF QUARTZ FROM 1880 TO 1914.

The United States Geological Survey's reports on mineral resources record a production of quartz or flint or silica beginning with the year 1880. For the first 14 years of this period, however, the recorded productions are largely estimates, and for the first nine years they are certainly very liberal estimates. Beginning with 1894, with a production of 48,584 short tons, the first year for which thoroughly reliable figures are at hand, the production shows in general a regular growth, and reached a maximum in 1914 of 153,401 short tons. In the years 1896, 1907, 1911 the production dropped off materially, but each succeeding year showed healthy recovery. The recorded values of the production of quartz show a wide and irregular range from year to year, particularly in the first years for which satisfactory data are available.

QUARTZ INDUSTRY BY STATES.

Arizona.—In Arizona only one firm reported production in 1914. The material was ground and was used for reverberatory bottoms.

California.—Four producers reported sales of quartz in California in 1914. Their output was used largely for pottery and chinaware. The material came from Placer, Shasta, Riverside, and Tulare counties. There had been no production in the preceding year.

Connecticut.—Only one operator reported production of quartz in Connecticut in 1914. The material was derived from quartz veins in Litchfield County, and was used in making soap, pottery, paint, and wood filler.

Maine.—In 1914 quartz was produced as a by-product in feldspar mining in Sagadahoc County.

Maryland.—Maryland ranked second in both quantity and value of output as a quartz producer. The reported quantity was 8,011 short tons, valued at $59,405, an increase of 2 per cent in quantity and of 7 per cent in value. Seven operators reported production, which came in part from six large quarries and in part was purchased from farmers. The material was all derived from quartz veins and was used for pottery, paint, soap, scouring powder, and chemical purposes. Hartford, Cecil, and Carroll counties were productive.

Massachusetts.—In 1914 a quarry and mill at Cheshire, Berkshire County, was the only Massachusetts producer of quartz for the purposes mentioned in this chapter. Part of the product of this company was ground and sold for use as abrasives; the remainder was used for building, for facing cement blocks, and for other purposes. The material quarried is a very pure quartzite.

Michigan.—In Michigan the only producer, as in previous years, was the Michigan Quartz Co., with mine and mill at Ishpeming and another mill at Milwaukee, Wis. Its product is derived from vein quartz and is used chiefly for paint and wood filler, but also as a polisher.

New York.—For the first time in many years production of quartz was reported in New York in 1914.

North Carolina.—As usual in North Carolina, in 1914 there was a single producer of quartz, who quarried quartzite at Mount Holly, in Gaston County. The output was used for packing acid towers.

Pennsylvania.—In 1914 quartz was marketed by 2 operators, 1 in Adams and 1 in Chester County. The output was less than in 1913.

South Dakota.—A very small production of quartz was credited to South Dakota in 1914.

Tennessee.—In 1914 Tennessee produced more quartz than all the other States combined, but the output was of comparatively low grade and of small value. The Tennessee Copper Co. was the only producer, and reported a larger production than in 1913. The product was quarried from quartzite and was used as flux in copper smelting.

West Virginia.—One producer at Berkeley Springs, Morgan County, reported production in 1914.

Wisconsin.—One firm operating in Flieth, Marathon County, produced quartz in 1914. The product is derived from a very pure quartzite, and is used for filter beds, for roofing, for concrete work, for chicken grits, and for sandpaper.

FLINT OR CHERT.

PRODUCTION.

So far as can be learned no flint (proper) or chert was produced for consumption as silica or for use as pebbles in grinding mills in the United States in 1914.

IMPORTS.

The imports for consumption of flint pebbles into the United States in 1914 were valued at $432,694, as compared with $324,662 in 1913, $289,904 in 1912, $236,158 in 1911, $307,286 in 1910, and $301,547 in 1909.

A detailed table of imports of flint pebbles of various kinds, by countries, and a discussion of domestic substitutes for foreign flint pebbles is given in the chapter on abrasives in Mineral Resources for 1914.

SAND AND SANDSTONE.

Sand and sandstone are finely crushed or ground for such uses as are outlined in preceding pages of this chapter. Production of such material in Illinois, Ohio, Pennsylvania, and West Virginia was reported to the United States Geological Survey in 1913 to the amount of 106,857 short tons, valued at $466,523. It was thought that all producers of this material had not been reached in the canvass for production statistics, and that this quantity did not represent the whole output for the country. The returns to the Survey on the production of 1914 are so incomplete that no publication of figures is warranted.

TRIPOLI.

The material commercially called tripoli in the United States is a residue from siliceous limestones which have been leached of their carbonate content. This material is nearly pure silica of very fine grain and may be either coherent or pulverulent. Tripoli is also used as an abrasive, and is therefore included in the chapter on abrasive materials. The statistics of the production of tripoli in 1914 are here repeated, because much of the output is used for the same purposes as the other forms of silica treated in this chapter. The following table summarizes the production of tripoli in the United States in 1914:

Marketed production of tripoli in the United States in 1914, by States, in short tons.

State.	Quantity.	Value.
Illinois	10,387	$59,394
Missouri, Pennsylvania, and Oklahoma	6,831	83,034
Total	17,218	142,428

DIATOMACEOUS EARTH.

Diatomaceous earth is largely made up of silica. It is a variety of opal—that is, amorphous silica combined with a small quantity of water. It represents the remains of aquatic plants known as diatoms. Diatomaceous earth, which is also commercially called infusorial earth, kieselguhr, and rarely in the United States, although properly, tripoli, is largely used as an abrasive material and is treated in the chapter on abrasive materials. The statistics of production are repeated here because the material is to some extent similar in composition and character to the other materials here considered and because it is in part put to the same uses.

Marketed production of diatomaceous earth in the United States in 1914, by States, in short tons.

State.	Quantity.	Value.
California, Nevada, and Washington	10,343	$98,819
Montana, Connecticut, New York, and Maryland	669	11,080
Total	11,012	109,899

FELDSPAR.

By Frank J. Katz.

INTRODUCTION.

The feldspar quarries in the United States, with a single exception, are restricted to the eastern seaboard States. The exception is California, where recently developed small but growing enterprises have made the State a producer of feldspar. An important factor in the restriction of feldspar mining to the New England, Middle Atlantic, and southern Appalachian States is the concentration about Trenton, N. J., and Liverpool, Ohio, of the factories that make pottery, tile, porcelain, china, and sanitary wares. These factories are the chief consumers of feldspar.

Feldspar is a compound of silica, alumina, and one or more of the bases potash, soda, and lime. There are two principal commercial varieties—potash spar and 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 varities 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. If its soda content is greater than its potash content, the feldspar is called anorthoclase.

Potash feldspar ranges in color from white to reddish; some are gray. Soda feldspar ranges in color from white to pale green. When first taken from the quarry feldspar is so hard that it is with difficulty scratched with a knife.

Most of the feldspar mined in the eastern part of the United States is of the potash or the 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 under these conditions lime-soda feldspar becomes crystalline.

Feldspar is used principally 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 due to the fact that it melts at a lower point than the other ingredients and serves as a flux, binding together the particles of clay and quartz. In glazes the percentage of feldspar used is higher than in the body, running from 30 to 50 per cent. Feldspar of a lower grade than that demanded by the pottery trade is used as a binder in making emery and corundum wheels, in manufacturing 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 making of scouring soaps and window wash. Ground feldspar has been used as a fertilizer, but with results of doubtful value. Attempts are being made to extract from feldspar its content of potash. Experiments directed to this end have not yet developed a commercial process, but some of the efforts may yet be successful.

Feldspar is ground before it is used. For use in pottery it is ground, as screen tests on commercial pottery spar have shown, so that from 99.3 to 99.8 per cent passes through a 100-mesh screen and from 96.7 to 98.2 per cent passes through a 200-mesh screen. Some feldspar prepared for use in abrasive soaps is even more thoroughly ground to reduce it to extreme and uniform fineness. For making glass and enameled ware, a tested sample of feldspar showed 94 per cent passing through a 100-mesh screen and 74 per cent through a 200-mesh screen. Feldspar for poultry grits and for roofing is crushed, not finely ground, and is graded by screening.[1]

MARKETED PRODUCTION.

The marketed production of feldspar in 1914 was 135,419 short tons, valued at $629,873. This, the largest recorded annual production of crude feldspar, was an increase over the output of 1913 of 14,464 tons, or 11.96 per cent, in quantity and a decrease of $146,678, or 18.89 per cent, in value. The sales of crude spar were 85,905 short tons, valued at $263,476, an increase of 40,514 tons, or 90 per cent, in quantity and of $114,927, or 80 per cent, in value, as compared with 1913. The production of ground spar was 49,514 short tons, valued at $366,397, a decrease of 26,050 tons, or 34.5 per cent, in quantity and of $261,605, or 41.5 per cent, in value, as compared with 1913.

The average price per ton in 1914 for crude spar was $3.07, compared with $3.31 in 1913 and $3.36 in 1912. The average price per ton in 1914 for ground spar was $7.40, compared with $8.31 in 1913 and $7.18 in 1912. The average price per ton in 1914 for the combined crude and ground output was $4.77, compared with $6.49 in 1913 and $6.01 in 1912. Of the total output, 63.44 per cent was sold by the producer crude and 36.56 per cent was sold ground. Of the total value, the crude represents 41.82 per cent and the ground 58.18 per cent.

The following tables show the production of feldspar in 1913 and 1914, by States, with the increase or decrease in quantity and value in the several States for 1914, as compared with 1913, and the totals for the United States classified as crude and ground from 1910 to 1914. These figures include feldspar used for all purposes and show the marketed product rather than the quantity actually quarried.

[1] For further and detailed information on deposits of feldspar and on mining, milling, and utilization of feldspar, the reader is referred to U. S. Geol. Survey Bull. 420: The feldspar deposits of the United States, by E. S. Bastin; and to U. S. Bureau of Mines Bull. 53: Mining and treatment of feldspar and kaolin in the southern Appalachian region, by A. S. Watts.

Marketed production of feldspar in 1913 and 1914, by States, in short tons.

1913.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	1,113	$3,838	....	....	1,113	$3,838
Connecticut	10,166	35,867	10,122	$79,903	20,288	115,770
Maine	(a)	(a)	38,114	346,779	b 38,114	b 346,779
Maryland	11,402	37,155	5,300	45,678	16,702	82,833
New York	6,859	21,304	15,891	97,756	22,750	119,060
Pennsylvania	3,685	19,454	5,944	56,397	9,629	75,851
Minnesota, North Carolina, and Vermont	c 12,166	c 30,931	193	1,489	c 12,359	c 32,420
Total d	45,391	148,549	75,564	628,002	120,955	776,551

1914.

State.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	2,778	$10,715	....	....	2,778	$10,715
Connecticut	11,099	42,965	5,414	$40,326	16,513	83,291
Delaware	(e)	(e)	....	....	(e)	(e)
Maine	12,553	30,925	17,510	163,635	30,063	194,560
Maryland	5,867	19,224	42	210	5,909	19,434
Minnesota	....	....	....	....	....	....
New Hampshire	(e)	(e)	....	....	(e)	(e)
New York	289	1,032	19,290	100,995	19,579	102,027
North Carolina	15,420	43,153	....	....	15,420	43,153
Pennsylvania	2,843	10,162	7,258	61,231	10,101	71,393
Vermont	....	....	....	....	....	....
Virginia	f 35,056	f 105,300	....	....	35,056	105,300
Total	85,905	263,476	49,514	366,397	135,419	629,873

a Included with miscellaneous States.
b Exclusive of crude product.
c Includes crude product from Maine.
d Includes 3,953 short tons of feldspar, valued at $19,681, used as abrasive.
e Included in Virginia.
f Virginia includes Delaware and New Hampshire.

Marketed production and value of feldspar, 1913–14, by States, in short tons, with increase and decrease and percentage of increase and decrease.

State.	1913.		1914.		Increase (+) or decrease (—), 1914.		Increase (+) or decrease (—), 1914.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Percentage.	Value.	Percentage.
California	1,113	$3,838	2,778	$10,715	+ 1,665	+149.59	+ $6,877	+179.18
Connecticut	20,288	115,770	16,513	83,291	— 3,775	— 18.61	— 32,479	— 28.05
Maine a	38,114	346,779	30,063	194,560	— 8,051	— 21.12	—152,219	— 43.89
Maryland	16,702	82,833	5,909	19,434	—10,793	— 64.62	— 63,399	— 76.54
New York	22,750	119,060	19,579	102,027	— 3,171	— 13.94	— 17,033	— 14.30
Pennsylvania	9,629	75,851	10,101	71,393	+ 472	+ 4.90	— 4,458	— 5.87
Other States b	12,359	32,420	50,476	148,453	+38,117	+308.41	+116,033	+357.90
Total	120,955	776,551	135,419	629,873	+14,464	+ 11.96	—146,678	— 18.89

a Exclusive of crude product. b Includes also crude product of Maine.

Marketed production of feldspar, 1910–1914, in short tons.

Years.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	45,391	148,549	75,564	628,002	120,955	776,551
1914	85,905	263,476	49,514	366,397	135,419	629,873

REVIEW OF FELDSPAR PRODUCTION FROM 1880 TO 1914.

The production of feldspar in the United States from 1880 to 1898 was small in quantity and ranged from a minimum of 7,000 tons in 1889 to 26,000 tons in 1895. The recorded production for the first years, 1880 to 1886, was determined by estimates rather than by the compilation of carefully canvassed statistics. Since 1887 the recorded figures supply fairly complete and reliable data. Beginning with 1900, with a production of 24,821 short tons, the yearly output of feldspar increased rapidly, reaching a maximum of 135,419 short tons in 1914. During the 23 years, 1892 to 1914, inclusive, the average price per ton for the annual production of feldspar has varied between $2.40 and $8.70; since 1898 the average annual price per ton has ranged from $5.50 to $8.70.

FELDSPAR INDUSTRY BY STATES.

Sales of feldspar in 1914 were reported from the following States: Named in the order of their production, Virginia, Maine, New York, Connecticut, North Carolina, Pennsylvania, Maryland, California, New Hampshire, and Delaware; named in the order of the value of their output, Maine, New York, Virginia, Connecticut, Pennsylvania, North Carolina, Maryland, California, New Hampshire, and Delaware.

California.—Three producers reported production of feldspar in 1914; 2 of these were in Tulare County and 1 in Monterey County. A number of quarries which have produced feldspar in recent years were idle. The entire California output was used for pottery manufactured in that State. The total production for the State in 1914 was 2,480 short tons of crude spar, valued at $10,715, an increase over the production reported for 1913 of 1,367 short tons, valued at $7,877, or of more than 100 per cent in quantity and more than 200 per cent in value.

Colorado.—No feldspar deposits in Colorado were operated in 1914.

Connecticut.—Connecticut was fourth in rank in production of feldspar in 1914. The production came from Middlesex and Hartford counties and amounted to 16,513 short tons, valued at $83,291, a decrease as compared with 1913 of 3,775 short tons and $32,479, or approximately 18.05 per cent in quantity and 28 per cent in value. There was only 1 mill in operation during the year according to reports received by the Survey. Connecticut feldspar was used for pottery, enamel ware, tile, glass, abrasives, and soaps.

Delaware.—There was only one productive feldspar quarry in Delaware in 1914 which shipped crude spar to Pennsylvania mills.

Delaware had previously, but not for many years, been a producer of feldspar.

Maine.—In 1914, Maine ranked first in the value of its feldspar output and was a close second in the number of tons produced. Three companies reported production in Androscoggin, Oxford, and Sagadahoc counties from 10 or more quarries. The output amounted to 30,063 short tons, valued at $194,560, a decrease of 8,051 tons and $252,219, or approximately 22 per cent in quantity and 73 per cent in value, as compared with 1913. The average price of crude spar in Maine was $2.50 a ton and ground spar ranged from $8 to $10 a ton. Maine feldspar was used chiefly for pottery, a small quantity being also sold for use as a binder in the manufacture of abrasive wheels.

Maryland.—Maryland was seventh in rank in both quantity and value of feldspar produced in 1914. The production was reported by 7 operators, although the number of quarries is considerably larger. The feldspar was shipped to Delaware, Pennsylvania, and New Jersey for grinding, there being only 1 mill within the State, which at present is making a small output of chicken grits. The production was 5,909 tons, valued at $19,434, a decrease of 10,793 tons and $63,399, or approximately 70 per cent in quantity and 77 per cent in value, as compared with the output in 1913. The average price in 1914 was $3.25 for crude. Feldspar was used chiefly for pottery, and some was sold for chicken grits.

Massachusetts.—There was no production of feldspar in Massachusetts in 1914.

Minnesota.—The single quarry in Minnesota, the product from which has been used exclusively for abrasive paper, was not in operation in 1914, and there were no sales of feldspar in the State.

New Hampshire.—New Hampshire ranked ninth in quantity and value of its production of feldspar in 1914. The output of the State was all shipped to Trenton, N. J., for grinding and was sold to manufacturers of pottery.

New York.—New York ranked second in value and third in quantity as a producer of feldspar in 1914. About 45 per cent of the material was unsorted pegmatite, which was only crushed or coarsely ground and used for coating ready roofing, for concrete facing, and for poultry grit; the remainder was ground fine for use in pottery, enamel ware, glass, and abrasive soaps. The productive quarries were in Essex and Westchester counties. There are 2 mills for coarse grinding—1 at Crown Point and 1 at Ticonderoga—and 1 for fine grinding at Bedford. The total production of the State for 1914 was 19,579 tons, valued at $102,027, as compared with 1913, a decrease of 3,171 tons, or 14 per cent, in quantity and of $17,033, or 14 per cent, in value. The prices in New York in 1914 for crude spar and crushed pegmatite ranged from $3 to $4 a ton; ground spar sold at $7.25 a ton.

In the vicinity of Gloversville, Fulton County, there was revived activity in developing feldspar products. Some quarries in that vicinity which were productive in previous years were being prepared for shipping. Test shipments only were made in 1914, but with the opening of 1915 the Eureka Flint & Spar Co., of Trenton, N. J., began regular shipments and marketed ground spar from Fulton County. The writer has seen some white chinaware made from this feldspar, which is exceptionally fine and uniform in whiteness and translucency.

North Carolina.—North Carolina in 1914 took sixth place in value and fifth in quantity as a producer of feldspar. The output was reported by 4 operators in the Spruce Pine district of Mitchell County. The product was all ground at Trenton, N. J., and at East Liverpool, Ohio, and was sold to manufacturers of pottery.

Pennsylvania.—Pennsylvania ranked fifth in value and sixth in quantity in the output of feldspar in 1914. Eight large quarries in Chester and Delaware counties and several unlisted small ones, whose output is purchased and reported by larger operators, produced 10,101 tons, valued at $75,393, an increase of 472 tons, or nearly 5 per cent, in quantity and a decrease of $3,458, or 4.5 per cent, in value, as compared with the production in 1913. Prices for crude spar in Pennsylvania ranged from $3 to $5.25 a ton and averaged about $8.50 a ton for ground feldspar. Pennsylvania feldspar is used for pottery, tile, enamel ware, glass, poultry grits, roofing, and abrasive soaps. A small quantity was also used for the manufacture of chemicals.

Tennessee.—There was no feldspar quarried in Tennessee in 1914. A mill at Erwin, Unicoi County, ground some feldspar produced in North Carolina.

Texas.—It is reported that preparations were made for the production of feldspar at O'Quinn, Fayette County. The material found there has been called feldspar and appears to be suitable for the manufacture of glazes and certain ceramic wares, but it is not feldspar.

Vermont.—No feldspar was produced in Vermont in 1914.

Virginia.—Virginia in 1914 reported a production of feldspar larger in quantity than that from any other State and exceeding in value that of any State but Maine and New York. This production was made by 1 quarry in Prince Edward County. All other quarries which have in the past produced or given promise of the production of feldspar were idle in 1914.

West Virginia.—No feldspar was produced in West Virginia. One company reported itself not ready to operate in 1914 but expecting to go into operation in 1915.

CLAY-WORKING INDUSTRIES.

By Jefferson Middleton.

GENERAL CONDITIONS.

The present report, except the section on clay mining, deals with the products of the clay-working industries, and the tables are made up to show the output of manufactured clay products and not the production of clay.

The year 1914 in the clay-working industries was not one of general prosperity. The total value of all clay products marketed in the year—the best criterion by which the status of the industry can be judged—was $164,986,983, compared with $181, 289, 132 in 1913, a decrease of $16,302,149, or 8.99 per cent; but on the other hand compared with 1908, there was an increase in 1914 or nearly twice that amount ($31,789,221, or 23.87 per cent). In fact only in the preceding four years has the total value of clay products exceeded that of 1914, so that although the condition of the industries was somewhat unsatisfactory in 1914, compared with its condition only a few years ago, it should be considered gratifying.

With the revival of business, which is clearly indicated, the great clay-working industries, with the inherent superiority of their products for many uses, are bound to come into their own, the setback of 1914 being but a temporary halt. The wide publicity given to the brick industries by the "build with brick" and "pave with brick" movements started in 1914 must prove of inestimable benefit in the extension of the use of this type of clay products.

Of the two great divisions of the industry, (1) brick and tile and (2) pottery, the former showed the larger decrease, both actual and proportionate. The decrease in the brick and tile industry was $13,707,935, or 9.57 per cent; the decrease in the pottery industry was $2,594,214, or 6.83 per cent.

The most prominent features in the industries were the continued large decrease in the production and value of common brick in the region supplying the New York City market, and the large increase in value of clay products in Iowa, Minnesota, Oklahoma, Maine, and West Virginia. The engineering and refractory products, vitrified brick, draintile, sewer pipe, stove lining, and fire brick, showed a net decrease in value of $4,745,629, and the structural materials showed a net decrease of $9,109,804 in 1914, compared with 1913.

In brick and tile industry decrease was shown in the quantity of common, front, vitrified, and fire brick, and in the value of every variety of product as classified in this report, except vitrified and fancy brick. The decrease in the quantity of common brick was 942,219,000 brick, or 11.65 per cent. Only one variety of brick and tile products reached its maximum value in 1914—vitrified paving brick.

In the pottery industry only one variety of ware, as classified in this report—red earthenware, the lowest grade—increased in value and this grade reached its maximum value. Notwithstanding the decrease in value of pottery products, the year 1914 was in some respects remarkable in the pottery industry. The value of the output, with the exception of 1912 and 1913, was the largest recorded; the industry was unusually active during the first half of the year, but failed to equal this activity in the second half. The decrease in value was principally in the porcelain electrical supply branch of the industry, the value of the white ware and china, which constitutes nearly half of the total, decreasing less than 1 per cent. The imports of pottery decreased in even greater proportion than the production, and were the smallest recorded for many years. As a consequence, the proportion of domestic production to consumption was the highest recorded—82 per cent.

In the statements made to the Geological Survey the producers reported quantities for common brick, front brick, vitrified paving brick, fire brick, and silica brick, but not for fancy or ornamental brick or for enameled brick. The average price of all varieties of brick except vitrified paving brick and silica brick decreased in 1914 compared with 1913. Vitrified paving brick attained its maximum average, $13.42 a thousand.

A notable feature of the clay-working industries in the last few years has been the concentration of the industry into fewer and larger units, principally by the elimination of the smaller temporary plants, though considerable consolidation has also been going on. This concentration is shown by the fact that the average value of output per operator has increased from $11,923 in 1895 to $42,743 in 1914.

There were no great general strikes in the clay-working industries in 1914. In the early part of the year a strike among the brick makers in Chicago caused a suspension of business for several months, which undoubtedly accounts in some measure for the decreased production in that district. In the pottery industry there was a strike of short duration in the western district among the jiggermen's helpers, which, however, had no serious effect on the industry.

ACKNOWLEDGMENTS.

The writer again desires to thank the clay workers of the country on behalf of the Geological Survey for their cooperation, without which this report would be impossible.

The State geological surveys of Alabama, Florida, Illinois, Iowa, Maryland, Michigan, Minnesota, Missouri, New Jersey, New Mexico, North Carolina, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin have cooperated in the collection of the statistics in these States, the completeness of the returns and the early 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 1913 and 1914, by States:

Value of the products of clay in the United States in 1913 and 1914, by States and Territories.

State or Territory.	1913			1914		
	Brick and tile.	Pottery.	Total.	Brick and tile.	Pottery.	Total.
Alabama	$2,071,423	$20,158	$2,091,581	$1,557,481	$16,542	$1,574,023
Arizona	218,542	....	218,542	156,167	....	156,167
Arkansas	509,867	19,757	529,624	432,586	19,400	451,986
California	5,054,703	290,255	5,344,958	4,116,358	345,303	4,461,661
Colorado	1,247,010	46,501	1,293,511	1,082,685	61,257	1,143,942
Connecticut and Rhode Island.	1,372,234	(a)	1,372,234	1,229,037	(a)	1,229,037
Delaware	187,280	....	187,280	154,718	....	154,718
District of Columbia	149,014	11,000	160,014	148,866	(b)	148,866
Florida	253,344	....	253,344	240,094	....	240,094
Georgia	2,664,091	28,528	2,692,619	2,242,073	20,961	2,263,034
Idaho and Nevada	150,701	....	150,701	110,864	....	110,864
Illinois	14,280,611	915,263	15,195,874	12,538,374	780,579	13,318,953
Indiana	7,311,940	1,186,706	8,498,646	6,503,207	1,152,078	7,655,285
Iowa	5,552,983	20,698	5,573,681	6,368,995	32,750	6,401,745
Kansas	1,919,910	(b)	1,919,910	1,905,961	(b)	1,905,961
Kentucky	2,812,158	102,118	2,914,276	2,286,980	89,426	2,376,406
Louisiana	638,491	(b)	638,491	422,062	(b)	422,062
Maine	661,573	(b)	661,573	914,808	(b)	914,808
Maryland	1,762,466	155,034	1,917,500	1,640,017	206,483	1,846,500
Massachusetts	1,583,530	231,345	1,814,875	1,462,453	219,104	1,681,557
Michigan	2,451,242	222,883	2,674,125	2,434,872	265,194	2,700,066
Minnesota	1,781,017	(b)	1,781,017	1,944,886	(b)	1,944,886
Mississippi	623,820	17,451	641,271	515,797	15,060	530,857
Missouri	6,598,664	3,412	6,602,076	6,074,340	2,944	6,077,284
Montana	456,897	(b)	456,897	440,519	(b)	440,519
Nebraska	886,166	(b)	886,166	640,955	(b)	640,955
New Hampshire	462,534	(b)	462,534	398,066	(b)	398,066
New Jersey	10,866,833	8,838,545	19,705,378	8,353,296	8,131,356	16,484,652
New Mexico	176,528	....	176,528	205,914	....	205,914
New York	8,627,818	2,841,658	11,469,476	6,923,141	2,155,792	9,078,933
North Carolina	1,600,723	13,683	1,614,406	1,447,994	12,796	1,460,790
North Dakota	262,580	....	262,580	266,046	....	266,046
Ohio	21,868,407	16,519,889	38,388,296	21,815,392	15,351,376	37,166,768
Oklahoma	573,371	....	573,371	786,314	....	786,314
Oregon	771,795	(b)	771,795	560,271	(b)	560,271
Pennsylvania	22,185,383	2,046,099	24,231,482	20,100,495	1,746,501	21,846,996
Porto Rico	6,359	(b)	6,359	5,974	....	5,974
South Carolina	573,459	9,782	583,241	557,977	10,668	568,645
South Dakota	46,685	....	46,685	57,711	....	57,711
Tennessee	1,347,985	145,100	1,493,085	1,449,120	97,195	1,546,315
Texas	2,968,975	80,374	3,049,349	2,222,240	58,747	2,280,987
Utah	708,906	(b)	708,906	676,142	(b)	676,142
Vermont	94,773	....	94,773	75,847	....	75,847
Virginia	1,705,651	(b)	1,705,651	1,472,348	(b)	1,472,348
Washington	2,390,226	(b)	2,390,226	1,809,491	(b)	1,809,491
West Virginia	1,783,383	3,424,887	5,208,270	1,830,947	3,930,464	5,761,411
Wisconsin	1,013,028	7,700	1,020,728	943,999	7,000	950,999
Wyoming	61,678	....	61,678	64,942	....	64,942
Other States	....	793,549	793,549	....	669,185	669,185
Total	143,296,757	37,992,375	181,289,132	129,588,822	35,398,161	164,986,983
Percentage of total	79.04	20.96	100.00	78.54	21.46	100.00

a Produced by Connecticut alone, and included in "Other States." b Included in "Other States."

This table shows that the value of the brick and tile products, as classified in this report, continues to form about four-fifths and that of the pottery products one-fifth of the total value. These proportions have been maintained approximately for many years. Every State is a producer of burned clay. Of the Territories, Alaska and Hawaii reported none for 1914. 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 1913 and 1914, showing increase or decrease with percentage of increase or decrease.

State or Territory.	1913	1914	Increase (+) or decrease (−) in 1914.	Percentage of increase (+) or decrease (−) in 1914.
Alabama	$2,091,581	$1,574,023	− $517,558	−24.74
Arizona	218,542	156,167	− 62,375	−28.54
Arkansas	529,624	451,986	− 77,638	−14.66
California	5,344,958	4,461,661	− 883,297	−16.53
Colorado	1,293,511	1,143,942	− 149,569	−11.56
Connecticut and Rhode Island	1,372,234	1,229,037	− 143,197	−10.44
Delaware	187,280	154,718	− 32,562	−17.39
District of Columbia	160,014	148,866	− 11,148	− 6.97
Florida	253,344	240,094	− 13,250	− 5.23
Georgia	2,692,619	2,263,034	− 429,585	−15.95
Idaho and Nevada	150,701	110,864	− 39,837	−26.43
Illinois	15,195,874	13,318,953	− 1,876,921	−12.35
Indiana	8,498,646	7,655,285	− 843,361	− 9.92
Iowa	5,573,681	6,401,745	+ 828,064	+14.86
Kansas	1,919,910	1,905,961	− 13,949	− .73
Kentucky	2,914,276	2,376,406	− 537,870	−18.46
Louisiana	638,491	422,062	− 216,429	−33.90
Maine	661,573	914,808	+ 253,235	+38.28
Maryland	1,917,500	1,846,500	− 71,000	− 3.70
Massachusetts	1,814,875	1,681,557	− 133,318	− 7.35
Michigan	2,674,125	2,700,066	+ 25,941	+ .97
Minnesota	1,781,017	1,944,886	+ 163,869	+ 9.20
Mississippi	641,271	530,857	− 110,414	−17.22
Missouri	6,602,076	6,077,284	− 524,792	− 7.95
Montana	456,897	440,519	− 16,378	− 3.58
Nebraska	886,166	640,955	− 245,211	−27.67
New Hampshire	462,534	398,066	− 64,468	−13.94
New Jersey	19,705,378	16,484,652	− 3,220,726	−16.34
New Mexico	176,528	205,914	+ 29,386	+16.65
New York	11,469,476	9,078,933	− 2,390,543	−20.84
North Carolina	1,614,406	1,460,790	− 153,616	− 9.52
North Dakota	262,580	266,046	+ 3,466	+ 1.32
Ohio	38,388,296	37,166,768	− 1,221,528	− 3.18
Oklahoma	573,371	786,314	+ 212,943	+37.14
Oregon	771,795	560,271	− 211,524	−27.41
Pennsylvania	24,231,482	21,846,996	− 2,384,486	− 9.84
Porto Rico	6,359	5,974	− 385	− 6.05
South Carolina	583,241	568,645	− 14,596	− 2.50
South Dakota	46,685	57,711	+ 11,026	+23.62
Tennessee	1,493,085	1,546,315	+ 53,230	+ 3.57
Texas	3,049,349	2,280,987	− 768,362	−25.20
Utah	708,906	676,142	− 32,764	− 4.62
Vermont	94,773	75,847	− 18,926	−19.97
Virginia	1,705,651	1,472,348	− 233,303	−13.68
Washington	2,390,226	1,809,491	− 580,735	−24.30
West Virginia	5,208,270	5,761,411	+ 553,141	+10.62
Wisconsin	1,020,728	950,999	− 69,729	− 6.83
Wyoming	61,678	64,942	+ 3,264	+ 5.29
Other States	[a] 793,549	[a] 669,185	− 124,364	−15.67
Total	181,289,132	164,986,983	−16,302,149	− 8.99

[a] Includes pottery products which could not be separately classified without disclosing individual figures.

Of the States and Territories represented in this table, 37 showed decrease in the value of clay products in 1914 compared with 1913 and 11 showed increase. Iowa showed the largest increase—$828,064, or 14.86 per cent. The largest proportionate increase was in Maine—38.28 per cent. The largest decrease was in New Jersey—$3,220,726, or 16.34 per cent; the largest proportionate decrease was in Louisiana—33.90 per cent. Of the 11 States that showed increase, 1 was in New England—Maine; 3 were in the Southern States—Tennessee, West Virginia, and Oklahoma; 2 in the Central States—Iowa and Michigan; 3 in the Northwestern States—Minnesota, North Dakota, and South Dakota; and 2 in the Rocky Mountain region—Wyoming and New Mexico. Nine of the States that showed increase in 1914 also showed increase in 1913, namely, Iowa, Maine, Michigan, Minnesota, North Dakota, Oklahoma, South Dakota, West Virginia, and Wyoming. Two States that showed decrease in 1913 showed increase in 1914, namely, New Mexico and Tennessee. Two of the first 10 States in value of production—Iowa and West Virginia—showed increase in 1914.

Value of the clay products of the United States in 1913 and 1914, with increase or decrease.

Product.	1913	1914	Increase (+) or decrease (−) in 1914.	Percentage of increase (+) or decrease (−) in 1914.
Common brick	$50,134,757	$43,769,524	−$6,365,233	−12.70
Vitrified paving brick or block	12,138,221	12,500,866	+ 362,645	+ 2.99
Front brick	9,614,138	9,289,623	− 324,515	− 3.38
Fancy or ornamental brick	109,703	124,459	+ 14,756	+13.45
Enameled brick	1,225,708	1,075,026	− 150,682	−12.29
Drain tile	8,558,320	8,522,039	− 36,281	− .42
Sewer pipe	14,872,103	14,014,767	− 857,336	− 5.76
Architectural terra cotta	7,733,306	6,087,652	− 1,645,654	−21.28
Fireproofing	8,620,216	8,385,337	− 234,879	− 2.72
Tile (not drain)	6,109,180	5,705,583	− 403,597	− 6.61
Stove lining	535,667	520,585	− 15,082	− 2.82
Fire brick	20,627,122	16,427,547	− 4,199,575	−20.36
Miscellaneous	3,018,316	3,165,814	+ 147,498	+ 4.89
Total brick and tile	143,296,757	129,588,822	−13,707,935	− 9.57
Total pottery	37,992,375	35,398,161	− 2,594,214	− 6.83
Grand total	181,289,132	164,986,983	−16,302,149	− 8.99

This table shows that two of the varieties of brick and tile products—vitrified paving brick and fancy brick—increased and 10 of the varieties decreased in value in 1914. In 1913 increase was shown in nine varieties and decrease in three.

The greatest of all clay products in point of value and geographic distribution, common brick, which decreased in value in 1910 and 1911 and increased in 1912, decreased again in 1913 and in 1914. The decrease in value in 1914 ($6,365,233) was the largest recorded since 1908 and was nearly half of the net brick and tile decrease.

Vitrified paving brick or block was the only one of the important varieties of brick and tile products to increase in value in 1914.

Sewer pipe, which increased steadily in value from 1909 to 1913, showed in 1914 the fourth largest decrease, $857,336, or 5.76 per cent.

Draintile, which showed a large decrease in 1912, and made a considerable gain in 1913, showed a small decrease in 1914—$36,281—the smallest decrease among important products.

Front or face brick, which is used in connection with common brick or hollow tile, naturally follows these products and showed a considerable decrease in value in 1914—$324,515.

Fireproofing, including hollow tile or block, which has been making great strides in the last few years, suffered setback in 1914 and showed a small decrease.

Tile, not drain, embracing various kinds of tile used principally in the structural industries, which has been of growing importance, and showed an increase of $299,685 in 1913 over 1912, decreased in value $403,597 in 1914.

Architectural terra cotta, one of the few products to decrease in value in 1913, showed the third largest actual decrease and the largest proportionate decrease in 1914—$1,645,654.

Fire brick, which showed large increase in value of output in 1912 and 1913, showed the second largest decrease in 1914—$4,199,575, or 20.36 per cent, from 1913. For 1914, silica brick was reported to the value of $2,951,525, which should be deducted from the figures here given to arrive at the value of the clay fire brick.

The total decrease in the brick and tile products in 1914 was $14,232,834; the total increase was $524,899, a net decrease of $13,707,935, from 1913; the pottery production showed a decrease of $2,594,214, the total net decrease for both industries being $16,302,149.

The following table shows the value of the production of clay in the United States from 1895 to 1914, inclusive, by varieties of products, the total for each year, and the number of active firms reporting:

Production and value of products of clay in the United States, 1895–1914, by varieties.

Year.	Number of active firms reporting.	Common brick.			Vitrified paving brick.		
		Quantity (thousands).	Value.	Average price per thousand.	Quantity (thousands).	Value.	Average price per thousand.
1895		6,017,965	$31,569,126	$5.25	381,591	$3,130,472	$8.20
1896	5,293	5,703,279	29,664,043	5.20	320,407	2,794,585	8.72
1897	5,424	5,292,532	26,430,207	4.99	435,851	3,582,037	8.22
1898	5,971	5,867,415	30,980,704	5.28	474,419	4,016,822	8.47
1899	6,962	7,695,305	39,887,522	5.18	580,751	4,750,424	8.18
1900	6,475	7,140,622	38,621,514	5.41	546,679	4,764,124	8.71
1901	6,421	8,038,579	45,503,076	5.66	605,077	5,484,134	9.06
1902	6,046	8,475,067	48,885,869	5.77	617,192	5,744,530	9.31
1903	6,034	8,463,683	50,532,075	5.97	654,499	6,453,849	9.86
1904	6,108	8,665,171	51,768,558	5.97	735,489	7,557,425	10.28
1905	5,925	9,817,355	61,394,383	6.25	665,879	6,703,710	10.07
1906	5,857	10,027,039	61,300,696	6.11	751,974	7,857,768	10.45
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
1913	4,065	8,088,790	50,134,757	6.20	958,680	12,138,221	12.66
1914	3,860	7,146,571	43,769,524	6.12	931,324	12,500,866	13.42

Production and value of products of clay in the United States, 1895–1914, by varieties—Continued.

Year.	Front brick. Quantity (thousands.)	Front brick. Value.	Front brick. Average price per thousand.	Fancy or ornamental brick (value).	Enameled brick (value).	Fire brick (value).	Stove lining (value).	Drain tile (value).
1895..	339,204	$4,399,367	$12.97	$652,519	(a)	$5,279,004	(b)	$3,450,961
1896..	270,335	3,390,941	12.54	763,140	(a)	4,944,723	(b)	2,613,513
1897..	310,918	3,855,033	12.40	685,048	(a)	4,094,704	(b)	2,623,305
1898..	295,833	3,572,385	12.08	358,372	$279,993	6,093,071	(b)	3,115,318
1899..	438,817	4,767,343	10.86	476,191	329,969	8,641,882	$416,235	3,682,394
1900..	344,516	3,864,670	11.09	289,698	323,630	9,830,517	462,541	2,976,281
1901..	415,343	4,709,737	11.34	372,131	463,709	9,870,421	423,371	3,143,001
1902..	458,391	5,318,008	11.60	335,290	471,163	11,970,511	630,924	3,506,787
1903..	433,016	5,402,861	12.48	328,387	569,689	[b]14,062,369	(b)	4,639,214
1904..	434,351	5,560,131	12.30	300,233	548,397	11,167,972	(b)	5,348,555
1905..	541,590	7,108,092	13.12	293,907	636,279	12,735,404	645,432	5,850,210
1906..	617,469	7,895,323	12.79	207,119	773,104	14,206,868	743,414	6,543,289
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
1913..	827,665	9,614,138	11.62	109,703	1,225,708	20,627,122	535,667	8,558,320
1914..	810,395	9,289,623	11.46	124,459	1,075,026	16,427,547	520,585	8,522,039

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.
1895..	$4,482,577	$2,512,193	$741,626	$2,572,628	$6,619,333	....	(c)	$65,409,806
1896..	4,588,503	2,359,983	1,706,504	1,618,127	1,210,719	$55,654,781	$7,455,627	63,110,408
1897..	4,069,534	1,841,422	1,979,259	1,476,638	1,413,595	52,050,782	10,309,209	62,359,991
1898..	3,791,057	2,043,325	1,900,642	1,746,024	2,000,743	59,898,456	14,589,224	74,487,680
1899..	4,560,334	2,027,532	1,665,066	1,276,300	6,065,928	78,547,120	17,250,250	95,797,370
1900..	5,842,562	2,372,568	1,820,214	2,349,420	2,896,036	76,413,775	19,798,570	96,212,345
1901..	6,736,969	3,367,982	1,860,269	2,867,659	2,945,268	87,747,727	22,463,860	110,211,587
1902..	7,174,892	3,526,906	3,175,593	3,622,863	3,678,742	98,042,078	24,127,453	122,169,531
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
1913..	14,872,103	7,733,306	8,620,216	6,109,180	3,018,316	143,296,757	37,992,375	181,289,132
1914..	14,014,767	6,087,652	8,385,337	5,705,583	3,165,814	129,588,822	35,398,161	164,986,983

[a] Enameled brick not separately classified prior to 1898.
[b] Stove lining not separately classified prior to 1899, is included in fire brick in 1903; in miscellaneous in 1904.
[c] Pottery, unclassified in 1895, is included in miscellaneous in that year.

This table shows the growth of the clay-working industries during the last 20 years. The total value of the products ranged from $62,359,991 in 1897 to $181,289,132 in 1913, an increase in 1913 over 1897 of $118,929,141, or 190.71 per cent. The increase in 1914 over 1895 was $99,577,177, or 152.24 per cent. The value in 1914 was greater than in 1911 by $2,750,802 and was exceeded by only four other years, 1913, 1912, 1910, and 1909. Compared with 1908, the year of the greatest decrease, there was an increase in 1914 of $31,789,221, or nearly 24 per cent. The fairest comparison, however, in a long series of years is perhaps by five-year averages, since unusual conditions may occur in a single year. On this basis the five-year average total annual values of the clay products of the United States were: 1895–1899, $72,233,051; 1900–1904, $118,135,826; 1905–1909, $153,838,251; and 1910–1914, $170,287,909. It thus appears that the value of the clay products of the country has considerably more than doubled in the 20 years covered by the table. In 7 years within this period—1896, 1897, 1904, 1907, 1908, 1911, and 1914—there was decrease. The greatest decrease was in 1908—$25,744,607, or 16.2 per cent—and the greatest increase was in 1909—$33,123,451, or 24.87 per cent. The maximum value was reached in 1914 in one brick and tile product—vitrified paving brick. The maximum value of brick and tile products and of pottery, as well as of the total, was reached in 1913.

The maximum quantity of common brick was reached in 1906 and the maximum value in 1905. The production in 1914 was less than the maximum by 2,880,468,000 brick, or 28.73 per cent, and was the smallest output since 1900. The value of common brick in 1914 was less than the maximum by $17,624,859, or 28.71 per cent. The average price per 1,000 ranged from $4.99 in 1897 to $6.25 in 1905. The average price in 1914 was 8 cents lower than in 1913. The average annual production during the first five years covered by the table was 6,115,299,000 brick and the average annual value was $31,706,320 compared with 8,297,479,000 brick and $50,161,072 during the last five years.

Vitrified paving brick reached its maximum quantity in 1909 and its maximum value in 1914. The output of 1914 was less by 92,330,000 brick than the maximum, but the value in 1914 exceeded by $362,645 the value in 1913. The average value per 1,000 ranged from $8.18 in 1899 to $13.42 in 1914. The average annual production for the first five years covered by the table was 438,604,000 brick, valued at $3,654,868, compared with 943,726,000 brick in the last five years, valued at $11,536,214, an increase of more than twofold in quantity and of more than threefold in value.

Front or face brick, which showed its maximum quantity in 1913 and its maximum value in 1909, decreased in 1914 by 17,270,000 brick, or 2.09 per cent, in quantity from 1913, and by $422,596 in value from 1909. During the first five years covered by the table, the average annual production of front brick was 331,021,000 brick, valued at $3,997,014, compared with 774,967,000 brick, valued at $9,119,598, during the last five years. The average price per 1,000 ranged from $10.86 in 1899 to $13.12 in 1905.

The use of fancy or ornamental brick, notwithstanding that it was one of the two varieties of brick and tile products to increase in value in 1914, is on the decline. This product is the only one to show a decrease in average annual value in the last five years ($163,210 in 1910–1914) compared with the first five years ($587,054 in 1895–1899) covered by the table. The maximum value, $763,140, of fancy brick was reached in the period covered by the table in 1896, and the minimum, $109,703, was in 1913.

Enameled brick has, on the whole, made steady progress since it was separately classified in these reports. It reached its maximum value in 1913 and showed a decrease in 1914. Notwithstanding this decrease, the production has more than trebled in value in the last few years.

The fire-brick industry has shown a remarkable growth, the value of the product having increased more than threefold in the last 20 years. It attained its maximum value in 1913, but showed a large decrease in 1914. The average annual value of output of fire brick in the first five years of the table was $5,810,677 and in the last five years it was $17,823,692.

Draintile reached its maximum value in 1910, after a steady increase for 10 years. Its value in 1914 was within $1,867,783, or 17.98

per cent of the maximum in 1910, or nearly 2½ times as great as it was in 1895. From 1895 to 1899 the average annual value of draintile was $3,097, 098, and from 1910 to 1914 it was $8,861,349.

The sewer-pipe industry has shown a large growth in the last 20 years. During the first five years of this period the average annual value of output was $4,298,401, and in the last five years it was $12,783,572, an increase of nearly threefold. It attained its maximum value in 1913 and showed a considerable decline in 1914. Its value in 1914, however, was the highest recorded except in 1913 and was $1,867,090 greater than in 1912.

Terra cotta reached its maximum value in 1912 and decreased considerably in 1913 and 1914. Compared with the earlier years of the table, however, the increase in the later years was very large. The average annual value of output from 1895 to 1899 was $2,156,891, and from 1910 to 1914 it was $7,079,193.

Fireproofing in 1895 was of minor importance, its output being valued at $741,626, or a little over 1 per cent of the total, compared with $8,620,216, or 4.75 per cent of the total, in 1913, an increase of over 1,000 per cent. From 1895 to 1899 the average annual value of the output of fireproofing was $1,598,619, and from 1910 to 1914 it was $6,990,094, a more than fourfold increase.

Tile, not drain, which embraces all kinds of tile except draintile, reached its maximum in 1913 and showed a considerable decrease in 1914. This product has shown many vicissitudes, but has, nevertheless, made much progress, the output in 1914 being more than twice as valuable as it was in 1895, and the annual average for the last five years of the table—$5,644,217—being more than three times as great as it was in 1895–1899, namely, $1,737,943.

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 1913 and 1914:

Rank of States, value of output, and percentage of total value of clay products in 1913 and 1914.

State or Territory.	1913				1914			
	Rank.	Number of active firms reporting.	Value.	Percentage of total value.	Rank.	Number of active firms reporting.	Value.	Percentage of total value.
Ohio	1	563	$38,388,296	21.18	1	543	$37,166,768	22.53
Pennsylvania	2	377	24,231,482	13.37	2	369	21,846,996	13.24
New Jersey	3	149	19,705,378	10.87	3	148	16,484,652	9.99
Illinois	4	281	15,195,874	8.38	4	263	13,318,953	8.07
New York	5	215	11,469,476	6.33	5	205	9,078,933	5.50
Indiana	6	257	8,498,646	4.69	6	240	7,655,285	4.64
Iowa	8	186	5,573,681	3.07	7	171	6,401,745	3.88
Missouri	7	105	6,602,076	3.64	8	98	6,077,284	3.68
West Virginia	10	58	5,208,270	2.87	9	58	5,761,411	3.49
California	9	91	5,344,958	2.95	10	84	4,461,661	2.70
Michigan	14	98	2,674,125	1.48	11	92	2,700,066	1.64
Kentucky	12	83	2,914,276	1.61	12	85	2,376,406	1.44
Texas	11	102	3,049,349	1.68	13	102	2,280,987	1.38
Georgia	13	92	2,692,619	1.49	14	76	2,263,034	1.37
Minnesota	20	69	1,781,017	.98	15	65	1,944,886	1.18
Kansas	17	43	1,919,910	1.06	16	42	1,905,961	1.16
Maryland	18	49	1,917,500	1.06	17	46	1,846,500	1.12
Washington	15	45	2,390,226	1.32	18	51	1,809,491	1.10
Massachusetts	19	60	1,814,875	1.00	19	57	1,681,557	1.02
Alabama	16	68	2,091,581	1.15	20	70	1,574,023	.95
Tennessee	23	79	1,493,085	.82	21	75	1,546,315	.94
Virginia	21	69	1,705,651	.94	22	67	1,472,348	.89

Rank of States, value of output, and percentage of total value of clay products in 1913 and 1914—Continued.

State or Territory.	1913				1914			
	Rank.	Number of active firms reporting.	Value.	Percentage of total value.	Rank.	Number of active firms reporting.	Value.	Percentage of total value.
North Carolina	22	157	$1,614,406	0.89	23	157	$1,460,790	0.89
Connecticut and Rhode Island	24	42	1,372,234	.76	24	38	1,229,037	.75
Colorado	25	68	1,293,511	.71	25	62	1,143,942	.69
Wisconsin	26	85	1,020,728	.56	26	77	950,999	.58
Maine	30	38	661,573	.37	27	37	914,808	.55
Oklahoma	34	31	573,371	.32	28	30	786,314	.48
Utah	29	30	708,906	.39	29	27	676,142	.41
Nebraska	27	56	886,166	.49	30	48	640,955	.39
South Carolina	33	41	583,241	.32	31	38	568,645	.34
Oregon	28	59	771,795	.43	32	52	560,271	.34
Mississippi	31	57	641,271	.35	33	51	530,857	.32
Arkansas	35	39	529,624	.29	34	34	451,986	.27
Montana	37	22	456,897	.25	35	21	440,519	.27
Louisiana	32	38	638,491	.35	36	41	422,062	.26
New Hampshire	36	26	462,534	.26	37	21	398,066	.24
North Dakota	38	11	262,580	.14	38	11	266,046	.16
Florida	39	15	253,344	.14	39	14	240,094	.15
New Mexico	42	13	176,528	.10	40	9	205,914	.12
Arizona	40	17	218,542	.12	41	14	156,167	.09
Delaware	41	15	187,280	.10	42	15	154,718	.09
District of Columbia	43	8	160,014	.09	43	8	148,866	.09
Idaho and Nevada	44	25	150,701	.08	44	20	110,864	.07
Vermont	45	5	94,773	.05	45	6	75,847	.05
Wyoming	46	8	61,678	.03	46	9	64,942	.04
South Dakota	47	7	46,685	.03	47	7	57,711	.04
Porto Rico	48	13	6,359	.00	48	6	5,974	.00
Other States			[a] 793,549	.44			[a] 669,185	.41
Total		4,065	181,289,132	100.00		3,860	164,986,983	100.00

[a] Undistributed pottery products.

The value of clay products ranged by States in 1914 from $5,974 in Porto Rico to $37,166,768, or 22.53 per cent of the total, in Ohio. For 1913, Ohio reported 21.18 per cent of the total. Ohio has been the leading State in the value of clay products since the statistics were first compiled by the Geological Survey in 1894. It is almost certain to maintain this position for many years, as the value of its output has always greatly exceeded that of the second State, Pennsylvania, and in 1914 this excess was $15,319,772, or over 70 per cent. Pennsylvania's output in 1914 was valued at $21,846,996, or 13.24 per cent of the total. New Jersey ranked third, as in 1913. There was no change in the relative rank of the first 6 States. Iowa, which was eighth in 1913, rose to seventh in 1914, changing places with Missouri. West Virginia, tenth in 1913, was ninth in 1914, changing places with California. Michigan rose from fourteenth in 1913 to eleventh in 1914, and Texas dropped from eleventh to thirteenth. Minnesota rose from twentieth to fifteenth. Washington fell from fifteenth to eighteenth, Alabama from sixteenth to twentieth, and Oregon from twenty-eighth to thirty-second. Maine rose from thirtieth to twenty-seventh, changing places with Nebraska, and Oklahoma rose from thirty-fourth to twenty-eighth. The first 10 States reported for 1914 wares valued at $128,253,688, or 77.74 per cent of the total; for 1913, the same States reported wares valued at $140,218,137, or 77.35 per cent of the total. The first 5 States reported wares in 1914 valued at $97,897,302, or 59.34 per cent of the total, compared with $108,990,506, or 60.12 per cent of the total, in 1913.

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 1913 and 1914:

Brick and tile products in the United States in 1913.

Rank.	State or Territory.	Common brick.			Vitrified brick or block.		
		Quantity (thousands).	Value.	Average price per thousand.	Quantity (thousands).	Value.	Average price per thousand.
15	Alabama	130,923	$730,148	$5.58	24,183	$361,722	$14.96
40	Arizona	20,478	181,042	8.84	....	....	....
35	Arkansas	64,680	433,242	6.70	(a)	(a)	8.09
9	California	295,729	1,699,426	5.75	1,923	44,725	23.26
25	Colorado	45,590	291,113	6.39	3,807	46,220	12.14
23	Connecticut and Rhode Island	185,737	1,252,126	6.74	(a)	(a)	15.30
41	Delaware	23,253	173,051	7.44	....	....	....
44	District of Columbia	14,614	110,064	7.53	....	....	....
39	Florida	42,450	240,126	5.66	....	....	....
12	Georgia	278,504	1,464,322	5.26	(a)	(a)	12.81
43	Idaho and Nevada	16,555	136,455	8.24	....	....	....
3	Illinois	1,155,480	6,445,821	5.58	133,938	1,883,199	14.06
6	Indiana	208,500	1,268,710	6.08	54,579	690,164	12.65
8	Iowa	143,263	1,052,036	7.34	16,398	222,105	13.54
16	Kansas	122,465	541,741	4.42	53,382	543,929	10.19
11	Kentucky	98,364	681,727	6.93	(a)	(a)	10.13
31	Louisiana	95,736	600,234	6.27	....	....	....
30	Maine	43,201	312,182	7.23	(a)	(a)	15.02
19	Maryland	153,053	1,004,146	6.56	(a)	(a)	17.91
22	Massachusetts	153,818	1,106,437	7.19	....	....	....
13	Michigan	273,571	1,626,287	5.94	8,571	126,062	14.71
18	Minnesota	129,261	800,441	6.19	(a)	(a)	15.85
32	Mississippi	90,801	523,526	5.77	....	....	....
7	Missouri	185,872	1,270,581	6.84	19,383	275,164	14.20
37	Montana	27,094	283,075	10.45	926	15,888	17.16
27	Nebraska	89,727	586,192	6.53	(a)	(a)	13.26
36	New Hampshire	56,904	462,534	8.13	....	....	....
4	New Jersey	401,702	2,391,287	5.95	....	....	....
42	New Mexico	10,009	89,538	8.95	(a)	(a)	10.90
5	New York	1,068,516	6,029,103	5.64	33,901	514,677	15.18
21	North Carolina	204,097	1,354,062	6.63	....	....	....
38	North Dakota	22,087	135,734	6.15	....	....	....
2	Ohio	407,685	2,523,014	6.19	304,391	3,308,975	10.87
34	Oklahoma	73,176	369,344	5.05	14,912	149,844	10.05
28	Oregon	36,885	302,584	8.20	(a)	(a)	25.00
1	Pennsylvania	704,493	4,772,229	6.77	140,407	1,814,833	12.93
48	Porto Rico	916	6,334	6.91	....	....	....
33	South Carolina	87,938	536,434	6.10	....	....	....
47	South Dakota	5,016	39,065	7.79	....	....	....
24	Tennessee	151,072	902,832	5.98	(a)	(a)	15.32
10	Texas	248,271	1,826,793	7.36	(a)	(a)	12.85
29	Utah	36,405	283,013	7.77	....	....	....
45	Vermont	9,498	62,431	6.57	....	....	....
20	Virginia	217,408	1,409,798	6.48	(a)	(a)	12.88
14	Washington	67,435	475,874	7.06	42,717	701,550	16.42
17	West Virginia	68,745	476,248	6.93	58,728	795,555	13.55
26	Wisconsin	116,534	815,461	7.00	....	....	....
46	Wyoming	5,279	56,794	10.76	....	....	....
	Other States[b]	....	....	....	46,534	643,609	13.83
	Total	8,088,790	50,134,757	6.20	958,680	12,138,221	12.66
	Percentage of brick and tile products	....	34.99	....	....	8.47	....
	Percentage of total of clay products	....	27.65	....	....	6.70	....

[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 1913—Continued.

Rank.	State or Territory.	Front brick. Quantity (thousands).	Front brick. Value.	Front brick. Average price per thousand.	Fancy or ornamental brick. Value.	Drain-tile. Value.	Sewer pipe. Value.	Architectural terra cotta. Value.	Fireproofing. Value.
15	Alabama	(a)	(a)	$15.29		$10,802	(a)		(a)
40	Arizona	(a)	(a)	24.00			(a)		(a)
35	Arkansas	2,819	$35,638	12.64		2,190			
9	California	16,605	368,149	22.17	(a)	34,413	$1,032,094	$629,103	$322,200
25	Colorado	10,851	129,590	11.94	(a)	47,871	(a)	(a)	25,220
23	Connecticut and Rhode Island	(a)	(a)	12.73	(a)				
41	Delaware	(a)	(a)	15.90		(a)			
44	District of Columbia					(a)	(a)		(a)
39	Florida					(a)			
12	Georgia	9,749	96,568	9.91		9,100	634,478	(a)	33,900
43	Idaho and Nevada	844	11,196	13.27	(a)				
3	Illinois	29,566	363,010	12.28	$2,295	1,225,190	787,896	1,908,399	592,337
6	Indiana	67,202	708,745	10.55		1,595,290	661,783	(a)	703,189
8	Iowa	14,078	181,911	12.92		2,798,816	503,360		762,563
16	Kansas	39,451	335,940	8.52	(a)	36,565	(a)	(a)	80,220
11	Kentucky	4,098	42,637	10.40		78,023	162,370		39,341
31	Louisiana	(a)	(a)	10.37		(a)			(a)
30	Maine	(a)	(a)	9.00		(a)	(a)		
19	Maryland	(a)	(a)	23.00	(a)	3,744		(a)	55,162
22	Massachusetts	869	17,380	20.00					(a)
13	Michigan	505	5,940	11.76		415,543	(a)		(a)
18	Minnesota	13,392	163,380	12.20		110,543	(a)		170,214
32	Mississippi	(a)	(a)	10.11		79,454			
7	Missouri	27,191	414,778	15.25	18,734	130,661	1,213,889	480,372	104,073
37	Montana	970	17,368	17.91		(a)	(a)		(a)
27	Nebraska	9,368	178,781	19.08	(a)	5,615			95,578
36	New Hampshire								
4	New Jersey	45,841	474,501	10.35	(a)	44,020	(a)	2,388,293	2,092,370
42	New Mexico	2,452	36,593	14.93		(a)			(a)
5	New York	7,636	83,823	10.98	(a)	83,695	(a)	1,110,726	208,625
21	North Carolina	(a)	(a)	8.89		13,584	(a)		(a)
38	North Dakota	(a)	(a)	20.04	(a)				(a)
2	Ohio	185,810	1,950,433	10.50	20,950	1,508,564	5,159,548		2,115,861
34	Oklahoma	3,119	31,103	9.97					
28	Oregon	3,757	96,043	25.56		73,873	(a)		55,308
1	Pennsylvania	214,734	2,325,201	10.83	35,446	11,730	1,326,971	506,100	480,675
48	Porto Rico								
33	South Carolina	(a)	(a)	13.49		(a)			(a)
47	South Dakota	(a)	(a)	15.12		(a)			(a)
24	Tennessee	16,085	154,681	9.62		42,294	(a)		(a)
10	Texas	21,766	293,077	13.46		8,840	(a)		129,763
29	Utah	14,760	173,589	11.76		29,698	(a)		(a)
45	Vermont								
20	Virginia	18,040	247,142	13.70	(a)	6,400	(a)		
14	Washington	6,122	128,989	21.07		28,172	501,102	316,628	157,069
17	West Virginia	2,732	33,484	12.26		3,191	(a)		(a)
26	Wisconsin	11,178	121,739	10.89		73,328			
46	Wyoming	(a)	(a)	15.07					
	Other States [b]	26,075	392,729	15.06	32,278	47,111	2,888,612	393,685	396,548
	Total	827,665	9,614,138	11.62	[c]1,335,411	8,558,320	14,872,103	7,733,306	8,620,216
	Percentage of brick and tile products		6.71		.93	5.97	10.38	5.40	6.02
	Percentage of total clay products		5.30		.74	4.72	8.20	4.27	4.75

[a] Included in "Other States."
[b] Includes all products made by less than 3 producers in 1 State.
[c] Includes enameled brick valued at $1,225,708 made in the following States: California, Colorado, Illinois, Maryland, Missouri, New Jersey, and Ohio.

Brick and tile products in the United States in 1913—Continued.

Rank.	State or Territory.	Tile, not drain.	Stove lining.	Fire brick.			Miscel-laneous.[a]	Total value.	Per-centage of total value.
		Value.	Value.	Quantity (thou-sands).	Value.	Aver-age price per thou-sand.	Value.		
15	Alabama	(b)		(b)	(b)	$17.74	$26,086	$2,071,423	1.45
40	Arizona			(b)	(b)	30.00		218,542	.15
35	Arkansas			(b)	(b)	13.17		509,867	.36
9	California	$151,252	(b)	19,305	$523,692	27.13	75,434	5,054,703	3.53
25	Colorado	(b)		14,261	306,843	21.52	58,965	1,247,010	.87
23	Connecticut and Rhode Island	(b)	(b)	(b)	(b)	22.00		1,372,234	.96
41	Delaware							187,280	.13
44	District of Columbia							149,014	.10
39	Florida							253,344	.18
12	Georgia	(b)		4,405	64,167	14.57		2,664,091	1.86
43	Idaho and Nevada							150,701	.11
3	Illinois	82,168		20,376	351,324	17.24	78,101	14,280,611	9.97
6	Indiana	(b)	(b)	6,016	105,286	17.50	573,184	7,311,940	5.10
8	Iowa	(b)		264	3,250	12.31	25,742	5,552,983	3.88
16	Kansas	(b)					31,464	1,919,910	1.34
11	Kentucky	301,094	(b)	79,342	1,428,938	18.01	2,780	2,812,158	1.96
31	Louisiana						16,105	638,491	.45
30	Maine			(b)	(b)	15.00		661,573	.46
19	Maryland		$23,006	14,444	295,707	20.47		1,762,466	1.23
22	Massachusetts	(b)	179,980	2,361	84,298	35.70	1,500	1,583,530	1.11
13	Michigan	(b)		(b)	(b)	16.41	35,000	2,451,242	1.71
18	Minnesota			(b)	(b)	16.67	17,348	1,781,017	1.24
32	Mississippi			(b)	(b)	25.00	8,000	623,820	.44
7	Missouri	(b)	(b)	104,728	2,138,368	20.42	138,720	6,598,664	4.60
37	Montana	(b)		1,244	49,542	39.82		456,897	.32
27	Nebraska						13,296	886,166	.62
36	New Hampshire							462,534	.32
4	New Jersey	1,308,787	(b)	43,181	1,246,294	28.86	353,378	10,866,833	7.58
42	New Mexico			1,223	24,920	20.38		176,528	.12
5	New York	67,700	67,327	8,215	341,524	41.57	39,900	8,627,818	6.02
21	North Carolina							1,600,723	1.12
38	North Dakota			(b)	(b)	27.51		262,580	.18
2	Ohio	2,492,380	(b)	109,884	1,961,020	17.85	728,399	21,868,407	15.26
34	Oklahoma						23,080	573,371	.40
28	Oregon			37	1,050	28.38		771,795	.54
1	Pennsylvania	385,322	142,303	361,548	7,094,794	19.62	680,839	22,185,383	15.48
48	Porto Rico						25	6,359	.00
33	South Carolina			1,426	21,832	15.31		573,459	.40
47	South Dakota							46,685	.03
24	Tennessee			697	13,205	18.95	152	1,347,985	.94
10	Texas		(b)	6,525	104,338	15.99	54,480	2,968,975	2.07
29	Utah		(b)	(b)	(b)	30.83	5,069	708,906	.49
45	Vermont		(b)					94,773	.07
20	Virginia			(b)	(b)	15.28	4,714	1,705,651	1.19
14	Washington		(b)	2,191	66,178	30.20	10,835	2,390,226	1.67
17	West Virginia	259,109		17,601	155,423	8.83	13,220	1,783,383	1.24
26	Wisconsin						2,500	1,013,028	.71
46	Wyoming							61,678	.04
	Other States [c]	1,061,368	123,051	23,779	429,323	18.05		(d)	
	Total	[e]6,109,180	535,667	[f]1,017,299	[f]20,627,122	20.28	3,018,316	143,296,757	100.00
	Percentage of brick and tile products	4.26	.37		14.39		2.11	100.00	
	Percentage of total of clay products.	3.37	.30		11.38		1.66	79.04	

[a] Including adobes, bake-oven tile, burnt-clay ballast, charcoal furnaces, chemical brick and tile, chimney pipe and tops, condensers, conduits, crucibles, flue pipe and lining, furnaces for heating irons, gas logs, glasshouse supplies, grave and lot markers, muffles, radial chimney brick and block, retorts, saggers, scorifiers, silo blocks, sundials, vases, 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] Including the following values: Floor tile, $2,483,082; wall tile, $1,763,992; roofing tile, $1,130,286; and faience tile, $731,820.

[f] In the total quantity and total value of fire brick are included, respectively, 174,246,000 silica brick, valued at $3,815,806, of which 132,042,000, valued at $2,608,940, was produced by Pennsylvania, and the remainder, 42,204,000, valued at $1,206,866, by Alabama, California, Colorado, Idaho, Illinois, Indiana, Missouri, Montana, New Jersey, Ohio, and Utah.

Brick and tile products in the United States in 1914.

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.
19	Alabama	110,731	$638,666	$5.77	18,679	$248,525	$13.31
41	Arizona	15,994	139,324	8.71	....	....	....
35	Arkansas	58,921	378,395	6.42	(a)	(a)	12.14
9	California	221,243	1,356,885	6.13	1,800	39,705	22.06
25	Colorado	33,717	211,037	6.26	(a)	(a)	11.52
24	Connecticut and Rhode Island	171,289	1,140,842	6.66	(a)	(a)	16.03
42	Delaware	18,513	147,196	7.95	....	....	....
43	District of Columbia	13,988	111,883	8.00	....	....	....
39	Florida	41,901	230,377	5.50	(a)	(a)	12.00
12	Georgia	214,979	1,040,557	4.84	16,470	234,855	14.26
44	Idaho and Nevada	12,638	101,410	8.02	....	....	....
3	Illinois	941,343	4,898,698	5.20	157,176	2,086,344	13.27
6	Indiana	180,701	1,061,935	5.88	42,937	576,892	13.44
7	Iowa	143,534	1,067,746	7.44	14,997	211,905	14.13
15	Kansas	106,930	486,854	4.55	50,707	594,229	11.72
11	Kentucky	90,124	594,514	6.60	(a)	(a)	12.74
36	Louisiana	63,768	387,517	6.08	....	....	....
27	Maine	39,961	311,924	7.81	....	....	....
18	Maryland	146,860	1,180,401	8.04	....	....	....
21	Massachusetts	139,632	1,023,070	7.33	....	....	....
10	Michigan	269,154	1,633,216	6.07	7,733	120,562	15.59
14	Minnesota	132,688	883,791	6.67	(a)	(a)	16.12
33	Mississippi	72,978	460,311	6.31	....	....	....
8	Missouri	169,029	1,157,852	6.85	26,217	424,170	16.18
34	Montana	26,732	270,738	10.13	(a)	(a)	22.50
30	Nebraska	81,691	519,991	6.37	(a)	(a)	11.14
37	New Hampshire	48,216	398,066	8.26	....	....	....
4	New Jersey	349,434	1,944,806	5.57	(a)	(a)	15.00
40	New Mexico	11,148	94,570	8.48	(a)	(a)	10.40
5	New York	908,868	4,666,037	5.13	31,240	515,672	16.51
23	North Carolina	183,648	1,216,180	6.62	....	....	....
38	North Dakota	16,857	140,784	8.35	....	....	....
1	Ohio	436,117	2,862,109	6.56	293,381	3,682,230	12.55
28	Oklahoma	74,391	374,774	5.04	9,912	127,792	12.89
31	Oregon	27,433	210,298	7.67	....	....	....
2	Pennsylvania	688,178	4,641,269	6.74	151,200	2,052,676	13.58
48	Porto Rico	762	5,970	7.83	....	....	....
32	South Carolina	89,148	505,839	5.67	....	....	....
47	South Dakota	6,178	52,404	8.48	....	....	....
22	Tennessee	137,406	843,363	6.14	(a)	(a)	15.26
13	Texas	182,695	1,180,586	6.46	1,684	23,599	14.01
29	Utah	33,493	270,564	8.08	....	....	....
45	Vermont	6,990	45,847	6.56	....	....	....
20	Virginia	187,102	1,229,356	6.57	(a)	(a)	10.00
17	Washington	51,657	351,565	6.81	(a)	(a)	18.99
16	West Virginia	68,022	450,242	6.62	67,750	899,215	13.27
26	Wisconsin	115,056	799,109	6.95	....	....	....
46	Wyoming	4,733	50,656	10.70	....	....	....
	Other States[b]	....	....	....	39,441	662,495	16.80
	Total	7,146,571	43,769,524	6.12	931,324	12,500,866	13.42
	Percentage of brick and tile products	....	33.77	....	....	9.65	....
	Percentage of total clay products	....	26.53	....	....	7.58	....

[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 1914—Continued.

Rank.	State or Territory.	Front brick.		Average price per thousand.	Fancy or ornamental brick.	Drain tile.	Sewer pipe.	Architectural terra cotta.	Fireproofing.
		Quantity (thousands).	Value.		Value.	Value.	Value.	Value.	Value.
19	Alabama	(a)	(a)	$11.42	(a)	$6,838	(a)	....	(a)
41	Arizona	(a)	(a)	25.00	....	....	(a)	....	(a)
35	Arkansas	1,602	$20,288	12.66	....	(a)	....	....	....
9	California	10,759	226,268	21.03	$21,245	30,284	$959,193	$535,735	$223,071
25	Colorado	10,642	133,068	12.50	(a)	53,971	(a)	(a)	(a)
24	Connecticut and Rhode Island	(a)	(a)	12.24	(a)	....	....	....	(a)
42	Delaware	....	....	....	....	(a)	....	....	....
43	District of Columbia	....	....	....	....	(a)	(a)	....	(a)
39	Florida	....	....	....	....	(a)	....	....	....
12	Georgia	7,475	77,721	10.40	....	8,883	647,733	(a)	36,140
44	Idaho and Nevada	(a)	(a)	12.04	....	....	....	....	(a)
3	Illinois	46,995	506,984	10.79	(a)	1,041,927	743,986	1,652,945	567,266
6	Indiana	80,349	799,520	9.95	....	1,332,002	586,683	(a)	823,462
7	Iowa	11,183	148,394	13.27	....	3,180,836	558,751	....	1,083,397
15	Kansas	31,079	271,104	8.72	(a)	34,130	(a)	(a)	88,427
11	Kentucky	3,828	38,674	10.10	....	51,645	(a)	....	33,442
36	Louisiana	(a)	(a)	11.94	....	....	....	....	(a)
27	Maine	(a)	(a)	8.59	....	(a)	(a)	....	....
18	Maryland	(a)	(a)	16.52	(a)	(a)	....	(a)	51,483
21	Massachusetts	950	20,000	21.05	....	....	....	....	(a)
10	Michigan	1,488	21,121	14.19	....	421,941	(a)	....	3,752
14	Minnesota	16,413	208,624	12.71	....	143,194	(a)	....	123,911
33	Mississippi	....	....	....	....	49,486	....	....	....
8	Missouri	27,692	411,943	14.88	19,473	143,245	1,236,236	478,006	168,053
34	Montana	754	13,750	18.24	....	(a)	(a)	....	(a)
30	Nebraska	2,511	45,326	18.05	....	1,872	....	....	67,586
37	New Hampshire	....	....	....	....	....	....	....	....
4	New Jersey	23,640	377,779	15.98	(a)	31,043	(a)	1,620,791	1,599,295
40	New Mexico	(a)	(a)	14.00	....	....	....	....	(a)
5	New York	5,810	59,039	10.16	(a)	66,217	(a)	889,468	161,725
23	North Carolina	(a)	(a)	11.42	....	11,850	(a)	....	(a)
38	North Dakota	5,860	117,356	20.03	....	....	....	....	(a)
1	Ohio	188,074	1,944,486	10.34	14,727	1,589,565	4,691,719	....	2,200,544
28	Oklahoma	2,729	25,641	9.40	....	....	....	....	....
31	Oregon	2,711	63,659	23.48	(a)	68,115	(a)	....	38,353
2	Pennsylvania	219,923	2,402,361	10.92	51,068	14,730	940,384	362,348	494,175
48	Porto Rico	....	....	....	....	....	....	....	....
32	South Carolina	2,156	28,880	13.40	....	(a)	....	....	(a)
47	South Dakota	(a)	(a)	18.00	....	(a)	....	....	(a)
22	Tennessee	18,594	190,893	10.27	1,469	48,551	(a)	....	(a)
13	Texas	18,450	249,611	13.53	....	14,414	(a)	....	145,830
29	Utah	14,742	189,131	12.83	....	25,911	(a)	....	39,921
45	Vermont	....	....	....	....	....	....	....	....
20	Virginia	16,831	212,537	12.63	(a)	4,500	(a)	....	(a)
17	Washington	5,319	109,197	20.53	....	48,750	462,898	220,788	127,371
16	West Virginia	2,354	37,114	15.77	....	3,733	(a)	....	(a)
26	Wisconsin	8,388	78,766	9.39	....	60,924	....	....	(a)
46	Wyoming	1,104	13,838	12.53	....	....	....	....	....
	Other States [b]	19,990	246,550	12.33	16,477	33,482	3,187,184	327,571	308,133
	Total	810,395	9,289,623	11.46	[c]1,199,485	8,522,039	14,014,767	6,087,652	8,385,337
	Percentage of brick and tile products	....	7.17	....	0.93	6.58	10.81	4.70	6.47
	Percentage of total clay products	....	5.63	....	.73	5.16	8.49	3.69	5.08

[a] Included in "Other States."
[b] Includes all products made by less than 3 producers in 1 State.
[c] Includes enameled brick valued at $1,075,026 made in the following States: California, Colorado, Illinois, Maryland, Missouri, and New Jersey.

Brick and tile products in the United States in 1914—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.		
19	Alabama			8,721	$167,021	$19.15	$21,577	$1,557,481	1.20
41	Arizona			(b)	(b)	10.80		156,167	.12
35	Arkansas			(b)	(b)	13.42		432,586	.33
9	California	$214,512	(b)	13,560	358,526	26.44	60,482	4,116,358	3.18
25	Colorado	(b)		10,606	209,368	19.74	113,252	1,082,685	.84
24	Connecticut and Rhode Island	(b)	(b)	(b)	(b)	21.99		1,229,037	.95
42	Delaware							154,718	.12
43	District of Columbia						3,270	148,866	.11
39	Florida							240,094	.18
12	Georgia	(b)	(b)	(b)	(b)	14.95		2,242,073	1.73
44	Idaho and Nevada			(b)	(b)	22.50		110,864	.09
3	Illinois	(b)	(b)	15,416	274,106	17.78	274,359	12,538,374	9.67
6	Indiana	511,433	(b)	3,723	93,900	25.22	426,220	6,503,207	5.02
7	Iowa	(b)		(b)	(b)	19.09	40,146	6,368,995	4.91
15	Kansas	(b)					122,954	1,905,961	1.47
11	Kentucky	270,688		58,780	1,075,158	18.29	11,615	2,286,980	1.76
36	Louisiana						17,596	422,062	.33
27	Maine			(b)	(b)	15.00	924	914,808	.71
18	Maryland		$21,393	12,448	243,043	19.52		1,640,017	1.27
21	Massachusetts	(b)	159,924	2,084	74,736	35.86		1,462,453	1.13
10	Michigan	(b)	(b)	(b)	(b)	19.78	35,000	2,434,872	1.88
14	Minnesota	(b)		(b)	(b)	22.27		1,944,886	1.51
33	Mississippi						6,000	515,797	.40
8	Missouri	(b)	(b)	76,177	1,554,431	20.41	86,845	6,074,340	4.69
34	Montana			1,226	50,517	41.20		440,519	.34
30	Nebraska							640,955	.49
37	New Hampshire							398,066	.31
4	New Jersey	1,139,895	(b)	34,545	897,442	25.98	244,601	8,353,296	6.45
40	New Mexico			(b)	(b)	13.70		205,914	.16
5	New York	(b)	57,837	7,797	321,048	41.18		6,923,141	5.34
23	North Carolina							1,447,994	1.12
38	North Dakota		(b)	(b)	(b)	16.42		266,046	.21
1	Ohio	2,331,079	51,192	102,735	1,833,740	17.85	552,816	21,815,392	16.83
28	Oklahoma						258,107	786,314	.61
31	Oregon	(b)		127	3,830	30.16	82	560,271	.43
2	Pennsylvania	388,887	129,419	298,183	5,774,677	19.37	786,675	20,100,495	15.51
48	Porto Rico						4	5,974	.00
32	South Carolina			1,130	16,850	14.91		557,977	.43
47	South Dakota							57,711	.04
22	Tennessee			1,087	19,717	18.14		1,449,120	1.11
13	Texas			4,860	82,838	17.04	45,008	2,222,240	1.71
29	Utah		(b)	(b)	(b)	33.53	5,113	676,142	.52
45	Vermont		(b)					75,847	.06
20	Virginia			882	11,641	13.20		1,472,348	1.14
17	Washington			1,054	29,869	28.34	27,872	1,809,491	1.40
16	West Virginia	207,778		17,796	146,668	8.24	24,848	1,830,947	1.41
26	Wisconsin		(b)					943,999	.73
46	Wyoming						448	64,942	.05
	Other States[c]	641,311	100,820	14,154	236,896	16.74		(d)	
	Total	[e]5,705,583	520,585	[f]816,784	[f]16,427,547	20.11	3,165,814	129,588,822	100.00
	Percentage of brick and tile products	4.40	0.40		12.68		2.44	100.00	
	Percentage of total clay products	3.46	.41		9.96		1.92	78.54	

[a] Including adobes, assay supplies, burnt-clay ballast, charcoal furnaces, chemical brick, chimney pipe and tops, condensers, conduits, crucibles, flue lining, furnaces for heating irons, gas logs, glass house supplies, grave markers, muffles, radial chimney brick and block, retorts, saggers, scorifiers, segment block, sundials, vases, 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] Including the following values: Roofing tile, $1,043,020; floor tile, $881,362, ceramic mosaic tile, $1,520,739; faïence tile, $675,615; wall tile, $1,584,847.

[f] In the total quantity and total value of fire brick are included, respectively, 129,693,000 silica brick, valued at $2,951,525, of which 98,336,000, valued at $2,061,826, were produced by Pennsylvania, and the remainder, 31,357,000, valued at $889,699, by Alabama, California, Colorado, Illinois, Indiana, Missouri, Montana, New Jersey, Ohio, and Utah.

Common brick, as its name implies, is the most widely distributed of the clay products, being reported for 1914 from every State and Territory except Alaska and Hawaii. There were 7,146,571,000 common brick reported for 1914, valued at $43,769,524, or $6.12 per 1,000, a decrease of 942,219,000 brick. In 1913 there was a decrease from 1912 of 466,448,000 brick. The value showed a decrease in 1914 of $6,365,233 from 1913. Six States, Iowa, Minnesota, New Mexico, Ohio, Oklahoma, and South Dakota, increased in both quantity and value in 1914 compared with 1913; three States, Maryland, Michigan, and North Dakota, and the District of Columbia, increased in value, but decreased in quantity; and one State, South Carolina, increased in quantity, but decreased in value.

In 1914, Illinois was the largest producer of common brick, as in 1913, followed by New York, Pennsylvania, Ohio, and New Jersey. Of the output in Illinois, 597,694,000 brick, or nearly two-thirds, was from Cook County, and of the output in New York, 679,120,000 brick, or nearly three-fourths, was from the Hudson River region. The average price per 1,000 in 1914 for common brick ranged from $4.55 in Kansas to $10.70 in Wyoming. In 1913 these States reported the extremes in average price of $4.42 and $10.76, respectively. In Illinois and New Jersey, there was a decline of 38 cents per 1,000; in New York the decline was 51 cents; in Pennsylvania it was 3 cents. In Ohio there was an advance of 37 cents. There was an increase in the average price per 1,000 in 21 States in 1914.

Vitrified paving brick or block, the fourth brick and tile product in value in 1914, was reported from 28 States, a decrease of 1 State—Florida and New Jersey entering the list of producers, and Maine, Maryland, and Oregon dropping out. Ohio, as for many years, was the leading State, reporting 31.50 per cent of the total quantity and 29.46 per cent of the total value in 1914. Illinois ranked second by a small margin over Pennsylvania. West Virginia was fourth, Kansas fifth, Indiana sixth, and New York seventh. The average price per 1,000 ranged in 1914 in the important producing States from $11.72 in Kansas to $18.99 in Washington, with a general average of $13.42, compared with $12.66 in 1913. The value of vitrified brick in 1914 constituted 9.65 per cent of the value of brick and tile products and 7.58 per cent of the value of the clay products.

Next to the common brick industry, that of the front or face brick branch—the fifth in value among the brick and tile products—is most widely distributed, production being reported from 41 States in 1914, a decrease of 2—Delaware and Mississippi. Pennsylvania, as for many years, was the leading front-brick producing State in 1914, reporting 219,923,000 brick, valued at $2,402,361. Pennsylvania's production in 1914 was 27.14 per cent of the total quantity and 25.86 per cent of the total value. Ohio ranked second, Indiana third, and Illinois fourth in 1914. Kansas was fifth in quantity and Missouri was fifth in value. The average price per 1,000 ranged from $8.59 in Maine to $25 in Arizona, with a general average of $11.46 compared with $11.62 in 1913. The value of front brick constituted 7.17 per cent of the value of all brick and tile products and 5.63 per cent of the value of all clay products in 1914.

Draintile was the sixth brick and tile product in 1914 in value and was reported from 36 States, 2 less than for 1913, Louisiana and New Mexico reporting none. Iowa, Ohio, Indiana, Illinois, and Michigan were the leading States in 1914 in production in the order named. These 5 States together reported draintile valued at $7,566,271, or 88.78 per cent of the total in 1914; for 1913 they reported draintile valued at $7,543,403, or 88.14 per cent of the total. Of these States, Iowa, Ohio, and Michigan showed increase and Indiana and Illinois showed decrease in value of draintile in 1914. The value of draintile in 1914 constituted 6.58 per cent of the value of all brick and tile tile products and 5.16 per cent of all clay products in 1914.

Sewer pipe was reported from 28 States in 1914, the same as for 1913. Ohio, as for many years, was the leading State, reporting a production valued at $4,691,719, or one-third of the total for the country. Missouri ranked second with an output valued at $1,236,236, displacing Pennsylvania, which became fourth. California was third, as in 1913. These 4 States reported 55.85 per cent of the total value for 1914. Sewer pipe ranked third in value among the brick and tile products and constituted 10.81 per cent of the total value of these products and 8.49 per cent of the value of all clay products in 1914.

Architectural terra cotta was reported from 12 States in 1914, the same number as in 1913. In only 7 States were there a sufficient number of producers to permit the publication of figures without disclosing individual returns. Illinois, with an output valued at $1,652,945, was the leading State, displacing New Jersey, which ranked second, with an output valued at $1,620,791. New York ranked third, as in 1913, reporting production valued at $889,468. These 3 States reported over 68 per cent of the total in 1914.

Fireproofing, including hollow building tile or block, was reported from 38 States in 1914, an increase of 4—Connecticut, Idaho, Virginia, and Wisconsin. Ohio was the leading State in 1914 and reported fireproofing valued at $2,200,544. New Jersey was second, with an output valued at $1,599,295, and Iowa was third. These 3 States reported 58.24 per cent of the total value in 1914. Fireproofing was the seventh brick and tile product in value in 1914, and constituted 6.47 per cent of all brick and tile products and 5.08 per cent of all clay products.

"Tile, not drain," includes roofing, floor, wall, mosaic ceramics, and faience tile. These products were reported from 19 States in 1914, the same number as in 1913. Minnesota and Oregon, which reported none of these wares for 1913, entered the list of producers in 1914, and Alabama and Montana dropped out. Ohio, as for many years, was the leading State, reporting wares valued at $2,331,079, or over 40 per cent of the total. New Jersey, as in 1913, ranked second with an output valued at $1,139,895, or about a fifth of the total. These 2 States therefore reported over 60 per cent of the total.

Fire brick in 1914, as for many years, was second only to common brick in value. It was reported from 33 States, the same number as for 1913. Mississippi, which reported fire brick for 1913, reported none for 1914, and Idaho entered the list for 1914. The quantity reported, including silica fire brick, decreased from 1,017,299,000 9-inch equivalent brick in 1913 to 816,784,000 brick in 1914, or 200,515,000 brick. The value fell from $20,627,122 in 1913 to $16,427,547 in 1914. The average price per 1,000 in 1914 for all fire brick was $20.11, compared with $20.28 in 1913. The total number of clay 9-inch equivalent fire brick was 687,091,000, valued at $13,476,022, or $19.61 per 1,000. This was a decrease of 155,962,000 brick in quantity and of $3,335,294 in value from 1913. Pennsylvania continues to be the leading producer of both clay and silica fire brick, reporting 43.40 per cent of the quantity and 42.85 per cent of the value of clay fire brick, and 75.82 per cent of the quantity and 69.86 per cent of the value of silica fire brick in 1914. If clay and silica fire brick be considered together, Pennsylvania produced nearly one-half of the total output reported for 1914. Ohio was second in quantity and value of fire brick in 1914; Missouri was third, Kentucky fourth, and New Jersey fifth. These 5 States reported 83.02 per cent of the output and 82.63 per cent of the value of clay fire brick in 1914. The average price per thousand ranged in the important States for clay fire brick from $8.24 in West Virginia to $41.20 in Montana. In 1913 West Virginia and New York reported the extremes of $8.83 and $41.57 respectively.

The production of silica fire brick in 1914 was 129,693,000 9-inch equivalent brick, valued at $2,951,525, or $22.76 per 1,000, compared with 174,246,000 brick valued at $3,815,806, or $21.90 per 1,000 in 1913. This was a decrease of 44,553,000 brick, or 25.57 per cent, in quantity and of $864,281, or 22.65 per cent, in value from 1913.

Fire brick constituted 12.68 per cent of the value of all brick and tile products in 1914 and 9.96 per cent of all clay products.

For many years Pennsylvania was the leading State in the output of brick and tile products, but in 1914, owing to the larger decrease in value of these products in that State than in Ohio, the latter became the leading State, reporting wares valued at $21,815,392, a decrease of $53,015 from 1913. Pennsylvania ranked second in the value of brick and tile products, reporting an output valued at $20,100,495, a decrease of $2,084,888 from 1913. Illinois was third, as in 1913, although it reported a decrease of $1,742,237 from 1913. New Jersey, showing a decrease of $2,513,537 from 1913, was fourth; New York was fifth, Indiana was sixth, Iowa was seventh, displacing Missouri, which was eighth; California was ninth, as in 1913; and Michigan was tenth, rising from thirteenth in 1913 and exchanging places with Texas.

TILE, NOT DRAIN.

Under the head "Tile, not drain" are embraced the varieties of higher grades of tile used almost exclusively in structural work. There are numerous subdivisions and trade names for these varieties, but, owing to the small number of producers of some of them, it has been thought best to classify them as roofing, floor, ceramic mosaic, faience, and wall tile. The following table shows the production of these tiles in 1913 and 1914:

Value of the tile, not drain, produced in the United States in 1913 and 1914, by varieties.

Variety.	1913		1914	
	Value.	Number of firms reporting each variety.	Value.	Number of firms reporting each variety.
Roofing	$1,130,286	24	$1,043,020	26
Floor	2,483,082	39	881,362	41
Ceramic mosaic	(a)		1,520,739	18
Faience	731,820	23	675,615	23
Wall	1,763,992	15	1,584,847	19
Total	6,109,180		5,705,583	

a Not separately classified in 1913.

Floor tile, including ceramic mosaics, continues to be the tile of greatest value and represented over 42 per cent of the total. In 1914 it was valued at $2,402,101, a decrease of $80,981 from 1913. In 1914 floor tile was reported from California, Colorado, Illinois, Indiana, Iowa, Kentucky, Massachusetts, Minnesota, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, and West Virginia. It was reported by 41 producers in these States, and ceramic mosaics were reported by 18 producers in Indiana, Kentucky, Massachusetts, New Jersey, New York, Ohio, Pennsylvania, and West Virginia. Ohio is the leading State in the production of ceramic mosaics; its output in 1914 was valued at $641,808, or 42 per cent of the total for this variety. New Jersey was second, with an output valued at $403,029, or 26 per cent of the total. These two States therefore reported more than two-thirds of the total for this variety.

Wall tile, constituting nearly 28 per cent of all tile, not drain, in 1914, was reported by 19 operators and was valued at $1,584,847. This was a decrease in value of $179,145 from 1913. Ohio was the leading producer of wall tile, reporting an output valued at $646,935 (made entirely in Muskingum County), a decrease of $191,925 from 1913. New Jersey ranked second with an output valued at $439,190, an increase of $145,486 over 1913. Wall tile was also made in California, Indiana, Kentucky, Missouri, and Pennsylvania.

Roofing tile was reported by 26 operators in 12 States, California, Colorado, Georgia, Illinois, Iowa, Kansas, Kentucky, Michigan, Missouri, Ohio, Pennsylvania, and West Virginia, and was valued at $1,043,020 in 1914, a decrease of $87,266 from 1913. Here again Ohio was the leading State with a production valued at $447,433, or nearly 43 per cent of the total. This was a decrease of $23,472 from 1913. California ranked second and Kansas was third in 1914.

Faience tile was the variety of lowest value in 1914 and was reported by 23 operators in 10 States to the value of $675,615, a decrease of $56,205 from 1913. Ohio was the leading State in 1914 and reported more than one-half of the total output.

HUDSON RIVER REGION.

Greater New York is the leading common-brick market in the United States, about a billion brick being used there annually. The principal source of this supply is the Hudson River region, extending from New York to Cohoes, on both sides of the river. Bergen County, N. J., has contributed largely to this market, and within the last few years the Raritan River region, in Middlesex County, N. J., has also sent the larger portion of its output of common brick to the New York market. For this reason it is included in the table showing the output of the Hudson River region. Connecticut also is at times a contributor to the New York City brick market. The water transportation enjoyed by the Hudson River yards and those located in the Hackensack and Raritan districts, however, gives them a great advantage, and it is only when the prices are high—above $7 a 1,000—that Connecticut brick can profitably enter the New York City market. As prices were unusually low in 1914, few, if any, Connecticut brick were shipped to New York City during that year.

The year 1914 was notable in this region principally for the continued large decrease in quantity and value. This decrease is attributed to the falling off in building operations in New York City in 1914.

The following table shows the production and value of common brick along Hudson River and in portions of New Jersey from 1901 to 1914, the number of operating firms reporting, and the average price received per thousand:

Production of common brick in the Hudson River district, 1901 to 1914.

Year.	Number of active 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 [a]	136	1,233,187	7,133,177	5.78
1913 [a]	132	1,025,308	5,636,061	5.50
1914 [a]	129	888,266	4,350,832	4.90

[a] Includes Raritan district, New Jersey.

The number of brick marketed in this region in 1914 decreased 137,042,000 brick, or 13.36 per cent in quantity, and the value decreased $1,285,229, or 22.80 per cent from 1913. The average price per 1,000 for the region decreased 60 cents from 1913. The number of active firms reporting has not varied greatly, and in 1914 it decreased 3 from the number for 1913. As in other branches of the clay-working industry, the number of active firms reporting is not equivalent to the number of yards, as some of the operators have more than one yard.

In the New York and Bergen County portions of the region, the production, 723,926,000 brick, valued at $3,525,307 in 1914, was the smallest since statistics for this region have been published by the Geological Survey. The average price per 1,000 for this portion of the region, $4.87, was 57 cents lower than in 1913, but was greater than in 1901, 1902, 1903, 1908, and 1910; and the number of active firms reporting, 118, decreased 3 as compared with 1913.

The following table shows the production of common brick in the Hudson River region in 1913 and 1914, by counties.

Production of common brick in the Hudson River district (from Cohoes to New York City) and in Raritan district, New Jersey, in 1913 and 1914, by counties.

County.	1913				1914			
	Number of active firms reporting.	Common brick.		Average price per thousand.	Number of active firms reporting.	Common brick.		Average price per thousand.
		Quantity.	Value.			Quantity.	Value.	
		Thousands.				*Thousands.*		
Albany	12	61,792	$363,964	$5.89	13	62,107	$335,152	$5.40
Columbia	6	58,593	300,624	5.13	6	42,511	204,104	4.80
Dutchess	18	113,120	610,457	5.40	17	81,455	378,877	4.65
Greene	5	24,214	118,845	4.91	6	23,979	107,400	4.48
Orange	9	98,493	525,887	5.34	9	91,000	383,500	4.21
Rensselaer	5	14,076	87,063	6.19	5	10,194	64,963	6.37
Rockland	25	163,612	890,188	5.44	23	131,076	642,267	4.90
Ulster	24	194,125	1,026,870	5.29	24	186,381	896,306	4.81
Westchester	7	51,748	297,504	5.75	6	50,417	270,830	5.37
Total for New York portion of district	111	779,773	4,221,402	5.41	109	679,120	3,283,399	4.83
Bergen County, N. J.	10	50,844	294,106	5.78	9	44,806	241,908	5.40
Raritan district (Middlesex County, N. J.)	11	194,691	1,120,553	5.76	11	164,340	825,525	5.02
Grand total	132	1,025,308	5,636,061	5.50	129	888,266	4,350,832	4.90

New York's portion of the region produced 76.45 per cent of the quantity and 75.47 per cent of the value of the output of the region. The output of this portion showed a decrease in 1914 of 100,653,000 brick, or 12.91 per cent, in quantity and of $938,003, or 22.22 per cent, in value from 1913.

Of the counties included in the New York portion, Ulster, as for many years, was first in output and value, reporting 186,381,000 brick, valued at $896,306, a decrease in quantity of 7,744,000 brick, and in value of $130,564 from 1913. Rockland was second, with 131,076,000 brick, valued at $642,267, a decrease of 32,536,000 brick in quantity and of $247,921 in value from 1913. Orange County was third in 1914, displacing Dutchess County, which was fourth. Every county decreased in value, and every county except Albany decreased in quantity. The increase in Albany County was 315,000 brick over 1913. In 1914 the highest average price per 1,000, $6.37, was, as in 1913, in Rensselaer County, an increase of 18 cents over 1913. The lowest average price in 1914, $4.21, a decrease of $1.13, was in Orange County. The average for New York's portion of the region was 58 cents lower than in 1913.

New Jersey's portion of the production of this region is comparatively small. In 1914 it was 209,146,000 brick, or 23.55 per cent, of the output of the region, and was valued at $1,067,433, or 24.53 per cent of the total value. Both Bergen County and the Raritan district decreased in quantity and value in 1914, compared with 1913. The average price per 1,000 in the New Jersey portion of the region was $5.10, or 66 cents lower than in 1913.

The number of active firms reporting decreased 3, of which 2 were in the New York portion of the region and 1 was in the New Jersey portion.

POTTERY.

INTRODUCTION.

The following tables show the status of the pottery industry in 1913 and 1914 and the production of pottery from 1898 to 1914. Imports are shown from 1886 to 1914, and exports from 1895 to 1914. The figures indicate that the condition of the industry in this country was not so satisfactory in 1914 as it has been in the previous few years. The business on hand at the potteries at the beginning of the year was sufficient to indicate that the year would be one of unusual activity, and so it was until the early summer. At that season, however, there is generally a lull in the industry, which normally resumes activity in the late summer or early fall. In 1914, however, this revival was not so vigorous as that of the early part of the year, and notwithstanding the decrease in imports during the latter part of the year, the domestic production did not correspondingly increase. The existing conditions present an opportunity for the American potter not only to expand the ever-increasing home consumption of his wares, but also to seek the trade of the Central American and South American markets, usually supplied by the European potters, which now offer an opportunity to develop foreign business commensurate with the importance of the industry.

The value of all domestic pottery marketed in 1914 was $35,398,161, a decrease of $2,594,214, or 6.83 per cent from 1913. The imports decreased even in greater proportion—17.96 per cent. The actual decrease in value of imports was $1,828,009.

Every product as classified in this report, except one—red earthenware—decreased in value in 1914 compared with 1913. Most of the other products and the total, however, compared favorably in value for 1914 with values for only two or three years before, and in comparison with the earlier years covered by this report the status of the industry in 1914 was very good. The total value of pottery products in 1914 was considerably more than twice as great as it was in 1898, and was greater than that of any year prior to 1912. The value of white ware in 1914 was more than double that of 1898, and was greater by $138,648 than that of 1912. The production of china increased in value more than twofold in 1914 compared with 1898, and its value in 1914 was $207,381 greater than in 1912.

PRODUCTION.

The following table shows the statistics of the production of pottery in the United States from 1898 to 1914:

Value of pottery products in the United States, 1898–1914, by varieties.

Year.	Number of active 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.
1898	453	$641,846	$2,408,657	$7,461,635	$942,753	$1,714,351	$451,677	$968,305	$14,589,224
1899	619	775,105	2,527,404	7,914,776	1,319,333	2,164,885	470,355	2,078,392	17,250,250
1900	561	832,447	[a]2,662,616	10,323,963	1,292,589	2,217,052	915,433	[a]1,554,470	19,798,570
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	[b]1,766,766	5,989,295	3,047,499	[b]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
1913	426	1,000,529	3,683,567	15,066,811	2,424,060	8,214,838	5,737,741	1,864,829	37,992,375
1914	412	1,059,904	3,349,301	14,968,079	2,384,686	7,874,269	4,130,270	1,631,652	35,398,161

[a] Yellow or Rockingham ware (decorated) for Ohio is included in miscellaneous.
[b] China, bone china, delft, and belleek ware for Ohio is included in miscellaneous.

Although the pottery products of the United States decreased $2,594,214, or 6.83 per cent, in value in 1914 from 1913 and $1,106,003, or 3.03 per cent, from 1912, they increased $879,601, or 2.55 per cent, compared with 1911. Compared by five-year intervals, the increase in 1914 was as follows: Over 1909, $4,348,720, or 14.01 per cent; 1904, $10,239,891, or 40.70 per cent; 1899, $18,147,911, or 105.20 per cent. The average annual production for the last five years covered by the table was nearly twice as great as that for the first five years, or $19,645,876 and $35,639,588, respectively.

In 1914 only one variety—red earthenware—increased in value, the increase being $59,375, or 5.93 per cent, over 1913. Porcelain electrical supplies showed the largest decrease—$1,607,471 or 28.02 per cent—and china showed the smallest—$39,374, or 1.62 per cent.

The value of white ware, including china, but excluding sanitary ware and porcelain electrical supplies, was $17,352,765, in 1914, compared with $17,490,871 in 1913, a decrease of $138,106, or 0.79 per cent. In 1914, however, the value of these wares was greater by $346,029, or 2.03 per cent, than in 1912, and their value constituted 49.02 per cent of the value of all pottery wares in 1914, 46.04 per cent in 1913, and 46.59 per cent in 1912. If the value of sanitary ware and porcelain electrical supplies be added, the total for 1914 would be $29,357,304, or 82.93 per cent of all pottery products, a decrease of $2,086,146, or 6.63 per cent, from the corresponding value for 1913.

In the following tables will be found the statistics of the production of pottery in the United States in 1913 and 1914, by States and varieties:

Value of pottery products in 1913, by varieties of products, by States.

Rank of State.	State.	Number of active firms reporting.	Red earthenware.	Stoneware and yellow and 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	9	$11,164	$8,994		
19	Arkansas	4	(a)	12,905		
8	California	11	33,481	49,720		
15	Colorado	5	(a)	(a)		
	Connecticut		(a)	(a)		
22	District of Columbia	3	11,000			
16	Georgia	19	17,238	11,290		
7	Illinois	23	46,175	624,194	(a)	
6	Indiana	11	(a)	61,550	(a)	
17	Iowa	4	2,414	(a)		
	Kansas			(a)		
13	Kentucky	7	25,818	75,800	(a)	
	Louisiana					
	Maine			(a)		
11	Maryland	6	7,534	(a)	(a)	
9	Massachusetts	11	(a)	27,400	(a)	
10	Michigan	6	106,527			
	Minnesota			(a)		
20	Mississippi	8	(a)	16,951		
25	Missouri	5	2,537	(a)		
	Montana		(a)			
	Nebraska		(a)			
	New Hampshire					
2	New Jersey	51	35,360	66,993	$834,716	$1,239,453
4	New York	23	38,290	(a)	(a)	763,322
21	North Carolina	23	2,318	10,365		
1	Ohio	105	236,883	1,649,186	10,548,628	
	Oregon		(a)	(a)		
5	Pennsylvania	27	187,625	268,407	839,838	(a)
	Porto Rico		(a)			
23	South Carolina	5	7,821	1,961		
12	Tennessee	8	2,153	36,153		
14	Texas	14	7,894	72,480		
	Utah		(a)			
	Virginia					
	Washington		(a)	(a)		
3	West Virginia	14		(a)	2,024,104	(a)
24	Wisconsin	3	7,700			
	Other States b		210,597	689,218	819,525	421,285
	Total	c 426	1,000,529	3,683,567	15,066,811	2,424,060
	Percentage of pottery products		2.63	9.70	39.66	6.38
	Percentage of total clay products		.55	2.03	8.31	1.34
	Number of firms reporting each variety		147	154	55	14

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 1913, by varieties of products, by States—Continued.

Rank of State.	State.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Percentage of total.
18	Alabama				$20,158	0.05
19	Arkansas			(b)	19,757	.05
8	California	(b)		$12,514	290,255	.76
15	Colorado			6,501	46,501	.12
	Connecticut		(b)		(c)	
22	District of Columbia				11,000	.03
16	Georgia				28,528	.08
7	Illinois	(b)	(b)	11,710	915,263	2.41
6	Indiana	$719,103	(b)		1,186,706	3.12
17	Iowa			(b)	20,698	.05
	Kansas				(c)	
13	Kentucky				102,118	.27
	Louisiana			(b)	(d)	
	Maine				(d)	
11	Maryland			2,500	155,034	.41
9	Massachusetts		(b)	12,429	231,345	.61
10	Michigan		(b)	(b)	222,883	.59
	Minnesota				(d)	
20	Mississippi				17,451	.05
25	Missouri				3,412	.01
	Montana				(d)	
	Nebraska				(d)	
	New Hampshire			(b)	(d)	
2	New Jersey	5,238,013	$1,190,448	233,562	8,838,545	23.26
4	New York	(b)	1,560,870	91,715	2,841,658	7.48
21	North Carolina			(b)	13,683	.04
1	Ohio	590,193	2,184,201	1,310,798	16,519,889	43.48
	Oregon				(d)	
5	Pennsylvania	153,000	295,908	(b)	2,046,099	5.39
	Porto Rico			(b)	(d)	
23	South Carolina				9,782	.03
12	Tennessee			(b)	145,100	.38
14	Texas				80,374	.21
	Utah				(d)	
	Virginia			(b)	(d)	
	Washington				(d)	
3	West Virginia	1,146,205	(b)	20,578	3,424,887	9.01
24	Wisconsin				7,700	.02
	Other states	368,324	506,314	162,522	[e] 793,549	2.09
	Total	8,214,838	5,737,741	1,864,829	37,992,375	100.00
	Percentage of pottery products	21.62	15.10	4.91	100.00	
	Percentage of total clay products	4.53	3.17	1.03	20.96	
	Number of firms reporting each variety.	44	36	66		

[a] Including aquarium ornaments, art and chemical pottery, craquelle porcelain, Guernsey earthenware, Hampshire, Niloak, Pewabic, Rookwood, Teco and Walley pottery, 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 [d] ($793,549).

[d] Included in [e] ($793,549).

[e] Made up of State totals of Connecticut, Kansas, Louisiana, Maine, Minnesota, Montana, Nebraska, New Hampshire, Oregon, Porto Rico, Utah, Virginia, and Washington.

Value of pottery products in 1914, by varieties of products, by States.

Rank of State.	State.	Number of active firms reporting.	Red earthenware.	Stoneware and yellow and Rockingham ware.	White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware.	China, bone china, delft, and belleek ware.
19	Alabama	13	$4,800	$11,742		
18	Arkansas	3	(a)	13,135		
8	California	12	36,931	(a)		
14	Colorado	5	(a)	(a)		
	Connecticut		(a)	(a)		
	District of Columbia		(a)			
17	Georgia	17	16,487	4,474		
7	Illinois	22	37,452	483,407	(a)	
6	Indiana	11	(a)	39,000	(a)	
16	Iowa	3	(a)	(a)		
	Kansas			(a)		
13	Kentucky	7	35,731	53,695		
	Louisiana		(a)			
	Maine			(a)		
11	Maryland	6	7,738	(a)	(a)	
10	Massachusetts	8	(a)	(a)		
9	Michigan	5	106,452			
	Minnesota		(a)	(a)		
20	Mississippi	7	(a)	14,510		
24	Missouri	5	2,243	(a)		
	Montana		(a)			
	Nebraska		(a)			
2	New Jersey	52	35,198	72,288	$727,637	$1,076,043
4	New York	21	36,251	(a)	(a)	784,604
21	North Carolina	21	1,477	11,078		
1	Ohio	103	300,453	1,592,102	10,227,806	
	Oregon		(a)	(a)		
5	Pennsylvania	23	194,581	282,511	(a)	(a)
22	South Carolina	5	8,843	(a)		
12	Tennessee	9	4,437	27,227		
15	Texas	14	12,724	44,230		
	Utah		(a)			
	Washington		(a)	(a)		
3	West Virginia	14		(a)	2,577,766	(a)
23	Wisconsin	3	7,000			
	Other States [b]		211,106	699,902	1,434,870	524,039
	Total	[c]412	1,059,904	3,349,301	14,968,079	2,384,688
	Percentage of pottery products		2.99	9.46	42.29	6.74
	Percentage of total clay products		.64	2.03	9.07	1.45
	Number of firms reporting each variety		149	146	50	13

[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 1914, by varieties of products, by States—Continued.

Rank of State.	State.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Percentage of total.
19	Alabama				$16,542	0.05
18	Arkansas			(b)	19,400	.06
8	California	$247,770		$15,952	345,303	.98
14	Colorado			27,600	61,257	.17
	Connecticut		(b)		(c)	
	District of Columbia				(c)	
17	Georgia				20,961	.06
7	Illinois	(b)	(b)	8,745	780,579	2.21
6	Indiana	739,132	(b)		1,152,078	3.25
16	Iowa			(b)	32,750	.09
	Kansas				(c)	
13	Kentucky				89,426	.25
	Louisiana			(b)	(c)	
	Maine				(c)	
11	Maryland	(b)		2,000	206,483	.58
10	Massachusetts			11,345	219,104	.62
9	Michigan	(b)	(b)	(b)	265,194	.75
	Minnesota				(c)	
20	Mississippi				15,060	.04
24	Missouri				2,944	.01
	Montana				(c)	
	Nebraska				(c)	
	New Hampshire			(b)	(c)	
2	New Jersey	5,058,204	$905,878	256,108	8,131,356	22.97
4	New York	(b)	940,029	54,851	2,155,792	6.09
21	North Carolina			(b)	12,796	.04
1	Ohio	619,931	1,472,359	1,138,725	15,351,376	43.37
	Oregon				(c)	
5	Pennsylvania	(b)	(b)	15,737	1,746,501	4.93
22	South Carolina				10,668	.03
12	Tennessee			(b)	97,195	.27
15	Texas			1,793	58,747	.17
	Utah				(c)	
	Virginia			(b)	(c)	
	Washington			(b)	(c)	
3	West Virginia	872,987	(b)		3,930,464	11.10
23	Wisconsin				7,000	.02
	Other States	336,245	812,004	98,796	[d] 669,185	1.89
	Total	7,874,269	4,130,270	1,631,652	35,398,161	100.00
	Percentage of pottery products	22.24	11.67	4.61	100.00	
	Percentage of total clay products	4.77	2.51	.99	21.46	
	Number of firms reporting each variety	46	37	65		

[a] Including aquarium ornaments, art and chemical pottery, craquelle porcelain, faïence, Guernsey earthenware, Hampshire, Niloak, Pewabic, Rookwood, Teco, and Walley pottery, jardinieres, mantle rings, Oxfordware, pins, stilts, and spurs for potters' use, porcelain door knobs, shuttle eyes and thread guides, porcelain hardware trimmings, porcelain interiors for refrigerators, tobacco pipes, toy marbles, turpentine cups, umbrella stands, vases, and water filters.

[b] Included in "Other States."

[c] Included in [d] ($669,185).

[d] Made up of State totals of Connecticut, District of Columbia, Kansas, Louisiana, Maine, Minnesota, Montana, Nebraska, New Hampshire, Oregon, Utah, Virginia, and Washington.

The number of States reporting for 1914 ware classed as pottery in this report was 37, a decrease of 1—Porto Rico dropping from the list of pottery producers. The important producing States, especially those reporting production of the higher grades of ware, are few. White ware was reported from 8 States, a decrease of 2; Kentucky and Massachusetts, which reported white ware for 1913, reported none for 1914. China was reported from 4 States, New Jersey, New York, Pennsylvania and West Virginia, the same as for 1913; sanitary ware was reported from 10 States, an increase of 2, Maryland and Michigan; and porcelain electrical supplies from 9 States, a decrease of 1, Massachusetts.

Red earthenware, the commonest of pottery products, was reported from 32 States in 1914, an increase of 1, Louisiana and Minnesota entering the list of producers of red earthenware and Porto Rico dropping out. Ohio was the leading State in 1914, as for many years, reporting red earthenware valued at $300,453, an increase of $63,570, or 26.84 per cent, over 1913. Pennsylvania was second and Massachusetts third, as in 1913. In 1914 Pennsylvania's production increased in value $6,956, or 3.71 per cent, over that of 1913. Ohio, Pennsylvania, and Massachusetts together reported about 62 per cent of the total value of this product in 1914 and about 60 per cent of the total in 1913. Red earthenware was reported by 149 producers in 1914, by 147 in 1913, and by 145 in 1912. It constituted 2.99 per cent of total value of pottery in 1914 and 2.63 per cent in 1913.

Stoneware, including yellow and Rockingham ware, was reported from 28 States in 1914, the same as in 1913. Ohio, in 1914, as for many years, was the leading State, reporting an output valued at $1,592,102, or 47.54 per cent of the total. This was a decrease of $57,084, or 3.46 per cent, from 1913. Illinois, as for some years, was second, showing a decrease of $140,787, or 22.56 per cent, in 1914. These two States reported 61.97 per cent of the total value of this variety of ware in 1914. The number of producers reporting stoneware, etc., continues to decrease, 146 reporting it for 1914, compared with 154 for 1913, 163 for 1912, and 175 for 1911.

The pottery products of greatest value are embraced under the heading "white ware," which represents the general household wares. Ohio has been the leading producer for many years, and reported for 1914 white ware valued at $10,227,806, a decrease of $320,822, or 3.04 per cent. Ohio's production in 1914 was 68.33 per cent of the value of the entire output, compared with 70.01 per cent in 1913 and 67.23 per cent in 1912. West Virginia was second, as for several years, and reported white ware valued at $2,577,766, an increase of $553,662, or 27.35 per cent. New Jersey was third, regaining that position and displacing Pennsylvania, which was fourth. New Jersey's production decreased $107,079, or 12.83 per cent, from 1913. White ware constituted 42.29 per cent of all pottery products in 1914, 39.66 per cent in 1913, and 40.62 per cent in 1912. The number of producers reporting white ware in 1914 was 50, a decrease of 5 from 1913 and of 13 from 1912.

New Jersey was the leading china-producing State in 1914, as for many years, and reported china valued at $1,076,043, a decrease in 1914 of $163,410, or 13.18 per cent, from 1913. The production of New Jersey constituted 45.12 per cent of the entire production in 1914. New York was second, Pennsylvania third, and West Virginia fourth. New York's production of china increased in 1914, $21,282, or 2.79 per cent over 1913. The production of china is still comparatively unimportant in the United States, constituting but 6.74 per cent of the pottery products of the country in 1914. The number of operators reporting china in 1914 was 13, a decrease of 1 from 1913.

New Jersey was the leading State in the production of sanitary ware in 1914, as for many years, reporting ware valued at $5,058,204, a decrease of $179,809, or 3.43 per cent. New Jersey's output was 64.24 per cent of the total for 1914. West Virginia was second, as in 1913, reporting sanitary ware valued at $872,987, a decrease of $273,218, or 23.84 per cent. Indiana was third, as for 1913, reporting ware valued at $739,132, an increase of $20,029 over 1913. The number of operators reporting sanitary ware in 1914 was 46, an increase of 2 over 1913. Sanitary ware constituted 22.24 per cent of the value of all pottery products in 1914, 21.62 per cent in 1913, and 21.65 per cent in 1912.

Ohio was the largest producer of porcelain electrical supplies in 1914, reporting an output valued at $1,472,359, or 35.65 per cent of the total. This was a decrease of $711,842, or 32.59 per cent, from 1913. New York was second and New Jersey third, as in 1913. New York's output decreased in value $620,841, or 39.78 per cent, and New Jersey's decreased $284,570, or 23.90 per cent. The other six States were comparatively unimportant producers, their combined output constituting less than one-fifth of the total value. The number of producers reporting porcelain electrical supplies for 1914 was 37, an increase of 1 over 1913. This variety constituted 11.67 per cent of the total value of pottery in 1914, 15.10 per cent in 1913, and 13.50 per cent in 1912.

Ohio is the leading pottery-producing State of the Union, reporting for 1914 wares valued at $15,351,376, or 43.37 per cent of the total, a decrease of $1,168,513, or 7.07 per cent, from 1913. Compared with 1912 there was a decrease in 1914 of about 1 per cent, and compared with 1911 there was an increase of $576,111, or 3.90 per cent. Ohio's principal pottery product is white ware, which constituted 66.62 per cent of the value of the entire pottery output of the State in 1914. The second product in importance is stoneware. Ohio produced every variety of pottery as classified in this report but one—china. New Jersey is the second largest pottery-producing State. For 1914 New Jersey reported wares valued at $8,131,356, or 22.97 per cent of the total, a decrease of $707,189, or 8 per cent. The principal pottery product of New Jersey is sanitary ware, which constituted 62.21 per cent of the State total in 1914. West Virginia is the third in rank among the pottery-producing States, and is the only one of the leading five States to show an increase in the value of pottery in 1914. Its pottery wares were valued at $3,930,464, or 11.10 per cent of the total, an increase of $505,577, or 14.76 per cent, over 1913. West Virginia's principal pottery product is white ware, which constituted 65.58 per cent of the State total in 1914. It is also a large producer of sanitary ware. New York was fourth and Pennsylvania was fifth, as for several years, the former reporting 6.09 per cent and the latter 4.93 per cent of the total. Indiana and Illinois maintained their relative ranks of sixth and seventh, reporting 3.25 and 2.21 per cent of the total, respectively. The first five States—Ohio, New Jersey, West Virginia, New York, and Pennsylvania—reported 88.46 per cent of the total production in 1914.

In considering the rank of States it should be borne in mind that the small number of producers in many of them in 1914, 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 1914 was valued at $8,349,442, and the production at $35,398,161, a total of $43,747,603. After deducting exports—domestic, $526,902, and foreign, $50,079—the net apparent consumption was valued at $43,170,622, of which the domestic production was 82 per cent. In 1913 this percentage was 79.86; in 1912 it was 81.45; in 1911 it was 78.93; 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 comparatively little importance. Production was reported for 1914 by 13 operators, an increase of 4. The output was valued at $16,542, a decrease of $3,616. The product consisted of red earthenware and stoneware.

Arkansas.—In Arkansas there were 3 active potters in 1914, who reported wares valued at $19,400, a decrease of $357 from 1913. The product consisted of red earthenware, stoneware, and art pottery.

California.—Pottery products of California were reported by 12 operators for 1914, an increase of 1. The value of the products in 1914 was $345,303, an increase of $55,048, or 18.97 per cent, over 1913. The product of greatest value was sanitary ware, made principally in Contra Costa County.

Colorado.—Colorado's pottery production for 1914 was reported by 5 operators, the same number as in 1913, and was valued at $61,257, an increase of $14,756, or 31.73 per cent, over 1913. Colorado's principal pottery product was stoneware made in Denver County. Red earthenware, art pottery, "fireproof china" cooking utensils, and chemical china are also reported from this State.

Connecticut.—The principal pottery product of Connecticut is porcelain electrical supplies made at Hartford. Red earthenware and stoneware are also made in Connecticut in small quantities.

District of Columbia.—Two operators in the District of Columbia reported production of red earthenware in 1914.

Georgia.—Georgia's pottery products in 1914 were valued at $20,961, a decrease of $7,567 from 1913. These consist entirely of red earthenware and stoneware and were reported by 17 operators, a decrease of 2.

Illinois.—Illinois is the seventh State in the production of pottery. In 1914 its pottery products were valued at $780,579, a decrease of $134,684, or 14.72 per cent, from 1913. The largest decrease was in stoneware—$140,787. The production of red earthenware, white ware, and miscellaneous items also decreased, but the output of sanitary ware and porcelain electrical supplies increased in value in 1914. Stoneware is the pottery product of chief value in Illinois, constituting 61.93 per cent of the total output in 1914, and is made in Brown, Greene, La Salle, McDonough, Tazewell, and Warren counties. In addition to the varieties of pottery named, aquarium ornaments, art pottery, filter disks, and tobacco pipes are made in Illinois. Twenty-two operators reported sales of pottery in 1914, a decrease of 1.

Indiana.—Indiana is the sixth State in rank in value of pottery products, reporting wares in 1914 valued at $1,152,078, a decrease of $34,628 from 1913. Indiana's principal pottery product is sanitary ware, of which it is the third largest producer. This ware constituted 64.16 per cent of Indiana's pottery products in 1914, and increased in value $20,029 over 1913. It is made in Howard and Vanderberg counties. There were 11 active operators in 1914, the same number as in 1913.

Iowa.—In Iowa the pottery industry is of small but increasing importance. The total value of pottery made in the State and marketed in 1914 was $32,750, an increase of $12,052 over 1913.

The principal pottery product of the State was stoneware. There were 3 active operators in 1914, a decrease of 1.

Kansas.—There were 2 pottery works in Kansas in 1914, 1 of which was idle. The only pottery product reported from Kansas in 1914 was stoneware.

Kentucky.—Seven operators reported pottery products valued at $89,426 in 1914, a decrease of $12,692 from 1913. Red earthenware and stoneware were the only products reported for 1914 from this State.

Louisiana.—Louisiana is the home of the Newcomb pottery, located at New Orleans, where the famous Newcomb art ware is made. Owing to the fact that there were less than 3 operators in Louisiana reporting pottery products for 1913, separate figures of production for the State can not be published.

Maine.—Stoneware is the only pottery product of Maine. There being only one producer, separate figures can not be published.

Maryland.—The value of Maryland's pottery products in 1914 was $206,483, an increase of $51,449, or 33.19 per cent, over 1913. Maryland's principal pottery product is white ware. Red earthenware, stoneware, and tobacco pipes are also made in this State, and in 1914 Maryland reentered the list of sanitary-ware producers, and 6 operators were active, the same number as in 1913.

Massachusetts.—The principal pottery product of Massachusetts is red earthenware, of which it was the third largest producer in 1914. Stoneware, art pottery, and shuttle eyes and thread guides are also made. The value of the pottery products of Massachusetts in 1914 was $219,104, a decrease of $12,241 from 1913. There were 8 active operators in Massachusetts in 1914, a decrease of 3 from 1913.

Michigan.—Michigan's pottery products in 1914 were valued at $265,194, an increase of $42,311, or 18.98 per cent, over 1913. The principal pottery product of the State is porcelain electrical supplies, with red earthenware second. Art pottery is also produced in this State. There were 5 active operators in the State in 1914, a decrease of 1.

Minnesota.—The only pottery products of Minnesota are red earthenware and stoneware, made at Red Wing, Goodhue County. There being but 1 operator reporting for 1914, separate figures of production are not published. There is one other plant in the State, which was idle in 1914.

Mississippi.—Mississippi's pottery products, red earthenware and stoneware, were valued at $15,060 in 1914, a decrease of $2,391 from 1913. There were 7 active operators in 1914, a decrease of 1.

Missouri.—Missouri is the leading Southern State in the production of clay wares, but its pottery industry is of minor importance. The value of the pottery output in 1914 was only $2,944, a decrease of $468 from 1913. Five operators reported for 1914, the same as for 1913.

Montana, Nebraska, and New Hampshire.—There was only 1 pottery operator in each of these States in 1914, so that statistics of production are not published separately.

New Jersey.—New Jersey ranks second in the production of pottery, reporting wares valued at $8,131,356 in 1914, or 22.97 per cent of the total for the United States, a decrease of $707,189, or 8 per cent, from 1913. New Jersey's leading product is sanitary ware, of which it is the largest producer, though every variety of pottery, as classified in this report, and in addition, art pottery, chemical ware, door knobs, hardware, smoking pipes, and souvenirs were reported from this State in 1914. Mercer County, in which Trenton is located, is the leading pottery-producing county of the State, reporting wares valued at $7,101,197, or 87.33 per cent of the State total in 1914. This was a decrease of $797,277 or 10.09 per cent from 1913. Sanitary ware is Mercer County's principal pottery product, the output reported for 1914 being valued at $4,376,665, a decrease of $243,665 from 1913. White ware was reported to the value of $727,637, a decrease of $107,079 from 1913. No red earthenware or stoneware was made in this county in 1914. New Jersey's entire china output (valued at $1,076,043 in 1914) comes from this county. Middlesex County was the second largest pottery-producing county in the State, reporting for 1914 wares, principally sanitary ware, valued at $418,035, an increase of $48,009 over 1913. There were 52 active potters in New Jersey in 1914, an increase of 1.

New York.—New York ranked fourth in 1914 in value of pottery products, 21 operators reporting wares valued at $2,155,792, or 6.09 per cent of the total. This was a decrease of $685,866, or 24.14 per cent, from 1913. New York's principal pottery product in 1914 was porcelain electrical supplies, manufactured chiefly in Schenectady and Ontario counties and also in Kings, Livingston, and Onondaga counties. These were valued at $940,029 or 43.60 per cent of the total value of pottery for the State. China production is second in importance, being valued at $784,604, or 36.40 per cent of the total. This was an increase of $21,282 over 1913. The principal china-making center is in Onondaga County. In addition to these wares the manufacture of every other variety of pottery as classified in this report, and of art pottery, chemical stoneware, hardware trimmings, and tobacco pipes, was reported for 1914.

North Carolina.—North Carolina had a comparatively large number of operators reporting for 1914, but the industry in this State is of little importance. Red earthenware, stoneware, and art pottery are the only products made there. The value of these products in 1914 was $12,796, a decrease of $887 from 1913.

Ohio.—Ohio is the leading State in the production of pottery. The value of the output in 1914 was $15,351,376, or 43.37 per cent of the value of the pottery of the entire country. This was a decrease of $1,168,513, or 7.07 per cent, from 1913. Every variety of pottery as classified in this report, except china, was reported produced in 1914, and in addition, art pottery, chemical pottery, cooking ware, jardinieres, mantle rings, stilts and pins, toy marbles, and umbrella stands. White ware was the variety of chief value ($10,227,806 in 1914) and constituted 66.62 per cent of the State total. This was a decrease of $320,822, or 3.04 per cent, from 1913. Columbiana is the leading county in the production of white ware, and reported a value of $6,126,819, or 59.90 per cent of the State total. Mahoning County was second, reporting white ware valued at $2,366,576, or 23.14 per cent of the State total. Stoneware and yellow and Rockingham ware (taken together) ranked second in importance in 1914, being valued at $1,592,102, or 10.37 per cent of the total value of pottery for the State. Porcelain electrical supplies ranked third in 1914, being reported to the value of $1,472,359, or 9.59 per cent of the State total, a decrease of $711,842, or 32.59 per cent from 1913.

Columbiana is the leading pottery-producing county of the State and reported wares valued at $7,095,749, or 46.22 per cent of the State total. This was a decrease of $1,152,905, or 13.98 per cent, from 1913. Mahoning County is second in importance and reported wares for 1914 valued at $2,504,726, or 16.32 per cent of the total for the State, an increase of $261,239, or 11.64 per cent, over 1913. The principal pottery product of Mahoning County is white ware. Muskingum is the third county in importance, reporting for 1914 wares valued at $1,441,423, or 9.39 per cent of the State total. This was an increase of $75,991, or 5.57 per cent, over 1913. East Liverpool, Columbiana County, is the leading pottery center of the State, its production being valued in 1914 at $5,632,523, a decrease of $1,050,484 from 1913. There were 103 active operators in Ohio in 1914, a decrease of 2 from 1913. Three new operators had not begun operations at the close of the year.

Oregon.—In Oregon only 2 potters reported production in 1914, so that figures can not be published. Red earthenware and stoneware are the only pottery products made in this State.

Pennsylvania.—Pennsylvania ranked fifth in pottery products in 1914, its output being valued at $1,746,501, or 4.93 per cent of the total. This was a decrease of $299,598, or 14.64 per cent, from 1913. White ware, sanitary ware, and porcelain electrical supplies all decreased in this State largely in 1914, and red earthenware, stoneware, and china increased. White ware is Pennsylvania's leading pottery product, this variety constituting over one-third of the total value of pottery for the State. Twenty-three active operators reported for 1914, a decrease of 4 from 1913. One new plant had not begun operations at the close of the year. Every variety of pottery as classified in this report, also art pottery and solid porcelain interiors for refrigerators, were made in Pennsylvania in 1914.

Porto Rico.—No pottery was reported from Porto Rico in 1914.

South Carolina.—The pottery industry of South Carolina is of minor importance. Five operators reported wares valued at $10,668 in 1914, an increase of $886 over 1913. Red earthenware and stoneware are the only products made in this State.

Tennessee.—Nine firms reported pottery production in Tennessee in 1914. The principal product is turpentine cups made in Hamilton County. The output of Tennessee pottery was valued at $97,195 in 1914, a decrease of $47,905 from 1913.

Texas.—Notwithstanding the fact that Texas has clays of the highest quality, it produces only the lower grades of pottery—red earthenware, stoneware, and filters. The total value of Texas pottery in 1914 was $58,747, a decrease of $21,627 from 1913. Fourteen active operators reported for 1914, the same number as for 1913.

Utah.—There were only two potters in Utah who reported production for 1914, so that no figures can be published. Red earthenware is the only pottery ware made in the State.

Virginia.—In Virginia two potters reported production for 1914. 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 value of pottery products in 1914. This State has increased in importance as a pottery-producing center rapidly within the last few years, and new works either in contemplation or under construction will still further increase its importance. Its production in 1914 was valued at $3,930,464, or 11.10 per cent of the total. This was an increase of $505,577, or 14.76 per cent, over 1913. West Virginia's pottery product of chief value is white ware, of which it is the second largest producer. The value of the white ware marketed in West Virginia in 1914 was $2,577,766, or 65.58 per cent of the pottery output of the State, an increase of $553,662, or 27.35 per cent, over 1913. This product is made principally in Hancock County opposite East Liverpool, Ohio. The pottery products of this county in 1914 were valued at $2,387,347, or 60.74 per cent of the State total. This was an increase of $492,665, or 26 per cent, over 1913. Sanitary ware was the second pottery product in importance in West Virginia in 1914, being valued at $872,987, a decrease of $273,218, or 23.84 per cent, from 1913. Fourteen operators reported production from this State in 1914, the same number as in 1913.

Wisconsin.—Wisconsin's pottery production in 1914—red earthenware only—was valued at $7,000, a decrease of $700 from 1913. Three potters reported for 1914, the same number as for 1913.

IMPORTS AND EXPORTS.

The following tables show the imports of clay products from 1886 to 1914, and the exports from 1895 to 1914:

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1886–1914.

Year.	Pottery.						Brick, fire brick, tile, etc.	Grand total.
	Brown earthen and common stone ware.[a]	Earthenware and crockery composed of a nonvitrified absorbent body.		China and porcelain.		Total.		
		Not decorated.	Decorated.	Not decorated.	Decorated.			
1886....	$37,820	....	....	$865,446	$3,350,145	$4,253,411	$951,293	$5,204,704
1887....	43,079	....	....	967,694	3,888,509	4,899,282	1,008,360	5,907,642
1888....	55,558	....	....	1,054,854	4,207,598	5,318,010	886,314	6,204,324
1889....	48,824	....	....	1,148,026	4,580,321	5,777,171	788,391	6,565,562
1890....	56,730	....	....	974,627	3,562,851	4,594,208	563,568	5,157,776
1891....	99,983	....	....	1,921,643	6,288,088	8,309,714	353,736	8,663,450
1892....	63 003	....	....	2,022,814	6,555,172	8,640,989	380,520	9,021,509
1893....	57 017	....	....	1,732,481	6,248,255	8,037,753	338,143	8,375,896
1894....	47,114	....	....	1,550,950	5,392,648	6,990,712	189,631	7,180,343
1895....	61,424	....	....	2,117,425	8,055,473	10,234,322	211,473	10,445,795
1896....	41,585	....	....	1,511,542	7,729,942	9,283,069	247,455	9,530,524
1897....	32,227	....	....	1,406,019	7,057,261	8,495,507	146,668	8,642,175
1898....	54,672	....	....	1,002,729	5,905,209	6,962,610	117,324	7,079,934
1899....	40,164	....	....	1,125,892	6,740,884	7,906,940	134,691	8,041,631
1900....	65,214	....	....	1,059,152	7,617,756	8,742,122	169,951	8,912,073
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	208,966	10,847,582
1912....	152,166	....	....	1,094,152	8,309,212	9,555 530	215,379	9,770,909
1913....	230,780	[b] $81,978	[b] $523,803	[c] 1,067,209	[c] 8,273,681	10,177,451	276,677	10,454,128
1914....	304,331	438,460	1,968,561	727,725	4,910,365	8,349,442	207,644	8,557,086

[a] Including Rockingham ware.
[b] Figures cover period from Oct. 4 to Dec. 31.
[c] Including wares classified under the act of 1913 as china and porcelain wares composed of a vitrified nonabsorbent body: Not decorated, $244,933; decorated, $2,204,851. After 1913 only wares composed of a vitrified nonabsorbent body are included.

The total value of imports of all clay products in 1914 decreased $1,897,042, or 18.15 per cent, from 1913; in 1913 there was an increase over 1912 of $683,219, or 6.99 per cent. The total value of imports for 1914 was the lowest since 1899, and was $5,253,846, or 38.04 per cent, less than that of 1907, the year of maximum value. Of the imports for 1914, 97.57 per cent was pottery and 2.43 per cent was brick and tile. The value of the pottery imports decreased $1,828,009, or 17.96 per cent, from 1913 and was $5,236,170 less than that of 1907, the year of maximum value of pottery imports. In 1914 the imports of the higher grades of pottery constituted 96.36 per cent of the total, the remaining 3.64 per cent being of the lower grades. The decrease in 1914 was entirely in the higher grades of ware, the lower grades increasing $73,551, or 31.87 per cent, over 1913.

The decrease in imports was confined to the second half of the year. In the first six months of 1914 the imports of pottery were valued at $4,405,781, compared with $4,098,830 for the corresponding period of 1913. During the second six months of 1914 the imports of pottery were valued at $3,943,661, compared with $6,078,621 for the corresponding period of 1913. Imports of pottery in the third quarter of 1914 were valued at $2,545,602 and during the fourth quarter at $1,398,059, compared with $2,958,518 and $3,120,103 in the third and fourth quarters, respectively, of 1913. Imports of brick and tile during the first half of 1914 were valued at $108,878, compared with $104,130 for the first six months of 1913; during the second half of the year they were valued at $98,766, compared with $172,547 during the second half of 1913.

Value of exports of clay wares of domestic manufacture from the United States, 1895–1914.

Year.	Brick.					Pottery.			Grand total.
	Building.	Fire.	Tile (except drain).	All other.	Total.	Earthen and stone ware.	China.	Total.	
1895	$34,732	$88,729			$123,461	$114,425	$24,872	$139,297	$262,758
1896	32,759	102,636			135,395	144,641	24,702	169,343	304,738
1897	30,383	110,626			141,009	177,320	30,283	207,603	348,612
1898	32,317	146,632			178,949	212,769	39,052	251,821	430,770
1899	77,783	214,375			292,158	467,925	43,807	511,732	803,890
1900	128,800	594,237			723,037	489,942	68,852	558,794	1,281,831
1901	74,210	467,379			541,589	476,957	49,863	526,820	1,068,409
1902	31,304	470,130			501,434	555,340	49,306	604,646	1,106,080
1903	63,774	375,503			439,277	527,689	61,312	589,001	1,028,278
1904	179,866	407,519			587,385	697,381	94,358	791,739	1,379,124
1905	263,876	536,002			799,878	882,069	101,485	983,554	1,783,432
1906	247,625	637,441			885,066	1,003,969	114,481	1,118,450	2,003,516
1907	185,192	631,779			816,971	1,022,730	108,911	1,131,641	1,948,612
1908		[a] 550,243		$113,243	663,486	906,266	77,494	983,760	1,647,246
1909		[a] 1,002,270		147,622	1,149,892	776,842	86,853	863,695	2,013,587
1910		[b] 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	[b] 448,939	1,117,161	[b] $539,116	1,717,895	3,823,111	1,037,637	140,147	1,177,784	5,000,895
1913	689 515	1,121,590	851,463	1,566,340	4,228,908	410,050	149,281	559,331	4,788,239
1914	524,239	734,134	658,695	1,134,035	3,051,103	390,693	136,209	526,902	3,578,005

[a] Includes all brick, other than building brick.
[b] Figures cover period from July 1 to Dec. 31.

The exports of domestic clay products in 1914 decreased in value $1,210,234, or 25.28 per cent, from 1913. In 1913 there was a decrease of $212,656, or 4.25 per cent, from 1912. Of these exports in 1914, 14.73 per cent was pottery and 85.27 per cent was brick and tile. In 1913, 11.68 per cent was pottery and 88.32 per cent brick and tile. In 1914 pottery exports decreased $32,429, or 5.80 per cent, from 1913, and brick and tile exports decreased $1,177,805, or 27.85 per cent, from 1913. These decreases were general, every item in the table decreasing in 1914. Of the pottery exports, earthen and stone ware decreased $19,357, or 4.72 per cent, and china decreased $13,072, or 8.76 per cent.

The following table shows the value of exports of clay wares of domestic manufacture from the United States in 1914, by grand divisions:

Value of clay wares of domestic manufacture exported from the United States in 1914, by grand divisions.

	Brick.					Pottery.			Grand total.
	Building.	Fire.	Tile (except drain).	All other.	Total.	Earthen and stone ware.	China.	Total.	
Europe	$48	$34,414	$6,982	$33,133	$43,577	$26,489	$20,158	$46,647	$90,224
Central America and West Indies	38,281	137,375	246,105	349,552	771,313	39,938	21,523	61,461	832,774
Canada	476,124	473,380	283,149	649,480	1,882,133	275,038	73,837	348,875	2,231,008
Mexico	6,432	28,665	2,000	15,439	52,536	3,185	4,899	8,084	60,620
Newfoundland	100	103	1,293	851	2,347	236	287	523	2,870
South America	3,166	56,893	79,973	44,225	184,257	32,118	5,075	37,193	221,450
Asia	....	5,318	3,851	4,185	13,354	8,127	5,131	13,258	26,612
Oceania	88	27,842	35,223	34,186	97,339	5,141	2,457	7,598	104,937
Africa	....	1,144	119	2,984	4,247	421	2,842	3,263	7,510
Total	524,239	734,134	658,695	1,134,035	3,051,103	390,693	136,209	526,902	3,578,005

Nearly 62 per cent of the brick and tile exports, more than 66 per cent of the pottery exports, and more than 62 per cent of total exports of clay products went to Canada. Central America and the West Indies ranked second, more than 25 per cent of the brick and tile exports, nearly 12 per cent of the pottery exports, and more than 23 per cent of total exports going to those countries.

CLAY PRODUCTS BY STATES.

In the following pages the statistics of the clay-working industry from 1910 to 1914, 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.

Alabama, like others of the Southern States, is rich in clays, but its rank as a clay-working State is not very high. In 1914 it was twentieth among the States, with products valued at $1,574,023, or less than 1 per cent of the total. This was a decrease of $517,558, or nearly 25 per cent from 1913. Alabama was tenth in the production and value of vitrified paving brick. The principal product was common brick, valued in 1914 at $638,666 and representing 40.58 per cent of the value of all of Alabama's clay products in that year.

Jefferson County was the principal clay-working county, reporting a production valued at $1,029,135, or 65.38 per cent of the total value for the State in 1914, a decrease of $284,297 from 1913. Nearly all of the fire brick produced in the State comes from Jefferson County and fire brick and vitrified brick are its principal clay products. The leading counties in the value of common brick in 1914 were, in the order of their importance, Jefferson, Montgomery, Russell, and Talladega.

Clay products of Alabama, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	135,785,000	129,694,000	136,989,000	130,923,000	110,731,000
Value	$746,961	$708,903	$759,409	$730,148	$638,666
Average per M	$5.50	$5.47	$5.54	$5.58	$5.77
Vitrified—					
Quantity	19,772,000	21,444,000	26,480,000	24,183,000	18,679,000
Value	$236,516	$246,707	$353,303	$361,722	$248,525
Average per M	$11.96	$11.50	$13.34	$14.96	$13.31
Front—					
Quantity	(a)	9,169,000	10,629,000	(a)	(a)
Value	(a)	$128,403	$132,033	(a)	(a)
Average per M	$15.96	$14.00	$12.42	$15.29	$11.42
Fancy ... value	....	(a)	(a)	....	(a)
Fire ... do	$163,672	$193,375	$240,434	(a)	$167,021
Draintile ... do	$3,773	$3,777	$5,465	$10,802	$6,838
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ... do	....	....	....	(a)	....
Pottery:					
Red earthenware ... do	$3,475	$11,243	$10,990	$11,164	$4,800
Stoneware and yellow and Rockingham ware .. value	$16,371	$14,753	$11,223	$8,994	$11,742
Miscellaneous ... do	$496,791	$639,941	$422,322	$968,751	$496,431
Total value	$1,667,559	$1,947,102	$1,935,179	$2,091,581	$1,574,023
Number of active firms reporting	87	82	74	68	70
Rank of State	22	17	17	16	20

a Included in "Miscellaneous."

CALIFORNIA.

California is one of the important clay-working States, being tenth in value of production in 1914, a loss of one number from 1913, when it was ninth. It was seventh in quantity and value of common brick and in the value of fireproofing, ninth in the value of front brick, second in the value of fancy brick, fourth in the value of enameled brick and architectural terra cotta, and sixth in the value of draintile and of clay fire brick. California reported for 1914 every variety of clay product as classified in this report, except white ware, china, and porcelain electrical supplies.

The total value of all California's clay production in 1914 was $4,461,661, a decrease of $883,297, or 16.53 per cent from 1913. California's principal clay product, common brick, made chiefly in Los Angeles and Contra Costa counties, was valued in 1914 at $1,356,885, or 30 per cent of the value of all clay products in the State, but a decrease of $342,541 from 1913. The average price per 1,000 in 1914 was 38 cents greater than in 1913. Sewer pipe, made principally in Los Angeles and Alameda counties, was second in value, being reported as valued at $959,193, a decrease of $72,901 from 1913. Architectural terra cotta ranked third in importance, and was valued at $535, 735, a decrease of $93,368 from 1913. The only products to show increase in 1914 were tile, not drain, red earthenware, and sanitary ware. Pottery produced in California in 1914 was valued at $345,303, an increase of $55,048 over 1913.

Los Angeles, the principal common brick producing county, reported 112,017,000 brick, valued at $618,730, or 50.63 per cent of the total quantity and 45.6 per cent of the value of common brick for the State in 1914. This was a decrease of 49,381,000 brick and of $217,642 from 1913. The principal product of Los Angeles County was common brick, with sewer pipe second, these two constituting more than half of the value of the county's clay products in 1914. Front brick, fireproofing, tile, not drain, and fire brick are also produced in this county to a considerable value. Los Angeles was also the leading clay-working county, reporting wares valued at $1,737,950 or 38.95 per cent of the State's total, a decrease of $649,708 from 1913.

Clay products of California, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	280, 265, 000	282, 199, 000	349, 797, 000	295, 729, 000	221, 243, 000
Value	$1, 694, 312	$1, 716, 442	$2, 198, 303	$1, 699, 426	$1, 356, 885
Average per M	$6. 05	$6. 08	$6. 28	$5. 75	$6. 13
Vitrified—					
Quantity	8, 538, 000	9, 186, 000	5, 443, 000	1, 923, 000	1, 800, 000
Value	$140, 130	$155, 885	$72, 495	$44, 725	$39, 705
Average per M	$16. 41	$16. 97	$13. 32	$23. 26	$22. 06
Front—					
Quantity	11, 475, 000	15, 197, 000	18, 714, 000	16, 605, 000	10, 759, 000
Value	$285, 468	$381, 226	$492, 617	$368, 149	$226, 268
Average per M	$24. 88	$25. 09	$26. 32	$22. 17	$21. 03
Fancy or ornamental . value	$48, 572	(a)	(a)	(a)	$21, 245
Enameled ... do	$100, 531	$113, 407	$134, 646	$160, 727	$89, 852
Fire ... do	$371, 017	$468, 120	$513, 583	$523, 692	$358, 526
Stove lining ... do	(a)	(a)	(a)	(a)	(a)
Draintile ... do	$55, 386	$34, 780	$37, 377	$34, 413	$30, 284
Sewer pipe ... do	$1, 031, 061	$999, 546	$1, 136, 429	$1, 032, 094	$959, 193
Architectural terra cotta ... do	$678, 249	$475, 647	$650, 637	$629, 103	$535, 735
Fireproofing ... do	$151, 503	$200, 923	$250, 931	$322, 200	$223, 071
Tile, not drain ... do	$97, 685	$90, 632	$76, 358	$151, 252	$214, 512
Pottery:					
Red earthenware ... do	$34, 367	$32, 146	$36, 091	$33, 481	$36, 931
Stoneware and yellow and Rockingham ware .. value	$42, 726	$48, 190	$54, 087	$49, 720	(a)
White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware ... value	....	....	(a)	....	....
Sanitary ware ... do	(a)	(a)	(a)	(a)	$247, 770
Porcelain electrical supplies, value	....	....	(a)	....	....
Miscellaneous ... value	$111, 384	$198, 922	$258, 896	$295, 976	$121, 684
Total value	$4, 842, 391	$4, 915, 866	$5, 912, 450	$5, 344, 958	$4, 461, 661
Number of active firms reporting	107	92	91	91	84
Rank of State	9	8	8	9	10

[a] Included in "Miscellaneous."

COLORADO.

The total value of Colorado's clay products in 1914 was $1,143,942, a decrease of $149,569, or 11.56 per cent, from 1913. Colorado's clay product of chief value in 1914 was common brick, which displaced by a small margin fire brick. The production of common brick was 33,717,000 brick, valued at $211,037, a decrease of 11,873,000 brick and of $80,076 from 1913.

Denver County was the chief producer of common brick, reporting 17,183,000 brick, valued at $96,813. This was a decrease of 979,000 brick and of $10,049 from 1913. Denver is the principal clay-working county, and reported wares valued at $633,707—more than one-half of the State's total. This was a decrease of $20,905 from 1913. Pueblo County is the principal producer of refractory wares. The pottery production of the State was valued at $61,257, an increase of $14,756 over 1913.

Clay products of Colorado, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	128,711,000	89,950,000	66,833,000	45,590,000	33,717,000
Value	$852,986	$559,519	$407,428	$291,113	$211,037
Average per M	$6.63	$6.22	$6.10	$6.39	$6.26
Vitrified—					
Quantity	(a)	2,334,000	(a)	3,807,000	(a)
Value	(a)	$31,572	(a)	$46,220	(a)
Average per M	$14.15	$13.53	$12.04	$12.14	$11.52
Front—					
Quantity	30,334,000	26,189,000	20,087,000	10,851,000	10,642,000
Value	$368,538	$294,783	$233,175	$129,590	$133,068
Average per M	$12.15	$11.26	$11.61	$11.94	$12.50
Fancy ... value	(a)	$1,220	$3,785	(a)	(a)
Enameled ... do	....	....	(a)	(a)	(a)
Fire ... do	$205,550	$182,766	$301,680	$306,843	$209,368
Draintile ... do	$18,066	$23,655	$20,250	$47,871	$53,971
Sewer pipe ... do	(a)	$297,800	(a)	(a)	(a)
Architectural terra cotta ... do	....	....	(a)	(a)	(a)
Fireproofing ... do	$32,565	(a)	$22,213	$25,220	(a)
Tile, not drain ... do	(a)	(a)	$2,200	(a)	(a)
Pottery:					
Red earthenware ... do	(a)	(a)	(a)	(a)	(a)
Stoneware and yellow and Rockingham ware ... value	(a)	(a)	(a)	(a)	(a)
Miscellaneous ... do	$556,009	$215,394	$446,663	$446,654	$536,498
Total value	$2,033,714	$1,606,709	$1,437,394	$1,293,511	$1,143,942
Number of active firms reporting	77	80	71	68	62
Rank of State	17	22	25	25	25

a Included in "Miscellaneous."

CONNECTICUT AND RHODE ISLAND.

There being but two producers in Rhode Island, it is impossible to publish figures for the State, and they are combined with those of Connecticut. The value of the brick and tile of these two States in 1914 was $1,229,037, a decrease of $143,197, or 10.44 per cent, from 1913. Connecticut's products were common brick, front brick, fireproofing, stove lining, fire brick, and pottery. Rhode Island makes common, vitrified, front, and fancy brick, and tile, not drain. Common brick, valued at $1,140,842, constituted over 92 per cent of the value of the brick and tile products of these two States in 1914, but decreased in value $111,284 from 1913. Hartford is the leading county in Connecticut, reporting brick and tile products valued at $561,756, or nearly one-half of the value of the production of the entire State. It reported more than one-half of the common brick marketed in these States and nearly one-half of their value in 1914. New Haven and Middlesex counties are also large producers of common brick. Fire brick is made only in New Haven County.

Clay products of Connecticut and Rhode Island, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	240,234,000	206,631,000	214,700,000	185,737,000	171,289,000
Value	$1,454,471	$1,153,409	$1,377,456	$1,252,126	$1,140,842
Average per M	$6.05	$5.58	$6.42	$6.74	$6.66
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$14.62	$15.50	$17.71	$15.30	$16.03
Front—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$15.75	$12.49	$13.25	$12.73	$12.24
Fancy or ornamental . value	(a)	(a)	(a)	(a)	(a)
Fire do	(a)	(a)	(a)	(a)	(a)
Stove lining do	(a)	(a)	(a)	(a)	(a)
Fireproofing do	....	....	....	....	(a)
Tile, not drain do	....	(a)	(a)	(a)	(a)
Pottery: [b]					
Red earthenware do	(b)	(b)	(b)	(b)	(b)
Stoneware and yellow and Rockingham ware . . value	(b)	(b)	(b)	(b)	(b)
Porcelain electrical supplies, value	(b)	(b)	(b)	(b)	(b)
Miscellaneous value	$114,015	$103,930	$87,544	$120,108	$88,195
Total value	$1,568,486	$1,257,339	$1,465,000	$1,372,234	$1,229,037
Number of active firms reporting	42	42	41	42	38
Rank of Connecticut and Rhode Island	23	25	24	24	24

[a] Included in "Miscellaneous."
[b] The value of the pottery products, which were produced by Connecticut alone, 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 1914 was $2,263,034, a decrease of $429,585, or 15.95 per cent, from 1913. In 1914 Georgia was eighth in the production of common brick, and sixth in the value of sewer pipe. The principal product was common brick, valued at $1,040,557, a decrease of $423,765 from 1913; the quantity, 214,979,000 brick, decreased 63,525,000 brick. The average price per 1,000 decreased 42 cents, or to $4.84. The value of common brick constituted 45 per cent of all clay products of the State. Sewer pipe ranked second in importance, its production being valued in 1914 at $647,733, or 28 per cent of the total for the State. This was an increase of $13,255 over 1913.

Bibb County was the leading producer of common brick and sewer pipe, and reported 68,655,000 common brick, valued at $279,938, or one-fourth of the output and value of the State. Richmond and Fulton counties were also large producers of common brick. Architectural terra cotta was produced only in Fulton County, and tile, not drain, in Liberty County. The production of pottery in Georgia was valued at $20,961 in 1914. Bibb County was the leading clay-working county of the State and reported wares for 1914 valued at $545,776, a decrease of $230,300 from 1913.

Clay products of Georgia, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	305,025,000	325,948,000	315,476,000	278,504,000	214,979,000
Value	$1,620,174	$1,692,610	$1,634,670	$1,464,322	$1,040,557
Average per M	$5.31	$5.19	$5.18	$5.26	$4.84
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	16,470,000
Value	(a)	(a)	(a)	(a)	$234,855
Average per M	$11.11	$12.22	$12.00	$12.81	$14.26
Front—					
Quantity	13,649,000	12,788,000	11,527,000	9,749,000	7,475,000
Value	$129,393	$112,675	$114,000	$96,568	$77,721
Average per M	$9.48	$8.81	$9.89	$9.91	$10.40
Fancy or ornamental . value	(a)	....	(a)	....	....
Fire ... do	$67,622	$86,000	$61,231	$64,167	(a)
Stove lining ... do	....	(a)	....	....	(a)
Draintile ... do	$8,920	$5,000	(a)	$9,100	$8,883
Sewer pipe ... do	$373,387	$417,267	$622,627	$634,478	$647,733
Architectural terra cotta ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	$19,354	(a)	(a)	$33,900	$36,140
Tile, not drain ... do	$51,800	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	$10,558	$17,530	$11,472	$17,238	$16,487
Stoneware and yellow and Rockingham ware . . value	$10,740	$6,800	$7,510	$11,290	$4,474
Miscellaneous ... do	$240,090	$298,498	$355,031	$361,556	$196,184
Total value	$2,532,038	$2,636,380	$2,806,541	$2,692,619	$2,263,034
Number of active firms reporting	109	109	96	92	76
Rank of State	15	13	12	13	14

a Included in "Miscellaneous."

ILLINOIS.

Illinois, which makes every variety of clay product as classified in this report, except china, was the leading State in 1914 in the production and value of common brick and in the value of architectural terra cotta, second in the production and value of vitrified paving brick and stoneware, third in the value of enameled brick, fourth in the production and value of front brick and in the value of drain tile, and fifth in the value of sewer pipe and fireproofing.

The total value of the clay products of Illinois in 1914 was $13,318,953, a decrease of $1,876,921, or 12.35 per cent, from 1913. The principal product of the State is common brick, the production of which decreased 214,137,000 brick and $1,547,123 from 1913. Of the common brick, Cook County reported 597,694,000 brick, valued at $2,661,476, which was 63.49 per cent of the quantity and 54.33 per cent of the value of common brick for the State and a decrease from 1913 of 119.988,000 brick in quantity and of $907,658 in value. This is the largest brick-making county in the country and is the second largest common brick making region of the United States, being surpassed only by the Hudson River region of New York, which embraces nine counties. The average price per 1,000 for common brick in Illinois in 1914 was $5.20, or 38 cents lower than in 1913. The average price in Cook County was $4.45, or 52 cents lower than in 1913. Second in importance was vitrified paving brick, which increased 23,238,000 brick and $203,145 over 1913, though the average price per 1,000 declined 79 cents. Knox, in which Galesburg is located, was the leading county in the production of vitrified brick, with Livingston County second and Vermilion County third. Architectural terra cotta was third product in point of value, although it decreased in value $255,454 from 1913. Vermilion was the leading county in the production of front brick. Kankakee County was the only producer of enameled brick. La Salle led in the production of draintile, fireproofing, and fire brick, and sewer pipe was produced chiefly in McDonough County. Cook County was the largest producer of architectural terra cotta, as well as of common brick. Pottery to the value of $780,579, principally stoneware, was reported for 1914.

Cook County, owing to the large local market, was the leading clay-working county in 1914 and reported products valued at $4,092,741, or 30.73 per cent of the total for the State in 1914, a decrease of $437,044 from 1913. Knox was second, with a production valued at $1,152,274, or 8.65 per cent of the State's total, an increase of $57,710 over 1913. The principal clay products of this county are vitrified brick and sanitary ware.

Illinois has been fourth among the States in the value of clay products for a number of years and reported 8.07 per cent of the total value for 1914.

Clay products of Illinois, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	1,196,526,000	1,074,486,000	1,210,499,000	1,155,480,000	941,343,000
Value	$6,896,836	$6,126,911	$6,437,331	$6,445,821	$4,898,698
Average per M	$5.76	$5.70	$5.32	$5.58	$5.20
Vitrified—					
Quality	115,903,000	124,623,000	136,708,000	133,938,000	157,176,000
Value	$1,415,355	$1,627,683	$1,839,721	$1,883,199	$2,086,344
Average per M	$12.21	$13.06	$13.46	$14.06	$13.27
Front—					
Quantity	22,138,000	19,786,000	21,894,000	29,566,000	46,995,000
Value	$274,699	$240,135	$268,433	$363,010	$506,984
Average per M	$12.41	$12.14	$12.26	$12.28	$10.79
Fancy or ornamental.value	$10,875	$10,281	$8,785	$2,295	(a)
Enameled.....do	(a)	(a)	(a)	(a)	(a)
Fire.....do	$368,730	$286,039	$319,619	$351,324	$274,106
Stove lining.....do	....	....	....	....	(a)
Draintile.....do	$1,613,698	$1,372,049	$1,189,910	$1,225,190	$1,041,927
Sewer pipe.....do	$538,633	$507,694	$500,844	$787,896	$743,986
Architectural terra cotta...do	$1,680,438	$1,879,275	$2,485,012	$1,908,399	$1,652,945
Fireproofing.....do	$552,905	$552,994	$507,222	$592,337	$567,266
Tile, not drain.....do	(a)	(a)	(a)	$82,168	(a)
Pottery:					
Red earthenware.....do	$25,658	$41,875	$35,827	$46,175	$37,452
Stoneware and yellow and Rockingham ware.value	$708,958	$832,813	$675,244	$624,194	$483,407
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)	(a)
Porcelain electrical supplies, value	....	(a)	(a)	(a)	(a)
Miscellaneous.....value	$1,089,376	$855,262	$943,042	$883,866	$1,025,838
Total value	$15,176,161	$14,333,011	$15,210,990	$15,195,874	$13,318,953
Number of active firms reporting	346	330	301	281	263
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 in value of products and producing 4.64 per cent of the total. It reported for 1914 every variety of clay ware as classified in this report except fancy brick, enameled brick, and china. It was third in the production and value of front brick, third in the value of draintile, sanitary ware, and tile, not drain, fourth in the value of fireproofing, sixth in the production and value of vitrified paving brick, and seventh in the value of sewer pipe.

The total value of Indiana's clay products in 1914 was $7,655,285, a decrease of $843,361, or 9.92 per cent, from 1913. Draintile was Indiana's principal clay product, which decreased $263,288, but constituted 17.4 per cent of the total for the State. Madison was the principal draintile-producing county in 1914, with a value of $172,199, a decrease of $13,906 from 1913. Common brick is the clay product of second importance, but showed a decrease of 27,799,000 brick and of $206,775 from 1913. Lake County was the principal producer of common brick, and was the second county in the value of all clay products. Clay is the principal clay-working county, and reported for 1914 wares valued at $1,245,853, about one-sixth of the State's total, a decrease of $83,222 from 1913. Sanitary ware is the principal pottery product in Indiana, and was valued at $739,132 in 1914.

Clay products of Indiana, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	234,297,000	192,057,000	202,056,000	208,500,000	180,701,000
Value	$1,402,154	$1,132,555	$1,204,494	$1,268,710	$1,061,935
Average per M	$5.98	$5.90	$5.96	$6.08	$5.88
Vitrified—					
Quantity	61,034,000	31,198,000	55,237,000	54,579,000	42,937,000
Value	$682,888	$392,136	$654,341	$690,164	$576,892
Average per M	$11.19	$12.57	$11.85	$12.65	$13.44
Front—					
Quantity	46,691,000	40,777,000	60,544,000	67,202,000	80,349,000
Value	$478,627	$480,709	$659,492	$708,745	$799,520
Average per M	$10.25	$11.79	$10.89	$10.55	$9.95
Fancy or ornamental..value	(a)	(a)	(a)	....	....
Fire..do	$166,217	$76,116	$114,419	$105,286	$93,900
Stove lining..do	(a)	(a)	(a)	(a)	(a)
Drain tile..do	$2,071,564	$2,006,803	$1,657,368	$1,595,290	$1,332,002
Sewer pipe..do	$406,543	$455,014	$544,491	$661,783	$586,683
Architectural terra cotta..do	(a)	(a)	(a)	(a)	(a)
Fireproofing..do	$466,877	$437,778	$623,123	$703,189	$823,462
Tile, not drain..do	$622,726	(a)	(a)	(a)	$511,433
Pottery:					
Red earthenware..value	$12,650	$5,700	(a)	(a)	(a)
Stoneware and yellow and Rockingham ware..value	$89,423	$81,567	$46,100	$61,550	$39,000
White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
Sanitary ware..value	$468,301	$549,470	$633,578	$719,103	$739,132
Porcelain electrical supplies, value	(a)	(a)	(a)	(a)	(a)
Miscellaneous..value	$1,232,040	$1,382,923	$1,797,845	$1,984,826	$1,091,326
Total	$8,100,010	$7,000,771	$7,935,251	$8,498,646	$7,655,285
Number of active firms reporting	249	302	278	257	240
Rank of State	6	6	6	6	6

a Included in "Miscellaneous."

IOWA.

Iowa ranked seventh in the value of clay products in 1914 and eighth in 1913. The total value of Iowa's clay products in 1914 was $6,401,745, an increase of $828,064, or 14.86 per cent, over 1913. In 1914 Iowa was the leading State in the production of draintile, the principal clay product of the State, third in the production of fireproofing, and eighth in the production of sewer pipe. Draintile was valued at $3,180,836, and constituted 49.69 per cent of the value of Iowa's clay products, an increase of $382,020 over 1913. Fireproofing was the clay product of second importance in Iowa, displaced common brick, and was valued at $1,083,397 in 1914, an increase of $320,834 over 1913. Common brick was third among Iowa's clay products in 1914, and showed an increase of $15,710 over 1913. The quantity of common brick increased 271,000 brick.

Cerro Gordo County is the leading producer of draintile and reported a value of $990,933, or nearly one-third the production of the entire State, a decrease of $52,507 from 1913. Webster County, the second county, reported draintile to the value of $621,284. Woodbury County is the leading producer of common brick.

Cerro Gordo, owing to its large production of draintile in 1914, was the leading county in the State in value of all clay products, and reported wares valued at $1,555,944, or 24.3 per cent of the State's total, an increase of $154,929 over 1913. Webster County, whose principal product also is draintile, was second, reporting wares valued at $1,179,113, or 18.42 per cent of the total value. The pottery production of Iowa in 1914 was valued at $32,750, an increase of $12,052.

Clay products of Iowa, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	149,914,000	154,434,000	148,472,000	143,263,000	143,534,000
Value	$1,088,266	$1,025,011	$1,017,097	$1,052,036	$1,067,746
Average per M	$7.26	$6.64	$6.85	$7.34	$7.44
Vitrified—					
Quantity	19,887,000	8,879,000	15,033,000	16,398,000	14,997,000
Value	$239,283	$103,384	$197,035	$222,105	$211,905
Average per M	$12.03	$11.64	$13.11	$13.54	$14.13
Front—					
Quantity	8,142,000	9,241,000	11,912,000	14,078,000	11,183,000
Value	$103,276	$114,178	$142,637	$181,911	$148,394
Average per M	$12.68	$12.36	$11.97	$12.92	$13.27
Fancy or ornamental. value		(a)	(a)		
Fire do	(a)		(a)	$3,250	(a)
Draintile do	$3,337,851	$2,468,962	$2,293,084	$2,798,816	$3,180,836
Sewer pipe do	$313,430	$284,817	$291,672	$503,360	$558,751
Fireproofing do	$200,965	$374,628	$535,254	$762,563	$1,083,397
Tile, not drain do				(a)	(a)
Pottery:					
Red earthenware do	$6,290	$6,936	(a)	$2,414	(a)
Stoneware and yellow and Rockingham ware value	(a)	(a)	(a)	(a)	(a)
Miscellaneous do	$38,880	$54,958	$45,547	$47,226	$150,716
Total value	$5,328,241	$4,432,874	$4,522,326	$5,573,681	$6,401,745
Number of active firms reporting	232	214	200	186	171
Rank of State	8	9	10	8	7

a Included in "Miscellaneous."

KANSAS.

The total value of clay products in Kansas in 1914 was $1,905,961, a decrease of $13,949 from 1913. The low prices of brick in this State, mentioned in previous reports as the principal feature of its clay-working industry in the State, prevailed also in 1914, though there was an advance in the average price of each variety. Vitrified brick is the leading clay product of Kansas, followed by common brick. The quantity of vitrified brick decreased 2,675,000 brick and the average price per 1,000 increased $1.53. The value of vitrified brick increased $50,300 and constituted over 31 per cent of the value of Kansas's clay products in 1914. Although common brick decreased 15,535,000 brick in quantity and $54,887 in value from 1913, its value constituted 25 per cent of the total for 1914.

The principal vitrified brick producing counties in Kansas in 1914, given in the order of the value of production, were Wilson, Crawford, and Montgomery. These three counties reported vitrified brick valued at $541,295, or 91.09 per cent, of the State's total. Wilson County was the largest producer of common brick in 1914, reporting 43,664,000 brick, valued at $176,180, with Allen County second and Neosho County third.

Wilson County was the leading clay-working county in 1914, its products being valued at $573,299, or more than 30 per cent of the State's total, an increase of $31,625 over 1913. Vitrified brick is the principal clay product of the county, though front brick and common brick are also largely produced. Montgomery County is second in importance, the principal products of this county in 1914 being vitrified brick, front brick, and tile, not drain.

Clay products of Kansas, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	218,353,000	183,809,000	145,986,000	122,465,000	106,930,000
Value	$922,940	$694,586	$584,273	$541,741	$486,854
Average per M	$4.22	$3.78	$4.00	$4.42	$4.55
Vitrified—					
Quantity	118,950,000	83,337,000	80,906,000	53,382,000	50,707,000
Value	$1,089,978	$823,505	$806,427	$543,929	$594,229
Average per M	$9.16	$9.88	$9.97	$10.19	$11.72
Front—					
Quantity	25,814,000	27,887,000	27,972,000	39,451,000	31,079,000
Value	$223,875	$213,711	$215,873	$335,940	$271,104
Average per M	$8.67	$7.66	$7.72	$8.52	$8.72
Fancy or ornamental. value	(a)	(a)	(a)	(a)	(a)
Fire do	....	(a)	(a)	....	....
Draintile do	$50,726	$35,875	$50,948	$36,565	$34,130
Sewer pipe do	(a)	(a)	(a)	(a)	(a)
Architectural terra cotta do	(a)	(a)	(a)	(a)	(a)
Fireproofing do	(a)	$15,257	$48,173	$80,220	$88,427
Tile, not drain do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Stoneware and yellow and Rockingham ware. value	(b)	(b)	(b)	(b)	(b)
Miscellaneous do	$374,008	$577,328	$330,806	$381,515	$431,217
Total value	$2,661,527	$2,360,262	$2,036,500	$1,919,910	$1,905,961
Number of active firms reporting	59	53	46	43	42
Rank of State	13	15	16	17	16

[a] Included in "Miscellaneous."
[b] The value of pottery products for Kansas could not be included in the State totals without disclosing the operation of individual establishments.

KENTUCKY.

The value of Kentucky's clay products in 1914 was $2,376,406, a decrease of $537,870, or 18.46 per cent, from 1913. Kentucky was fourth in the production and value of fire brick in 1914, and fifth in the production of tile, not drain. Kentucky's leading clay product is fire brick, which decreased $353,780 in value. The quantity of 9-inch equivalent fire brick marketed in Kentucky in 1914 was 58,780,000, a decrease of 20,562,000 brick from 1913. The value of fire brick constituted 45.24 per cent of the value of Kentucky's clay products in 1914. Common brick was second in importance, being valued at $594,514, a decrease of $87,213 from 1913. Tile, not drain, valued at $270,688, was third in importance. Kentucky's production of pottery in 1914 was valued at $89,426.

Carter County is the chief producer of fire brick, reporting 35,081,000 9-inch equivalent fire brick, valued at $656,655, or about 60 per cent of the output and value of the State. This was a decrease of 6,721,000 brick in quantity and of $161,723 in value from 1913. Fire brick was the only clay product made in Carter County in 1914. Jefferson County is second in the manufacture of fire brick and the leading county in the production of common brick, reporting 22,536,000 common brick, valued at $156,862, for 1914, an increase of 1,363,000 brick and of $4,264 over 1913.

Carter County was the leading county in the value of clay products in 1914, Jefferson County being second with wares valued at $540,165. These two counties reported nearly one-half of the value of the clay products of the State for 1914. Kenton County was third with products valued at $255,533, principally tile, not drain.

Clay products of Kentucky, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	115,890,000	107,771,000	99,119,000	98,364,000	90,124,000
Value	$743,732	$692,378	$656,373	$681,727	$594,514
Average per M	$6.42	$6.42	$6.62	$6.93	$6.60
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$12.74	$12.37	$8.36	$10.13	$12.74
Front—					
Quantity	10,238,000	8,972,000	5,025,000	4,098,000	3,828,000
Value	$99,532	$90,330	$46,300	$42,637	$38,674
Average per M	$9.72	$10.07	$9.21	$10.40	$10.10
Fancy ... value	(a)		(a)		
Fire ... do	$955,557	$890,810	$1,000,056	$1,428,938	$1,075,158
Stove lining ... do				(a)	
Draintile ... do	$66,217	$64,005	$71,826	$78,023	$51,645
Sewer pipe ... do	(a)	(a)	(a)	$162,370	(a)
Architectural terra cotta ... do					
Fireproofing ... do	(a)	(a)	$29,530	$39,341	$33,442
Tile, not drain ... do	$318,966	$292,563	$310,945	$301,094	$270,688
Pottery:					
Red earthenware ... do	$10,004	$12,880	$22,523	$25,818	$35,731
Stoneware and yellow and Rockingham ware ... value	$139,417	$101,214	$91,681	$75,800	$53,695
White ware, including C. C. ware, white granite semi-porcelain ware, and semi-vitreous porcelain ware, value				(a)	
Miscellaneous ... value	$234,112	$223,914	$214,506	$78,528	$222,859
Total value	$2,567,537	$2,368,094	$2,443,740	$2,914,276	$2,376,406
Number of active firms reporting	95	96	90	83	85
Rank of State	14	14	14	12	12

a Included in "Miscellaneous."

MARYLAND.

Maryland's clay products were valued at $1,846,500 in 1914, a decrease of $71,000, or 3.70 per cent, from 1913. Maryland ranked fifth in the value of enameled brick and tenth in production and ninth in the value of clay fire brick. Maryland's clay product of chief value is common brick, which increased $176,255 in value over 1913, but decreased 6,193,000 brick in quantity. The average value per 1,000 increased $1.48 to $8.04, which accounts for the increase in the value of common brick although the quantity decreased. The value of common brick constituted 63.93 per cent of the value of all of Maryland's clay products in 1914. Fire brick is Maryland's second clay product in point of value, 12,448,000 9-inch equivalent brick being reported for 1914, valued at $243,043, a decrease in quantity of 1,996,000 brick and of $52,664 in value, compared with 1913.

The chief center of production of common brick was in the city of Baltimore and in Baltimore County. These two localities reported 110,475,000 common brick, valued at $913,667, or 75 and 77 per cent of the quantity and value of the State, respectively. This was a decrease of 1,419,000 brick in quantity, but an increase of $188,232 in value over 1913. Frederick County is also a large producer of common brick, reporting 10,203,000 brick in 1914, valued at $73,956. Allegany County was the leading fire brick producing county, reporting 10,545,000 9-inch equivalent brick, valued at $196,197, which was 84.71 per cent of the production and 80.73 per cent of the value of fire brick for the State.

Baltimore City and Baltimore County, whose chief product is common brick, but which also report high-grade pottery, constituted the principal clay-working center of the State, reporting production valued at $1,206,543, or 65.34 per cent of the total for 1914, a decrease of only $1,031 from 1913. Baltimore County was the leading county in 1914, reporting wares valued at $733,832, and Baltimore City was second, with wares valued at $472,711.

Clay products of Maryland, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	164,795,000	160,229,000	154,560,000	153,053,000	146,860,000
Value	$1,051,381	$999,791	$1,053,335	$1,004,146	$1,180,401
Average per M	$6.38	$6.24	$6.82	$6.56	$8.04
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	....
Value	(a)	(a)	(a)	(a)	....
Average per M	$16.96	$16.98	$17.93	$17.91	....
Front—					
Quantity	260,000	757,000	1,968,000	(a)	(a)
Value	$3,953	$10,574	$39,664	(a)	(a)
Average per M	$15.20	$13.97	$20.15	$23.00	$16.52
Fancy or ornamental..value	(a)	(a)	(a)	(a)	(a)
Enameled..do	(a)	(a)	(a)	(a)	(a)
Fire..do	$296,541	$249,674	$262,817	$295,707	$243,043
Stove lining..do	$23,067	$28,469	$26,673	$23,006	$21,393
Draintile..do	$5,899	$8,048	$3,043	$3,744	(a)
Architectural terra cotta..do	(a)	(a)	(a)	(a)	(a)
Fireproofing..do	....	....	(a)	$55,162	$51,483
Tile, not drain..do	....	(a)	....	....	....
Pottery:					
Red earthenware..do	$9,171	$8,281	$8,451	$7,534	$7,738
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..value	(a)	(a)	....	....	(a)

[a] Included in "Miscellaneous."

Clay products of Maryland, 1910–1914—Continued.

Product.	1910	1911	1912	1913	1914
Miscellaneous............value..	$458,261	$467,597	$471,770	$528,201	$342,442
Total value..................	$1,848,273	$1,772,434	$1,865,753	$1,917,500	$1,846,500
Number of active firms reporting.	55	56	55	49	46
Rank of State....................	19	18	19	18	17

MASSACHUSETTS.

The value of clay products in Massachusetts in 1914 decreased $133,318, or 7.35 per cent, from 1913. The chief clay product of Massachusetts is common brick, which decreased 14,186,000 brick in quantity and $83,367 in value in 1914, compared with 1913. The average price per 1,000 increased 14 cents to $7.33. The value of common brick constituted 60.84 per cent of the value of all clay products in Massachusetts in 1914. Stove lining was second among the brick and tile products in value, being reported at $159,924 in 1914, a decrease of $20,056 from 1913. Massachusetts is the leading State in this variety of clay product and reported 30.72 per cent of the total for the country. Pottery to the value of $219,104 was reported for 1914.

Middlesex County is the leading clay-working county reporting over one-fifth of the production for the State. Bristol County was second, and Suffolk third.

Hampden County was the leading county in the production and value of common brick in 1914, with Middlesex second, and Hampshire third. These 3 counties reported more than one-half of the production and value of common brick in the State. Bristol reported all the stove lining produced and was also the leading fire-brick producing county of the State.

Clay products of Massachusetts, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity................	165,315,000	166,834,000	157,527,000	153,818,000	139,632,000
Value....................	$1,120,924	$1,079,778	$1,095,584	$1,106,437	$1,023,070
Average per M..........	$6.78	$6.47	$6.95	$7.19	$7.33
Front—					
Quantity................	(a)	(a)	(a)	869,000	950,000
Value....................	(a)	(a)	(a)	$17,380	$20,000
Average per M..........	$15.44	$18.00	$20.00	$20.00	$21.05
Fire...................do....	$71,780	$70,104	$83,454	$84,298	$74,736
Stove lining...............do....	$166,018	$167,802	$173,256	$179,980	$159,924
Fireproofing..............do....	(a)	(a)	(a)	(a)	(a)
Tile, not drain............do....	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware......do....	$148,909	$150,038	$163,010	(a)	(a)
Stoneware and yellow and Rockingham ware..value..	$9,654	$13,541	$26,300	$27,400	(a)
White ware, including C. C. ware, white granite ware, semiporcelain and semivitreous porcelain ware, value......................	(a)	(a)	(a)	(a)	....
Porcelain electrical supplies, value......................	(a)	(a)	(a)	(a)	....
Miscellaneous...........value..	$190,128	$219,024	$225,562	$399,380	$403,827
Total value................	$1,707,413	$1,700,287	$1,767,166	$1,814,875	$1,681,557
Number of active firms reporting.	71	68	63	60	57
Rank of State..................	21	20	20	19	19

a Included in "Miscellaneous."

MICHIGAN.

The value of Michigan's clay products in 1914 was $2,700,066, an increase of $25,941, or 0.97 per cent, over 1913. In 1914, Michigan ranked fifth among the States in the value of drain tile and sixth in the production and value of common brick. Michigan's leading clay product is common brick, which decreased in quantity 4,417,000 brick but increased in value $6,929 in 1914 over 1913. The value of common brick constituted 60.49 per cent of the value of all clay products in the State in 1914. Draintile is second in importance in Michigan, and was reported to the value of $421,941 for 1914, an increase of $6,398 over 1913. Michigan's production of pottery in 1914 was valued at $265,194.

Wayne County, in which Detroit is located, was the leading common brick producing county and reported 222,083,000 brick, valued at $1,352,091, or 82.51 per cent of the quantity and 82.79 per cent of the value of common brick for the entire State in 1914, an increase of 6,557,000 brick in quantity and of $81,452 in value over 1913. This county was the third largest common brick producing center of the country. It was also the leading clay-working county of the State reporting for 1914 a total value of $1,651,553, or 61.17 per cent of the total value for the State and an increase of $98,434 over 1913. 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, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	232,551,000	252,465,000	271,189,000	273,571,000	269,154,000
Value	$1,363,316	$1,301,998	$1,592,283	$1,626,287	$1,633,216
Average per M	$5.86	$5.16	$5.87	$5.94	$6.07
Vitrified—					
Quantity	9,080,000	5,597,000	(a)	8,571,000	7,733,000
Value	$116,446	$78,336	(a)	$126,062	$120,562
Average per M	$12.82	$14.00	$13.94	$14.71	$15.59
Front—					
Quantity	2,209,000	2,498,000	3,934,000	505,000	1,488,000
Value	$27,533	$31,572	$41,476	$5,940	$21,121
Average per M	$12.46	$12.64	$10.54	$11.76	$14.19
Fire ... value	....	(a)	(a)	(a)	(a)
Stove lining ... do	(a)	(a)	(a)	....	(a)
Draintile ... do	$348,205	$313,072	$387,945	$415,543	$421,941
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	....	(a)	$1,461	(a)	$3,752
Tile, not drain ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	$90,450	$80,580	$99,555	$106,527	$106,452
White ware, including C. C. ware, white granite ware, semi porcelain ware, and semivitreous porcelain ware ... value	....	....	....	....	(a)
Sanitary ware ... do	....	....	(a)	....	....
Porcelain electrical supplies, value	(a)	(a)	(a)	(a)	(a)
Miscellaneous ... value	$250,272	$278,374	$422,778	$393,766	$393,022
Total value	$2,196,222	$2,083,932	$2,545,498	$2,674,125	$2,700,066
Number of active firms reporting	118	111	101	98	92
Rank of State	16	16	13	14	11

a Included in "Miscellaneous."

MINNESOTA.

The value of clay products in Minnesota in 1914, exclusive of pottery, was $1,944,886, an increase of $163,869, or 9.20 per cent, over 1913. Minnesota was seventh among the States in the value of draintile and ninth in the value of sewer pipe in 1914. The principal clay product is common brick, of which 132,688,000 brick, valued at $883,791, were reported for 1914, an increase of 3,427,000 brick in quantity and an increase of $83,350 in value, compared with 1913. The average price per 1,000 increased 48 cents to $6.67 in 1914. The value of the common brick constituted 45.44 per cent of all of Minnesota's brick and tile products in 1914. Sewer pipe ranks second, but as it was made by less than three producers figures of production are not published. Front brick is third, and increased $45,244 over 1913.

Carver County was the largest producer of common brick in 1914, with Carlton second and Hennepin third.

Goodhue County led in clay working in the State; Hennepin was second, and Carver was third.

Clay products of Minnesota, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	182,895,000	153,015,000	129,604,000	129,261,000	132,688,000
Value	$1,104,898	$868,037	$760,983	$800,441	$883,791
Average per M	$6.04	$5.67	$5.87	$6.19	$6.67
Vitrified—					
Quantity		(a)	(a)	(a)	(a)
Value		(a)	(a)	(a)	(a)
Average per M		$13.16	$16.34	$15.85	$16.12
Front—					
Quantity	7,240,000	10,853,000	11,555,000	13,392,000	16,413,000
Value	$88,000	$135,085	$144,125	$163,380	$208,624
Average per M	$12.15	$12.45	$12.47	$12.20	$12.71
Fire ... value	(a)	(a)	(a)	(a)	(a)
Draintile ... do	$160,706	$121,965	$126,690	$110,543	$143,194
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	$93,731	$109,812	$160,804	$170,214	$123,911
Tile, not drain ... do		(a)			(a)
Pottery:					
Earthenware and stoneware, value	(b)	(b)	(b)	(b)	(b)
Miscellaneous ... value	$453,961	$458,579	$418,438	$536,439	$585,366
Total value	$1,901,296	$1,693,478	$1,611,040	$1,781,017	$1,944,886
Number of active firms reporting	84	81	79	69	65
Rank of State	18	21	21	20	15

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 most important clay-working States of the country and is the leading Southern State. It reported for 1914 every variety of brick and tile products as classified in this report and was the eighth State in the value of clay products. In 1914 it was the eighth State in the production and ninth in the value of vitrified paving brick, sixth in the production and fifth in the value of front brick, third in the value of fancy brick, second in the value of enameled brick, sixth in the value of draintile, second in the value of sewer pipe, fifth in the value of architectural terra cotta, and third in the production and value of fire brick.

The total value of the clay products of Missouri in 1914 was $6,077,284, a decrease of $524,792, or 7.95 per cent, from 1913. Fire brick is the product of chief value, and 76,177,000 9-inch equivalent clay fire brick were reported from Missouri for 1914, valued at $1,554,431, or $20.41 per 1,000, a decrease of 28,551,000 brick and of $583,937 from 1913. The value of clay fire brick constituted 25.58 per cent of the total value of clay products. Sewer pipe was second in value and increased $22,347 over 1913. Common brick was third in value in 1914, but it decreased 16,843,000 brick and $112,729 from 1913. Architectural terra cotta was fourth, the output in 1914 being valued at $478,006, a decrease of $2,366 from 1913. Pottery production to the value of $2,944 was reported for 1914.

The leading county in the production of fire brick in 1914 was St. Louis, which reported 29,172,000 9-inch equivalent fire brick, a decrease of 8,013,000 brick from 1913. St. Louis City was second with a production of 26,227,000 fire brick, a decrease of 13,752,000 brick from 1913. In value of fire brick in 1914, however, St. Louis City was first, its output being valued at $651,977, a decrease of $315,699 from 1913, and St. Louis County was second, its output being valued at $557,249, a decrease of $128,189, compared with 1913. These two localities produced 72.72 per cent of the quantity and 77.79 per cent of the value of fire brick for the State. They also led in the production of common brick; St. Louis City, however, reported a decline of 9,790,000 brick and of $76,651 compared with 1913, whereas St. Louis County reported 40,857,000 common brick valued at $272,546 in 1914, an increase of 3,193,000 brick and of $25,782 over 1913. The two localities produced 66.52 per cent of the total quantity and 66.31 per cent of the total value of the common brick of the State. St. Louis City is also the leading producer of every other variety of clay product, except fireproofing and stove lining; Henry County was the leading producer of fireproofing and Audrain County the only producer of stove lining. St. Louis City is the only place in the State where enameled brick, tile, not drain, and silica brick are made.

St. Louis City is the leading clay-working district in the State and reported in 1914 wares valued at $3,520,271, or 57.93 per cent of the value of the entire State. St. Louis County was second, reporting production valued at $854,980, or 14.07 per cent of the total. Jackson County was third, Henry fourth, and Randolph fifth. St. Louis City and St. Louis County reported together 71.99 per cent of the value of the clay products of the State in 1914.

Clay products of Missouri, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	201,281,000	217,466,000	188,496,000	185,872,000	169,029,000
Value	$1,284,997	$1,309,164	$1,243,070	$1,270,581	$1,157,852
Average per M	$6.38	$6.02	$6.59	$6.84	$6.85
Vitrified—					
Quantity	56,703,000	44,813,000	30,551,000	19,383,000	26,217,000
Value	$647,441	$488,299	$342,930	$275,164	$424,170
Average per M	$11.42	$10.90	$11.22	$14.20	$16.18
Front—					
Quantity	38,428,000	25,491,000	19,963,000	27,191,000	27,692,000
Value	$516,505	$330,332	$264,375	$414,778	$411,943
Average per M	$13.44	$12.96	$13.24	$15.25	$14.88
Fancy or ornamental. value	$23,673	$24,269	$19,838	$18,734	$19,473
Enameled ... do	(a)	(a)	(a)	(a)	(a)
Fire ... do	$2,059,845	$1,763,548	$1,941,347	$2,138,368	$1,554,431
Stove lining ... do	(a)	(a)	(a)	(a)	(a)
Draintile ... do	$121,068	$164,393	$141,297	$130,661	$143,245
Sewer pipe ... do	$1,210,348	$1,156,626	$1,178,482	$1,213,889	$1,236,236
Architectural terra cotta ... do	(a)	$402,969	$654,163	$480,372	$478,006
Fireproofing ... do	$146,931	$123,499	$75,155	$104,073	$168,053
Tile, not drain ... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware ... do	$3,080	$2,755	(a)	$2,537	$2,243
Stoneware and yellow and Rockingham ware .. value	$25,981	$2,453	$2,015	(a)	(a)
Miscellaneous ... do	$1,047,897	$506,046	$549,793	$552,919	$481,632
Total value	$7,087,766	$6,274,353	$6,412,861	$6,602,076	$6,077,284
Number of active firms reporting	150	122	110	105	98
Rank of State	7	7	7	7	8

a Included in "Miscellaneous."

NEW JERSEY.

New Jersey ranks third in the value of clay products. It is the only State that reports every variety of product herein classified. It is second in the value of pottery products and fourth in the value of brick and tile products. In 1914 it was first in the value of china and sanitary ware and enameled brick; second in the value of architectural terra cotta, fireproofing, and tile not drain; third in the value of porcelain electrical supplies and white ware and fifth in the production and value of common and fire brick.

The value of New Jersey's clay products in 1914 was $16,484,652—brick and tile products $8,353,296 and pottery $8,131,356—a decrease from 1913 of $3,220,726, or 16.34 per cent. This decrease was principally in the brick and tile industries—$2,513,537. New Jersey's leading clay product is sanitary ware, which was reported to the value of $5,058,204, a decrease of $179,809 from 1913, and constituted 30.68 per cent of the total value of New Jersey's clay products in 1914. Common brick was second, and constituted 11.8 per cent of the total value, although it reported a decrease of 52,268,000 brick and of $446,481 from 1913. Architectural terra cotta ranked third, and decreased $767,502 from 1913. Fireproofing ranked fourth, with a decrease of $493,075 from 1913. Tile not drain is also an important product in this State, being reported to the value of $1,139,895 in 1914, a decrease of $168,892 from 1913.

Mercer County, in which Trenton is located, is the most important clay-working county in the State, and its leading product is sanitary ware, which was reported to the value of $4,376,665 in 1914, or 26.55

per cent of the State's total for all clay products—a decrease of $243,665 from 1913. The value of all of the Mercer County clay products in 1914 was $7,688,266, or 46.64 per cent of the State's total, a decrease of $930,230 from 1913. Middlesex County, second in importance as a clay-working county, its production being valued at $6,344,525 or 38.49 per cent of the State's total in 1914, was the principal producer of common brick, reporting 164,340,000 brick, valued at $825,525. This county is the leading producer of every variety of brick and tile products, and it was the only county in which enameled brick, stove lining, and silica brick were produced in 1914. It reported also architectural terra cotta valued at $1,354,884, fireproofing valued at $1,453,722, and tile, not drain, valued at $664,674, and its production of clay fire brick was 28,245,000 9-inch equivalent brick, valued at $716,243, in 1914. Bergen County was second in the manufacture of common brick, with 44,806,000 brick, valued at $241,908, in 1914. The principal market for Bergen County common brick (its only clay product) is Greater New York.

In brick and tile products, Middlesex County was first, with products valued at $5,926,490, and Mercer County second, with products valued at $587,069. In pottery, Mercer was first, with products valued at $7,101,197, and Middlesex second, with $418,035.

Clay products of New Jersey, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	401,103,000	429,367,000	429,309,000	401,702,000	349,434,000
Value	$2,215,628	$2,401,962	$2,592,091	$2,391,287	$1,944,806
Average per M	$5.52	$5.59	$6.04	$5.95	$5.57
Vitrified—					
Quantity		(a)			(a)
Value		(a)			(a)
Average per M		$14.99			$15.00
Front—					
Quantity	47,451,000	47,606,000	48,852,000	45,841,000	23,640,000
Value	$609,845	$528,656	$558,372	$474,501	$377,779
Average per M	$12.85	$11.10	$11.43	$10.35	$15.98
Fancy or ornamental. value	(a)	(a)	(a)	(a)	(a)
Enameled do	(a)	(a)	(a)	(a)	(a)
Fire do	$1,001,063	$1,344,884	$1,460,988	$1,246,294	$897,442
Stove lining do	(a)	(a)	(a)	(a)	(a)
Draintile do	$23,147	$26,502	$50,984	$44,020	$31,040
Sewer pipe do	(a)	$103,137	(a)	(a)	(a)
Architectural terra cotta do	$2,000,039	$1,669,973	$2,330,065	$2,388,293	$1,620,791
Fireproofing do	$1,582,101	$1,728,811	$2,031,350	$2,092,370	$1,599,295
Tile not drain do	$1,199,113	$1,197,330	$1,255,246	$1,308,787	$1,139,895
Pottery:					
Red earthenware do	$26,529	$38,910	$36,655	$35,360	$35,198
Stoneware and yellow and Rockingham ware. value	$55,734	$75,915	$48,297	$66,993	$72,288
White ware, including C. C. ware, white granite semi-porcelain ware, and semi-vitreous porcelain ware, value	$1,345,156	$1,148,904	$1,090,683	$834,716	$727,637
China, bone china, delft, and belleek ware value	$1,131,412	$1,105,278	$1,155,766	$1,239,453	$1,076,043
Sanitary ware do	$4,955,066	$4,898,588	$5,199,278	$5,238,013	$5,058,204
Porcelain electrical supplies, value	$874,013	$913,921	$1,146,467	$1,190,448	$905,878
Miscellaneous value	$815,463	$995,457	$882,311	$1,154,843	$998,353
Total value	$17,834,309	$18,178,228	$19,838,553	$19,705,378	$16,484,652
Number of active firms reporting	167	162	155	149	148
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 reported for 1914 every variety as classified in this report, except enameled brick and silica brick. It ranked fifth in the value of brick and tile products and fourth in pottery. Its most interesting feature is the remarkable production of common brick along Hudson River, the largest brick-producing region in the country and probably in the world. New York was the second State in 1914 in the production and value of common brick, Illinois being first. It was also second in the value of china and porcelain electrical supplies, third in the value of terra cotta and stove lining, fifth in the value of white ware, and seventh in the production and value of vitrified paving brick.

The value of clay products in New York in 1914 was $9,078,933—$6,923,141 brick and tile and $2,155,792 in pottery—a decrease of $2,390,543 from 1913. Common brick is New York's principal clay product. For 1914 a decrease was reported of 159,648,000 brick and $1,363,066 from 1913, the decrease being principally in the Hudson River region—100,653,000 brick and $938,003. The average price per 1,000 in 1914 for the whole State was $5.13, a decrease of 51 cents, in the Hudson River region the decline was 58 cents. The value of common brick constituted 51.39 per cent of all of New York's clay products in 1914. Next to common brick in value are porcelain electrical supplies, which decreased $620,841 in 1914. The third in rank in 1914 was architectural terra cotta, which decreased $221,258 from 1913. China ranked fourth and increased $21,282 over 1913.

Ulster was the leading county in the production of common brick, reporting 186,381,000 brick in 1914, valued at $896,306. Rockland County was second, with 131,076,000 brick, valued at $642,267.

Onondaga, owing to its large pottery production, was the leading county in the value of clay products in 1914 and reported wares valued at $1,078,375—pottery $932,343 and brick and tile $146,032—a net increase over 1913 of $3,648. Ulster County, whose only clay product is common brick, was second in value of clay products in 1914 and Erie was third. Ontario and Schenectady counties are the principal producers of porcelain electrical supplies and reported together in 1914 a production valued at $596,735, or nearly two-thirds of the State total for this variety, a decrease of $428,561 from 1913.

Clay products of New York, 1910–1914.

Products.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	1,380,084,000	1,143,726,000	1,273,641,000	1,068,516,000	908,868,000
Value	$6,897,438	$5,918,286	$7,311,675	$6,029,103	$4,666,037
Average per M	$5.00	$5.17	$5.74	$5.64	$5.13
Vitrified—					
Quantity	21,662,000	17,035,000	18,634,000	33,901,000	31,240,000
Value	$334,432	$290,728	$287,089	$514,677	$515,672
Average per M	$15.44	$17.07	$15.41	$15.18	$16.51
Front—					
Quantity	9,229,000	9,942,000	9,499,000	7,636,000	5,810,000
Value	$137,748	$133,563	$123,378	$83,823	$59,039
Average per M	$14.93	$13.43	$12.99	$10.98	$10.16
Fancy or ornamental .value	(a)	(a)	(a)	(a)	(a)
Fire do	$514,990	$347,415	$328,644	$341,524	$321,048
Stove lining do	$86,248	$82,803	$75,751	$67,327	$57,837
Draintile do	$272,836	$112,609	$51,005	$83,695	$66,217
Sewer pipe do	$136,576	$116,184	(a)	(a)	(a)
Architectural terra cotta do	$1,108,371	$673,529	$1,139,291	$1,110,726	$889,468
Fireproofing do	$210,954	$227,871	$217,411	$208,625	$161,725
Tile, not drain do	$72,815	$86,602	$45,865	$67,700	(a)
Red earthenware do	$26,863	$34,295	$31,497	$38,290	$36,251
Stoneware and yellow and Rockingham ware value	$43,325	$40,946	(a)	(a)	(a)
White ware, including C. C. ware, white granite, semi-porcelain ware, and semi-vitreous porcelain ware, value	(a)	(a)	(a)	(a)	(a)
China, bone china, delft, and belleek ware value	$642,592	$730,983	$691,065	$763,322	$784,604
Sanitary ware do	(a)	(a)	(a)	(a)	(a)
Porcelain electrical supplies, value	$957,101	$988,716	$1,269,108	$1,560,870	$940,029
Miscellaneous value	$429,660	$399,846	$487,079	$599,794	$581,006
Total value	$11,871,949	$10,184,376	$12,058,858	$11,469,476	$9,078,933
Number of active firms reporting	240	222	219	215	205
Rank of State	5	5	5	5	5

[a] Included in "Miscellaneous."

NORTH CAROLINA.

The value of clay products in North Carolina in 1914 was $1,460,790, a decrease of $153,616, or 9.52 per cent, from 1913. The chief clay product is common brick, which decreased 20,449,000 brick in quantity and $137,882 in value from 1913, and whose value constituted 83.25 per cent of all clay products in North Carolina in 1914. Front brick and draintile were made in small quantities. Sewer pipe was made in considerable quantity by one operator; hence the figures are not published. The production of pottery was valued at $12,796 in 1914.

Wayne is the principal common-brick producing county and reported 25,682,000 brick, valued at $177,775 in 1914, a decrease of 7,618,000 brick in quantity and of $52,225 in value from 1913. Craven County was second in quantity and value and Pitt County was third.

Guilford is the principal clay-working county in the State and reported for 1914 products valued at $249,263, a decrease of $32,279 from 1913. Common brick, draintile, sewer pipe, and fireproofing were reported from this county for 1914. Wayne County was second in the value of all clay products in 1914.

Clay products of North Carolina, 1910–1914.

Products.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	167,966,000	178,235,000	193,058,000	204,097,000	183,648,000
Value	$1,039,319	$1,076,183	$1,236,443	$1,354,062	$1,216,180
Average per M	$6.19	$6.04	$6.40	$6.63	$6.62
Front—					
Quantity	550,000	(a)	(a)	(a)	(a)
Value	$5,800	(a)	(a)	(a)	(a)
Average per M	$10.55	$9.81	$8.92	$8.89	$11.42
Fire ... value	....	(a)	$4,430	....	....
Draintile ... do	$9,555	$11,704	$10,745	$13,584	$11,850
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	(a)	....	(a)	(a)
Pottery:					
Red earthenware ... do	$1,961	$1,333	$778	$2,318	$1,477
Stoneware and yellow and Rockingham ware .. value	$13,029	$7,223	$8,172	$10,365	$11,078
Miscellaneous ... do	$154,000	$183,683	$205,085	$234,077	$220,205
Total value	$1,223,664	$1,280,126	$1,465,653	$1,614,406	$1,460,790
Number of active firms reporting.	184	163	162	157	157
Rank of State	25	24	23	22	23

a Included in "Miscellaneous."

OHIO.

Ohio is the leading State of the Union in the value of clay products. For 1914 it reported all the brick and tile products as classified in this report, except enameled brick and terra cotta, and all the pottery products except china. It was the leading State in 1914 in the production and value of vitrified paving brick, and in the value of sewer pipe, fireproofing, tile, not drain, red earthenware, stoneware, white ware, and porcelain electrical supplies; second in the value of draintile and in the production and value of front brick and fire brick; and fourth in the production and value of common brick, and in value of fancy brick and sanitary ware.

The value of its clay products in 1914 was $37,166,768, or 22.53 per cent of the total for the country, a decrease of $1,221,528 from 1913. Ohio's brick and tile production in 1913 was valued at $21,815,392 and its pottery production at $15,351,376. Ohio's principal clay product is white ware, which reported a decrease of $320,822 from 1913 and whose value constituted 27.52 per cent of the value of all Ohio's clay products in 1914. Sewer pipe was the second product and reported a decrease of $467,829 from 1913. Vitrified brick, the third product in value, decreased 11,010,000 brick in quantity but increased $373,255 in value in 1914. The fourth product, common brick, increased 28,432,000 brick in quantity and $339,095 in value over 1913. Common brick was followed in order by tile, not drain, which decreased $161,301 from 1913, and fireproofing, which increased $84,683 over 1913.

Sewer pipe is produced most largely in Summit County and next in quantity in Jefferson County, these two counties reporting 62.22 per cent of the total for the State. The leading county in the value of vitrified paving brick in 1913 was Stark; Athens was second in production and third in value, and Cuyahoga was third in production but second in value in 1914. Cuyahoga was the leading county in production of common brick in 1914, reporting 127,450,000 brick, valued at $789,789, or 29.22 per cent of the quantity and 27.59 per cent of the value for the entire State, and an increase of 19,654,000 brick in quantity and of $149,766 in value over 1913. The city of

Cleveland furnishes the principal market for this output. Lucas County was second, reporting a decrease of 187,000 brick in quantity but an increase of $47,769 in value compared with 1913. Columbiana the most important clay-working county in Ohio, is the principal producer of white ware. The clay products for this county in 1914 were valued at $7,604,912, or 20.46 per cent of the State's total, and a decrease of $1,315,941 from 1913; and the value of the white ware in 1914 was $6,126,819, or 59.9 per cent of the total for the State, and a decrease of $537,863 from 1913.

Muskingum, the second county in the State in the value of all clay products, reported wares valued at $3,479,960, of 9.36 per cent of the State's total, a decrease of $135,645 from 1913. Of the value in 1914 of Muskingum's clay products $2,038,537 was brick and tile, principally tile, not drain, and $1,441,423 was pottery, principally stoneware. Summit County was third in importance, reporting clay products valued at $3,308,865, a decrease of $78,153 from 1913. Of this total, $2,405,829 was brick and tile and $903,036 was pottery. Summit County's principal brick and tile product is sewer pipe ($1,638,533 in 1914) and its principal pottery product is porcelain electrical supplies ($452,774 in 1914). Mahoning County, fourth in the value of clay products, reported for 1914 wares valued at $2,689,113, of which $2,504,726 was pottery and $184,387 was brick and tile, the principal pottery product being white ware ($2,366,576 in 1914).

Clay products of Ohio, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	409,773,000	389,515,000	395,836,000	407,685,000	436,117,000
Value	$2,507,742	$2,299,194	$2,414,482	$2,523,014	$2,862,109
Average per M	$6.12	$5.90	$6.10	$6.19	$6.56
Vitrified—					
Quantity	289,817,000	315,944,000	268,271,000	304,391,000	293,381,000
Value	$2,876,157	$3,200,475	$2,830,309	$3,308,975	$3,682,230
Average per M	$9.92	$10.13	$10.55	$10.87	$12.55
Front—					
Quantity	134,759,000	159,118,000	184,405,000	185,810,000	188,074,000
Value	$1,489,094	$1,630,898	$1,836,989	$1,950,433	$1,944,486
Average per M	$11.05	$10.25	$9.96	$10.50	$10.34
Fancy or ornamental..value	$32,995	$25,340	$16,692	$20,950	$14,727
Enameled....do	....	....	(a)	(a)	....
Fire....do	$1,709,039	$1,539,450	$1,629,638	$1,961,020	$1,833,740
Stove lining....do	(a)	$86,673	$37,544	(a)	$51,192
Draintile....do	$1,869,823	$1,684,420	$1,546,723	$1,508,564	$1,589,565
Sewer pipe....do	$3,289,537	$3,445,601	$4,022,078	$5,159,548	$4,691,719
Fireproofing....do	$934,960	$1,086,287	$1,750,715	$2,115,861	$2,200,544
Tile, not drain....do	$1,896,572	$2,312,482	$2,421,783	$2,492,380	$2,331,079
Pottery:					
Red earthenware	$161,799	$233,060	$263,085	$236,883	$300,453
Stoneware and yellow and Rockingham ware..value	$1,664,572	$1,758,785	$1,832,266	$1,649,186	$1,592,102
White ware, including C. C. ware, white granite, semi-porcelain ware, and semi-vitreous porcelain ware, value	$9,730,408	$9,612,315	$9,969,491	$10,548,628	$10,227,806
Sanitary ware....do	$327,438	$378,779	$451,971	$590,193	$619,931
Porcelain electrical supplies, value	$1,277,144	$1,610,925	$1,827,290	$2,184,201	$1,472,359
Miscellaneous....value	$1,758,668	$1,759,211	$1,960,452	$2,138,460	$1,752,726
Total value	$31,525,948	$32,663,895	$34,811,508	$38,388,296	$37,166,768
Number of active firms reporting	683	633	596	563	543
Rank of State	1	1	1	1	1

a Included in "Miscellaneous."

PENNSYLVANIA.

Pennsylvania ranks second in the value of clay products, reporting for 1914 every variety of ware as classified in this report except enameled brick. In 1914 it was second in the value of brick and tile products and fifth in the value of pottery; it was the leading producer of front, fancy, and fire brick, reporting one-fourth of the front brick, one-third of the fancy brick, and two-fifths of the clay fire brick; second in the production of stove lining and red earthenware; third in the production and value of common brick and vitrified paving brick and in the value of china; fourth in the value of sewer pipe, tile, not drain, stoneware, and white ware, and sixth in the value of terra cotta and fireproofing.

Pennsylvania's clay products in 1914, valued at $21,846,996, decreased $2,384,486, or 9.84 per cent, from 1913. This total was 13.24 per cent of the value of all clay products of the country. Its brick and tile production was valued at $20,100,495 and its pottery production at $1,746,501. Its principal brick and tile product is fire brick, and its chief pottery product is white ware.

Pennsylvania's clay product of greatest value is fire brick. Silica fire brick included, Pennsylvania produced 396,519,000 9-inch equivalent brick for 1914, valued at $7,836,503, or $19.76 per 1,000, a decrease of 97,071,000 brick in quantity and of $1,867,231 in value from 1913. Of the clay fire brick, Pennsylvania reported 298,183,000 brick, valued at $5,774,677, or $19.37 per 1,000, a decrease of 63,365,000 brick and of $1,320,117 from 1913. It reported 98,336,000 9-inch equivalent silica fire brick for 1914, valued at $2,061,826, or $20.97 per 1,000. This was a decrease of 33,706,000 brick in quantity and of $547,114 in value from 1913. The value of all fire-brick production in Pennsylvania in 1914 was 35.87 per cent of the State's total for all clay products. Pennsylvania's second clay product in value is common brick. The quantity reported for 1914 was 688,178,000 brick, valued at $4,641,269, or $6.74 per 1,000, a decrease of 16,315,000 brick in quantity and of $130,960 in value from 1913. Its third product in output is front brick, which increased 5,189,000 brick and $77,160 in value over 1913. The average value per 1,000 increased 9 cents to $10.92.

Philadelphia County, the fourth largest common-brick center of the country, with the city of Philadelphia for a market, is the principal producer in Pennsylvania of common brick, reporting 182,381,000 brick for 1914, valued at $1,288,467, a decrease of 3,750,000 brick in quantity and of $65,153 in value from 1913, and Allegheny County, the home of "Greater Pittsburgh," is second, with 113,094,000 brick, valued at $767,663, in 1914, an increase of 20,664,000 brick in quantity and of $146,939 in value over 1913. Vitrified paving brick was produced most largely in Lawrence County in 1914, with Beaver County second and McKean third. Front brick is made chiefly in Armstrong County, 78,232,000 brick, valued at $875,797, or over one-third of the production and value for the State being reported for 1914 from this county, an increase of 7,738,000 brick in quantity and of $69,601 in value over 1913. Clearfield County is the largest producer of clay fire brick and reported 81,422,000 9-inch equivalent brick, valued at $1,587,959, or more than one-fourth of the production and value of all clay fire brick for the State, a decrease of 19,719,000 brick in quantity and of $621,103 in value from 1913. Huntingdon County is the largest producer of silica fire brick and reported 53,485,000 9-inch equivalent brick, valued at $1,200,571, or over one-half of the production and value for the State, a decrease of 16,802,000 brick in quantity and of $232,684 in value from 1913.

Allegheny County, displacing Clearfield, was the most important clay-working county in the State in 1914, and reported wares, valued at $2,328,483, an increase of $134,841 over 1913. Allegheny County's chief product was fire brick. Clearfield County was second in importance in clay working, its products being valued at $2,058,101, a decrease of $554,090 from 1913. Clearfield's principal product is fire brick, though considerable quantities of vitrified and front brick are made there also. Philadelphia County was third with clay products valued at $2,052,920, a decrease of $134,225 from 1913. The principal product of this county is common brick, though architectural terra cotta and fire brick are also important products.

Clay products of Pennsylvania, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	828,703,000	774,122,000	697,023,000	704,493,000	688,178,000
Value	$5,371,707	$4,963,232	$4,590,784	$4,772,229	$4,641,269
Average per M	$6.48	$6.41	$6.59	$6.77	$6.74
Vitrified—					
Quantity	101,330,000	124,125,000	112,372,000	140,407,000	151,200,000
Value	$1,204,724	$1,511,061	$1,411,096	$1,814,833	$2,052,676
Average per M	$11.89	$12.17	$12.56	$12.93	$13.58
Front—					
Quantity	171,415,000	184,569,000	217,328,000	214,734,000	219,923,000
Value	$2,001,967	$2,111,492	$2,321,479	$2,325,201	$2,402,361
Average per M	$11.68	$11.44	$10.68	$10.83	$10.92
Fancy or ornamental . value	$35,768	$44,883	$43,186	$35,446	$51,068
Enameled . do	(a)	(a)	(a)	....	....
Fire . do	$6,454,928	$5,555,529	$6,178,870	$7,094,794	$5,774,677
Stove lining . do	$132,567	$164,848	$138,630	$142,303	$129,419
Draintile . do	$11,480	$12,779	$12,421	$11,730	$14,730
Sewer pipe . do	$583,418	$560,809	$829,917	$1,326,971	$940,384
Architectural terra cotta . do	$472,150	$389,000	$569,943	$506,100	$362,348
Fireproofing . do	$300,187	$300,687	$350,219	$480,675	$494,175
Tile, not drain . do	$413,047	$358,913	$385,952	$385,322	$388,887
Pottery:					
Red earthenware . do	$178,348	$159,420	$162,137	$187,625	$194,581
Stoneware and yellow and Rockingham ware . value	$323,990	$304,998	$281,526	$268,407	$282,511
White ware, including C. C. ware, white granite ware, semiporcelain ware, and semivitreous porcelain ware . value	(a)	(a)	$902,585	$839,838	(a)
China, bone china, delft, and belleek ware . value	$188,122	$216,724	$280,472	(a)	(a)
Sanitary ware . do	$254,747	$215,590	$185,000	$153,000	(a)
Porcelain electrical supplies . value	(a)	(a)	$307,636	$295,908	(a)
Miscellaneous . do	$4,167,135	$3,400,068	$2,585,368	$3,591,100	$4,117,910
Total value	$22,094,285	$20,270,033	$21,537,221	$24,231,482	$21,846,996
Number of active firms reporting	451	423	393	377	369
Rank of State	2	2	2	2	2

a Included in "Miscellaneous."

TENNESSEE.

The total value of all Tennessee's clay products in 1914 was $1,546,315, an increase of $53,230, or 3.57 per cent, over 1913. The principal product was common brick, of which 137,406,000 were reported for 1914, valued at $843,363, or $6.14 per 1,000, a decrease of 13,666,000 brick in quantity and of $59,469 in value. The value of common brick constituted 54.54 per cent of the value of all clay products of the State in 1914. Front brick was second in importance in 1914, there being 18,594,000 brick reported, valued at $190,893, an increase of 2,509,000 brick in quantity and of $36,212 in value over 1913.

Davidson County was the largest producer of common brick in 1914, reporting 30,887,000 brick, valued at $173,734. Shelby County was second in the value of common brick ($164,853), although Sullivan County's production (24,428,000) was larger than Shelby's (20,461,000 brick) in 1914.

Hamilton County was the principal clay-working county of the State, its production being valued in 1914 at $454,774, or 29.41 per cent of the State's total, an increase of $13,793 over 1913, and Davidson County was second. Hamilton County's chief clay products in 1914 were common brick, front brick, sewer pipe, and turpentine cups; and Davidson's chief products were common brick and front brick.

Clay products of Tennessee, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	140,878,000	144,824,000	154,211,000	151,072,000	137,406,000
Value	$826,533	$842,864	$903,032	$902,832	$843,363
Average per M	$5.87	$5.82	$5.86	$5.98	$6.14
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$10.80	$10.41	$11.11	$15.32	$15.26
Front—					
Quantity	10,119,000	9,547,000	11,118,000	16,085,000	18,594,000
Value	$98,450	$94,733	$101,575	$154,681	$190,893
Average per M	$9.73	$9.92	$9.14	$9.62	$10.27
Fancy ....value..	(a)	(a)	(a)	....	$1,469
Fire ....do....	$14,907	$15,915	$10,981	$13,205	$19,717
Draintile ....do....	$29,707	$51,721	$39,459	$42,294	$48,551
Sewer pipe ....do....	(a)	(a)	(a)	(a)	(a)
Fireproofing ....do....	(a)	(a)	(a)	(a)	(a)
Pottery:					
Red earthenware......do....	$4,540	$3,938	$1,205	$2,153	$4,437
Stoneware and yellow and Rockingham ware..value..	$44,640	$38,759	$44,089	$36,153	$27,227
Miscellaneous ....do....	$395,511	$337,170	$400,675	$341,767	$410,658
Total value	$1,414,288	$1,385,100	$1,501,016	$1,493,085	$1,546,315
Number of active firms reporting	97	84	80	79	75
Rank of State	24	23	22	23	21

a Included in "Miscellaneous."

TEXAS.

The value of clay products in Texas in 1914 was $2,280,987, a decrease of $768,362, or 25.20 per cent, from 1913. In 1913 Texas was the tenth State in the production and value of common brick; it was ninth in the production of front brick and eighth in value. The principal product is common brick. There were reported for 1914, 182,695,000 brick, valued at $1,180,586, a decrease of 65,576,000 brick in quantity and of $646,207 in value from 1913. The value of common brick constituted 51.76 per cent of the value of all clay products of the State. Sewer pipe ranked second, front brick third, and fireproofing fourth. The production of pottery was valued at $58,747 in 1914.

Ellis County was the largest producer of common brick for 1914, reporting 59,595,000 brick, valued at $377,714, a decrease of 30,886,000 brick in quantity and of $234,677 in value. Sewer pipe was reported from Wilson and Bowie counties in considerable quantities, but there being less than 3 producers figures are not published. Ellis County is the leading clay-working county in the State. It reported nothing but common brick for 1914.

Clay products of Texas, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	271,640,000	255,811,000	242,748,000	248,271,000	182,695,000
Value	$1,779,062	$1,596,763	$1,590,960	$1,826,793	$1,180,586
Average per M	$6.55	$6.24	$6.55	$7.36	$6.46
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$13.67	$15.92	$14.56	$12.85	$14.01
Front—					
Quantity	21,646,000	19,331,000	24,510,000	21,766,000	18,450,000
Value	$325,074	$297,847	$394,524	$293,077	$249,611
Average per M	$15.02	$15.41	$16.10	$13.46	$13.53
Fire ... do	$75,950	$78,230	$112,983	$104,338	$82,838
Stove lining ... do				(a)	
Draintile ... do	$18,408	$12,817	$10,694	$8,840	$14,414
Sewer pipe ... do	(a)	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	$47,038	$57,433	$129,763	$145,830
Pottery:					
Red earthenware ... do	$6,481	$8,963	$9,351	$7,894	$12,724
Stoneware and yellow and Rockingham ware ... value	$112,604	$123,454	$137,253	$72,480	$44,230
Miscellaneous ... do	$546,351	$494,807	$572,870	$606,164	$550,754
Total value	$2,863,930	$2,659,919	$2,886,068	$3,049,349	$2,280,987
Number of active firms reporting	124	118	104	102	102
Rank of State	12	12	11	11	13

a Included in "Miscellaneous."

VIRGINIA.

The total value of Virginia's clay products in 1914 was $1,472,348, a decrease of $233,303, or 13.68 per cent, from 1913. In 1914 Virginia was the eighth State in the production and value of common brick and was tenth in the production and value of front brick. Virginia's chief clay product is common brick, principally from the Coastal Plain region. There were 187,102,000 brick reported for 1914, valued at $1,229,356, a decrease of 30,306,000 brick and of $180,442 from 1913. This product constituted 83.5 per cent of the value of the State's clay products in 1914. Front brick is the only other clay product of importance in Virginia. In 1914 it was valued at $212,537, a decrease of $34,605 from 1913. The average price per 1,000 of common brick increased 9 cents to $6.57, and that for front brick decreased $1.07 to $12.63.

Henrico was the leading county producing common brick in 1914 and reported 40,300,000 brick, valued at $285,675, or $7.09 per 1,000, a decrease of 4,026,000 brick, but an increase of $1,144 in value compared with 1913. The average price per 1,000 in this county increased 67 cents. Alexandria County was second, reporting 23,695,000 brick, valued at $144,604, or $6.10 per 1,000, a decrease of 6,032,000 brick and of $35,258 from 1913. These two counties are the principal sources of supply of common brick for Richmond, Va., and Washington, D. C., respectively. Front brick was made most largely in Alexandria County, and it is that county's chief clay product.

Alexandria County was the leading clay-working county in the State in 1914, reporting wares valued at $343,856, a decrease of $79,707 from 1913.

Clay products of Virginia, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	229,982,000	219,035,000	244,541,000	217,408,000	187,102,000
Value	$1,460,460	$1,374,439	$1,513,338	$1,409,798	$1,229,356
Average per M	$6.35	$6.27	$6.19	$6.48	$6.57
Vitrified—					
Quantity				(a)	(a)
Value				(a)	(a)
Average per M				$12.88	$10.00
Front—					
Quantity	20,813,000	21,032,000	21,755,000	18,040,000	16,831,000
Value	$294,348	$314,201	$313,551	$247,142	$212,537
Average per M	$14.14	$14.94	$14.41	$13.70	$12.63
Fancy or ornamental . value	(a)	(a)	(a)	(a)	(a)
Fire . do	(a)	(a)	(a)	(a)	$11,641
Draintile . do	$5,276	$10,875	$4,025	$6,400	$4,500
Sewer pipe . do	(a)	(a)	(a)	(a)	(a)
Fireproofing . do					(a)
Pottery:					
Sanitary ware . do		(a)			
Porcelain electrical supplies, value	(a)				
Miscellaneous . value	$79,603	$40,385	$43,260	$42,311	$14,314
Total value	$1,839,687	$1,739,900	[b] $1,874,174	[b] $1,705,651	[b] $1,472,348
Number of active firms reporting	84	77	75	69	67
Rank of State	20	19	18	21	22

[a] Included in "Miscellaneous."

[b] The value of pottery products for Virginia for 1912, 1913, and 1914 could not be included in the State total without disclosing individual figures. The entire product for those years was classified as miscellaneous pottery.

WASHINGTON.

The total value of the clay products of Washington in 1914 was $1,809,491, a decrease of $580,735, or 24.3 per cent from 1913. Every product except draintile decreased in value in 1914 compared with 1913. Washington was the ninth State in the production and eighth in the value of vitrified brick, and seventh in the value of architectural terra cotta. Washington's principal clay product in 1914 was sewer pipe, which was valued at $462,898, a decrease of $38,204 from 1913. Vitrified brick ranked second, but there being less than 3 producers in 1914, figures are not published. Common brick was the third product in value, and there were 51,657,000 brick reported for 1914, valued at $351,565, a decrease of 15,778,000 brick and of $124,309 from 1913.

King County, with Seattle and Tacoma for markets, is the principal producer of common brick, and reported 25,678,000 brick in 1914, or 49.71 per cent of the State's total, valued at $164,710, or 46.85 per cent of the total. This was a decrease of 5,134,000 brick and of $43,245 from 1913. King is also the leading clay-working county, reporting wares in 1914 valued at $1,091,525, or 60.32 per cent of the State's total, a decrease of $425,782, from 1913. Spokane County, whose principal product in 1914 was sewer pipe, was second with wares valued at $265,842.

Clay products of Washington, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	130,634,000	99,588,000	78,000,000	67,435,000	51,657,000
Value	$956,510	$695,100	$547,061	$475,874	$351,565
Average per M	$7.32	$6.98	$7.01	$7.06	$6.81
Vitrified—					
Quantity	(a)	40,291,000	(a)	42,717,000	(a)
Value	(a)	$743,352	(a)	$701,550	(a)
Average per M	$18.87	$18.45	$16.88	$16.42	$18.99
Front—					
Quantity	5,570,000	5,224,000	6,881,000	6,122,000	5,319,000
Value	$124,952	$118,615	$146,265	$128,989	$109,197
Average per M	$22.43	$22.71	$21.26	$21.07	$20.53
Fancy value		(a)			
Fire do	$25,017	$63,654	$34,293	$66,178	29,869
Stove lining		(a)	(a)	(a)	
Draintile do	$34,128	$29,314	$24,676	$28,172	$48,750
Sewer pipe do	$817,086	$738,473	$496,500	$501,102	$462,898
Architectural terra cotta do	$198,358	$283,608	$365,109	$316,628	$220,788
Fireproofing do	$114,501	$153,180	$163,077	$157,069	$127,371
Tile, not drain do			(a)		
Pottery:					
Red earthenware do	(b)	(b)	(b)	(b)	(b)
Stoneware and yellow and Rockingham ware value	(b)	(b)	(b)	(b)	(b)
Miscellaneous do	$753,302	$758,428	$611,889	$14,664	$459,053
Total value	$3,023,854	$2,840,372	$2,388,870	$2,390,226	$1,809,491
Number of active firms reporting	65	55	50	45	51
Rank of State	11	11	15	15	18

[a] Included in "Miscellaneous."
[b] The value of pottery products for Washington could not be included in the State totals without disclosing the operations of individual establishments.

WEST VIRGINIA.

West Virginia was the ninth State in the value of clay products in 1914, a gain of one place in rank over 1913. Its clay products were valued at $5,761,411—pottery $3,930,464, or 68.22 per cent of the total, and brick and tile $1,830,947, or 31.78 per cent of the total.

This was an increase of $553,141, or 10.62 per cent, over 1913. This increase was principally in pottery ($505,577), brick and tile increasing only $47,564. In 1914 West Virginia was second in the value of white ware and sanitary ware, fourth in the value of china and porcelain electrical supplies and in the production and value of vitrified paving brick, and seventh in the value of tile, not drain. West Virginia's principal clay product is white ware; in 1914 it was valued at $2,577,766, or 44.74 per cent of the State's total. Second in importance in 1914 was vitrified brick, valued at $899,215, an increase of $103,660 over 1913. The quantity of vitrified brick increased 9,022,000 brick in 1914, and the average price per 1,000 decreased 28 cents, to $13.27. The third product was sanitary ware, which was valued at $872,987, a decrease of $273,218 from 1913. Common brick, the fourth product in value, also decreased slightly in quantity and value—723,000 brick and $26,006. The average price per 1,000 for common brick decreased 31 cents, or to $6.62.

Hancock County is the leading producer of vitrified brick and reported 53,729,000 brick, valued at $723,557, or 79.3 per cent of the quantity and 80.47 per cent of the value for the entire State in 1914. This was an increase of 3,679,000 brick and of $34,294 over 1913.

Hancock is the leading clay-working county of the State, its production in 1914 being valued at $3,275,501, or 56.85 per cent of the State's total, an increase of $435,637 over 1913. Of this production, $2,387,347 was pottery, principally white ware, and $888,154 was brick and tile, principally vitrified brick. West Virginia ranked third in the value of pottery produced in 1914.

Clay products of West Virginia, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	77,916,000	59,961,000	60,819,000	68,745,000	68,022,000
Value	$508,422	$400,916	$393,864	$476,248	$450,242
Average per M	$6.53	$6.69	$6.48	$6.93	$6.62
Vitrified—					
Quantity	46,098,000	56,956,000	52,200,000	58,728,000	67,750,000
Value	$564,578	$681,747	$633,709	$795,555	$899,215
Average per M	$12.25	$11.97	$12.14	$13.55	$13.27
Front—					
Quantity	(a)	(a)	(a)	2,732,000	2,354,000
Value	(a)	(a)	(a)	$33,484	$37,114
Average per M	$10.00	$14.98	$12.00	$12.26	$15.77
Fire....value	$32,003	$74,596	$105,719	$155,423	$146,668
Draintile....do	$2,330	$3,487	(a)	$3,191	$3,733
Sewer pipe....do	(a)	(a)	(a)	(a)	(a)
Fireproofing....do	(a)	(a)	(a)	(a)	(a)
Tile, not drain....do	$104,633	$136,586	$200,390	$259,109	$207,778
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	$1,894,429	$1,920,294	$2,051,987	$2,024,104	$2,577,766
China, bone china, delft, and belleek ware....do	....	(a)	$50,002	(a)	(a)
Sanitary ware....do	$618,868	$814,599	$1,156,478	$1,146,205	$872,987
Porcelain electrical supplies, value	(a)	(a)	(a)	(a)	(a)
Miscellaneous....value	$272,782	$301,195	$183,725	$314,951	$565,908
Total value	$3,998,045	$4,333,420	$4,775,874	$5,208,270	$5,761,411
Number of active firms reporting	56	55	54	58	58
Rank of State	10	10	9	10	9

[a] Included in "Miscellaneous."

WISCONSIN.

The total value of Wisconsin's clay products in 1914 was $950,999, a decrease of $69,729, or 6.83 per cent, from 1913. Wisconsin's principal clay product is common brick, of which there were 115,056,000 reported for 1914, valued at $799,109, a decrease of 1,478,000 brick and of $16,352 from 1913. The value of common brick constituted 84.03 per cent of the total value of Wisconsin's clay products in 1914. The pottery produced in Wisconsin in 1914, which was entirely red earthenware, was valued at $7,000.

Milwaukee was the leading clay-working county with products in 1914 valued at $297,134, nearly all of which was common brick. This county reported 41,928,000 common brick, valued at $288,934, an increase of 3,795,000 brick and of $19,991 over 1913. There was a slight increase in the value of Milwaukee County's clay products in 1914 over 1913. Dunn County, whose principal clay product also is common brick, was second in 1914, and reported a decrease in value of $33,057 from 1913.

Clay products of Wisconsin, 1910–1914.

Product.	1910	1911	1912	1913	1914
Brick:					
Common—					
Quantity	161,083,000	151,331,000	122,910,000	116,534,000	115,056,000
Value	$1,071,457	$985,824	$830,773	$815,461	$799,109
Average per M	$6.65	$6.51	$6.76	$7.00	$6.95
Front—					
Quantity	2,400,000	9,920,000	14,096,000	11,178,000	8,388,000
Value	$29,900	$100,140	$135,520	$121,739	$78,766
Average per M	$12.46	$10.09	$9.61	$10.89	$9.39
Fancy or ornamental. value	(a)				
Stove lining ... do					(a)
Draintile ... do	$64,391	$58,547	$67,993	$73,328	$60,924
Fireproofing ... do		(a)			(a)
Pottery:					
Red earthenware ... do	$8,965	$8,600	$7,900	$7,700	$7,000
Miscellaneous ... do	$2,170	$5,028	$2,300	$2,500	$5,200
Total value	$1,176,883	$1,158,139	$1,044,486	$1,020,728	$950,999
Number of active firms reporting	112	101	92	85	77
Rank of State	26	26	26	26	26

[a] Included in "Miscellaneous."

CLAY.

INTRODUCTION.

Clay available for the manufacture of clay products is one of the most widely distributed 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 and tile, for paper making, and for refractory products.

The condition of the clay-mining industry in 1914 was not so satisfactory as in 1913, the production and value showing considerable decrease. But three varieties showed increase over 1913, and none reached its maximum quantity or value in 1914. Compared with earlier years, however, the conditions should be encouraging. There were but two years when the value of the clay marketed exceeded that of 1914. In 1913 but two varieties, slip clay and brick clay, decreased as compared with 1912, and two varieties, paper clay and fire clay, reached their maximum quantity and value. Kaolin, which is the purest form of clay, and in some respects the most important of our clays, showed an increase in quantity and value in 1914, as compared with 1913, as did ball clay also, which is an indication that domestic kaolin is being used to an increasing extent in the manufacture of American pottery, as these clays find their chief use in these wares. Brick clay also showed an increase over 1913 in quantity and value. The average price per ton for four of the varieties of clay increased in 1914, and the general average increased 12 cents.

The total imports of clay showed the remarkable increase in 1914 of nearly 18 per cent in quantity and 14 per cent in value, and imports of kaolin increased 22 per cent in quantity and more than 18 per cent in value, compared with 1913.

PRODUCTION.

The following table shows the production of clay in 1913 and 1914, by varieties:

Production of clay in the United States in 1913 and 1914, by varieties, in short tons.

Variety.	1913			1914		
	Quantity.	Value.	Average price. per ton.	Quantity.	Value.	Average price per ton.
Kaolin	28,834	$235,457	$8.17	34,191	$284,817	$8.33
Paper clay	126,377	567,977	4.49	116,328	558,334	4.80
Slip clay	10,902	24,505	2.25	8,237	17,731	2.15
Ball clay	67,134	237,672	3.54	67,927	255,767	3.77
Fire clay	1,820,379	2,592,591	1.42	1,409,467	2,147,277	1.52
Stoneware clay	153,353	143,587	.94	130,383	116,610	.89
Brick clay	158,890	137,976	.87	199,154	161,852	.81
Miscellaneous	282,120	240,694	.85	244,173	214,180	.88
Total	2,647,989	4,180,459	1.58	2,209,860	3,756,568	1.70

The total quantity of clay mined and sold as such in 1914 was 2,209,860 short tons, compared with 2,647,989 tons in 1913, a decrease of 438,129 tons, or 16.55 per cent. This clay was valued at $3,756,568, or $1.70 per ton, compared with $4,180,459, or $1.58 per ton, in 1913, a decrease of $423,891, or 10.14 per cent. Every variety except kaolin, ball, and brick clay decreased in quantity and value in 1914. Fire clay showed the largest decrease in quantity, 410,912 tons; stoneware clay decreased 22,970 tons; paper clay, 10,049 tons; and slip clay, 2,665 tons. Brick clay increased 40,264 tons, and kaolin increased 5,357 tons. Fire clay showed the largest decrease in value, $445,314; stoneware clay decreased $26,977, and paper clay decreased $9,643 in value, compared with 1913. Kaolin showed the largest increase in value, $49,360; brick clay increased $23,876; and ball clay increased $18,095 over 1913. Fire clay is the principal variety judged by quantity and value of clay sold, this variety constituting 63.78 per cent of the quantity, and 57.16 per cent of the value of all clay marketed as such in 1914. Paper clay was second in value of output. The average price per ton varied but little in 1914 compared with 1913, the general average increasing only 12 cents per ton. The greatest change was in paper clay, which advanced 31 cents per ton; kaolin increased 16 cents a ton, and ball clay, 23 cents a ton.

Clay mined and sold in the United States, 1905–1914, 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
1913	28,834	235,457	126,377	567,977	10,902	24,505	67,134	237,672	1,820,379	2,592,591
1914	34,191	284,817	116,328	558,334	8,237	17,731	67,927	255,767	1,409,467	2,147,277

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
1913	153,353	143,587	158,890	137,976	282,120	240,694	2,647,989	4,180,459
1914	130,383	116,610	199,154	161,852	244,173	214,180	2,209,860	3,756,568

[a] Included in "Miscellaneous" in 1905 and 1906.

This table shows that the maximum both in quantity and value of clay mined and sold in the period covered was attained in 1913. The production rose steadily, except in 1908 and 1911, from 1,806,133 short tons in 1905 to 2,647,989 tons in 1913, and in value from $2,768,006 to $4,180,459, an increase in production of 841,856 tons, or 46.61 per cent, and in value of $1,412,453, or 51.03 per cent. The total quantity and value for 1914 decreased from 1913, but were large compared with earlier years. In only three years, 1910, 1912, and 1913, was the production of 1914 exceeded, and in only two years, 1912 and 1913, was the value of clay marketed greater than in 1914. Kaolin reached its maximum production and value in 1906, and its minimum in quantity in 1912 and its minimum in value in 1908. Paper clay and fire clay reached their greatest quantity and value in 1913. Ball clay reached its maximum quantity and value in 1910.

Clay mined and sold in the United States in 1913, 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									49,601	$53,269	(b)	(b)					49,901	$53,419
California									97,793	104,980	6,384	$5,663	24,141	$32,163	25,553	$24,503	153,871	167,309
Colorado									25,910	43,364	(b)	(b)	39,038	26,228			65,579	70,350
Connecticut													(b)	(b)			(b)	(b)
Delaware	6,830	$57,343							(b)	(b)							11,482	66,647
Florida							(b)	(b)									(b)	(b)
Georgia			69,740	$299,110	(b)	(b)			13,650	8,475	(b)	(b)			71,480	9,851	156,374	324,671
Idaho									(b)	(b)							(b)	(b)
Illinois									106,216	125,477	55,001	43,616	(b)	(b)	(b)	(b)	194,937	204,037
Indiana									64,481	57,169	(b)	(b)			5,260	8,760	74,581	70,929
Iowa									(b)	(b)			(b)	(b)	1,737	1,066	2,655	1,900
Kentucky							(b)	(b)	81,029	98,168	(b)	(b)	(b)	(b)	10	200	91,114	113,871
Maryland	(b)	(b)	(c)	(c)					21,235	32,850	2,375	2,075	(b)	(b)	c 759	c 1,180	24,829	36,955
Massachusetts									(b)	(b)			(b)	(b)	100	100	843	1,807
Michigan					1,710	$6,504											1,710	6,504
Minnesota															(b)	(b)	(b)	(b)
Mississippi											(b)	(b)					(b)	(b)
Missouri	304	1,957							235,606	465,900	(b)	(b)	(b)	(b)	520	525	238,032	470,277
Montana									3,410	3,314							3,410	3,314
New Jersey							2,256	$8,522	327,175	576,957	18,231	43,180	35,134	29,941	65,339	111,089	448,135	769,689
New Mexico									3,513	9,906							3,513	9,906
New York					(b)	(b)			(b)	(b)					1,124	902	5,518	9,568
North Carolina	16,332	139,629									(b)	(b)					16,352	139,644
North Dakota									(b)	(b)							(b)	(b)
Ohio					(b)	(b)			250,003	205,407	62,381	40,005	37,341	18,438	31,790	11,900	384,325	277,455
Oregon									(b)	(b)	(b)	(b)					(b)	(b)
Pennsylvania	(b)	(b)	25,069	148,347					421,751	656,825			12,345	15,705	20,333	15,914	479,548	836,916
South Carolina			31,568	120,520					(b)	(b)							32,222	124,249
Tennessee							29,258	85,500	26,470	38,422	250	161			326	489	56,304	124,572
Texas									2,119	8,830	(b)	(b)			2	10	2,746	9,465
Utah									4,969	11,708							4,969	11,708
Vermont	(b)	(b)															(b)	(b)
Virginia									789	2,284					2,000	200	2,789	2,484
Washington					(b)	(b)			754	6,672							2,028	8,837
West Virginia									77,171	65,239							77,171	65,239
Wisconsin													(b)	(b)	305	413	742	1,286
Wyoming															(b)	(b)	(b)	(b)
Other States[d]	5,368	36,528			9,192	18,001	35,620	143,650	6,734	17,375	8,731	8,887	10,891	15,501	55,482	53,592	e 62,309	e 197,451
Total	28,834	235,457	126,377	567,977	10,902	24,505	67,134	237,672	1,820,379	2,592,591	153,353	143,587	158,890	137,976	282,120	240,694	2,647,989	4,180,459

[a] Including bentonite, modeling clay, pipe clay, terra cotta clay, and clay for medicinal use. [b] Included in "Other States."
[c] Paper clay for Maryland is included in Maryland miscellaneous. [d] Includes all products made by less than three producers in one State.
[e] Made up of State totals of Connecticut, Florida, Idaho, Minnesota, Mississippi, North Dakota, Oregon, Vermont, and Wyoming.

Clay mined and sold in the United States in 1914, 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									27,973	$34,607							27,973	$34,607
Arkansas									(*b*)	(*b*)							(*b*)	(*b*)
California	(*b*)	(*b*)					(*b*)	(*b*)	56,391	66,732	21,070	$18,541	28,699	$35,223	133	$2,131	108,543	139,727
Colorado									15,832	35,791			41,217	28,111	100	250	57,149	64,152
Connecticut													(*b*)	(*b*)			(*b*)	(*b*)
Delaware	7,819	$66,282							(*b*)	(*b*)							10,371	71,386
Florida							(*b*)	(*b*)									(*b*)	(*b*)
Georgia			62,298	$267,011					11,461	7,116	(*b*)	(*b*)	(*b*)	(*b*)	71,795	15,795	146,374	290,814
Illinois									125,071	138,876	25,012	19,842	(*b*)	(*b*)	(*b*)	(*b*)	161,084	168,354
Indiana									31,849	29,344	(*b*)	(*b*)	(*b*)	(*b*)	2,300	4,600	39,055	37,644
Iowa									(*b*)	(*b*)					10,500	4,000	10,750	4,250
Kentucky					(*b*)	(*b*)	(*b*)	(*b*)	54,771	57,946	(*b*)	(*b*)			59	250	66,229	91,837
Maryland	(*b*)	(*b*)	(*c*)	(*c*)					14,288	25,194	(*b*)	(*b*)	8,987	11,304	*c* 1,400	*c* 1,450	29,755	43,498
Massachusetts									(*b*)	(*b*)			481	642			1,181	2,742
Michigan					1,463	$4,572											1,463	4,572
Minnesota															(*b*)	(*b*)	(*b*)	(*b*)
Mississippi											(*b*)	(*b*)					(*b*)	(*b*)
Missouri	313	2,217							203,755	432,786	3,199	3,889			(*b*)	(*b*)	209,181	463,703
Montana									2,757	9,205					221	443	2,978	9,648
Nebraska									(*b*)	(*b*)	(*b*)	(*b*)			(*b*)	(*b*)	(*b*)	(*b*)
New Jersey					(*b*)	(*b*)	2,596	$13,341	273,973	485,599	11,465	25,532	22,295	24,229	63,373	99,870	373,703	648,584
New Mexico									1,310	2,637					732	2,058	2,042	4,695
New York					(*b*)	(*b*)			(*b*)	(*b*)					2,689	1,640	5,640	7,286
North Carolina	17,168	164,534									(*b*)	(*b*)			600	300	17,773	164,837
North Dakota									(*b*)	(*b*)							(*b*)	(*b*)
Ohio					3,095	4,763			171,705	162,944	59,577	37,781	53,714	26,716	36,242	15,152	324,333	247,356
Oregon									(*b*)	(*b*)	(*b*)	(*b*)					(*b*)	(*b*)
Pennsylvania			26,124	161,451					306,183	519,505	(*b*)	(*b*)	28,152	22,366	14,615	9,810	376,697	715,458
South Carolina			27,906	129,872					(*b*)	(*b*)							28,421	133,047
Tennessee							30,460	87,332	31,377	41,461	(*b*)	(*b*)			274	433	62,861	129,976
Texas									1,460	8,594	(*b*)	(*b*)			30	150	2,362	9,616
Utah									5,837	13,961							5,837	13,961
Vermont	4,941	33,584							(*b*)	(*b*)							4,976	33,701

a Including bentonite, modeling clay, pipe clay, terra-cotta clay, and clay for medicinal use.
b Included in "Other States."
c Paper clay, for Maryland, is included in "Maryland Miscellaneous."

Clay mined and sold in the United States in 1914, by States, in short tons—Continued.

State.	Kaolin.		Paper clay.		Slip clay.		Ball clay.		Fire clay.		Stoneware clay.		Brick clay.		Miscellaneous clay.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Virginia									(a)	(a)					1,200	$120	2,177	$2,722
Washington					(a)	(a)			342	$3,139							691	3,829
West Virginia									67,265	53,545							67,265	53,545
Wisconsin									(a)	(a)			(a)	(a)	160	200	646	1,149
Wyoming															(a)	(a)	(a)	(a)
Other States [b]	3,950	$18,200			3,679	$8,396	34,871	$155,094	5,867	18,295	10,060	$11,025	15,609	$13,261	37,750	55,528	[c] 62,350	[c] 159,872
Total	34,191	284,817	116,328	$558,334	8,237	17,731	67,927	255,767	1,409,467	2,147,277	130,383	116,610	199,154	161,852	244,173	214,180	2,209,860	3,756,568

[a] Included in "Other States."
[b] Includes all products made by less than 3 producers in 1 State.
[c] Made up of State totals of Arkansas, Connecticut, Florida, Minnesota, Mississippi, Nebraska, North Dakota, Oregon, and Woyming.

Thirty-eight States reported sales of clay for 1914, an increase of 1 over 1913, Arkansas and Nebraska entering the list of producers, and Idaho dropping out. The leading clay-producing State, as for many years, in both quantity and value of output, was Pennsylvania. In 1914 the production of Pennsylvania was 376,697 short tons, valued at $715,458, a decrease of 102,851 tons, or 21.45 per cent, in quantity and of $121,458, or 14.51 per cent in value, compared with 1913. Pennsylvania reported 17.05 per cent of all clay sold in 1914 and 19.05 per cent of the total value. Of Pennsylvania's total clay production in 1914, fire clay was 81.28 per cent of the quantity and 72.61 per cent of the value. New Jersey ranked second, as for several years, reporting 373,703 short tons of clay, valued at $648,584, a decrease of 74,432 tons, or 16.61 per cent, and of $121,105, or 15.73 per cent, compared with 1913. New Jersey's production was 16.91 per cent of the total clay mined in 1914 and 17.27 per cent of its value. In this State fire clay was also the leading kind, 73.31 per cent of the quantity of clay mined in the State and 74.87 per cent of the value being of this variety. As in 1913, Ohio, the leading clay-manufacturing State, was third in quantity and fifth in value of clay marketed, and Missouri was fourth in quantity and third in value. In 1914, Ohio showed a decrease of 59,992 tons and $30,099 from 1913. Missouri showed a decrease from 1913 in both production and value of clay, of 28,851 tons and $6,574, respectively. Illinois was fifth in production and sixth in value of clay marketed, and Georgia was sixth in production and fourth in value. Both of these States showed decrease in production and value of clay marketed in 1914, compared with 1913. These six States—Pennsylvania, New Jersey, Ohio, Missouri, Illinois, and Georgia—reported 1,591,372 tons, or 72.01 per cent of the total quantity, and $2,534,269, or 67.46 per cent, of the total value in 1914.

Of the 23 remaining States for which totals are published, 16 showed decrease in quantity of clay marketed and 7 showed increase; 12 showed decrease in value and 11 showed increase. Eleven States decreased in quantity and value; 6 States, Iowa, Maryland, Massachusetts, North Carolina, Tennessee and Utah, showed increase in both; 4 States, Delaware, Montana, South Carolina, Texas, and Virginia, showed decrease in quantity and increase in value; and 1 State, New York, showed increase in quantity and decrease in value.

In 1914, as in 1913, Pennsylvania was the leading State in the production and value of fire clay, reporting 306,183 short tons, valued at $519,505, a decrease in quantity of 115,568 tons, or 27.4 per cent, and in value of $137,320, or 20.91 per cent, from 1913. New Jersey was second, reporting 273,973 tons, valued at $485,599, a decrease of 53,202, and of $91,358 from 1913. Missouri was third in production and value, Ohio was fourth, and Illinois fifth, In 1913, Pennsylvania was first and New Jersey second in production and value. The average price per ton of fire clay in these States in 1914 was: Illinois, $1.11; Missouri, $2.12; New Jersey, $1.77; Ohio, $0.95; and Pennsylvania, $1.70. In 1913, the corresponding prices of fire clay were: $1.18, $1.98, $1.76, $0.82, and $1.56, respectively.

Kaolin was reported from 6 States for 1914, the same number as for 1913. In 1914, California reported kaolin and Pennsylvania reported none. North Carolina is the leading State, reporting 17,168 tons, valued at $164,534, or more than 50 per cent of the quantity and value, an increase of 836 tons and $24,905 in 1914 over 1913.

IMPORTS.

The following table shows the imports of clay from 1901 to 1914:

Classified imports of clay for consumption, 1901–1914, in short tons.

Year.	Kaolin or china clay.			All other clays.						Total.	
				Unwrought.		Wrought.		Common blue.			
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1901	131,887	$742,984	$5.63	30,909	$175,659	6,392	$84,807	6,872	$82,700	176,060	$1,086,150
1902	149,029	883,092	5.93	28,931	138,032	3,002	47,093	7,815	86,588	188,777	1,154,805
1903	157,088	898,573	5.72	32,691	152,018	2,725	36,211	10,165	110,794	202,669	[a]1,198,418
1904	160,046	891,708	5.57	25,402	123,241	1,363	25,026	5,263	50,364	192,074	1,090,339
1905	187,803	1,019,650	5.43	30,661	151,583	1,560	38,036	5,909	54,390	225,933	1,263,659
1906	223,404	1,208,189	5.41	33,267	166,366	1,889	37,549	9,220	84,578	267,780	1,496,682
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
1913	268,666	1,623,993	6.04	42,582	155,693	1,889	22,178	24,986	204,911	338,123	2,006,775
1914	328,038	1,927,425	5.88	50,069	195,956	3,232	41,712	16,761	122,325	398,100	2,287,418

[a] Includes clay not otherwise provided for, valued at $822, but for which no quantity is reported.

The imports of clay, except for kaolin or china clay and the clay designated as "common blue"—a high-grade fire clay—are unimportant. Imports of every variety of clay, except "common blue" which comes chiefly from Germany, increased in quantity and value in 1914, compared with 1913, and each variety, except "common blue," reached its maximum quantity and each variety, except wrought clay and common blue, reached its maximum value in 1914. Of the clays imported, 82.4 per cent of the quantity and 84.26 per cent of the value was kaolin or china clay in 1914.

The total quantity imported increased 59,977 tons, or 17.74 per cent, and the value increased $280,643, or 13.98 per cent, compared with 1913. Imports of kaolin increased in quantity 59,372 tons, or 22.1 per cent, and in value $303,432, or 18.68 per cent, compared with 1913.

The average price per short ton of imported kaolin decreased 16 cents, compared with 1913. The imports of kaolin during the first half of 1914 were greater by 3,397 short tons than those of the second half of the year, but the imports of kaolin during the second half of 1914 were greater by 57,070 tons than those of the second half of 1913. The value of the kaolin imported during the second half of the year exceeded by $22,061 that of the first half, and was greater by $337,371 than that imported during the second half of 1913. Common blue clay decreased in quantity 8,225 tons, or 32.94 per cent, and in value, $82,586, or 40.3 per cent compared with 1913.

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 157 cities. For 113 cities sufficient detail was received to include these cities in a table showing classes of buildings; for 34 cities only the totals for permits and cost of buildings could be obtained; and for 10 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 1913 and 1914 in 48 cities; also the increase or decrease in the cost of building operations, with the percentage of increase or decrease. Used as an index of prosperity, the figures here given show, on the whole, that the building industries were not in a very prosperous condition in 1914 as compared with 1913, although 10 cities that showed decrease in the cost of building operations in 1913 rallied and showed increase in 1914. The most noteworthy features in the building industries in 1914, besides the general decrease in the cost of building operations, were the great decrease in New York City—by which it lost its rank as the leading city of the country in the cost of building operations—and the comparatively small decrease in the number of permits or buildings in 1914—564 or only 0.28 per cent—thus indicating the less costly character of operations carried on during the year.

The total cost of building operations in these 48 cities in 1914 was $619,752,354, compared with $673,220,625 in 1913. Sixteen of these cities showed increase and 32 showed decrease in the cost of building operations in 1914; the total decrease was $93,936,048, and the total increase was $40,467,777, a net decrease of $53,468,271, or 7.94 per cent, as compared with 1913. Twenty of these cities showed increase and 28 showed decrease in 1913, the net decrease being $79,473,964.

Various causes are assigned for these changes. Many of the cities ascribe the decrease in 1914 to the financial stringency and the European war, others to the less costly character of buildings, and some to overbuilding in 1913 and to labor troubles. In 1913 there was great activity in New York State in building operations in anticipation of a State housing law which imposed certain restrictions, and there was a correspondingly large falling off in 1914. In the Borough of Manhattan, the superintendent of buildings makes the following statement in his report:

> Not in 25 years have new building operations in the Borough of Manhattan reached such a low stage as in the year past.
>
> The decline in building operations can be attributed directly to the general business depression accentuated in large part by the disturbed financial conditions brought about by the European war, also as a contributing cause sight must not be lost of the fact that the numerous laws relating to building construction have affected adversely, and have had a tendency to retard, activity in building operations.

The increases were due in some cities to the erection in 1914 of State or municipal buildings or to betterment of general conditions and to natural growth. San Francisco's large increase was no doubt due to the activity of building operations in anticipation of the Panama-Pacific Exposition.

Builing operations in a number of the leading cities of the United States in 1913 and 1914.

City.	1913		1914		Increase (+) or decrease (−) in 1914.	Percentage of increase or decrease in 1914.
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.		
Atlanta, Ga	3,606	$5,112,944	3,146	$4,564,387	− $548,557	−10.73
Baltimore, Md	13,321	14,053,802	12,058	16,308,299	+ 2,254,497	+16.04
Boston, Mass	4,549	22,780,011	4,247	23,187,282	+ 407,271	+ 1.79
Brooklyn, N. Y	10,962	34,762,506	11,445	41,872,307	+ 7,109,801	+20.45
Buffalo, N. Y	4,059	13,300,360	3,984	10,709,000	− 2,591,360	−19.48
Cambridge, Mass	527	6,588,685	541	6,300,105	− 288,580	− 4.38
Chicago, Ill	10,792	89,668,427	9,938	83,261,710	− 6,406,717	− 7.14
Cincinnati, Ohio	2,952	7,543,475	3,600	8,150,000	+ 606,525	+ 8.04
Cleveland, Ohio	6,160	22,543,365	12,790	26,991,050	+ 4,447,685	+19.73
Columbus, Ohio	3,888	5,508,408	2,636	6,885,065	+ 1,376,657	+24.99
Dayton, Ohio	1,189	3,288,350	870	2,977,990	− 310,360	− 9.44
Denver, Colo	2,034	2,797,148	3,721	3,750,460	+ 953,312	+34.08
Detroit, Mich	9,326	30,434,380	7,844	28,207,395	− 2,226,985	− 7.32
Fall River, Mass	557	1,507,855	590	1,493,235	− 14,620	− .97
Grand Rapids, Mich	1,726	4,169,000	1,982	3,618,119	− 550,881	−13.21
Hartford, Conn	1,169	5,784,751	1,025	4,052,076	− 1,732,675	−29.95
Indianapolis, Ind	5,400	9,361,973	5,693	7,933,381	− 1,428,592	−15.26
Jersey City, N. J	1,344	5,413,607	1,171	3,826,174	− 1,587,433	−29.32
Kansas City, Kans	692	1,252,860	737	1,110,988	− 141,872	−11.32
Kansas City, Mo	3,719	10,578,162	3,253	10,204,970	− 373,192	− 3.53
Los Angeles, Cal	16,442	31,641,921	9,979	17,361,925	−14,279,996	−45.13
Louisville, Ky	2,402	3,617,540	2,306	4,397,310	+ 779,770	+21.56
Lowell, Mass	531	969,868	633	773,514	− 196,354	−20.25
Memphis, Tenn	3,363	3,949,368	2,617	2,946,818	− 1,002,550	−25.39
Milwaukee, Wis	4,015	13,647,624	3,865	9,882,085	− 3,765,539	−27.59
Minneapolis, Minn	6,135	12,857,935	6,015	15,214,525	+ 2,356,590	+18.33
Newark, N. J	3,075	16,317,973	2,105	10,061,910	− 6,256,063	−38.34
New Bedford, Mass	1,245	3,067,700	1,062	3,039,736	− 27,964	− .91
New Haven, Conn	1,100	4,790,151	1,136	4,380,842	− 409,309	− 8.54
New Orleans, La	1,857	4,088,261	1,635	2,948,751	− 1,139,510	−27.87
New York, N. Y	9,443	107,104,707	8,764	74,030,241	−33,074,466	−30.88
Oakland, Cal	3,748	8,535,251	3,649	4,717,520	− 3,817,731	−44.73
Omaha, Nebr	1,236	4,110,733	1,295	4,610,456	+ 499,723	+12.16
Philadelphia, Pa	7,700	35,125,810	12,774	34,694,340	− 431,470	− 1.23
Pittsburgh, Pa	2,943	15,470,955	3,522	18,194,182	+ 2,723,227	+17.60
Portland, Oreg	6,710	12,956,915	5,959	8,334,075	− 4,622,840	−35.68
Providence, R. I	3,184	7,289,100	3,589	6,334,900	− 954,200	−13.09
Richmond, Va	1,501	3,636,476	1,591	3,391,571	− 244,905	− 6.73
Rochester, N. Y	3,268	9,642,124	3,247	8,733,257	− 908,867	− 9.43
St. Joseph, Mo	713	895,079	740	625,574	− 269,505	−30.11
St. Louis, Mo	8,302	15,340,012	9,418	12,885,398	− 2,454,614	−16.00
St. Paul, Minn	3,564	9,456,450	3,741	14,718,696	+ 5,262,246	+55.65
San Francisco, Cal	5,606	21,037,264	5,907	28,177,563	+ 7,140,299	+33.94
Scranton, Pa	628	1,413,559	665	1,668,904	+ 255,345	+18.06
Seattle, Wash	9,597	9,321,115	9,104	12,664,970	+ 3,343,855	+35.87
Syracuse, N. Y	1,855	5,206,768	1,855	3,412,184	− 1,794,584	−34.47
Washington, D. C	4,585	10,499,402	3,701	10,415,645	− 83,757	− .80
Worcester, Mass	1,576	4,780,495	1,587	5,731,469	+ 950,974	+19.89
Total	204,296	673,220,625	203,732	619,752,354	−53,468,271	− 7.94

San Francisco showed the largest increase, $7,140,299, or 33.94 per cent. The city to show the second largest increase was Brooklyn, $7,109,801, or 20.45 per cent. The city to show the largest proportionate increase was St. Paul, 55.65 per cent, or $5,262,246. In 1913 the greatest decrease was in New York City, $56,414,655, or 34.5 per cent, and the largest increase was in Chicago, $6,492,527, or 7.81 per cent.

Of these cities 5, Cleveland, Columbus, Pittsburgh, St. Paul, and Seattle, showed increase in the cost of building operations in both 1913 and 1914; 10 cities that showed decrease in 1913 showed increase in 1914, namely, Boston, Brooklyn, Cincinnati, Denver, Louisville, Minneapolis, Omaha, San Francisco, Scranton, and Worcester; 18 showed decrease in both 1913 and 1914; and 14 that showed increase in 1913 showed decrease in 1914.

New York City (boroughs of the Bronx and of Manhattan) which has been the leading city in the cost of building operations since statistics on this subject were published by the Geological Survey, was second in 1914, having been passed by Chicago. The cost of building operations in Chicago in 1914 was $83,261,710, a decrease of $6,406,717, or 7.14 per cent, from 1913. In New York City the cost of building operations in 1914 was $74,030,241, a decrease of $33,074,466—Manhattan, $29,049,383, and the Bronx, $4,025,083—or 30.88 per cent, from 1913. Chicago's building operations, therefore, in 1914 cost $9,231,469, or 12.47 per cent more than those of New York City, and constituted 13.43 per cent of the total cost of the building operations in these 48 cities.

The total number of permits or buildings decreased from 204,296 in 1913 to 203,732 in 1914, a decrease of 564. The number in 1914 ranged from 541 in Cambridge to 12,790 in Cleveland. The average cost per operation in these 48 cities in 1914 was $3,042 compared with $3,295 in 1913. In Chicago the average cost was $8,378 in 1914 and $8,309 in 1913. In New York it was $8,447 in 1914 and $11,342 in 1913. In Brooklyn, the third city in the cost of building operations in 1914, the average cost per permit or building was $3,659 in 1914 and $3,171 in 1913. In Philadelphia, the fourth city, it was $2,716 in 1914 and $4,561 in 1913; and in Detroit, the fifth city, it was $3,596 in 1914 and $3,263 in 1913.

Building statistics of the leading cities of the United States, by character of operations, in 1914—Continued.

City.	Wooden buildings.								Fire-resisting buildings. Brick or hollow tile.	
	New.		Additions, alterations, and repairs.		Miscellaneous.		Total.		New.	
	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	1,209	$1,902,070	535	$190,225			1,744	$2,092,295	253	$1,775,980
Albany, N. Y	242	1,300,000	82	82,000			324	1,382,000	55	550,000
Allentown, Pa	50	17,121	34	12,295	8	$4,100	92	33,516	468	1,448,885
Altoona, Pa	295	542,056	161	60,618	257	9,599	713	612,273	50	342,078
Atlanta, Ga	830	1,985,899	1,018	421,202	330	210,993	2,178	2,618,094	82	1,199,383
Augusta, Ga	292	280,045	960	112,022			1,252	392,067	17	391,511
Bay City, Mich	300	150,000	44	50,035			344	200,035	34	125,000
Bayonne, N. J	129	449,600	88	52,210			217	501,810	49	439,293
Binghamton, N. Y	717	975,502	754	238,594			1,471	1,214,096		
Birmingham, Ala	1,044	1,336,843	2,002	291,501			3,046	1,628,344	80	634,455
Boston, Mass	1,100	4,439,918	1,349	720,252			2,449	5,160,170	329	9,101,315
Bridgeport, Conn	662	1,452,797	95	59,917	207	105,315	964	1,618,029	44	1,746,352
Brockton, Mass	355	804,357	208	143,062			563	947,419	12	206,900
Buffalo, N. Y	2,456	4,020,000	1,259	1,007,000			3,715	5,027,000	196	3,756,000
Cambridge, Mass	151	689,100	265	180,575			416	869,675	47	1,264,725
Camden, N. J	86	163,200	70	54,400	45	5,100	201	222,700	118	1,187,700
Canton, Ohio	368	605,170	75	51,575			443	656,745	89	704,900
Charleston, S. C	201	250,310	192	59,310			393	309,620	33	125,290
Cincinnati, Ohio	900	1,600,000	a 1,600	a 800,000			2,500	2,400,000		
Cleveland, Ohio	2,758	8,862,810	2,051	959,785	6,650	1,135,905	11,459	10,958,500	b 940	b 14,733,150
Columbus, Ohio	1,010	1,339,570	575	137,180			1,585	1,476,750	503	2,963,080
Covington, Ky	85	124,175	56	24,225			141	148,400	98	426,575
Dayton, Ohio	629	1,266,310	136	87,470			765	1,353,780	82	1,198,420
Des Moines, Iowa	425	1,235,846	140	150,000	18	30,000	583	1,415,846		
Detroit, Mich	5,145	12,378,125	1,282	858,375			6,427	13,236,500	866	6,353,175
Dubuque, Iowa	62	153,400	5	1,200			67	154,600	15	858,000
Duluth, Minn	658	1,090,014	702	225,833			1,360	1,315,847	c 231	c 1,489,376
East St. Louis, Ill	139	210,635	85	30,232	167	35,268	391	276,135	126	563,833
Elizabeth, N. J	256	840,255	90	62,218			346	902,473	47	359,218
Elmira, N. Y	241	448,450					241	448,450	13	759,550
Erie, Pa	648	1,157,713	d 771	d 474,982			1,419	1,632,695	137	1,133,574
Evansville, Ind	462	563,827	649	99,416	61	9,216	1,172	672,459	c 69	c 519,815
Fall River, Mass	346	700,000	180	200,000			526	900,000	14	340,000

Fitchburg, Mass	97	196,397	88	72,715	9	15,200	194	284,312	11	162,200
Flint, Mich	404	369,651	235	120,581			639	490,232	12	282,796
Fort Worth, Tex	317	518,480	177	89,076			494	607,556	60	911,450
Galveston, Tex	496	618,840	657	111,503			1,153	730,343	20	178,075
Grand Rapids, Mich	987	1,326,343	743	293,647			1,730	1,619,990	e 157	e 1,654,199
Harrisburg, Pa	48	47,675	45	28,175			93	75,850	386	1,053,450
Hartford, Conn	212	1,258,470	271	260,612	279	158,975	762	1,678,057	105	2,035,874
Haverhill, Mass	194	559,735	42	66,200			236	625,935	11	282,100
Hoboken, N. J	31	28,875	82	48,094	1	1,100	114	78,069	25	409,164
Holyoke, Mass	58	208,552	37	17,345			95	225,897	33	331,119
Houston, Tex	1,086	1,437,753	2,793	313,844	64	34,601	3,943	1,786,198	30	425,771
Indianapolis, Ind	1,591	3,664,785	f 2,698	f 1,063,305	f 1,298	f 955,672	5,587	5,683,762	38	297,840
Jacksonville, Fla	528	809,785	165	90,796			693	900,581	71	628,025
Kalamazoo, Mich	199	150,257	30	70,000			229	220,257	7	85,000
Kansas City, Kans	404	527,697			266	97,925	670	625,622	59	326,966
Kansas City, Mo	1,472	2,740,395	744	374,350	284	44,505	2,500	3,159,250	420	5,293,320
Knoxville, Tenn	76	167,773	361	48,510			437	216,283	7	141,300
Lawrence, Mass	116	630,830	86	162,727			202	793,557	16	441,500
Lincoln, Nebr	285	548,780	103	64,882			388	613,662	34	268,900
Los Angeles, Cal	6,095	9,372,977	2,311	1,019,681			8,406	10,392,658	268	2,690,945
Louisville, Ky	707	1,495,020	689	119,320	310	68,730	1,706	1,683,070	153	797,520
Lowell, Mass	228	436,685	311	195,271			539	631,956	35	87,740
Lynn, Mass	283	557,494	279	168,632			562	726,126	19	876,001
McKeesport, Pa	58	117,127	f 60	f 44,959			118	162,086	20	115,655
Manchester, N. H	376	726,494	505	256,475			881	982,969	16	264,250
Milwaukee, Wis	1,865	5,067,958	1,327	1,099,198	116	43,805	3,308	6,210,961	263	1,996,127
Minneapolis, Minn	3,015	5,084,905	2,246	981,245			5,261	6,066,150	179	1,824,615
Montgomery, Ala	215	161,300	176	68,055			391	229,355	15	99,735
New Bedford, Mass	416	1,508,850	354	244,260	200	127,370	970	1,880,480	25	858,366
New Britain, Conn	106	339,300	289	85,460			395	424,760	39	510,500
Newton, Mass	377	1,269,603	227	204,743			604	1,474,346	g 54	g 339,250
New York, N. Y	133	458,647	1,575	368,086			1,708	826,733	856	27,745,700
Norfolk, Va	191	418,211	118	64,084	48	23,765	357	506,060	170	963,771
Oakland, Cal	1,725	3,204,697	1,797	564,648			3,522	3,769,345	45	138,154
Oklahoma, Okla	103	219,695	38	22,645	1	40	142	242,380	23	173,887
Omaha, Nebr	887	1,755,155	76	20,900	1	5,000	964	1,781,055	141	1,094,973

a Additions, etc., to all classes of buildings for Cincinnati are included with additions, etc., to wooden buildings.

b New concrete, new steel-skeleton buildings, and miscellaneous operations, fire-resisting buildings for Cleveland, Ohio, are included with new brick or hollow-tile buildings, and additions, etc., to steel-skeleton buildings are included with additions, etc., to brick or hollow-tile buildings.

c All classes of new fire-resisting buildings for Duluth, Minn., and Evansville, Ind., are included with new brick or hollow-tile buildings. Additions, etc., to all classes of fire-resisting buildings for Duluth are also included under this head, while additions, etc., to all classes of fire-resisting buildings for Evansville are included with additions, etc., to brick or hollow-tile buildings.

d Additions, etc., to all classes of buildings for Erie, Pa., are included with additions, etc., to wooden buildings

e New concrete and new steel-skeleton buildings for Grand Rapids, Mich., are included with new brick or hollow-tile buildings, and additions, etc., to concrete buildings are included with additions, etc., to brick or hollow-tile buildings.

f Additions, etc., to brick or hollow-tile buildings for Indianapolis, Ind., and McKeesport, Pa., are included with additions, etc., to wooden buildings. With miscellaneous operations (wooden buildings) for Indianapolis are included some fire-proof operations not separately classified.

g New stone and new concrete buildings for Newton, Mass., are included with new brick buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1914—Continued.

City.	Wooden buildings.								Fire-resisting buildings. Brick or hollow tile.	
	New.		Additions, alterations, and repairs.		Miscellaneous.		Total.		New.	
	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.
Passaic, N. J.	103	$168,822	113	$51,560			216	$220,382	48	$497,140
Paterson, N. J.	237	507,038	450	99,589			687	606,627	99	764,832
Pawtucket, R. I.	210	705,760	149	66,150	20	$3,400	379	775,310	16	368,700
Philadelphia, Pa.	24	59,350	96	15,200			120	74,550	7,814	19,102,055
Pittsburgh, Pa.	a 749	a 5,500,000	(a)	(a)	1,839	1,324,560	2,588	6,824,560	780	10,959,622
Portland, Me.	228	590,625	132	158,895			360	749,520	26	323,350
Portland, Oreg.	2,524	3,605,825	2,500	660,495	23	567,075	5,047	4,833,395	122	1,074,435
Providence, R. I.	1,016	2,689,600	2,262	817,300			3,278	3,506,900	84	1,210,600
Quincy, Ill.	27	61,000					27	61,000	34	169,900
Reading, Pa.									276	998,725
Richmond, Va.	134	183,272	377	87,671			511	270,943	623	2,746,965
Rochester, N. Y.	1,650	4,861,689	983	430,285	8	20,300	2,641	5,312,274	176	2,632,053
Sacramento, Cal.	477	1,075,444	637	241,566			1,114	1,317,010	37	198,901
Saginaw, Mich.	304	416,814	155	57,841			459	474,655	18	144,920
St. Joseph, Mo.	221	197,492	309	77,604			530	275,096	116	252,150
Salem, Mass.	422	1,440,467	133	142,993			555	1,583,460	70	693,450
Salt Lake City, Utah	137	93,183	68	32,372			205	125,555	701	2,318,169
San Antonio, Tex.	763	850,035	756	145,252	476	46,335	1,995	1,041,622	32	383,000
San Diego, Cal.	898	1,482,650	649	125,750			1,547	1,608,400	74	586,324
San Francisco, Cal.	2,002	16,613,300	3,370	805,050			5,372	17,418,350	90	2,720,000
Savannah, Ga.	789	925,600	120	59,625	49	13,495	958	998,720	25	271,900
Schenectady, N. Y.	461	814,618	185	63,336			646	877,954	85	b 623,057
Scranton, Pa. c	198	546,846	224	144,402	153	75,341	575	766,589	28	597,670
Seattle, Wash.	3,750	4,216,040	d 5,126	d 1,040,215	(d)	(d)	8,876	5,256,255	41	1,252,400
Sioux City, Iowa	471	1,120,142	139	45,985			610	1,166,127	49	507,400
Somerville, Mass.	265	1,250,000	104	84,137			369	1,334,137	16	143,500
South Bend, Ind.	364	458,477					364	458,477	65	677,704
Spokane, Wash.	357	364,650	193	75,925			550	440,575	45	359,140
Springfield, Ill.	174	344,925	109	67,290			283	412,215	47	508,400
Springfield, Mass.	642	1,946,465	475	393,118	39	4,735	1,156	2,344,318	150	1,972,673
Superior, Wis.	428	619,366	325	130,572			753	749,938	14	153,256
Syracuse, N. Y.	743	1,860,288	964	566,516			1,707	2,426,804	49	375,900
Tacoma, Wash.	407	585,229	e 689	e 306,400	e 346	e 67,139	1,440	958,768	17	512,860

Tampa, Fla.	602	663,770	808	173,128	60	12,355	1,470	849,253	37	196,000
Toledo, Ohio	f 2,680	f 4,129,027					2,680	4,129,027	155	1,837,605
Troy, N. Y.	(g)	221,865	(g)	57,703			(g)	279,568	(g)	147,709
Utica, N. Y.	298	718,470	182	131,070			480	849,540	48	735,200
Washington, D. C.	259	759,150	558	99,539	23	36,404	840	895,093	1,251	8,194,941
West Hoboken, N. J.	35	39,855	84	36,550			119	76,405	41	598,803
Wheeling, W. Va.	42	51,565	245	66,525			287	118,090	27	373,240
Wichita, Kans.	79	191,650	61	12,630			140	204,280	18	207,100
Wilkes Barre, Pa.	193	249,206	269	96,175	283	32,827	745	378,208	127	486,312
Woonsocket, R. I.	130	94,121	74	32,430			204	126,551	9	142,050
Yonkers, N. Y.	197	612,250	42	33,300			239	645,550	65	453,800
Total	75,322	165,226,250	63,361	24,453,877	13,939	5,326,150	152,622	195,006,277	22,565	181,957,682
Percentage of total		30.32		4.49		.98		35.79		33.39

[a] Additions, etc., to wooden buildings for Pittsburgh, Pa., are included with new wooden buildings, and additions, etc., to concrete buildings are included with new concrete buildings.

[b] The cost of new stone, new concrete, and new steel-skeleton buildings for Schenectady, N. Y., is included with the cost of new brick buildings.

[c] The statistics for Scranton, Pa., are for 11 months only, Feb. 1 to Dec. 31.

[d] With additions, etc., to wooden buildings for Seattle, Wash., are included miscellaneous operations, wooden buildings; with new concrete buildings are included new steel-skeleton buildings, and additions, etc., to steel-skeleton buildings are included with additions, etc., to concrete buildings.

[e] Additions, etc., to all classes of fire-resisting buildings for Tacoma, Wash., are included with additions, etc., to wooden buildings, and miscellaneous operations, fire-resisting buildings are included with miscellaneous operations, wooden buildings.

[f] With new wooden buildings for Toledo, Ohio, are included all operations for wooden buildings.

[g] The number of permits or buildings for Troy, N. Y., El Paso, Tex., and Trenton, N. J., was not given.

Building statistics of the leading cities of the United States, by character of operations, in 1914—Continued.

City.	Fire-resisting buildings—Continued.											
	Brick or hollow tile—Continued.		Stone.				Concrete.				Steel skeleton.	
	Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.		New.	
	Number of per-mits or buildings.	Cost.	Number of per-mits or buildings.	Cost.	Number of per-mits or buildings.	Cost.	Number of per-mits or buildings.	Cost.	Number of per-mits or buildings.	Cost.	Number of per-mits or buildings.	Cost.
Akron, Ohio	95	$161,740										
Albany, N. Y	40	67,000					2	$485,000			3	$2,600,000
Allentown, Pa	88	94,450	4	$281,200			18	47,855				
Altoona, Pa	47	31,574	1	60,000	1	$1,800					1	30,000
Atlanta, Ga	722	641,114										
Augusta, Ga			1	325,000							2	610,000
Bay City, Mich	9	4,100									1	75,000
Bayonne, N. J	8	8,613					1	31,650				
Binghamton, N. Y												
Birmingham, Ala	373	274,020	1	200			15	494,450				
Boston, Mass	1,262	2,609,573	4	183,750	37	72,505	39	911,255	23	$74,162	48	4,359,352
Bridgeport, Conn	10	210,640					14	91,319				
Brockton, Mass	11	61,370										
Buffalo, N. Y	53	258,000					1	300,000			9	1,294,000
Cambridge, Mass	31	87,915					26	3,725,285	5	95,975		
Camden, N. J	77	60,800					4	775,000				
Canton, Ohio	15	28,700			1	19,000						
Charleston, S. C	54	47,583										
Cincinnati, Ohio												
Cleveland, Ohio	a 391	a 1,299,400					(a)	(a)			(a)	(a)
Columbus, Ohio	391	433,140	3	128,100	6	62,910	39	852,640	12	57,010	1	900,000
Covington, Ky	53	55,615										
Dayton, Ohio	16	104,520					3	55,570	2	1,700	2	264,000
Des Moines, Iowa	20	65,000					6	425,000	6	40,000		
Detroit, Mich	463	1,307,820					34	3,142,800	7	179,000	26	3,107,500
Dubuque, Iowa					1	15,000						
Duluth, Minn												
East St. Louis, Ill	10	47,850					2	72,500				
Elizabeth, N. J	24	69,043					13	5,900				
Elmira, N. Y							26	98,050				
Erie, Pa												

Evansville, Ind	b 86	b 66,714										
Fall River, Mass	4	30,000	2	70,000			10	90,000				
Fitchburg, Mass	12	45,428					5	19,346	1	1,500		
Flint, Mich												
Fort Worth, Tex	44	94,475					14	558,900	1	200		
Galveston, Tex	15	138,550					8	135,600			1	150,000
Grand Rapids, Mich	95	343,930					(c)	(c)			(c)	(c)
Harrisburg, Pa	73	95,325	6	34,400								
Hartford, Conn	123	251,970										
Haverhill, Mass	19	70,900					10	19,300	1	700	1	150,000
Hoboken, N. J	59	99,660					1	150,000				
Holyoke, Mass	50	159,745									5	466,500
Houston, Tex	427	163,943			1	25	19	670,749	25	81,720	1	670,000
Indianapolis, Ind	(d)	(d)					33	44,320			35	1,907,459
Jacksonville, Fla	124	138,864										
Kalamazoo, Mich							1	10,000	5	75,000	2	155,000
Kansas City, Kans							8	158,400				
Kansas City, Mo	309	468,400	4	52,000	3	10,600	7	785,000	6	11,400	4	425,000
Knoxville, Tenn	119	51,124										
Lawrence, Mass	15	55,238					9	16,400	1	950		
Lincoln, Nebr	24	72,400	e 12	e 48,325	(e)	(e)	(e)	(e)	(e)	(e)	(e)	(e)
Los Angeles, Cal	f 1,282	f 1,001,009					19	1,652,313	(f)	(f)	4	1,625,000
Louisville, Ky	359	417,690					10	451,335			9	451,335
Lowell, Mass	59	53,818										
Lynn, Mass	19	360,000	1	1,500			4	15,250	1	150		
McKeesport, Pa	(d)	(d)										
Manchester, N. H	52	82,648	2	160,000								
Milwaukee, Wis	100	82,735	e 192	e 1,588,910			(e)	(e)			(e)	(e)
Minneapolis, Minn	321	766,835	1	150	7	10,850	100	2,277,435	50	181,630	66	3,943,885
Montgomery, Ala	38	39,810										
New Bedford, Mass	67	300,890										
New Britain, Conn	76	170,980					3	108,600				
Newton, Mass			(g)	(g)			(g)	(g)				
New York, N. Y	5,253	7,333,421									157	33,614,200
Norfolk, Va	66	121,240					5	240,660	1	7,500	1	151,213
Oakland, Cal	37	103,876					28	226,727	2	2,500	12	472,148
Oklahoma, Okla	44	55,375					1	1,500,800				
Omaha, Nebr	184	289,428					5	618,000			1	827,000

[a] New concrete, new steel-skeleton buildings, and miscellaneous operations, fire-resisting buildings for Cleveland, Ohio, are included with new brick or hollow-tile buildings, and additions, etc., to steel-skeleton buildings are included with additions, etc., to brick or hollow-tile buildings.

[b] All classes of new fire-resisting buildings for Duluth, Minn., and Evansville, Ind., are included with new brick or hollow-tile buildings. Additions, etc., to all classes of fire-resisting buildings for Duluth are also included under this head, while additions, etc., to all classes of fire-resisting buildings for Evansville are included with additions, etc., to brick or hollow-tile buildings.

[c] New concrete and new steel-skeleton buildings for Grand Rapids, Mich., are included with new brick or hollow-tile buildings, and additions, etc., to concrete buildings are included with additions, etc., to brick or hollow-tile buildings.

[d] Additions, etc., to brick or hollow-tile buildings for Indianapolis, Ind., and McKeesport, Pa., are included with additions, etc., to wooden buildings. With miscellaneous operations (wooden buildings) for Indianapolis are included some fire-proof operations not separately classified.

[e] New concrete and new steel-skeleton buildings for Lincoln, Nebr., and Milwaukee, Wis., are included in new stone buildings. Additions, etc., to the classes of buildings for Lincoln, Nebr., as well as additions, etc., to stone buildings are included under this head.

[f] Additions, etc., to concrete and steel-skeleton buildings for Los Angeles, Cal., are included wifh additions, etc. to brick buildings.

[g] New stone and new concrete buildings for Newton, Mass., are included with new brick buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1914—Continued.

City.	Fire-resisting buildings—Continued.													
	Brick or hollow tile—Continued.		Stone.				Concrete.				Steel skeleton.	
	Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.		New.		Additions, alterations, and repairs.		New.	
	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.
Passaic, N. J.	67	$138,627										
Paterson, N. J.	60	133,580					26	$27,875	4	$2,205		
Pawtucket, R. I.							63	4,967				
Philadelphia, Pa.	4,709	4,511,485	28	$120,000	6	$8,500	22	1,656,500	5	73,600	46	$8,115,375
Pittsburgh, Pa.	130	300,000	4	50,000	2	21,400	a 13	a 28,600	(a)	(a)		
Portland, Me.	19	72,175										
Portland, Oreg.	622	278,825					14	759,000	b 150	b 81,420	4	1,307,000
Providence, R. I.	167	666,000			1	150,000	45	729,300	14	72,100		
Quincy, Ill.							1	100,000			3	203,000
Reading, Pa.			31	90,425			27	25,950			(c)	(c)
Richmond, Va.	457	373,663										
Rochester, N. Y.	197	390,629					108	227,025	80	51,305	3	81,000
Sacramento, Cal.	254	284,474					8	375,593	5	154,000		
Saginaw, Mich.	54	60,180										
St. Joseph, Mo.	82	47,185					2	46,168				
Salem, Mass.	5	12,880					42	840,435				
Salt Lake City, Utah	142	140,623									2	400,000
San Antonio, Tex.	147	354,820	2	14,000			26	718,700			2	302,000
San Diego, Cal.	293	83,840					12	407,600			2	71,000
San Francisco, Cal.	265	650,312	23	4,781,963	15	100,000	74	2,286,938	68	220,000		
Savannah, Ga.	25	36,060	1	75,000								
Schenectady, N. Y.	35	76,444	9	(d)			32	(d)			10	(d)
Scranton, Pa.[e]	55	164,345										
Seattle, Wash.	139	138,810					f 18	f 5,756,500	f 30	f 261,005	(f)	(f)
Sioux City, Iowa.	33	55,925					6	243,500				
Somerville, Mass.	6	30,600					14	5,494				
South Bend, Ind.							21	50,790				
Spokane, Wash.	92	182,512										
Springfield, Ill.	44	134,505										
Springfield, Mass.	166	642,251										
Superior, Wis.	17	40,925										

Syracuse, N. Y.	35	48,675	1	500	1	7,500	47	107,155	9	6,750	5	429,900
Tacoma, Wash.	(g)	(g)			(g)	(g)			(g)	(g)		
Tampa, Fla.	136	101,435	3	32,030	2	75	5	321,500	6	1,440	1	82,500
Toledo, Ohio	80	118,550										
Troy, N. Y.	(h)	52,853					(h)	700				
Utica, N. Y.	42	66,060					22	130,130				
Washington, D. C.	1,452	1,261,412					10	18,285			1	26,614
West Hoboken, N. J.												
Wheeling, W. Va.	287	291,451					8	646,128				
Wichita, Kans.	13	20,400					2	86,000				
Wilkes-Barre, Pa.	141	128,718	1	150,000								
Woonsocket, R. I.	3	500	2	4,700			4	9,400				
Yonkers, N. Y.	39	161,600	10	104,400	6	4,300						
Total	24,328	33,809,330	349	8,356,553	90	484,465	1,215	36,873,642	520	1,734,922	471	69,266,981
Percentage of total		6.20		1.53		.09		6.77		.32		12.71

[a] Additions, etc., to wooden buildings for Pittsburgh, Pa., are included with new wooden buildings, and additions, etc., to concrete buildings are included with new concrete buildings.

[b] Additions, etc., to steel-skeleton buildings for Portland, Oreg., are included with additions, etc., to concrete buildings.

[c] New steel-skeleton buildings for Reading, Pa., are included with miscellaneous fire-resisting buildings.

[d] The cost of new stone, new concrete, and new steel-skeleton buildings for Schenectady, N. Y., is included with the cost of new brick buildings.

[e] The statistics for Scranton, Pa., are for 11 months only, Feb. 1 to Dec. 31.

[f] With additions, etc., to wooden buildings for Seattle, Wash., are included miscellaneous operations, wooden buildings; with new concrete buildings are included new steel-skeleton buildings, and additions, etc., to steel-skeleton buildings are included with additions, etc., to concrete buildings.

[g] Additions, etc., to all classes of fire-resisting buildings for Tacoma, Wash., are included with additions, etc., to wooden buildings, and miscellaneous operations, fire-resisting buildings are included with miscellaneous operations, wooden buildings.

[h] The number of permits or buildings for Troy, N. Y., El Paso, Tex., and Trenton, N. J., was not given.

Building statistics of the leading cities of the United States, by character of operations, in 1914—Continued.

City.	Fire-resisting buildings—Continued.						Grand total.		Rank of cities in cost of buildings erected in 1914.
	Steel skeleton—Contd. Additions, alterations, and repairs.		Miscellaneous.		Total.				
	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					348	$1,937,720	2,092	$4,030,015	40
Albany, N. Y					100	3,702,000	424	5,084,000	31
Allentown, Pa			10	$4,100	588	1,876,490	680	1,910,006	74
Altoona, Pa					100	465,452	813	1,077,725	112
Atlanta, Ga			164	105,796	968	1,946,293	3,146	4,564,387	36
Augusta, Ga					20	1,326,511	1,272	1,718,578	80
Bay City, Mich					44	204,100	388	404,135	143
Bayonne, N. J					58	479,556	275	981,366	117
Binghamton, N. Y					a 150	a 1,011,551	1,621	2,225,647	66
Birmingham, Ala			9	11,905	478	1,415,030	3,524	3,043,374	51
Boston, Mass	28	$92,900	28	622,300	1,798	18,027,112	4,247	23,187,282	8
Bridgeport, Conn					68	2,048,311	1,032	3,666,340	44
Brockton, Mass					23	268,270	586	1,215,689	102
Buffalo, N. Y			10	74,000	269	5,682,000	3,984	10,709,000	16
Cambridge, Mass			16	256,530	125	5,430,430	541	6,300,105	27
Camden, N. J			215	131,135	414	2,154,635	615	2,377,335	62
Canton, Ohio					105	752,600	548	1,409,345	92
Charleston, S. C					87	172,873	480	482,493	139
Cincinnati, Ohio					a 1,100	a 5,750,000	3,600	8,150,000	23
Cleveland, Ohio	(b)	(b)	(b)	(b)	1,331	16,032,550	12,790	26,991,050	7
Columbus, Ohio			96	11,435	1,051	5,408,315	2,636	6,885,065	25
Covington, Ky			23	2,730	174	484,920	315	633,320	130
Dayton, Ohio					105	1,624,210	870	2,977,990	54
Des Moines, Iowa	4	36,000			36	566,000	619	1,981,846	70
Detroit, Mich	21	880,600			1,417	14,970,895	7,844	28,207,395	5
Dubuque, Iowa					16	873,000	83	1,027,600	114
Duluth, Minn					231	1,489,376	1,591	2,805,223	58
East St. Louis, Ill			3	10,050	141	694,233	532	970,368	118
Elizabeth, N. J			1	300	85	434,461	431	1,336,934	96
Elmira, N. Y					39	857,600	280	1,306,050	98
Erie, Pa					137	1,133,574	1,556	2,766,269	59
Evansville, Ind			15	10,795	170	597,324	1,342	1,269,783	99
Fall River, Mass			34	63,235	64	593,235	590	1,493,235	89
Fitchburg, Mass			8	147,200	37	375,674	231	659,986	129
Flint, Mich					12	282,796	651	773,028	124
Fort Worth, Tex			9	9,350	128	1,574,375	622	2,181,931	67

Galveston, Tex.			9	8,750	53	610,975	1,206	1,341,318	95
Grand Rapids, Mich.					252	1,998,129	1,982	3,618,119	45
Harrisburg, Pa.			14	10,475	479	1,193,650	572	1,269,500	100
Hartford, Conn.			35	86,175	263	2,374,019	1,025	4,052,076	39
Haverhill, Mass.					42	523,000	278	1,148,935	107
Hoboken, N. J.			2	139,400	87	798,224	201	876,293	121
Holyoke, Mass.					88	957,364	183	1,183,261	105
Houston, Tex.	5	$4,185			508	2,016,393	4,451	3,802,591	42
Indianapolis, Ind.					106	2,249,619	5,693	7,933,381	24
Jacksonville, Fla.					195	766,889	888	1,667,470	82
Kalamazoo, Mich.					15	325,000	244	545,257	136
Kansas City, Kans.					67	485,366	737	1,110,988	111
Kansas City, Mo.					753	7,045,720	3,253	10,204,970	18
Knoxville, Tenn.					126	192,424	563	408,707	142
Lawrence, Mass.					41	514,088	243	1,307,645	97
Lincoln, Nebr.	(c)	(c)			70	389,625	458	1,003,287	115
Los Angeles, Cal.	(d)	(d)			1,573	6,969,267	9,979	17,361,925	10
Louisville, Ky.			69	596,360	600	2,714,240	2,306	4,397,310	37
Lowell, Mass.					94	141,558	633	773,514	123
Lynn, Mass.	1	300	3	285,310	48	1,538,511	610	2,264,637	65
McKeesport, Pa.					20	115,655	138	277,741	147
Manchester, N. H.			5	160,000	75	666,898	956	1,649,867	83
Milwaukee, Wis.			2	3,352	557	3,671,124	3,865	9,882,085	20
Minneapolis, Minn.	30	142,975			754	9,148,375	6,015	15,214,525	12
Montgomery, Ala.					53	139,545	444	368,900	144
New Bedford, Mass.					92	1,159,256	1,062	3,039,736	52
New Britain, Conn.					118	790,080	513	1,214,840	103
Newton, Mass.					54	339,250	658	1,813,596	76
New York, N. Y.	790	4,510,187			7,056	73,203,508	8,764	74,030,241	2
Norfolk, Va.			83	24,237	326	1,508,621	683	2,014,681	69
Oakland, Cal.	3	4,770			127	948,175	3,649	4,717,520	34
Oklahoma, Okla.					68	1,730,062	210	1,972,442	72
Omaha, Nebr.					331	2,829,401	1,295	4,610,456	35
Passaic, N. J.					115	635,767	331	856,149	122
Paterson, N. J.			8	4,521	197	933,013	884	1,539,640	88
Pawtucket, R. I.					79	373,667	458	1,148,977	106
Philadelphia, Pa.	24	1,032,275			12,654	34,619,790	12,774	34,694,340	4
Pittsburgh, Pa.			5	10,000	934	11,369,622	3,522	18,194,182	9
Portland, Me.					45	395,525	405	1,145,045	109
Portland, Oreg.	(e)	(e)			912	3,500,680	5,959	8,334,075	22
Providence, R. I.					311	2,828,000	3,589	6,334,900	26
Quincy, Ill.					38	472,900	65	533,900	137

a The total only was given for fire-resisting buildings for Binghamton, N. Y., and Cincinnati, Ohio, i. e., respectively, 150 permits or buildings, costing $1,011,551, and 1,100 permits or buildings, costing $5,750,000. The percentages for these values, equivalent to 0.19 of 1 per cent for Binghamton, and 1.06 per cent for Cincinnati, are included in the percentage for total fire-resisting buildings. Additions, etc., to all classes of buildings for Cincinnati are included with additions, etc., to wooden buildings.

b New concrete, new steel-skeleton buildings, and miscellaneous operations, fire-resisting buildings for Cleveland, Ohio, are included with new brick or hollow-tile buildings, and additions, etc., to steel-skeleton buildings are included with additions, etc., to brick or hollow-tile buildings.

c New concrete and new steel-skeleton buildings for Lincoln, Nebr., and Milwaukee, Wis., are included in new steel buildings. Additions, etc., to these classes of buildings, for Lincoln, Nebr., as well as additions, etc., to stone buildings, are also included under this head.

d Additions, etc., to concrete and steel-skeleton buildings for Los Angeles, Cal., are included with additions, etc., to brick buildings.

e Additions, etc., to steel-skeleton buildings for Portland, Oreg., are included with additions, etc., to concrete buildings.

Building statistics of the leading cities of the United States, by character of operations, in 1914—Continued.

City.	Fire-resisting buildings—Continued.						Grand total.		Rank of cities in cost of buildings erected in 1914.
	Steel skeleton—Contd. Additions, alterations, and repairs.		Miscellaneous.		Total.				
	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	Number of permits or buildings.	Cost.	
Reading, Pa.			*a* 136	*a* $33,750	470	$1,148,850	470	$1,148,850	108
Richmond, Va.					1,080	3,120,628	1,591	3,391,571	47
Rochester, N. Y.	29	$34,646	13	4,325	606	3,420,983	3,247	8,733,257	21
Sacramento, Cal.					304	1,012,968	1,418	2,329,978	64
Saginaw, Mich.					72	205,100	531	679,755	126
St. Joseph, Mo.			10	4,975	210	350,478	740	625,574	131
Salem, Mass.					117	1,546,765	672	3,130,225	49
Salt Lake City, Utah					845	2,858,792	1,050	2,984,347	53
San Antonio, Tex.			54	25,990	263	1,798,510	2,258	2,840,132	57
San Diego, Cal.					381	1,148,764	1,928	2,757,164	60
San Francisco, Cal.					535	10,759,213	5,907	28,177,563	6
Savannah, Ga.			1	2,000	52	384,960	1,010	1,383,680	94
Schenectady, N. Y.					171	699,501	817	1,577,455	85
Scranton, Pa. *b*			7	140,300	90	902,315	665	1,668,904	81
Seattle, Wash.	(*c*)	(*c*)			228	7,408,715	9,104	12,664,970	15
Sioux City, Iowa					88	806,825	698	1,972,952	71
Somerville, Mass.			41	60,336	77	239,930	446	1,574,067	86
South Bend, Ind.					86	728,494	450	1,186,971	104
Spokane, Wash.					137	541,652	687	982,227	116
Springfield, Ill.					91	642,905	374	1,055,120	113
Springfield, Mass.			20	97,000	336	2,711,924	1,492	5,056,242	32
Superior, Wis.			7	597,500	38	791,681	791	1,541,619	87
Syracuse, N. Y.	1	9,000			148	985,380	1,855	3,412,184	46
Tacoma, Wash.	(*d*)	(*d*)	(*d*)	(*d*)	17	512,860	1,457	1,471,628	90
Tampa, Fla.			24	30,795	214	765,775	1,584	1,615,028	84
Toledo, Ohio					235	1,956,155	2,915	6,085,182	28
Troy, N. Y.					(*e*)	201,262	(*e*)	480,830	140
Utica, N. Y.			7	4,900	119	936,290	599	1,785,830	78
Washington, D. C.			147	19,300	2,861	9,520,552	3,701	10,415,645	17
West Hoboken, N. J.					41	598,803	160	675,208	128
Wheeling, W. Va.					322	1,310,819	609	1,428,909	91
Wichita, Kans.			10	1,650	43	315,150	183	519,430	138
Wilkes-Barre, Pa.					269	765,030	1,014	1,143,238	110
Woonsocket, R. I.					18	156,650	222	283,201	146
Yonkers, N. Y.			29	32,250	149	756,350	388	1,401,900	93
Total	936	6,747,838	1,382	3,844,512	*f* 53,106	*f* 349,837,476	205,728	544,843,753	

Percentage of total		1.24		.71		f 64.21		100.00	
Atlantic City, N. J							1,323	3,137,743	48
Baltimore, Md							12,058	16,308,299	11
Berkeley, Cal							1,086	g 2,082,949	68
Brooklyn, N. Y							11,445	41,872,307	3
Butte, Mont							227	621,685	132
Chattanooga, Tenn							2,129	967,277	119
Chester, Pa							453	1,221,200	101
Chicago, Ill							9,938	83,261,710	1
Dallas, Tex							1,852	5,093,497	30
Davenport, Iowa							569	1,872,172	75
Denver, Colo							3,721	3,750,460	43
El Paso, Tex							(e)	1,934,297	73
Fort Wayne, Ind							743	2,351,535	63
Jersey City, N. J							1,171	3,826,174	41
Lancaster, Pa							388	689,956	125
Macon, Ga							617	676,210	127
Malden, Mass							339	593,695	133
Memphis, Tenn							2,617	2,946,818	56
Mobile, Ala							223	576,000	134
Newark, N. J							2,105	10,061,910	19
New Haven, Conn							1,136	4,380,842	38
New Orleans, La							1,635	2,948,751	55
Peoria, Ill							802	4,757,511	33
Pueblo, Colo							214	333,270	145
St. Louis, Mo							9,418	12,885,398	14
St. Paul, Minn							3,741	14,718,696	13
Terre Haute, Ind							683	950,326	120
Topeka, Kans							429	547,280	135
Trenton, N. J							(e)	1,736,492	79
Waterbury, Conn							612	1,800,200	77
Wilmington, Del							577	2,519,443	61
Worcester, Mass							1,587	5,731,469	29
York, Pa							521	471,200	141
Youngstown, Ohio							1,087	3,055,221	50
Grand total							281,174	785,525,746	

a New steel-skeleton buildings for Reading, Pa., are included with miscellaneous fire-resisting buildings.

b The statistics for Scranton, Pa., are for 11 months only, Feb. 1 to Dec. 31.

c With additions, etc., to wooden buildings for Seattle, Wash., are included miscellaneous operations, wooden buildings; with new concrete buildings are included new steel-skeleton buildings, and additions, etc., to steel-skeleton buildings are included with additions, etc., to concrete buildings.

d Additions, etc., to all classes of fire-resisting buildings for Tacoma, Wash., are included with additions, etc., to wooden buildings, and miscellaneous operations, fire-resisting buildings are included with miscellaneous operations, wooden buildings.

e The number of permits or buildings for Troy, N. Y., El Paso, Tex., and Trenton, N. J., was not given.

f The total only was given for fire-resisting buildings for Binghamton, N. Y., and Cincinnati, Ohio, i. e., respectively, 150 permits or buildings, costing $1,011,551, and 1,100 permits or buildings, costing $5,750,000. The percentages for these values, equivalent to 0.19 of 1 per cent for Binghamton, and 1.06 per cent for Cincinnati, are included in the percentage for total fire-resisting buildings. Additions, etc., to all classes of buildings for Cincinnati are cincluded with additions, etc., to wooden buildings.

g Includes cost of buildings at the University of California, permits for which were not issued through the city of Berkeley.

The 147 cities included in this table reported building operations costing $785,525,746 in 1914. Of this number, 113 cities reported sufficient detail to permit the publication of statistics of building operations by classes of structures. These 113 cities reported 205,728 permits or buildings, work on which cost $544,843,753. Of this total, new buildings of every variety as reported cost approximately $461,681,108, or over five-sixths of the total; additions, alterations, and repairs cost $67,230,432, or nearly one-eighth of the total; miscellaneous operations $9,170,662, or less than 2 per cent; and $6,761,551, or 1.25 per cent, was reported as fire-resisting buildings unclassified.

It should be borne in mind, however, that these statistics of building operations by kinds, especially in the totals, are only approximate, as many cities were unable to report strictly in accordance with the classification given in the table. It is believed, however, that the figures as published are accurate enough to give a good idea of the relative importance of the various kinds of operations enumerated.

The ranks of the several cities in the different varieties of building operations are probably relative and not actual, as some of the cities for which no details can be published may have exceeded some of the cities reporting in cost of some of the classes of buildings.

Taken by classes, the new wooden buildings in 1914 in these 113 cities cost $165,226,250, or 30 per cent of the total cost of all operations, and new brick buildings cost $181,957,682, or a little more than a third of the total. All other new buildings cost $114,497,176, or more than a fifth of the total. Of the total cost of new buildings, those constructed of wood constituted 35.79 per cent. New fire-resisting buildings cost $296,454,858, or 64.21 per cent of the total. Of the cost of all new fire-resisting buildings, 61.38 per cent was for brick buildings; 2.82 per cent, or $8,356,553, was for stone buildings; 12.44 per cent, or $36,873,642, for concrete buildings; and 23.37 per cent, or $69,266,981, for steel skeleton buildings. Of the cost of all additions, alterations, and repairs, $24,453,877, or 36.37 per cent, was for wooden buildings and $42,776,555, or 63.63 per cent, for fire-resisting buildings. Of the additions, alterations, and repairs to fire-resisting buildings, 79.04 per cent, or $33,809,330, was for brick buildings; 1.13 per cent, or $484,465, for stone buildings; 4.05 per cent, or $1,734,922, for concrete buildings; and 15.77 per cent, or $6,747,838, for steel skeleton buildings.

Operations on brick buildings (new additions, alterations, and repairs) cost $215,767,012, or 39.60 per cent of the entire cost of all operations in these 113 cities, all other fire-resisting buildings contributing $123,464,401, or 22.66 per cent. In addition to the brick or hollow tile used in the construction of brick buildings, large quantities are also used in foundations, in chimneys to wooden buildings, and in the construction of nearly all fire-resisting buildings.

The average cost of new wooden buildings in these 113 cities in 1914 was $2,194; of new brick buildings, $8,063; of new stone buildings, $23,944; of new concrete buildings, $30,349; and of steel skeleton buildings, $147,064.

Wooden buildings.—Los Angeles reported, as for several years, the largest number of new wooden buildings, 6,095, in 1914, a decrease of 4,282 buildings from 1913. The average cost per permit or building in 1914 was $1,537, compared with $1,396 in 1913. Detroit was second in 1914, as for several years, reporting 5,145 buildings, at an average cost of $2,406, a decrease of 1,386 in the number of wooden buildings, but an increase of $81 in the average cost. Seattle was third in 1914. The others of the first 10 cities in the number of new wooden buildings in 1914 in the order of their rank were: Minneapolis, Cleveland, Toledo, Portland (Oreg.), Buffalo, San Francisco, and Milwaukee.

San Francisco, which was ninth in the number, was the leading city in the cost of new wooden buildings in 1914, displacing Detroit, and reporting the cost at $16,613,300, an increase of $9,371,029 over 1913. Detroit's new wooden buildings cost $12,378,125 in 1914, a decrease of $2,803,945 from 1913. The cost of new wooden buildings in 1914 in Los Angeles was $9,372,977, a decrease of $5,112,118 from 1913. The rank of the next seven cities in cost of new wooden buildings was: Cleveland, Pittsburgh, Minneapolis, Milwaukee, Rochester, Boston, and Seattle.

Of the leading 10 cities in the cost of all operations on wooden buildings, 6 cities—Cleveland, Indianapolis, Milwaukee, Minneapolis, Pittsburgh, and San Francisco—showed increase in the cost of this class of operations in 1914, compared with 1913, and 4 cities—Detroit, Los Angeles, Rochester, and Seattle—showed decrease. The wooden buildings reported for New York City were erected principally in the Borough of The Bronx.

Fire-resisting buildings.—Of the 113 cities for which details were given, New York reported the greatest cost of fire-resisting buildings. New buildings, additions, and alterations included, this cost in 1914 was $73,203,508, or one-fifth of the total cost of this class of buildings—a large decrease, $32,893,942, from 1913. Of the other 9 leading cities in this class of structures, 6 cities, Boston, Cleveland, Detroit, Minneapolis, Seattle, and Washington, showed increase, and 3 cities, Philadelphia, Pittsburgh, and San Francisco, showed decrease.

Brick or hollow-tile buildings.—New York was the leading city in the cost of new buildings of this class in 1914, reporting 856 buildings that cost $27,745,700, or one-seventh of the total. The average cost of these buildings was $32,413 in 1914, compared with $46,671 in 1913. Philadelphia was the second city, reporting 7,814 buildings that cost $19,102,055, an average of $2,445. This was an increase of 2,021 in the number, but a decrease in the cost of $6,203,435 from 1913 and a decrease in the average cost of $1,923. The next 8 cities in cost of new brick or hollow-tile buildings, in order of their rank, were: Cleveland, Pittsburgh, Boston, Washington, Detroit, Kansas City, Mo., Buffalo, and Columbus.

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.

These reports may be examined in many public libraries.

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ABRASIVE MATERIALS.

By Frank J. Katz.

INTRODUCTION.

Industrial operations employ a great variety of abrasive materials. This chapter is concerned with only those mineral products which, as such or as essential constituents of manufactured products, are used for grinding and polishing and other abrasive operations, and it includes the statistics of production, as to both quantity and value, either of the raw material alone or of such material as at most has not been advanced beyond that stage of manufacture at which it is sold by the mine or quarry operator.

Artificial abrasives are included for comparison and because of their strong influence on the industry and markets of natural abrasives.

The statistics are given herein of only that part of the production of any mineral material that properly enters into the abrasive industries. Thus, only a small percentage of the sandstone quarried is used in the manufacture of abrasives grindstones and pulpstones, the remainder being used chiefly in the building industry. The segregation of the production is not difficult in this instance, but there is difficulty in separating the production of the diatomaceous (infusorial) earth which is used strictly for abrasive purposes from that which is used in manufacture of filters or of insulating or fireproofing material. Here the total production must be included.

On the other hand, quartz and feldspar, both of which are used as abrasives, are excluded from this discussion because the precise separation according to their uses of these materials can not be made, their principal uses being for purposes other than abrasive, and therefore they are considered in other chapters.

MARKETED PRODUCTION.

The total value of the abrasive materials which are considered in this chapter and which entered trade during 1914 decreased about 21 per cent, as compared with the value for 1913. There was a decrease in both domestic production of natural and artificial abrasives and also in their importation. The value of natural abrasives produced decreased about 25 per cent; of artificial abrasives, about 16 per cent; and of imports, about 20 per cent.

Among the natural abrasives a gain was shown in the production of pumice. There was a decrease in quantity and value of all other abrasive products. The total estimated value of all the abrasive materials consumed in the United States during the six years 1909 to 1914, inclusive, is given in the table following.

Total value of all abrasive materials [a] consumed in the United States, 1909–1914.

Year.	Natural abrasives.	Artificial abrasives.	Imports.	Total value.
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	1,601,993	1,747,120	898,892	4,248,005
1913	1,648,578	2,017,458	916,913	4,582,949
1914	1,200,143	1,685,410	728,710	3,614,263

[a] Exclusive of feldspar and the various forms of quartz. See chapters on feldspar and silica (quartz).

The value of abrasive materials imported for consumption into the United States, 1912 to 1914, is as follows:

Value of abrasive materials imported into the United States, 1912–1914.

Material.	1912	1913	1914
Millstones and burrstones	$27,562	$40,198	$15,000
Grindstones	131,080	139,386	109,539
Hones, oilstones, and whetstones	45,398	40,222	33,655
Emery and corundum	491,725	474,299	383,436
Infusorial earth, tripoli, and rottenstone	24,253	28,696	20,004
Pumice	74,478	93,408	92,668
Diamond dust and bort	94,396	100,704	74,408
Total	888,892	916,913	728,710

NATURAL ABRASIVES.

Under the head of natural abrasives in this report are included (1) millstones and related quarry products, such as chasers and drag stones, (2) grindstones and pulpstones, (3) oilstones and scythestones, (4) corundum and emery, (5) abrasive garnet, (6) diatomaceous (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 chapters entitled "Feldspar" and "Silica" (quartz).

Natural abrasives were produced in 1914 in 24 States, which are listed below:

Alabama............Millstones.
Arkansas............Oilstones.
California............Diatomaceous (infusorial) earth and pumice.
Connecticut..........Diatomaceous (infusorial) earth.
Illinois..............Tripoli.
Indiana..............Oilstones.
Kansas..............Pumice.
Kentucky............Oilstones.
Maryland............Diatomaceous (infusorial) earth.
Massachusetts........Diatomaceous (infusorial) earth.
Michigan............Grindstones and scythestones.
Missouri............Tripoli.
Nebraska............Pumice.
Nevada..............Diatomaceous (infusorial) earth.
New Hampshire.....Garnet and scythestones.
New York............Millstones, emery, garnet, and diatomaceous (infusorial) earth.
North Carolina......Millstones and garnet.

Ohio................Grindstones, pulpstones, oilstones, and scythestones.
Oklahoma...........Tripoli.
Pennsylvania........Millstones and rottenstone.
Vermont.............Scythestones.
Virginia..............Millstones.
Washington..........Diatomaceous (infusorial) earth.
West Virginia.......Grindstones.

In the following table is given the value of natural abrasives produced in the last five years:

Value of natural abrasives produced in the United States, 1910–1914, by kinds.

Abrasive.	1910	1911	1912	1913	1914
Millstones	$28,217	$40,069	$71,414	$56,163	$43,316
Grindstones and pulpstones	796,294	907,316	916,339	855,627	689,344
Oilstones and scythestones	228,694	214,991	232,218	207,352	167,948
Emery	15,077	6,778	6,652	4,785	2,425
Garnet	113,574	121,748	163,237	183,422	145,510
Abrasive quartz and feldspar	(a)	(a)	(a)	(a)	(a)
Diatomaceous (infusorial) earth and tripoli	130,006	147,462	125,446	285,821	142,428
Pumice	94,943	88,399	86,687	55,408	59,172
Total	1,406,805	1,526,763	1,601,993	1,648,578	1,200,143

a See chapters on feldspar and silica (quartz).

MILLSTONES.

PRODUCTION.

The production of millstones and related quarry products, burrstones, chasers, and drag stones in the United States in 1914 amounted to $43,316 in value, a decrease of $12,847, or 22.87 per cent, compared with the value in 1913. The production in this country in 1914 was, nevertheless, larger than in any year of the preceding decade, except 1906, 1912, and 1913.

During the 35 years for which the production of millstones is recorded 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 in the grain milling industry 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 might be assumed, 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, $13,878, 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.

American millstones have been and are still for the most part made of quartz sandstones and conglomerates. Some are made of granite. The production recorded in the Survey's reports on mineral resources is only that which has been made for other than purely local use. A small number of stones for local use have been made, particularly in the mountain sections of the Southern States, and various hard quartz or other rocks have been so employed.

Millstones were produced in 1914 in Alabama, New York, North Carolina, Pennsylvania, and Virginia, the same States that have produced them in recent years. The output in New York fell off about 25 per cent; it decreased very materially in other States—about 15 per cent in Virginia and slightly in Pennsylvania. Virginia was first, New York second, and North Carolina third in value of output.

In the following table is given the value of millstones, chasers, and rider or drag stones produced in the United States from 1910 to 1914, inclusive:

Value of millstones produced in the United States, 1910–1914, by States.

State.	1909	1910	1911	1912	1913	1914
New York	$13,138	$13,753	$13,335	$34,246	$21,987	$16,748
Virginia		5,273	17,635	25,866	23,530	20,100
North Carolina				9,352	8,772	5,164
Pennsylvania	22,255	9,191	9,099	1,950	1,874	1,304
Alabama						
Total	35,393	28,217	40,069	71,414	56,163	43,316

The following table gives the value of millstones produced in the United States since 1880:

Value of millstones produced in the United States, 1880–1914.

1880	$200,000	1898	$25,934
1881	150,000	1899	28,115
1882	200,000	1900	32,858
1883	150,000	1901	57,179
1884	150,000	1902	59,808
1885	100,000	1903	52,552
1886	140,000	1904	37,338
1887	100,000	1905	37,974
1888	81,000	1906	48,590
1889	35,155	1907	31,741
1890	23,720	1908	31,420
1891	16,587	1909	35,393
1892	23,417	1910	28,217
1893	16,639	1911	40,069
1894	13,887	1912	71,414
1895	22,542	1913	56,163
1896	22,567	1914	43,316
1897	25,932		

IMPORTS.

The imports of burrstones and millstones for consumption in the United States in 1914 were valued at $15,000, as compared with $40,198 in 1913. The decrease was in material imported in the rough as well as in imports of finished stones. The latter have never been large, but decreased, relatively, much more than the rough material.

The value of the imports of burrstones and millstones during the last six years is given in the following table:

Value of burrstones and millstones imported and entered for consumption in the United States, 1909–1914.

Year.	Rough.	Made into millstones.	Total.	Year.	Rough.	Made into millstones.	Total.
1909	$22,125	$465	$22,590	1912	$26,236	$1,326	$27,562
1910	33,740	1,023	34,763	1913	36,276	3,922	40,198
1911	35,153	875	36,028	1914	14,291	709	15,000

THE MILLSTONE INDUSTRY.

In this report for 1909 and for 1913 descriptive notes were given on the millstone industry in New York and Virginia. As the industry is one which undergoes little change from year to year, statements made in former reports may be consulted to supplement the data in this report.

New York.—New York led 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 a white quartz conglomerate or coarse sandstone, and is quarried from the Shawangunk conglomerate, which is found near the western base of Shawangunk Mountain, in the valley of Roundout 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.

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 of Mississippian (lower Carboniferous) age. The material from which the stones are quarried varies from 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. It underlies Brush Mountain for miles, and for this reason the millstones are frequently termed Brush Mountain stones. The stones can not be quarried by blasting, and are therefore extracted by hand power, with drill and hammer, plug, and feathers. Mill stones and drag or rider stones are the principal products made at the Virginia quarries. Three operating firms or individuals reported production during 1914.

North Carolina.—In North Carolina at Parkewood, Moore County, a quartz conglomerate known as the North Carolina grit has been used for making millstones. At Faith and near Salisbury in Rowan County a granite is quarried and made into millstones, mostly for grinding corn and oats in North Carolina and Georgia and other Southern States. Three operators reported production of millstones in 1914.

Pennsylvania.—In Lancaster County a quartz conglomerate which has been known to the trade as Cocalico stone is made into millstones. One manufacturer reported production in 1914.

Alabama.—Near Dutton, Jackson County, millstones are made from sandstones of Pennsylvanian age. A few stones were fashioned by one manufacturer in 1914.

Vermont.—A quartz conglomerate rock similar to the New York Esopus stone is found near Fair Haven, Rutland County. No millstones have been made of this rock in recent years.

Ohio.—At Peninsula, in Summit County, a white variety of the Berea grit was quarried for the purpose of grinding oatmeal and pearling barley, for which it was said to be especially well adapted. At present no millstones are made from the Berea grit.

California.—It was reported many years ago that on an eminence known as Little Butte, in Owens River valley, a rock suitable for the manufacture of burrstones was found. It is said to be hard, brecciated, and very much like the French burrstone.

In addition to these localities stones of different varieties and more or less suitable for coarse work are or have been quarried and fashioned for use in local mills in many States.

GRINDSTONES AND PULPSTONES.

PRODUCTION.

The value of the grindstones and pulpstones produced in the United States in 1914 was $689,344, a decrease of $166,283, or nearly 19.5 per cent, as compared with $855,627, the value for 1913. The decrease is in the value of the grindstones, the pulpstone production having increased very materially over 1913.

The States and the number of quarries in each State producing grindstones in 1914 were: Michigan, 3 quarries; Ohio, 23 quarries; and West Virginia, 1 quarry. Ohio, as usual, maintained the leading position in the industry, the value of the output of the State being about eight times that of Michigan. The output of West Virginia was comparatively small. Ohio also produced pulpstones from 2 quarries. Montana and Utah have ceased to be producers of grindstones.

The following table shows the value of grindstones and pulpstones produced in the United States from 1910 to 1914, by States:

Value of grindstones and pulpstones produced in the United States, 1910–1914, by States.

State.	1910	1911	1912	1913	1914
Colorado	(a)	(a)			
Michigan	(a)	(a)	(a)	(a)	(a)
Montana		(a)	(a)		
Ohio	$699,033	$742,107	$787,621	$737,572	$606,001
Utah			(a)		
West Virginia	(a)	(a)	(a)	(a)	(a)
Other States	[b] 97,261	[c] 165,209	[d] 128,718	[e] 118,055	[e] 83,343
Total	796,294	907,316	916,339	855,627	689,344

[a] Included in "Other States."
[b] Includes Colorado, Michigan, and West Virginia.
[c] Includes Colorado, Michigan, Montana, and West Virginia.
[d] Includes Michigan, Montana, Utah, and West Virginia.
[e] Includes Michigan and West Virginia.

The record of production of grindstones and pulpstones goes back to 1880. For the first nine years the estimates were based on only a partial canvass of the industry, and for 1880 to 1885, inclusive, the figures given in the volumes of Mineral Resources appear to have been made with a too large factor of safety.

Beginning with $439,587 in 1889 the production increased slightly until 1892, when there was a large decrease to $272,244. The production has subsequently trebled in value, attaining a maximum of $916,339 in 1912, and has suffered setbacks only in 1908 and 1914, which were years of generally disturbed business.

The value of the production of pulpstones and grindstones in the United States from 1880 to 1914, inclusive, is shown in the following table:

Value of grindstones and pulpstones[1] produced in the United States, 1880–1914.

1880	$500,000	1892	$272,244	1904	$881,527
1881	500,000	1893	338,787	1905	777,606
1882	700,000	1894	223,214	1906	744,894
1883	600,000	1895	205,768	1907	896,022
1884	570,000	1896	326,826	1908	536,095
1885	500,000	1897	368,058	1909	804,051
1886	250,000	1898	500,388	1910	796,294
1887	224,400	1899	684,298	1911	907,316
1888	281,800	1900	710,026	1912	916,339
1889	439,587	1901	580,703	1913	855,627
1890	450,000	1902	667,431	1914	689,344
1891	476,113	1903	721,446		

IMPORTS.

The value of the imports of grindstones decreased in 1914 to $109,539, as compared with $139,386 in 1913.

The imports for the last five years are given below:

Value of pulpstones and grindstones imported and entered for consumption in the United States, 1910–1914.

1910	$106,596	1913	$139,386
1911	123,727	1914	109,539
1912	131,080		

CANADIAN PRODUCTION.[2]

The value of the production of grindstones, scythestones, and wood-pulp stones in Canada in 1914[3] amounted to $54,497, as compared with $51,325 in 1913. Below is given the value of the Canadian production of grindstones, etc., during the last six years:

Value of production of grindstones, etc., in Canada, 1909–1914.

1909	$50,944	1912	$52,090
1910	47,196	1913	51,325
1911	52,942	1914	54,497

[1] Pulpstones first reported in 1898.
[2] From reports of Canada Dept. Mines.
[3] Preliminary report on the mineral production of Canada during 1914: Canada Dept. Mines, 1915.

OILSTONES AND SCYTHESTONES.

PRODUCTION.

The production of oilstones (including hones and whetstones) and scythestones in the United States during 1914 amounted to $167,948 in value, a decrease of $39,404 as compared with the value for 1913. Oilstones were produced in Arkansas, Indiana, Ohio, Kentucky, and Pennsylvania, especially in Arkansas, which has led in the production for many years. New Hampshire led in the production of scythestones, but Vermont, Ohio, and Michigan 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.

The value of oilstones (including whetstones) and scythestones produced in the United States since 1880 is given below:

Value of oilstones and scythestones produced in the United States, 1880–1914.

1880	$8,000	1892	$146,730	1904	$188,985
1881	8,500	1893	135,173	1905	244,546
1882	10,000	1894	136,873	1906	268,070
1883	10,000	1895	155,881	1907	[1] 264,188
1884	12,000	1896	127,098	1908	[1] 217,284
1885	15,000	1897	149,970	1909	[2] 214,019
1886	15,000	1898	180,486	1910	[1] 228,694
1887	16,000	1899	208,283	1911	[2] 214,991
1888	18,000	1900	174,087	1912	[2] 232,218
1889	32,980	1901	158,300	1913	[2] 207,352
1890	69,909	1902	221,762	1914	[3] 167,948
1891	150,000	1903	366,857		

During the 35 years (1880–1914) for which the value of the production of these materials is recorded, there have been many fluctuations in yearly totals, but with a broadly consistent increase. In the first decade the values recorded are for rough stones only. These values increased regularly from $8,000 to $69,909. Subsequently, values of finished products are recorded, ranging in the second decade from $127,098 to $208,283. In the following 15 years the value of the production ranged from $158,300 to $366,857 annually, but being for the most part about $200,000. The year 1914 showed the lowest production since 1901.

IMPORTS.

The value of all kinds of hones, oilstones, and whetstones imported into the United States in the last five years is given below.

Value of imports of hones, oilstones, and whetstones, 1910–1914.

1910	$45,819	1913	$40,222
1911	54,379	1914	33,655
1912	45,398		

[1] Includes a quantity of "rubbing stone" quarried in Indiana.
[2] Includes a quantity of honestone quarried in Kentucky and "rubbing stone" quarried in Indiana.
[3] Includes a quantity of honestone quarried in Kentucky and Pennsylvania and "rubbing stone" quarried in Indiana.

CORUNDUM AND EMERY.

PRODUCTION.

The United States produced no corundum in 1914 and has produced none since 1906.

The domestic production of emery in 1914 appears to have come entirely from the region near Peekskill in Westchester County, N. Y. The Survey received no report of production in 1913 and 1914 from the mines in Chester, Hampden County, Mass., which have for many years produced an annually diminishing quantity. The returns from New York producers have been incomplete, and the entry in the following table for 1914 is an estimate, which is, however, believed to be a close approximation to the actual quantity produced. The value given in the table is merely an estimate of the cost of mining and preparing the material as shipped from the mines, based on reports made by some of the producers. The estimated domestic production for 1914 is 485 short tons, which is 472 tons, or about 50 per cent less than the estimated output for 1913. The estimated value of the output for 1914 (cost of production) is $2,425, which is $2,360, or about 50 per cent, less than that for 1913

The 35-year period covering the record of the production of corundum and emery has witnessed, first, an increase in quantity and value; then, decreasing value per ton and increasing quantity of production, which maintained a total annual value of about $100,000 until 1902; and finally, a decrease in both quantity and value of output, until corundum mining has ceased and emery mining is now nearly dead. Artificial abrasives have very largely displaced these natural products.

In the following tables are given the quantity and estimated value of the corundum and emery produced in the United States from 1881 to 1906 and the quantity and estimated value of emery produced in the United States since 1907:

Annual marketed production of corundum and emery, 1881–1906, in short tons.

Year.	Quantity.	Value.[a]	Year.	Quantity.	Value.[a]	Year.	Quantity.	Value.[a]
1881	500	$80,000	1890	1,970	$89,395	1899	4,900	$150,600
1882	500	80,000	1891	2,247	90,230	1900	4,305	102,715
1883	550	100,000	1892	1,771	181,300	1901	4,305	146,040
1884	600	108,000	1893	1,713	142,325	1902	4,251	104,605
1885	600	108,000	1894	1,495	95,936	1903	2,542	64,102
1886	645	116,190	1895	2,102	106,256	1904	1,916	56,985
1887	600	108,000	1896	2,120	113,246	1905	2,126	61,464
1888	589	91,620	1897	2,165	106,574	1906	1,160	44,310
1889	2,245	105,567	1898	4,064	275,064			

[a] Estimated.

Annual marketed production of emery, 1907–1914, in short tons.

Year.	Quantity.	Value.[a]	Year.	Quantity.	Value.[a]
1907	1,069	$12,294	1911	659	$6,778
1908	669	8,745	1912	992	6,652
1909	1,580	18,185	1913	[a] 957	[a] 4,785
1910	1,028	15,077	1914	[a] 485	[a] 2,425

[a] Estimated.

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 1914 was marked by a decrease 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, 1910–1914.

Year.	Grains.		Ore and rock.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Long tons.*			
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	369,529	16,871	491,725
1913	2,496,372	114,786	17,123	342,809	16,704	474,299
1914	1,781,821	79,989	12,909	280,866	22,581	383,436

CANADIAN CORUNDUM.

The following table gives the quantity and value of Canadian corundum shipped during the last six years:

Shipments of Canadian corundum, 1909–1914, in short tons.[a]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1909	1,491	$162,492	1912	1,960	$239,091
1910	1,870	198,680	1913	1,177	137,036
1911	1,472	161,873	1914	548	72,176

[a] Figures taken from the annual reports on mineral production of Canada, Canada Dept. Mines.

ABRASIVE GARNET.

PRODUCTION.

The sales of domestic abrasive garnet in the United States in 1914 amounted to 4,231 short tons, valued at $145,510. This was a decrease of 1,077 tons, or 20 per cent, in quantity and nearly 21 per cent in value, as compared with the year 1913 of maximum production. The product was considerably smaller than that of 1912, but exceeded that of all years preceding 1912.

The prevailing price for abrasive garnet for 1914 and also for 1913 was about $35 a ton. Small quantities sold for less, even as low as $20 a ton of crude material, and some cleaned and graded material brought $50 a ton.

The following table gives the quantity and value of abrasive garnet produced annually in the United States since 1894, the year for which statistics of garnet production were first obtained.

Marketed production of abrasive garnet, 1894–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.	Year.	Quantity.	Value.
1894 [a]	2,401	$90,660	1901	4,444	$158,100	1908	1,996	$64,620
1895 [a]	3,325	95,050	1902	3,926	132,820	1909	2,972	102,315
1896 [a]	2,686	68,877	1903	3,950	132,500	1910	3,814	113,574
1897 [a]	2,554	80,853	1904	3,854	117,581	1911	4,076	121,748
1898 [a]	2,967	86,850	1905	5,050	148,095	1912	4,947	163,237
1899 [a]	2,765	98,325	1906	4,650	157,000	1913	5,308	183,422
1900	3,185	123,475	1907	7,058	211,686	1914	4,231	145,510

[a] Exclusive of North Carolina production for which statistics are lacking.

The Tenth Census reports a production in Pennsylvania of 60 tons of garnet, valued at $1,200, made during the "Census year." For the succeeding years up to and including 1893 there is no record of the production of abrasive garnet. From 1894 to 1899 the record is complete except for the North Carolina output, which, however, was probably small, as in recent years. From 1900 to 1914 the table records the entire marketed production.

The increase in production of abrasive garnet appears to have been nearly uniformly steady. The year 1901 was marked by an abnormally high output, which was followed in 1902 by a smaller production, still, however, exceeding that of 1900. The year 1907 brought an excessive overproduction, which, coupled with the general business depression in the country, resulted in a record for minimum production and value in 1908.

Recovery was steady in succeeding years through 1913. In 1914 the industry made a very considerable showing by attaining to nearly 80 per cent of its 1913 mark.

ABRASIVE GARNET INDUSTRY IN 1914.

New York maintained its preeminence as a garnet producer, having to its credit more than 90 per cent of the total for the United States in 1914. The New Hampshire output was still small, but greater in 1914 than in the preceding year. The garnet quarries and mills of these States were described in the report for 1913.

In North Carolina two previously active quarries were idle in 1914, and one large deposit which had formerly been a producer and had given promise of again making important production made a small trial output.

Pennsylvania and Connecticut deposits were inactive.

IMPORTS.

Abrasive garnet has been imported from Spain during recent years. No records of imports of this "duty free" material are kept and little definite information about it is obtainable. The following statements are abstracted from reports by United States consuls, published in the Daily Consular and Trade Reports:

There are three garnet mines in Spain, all in the Province of Almeria. They produced 600 tons in 1911. Exports from the port of Almeria, Spain, for 1913 included 1,239 tons of "garnet ore," of which 700 tons came to the United States. The value of the product at the mines in April, 1914, was $7.75 a ton, the expense to shipboard about $6.65 a ton.

TRIPOLI AND DIATOMACEOUS (INFUSORIAL) EARTH.

PRODUCTION.

Tripoli and diatomaceous (infusorial) earth have been combined for consideration in these reports for many years for the reasons (1) that, because of the confusion in names, it was not expedient to make the separation in the earlier canvasses after the beginning of the production of what is now called tripoli, and (2) that uses of the materials as abrasives are in part the same. The following table gives, as usual, the combined productions of diatomaceous earth and tripoli annually since 1880. It is there shown that the increase in quantity and value of the output of these materials has not been far from regular. The production of tripoli in Missouri has been regularly recorded only since 1889, which accounts for the marked increase in that year. The following tables show the value of the annual combined production of tripoli and diatomaceous (infusorial) earth since 1880, and separately the production of tripoli and of diatomaceous earth by States in 1913 and 1914:

Marketed production of diatomaceous earth and tripoli, 1880–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	1,833	$45,660	1892		$43,655	1904	6,274	$44,164
1881	1,000	10,000	1893		22,582	1905	10,977	64,637
1882	1,000	8,000	1894	2,584	11,718	1906	8,099	72,108
1883	1,000	5,000	1895	4,954	20,514	1907	14,824	104,406
1884	1,000	5,000	1896	3,846	26,792	1908		97,442
1885	1,000	5,000	1897	3,833	22,835	1909	18,680	122,348
1886	1,200	6,000	1898	2,733	16,691	1910		130,006
1887	3,000	15,000	1899	4,334	37,032	1911	16,082	147,462
1888	1,500	7,500	1900	3,615	24,207	1912	16,706	125,446
1889	3,466	23,372	1901	4,020	52,950	1913	27,383	285,821
1890	2,532	50,240	1902	5,665	53,244	1914	28,230	252,327
1891		21,988	1903	9,219	76,273			

Marketed production of tripoli in the United States in 1913 and 1914, by States, in short tons.

State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Illinois	12,994	$128,892	10,387	$59,394
Missouri	7,529	83,995	6,721	81,434
Other States [a]	274	3,694	110	1,600
Total	20,797	216,581	17,218	142,428

[a] 1913: Pennsylvania, Tennessee, and Georgia; 1914: Oklahoma and Pennsylvania.

Marketed production of diatomaceous (infusorial) earth in the United States in 1913 and 1914, by States, in short tons.

State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Western States [a]	6,035	$55,056	10,343	$98,819
Eastern States [b]	551	14,184	669	11,080
Total	6,586	69,240	11,012	109,899

[a] California, Nevada, and Washington.
[b] 1913: Connecticut, New York, Maryland, Virginia, and Florida; 1914: Massachusetts, Connecticut, New York, and Maryland.

TRIPOLI.

The material called tripoli, in the trade in the United States, is a light, porous, and generally purely siliceous rock which has resulted from the leaching of calcareous material from very siliceous limestones or highly calcareous cherts. Tripoli was produced in 1914 in Oklahoma, Missouri, Illinois, and Pennsylvania. Deposits in Arkansas and in Oklahoma are not yet commercially productive. Deposits in Tennessee and Georgia were not worked in 1914. Some of the Missouri tripoli is and always has been produced and used as an abrasive and for other purposes, but much of it is used in the manufacture of filters. The Illinois product is used as paint, wood filler, metal polish, in soaps, in cleansers, for making glass, and for facing foundry molds.

No attempt has been made to procure from producers of tripoli a definite statement of the exact proportion used as an abrasive, nor has any attempt been made to get at the production of rough tripoli blocks worked up into filter stones.

Even if this output had been ascertained it would be impossible to value the product on a uniform basis and thus to obtain a reliable ratio between quantity and value, for the reason that the price of filter stones varies and is dependent not only on the size of the stones but also on the amount of work done on each stone.

PRODUCTION.

The production of tripoli for all purposes in the United States in 1914 was valued at $142,428 and in quantity was approximately 17,218 short tons.[1]

As compared with 1913 there was a decrease of 3,579 tons, or 17 per cent, in quantity and of $74,153, or 35 per cent, in value. The falling off was mainly in Illinois and is more apparent than real, for reports from that State in 1913 were of production enormously in excess of previous years. The production in 1914 for Illinois and Missouri also exceeds their respective productions in all years previous to 1913. As formerly, the Missouri product is to a large extent used for making filters, and the Illinois product (which many of the producers prefer to call "silica") is used as paint, wood filler, metal

[1] Owing to delinquency on the part of important producers in reporting to the Survey, this figure for output is in part estimated and of doubtful accuracy. More satisfactory data were obtained for the value, for which the figures given are reliable.

polish, in soaps, in cleansers, for making glass, and for facing foundry molds.

In Illinois 6 mines in Union County and 2 in Alexander County reported production. No new deposits were developed and a number of mines formerly worked were idle during the year.

In Missouri 4 operators in Newton County were active in 1913. There were no new developments.

One operator in Okfuskee County, Okla., reports small sample shipments. As yet nothing has been learned of the character of the material mined or of the deposit worked. The company which in 1912 began development of the tripoli deposits near Peoria is bankrupt, and there was no activity in that field.

The new operation in Tennessee described in this report for 1913 was suspended in 1914.

In Arkansas the tripoli deposits near Butterfield have not yet become commercially productive.

The company operating a tripoli deposit in Murray County, Ga., suspended operations in 1914.

Pennsylvania produced as usual a small quantity of "rottenstone" in Lycoming County in 1914.

DIATOMACEOUS EARTH.

Diatomaceous earth, called also infusorial earth and kieselguhr, is a light earthy material which from some sources is loose and powdery and from others is more or less firmly coherent. It often resembles chalk or clay in its physical properties, but can be distinguished at once from chalk by the fact that it does not effervesce when treated with acids. It is generally white or gray in color, but may be brown or even black when mixed with much organic matter.

Diatomaceous earth is made up of remains of minute aquatic plants and is composed, chemically, of hydrous silica.

Owing to its porosity, it has great absorptive powers and high insulating efficiency and is an effective filter. The hardness, the minute size, and the shape of its grains make it an excellent metal polishing agent.

Heretofore diatomaceous or infusorial earth has been largely used as an abrasive in the form of polishing powders and scouring soaps, but of late its uses have been considerably extended. Because of its porous nature, it has been used in the manufacture of dynamite as a holder of nitroglycerin, but, so far as known, not recently in the United States. It is used by sugar refiners for filtering or clarifying. Its porosity also renders it a nonconductor of heat, and this quality in connection with its lightness has very greatly extended its use as an insulating packing material for safes, steam pipes, and boilers, and as a fireproof building material. In this country it is reported to be used in the manufacture of records for talking machines. For this purpose it is boiled with shellac, and the resulting product has the necessary hardness to give good results. In Europe, especially in Germany, infusorial earth has lately found extended application. It has been used in preparing artificial fertilizers, especially in the absorption of liquid manures; in the manufacture of water glass, of various cements, of glazing for tiles, of artificial stone, of ultramarine and various pigments, of aniline and alizarin colors, of paper, sealing wax, fireworks, gutta-percha objects, Swedish matches, solidified bromide, scouring powders, papier-mâché, and many other articles. There is a steadily growing demand for it.

PRODUCTION.

The production in the United States of diatomaceous earth (also called diatomite, infusorial earth, kieselguhr, tripoli, and tripolite, and sold under various trade names) amounted in 1914 to 11,012 short tons, valued at $109,899. This was an increase of 4,426 tons, or 67 per cent, in quantity and of $40,659, or 37 per cent, in value. In both quantity and value the production of diatomaceous earth in 1914 was very much larger than any previously recorded. The year marks the firm establishment of an industry based on newly improved and extended uses of the material for insulating and fireproofing and for filtering.

Complete separation of the statistics of production for abrasive purposes only has not been possible. It may be safely estimated, however, that about 6 per cent of the total quantity and about 16 per cent of the total value of the production of 1914 is represented by abrasive materials. The quantities are small and probably not far different from those so used in other recent years.

During the year the numerous inquiries and communications addressed to the Survey concerning newly discovered deposits and recent developments on new and old deposits have indicated a growing interest in the material. Furthermore, certain large manufacturers of structural material have been considering the use of diatomaceous earth in their products. It may be expected that there will be continued increase of the production of diatomaceous earth.

The table shows production for 1913 and 1914 by Western and Eastern States. It will be noted that the production in the Eastern States is small in quantity but valued per ton at from two to three times as much as the Western output. The difference is due to the fact that the eastern product was sold as high-grade cleansing and polishing preparations, whereas the western product went largely into the manufacture of structural materials and insulation. The difference will probably disappear when the projected industries based on the Maryland-Virginia deposits get under way.

IMPORTS.

The value of the imports of rottenstone and of tripoli for the last six years has been as follows:

Value of tripoli, diatomaceous earth, and rottenstone imported for consumption into the United States, 1909–1914.

1909	$24,024	1912	$24,253
1910	56,657	1913	28,696
1911	35,665	1914	20,004

PUMICE.

The pumice produced in the United States in 1914 amounted to 27,591 short tons, valued at $59,172. This was an increase of 3,028 tons in quantity and of $3,764 in value, as compared with the production of 1913.

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 has been so used—is not included. The material has come from six States: California, Inyo and Siskiyou counties; Kansas, Morton and Phillips counties; Nebraska, Furnas, Lincoln, and Harlan counties; Idaho, Cassia and Power counties; Dakota, Custer County; and Utah, Millard County. In 1914 the production came from Kansas, Nebraska, Utah, and California.

The pumice deposits in Oklahoma are described in a recent publication by the Oklahoma Geological Survey.[1]

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 has been regularly recorded only since 1902. There has been a steady increase in the quantity until it is now 40 times what it was 12 years ago. The value, however, as recorded, shows very large gains in 1910 to 1912. This is owing to the fact that in those years the value recorded was for both partly manufactured and crude material.

The production of pumice in the United States during the last five years is given in the following table:

Marketed production of pumice in the United States, 1910–1914, in short tons.

Year.	Quantity.	Value.	Price per ton.
1910	23,271	$94,943	$4.08
1911	21,689	88,399	4.08
1912	27,146	86,687	3.19
1913	24,563	55,408	2.26
1914	27,591	59,172	2.14

The value of the pumice imported for consumption, 1909–1914, is shown below:

Value of pumice imported for consumption into the United States, 1909–1914.

1909	$100,997	1912	$74,478
1910	104,425	1913	93,408
1911	118,977	1914	92,668

PEBBLES FOR GRINDING.

GENERAL STATEMENT.

Pebbles used for grinding minerals, ores, cement, and clinker, are properly considered abrasive materials. They have not heretofore been included in this report on abrasive materials because none had been produced in this country except for limited local use and because the records of imports of foreign pebbles for grinding are not kept

[1] Buttram, Frank, Volcanic dust in Oklahoma: Oklahoma Geol. Survey Bull. 13, 1914.

separate from those of pebbles which are crushed and used as "flint" in the ceramic industry. The chapters on quartz or flint in the Mineral Resources have annually given the quantity of the imports of pebbles used both for grinding and as flint. Little or no interest had been taken in domestic sources of flint until the fall of 1914, when the threatened interruption of imports from Denmark and France, the principal sources of foreign supply, aroused American jobbers and consumers to seek independence from the established foreign sources. This new interest in possible American sources of flint pebbles or substitutes therefor has called forth the information of which the following is a summary.

Pebbles are used as grinders by revolving them with the material to be ground in troughs of various cylindrical or conical forms. The crushing and the fine grinding are accomplished in part by the impact of "cascading" pebbles and in part by the slipping or rubbing of the pebbles on the material to be ground. The relative amount of reduction accomplished by these two methods depends, among other things, on the form and the character of the lining of the mill and on the shape of the pebbles. Well-rounded pebbles ranging in diameter from about 1½ to 4 inches are preferred. As the pebbles themselves suffer reduction, they must be hard and tough and not liable to fracture. In these respects selected Danish and French flint pebbles have proved most acceptable. Danish pebbles are generally in highest favor. Besides Denmark and France, Belgium, Norway, and England have supplied flint pebbles, and grinding pebbles have also been imported from Germany, Italy, Labrador, Newfoundland, and Japan.

The exact quantity of pebbles annually imported for grinding is not determinable, as the records of consumption show only the total combined value of pebbles imported. Of the values assigned in the following table a large part of those for Belgium, Denmark, and France are for grinding pebbles of flint. The whole of the values for Canada, Newfoundland, and Labrador are probably for grinding pebbles which are not flint. Much of the value credited to England and a large part of that to Belgium, Denmark, and France is for flint which was ground after arriving in this country.

The value of pebbles of various kinds imported for consumption into the United States during the years 1912, 1913, and 1914, by countries, is shown in the following table:

Value of pebbles imported for consumption into the United States in 1912, 1913, and 1914, by countries.

Country.	1912	1913	1914
Belgium	$99,472	$40,947	$70,851
Canada	14,141	8,599	63,996
Denmark	78,123	134,625	193,029
England	870	2,626	2,199
France	99,140	121,854	116,571
Germany	67	2	91
Italy			22
Japan			12
Newfoundland and Labrador		10,800	8,448
Norway	239		1,846
Sweden		56	22,081
Total	292,052	319,509	479,146

PEBBLES FOR GRINDING IN THE UNITED STATES.

In this country grinding by pebble mills is practiced chiefly in the manufacture of cement, in the metallurgy of gold and silver ores, and in the grinding of feldspar and quartz and of certain mineral pigments. These industries have grown to be in a large measure dependent on this method of pulverizing, so that after August 1, 1914, when conditions in Europe threatened to make it difficult to obtain an ample supply of flint pebbles and when there were sharp advances in price quotations on pebbles, efforts were made to find a domestic supply of similar pebbles and to find and test domestic substitutes for flint pebbles. On account of the large quantity of foreign flint available and the low prices at which it had been offered there had been little such effort prior to 1914 on the part of geologists, dealers, or users of flint pebbles. And yet some work along this line had been done. Pebbles of granite, quartzite, and other material have long been imported from Newfoundland and Ontario. Some cement plants had successfully used local stream and beach pebbles. Late in 1913 Mr. Omar Maras, of Nevada, began the experimental manufacture of substitute pebbles, which has since met with considerable success.

Sources of domestic flint pebbles are probably still only partly known. The principal localities in which they have been noted in particular abundance are all in the Gulf States. It may be stated that, in general, flint pebbles in that region are to be found in that part of the Coastal Plain which borders the southern Appalachian and Ozark Mountain regions. Flint pebbles are to be looked for in this Coastal Plain region along stream terraces and bottoms. The pebbles are for the most part small, few exceeding 2½ inches in diameter, and it does not seem probable that they will meet the requirements of mill practice, particularly because satisfactory pebbles can be obtained elsewhere. Another possible source of American pebbles which is worthy of investigation is the area of flint-bearing Cretaceous limestone, particularly the formation named the Edwards limestone in the United States Geological Survey publications on central Texas. Other kinds of tough, siliceous, and not unfamiliar pebbles found in abundance in some parts of the United States consist of agate, carnelian, and petrified wood. Stream bottoms or shore deposits containing them should be searched. At present there is no satisfactory information as to the availability of these materials for pebbles for grinding.

The above-mentioned material has given no promise of successful substitution of domestic material for foreign flints, but the success in recent experiments on the substitution of other materials seems to be a herald of American independence. For example, selected, well-rounded quartz pebbles from stream gravels in Amador County, Cal., have been satisfactorily substituted for Danish pebbles in a gold mill. One of the large California rock-dressing plants which handles dredge tailings in the gold placer fields is sorting pebbles suitable for this use. A cement mill on the Pacific coast is making large use of pebbles which are found in great quantities along the shore. It is reported that in fineness and quantity of output the results of the use of these pebbles are as good as results obtained with foreign pebbles. Other

California cement mills have used local pebbles at times during the last 10 years, but no specific records of the results are to be had. Pebbles from the north shore of Lake Superior and from Conception Bay, Newfoundland, which are largely quartzite and granite, have been supplied to cement grinders for many years. There are within the borders of the United States numerous deposits of gravel containing pebbles as good as these Canadian pebbles. Suitable rhyolite and basalt pebbles can be found in the Rocky Mountains and in the Pacific States. Granite pebbles are abundant on the flanks of the Sierra Nevada in proximity to many gold mills. In the eastern United States rhyolite and felsite are abundant on the eastern coast from Marblehead, Mass., to Eastport, Me. As to the quantity available, it is impossible to make definite statement, but it may confidently be ventured that thousands of tons may be gathered in favorable localities along the shores of Maine and of Lake Superior.

The artificial preparation of pebbles for grinding has, locally at least, been successful. Tube mills were first supplied with cast-iron balls for grinding. As these were not satisfactory for all purposes, flint pebbles supplanted them. Porcelain balls had been used, but they are not so hard and efficient as flint. The manufacture of pebbles or balls from natural rock has been tried at Manhattan, Nev. At that place the dense and banded but originally homogeneous rhyolite, which has been silicified so that it is now spoken of as onyx, is used. The rock is broken into blocks of suitable size and then rounded off by tumbling a charge of blocks in a revolving chamber. The roughly rounded pebbles so made have been tested in several of the large Tonopah metallurgical mills and have been found to be quite as efficient as Danish flint pebbles.[1] Another substitute for flint pebbles has been found in the use of chunks of flinty ore. Satisfactory data are not at hand to judge of the success of this practice, but at any rate further experiment along the line of using chunks of the substance to be ground instead of pebbles should be made before the method is discredited.

Angular blocks of basalt lava have been used in two instances known to the Survey. At a gold mine in eastern Oregon a dike of tough mineralized trap rock encountered in mining supplied blocks which were substituted for flint pebbles in the tube mill. Results of this practice seemed to be satisfactory as a matter of economical grinding and at the same time there was a recovery of the mineral in the trap rock. The other example of the use of basalt gravel is from the cement mill of the United States Reclamation Service at the Arrowrock dam. The angular blocks of basalt rock collected along the line of the Arrowrock Railroad have been used with entire satisfaction. It is found that the corners and edges of the basalt rocks ground off quickly and the chunks were reduced to spherical or ellipsoidal forms. According to the superintendent of the mill these pebbles wear longer than Danish pebbles, and he believes that they are actually more effective.

From the foregoing outline it is concluded that pebble-mill grinding in the United States need not suffer because of conditions in Europe.

[1] See note on this use in the chapter on the cement industry, Mineral Resources, 1914.

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ARTIFICIAL ABRASIVES.

The artificial abrasives here considered include carborundum and crystolon, which are carbides of silicon; alundum and aloxite, which are crystalline aluminum oxides; and crushed steel and steel shot. So far as known to the Survey, these are the only artificial abrasives manufactured in the United States. Artificial abrasives with other names are either special forms of the above-named products marketed under trade names or are imported products.

The production of artificial abrasives since 1906 is given in the following table:

Marketed production of artificial abrasives in the United States, 1906–1914, in pounds.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1906	11,774,300	$777,081	1911	21,292,000	$1,493,040
1907	14,632,000	1,027,246	1912	29,002,000	1,747,120
1908	8,698,000	626,340	1913	33,489,000	2,017,458
1909	20,468,000	1,365,820	1914	27,191,611	1,685,410
1910	23,027,000	1,604,030			

MAGNESITE.

By Charles G. Yale and Hoyt S. Gale.

GENERAL STATEMENT.

The magnesite consumed in the United States during 1914 amounted to 122,000 short tons of calcined and 13,000 short tons of crude, imported, and 11,293 short tons of raw, domestic, a total equivalent to about 132,000 short tons of calcined magnesite. Thus only 4 per cent of the magnesite used in this country in 1914 was of domestic production. Nearly 93 per cent was imported from Austria and Hungary for making refractory bricks and other articles, the remaining 3 per cent was imported chiefly from Greece, either directly or through ports in Holland, Germany, and England. The principal consumption is in the Eastern States and is supplied by importation, whereas the entire domestic production comes from California and is used almost entirely on the west coast.

With magnesite, as with other products for which this country has been largely dependent on foreign sources of supply, the most notable factor affecting production and distribution in 1914 was the European war. During the early part of the year the conditions were much the same as they had been during the years immediately preceding, showing a somewhat fluctuating though gradually increasing consumption of magnesite and its products. The first influence of the war was to stimulate the trade, both as to the imports from abroad and as to the development of domestic resources. The effect of this stimulation continued well on through 1914, and at the close of the year large imports of magnesite and allied products were still being received, evidently because of an effort to lay by stocks to tide over possible future needs.

The dependence of American users of magnesite on foreign supplies is due to several causes, chiefly to the character of the Austrian and Hungarian deposits. These ores contain 6 to 8 per cent of iron, which makes them more available for furnace use than the purer magnesite obtained in many other parts of the world; and, moreover, the form of the deposits is such that this foreign ore can be produced more cheaply in large quantities. Besides, it is more readily manufactured into refractory brick than the purer material. As has been noted, this source supplied 93 per cent of the consumption of this material in the United States in 1914.

Some of the purer grades of magnesite, like the American and the Grecian, are used for making refractory linings or are made into bricks, but though these articles are more refractory than those made of magnesite of lower grade they are also considerably more expensive, both in the raw material required and in the calcining and manufacture. On the whole, it is extremely doubtful whether, so long as the Austrian and Hungarian material is available, the American deposits can supply the demand for magnesite for making ordinary refractory material, both because of the small extent of the purer deposits and because of the greater cost of working material of this class.

There is little doubt that, so far as quantity and quality alone are concerned, the California deposits might readily supply the demand in this country for the purer grades of magnesite, such as are used in making cement, paints, fireproof and damp-proof coatings, and in the manufacture of paper and other products, but the California deposits are so far from the principal markets of the country that the overland freight rates prohibit their shipment. It has been hoped that the Panama Canal will give cheaper transportation, so that the California magnesite may be brought to our eastern markets at prices to compete with those of the foreign product. Crude Euboean magnesite is sold at $7 to $8 a short ton on board steamer in New York. Crude domestic magnesite in the same market would have to stand the cost of shipment by water (amounting at the very least to a large part of this price) plus transportation by rail from the mines to the ships. Calcined (not ground) Euboean magnesite is usually sold in New York at a lower price than that at which similar material is held at the mines in California.

Now that ocean traffic with most of the foreign ports of supply is largely cut off, attention is naturally directed to the California deposits. These are numerous, and many of them are fairly large and the material is of excellent quality and appears to be admirably adapted to use in making cement or other plastic material. Certain deposits, notably some in Tulare, Santa Clara, and San Benito counties, are large and consist of exceptionally pure material. There are some large outcrops of siliceous magnesite and possibly a quantity of purer material in Sonoma County.

There has been much speculative inquiry as to California magnesite and magnesite mines. At the same time the local owners, although themselves doing little or nothing toward development, have held the properties for sale at figures so high as to prevent their purchase. Moreover it is generally agreed that by the time these properties can be opened and equipped the market will probably have returned to its usual condition. On the prices which resulted from the war practically no business has been done by California dealers. Offers to buy in very large quantities were made to California producers, but the prices were so low that none were accepted. In fact, the California mines were not in a position to furnish magnesite in large quantities. With the exception of one mine, the output of which was already contracted for, none were at the time able to deliver even 500 tons a month. Aside from that mine only two others are of known present productive magnitude, and both are from 30 to 35 miles from a railroad and would have to make deliveries to the railroad by wagon or auto truck, and could therefore do no large business. For these reasons no serious attempt has been made by the California producers to place their magnesite on the eastern markets, where it would have to compete with material mined and shipped at much less cost.

The Tulare Mining Co. has been for some years the only large producer of magnesite on the Pacific coast. Almost the entire output of the mines near Portersville is used by the Crown Willamette Paper Co., only a few hundred tons surplus each year being sold to those who grind and retail magnesite in San Francisco. Aside from the output from the mines of this company, the production of magnesite in California for the last few years has been very small. Since the beginning of the war there has been much talk of opening and developing new or old properties, but thus far very little has been done. Three mines, so far as known, have been sold—the Western Magnesite Co.'s mine, at Red Mountain, in Alameda County; the Harker, in Tulare County; and the Phelan, in Napa County. None of these mines has made any output since it passed into new ownership, although preparations for production are now (1915) under way at two of them.

A freight rate of $4 a ton from San Francisco to points on the Atlantic seaboard through the Panama Canal was at first quoted and then withdrawn, as scarcity of bottoms became apparent. Later the freights on magnesite were advanced, and still stand at $10 a ton from the Atlantic to the Pacific coast and at $7 a ton from San Francisco to the Atlantic seaboard; but, even when lower freight rates were offered, eastbound magnesite was not sought by the carriers. The charge on magnesite by rail to the Atlantic ports was for years $15 a ton, but since the Panama Canal was opened the charge has been reduced to $10 a ton.

In addition to costs at the mine, local freight rates from the mine to ocean-shipping points must be considered. The only large producing mine in California has to pay $4 a ton to deliver its magnesite in San Francisco.

It must be confessed also that if all the developed deposits in California (the only State in which commercial deposits are now available) were to be worked to full capacity they could furnish only a small part of the magnesite needed in the United States. It is not to be expected, therefore, that at present rates much magnesite will be shipped from California to eastern points, and the magnesite producers of the Pacific coast will have to look principally to the local market for their business. For some years the consumption on the Pacific coast has been less than 6,000 short tons of calcined magnesite a year.

CHARACTER.

Magnesite is a natural form of magnesium carbonate that is fairly pure and free from other materials. It consists of a metallic element—magnesium—in combination with carbonic acid, or, as usually expressed, it is composed of magnesia, or oxide of magnesium, 47.6 per cent, and carbon dioxide, 52.4 per cent, and is split up into these two components by heating. Pure magnesite is commonly a white, very fine-grained porcelain-like rock, which is actually minutely crystalline, but very fine and compact.

Magnesite is found in many parts of the world, the deposits of commercial importance belonging to two principal and quite distinct types. The most widely distributed type is fine-grained massive magnesite, which occurs as vein deposits. This type is associated with basic intrusive magnesian rock, which if somewhat altered is generally called serpentine. To this class belong the deposits on the island of Euboea, in Greece, practically all the deposits in California, and deposits in many other parts of the world.

The other form of magnesite is of sedimentary origin or is found in immediate relation to sedimentary rocks, in which it occurs as a massive, more or less coarsely crystalline rock resembling coarse dolomite or marble in texture, an extreme phase of the supermagnesian dolomites. The deposits of Austria and Hungary are of this type, and perhaps also the deposits near Quebec, in Canada.

A more complete description of the occurrences of magnesite in the United States and references to foreign deposits may be found in Bulletins 355 and 540 of the United States Geological Survey.

DERIVED PRODUCTS.

Magnesite is ordinarily marketed either crude or as the calcined product, but a considerable number of derived and of more or less manufactured products are made wholly or in part from magnesite.

CRUDE.

Magnesite as mined, in its crude or natural form, is essentially carbonate of magnesium with some impurities. As such it may be considered a source either of magnesia (magnesium oxide) or of carbon dioxide gas, these being produced by its decomposition by extreme heat or calcining.

CALCINED.

Magnesite that has been calcined consists essentially of magnesia (magnesium oxide). In practice the process of calcining is carried out so as to manufacture magnesia in two forms, which have quite different properties, namely, the "caustic" calcined magnesite and the "dead-burned" magnesite. These products are obtained by different degrees of calcination of the raw magnesite.

Caustic calcined.—If the magnesite be heated at moderate temperature (considerably below that required for fusion) in the furnaces commonly used for such purposes the dissociation of the magnesium carbonate into magnesia and carbon dioxide may be made fairly complete, but it may not render the residual product so inert to recombination as if it had been calcined at a higher temperature. In practice this more moderate heating for the production of so-called caustic calcined magnesite is so conducted that, although most of the carbon dioxide is driven off, from 3 to 8 per cent is intentionally left combined in the residue. The calcined product then partakes somewhat of the properties of caustic lime, which is produced by similar heating of limestone, and, like lime, the magnesia is also susceptible to reaction with water and with carbon dioxide of the air. In this form magnesia also readily combines with certain other reagents, such as magnesium chloride, and it is upon this latter fact that its important use in magnesia cement is based.

Dead-burned magnesite.—When, however, the calcining is carried on at much higher temperature, essentially all moisture and combined carbon dioxide of the magnesite may be driven off, and the heating being carried beyond this point the material may be brought to incipient fusion. The product then obtained is known as dead-burned magnesite. Nearly all shrinkage due to the calcining is then taken up, and the product resulting is a very dense, fire-resistant, and chemically inactive substance. It will not slake upon ordinary exposure as lime and caustic magnesia do, nor will it combine with chemicals for use as cement, although it has lately been found to be susceptible to change in contact with steam. The dead-burned magnesite is used for making refractory materials, such as brick, or, in crushed form, the bottoms of open-hearth steel furnaces. Magnesite brick is used chiefly in open-hearth steel furnaces, copper converters, reverberatories, settlers, and electric and other melting, heating, and welding furnaces.

OTHER DERIVED PRODUCTS.

Magnesite, raw or calcined, is also used in the manufacture of derived salts, such as epsom salts (magnesium sulphate), and magnesium chloride, which, although obtained largely by import, are in part made from magnesite in this country. Magnesia materials are also derived from other magnesian rocks besides magnesite, as, for instance, from dolomite. Calcined magnesite is converted into magnesium bisulphite for use in the manufacture of paper. A basic carbonate known as light magnesia or magnesia alba is made from magnesite by chemical precipitation. (See p. 574.) Metallic magnesium is usually manufactured from magnesium salts, such as those derived from natural salt deposits, but may be obtained less directly from magnesite.

MAGNESIUM CHLORIDE.

The statistics of imports do not show separate returns for the magnesium chloride imported during 1914. Until recently imports have represented practically the entire consumption of this material in this country. Magnesium chloride is largely used for making oxychloride, or Sorel cement, and for dressing cotton goods. Some of the refined salt is used in chemical laboratories. Ordinary commercial magnesium chloride is shipped to this country from Germany, where it is derived from the potash deposits as a hard, glassy fused salt, packed in 1,000-pound wooden casks. It absorbs water rapidly.

Magnesium chloride has lately been manufactured in various ways in this country as a consequence of the restrictions on export of the German salts. Here it has been made chiefly by solution of magnesite with hydrochloric acid, but by one manufacturer, at least, it was produced by reaction of serpentine with spent liquors containing hydrochloric acid. A concentrated solution of magnesium chloride in water has a density of about 34° Baumé. For use in cement it is customarily diluted to about 24° Baumé. The material thus manufactured from acid and magnesite is described as purer than the ordinary German salt, which is generally contaminated with more or less potash salts, said to be detrimental in cement manufacture. However, this process of manufacture with acid is expensive, whereas the German salt is obtained in enormous quantities as a by-product. Even if magnesium chloride thus manufactured could be sold for $30 a ton—a price a little higher than the reported cost of making this salt with acid—it would not serve well for long shipment without further concentration, for thus made it is in the form of a solution—generally of gravity not over 30° Baumé—and it is too bulky and heavy to permit much transportation.

Magnesium chloride is also obtained as a by-product from bitterns of the salt refineries, and at least one company established a plant for its production in this way during 1914.

Some of the magnesium chloride recently imported has come from England, where there seems to have been a regular production, doubtless by manufacture from German salts.

MAGNESIUM SULPHATE.

During 1914 the imports for consumption of magnesium sulphate, or epsom salts, amounted to 6,915 short tons, and this quantity probably represented the greater part of this salt used in this country. The imported magnesium sulphate is a by-product of the German potash salt industry. Some of the purified salt (epsom salts), most of which is used in medicine and in chemical laboratories, is manufactured in this country by treating magnesite or dolomite with acid. Doubtless much of this purified salt goes into the drug trade or into the manufacture of laxative mineral waters, of which many kinds are on the market. Magnesium sulphate has important uses in the textile industries and is used also to a certain extent in tanning leather, in part to soften certain leathers, and, it is reported, because it thickens the leather and increases its weight.

There are some natural deposits of magnesium sulphate in this country, but it is doubtful whether the natural salt, at points from which the cost of rail transportation to a market would be high, can compete with that imported.

LIGHT CARBONATE OR MAGNESIA ALBA.

Magnesia calcined, and carbonate, medicinal, referred to in import tables, include the basic carbonate known as light magnesia or magnesia alba. This is usually prepared by chemical precipitation from solution of the commercial sulphate or of the chloride with sodium carbonate. The manufacture of the light or basic carbonate from dolomite is a well-defined special industry in this country, as well as an old industry abroad. Here it seems to center on the limestone or dolomite belt north of Philadelphia. There are five extensive plants for the manufacture of the basic carbonate in Pennsylvania, at Valley Forge, Plymouth Meeting, Ambler, Franklin, and Manville, and there is also a large plant at Milwaukee, Wis. The rock is calcined and the light magnesia is obtained by precipitation from solution. It is used as filler, as fireproof material, and as nonconductor of heat in coverings for steam pipe and in other heat insulators, where it is commonly mixed with asbestos fiber. The basic carbonate has also many other uses, including the medicinal and a minor use in paints. The price toward the close of 1914 was about $6 a hundred pounds, but earlier it was sold as low as $4.

METALLIC MAGNESIUM.

The average wholesale price for metallic magnesium in this country during 1914 is reported as about $1.40 a pound f. o. b. New York. This refers to the imported metal, and the price includes the duty of 25 per cent ad valorem.

Although the metal used here has probably all been made abroad, heretofore chiefly in Germany, the restrictions on its import resulting from war conditions have induced some activity looking toward its manufacture in this country. A firm in New York advertises "Metallic magnesium made in America," and, according to reports, steps are being taken to manufacture it at other places.

Magnesium is prepared in its metallic form by electrolytic means. It has lately become of considerable importance as a constituent of an alloy with aluminum, known as magnaleum, and of other alloys with zinc which combine lightness with strength and rigidity and resistance to oxidation. It is used to a considerable extent in the construction of aeroplanes, so that in this country some of these alloys are referred to as "aero-metal." The demand for magnesium for these alloys and the loss of the supplies from abroad will probably soon establish the domestic manufacture of these materials. Metallic magnesium in the form of wire, ribbon, or powder is used for flash light in photographic work, a use which creates an appreciable demand.

USES.

MANUFACTURE OF PAPER.

The availability of magnesite in the California deposits has led to its considerable use in the manufacture of wood-pulp paper on the Pacific coast. Magnesia, in the form of the bisulphite, 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 afterward injurious to sizing agents.

The process of making paper 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 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.

The greater part of the California magnesite is now used in the manufacture of paper by this process. The Portersville deposits, which have been for years the largest producers, have been worked primarily for the use of paper makers.

OXYCHLORIDE OR SOREL CEMENT.

The use of magnesite for the manufacture of cement, known as oxychloride or Sorel cement, is based on the fact that a mixture of finely ground calcined magnesite when wet with a solution of magnesium chloride of a certain strength will solidify or set as an exceedingly strong and hard mass. This mixture is generally modified by the addition of various filler materials, such as wood flour, cork, talc, silex, asbestos, clay, marble dust, sand, and other materials, besides coloring matter. The cement thus produced is put out under many trade names, especially referred to as sanitary flooring. When well laid, magnesite cement has some decided advantages over other cements for use as flooring. It produces a smooth even floor, which may be laid in large areas without cracking. It takes colors advantageously and is susceptible of good polish by oiling or waxing. It is laid in a plastic state on wood, steel, or concrete. Its surface seems to have a resilience not given by ordinary cement, and it does not pulverize or grind to dust. This cement is also used for making artificial marble and tiles, and to a certain extent has been successfully used as a plastic or stucco for exterior finish.

It appears, however, that practical difficulties are encountered in the manipulation of magnesia cement which are not yet wholly understood and which have at times led to criticism and dissatisfaction with the material. These criticisms have possibly not always been merited, but they have undoubtedly impeded the wider use of the material in the building trades. Nevertheless this use of magnesia cement in floors and as stucco or wall and outside plaster is evidently gaining rapidly in importance both in this country and abroad. A number of firms in this country are already established in the business of producing the cement, and good examples of large floors laid in this material may be found in most of the principal cities. The material is usually known under various suggestive trade names, among which may be mentioned asbestolith, asbestos floors, compolite, compostone, kellastone, marbleloid, monolith, petrified wood, sanitary floors, stonewood, tileine, and velvetile. Recently an organization of such firms under the name of the Composition Floor Manufacturers' Association of Chicago has been established for the purpose of promoting the sale and use of composition flooring as a building material, the establishment of a uniform specification for the laying of such floors, and in order that the members may unite in a demand upon the dealers in raw materials that prices shall be made and materials furnished based on a standard specification as to composition or purity. One of the principal difficulties encountered by the companies making magnesite composition flooring lies in the uncertainty as to the quality of their raw materials, which are purchased largely through brokers in lots that vary from time to time in composition, quality, and freshness. It seems, therefore, that the establishment of some standard or specification for these raw materials might be a very important matter to this industry.

CARBON DIOXIDE.

The manufacture of carbon dioxide from raw magnesite consists in the decomposition of the magnesium carbonate by roasting and 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. Carbon dioxide is manufactured in this way in the eastern part of the country from imported magnesite, the magnesia being in that case a by-product of the manufacture of the gas. By far the greater part, however, of the raw magnesite produced or imported is calcined primarily for the magnesia, and the carbon dioxide is allowed to go to waste. As the reduction of raw magnesite to magnesia also reduces the weight by approximately one-half, the calcining is commonly done at the mine in order to lessen shipping cost on the product, and facilities for saving the gas are seldom provided.

The use of magnesite for the manufacture of carbon dioxide is dependent on the ability to make use of the resulting magnesia. But it appears that apparatus designed to save the gas does not usually burn the magnesite to the proper degree to produce a good caustic magnesia—generally too much carbon dioxide is left in the residue—and for this reason it is understood that this use of magnesite is not on the increase.

MAGNESIA PAINTS.

The use of finely ground caustic calcined magnesite in fire-retarding paint is now one of its important applications. Inflammable materials which are coated with a paint made of the ground calcined magnesite and magnesium chloride dissolved in water show a marked resistance to fire, so that although the materials may be burned by the direct application of heat and flame, nevertheless the damage by fire is usually confined. This property of magnesite may be of use in many ways, varying from its application to theater curtains and garments to the larger expected applications in the construction of fireproof buildings.

The larger buildings of the Panama-Pacific Exposition, as well as other buildings on the exposition grounds, were treated with a fireproofing and damp-proofing magnesia paint. This paint is manufactured as a dry powder, to which cold water is added for use, and is put on by spraying. The contracts for the exposition buildings required 285 tons of paint. Small fires which have occurred on the roofs or elsewhere in the exposition buildings have been confined to small areas, it is said, none having spread more than 30 feet before they were extinguished.

PRODUCTION.

The crude magnesite produced and sold or treated in the United States in 1914 amounted to 11,293 short tons, valued at $124,223, or 17.2 per cent more than the production in 1913, which was 9,632 tons, valued at $77,056.

The production continues to be derived from California exclusively, the material having been obtained in 1914 from 6 mines in the counties of Alameda, Santa Clara, Sonoma, and Tulare.

In California production from the main properties continued about as usual, showing some increase at the close of the year. There were 6 mines working regularly or intermittently, but greater activity at the close of the year gave promise of a more extended development during 1915. Of these mines, only 1, as in 1913, made an output of any moment, the others producing only small quantities intermittently.

The following table shows the quantity and value of the domestic output of magnesite from 1891 to 1914, inclusive:

Quantity and value of crude magnesite produced in the United States, 1891–1914, in short tons.

	Quantity.	Value.		Quantity.	Value.
1891	439	$4,390	1903	3,744	$10,595
1892	1,004	10,040	1904	2,850	9,298
1893	704	7,040	1905	3,933	15,221
1894	1,440	10,240	1906	7,805	23,415
1895	2,220	17,000	1907	7,561	22,683
1896	1,500	11,000	1908	6,587	19,761
1897	1,143	13,671	1909	9,465	37,860
1898	1,263	19,075	1910	12,443	74,658
1899	1,280	18,480	1911	9,375	75,000
1900	2,252	19,333	1912	10,512	84,096
1901	3,500	10,500	1913	9,632	77,056
1902	2,830	8,490	1914	11,293	124,223

In connection with this table it is to be noted that, although no statistics of domestic production are available prior to 1891, yet there has previously been some small output in California. Mineral Resources for both the years 1886 and 1887 refer to the magnesite mines of Cedar Mountain, Alameda County, Cal., but give no figures of output or value. In the report for 1886 a description of the Cedar Mountain mine is given, and it is stated that several carloads of ore were shipped in sacks to New York by railroad after being brought down from the mountain on the backs of horses.

The value assigned to the domestic production in 1914 is based on a price of $25 to $30 a ton of ordinary calcined, not ground, in sacks at San Francisco, which is assumed to be approximately equivalent to $10 to $12 for the raw magnesite at the same point. The price of $11 a ton for the crude product at San Francisco has therefore been taken, which is $3 a ton higher than in 1913.

NEW DEPOSITS AND RECENT DEVELOPMENTS.

The discovery of several new deposits of magnesite near Towle, in Placer County, Cal., was reported to the Survey early in the year, although later investigation indicates that these are probably not of large importance. Several other deposits, hitherto unrecorded, were also reported, including magnesite and dolomite near Bagdad and magnesite near Victorville, both in San Bernardino County, and a report, with samples, was received from a supposed magnesite deposit near Benson, Ariz.

CALIFORNIA.

Some work has been done on the deposits at Red Mountain and Cedar Mountain, near Livermore, Alameda County, and the old workings of one of the idle mines near Portersville, Tulare County, have been reopened. The mine in San Benito County still remains undeveloped and unproductive. A new mine has become productive in a small way near Madrone station, Santa Clara County, and there has been some little development of the deposits on East Austin Creek, in Sonoma County. The location of the magnesite deposits in California is shown on Plate IV.

MAP OF A PART OF CALIFORNIA, SHOWING DISTRIBUTION OF MAGNESITE DEPOSITS.

Placer County.—Recently discovered deposits of magnesite near Towle, in Placer County, Cal., were reported early in the year and described as situated in sec. 6, T. 15 N., R. 11 E., and in secs. 24 and 36, T. 16 N., R. 10 E. Later in the season these deposits were examined by H. S. Gale. The magnesite described as situated in sec. 6, lies in the bed of Canyon Creek about one-fourth of a mile south of and below the railroad at Towle station. That in sec. 24, lies 2½ miles north, a little east of Towle in the steep canyon slope on the south side of Bear River. The locality described as in sec. 36 was not visited, nor any further information concerning it obtained, nor is it supposed to be of importance. In both deposits examined the magnesite occurs in thin veins and irregular lenses or masess in brecciated serpentine, in general so far as exposed much mixed with the serpentine wall rock and rarely in masses of considerable size or purity as compared with the numerous other larger deposits that are known in California. Although the zone in which these deposits occur is doubtless traceable for a considerable distance by occasional outcroppings of magnesite from place to place, the aggregate quantity of material available as indicated by exposures certainly does not appear to be large. The deposits, so far as known, are therefore of doubtful value, although there is, of course, always the possibility that larger masses may be discovered or developed by opening the outcroppings.

In the chapter on magnesite for 1913 acknowledgment was given to a protest that had been received concerning the description and summary given in Survey Bulletin 540[1] of the deposits in the vicinity of Iowa Hill and Damascus, south of the American River canyon. The district referred to has once more been reviewed in the field under the guidance of a representative of the interested parties, and the evidence obtained does not in any degree alter the original conclusions concerning this property. Like the deposits nearer the Southern Pacific Railroad, in this same vicinity, the exposures are not of large extent nor apparently of much importance. Although numerous outcrops or shallow prospects were observed, they were not such as to offer much encouragement in the hope of developing large bodies of magnesite. Material showing some small veins of good magnesite in serpentine was long ago thrown out in driving some tunnels in search of pay gravel in the placer gold workings, and the weathering veins are still exposed in some of these old tunnels. The material is far from transportation facilities, and its exportation at present would have to be over a difficult wagon road, which would prohibit the shipment of such material. The amount of actual prospecting for magnesite done on the deposits has been very small.

Sonoma County.—Only a few sample shipments of crude magnesite were made in 1914 from the deposits on East Austin Creek, 8 miles north of Cazadero. The shipments were made for the purpose of having them tested in different parts of the country, and some were sent east through the Panama Canal. Neither the short 24-inch gage railroad nor the calcining plant was completed in 1914, so that, aside from the sample shipments, there was no production. In May, 1915, the State authorities of California granted a permit to the

[1] Gale, Hoyt S., Late developments of magnesite deposits in California and Nevada: U. S. Geol. Survey Bull 540, pp. 501–503, 1913.

Sonoma Magnesite Co., owning these deposits, to sell 3,000 shares of capital stock at par ($10), to net the company 80 per cent of the selling price to be used in completing the railroad line to the property and in finishing the plant. It is claimed by those in charge of the work that a large quantity of available ore has been proved on East Austin Creek since the examination of the property by the writer[1] in September, 1912.

Three mines in Sonoma County made small shipments, which did not exceed 350 tons. The material was sent to San Francisco in crude form, mainly for use in steel plants; there it was crushed and mixed with the calcined product. A portion of this shipment was calcined at a plant in Berkeley, the carbonic acid gas being saved.

Alameda County.—Renewed activity at the Red Mountain deposits, about 35 miles from Livermore, as well as at Ceder Mountain, about 13 miles southeast of the same shipping point, has been reported for 1914. Some magnesite has been hauled by auto trucks from the mines to the railroad at Livermore for shipment. It is understood that the interests of the Western Magnesite Co. in the Red Mountain deposits have been purchased by H. E. Stock, of Wyoming, who has organized the Magnesite Products Co., with the intention of building the long-contemplated railroad and thoroughly developing the mines.

Santa Clara County.—On July 1, 1914, H. Sherlock opened a new mine, under lease from the Bay City Water Co., near Coyote station, between Madrone and Morgan Hill, on the west side of the Santa Clara Valley. The ore is shipped to the Pure Carbonic Co., of Berkeley, where it is calcined and the gas recovered, the calcined ore being shipped to the Hawley Pulp & Paper Co., of Oregon. This magnesite is of poor grade and calcines at a big loss.

San Benito County.—Some activity was shown looking to the development of the large deposit of magnesite in San Benito County, but there was no actual production during 1914, as the deposit still lacks facilities for transportation.

Tulare County.—The old mine 4 miles northeast of Portersville, formerly under lease to the Crown Paper Co. but idle for some years, has been sold by Charles S. Harper to H. S. Doyle and associates in the Adamant Paint Co. The mine has been reopened since the close of 1914, and exploration work is reported to have shown considerable bodies of ore. Rotary kilns are to be installed, and it is intended to calcine the ore at the mine and then crush and prepare it at a new plant on the Alameda County side of San Francisco Bay. The company plans to make a magnesite cement, prepared for use but in a dry form when sold.

The property on South Fork of Tule River, about 10 miles east of Portersville, continued regular production throughout the year, with further extension of development. There were some steps taken to enlarge the output from California of finely ground, calcined magnesite for use in cement by the establishment of an additional plant for grinding and packing this material at Portersville. This is in addition to the plant already established at Redwood.

San Bernardino County.—Report has lately been received of the existence of large outcroppings of magnesite in the San Bernardino

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[1] Gale, H. S.

Mountains, about 12 miles east of Victorville. No examination has been made of the deposit for the Survey, and the following notes are from a correspondent. The deposit is described as not far from the Side-Winder mine and close to the Victor Portland Cement Co.'s properties. The magnesite is said to outcrop in an area several hundred feet in width in veins varying from a few inches to several feet in thickness; in one place "quite an overflow of 20 or 30 feet" is said to occur along the crest of a ridge containing serpentine on one side and limestone or marble on the other. Iron ore is described on the crest of the ridge below the magnesite.

Report has been received from several sources of magnesite at some points in the vicinity of Bagdad, on the Atchison, Topeka & Santa Fe Railway, in San Bernardino County. The locations are given as in secs. 25, 26, and 27, T. 7 N., R. 10 E., San Bernardino meridian. The deposit is reported to have been tested and found to be largely dolomite, a small part of which was described as possibly magnesite, but not enough to be of commercial value. A main part of the deposit as reported is over 100 feet wide and shows in cuts and outcrops for nearly a mile. The material is exposed in dry washes. The distance to the railroad is given as 4 miles. Samples of the rock sent to the Geological Survey are of a very fine-grained, massive white rock, somewhat resembling characteristic California magnesite.

Other California properties.—Among the nonproducing magnesite properties in California in 1914 the Magnesco Refractory Products Co., of Los Angeles, formerly the California Magnesite Co., gave an option on its property at Winchester, Riverside County, and the holders of the option did considerable development work during the year, but shipped no ore.

The Fresno Magnesite Co., near Sanger, Fresno County, was engaged in exploration and development work, but did not offer any magnesite for sale. A tunnel is being run to tap the ledge and winzes have been sunk below the present lowest workings.

Carl A. Williams, of Los Angeles, has leased from the Southern Pacific Co. the magnesite mine near Bissell, Kern County, which was fully described in this report for the year 1911. He did not commence development work until after the close of 1914.

The mine at Chiles Valley, Napa County, formerly owned by J. D. Phelan, of San Francisco, has been sold to T. B. Edington, of Chiles, but no output was made in 1914.

The National Magnesia Manufacturing Co. has established a plant at Redwood City, Cal., and began in 1915 to manufacture magnesia and magnesia covering for pipes, etc. The magnesite was obtained from Tulare and Napa counties.

The John D. Hoff Asbestos Co. has put grinding mills into its plant in Alameda County and is making an asbestos-magnesite compound for flooring, artificial stone, and fireproofing. The company is also making a fireproof and damp-proof paint for rough timber and for brick and cement work.

ARIZONA.

A recent report, with accompanying samples, declaring the existence of a workable deposit of magnesite near Benson, Ariz., has been sent to the Geological Survey. The samples resembled magnesite, but proved on testing to be nearly pure calcium carbonate, containing very little magnesium.

PRICES.

Market quotations for magnesite are given in various trade journals[1] in which the marketed magnesite is generally divided into the two classes, "raw" and "calcined." The classification of magnesite and its derived products as handled in the markets is, in fact, not so simple as this, as may be seen from the description of the methods of treatment and uses given on pages 572 to 577. Moreover, there were marked fluctuations of prices in the various markets for magnesite and its products in 1914, most of which are not adequately represented in the quotations published in the trade journals, and many of which it is, in fact, not practicable to record in detail. The immediate cause of these fluctuations has, of course, been the European war.

The normal prices of the earlier part of the year may be expressed as follows:

Prices of magnesite in 1914.

	Per short ton.
New York market:	
Grecian (Eubœan) calcined "caustic," fine ground (in paper-lined barrels)	\$25 to \$35
Grecian (Eubœan) calcined "caustic," not ground (in sacks)	\$17.50 to \$20
Grecian (Eubœan) crude (bulk)	\$7 to \$8
Austrian, calcined, dead-burned, crushed or fine ground (bulk)	\$16.15 to \$16.25
Pacific coast, San Francisco or Los Angeles markets:	
Domestic, calcined "caustic," fine ground (in paper-lined barrels)	\$35 to \$40
Domestic, calcined, not ground, (in sacks)	\$25 to \$30
Norwegian calcined, dead-burned, crushed or fine ground	\$20 to \$22
Austrian and Grecian, calcined, dead-burned, crushed or fine ground	\$27.50

Magnesium chloride has been quoted at \$15 to \$25 a ton normally, for the ordinary fused material, and magnesium sulphate at \$1.10 to \$1.50 per 100 pounds in New York. Sharp advances in the prices of both these materials followed the outbreak of the war, but later prices settled back toward their former level, remaining, however, considerably above the figures held before the war. Early in 1915 Austrian calcined magnesite was quoted at \$22 to \$25 a short ton, and Grecian caustic calcined, not ground, at \$24 ex-steamer. Raw magnesite is reported to have been offered f. o. b. San Pedro, Cal., at \$9 a ton.

Before the war, Grecian calcined magnesite, powdered and packed in barrels, was offered in the San Francisco market freely at \$25 to \$30 a ton. Sales were made at prices as high as \$40 and even as high as \$50 a ton by the local jobbers handling this magnesite, but they were all small sales. No large quantities were sold at any such prices as these in 1914, the price for the powdered having ranged

[1] Journal of Industrial and Engineering Chemistry, Easton, Pa.; Oil, Paint, and Drug Reporter, New York; Drugs, Oils, and Paints, Pittsburgh; Mining and Scientific Press, San Francisco, and others.

between $25 and $30 a ton. Among the owners of the California magnesite deposits the idea seems to prevail that prices quoted for the calcined powdered ore were much higher than can be obtained for large quantities.

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 1912 to 1914, inclusive, and also imports for the fiscal years 1912 to 1914, 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 for calendar years 1912–1914, in pounds.

	1912.		1913.		1914.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Magnesia:						
Calcined, medicinal	104,106	$16,326	54,915	$10,034	159,547	$19,342
Carbonate of, medicinal	62,404	2,812	70,823	4,880	46,183	2,527
Sulphate of (Epsom salts)	10,703,209	41,739	8,121,677	32,884	13,826,899	53,768
Magnesite:						
Calcined, not purified	250,503,372	1,265,339	334,187,404	1,672,565	243,633,205	1,323,194
Crude	35,810,752	104,326	26,479,109	84,911	26,708,381	54,677

Imports of magnesite calcined, not purified, for fiscal years ending June 30, 1912–1914, by countries, in short tons.

Country.	1912	1913	1914
Europe:			
Austria-Hungary	99,104	163,715	134,260
Belgium	25		11
Germany	689	2,412	2,578
Greece	114	1,605	3,232
Denmark			58
Italy			
Netherlands	2,410	4,508	4,191
Norway	163		
United Kingdom—			
England	61	1	12
Scotland			1
North America:			
Canada	234	350	404
Mexico	81		
Asia: East Indies, British	57		
Total	102,938	172,591	144,747

Imports of magnesite, showing ports of receipt during the fiscal year, ended June 30, 1914, by customs district, in short tons.

Customs district.	Crude.[a]	Calcined.	Customs district.	Crude.[a]	Calcined.
New York, N. Y.	10,700	6,221	Michigan		143
Philadelphia, Pa		113,805	Rochester		10
New Orleans, La		23,258	St. Lawrence		274
Vermont	92		Chicago		12
Maryland		61	San Francisco		47
Massachusetts		243			
Southern California		673	Total	10,792	144,747

[a] Imports for consumption.

According to the records of imports the receipts of foreign magnesite, which constitute the bulk of our consumption, continued almost to the close of 1914 about the same as for the years immediately preceding. In November and December the magnesite which had formerly come from Rotterdam, Hamburg, and to a less extent from Hull, Liverpool, and Manchester, most of which had been originally derived from Greece, is noted in the records as coming from Copenhagen, Genoa, Glasgow, and Liverpool, and much of the crude and calcined material was brought to this country direct from Limni. Supplies of magnesite for refractory uses formerly brought largely throug the port of Trieste were presumably, shortly after the beginning of the war, cut off, although for a time some shipments appear to have come through.

Toward the close of the year there was quite a flurry in the market for ground caustic calcined magnesite and, especially, magnesium chloride for use in cement. It appears that many of the firms dealing in magnesia cement flooring found themselves short of supplies of these materials at the outbreak of the war and having considerable contracts to fulfill were obliged to bid for the available stock. As a result prices of these classes of magnesite materials rose to unprecedented figures for a while. The stock of magnesium chloride, mostly imported from Germany, was soon exhausted, but until the close of the year considerable shipments continued to come in.

As to supplies of the raw or unground calcined magnesite from the Grecian mines, only general restrictions on shipping need have caused any shortage on imports direct from the country during 1914. Receipts of raw magnesite during the last quarter of the year exceeded those of any other quarter of the year and were double that of the largest receipt during a previous similar period, a condition, doubtless, caused by the diversion of this material from the customary route via Hamburg or Rotterdam as formerly sent for calcining and grinding.

TARIFF REGULATIONS.

The tariff act of October 3, 1913, contains the following provisions relating to magnesia materials and magnesite:

DUTIABLE LIST.

Schedule A.—Chemicals, oils, and paints. Magnesia: Calcined, 3½ cents per pound; carbonate of, precipitated, 1½ cents per pound; sulphate of, or Epsom salts, $\frac{1}{10}$ cent per pound.

Schedule B.—Earths, earthenware, and glassware. Firebrick, magnesite, brick, chrome brick, etc., * * * not glazed, enameled, painted, vitrified, ornamented, or decorated in any manner, 10 per centum ad valorem.

Schedule C.—Metals and manufactures of. * * * Barium, calcium, magnesium, * * * and alloys of which said metals are the component material of chief value, 25 per centum ad valorem.

FREE LIST.

Magnesite, crude or calcined, not purified.

BIBLIOGRAPHY AND ABSTRACTS OF PUBLICATIONS ON MAGNESITE DURING 1914.

CHASE, B. F., Magnesite mining in Italy: Daily Cons. and Trade Repts., Nov. 5, 1914.

Quotation from a newspaper of Milan, Italy, announcing organization at Leghorn of a company to prospect for and mine magnesite and manganese in the district of Castiglioncello (Pisa).

GALE, W. H., Magnesite mines of Greece: Daily Cons. and Trade Repts., 1914, pp. 1239–1241, June 2, 1914.

Describes briefly the occurrence of magnesite on the island of Euboea. Some of these veins attain a thickness of 50 to 60 feet. The output for 1912 of the several corporations mining magnesite is given.

MORGANROTH, L. C., The occurrence, preparation, and use of magnesite: Am. Inst. Min. Eng. Trans., October, 1914 [Bull. 93, pp. 2345–2352].

An interesting summary of the available magnesite resources from the practical point of view. Magnesite is distinguished as of two classes, described under the terms "massive" and "crystalline." The crystalline type of Austria-Hungary is given special consideration, its relation to dolomite and association with siderite and talc being noted. General location of deposits of this type in a northeast-southwest belt that would cross if extended between cities of Vienna and Budapest. The largest deposit of the Austrian group near the town of Veitsch, and methods of mining and preparation at that place are reviewed in some detail. Reference to distinct type of magnesite deposits in Norway and Sweden, where a crystalline form occurs in serpentine. In a review of uses of magnesite, reference is made to crude, caustic, and dead-burned forms, especially to the distinctive qualities of the Austria-Hungarian material as compared with those of the purer Grecian type, and relative advantages of the former for certain purposes.

——— Some facts regarding magnesite: Iron Trade Review, Oct. 29, 1914, p. 822 (review of Am. Inst. Min. Eng. paper (Bull. 93, pp. 2345–2352).

WDOWISZEWSKI, HENRYK, Ueber die Bestimmung von Magnesia in magnesiten [On the determination of magnesia in magnesites]: Chem. Zeitung, No. 89, pp. 949–950, July 25, 1914.

YALE, C. G., and GALE, H. S., Magnesite: U. S. Geol. Survey Mineral Resources, 1913, pt. 2, pp. 441–454, 1914.

Chapter for 1913 similar in form to the chapter of which this summary is a part.

YOUNGMAN, R. H., Effect of steam upon magnesite brick: Iron Trade Rev., Oct. 8, 1914, pp. 683–684.

[This is a duplicate of the article summarized from Metall. & Chem. Eng., Oct., 1914.]

——— Effect of steam upon magnesite brick and calcined magnesite: Metall. & Chem. Eng., vol. 12, No. 10, p. 620, October, 1914.

All calcined magnesite, even the most thoroughly burned brick, will hydrate in contact with steam, causing it to disintegrate to an almost impalpable powder. This fact, only recently well recognized, is of importance to users of these refractory materials.

ANON., An Austrian magnesite property developed by American capital (illust.): Iron Trade Rev., Oct. 22, 1914, pp. 772–773.

Description covers practically the same matter as that in Brick and Clay Record, Sept. 1, 1914. Location of plant is more completely given as at Radentheim, 36½ miles north of Trieste; the exact location of the quarry

being at Bruch station, on the north slope of the Millstatter Alps, about 4 miles north of Radentheim, near the foot of Lake Millstatter, and 10 miles north of Ferndorf on the railway in the valley of the Drau River.

ANON., Austrian magnesite developed by American capital: Brick and Clay Record, Sept. 1, 1914, pp. 474–475 (illust.).

Describes plant of Austro-American Magnesite Co., affiliated with the American Refractories Co., which is at Radentheim, Austria, where it is said there has been found and developed since 1908 a new and immense deposit of magnesite "proven to be the largest and best deposit of magnesite known." The magnesite is calcined near the mine, and recently a large plant for the manufacture of refractory brick has been constructed, so that both brick and calcined magnesite in grain form will be shipped via Trieste, the Austrian seaport, largely to American ports of entry.

——— Review of Pittsburgh meeting of the Am. Inst. Min. Eng., Oct. 8–10, 1914: California magnesite, a paragraph of the discussion which followed the paper presented by L. C. Morganroth (G. Y.).

A somewhat disparaging opinion of the prospects for development of California magnesite quoted. Foreign deposits can be mined and shipped to American markets more cheaply than domestic deposits can be utilized.

——— Magnesite mines of Greece: Eng. and Min. Jour., vol. 97, No. 26, p. 1278, June 27, 1914.

(Abstract from Daily Cons. and Trade Repts., June 2, 1914.)

——— Magnesite deposit in Placer County, Cal.: Eng. and Min. Jour., vol. 98, No. 19, Nov. 7, p. 851, 1914.

Brief paragraph announces the report of a magnesite deposit near Alta, situated between the Boardman ditch and Bear River, stated to be much larger than that near Towle.

——— Magnesite, Eng. and Min. Jour., vol. 98, No. 10, pp. 443–450, Sept. 5, 1914.

Shortage of supply due to the war. Stocks on hand said to be about three months' supply.

——— Effect of steam on magnesite brick: Eng. and Min. Jour., vol. 98, No 19, p. 829, Nov. 7, 1914.

Abstract of article by R. H. Youngman (Iron Trade Review, Oct. 8, 1914).

——— Effect of steam on magnesite: The Iron Age, Oct. 1, p. 770, 1914.

Abstract of an article by R. H. Youngman, which appeared in Metall. and Chem. Eng., October, 1914, and in Iron Trade Review, Oct. 8, 1914.

COAL.

By C. E. Lesher.

PREFACE.

By Edward W. Parker.

With the completion of the report on the production of coal for 1913, and some preparatory work on the report for 1914, the author, for a quarter of a century, of these chapters turns over the work to other hands. The first report of this series prepared by the writer was for the two years 1889 and 1890, and his report for 1913 thus rounded out just 25 years of statistical reports on the development of coal mining in the United States. During this period the industrial progress of the United States as recorded in the production of coal has been phenomenal, and it is a matter of sincere pride to the author of these reports that he was one of the instruments engaged in recording that progress. In 1889 the total production of coal in the United States was 141,229,513 short tons, and this quantity, though smaller than that of the preceding year, 1888, was thought to be a pretty large output, exceeding that of any previous year with the exception of 1888, and being more than double what it had been in 1879, 10 years before. In 1913 the production had reached the really enormous output of 569,960,219 tons—more than quadruple that of 1889. On account of the unsettled conditions in 1914 there was a decrease in coal production of over 56,000,000 tons (more than the total production in the year of the Centennial Exposition), but as the present report goes to press there is evidence that the period of shock, and even the period of adjustment, are over, and that a period of revival has set in, which promises that it will bring the production of the current year (1915), if not up to that of 1913, at least to or beyond that of 1914.

Notable changes aside from the great increase in production have taken place within the last 25 years, one of which, the introduction of mechanical methods in place of manual labor, has exerted a potent influence in the mining of bituminous coal. In 1889 the use of mining machines was in an experimental stage and was relatively so unimportant as not to be considered in the statistical treatment; in 1913 over 50 per cent of the output of the bituminous coal was machine mined, and an appreciable quantity of anthracite was also produced by the use of machines.

During the last quarter of a century the cause of unionism among the miners has shown noteworthy progress and a number of coal-mining States are now well organized. Prices of labor have been markedly advanced, the higher cost of labor having been chiefly offset by the economies effected through the use of mining machines and other mechanical and technical improvements.

In 1889 all the bituminous coal made into coke in the United States was carbonized in beehive ovens or in ovens of similar type where the process is one of partial combustion. The first retort oven coke was made at Syracuse, N. Y., in 1892, and in 1913 more than 25 per cent of the coke manufactured in the United States was made in retort or by-product recovery ovens.

It is perhaps not out of place here to state that of the total production of coal in the United States since mining began, 9,844,159,937 short tons to the close of 1913, more than 80 per cent, was produced in the last 25 years of that period.

In surrendering the preparation of this report to other hands the writer desires to express his sincere appreciation of the cordial cooperation and good will extended to him by the coal operators of the United States during the 25 years of his service in the statistical work of the Geological Survey. As the value to the trade of these official records has become more and more recognized the cooperation has been all the more willingly extended. The new energy put into the work by the change of hands can but result in added value and interest to the reports, and the writer cordially bespeaks for Mr. Lesher the same helpful aid that has been given to him.

Finally and most heartily is it the writer's duty and pleasure to pay tribute to the loyal, spontaneous, and efficient cooperation of his statistical and stenographic assistants, who have borne the tedium of the work, particular recognition being tendered to Miss Lida Mann for her painstaking and accurate work in preparing for a number of years the tabular statements included in the reports.

INTRODUCTION.

GENERAL STATEMENT.

The history of the coal-mining industry in 1914 presented a marked contrast to that of the preceding year. In 1913 the production of both anthracite and bituminous coal reached the highest point ever recorded; in 1914 the output fell below that of 1913, and even of 1912. In consequence of the panic of 1907 the production of coal declined in 1908 more than 13 per cent in one year; but recovery was rapid, and in 1913, five years later, the output of coal in the United States had increased 37 per cent. The stupendous rate of production maintained in 1912 and 1913 was carried over into the early months of 1914, although there is evidence in the statistics of the iron trade that the depression in that industry, the ups and downs of which are reflected strongly, though perhaps somewhat tardily, in the coal industry, really began as early as the middle of 1913, and, except for the partial and temporary recovery in February and March, 1914, continued to the end of that year. After the close of the first quarter of 1914 the demand for bituminous coal decreased, and during the last quarter the conditions in many of the coal-mining regions were little short of demoralized.

The European war, though it began as early as August, 1914, does not appear to have exerted a marked effect upon the production of coal in this country in that year. Certain Rocky Mountain fields, the production of which is small compared with that of the United States as a whole, suffered decrease as the result of the curtailment in copper smelting after the war began. After August shipping fell off, and there was a notable loss of bunker trade on the Atlantic seaboard, which was only partly offset by increased exports during the latter part of the year. Although the market for the very large cotton crop in 1914 was demoralized by the war, the cotton was ginned and the quantity of coal required for that purpose was nearly normal.

The effect on the production of coal in 1914 of the two great strikes, one in Colorado and the other in Ohio, was not so serious as it would have been in a year when the demand for coal was strong. The deficit in Colorado caused by the strike was supplied by neighboring fields, those in New Mexico benefiting particularly. The decreased output in Ohio, which assumed large proportions by reason of the labor trouble, was partly made up by coal from adjacent States—Pennsylvania and, particularly, Kentucky and West Virginia. As usual in times of depression and of decreased production, there was a plentiful supply of labor throughout the bituminous coal-mining regions during the entire year, and likewise there was no complaint of inadequate transportation facilities. Anthracite being now very largely a domestic fuel, the amount of its output depends more on labor conditions and on temperature than on general business conditions. The decrease in the anthracite output in 1914 was less than 1 per cent in quantity and 3.6 per cent in value.

In view of the general depression and the resultant lighter demand for coal, the firmness of prices in 1914 is notable. That the percentage of decrease in value was only slightly greater than that of production is to be accounted for on the ground that there was no general decrease in wages and no lowering of the cost of mining and that buyers, particularly of bituminous coal, being in position to dictate, were more exacting in their requirements and took only the better grades of coal, not buying the lower grades, and leaving the slack to be discarded. The inevitable result was that the net returns to the operators were less than a comparison of average values for the two years would indicate.

ACKNOWLEDGMENTS.

Needless to say, the new author, who took charge of the work in May, 1915, could not so promptly have prepared the present report in its completeness had it not been for the thorough manner in which Mr. Parker has, through his many years of labor, systematized the gathering and the method of compiling and presenting the statistics. The statistics of coal production which are presented in the series of volumes of which this report is a part and which have been compiled from voluntary returns by the operators have their value largely because of the hearty good will and cooperation of the corporations, firms, and individuals engaged in the industry. The author wishes to second heartily Mr. Parker's statement in his foreword of appreciation of this assistance, and to acknowledge also the assistance in the collection of the statistics for 1914 on the part of the State geologists of Alabama, Illinois, Iowa, Maryland, New Mexico,

North Carolina, Oregon, Pennsylvania, Virginia, and Washington; of the mine inspectors of Alabama, Ohio, and West Virginia; and of the chief mine inspector of Kentucky. Acknowledgment is also made to the secretaries of boards of trade, to railroad officials, and to other local authorities for contributions on the coal trade of some of the principal cities. Recognition of these contributions is also given under the caption "Coal-trade review." Not the least of the writer's acknowledgments in preparing his first report are due to the efficient clerical and stenographic assistants in the United States Geological Survey. The entire statistical compilations in the following pages, with the exception of Pennsylvania anthracite, have been prepared by Miss Lida Mann. The anthracite tables were prepared by Mrs. H. L. Bennit.

UNIT OF MEASUREMENT.

The standard unit of measurement adopted for this report is the short ton of 2,000 pounds, although for certain uses the long ton is employed. All anthracite coal is mined and sold by the long ton of 2,240 pounds. Hence, in reports of the production of Pennsylvania anthracite the long ton is used. The long ton is used also in the statistics of imports and exports of coal. In all other statistics of production reported to the Survey 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 1914.

Total production of coal in 1914, 513.525,477 short tons; spot value, $681,490,643.

Pennsylvania anthracite.—Total production in 1914, 81,090,631 long tons (equivalent to 90,821,507 short tons); spot value, $188,181,399.

Bituminous coal and lignite.—Total production in 1914, 422,703,970 short tons; spot value, $493,309,244.

Production.—The year 1914 will be remembered as one of general depression in the coal-mining industry, comparable to some extent to the disastrous year 1908, yet the total production in 1914 was exceeded in but two previous years, 1912 and 1913. The decrease from 1913, when the production amounted to 569,960,219 tons, was 56,434,742 tons, or 9.9 per cent. The value of both bituminous coal and anthracite decreased slightly more than the quantity, but the decrease in anthracite, the more valuable output, was but slight. The total value of the combined production of anthracite and bituminous coal in 1914 was $681,490,643, which, compared with 1913, when it amounted to $760,416,079, showed a decrease of $78,925,436, or 10.4 per cent.

The production of anthracite in Pennsylvania decreased from 81,718,680 long tons, or 91,524,922 short tons, valued at $195,181,127, in 1913 to 81,090,631 long tons, or 90,821,507 short tons, valued at $188,181,399, in 1914. The decrease was 628,049 long tons (703,415 short tons), or 0.8 per cent, in quantity and $6,999,728, or 3.6 per cent, in value.

The total production of bituminous coal and lignite decreased from 478,435,297 short tons in 1913 to 422,703,970 tons in 1914, the decrease in quantity amounting to 55,731,327 tons, or 11.6 per cent, and the decrease in value to $71,925,708, or 12.7 per cent, from $565,234,952 in 1913 to $493,309,244 in 1914.

The decrease in the production of anthracite was due in part to mild weather during the winter months in the area where it is used almost exclusively for a domestic fuel and to decreased exports to Canada. A further cause contributing to the decrease was a general feeling of uneasiness during the last months of 1914 among the users of domestic coal, both in the United States and in Canada, especially in the larger cities of the East, a feeling probably induced by the European war and the uncertainties of its effects. This caused an increase of domestic economy, one of the results of which was the curtailment in the use of anthracite.

The decrease in production of bituminous coal was generally distributed over the country, there being but seven States where the production in 1914 was greater than in 1913. Two of these States, North Dakota and South Dakota, produce lignite only, and have relatively very small outputs. New Mexico's increase was due to ability to supply markets ordinarily furnished by coal from Colorado, which, in 1914, suffered from a serious strike. The other States which showed increase were West Virginia, Kentucky, Michigan, and Oregon. The greatest decrease was in Pennsylvania, whose output fell off almost 26,000,000 tons, or nearly 15 per cent. The most notable decrease was in Ohio, where because of strike conditions, the decrease was over 17,300,000 tons, or nearly half, as compared with 1913. Illinois decreased over 4,000,000 tons, Alabama over 2,000,000 tons, and Colorado over 1,000,000 tons. The decrease in Pennsylvania was greater than the total output in 1914 in any of the coal-mining States, except West Virginia and Illinois.

The number of men employed and its relation to output.—In respect to the number of men employed in the coal industry, the year 1914 exceeded all previous records. The total number of employees in both anthracite and bituminous mines for the first time exceeded three-quarters of a million. In the bituminous mines this record was attained without sacrifice of efficiency, for though the average number of days of work in the year was the smallest except in one year, 1908, since 1896, or in 18 years, and the average output per man for the year was the lowest in five years, the daily production by each employee was the highest on record in bituminous coal mining. That fact does not necessarily indicate, as might be inferred, that when times are hard and labor is abundant and when competition for employment is keener, the laborer does better work to hold his place, for among the increased number of employees in 1914 there were undoubtedly a larger proportion than usual of the less skillful. On the contrary, in these days, when a large proportion of the laborers engaged in coal mining do not speak English and are inexperienced and the truly skillful miner is in the minority, and when more than ever the output is coming from mines of a capacity unheard of a few years ago, the apparent efficiency of labor is due to efficiency of management. When times are good and prices are strong quantity governs rather than cost. When demand is slack and prices fall competition in an industry as widespread and as loosely knit as bituminous coal mining, becomes keen; cost governs; and scientific management is at a premium. This is the more true in a lean year, such as is here being recorded, because of the effect of the over-development that has taken place in the prosperous years preceding. The total productive capacity was greatly increased in 1912 and 1913 by the opening of many new mines. These younger projects in general have the best of modern equipment and have been carefully designed and laid out. Mining costs are lower than in mines similarly situated but more or less worked out, and operators are consequently better able to mine at a profit under adverse market conditions. To meet this competition the older mines must reduce costs, and that can be accomplished (unless the mine is wantonly robbed) only by scientific management along engineering and administrative lines.

The number of men employed in the coal mines of the United States in 1914 was 763,185, of whom 179,679 were engaged in the production of anthracite and 583,506 in the bituminous and lignite mines. The average number of days of employment of each man was 207 for the United States; 195 for bituminous and lignite and 245 for anthracite. In the bituminous mines the yearly average decreased from 837 tons in 1913 to 724 tons in 1914. The daily average increased from 3.61 to 3.71 tons. The average time made at the anthracite mines was exceeded only by the records of 1911 (246 days) and 1913 (257 days). The average yearly production of anthracite by each employee decreased from 520 short tons in 1913 to 505 tons in 1914, owing to the fewer days worked. The output per day was 2.06 tons, a slight gain as compared with 2.02 tons in 1913.

Labor troubles.—The biennial wage-scale agreements in the organized bituminous coal mining districts of the United States made in 1912 expired April 1, 1914, and, as is usual in the even years pending the settlement of new agreements, there was a large number of men on strike. The most serious conflict was in Ohio, where, because of the requirements placed on the operators by the antiscreen or mine-run law, the strike continued throughout the year in the greater part of the State and was largely responsible for a decrease in the coal output of nearly 50 per cent. A total of 40,577 men were affected by the strike for an average of 159 days. In other States the wage agreements were effected without serious loss of time. The Colorado strike, inaugurated in September, 1913, in an attempt to force recognition of the miners' union, was in effect until officially declared off in December, 1914. In the entire State of Colorado 4,418 men were idle for an average of 247 days, and the production for the year was reduced over 11 per cent.

Local labor disturbances occurred in all of the coal-mining States except California, Georgia, Idaho, Michigan, Nevada, New Mexico, North Dakota, South Dakota, Tennessee, and Virginia. Labor troubles in the anthracite region were numerous but not long-continued, 26,115 men, or about one-seventh of the total number, being on strike for an average of seven days each. Among the bituminous States, Ohio had the largest number of men on strike, and Colorado had the largest number of idle days.

Accidents.—The record of fatal accidents in the coal mines of the United States for 1914, compiled by the Bureau of Mines, shows a decrease from 1913, the number of men killed decreasing from 2,785 in 1913 to 2,454 in 1914. Of the total number of fatal accidents in 1914, 595 occurred in the anthracite mines of Pennsylvania and 1,859 in the bituminous coal and lignite mines. As usual, the most prolific cause of deaths was the falling of roof and coal, which killed 1,131 miners, or 46 per cent of the total number of deaths. In 1913 the deaths due to falls of roof and coal were 1,264, or 45.4 per cent of the total. The decline in the number of fatal accidents in 1914 was due principally to the fact that there were fewer large coal-mine disasters than in 1913. The worst disaster in 1914 was an explosion of gas on April 28 in a mine at Eccles, W. Va., which resulted in the deaths of 181 men. Next to this was the gas explosion at Royalton, Ill., on October 27, 1914, attended by 52 fatal accidents. The total number of men who lost their lives by gas explosions in 1914 was 332 against 91 in 1913. There was a decrease in the number of men killed by explosions of dust from 423 in 1913 to 17 in 1914. Mine cars and locomotives underground killed 380 men in 1914 against 424 in 1913, and 68 men were killed from that cause on the surface in 1914 against 78 in 1913. Premature blasts and other accidents incident to the use of explosives killed 146 men in 1914 and 138 in 1913. The total number of fatal accidents underground decreased from 2,562 in 1913 to 2,200 in 1914. Shaft accidents increased from 62 to 88, and the total number of fatal accidents on the surface increased from 161 to 166. The death rate per thousand employees in the anthracite region was 3.31 in 1914 against 3.52 in 1913. In the bituminous regions the death rate per thousand was 3.19 in 1914 against 3.79 in 1913, and the death rate for the entire country in 1914 was 3.22 against 3.73 in 1913. The quantity of anthracite mined for each life lost in 1914 was 136,286 long tons (152,641 short tons), against 132,231 long tons (148,098 short tons) in 1913, and the quantity of bituminous coal mined for each fatality in 1914 was 227,382 short tons against 220,782 tons in 1913. The total of anthracite and bituminous coal mined for each life lost in 1914 was 209,261 tons against 204,653 tons in1913.

Washed coal.—The production of anthracite in Pennsylvania includes an appreciable quantity of usable fuel recovered from the old culm banks by washeries. The quantity of coal recovered in the 25 years since the first washery was constructed (in 1890) has amounted to about 51,000,000 long tons, considerably more than the annual production of anthracite at the beginning of the period. In 1914 the washery product amounted to 1,719,547 long tons. In the bituminous regions the principal use of washeries is to improve the quality of slack coal used in the manufacture of coke by reducing the ash and sulphur, although considerable quantities, particularly in Illinois and Washington, are washed in the preparation of sized coal for household use. The quantity of bituminous coal washed at the mines in 1914 was 22,848,647 short tons. The washeries yielded 20,264,141 tons of cleaned coal and 2,584,506 tons of refuse.

Consumption.—More than 95 per cent of the total production of anthracite and bituminous coal in the United States continues to be consumed within the country, although the efforts to build up an export trade, particularly for the high-grade bituminous coals, has resulted in a considerable expansion of business done with foreign countries. Notwithstanding the fact that the total exports of coal in 1914 decreased over 4,000,000 tons, the shipments of bituminous coal to foreign countries from the Atlantic seaboard showed an increase as compared with 1913, the decrease being due to the smaller quantity exported to Canada. The total quantity of coal exported from the United States decreased from 24,798,080 short tons (22,141,143 long tons) in 1913 to 19,747,945 short tons (17,632,094 long tons) in 1914. Of the latter, 4,289,873 short tons (3,830,244 long tons) were anthracite and 15,458,072 short tons (13,801,850 long tons) were bituminous coal. The imports in 1914 amounted to 1,563,524 short tons, which, added to the consumption of domestic coal, made the total consumption in that year 495,341,056 short tons, which is equivalent to 96.4 per cent of the domestic production. In this statement no account is taken of the stock on hand at the beginning and at 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. Considerable quantities of anthracite are sometimes put into storage yards during the summer months or in anticipation of extended suspensions, but they are usually disposed of in the same year that they are mined and stored and affect neither production nor prices.

Marketable product.—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 the 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 at the mines is also considered in this report.

The quantity of coal consumed in the manufacture of coke at the mines in 1914 was 34,791,656 short tons, against 49,458,320 tons in 1913, a decrease of 14,666,664 tons, or 29.6 per cent, as compared with a decrease of 11.6 per cent in the total production of bituminous coal and of 9.9 per cent in the production of anthracite and bituminous coal combined. The coal shipped to market, used in the manufacture of coke and sold locally, amounted in 1914 to 493,329,124 short tons, as compared with 548,677,819 short tons in 1913. This is usually considered the marketable product. The colliery consumption, which represents the difference between the marketable product and the total output, amounted in 1914 to 20,196,353 short tons. The colliery consumption in the anthracite region, consisting almost entirely of culm or waste material, averages somewhat over 10 per cent of the total anthracite output. In 1914, out of a total production of 81,090,631 long tons, 8,707,052 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 1914 it was 10,444,455 short tons out of a total production of 422,703,970 tons.

PRODUCTION.

STATISTICS FOR 1913 AND 1914.

The statistics of the production of coal in the United States in 1913 and 1914, by States, with the distribution of the product for consumption, are shown in the following tables:

Production of coal in the United States in 1913, 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 at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Alabama	15,094,036	163,180	752,686	1,668,620	17,678,522	$23,083,724	$1.31	255	24,552
Arkansas	2,117,358	7,987	108,762		2,234,107	3,923,701	1.76	174	4,652
California and Alaska	16,432	2,256	8,223		26,911	95,173	3.54	302	40
Colorado	7,136,633	365,216	328,249	1,402,412	9,232,510	14,035,090	1.52	229	11,990
Georgia	122,499	1,303	7,518	124,306	255,626	361,319	1.41	261	500
Idaho and Nevada	15	2,107	55		2,177	5,285	2.43	183	12
Illinois	57,329,079	2,568,957	1,720,708		61,618,744	70,313,605	1.14	189	79,529
Indiana	16,034,285	663,018	468,368		17,165,671	19,001,881	1.11	190	22,235
Iowa	6,824,933	535,170	165,833		7,525,936	13,496,710	1.79	195	15,757
Kansas	6,903,287	117,303	181,620		7,202,210	12,036,292	1.67	197	12,479
Kentucky	18,029,826	739,622	454,718	392,434	19,616,600	20,516,749	1.05	212	26,332
Maryland	4,666,758	49,349	63,732		4,779,839	5,927,046	1.24	248	5,645
Michigan	1,111,990	58,251	61,545		1,231,786	2,455,227	1.99	188	3,305
Missouri	3,765,534	457,114	95,477		4,318,125	7,468,308	1.73	187	10,418
Montana	3,022,298	111,130	107,545		3,240,973	5,653,539	1.74	228	3,630
New Mexico	2,685,880	27,511	56,983	938,432	3,708,806	5,401,260	1.46	289	4,329
North Dakota	349,832	129,496	15,992		495,320	750,652	1.52	221	641
Ohio	33,525,096	1,996,382	674,288	4,761	36,200,527	39,948,058	1.10	206	45,815
Oklahoma	3,841,096	59,475	265,199		4,165,770	8,542,748	2.05	197	9,044
Oregon	31,582	8,617	5,864		46,063	116,724	2.53	283	203
Pennsylvania, bituminous	127,958,404	4,122,430	3,806,529	37,893,854	173,781,217	193,039,806	1.11	267	172,196
South Dakota	503	10,037			10,540	20,648	1.96	137	48
Tennessee	6,082,221	78,796	160,180	538,987	6,860,184	7,839,721	1.14	241	11,238
Texas	2,358,578	12,188	58,378		2,429,144	4,288,920	1.77	253	5,101
Utah	2,527,110	46,635	110,896	570,187	3,254,828	5,384,127	1.65	273	4,158
Virginia	6,615,481	83,432	175,792	1,953,363	8,828,068	8,952,653	1.01	280	9,162
Washington	3,520,554	62,702	175,937	118,698	3,877,891	9,243,137	2.38	260	5,794
West Virginia	64,758,956	1,308,491	1,334,423	3,852,266	71,254,136	71,822,804	1.01	234	74,746
Wyoming	7,003,990	83,673	305,403		7,393,066	11,510,045	1.56	232	8,331
Total bituminous	403,434,246	13,871,828	11,670,903	49,458,320	478,435,297	565,234,952	1.18	232	571,882
Pennsylvania, anthracite	79,904,353	2,009,072	9,611,497		91,524,922	195,181,127	2.13	257	175,745
Grand total	483,338,599	15,880,900	21,282,400	49,458,320	569,960,219	760,416,079	1.33	238	747,627

Production of coal in the United States in 1914, 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 at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Alabama	13,145,854	132,793	626,082	1,688,693	15,593,422	$20,849,919	$1.34	226	24,042
Arkansas	1,735,869	13,605	87,066	....	1,836,540	3,158,168	1.72	143	4,339
California, Idaho, and Nevada	4,200	9,174	600	....	13,974	39,821	2.85	291	43
Colorado	6,402,790	314,148	300,145	1,153,476	8,170,559	13,601,718	1.66	244	10,098
Georgia	85,645	1,400	7,900	71,553	166,498	239,462	1.44	207	355
Illinois	53,583,390	2,516,503	1,489,304	....	57,589,197	64,693,529	1.12	173	79,499
Indiana	15,497,998	689,057	454,077	....	16,641,132	18,290,928	1.10	168	23,175
Iowa	6,676,392	617,768	156,862	....	7,451,022	13,364,070	1.79	204	16,057
Kansas	6,553,243	148,928	158,817	....	6,860,988	11,238,253	1.64	192	12,448
Kentucky	18,896,135	637,919	452,129	396,580	20,382,763	20,852,463	1.02	187	28,764
Maryland	4,019,622	49,569	64,356	....	4,133,547	5,234,796	1.27	241	5,403
Michigan	1,158,904	59,202	64,924	....	1,283,030	2,559,786	1.99	201	2,800
Missouri	3,417,140	438,211	80,629	....	3,935,980	6,802,325	1.73	179	9,549
Montana	2,600,687	100,515	103,971	....	2,805,173	4,913,191	1.75	209	3,350
New Mexico	3,047,328	34,141	53,385	742,835	3,877,689	6,230,871	1.61	283	4,178
North Dakota	347,806	143,797	15,082	....	506,685	771,379	1.52	216	558
Ohio	16,397,457	1,960,719	484,508	431	18,843,115	21,250,642	1.13	108	45,401
Oklahoma	3,700,497	42,570	245,546	....	3,988,613	8,204,015	2.06	205	8,078
Oregon	37,152	5,798	8,608	....	51,558	143,556	2.78	266	190
Pennsylvania, bituminous	114,876,895	3,536,600	3,384,011	26,185,788	147,983,294	159,006,296	1.07	214	184,201
South Dakota	4,274	7,576	....	....	11,850	20,456	1.73	152	47
Tennessee	5,450,074	61,399	154,723	277,062	5,943,258	6,776,573	1.14	220	10,116
Texas	2,247,773	11,303	64,697	....	2,323,773	3,922,459	1.69	237	4,635
Utah	2,355,687	43,199	100,739	603,411	3,103,036	4,935,454	1.59	210	4,112
Virginia	6,438,133	84,349	144,930	1,292,123	7,959,535	8,032,448	1.01	235	9,183
Washington	2,706,341	79,831	155,386	123,262	3,064,820	6,751,511	2.20	191	5,805
West Virginia	67,024,189	1,134,170	1,292,825	2,256,442	71,707,626	71,391,408	.99	201	78,963
Wyoming	6,093,804	88,336	293,153	....	6,475,293	10,033,747	1.55	192	8,117
Total bituminous	364,505,279	12,962,580	10,444,455	34,791,656	422,703,970	493,309,244	1.17	195	583,506
Pennsylvania, anthracite	78,919,732	2,149,877	9,751,898	....	90,821,507	188,181,399	2.07	245	179,679
Grand total	443,425,011	15,112,457	20,196,353	34,791,656	513,525,477	681,490,643	1.33	207	763,185

The relative growth in the production of anthracite and bituminous coal in comparison with the increase in population is graphically illus-

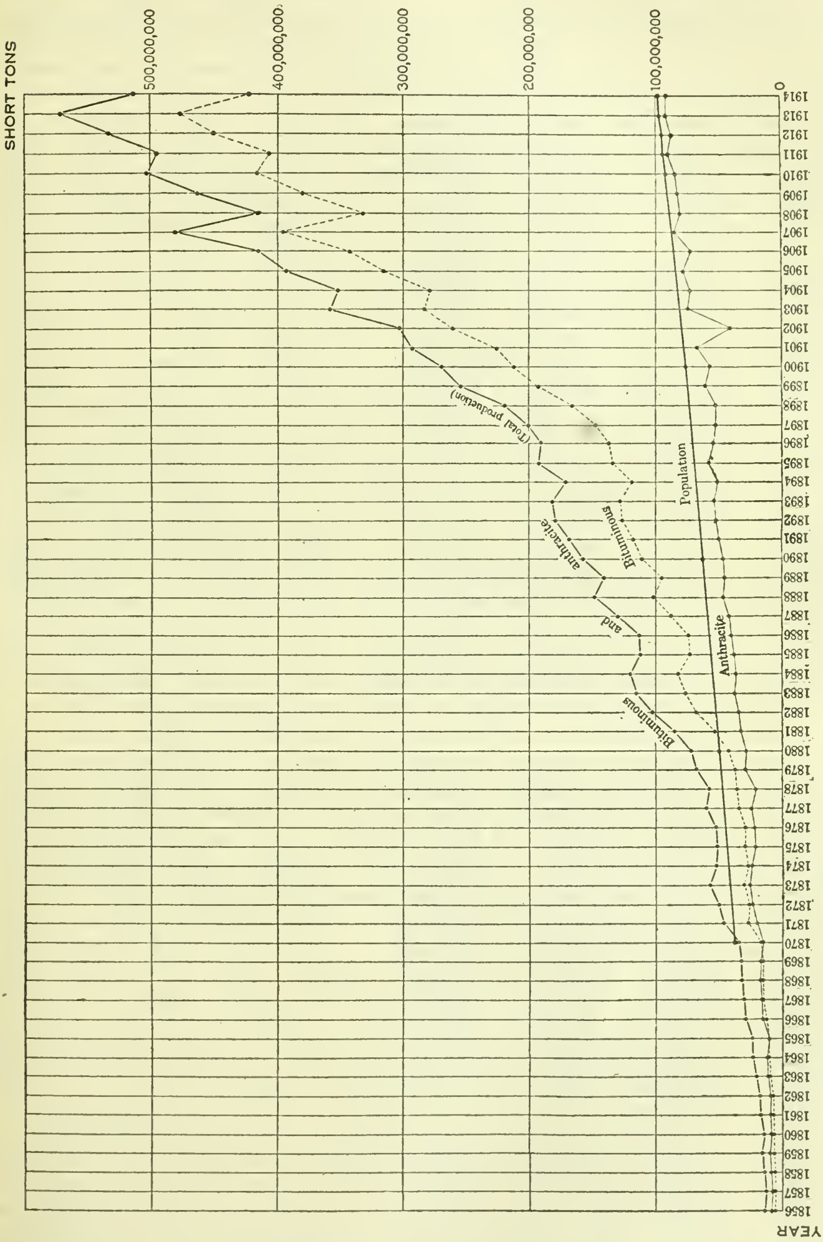

FIGURE 11.—Curve showing relation of increase in population in the United States to production of coal, 1856 to 1914.

trated in the accompanying diagram (fig. 11), the starting point for the population being taken at 1870, when approximately one ton of coal was produced for each inhabitant and when the productions of anthracite and of bituminous coal were about equal. It will be observed that the curve illustrating the production of anthracite (which has been practically eliminated as a manufacturing fuel and is now restricted mainly to domestic consumption) follows a line approximately parallel with the curve of population and has been fairly regular in its course. The variations in the production of anthracite have been due principally to labor troubles and not, as is the case with bituminous coal, to trade conditions. The most violent change in the anthracite curve was in 1902 when, because of the great strike of that year, the production dropped below that of any year since 1886. The breaks in the upward trend of production of bituminous coal are noted in the years of business depression, particularly in 1908, when the production of anthracite was scarcely affected. During the last 26 years the production of bituminous coal has grown very rapidly, and only once in this period have two years been required to recover from the effects of a business depression. This was in 1908 and 1909 and followed the boom year, 1907, when the largest increase over a preceding year in the history of the industry had been recorded. In the last 26 years, or since 1888, the production of anthracite has increased from 46,619,564 short tons to 90,821,507 tons, or nearly 95 per cent, while the production of bituminous coal has increased from 102,040,093 tons to 422,703,970 tons, or 314 per cent. The total production of coal in the United States at the present time is nearly three and one-half times what it was 26 years ago. In this rapid development the United States has far outstripped the other countries of the world. The rate of increase in the production of all kinds of coal in Great Britain and France has been about the same as that of anthracite in Pennsylvania. Germany's production has increased much more rapidly, but at a considerably slower rate than the production of bituminous coal or than the total production in the United States.

Increase and decrease.—As shown in the following table, there were only seven States in which the output of coal in 1914 was greater than in 1913. Five of the seven, Kentucky, Michigan, New Mexico, North Dakota, and West Virginia, had outputs in excess of 500,000 tons, and two States, Oregon and South Dakota, had each a production of less than 100,000 tons. The largest increase was in Kentucky, 766,163 short tons, or 3.9 per cent, and the smallest was in South Dakota, 1,310 tons, or 12.4 per cent. Although the percentage of increase in West Virginia was small, 0.6, the amount of increase was almost 500,000 tons. The other increases were all small. The greatest decrease was in Pennsylvania, 25,797,923 tons, or 14.9 per cent; the decrease in Ohio was 17,357,412 tons, or 48 per cent; in Illinois it was 4,029,547 tons, or 6.5 per cent; in Alabama, 2,085,100 tons, or 11.8 per cent; and in Colorado, 1,061,951 tons, or 11.5 per cent. The decreases in other States ranged from 74,914 tons, or 1 per cent, in Iowa, to 917,773 tons, or 12.4 per cent, in Wyoming.

In 16 out of 30 States there was a greater percentage of decrease in value than in output. For the United States as a whole the decrease was 56,434,742 tons, or 9.9 per cent, in quantity and $78,925,436, or 10.4 per cent, in value. The decrease in bituminous coal was 55,731,327 tons, or 11.6 per cent, in quantity and $71,925,708, or 12.7 per cent, in value. In anthracite the decrease was 703,415 short tons, or 0.8 per cent, in quantity and $6,999,728, or 3.6 per cent, in value.

The total production and value in the last five years, by States, with the increase and decrease in 1914, as compared with 1913, are shown in the following table:

Quantity and value of coal produced in the United States, 1910–1914, by States, and increase or decrease in 1914, in short tons.

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 and Nevada	[b] 4,448	[b] 17,426	1,821	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
South Dakota				
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

State.	1912		1913	
	Quantity.	Value.	Quantity.	Value.
Alabama	16,100,600	$20,829,252	17,678,522	$23,083,724
Arkansas	2,100,819	3,582,789	2,234,107	3,923,701
California and Alaska	11,333	26,441	26,911	95,173
Colorado	10,977,824	16,345,336	9,232,510	14,035,090
Georgia and North Carolina	227,703	338,926	[a] 255,626	[a] 361,319
Idaho and Nevada	[b] 2,964	[b] 9,313	2,177	5,285
Illinois	59,885,226	70,294,338	61,618,744	70,313,605
Indiana	15,285,718	17,480,546	17,165,671	19,001,881
Iowa	7,289,529	13,152,088	7,525,936	13,496,710
Kansas	6,986,182	11,324,130	7,202,210	12,036,292
Kentucky	16,490,521	16,854,207	19,616,600	20,516,749
Maryland	4,964,038	5,839,079	4,779,839	5,927,046
Michigan	1,206,230	2,399,451	1,231,786	2,455,227
Missouri	4,339,856	7,633,864	4,318,125	7,468,308
Montana	3,048,495	5,558,195	3,240,973	5,653,539
New Mexico	3,536,824	5,037,051	3,708,806	5,401,260
North Dakota	499,480	765,105	495,320	750,652
Ohio	34,528,727	37,083,363	36,200,527	39,948,058
Oklahoma	3,675,418	7,867,331	4,165,770	8,542,748
Oregon	41,637	108,276	46,063	116,724
Pennsylvania, bituminous	161,865,488	169,370,497	173,781,217	193,039,806
South Dakota			10,540	20,648
Tennessee	6,473,228	7,379,903	6,860,184	7,839,721
Texas	2,188,612	3,655,744	2,429,144	4,288,920
Utah	3,016,149	5,046,451	3,254,828	5,384,127
Virginia	7,846,638	7,518,576	8,828,068	8,952,653
Washington	3,360,932	8,042,871	3,877,891	9,243,137
West Virginia	66,786,687	62,792,234	71,254,136	71,822,804
Wyoming	7,368,124	11,648,088	7,393,066	11,510,045
Total bituminous	450,104,982	517,983,445	478,435,297	565,234,952
Pennsylvania anthracite	84,361,598	177,622,626	91,524,922	195,181,127
Grand total	534,466,580	695,606,071	569,960,219	760,416,079

[a] Georgia only. [b] Idaho only.

Quantity and value of coal produced in the United States, 1910–1914, by States, and increase or decrease in 1914, in short tons—Continued.

State.	1914		Increase (+) or decrease (−), 1914.		Percentage of increase or decrease 1914.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	15,593,422	$20,849,919	− 2,085,100	−$2,233,805	−11.8	− 9.7
Arkansas	1,836,540	3,158,168	− 397,567	− 765,533	−17.8	−19.5
California and Alaska	[a] 13,974	[a] 39,821	− [a] 15,114	− [a] 60,637	−52.0	−60.4
Colorado	8,170,559	13,601,718	− 1,061,951	− 433,372	−11.5	− 3.1
Georgia and North Carolina	[b] 166,498	[b] 239,462	− 89,128	− 121,857	−34.8	−33.7
Idaho and Nevada	(a)	(a)	(a)	(a)		
Illinois	57,589,197	64,693,529	− 4,029,547	− 5,620,076	− 6.5	− 8.0
Indiana	16,641,132	18,290,928	− 524,539	− 710,953	− 3.1	− 3.7
Iowa	7,451,022	13,364,070	− 74,914	− 132,640	− 1.0	− 1.0
Kansas	6,860,988	11,238,253	− 341,222	− 798,039	− 4.7	− 6.6
Kentucky	20,382,763	20,852,463	+ 766,163	+ 335,714	+ 3.9	+ 1.6
Maryland	4,133,547	5,234,796	− 646,292	− 692,250	−13.5	−11.7
Michigan	1,283,030	2,559,786	+ 51,244	+ 104,559	+ 4.2	+ 4.3
Missouri	3,935,980	6,802,325	− 382,145	− 665,983	− 8.9	− 8.9
Montana	2,805,173	4,913,191	− 435,800	− 740,348	−13.5	−13.1
New Mexico	3,877,689	6,230,871	+ 168,883	+ 829,611	+ 4.6	+15.4
North Dakota	506,685	771,379	+ 11,365	+ 20,727	+ 2.3	+ 2.8
Ohio	18,843,115	21,250,642	−17,357,412	−18,697,416	−48.0	−46.8
Oklahoma	3,988,613	8,204,015	− 177,157	− 338,733	− 4.3	− 4.0
Oregon	51,558	143,556	+ 5,495	+ 26,832	+12.0	+23.0
Pennsylvania, bituminous	147,983,294	159,006,296	−25,797,923	−34,033,510	−14.9	−17.6
South Dakota	11,850	20,456	+ 1,310	− 192	+12.4	− 0.9
Tennessee	5,943,258	6,776,573	− 916,926	− 1,063,148	−13.4	−13.6
Texas	2,323,773	3,922,459	− 105,371	− 366,461	− 4.3	− 8.5
Utah	3,103,036	4,935,454	− 151,792	− 448,673	− 4.7	− 8.3
Virginia	7,959,535	8,032,448	− 868,533	− 920,205	− 9.8	−10.3
Washington	3,064,820	6,751,511	− 813,071	− 2,491,626	−21.0	−27.0
West Virginia	71,707,626	71,391,408	+ 453,490	− 431,396	+ 0.6	− 0.6
Wyoming	6,475,293	10,033,747	− 917,773	− 1,476,298	−12.4	−12.8
Total bituminous	422,703,970	493,309,244	−55,731,327	−71,925,708	−11.6	−12.7
Pennsylvania anthracite	90,821,507	188,181,399	− 703,415	− 6,999,728	− 0.8	− 3.6
Grand total	513,525,477	681,490,643	−56,434,742	−78,925,436	− 9.9	−10.4

[a] California, Idaho, and Nevada. [b] Georgia only.

The annual production of coal in each State from the time of earliest record until the close of 1914 is given in connection with the discussion of production in the several States. (See also tabular statement in pocket.)

The following table shows the total production of anthracite in Pennsylvania, in short tons, since 1807, the total production of bituminous coal since 1820, and the total annual production up to the close of 1914.

PRODUCTION OF COAL IN THE UNITED STATES FROM 1807 TO THE CLOSE OF 1914, IN SHORT TONS.

Year.	Pennsylvania anthracite.	Bituminous.	Total.
1807–1820	12,000	3,000	15,000
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.....	95,500	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
1913.....	91,524,922	478,435,297	569,960,219
1914.....	90,821,507	422,703,970	513,525,477
Total.	2,537,517,517	7,820,167,897	10,357,685,414

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. Anthracite has been discovered in Whatcom County, Wash., and in Routt County, Colo., but there has been no production in either place.

The bituminous and lignite fields are scattered widely over the United States and include an area of more than 450,000 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, 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. Copies of this report 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 geologic work done by the Geological Survey in the coal-mining States of the Rocky Mountain region has greatly advanced the knowledge of the coal reserves in those States, and the areas now known to contain workable coal exceed by many square miles and the reserves by many million tons the earlier estimates published in this series of reports.

The known coal areas of the United States aggregate a total of 339,887 square miles, to which may be added 89,482 square miles supposed to contain workable coal, but knowledge of them is not sufficient to warrant a definite statement to that effect. In addition, there are 28,470 square miles where the coal lies at depths of 3,000 feet or more.

The supply of coal before mining began is now estimated to have been 3,554,383,400,000 tons. Classified according to the character of the coal, the original supply consisted of 21,000,000,000 short tons of anthracite (exclusive of the small areas in Colorado and New Mexico); 1,834,100,000 tons of semianthracite; 47,913,500,000 tons of semibituminous coal; 1,444,036,500,000 tons of bituminous coal; 948,084,900,000 tons of subbituminous coal, or black lignite; and 1,087,514,400,000 tons of lignite, or brown coal. The coal lying from 3,000 to 6,000 feet below the surface is estimated at about 675,000,000,000 short tons.

It will be observed from these figures that nearly 60 per cent of the entire reserve is composed of subbituminous and lignite, and that barely 40 per cent is represented by the higher grades—anthracite, semianthracite, and bituminous coal.

The total production at the close of 1914 has amounted to 2,537,517,517 short tons of anthracite and 7,820,167,897 short tons of bituminous coal, an aggregate of 10,357,685,414 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 the 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 places 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 5,075,035,034 tons. In the bituminous fields, estimating half a ton lost for every ton produced, the exhaustion is equivalent to 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 a little more than 99.5 per cent of the original supply.

The following statistics cover the annual production of coal in each of the various regions from 1887 to the close of 1914:

Total production of each region, 1887–1914, in short tons.

	Anthracite.	Bituminous.			
		Atlantic coast.	Appalachian.	Northern.	
Area [a] ... square miles	[b] 509	210	69,332	11,000	
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	
1913	91,524,922	....	330,737,079	1,231,786	
1914	90,821,507	....	284,813,462	1,283,030	

	Bituminous—Continued.			
	Eastern.	Western and Southwestern.	Rocky Mountain, etc.	Pacific coast and Alaska.
Area [a] ... square miles	48,500	141,200	178,022	2,070
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
1913	87,302,055	27,875,292	27,338,220	3,950,865
1914	82,129,925	26,396,916	24,952,567	3,128,070

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

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.

Several changes took place in the rank of the coal-producing States in 1914, the most notable of which was the supplanting of Ohio by Kentucky as fourth in quantity of output. In 1881 and 1882 Ohio was next to Pennsylvania and second in rank as a coal-producing State, supplanting Illinois temporarily. In 1883 Illinois again assumed second place and Ohio occupied third place until 1895, but was passed in 1896 by West Virginia. From 1896 to 1913 Ohio occupied fourth place. In the meantime Kentucky progressed upward from eleventh in rank in 1886 to ninth in 1901, seventh in 1910, fifth in 1912, and to fourth place in 1914, displacing Ohio. This change, the result of the crippled condition of Ohio because of labor troubles in 1914, which acted both greatly to decrease Ohio's output and to afford in some measure an opportunity for Kentucky to increase, is not considered permanent. The margin in favor of Kentucky is so small that in all probability Ohio will recover sufficiently in 1915 to regain the lost place. Indiana succeeded Alabama in sixth place, and Kansas supplanted Wyoming in eleventh place. Washington dropped from seventeenth to nineteenth in order of output, and from twelfth to sixteenth in value. In value of output Ohio maintained fourth place, and Alabama, dropping from sixth to seventh in quantity of output, was sixth in order of value.

Rank of coal-producing States in 1913 and 1914, with quantity and value of production and percentage of each.

1913.

Production.				Value.			
Rank.	State.	Quantity (short tons).	Percentage of total production.	Rank.	State.	Value.	Percentage of total value.
1	Pennsylvania:			1	Pennsylvania:		
	Anthracite	91,524,922	16.1		Anthracite	$195,181,127	25.7
	Bituminous	173,781,217	30.5		Bituminous	193,039,806	25.4
2	West Virginia	71,254,136	12.5	2	West Virginia	71,822,804	9.5
3	Illinois	61,618,744	10.8	3	Illinois	70,313,605	9.2
4	Ohio	36,200,527	6.3	4	Ohio	39,948,058	5.3
5	Kentucky	19,616,600	3.4	5	Alabama	23,083,724	3.0
6	Alabama	17,678,522	3.1	6	Kentucky	20,516,749	2.7
7	Indiana	17,165,671	3.0	7	Indiana	19,001,881	2.5
8	Colorado	9,232,510	1.6	8	Colorado	14,035,090	1.8
9	Virginia	8,828,068	1.5	9	Iowa	13,496,710	1.8
10	Iowa	7,525,936	1.3	10	Kansas	12,036,292	1.6
11	Wyoming	7,393,066	1.3	11	Wyoming	11,510,045	1.5
12	Kansas	7,202,210	1.3	12	Washington	9,243,137	1.2
13	Tennessee	6,860,184	1.2	13	Virginia	8,952,653	1.2
14	Maryland	4,779,839	.8	14	Oklahoma	8,542,748	1.1
15	Missouri	4,318,125	.8	15	Tennessee	7,839,721	1.0
16	Oklahoma	4,165,770	.7	16	Missouri	7,468,308	1.0
17	Washington	3,877,891	.7	17	Maryland	5,927,046	.8
18	New Mexico	3,708,806	.7	18	Montana	5,653,539	.7
19	Utah	3,254,828	.6	19	New Mexico	5,401,260	.7
20	Montana	3,240,973	.6	20	Utah	5,384,127	.7
21	Texas	2,429,144	.4	21	Texas	4,288,920	.6
22	Arkansas	2,234,107	.4	22	Arkansas	3,923,701	.5
23	Michigan	1,231,786	.2	23	Michigan	2,455,227	.3
24	North Dakota	495,320	.1	24	North Dakota	750,652	.1
25	Georgia	255,626		25	Georgia	361,319	
26	Oregon	46,063		26	Oregon	116,724	
27	California and Alaska	26,911	.1	27	California and Alaska	95,173	.1
28	South Dakota	10,540		28	South Dakota	20,648	
29	Idaho and Nevada	2,177		29	Idaho and Nevada	5,285	
	Total	569,960,219	100.0		Total	760,416,079	100.0

Rank of coal-producing States in 1913 and 1914, with quantity and value of production and percentage of each—Continued.

1914.

Production.				Value.			
Rank.	State.	Quantity (short tons).	Percentage of total production.	Rank.	State.	Value.	Percentage of total value.
1	Pennsylvania:			1	Pennsylvania:		
	Anthracite	90,821,507	17.7		Anthracite	$188,181,399	27.6
	Bituminous	147,983,294	28.8		Bituminous	159,006,296	23.3
2	West Virginia	71,707,626	14.0	2	West Virginia	71,391,408	10.5
3	Illinois	57,589,197	11.2	3	Illinois	64,693,529	9.5
4	Kentucky	20,382,763	4.0	4	Ohio	21,250,642	3.1
5	Ohio	18,843,115	4.0	5	Kentucky	20,852,463	3.0
6	Indiana	16,641,132	3.2	6	Alabama	20,849,919	3.0
7	Alabama	15,593,422	3.0	7	Indiana	18,290,928	2.7
8	Colorado	8,170,559	1.6	8	Colorado	13,601,718	2.0
9	Virginia	7,959,535	1.5	9	Iowa	13,364,070	2.0
10	Iowa	7,451,022	1.4	10	Kansas	11,238,253	1.6
11	Kansas	6,860,988	1.3	11	Wyoming	10,033,747	1.5
12	Wyoming	6,475,293	1.2	12	Oklahoma	8,204,015	1.2
13	Tennessee	5,943,258	1.2	13	Virginia	8,032,443	1.2
14	Maryland	4,133,547	.8	14	Missouri	6,802,325	1.0
15	Oklahoma	3,988,613	.8	15	Tennessee	6,776,573	1.0
16	Missouri	3,935,980	.8	16	Washington	6,751,511	1.0
17	New Mexico	3,877,689	.7	17	New Mexico	6,230,871	.9
18	Utah	3,103,036	.6	18	Maryland	5,234,796	.8
19	Washington	3,064,820	.6	19	Utah	4,935,454	.7
20	Montana	2,805,173	.5	20	Montana	4,913,191	.7
21	Texas	2,323,773	.4	21	Texas	3,922,459	.6
22	Arkansas	1,836,540	.3	22	Arkansas	3,158,168	.5
23	Michigan	1,283,030	.2	23	Michigan	2,559,786	.4
24	North Dakota	506,685	.1	24	North Dakota	771,379	.1
25	Georgia	166,498		25	Georgia	239,462	
26	Oregon	51,558		26	Oregon	143,556	
27	California, Idaho, and Nevada	13,974	.1	27	California, Idaho, and Nevada	39,821	.1
28	South Dakota	11,850		28	South Dakota	20,456	
	Total	513,525,477	100.0		Total	681,490,643	100.0

PRODUCTION BY CLASSES OF MINES.

Since 1909 the chapters on the production of coal have included statements showing the distribution of the output according to the importance of the producing mines in the various States. In these statements the mines have been divided into five classes, those of the first class including the mines producing 200,000 short tons or more during the year; mines of the second class, those producing from 100,000 to 200,000 tons; mines of the third class, those having a production of from 50,000 to 100,000 tons; mines of the fourth class, those producing from 10,000 to 50,000 tons; and mines of the fifth class, those producing less than 10,000 tons. In these compilations only the commercial mines have been considered. No account has been taken of the number or production of country banks operated for purely neighborhood consumption, nor of the anthracite recovered from the old culm banks or river beds. Some producers in making their reports to the Geological Survey combine the production of two or more mines, if located in the same county, 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.

In previous volumes of this series it has been shown that there is a tendency toward the development of larger mines. It was pointed out in the report for 1913 that in the five years from 1909 to 1913 for which these figures are available production had increased nearly 100,000,000 tons in the bituminous regions, with practically no change in the number of mines; that the average production from mines of the first class had increased 16 per cent; and that the production from all the mines of that class had increased from 42 per cent of the bituminous output in 1909 to 50 per cent in 1913.

The period from 1909 to 1913 was one of almost steady growth for the bituminous-coal industry and witnessed a marked development of the smaller into the larger coal-producing units. During the years 1909 to 1914, inclusive, production at mines of the third, fourth, and fifth classes—that is, all mines producing less than 100,000 tons each—did not materially change. The total production of mines having an annual output of 200,000 tons, however, has increased and decreased in unison with changes in the total output. The years 1911 and 1914 showed decreases in the bituminous output of approximately 3 and 12 per cent, respectively, as compared with the corresponding preceding years, and the production at mines of the largest class in those years decreased 7 and 24 per cent. The increase in the total commercial output in 1910 was 10 per cent; in 1912, 11 per cent; and in 1913, 6 per cent; the increased output from mines of the first class in those years was 19, 24, and 9 per cent, respectively. In other words, periods of prosperity and depression have their greatest effect upon the output of the largest mines.

Among the individual States Kentucky showed the greatest increase in production in 1914. In that State the number of mines of the first class increased from 10 to 12 and of the second class from 51 to 64. The percentage of total output from those two classes of mines increased from 55 in 1913 to 59 in 1914. In Ohio, on the other hand, which State outside of Pennsylvania showed the largest decrease in total production in 1914, the number of mines of the first class decreased from 56 to 6 and of the second class from 70 to 46. The percentage of total output from mines of those two classes decreased from 75 in 1913 to 43 in 1914.

In the following tables a statement of the number and the percentage of mines of each class, their total and their average production, the percentage of the total output contributed by each class during the last five years, and the statistics of production by classes of mines in 1913 and 1914, by States, are presented:

Production of coal in the United States in 1910–1914, according to classes of mines, in short tons.

	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.
1910.															
Bituminous	618	10.6	191,518,675	309,901	46.0	763	13.1	107,052,053	140,304	25.7	960	16.5	68,858,273	71,727	16.5
Pennsylvania anthracite	157	51.0	65,788,484	419,035	82.5	64	20.8	10,664,819	166,638	13.4	26	8.4	2,281,971	87,768	2.9
Total	775	12.7	257,307,159	332,009	51.9	827	13.5	117,716,872	142,342	23.7	986	16.1	71,140,244	72,150	14.3
1911.															
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
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
1912.															
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
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
1913.															
Bituminous	694	12.0	241,463,241	347,930	50.6	837	14.5	118,475,544	141,548	24.8	959	16.6	69,018,483	71,969	14.4
Pennsylvania anthracite	174	62.6	78,949,046	453,730	89.5	39	14.0	6,611,711	169,531	7.5	21	7.6	1,832,621	87,268	2.1
Total	868	14.3	320,412,287	369,139	56.7	876	14.5	125,087,255	142,794	22.1	980	16.2	70,851,104	72,297	12.5
1914.															
Bituminous	539	9.6	184,220,942	341,783	43.7	861	15.4	121,127,926	140,683	28.7	912	16.3	66,264,891	72,659	15.7
Pennsylvania anthracite	178	65.7	79,127,235	444,535	90.0	37	13.7	6,284,198	169,843	7.2	24	8.8	1,928,040	80,335	2.2
Total	717	12.2	263,348,177	367,292	51.7	898	15.3	127,412,124	141,884	25.0	936	16.0	68,192,931	72,856	13.4

	Fourth class. (Mines producing 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.
1910.													
Bituminous	1,568	27.0	42,282,021	26,966	10.2	1,909	32.8	6,561,235	3,437	1.6	5,818	416,272,257	71,549
Pennsylvania anthracite	28	9.1	812,517	29,018	1.0	33	10.7	147,808	4,479	.2	308	79,695,599	258,752
Total	1,596	26.0	43,094,538	27,002	8.7	1,942	21.7	6,709,043	3,458	1.4	6,126	495,967,856	80,961
1911.													
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
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
1912.													
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
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
1913.													
Bituminous	1,558	27.0	42,292,052	27,145	8.9	1,728	29.9	6,280,271	3,635	1.3	5,776	477,529,591	82,675
Pennsylvania anthracite	21	7.6	683,956	32,569	.8	23	8.2	94,300	4,100	.1	278	88,171,634	317,164
Total	1,579	26.1	42,976,008	27,217	7.6	1,751	28.9	6,374,571	3,641	1.1	6,054	565,701,225	93,443
1914.													
Bituminous	1,604	28.7	43,704,661	27,247	10.4	1,676	30.0	6,320,426	3,771	1.5	5,592	421,638,846	75,400
Pennsylvania anthracite	17	6.3	478,989	28,176	.5	15	5.5	59,779	3,985	.1	271	87,878,241	324,274
Total	1,621	27.7	44,183,650	27,357	8.7	1,691	28.8	6,380,205	3,773	1.2	5,863	509,517,087	86,904

Production of coal in the United States in 1913 and 1914, according to classes of mines, in short tons.

1913.

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	19	8.5	6,112,051	321,687	34.6	42	18.7	5,862,478	139,583	33.2	44	19.6	3,121,545	70,944	17.6
Alaska															
Arkansas	1	1.9	242,134	242,134	10.8	3	5.7	392,314	130,771	17.6	15	28.3	1,073,798	71,587	48.1
California															
Colorado	7	4.1	2,097,317	299,617	22.7	21	12.3	2,941,436	140,068	31.9	33	19.3	2,422,162	73,399	26.3
Georgia	1	50.0	235,892	235,892	92.3										
Idaho and Nevada															
Illinois	107	20.3	40,655,172	379,955	66.0	93	17.7	13,411,198	144,206	21.8	62	11.8	4,462,182	71,971	7.3
Indiana	28	12.1	8,078,659	288,524	47.2	38	16.5	5,445,416	143,300	31.9	28	12.1	1,902,734	67,955	11.1
Iowa	6	3.0	1,498,626	249,771	20.0	18	8.9	2,556,474	142,026	34.1	23	11.3	1,614,686	70,203	21.5
Kansas						29	19.1	3,693,794	127,372	51.4	42	27.6	2,439,049	58,073	34.0
Kentucky	10	3.0	3,488,229	348,823	17.9	51	15.4	7,244,988	142,059	37.2	80	24.2	5,596,564	69,957	28.7
Maryland	5	7.5	2,165,695	433,139	45.4	5	7.5	752,000	150,400	15.8	14	20.9	1,130,068	80,719	23.7
Michigan						2	7.7	213,625	106,813	17.3	12	46.1	807,028	67,252	65.6
Missouri						12	5.8	1,531,063	127,588	36.2	15	7.2	1,132,721	75,515	26.8
Montana	3	7.0	1,744,790	581,597	54.0	7	16.3	983,401	140,486	30.4	3	7.0	187,580	62,527	5.8
New Mexico	6	16.7	2,322,024	387,004	62.6	6	16.7	1,044,073	174,012	28.2	1	2.7	96,392	96,392	2.6
North Dakota						1	1.8	188,691	188,691	39.5					
Ohio	56	8.4	16,294,149	290,967	45.3	70	10.5	10,523,196	150,331	29.3	63	9.4	4,727,287	75,036	13.1
Oklahoma	1	1.1	202,404	202,404	4.9	9	9.5	1,204,629	133,848	28.9	22	23.1	1,586,964	72,135	38.1
Oregon															
Pennsylvania, bituminous	316	21.0	115,861,271	366,650	66.7	209	13.9	29,297,912	140,181	16.9	225	15.0	16,809,008	74,707	9.7
Tennessee	5	3.8	1,305,260	261,052	19.0	14	10.5	1,911,575	136,541	27.9	29	21.8	1,824,108	62,900	26.6
Texas	1	2.1	222,430	222,430	9.2	9	19.2	950,675	105,631	39.1	8	17.0	541,021	67,628	22.3
Utah	7	25.9	2,667,421	381,060	82.0	2	7.4	317,823	158,912	9.8	3	11.1	207,831	69,277	6.4
Virginia	14	23.3	6,342,058	453,004	71.8	7	11.7	945,216	135,031	10.7	10	16.7	808,086	80,809	9.2
Washington	4	7.6	1,059,956	264,989	27.3	13	24.5	1,803,775	138,752	46.5	9	17.0	596,115	66,235	15.4
West Virginia	89	11.3	26,770,693	300,794	37.6	147	18.7	20,610,855	140,210	29.0	212	27.0	15,450,576	72,880	21.7
Wyoming	8	13.1	2,097,010	262,126	28.4	29	47.5	4,648,937	160,308	62.9	6	9.8	480,978	80,163	6.5
Total bituminous	694	12.0	241,463,241	347,930	50.6	837	14.5	118,475,544	141,548	24.8	959	16.6	69,018,483	71,969	14.4
Pennsylvania, anthracite	174	62.6	78,949,046	453,730	89.5	39	14.0	6,611,711	169,531	7.5	21	7.6	1,832,621	87,268	2.1
Grand total	868	14.3	320,412,287	369,139	56.7	876	14.5	125,087,255	142,794	22.1	980	16.2	70,851,104	72,297	12.5

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	94	42.0	2,448,122	26,044	13.8	25	11.2	133,496	5,340	0.8	224	17,677,692	78,918
Alaska						1	100.0	2,072	2,072	100.0	1	2,072	2,072
Arkansas	19	35.8	474,753	24,987	21.2	15	28.3	50,406	3,360	2.2	53	2,233,405	42,140
California	1	50.0	18,209	18,209	73.3	1	50.0	6,630	6,630	26.7	2	24,839	12,420
Colorado	54	31.6	1,559,566	28,881	16.9	56	32.7	203,680	3,637	2.2	171	9,224,161	53,942
Georgia	1	50.0	19,734	19,734	7.7						2	255,626	127,813
Idaho, Nevada, and South Dakota						5	100.0	7,337	1,467	100.0	5	7,337	1,467
Illinois	99	18.8	2,467,368	24,923	4.0	165	31.4	551,727	3,344	.9	526	61,547,647	117,011
Indiana	51	22.1	1,390,194	27,259	8.1	86	37.2	287,753	3,346	1.7	231	17,104,756	74,047
Iowa	54	26.6	1,505,924	27,887	20.1	102	50.2	323,034	3,167	4.3	203	7,498,744	36,940
Kansas	29	19.1	800,754	27,612	11.2	52	34.2	243,626	4,685	3.4	152	7,177,223	47,219
Kentucky	103	31.1	2,827,836	27,455	14.5	87	26.3	338,757	3,894	1.7	331	19,496,374	58,901
Maryland	19	28.3	615,900	32,416	12.9	24	35.8	105,687	4,404	2.2	67	4,769,350	71,184
Michigan	6	23.1	191,541	31,924	15.6	6	23.1	18,432	3,072	1.5	26	1,230,626	47,332
Missouri	47	22.6	1,141,065	24,278	26.9	134	64.4	426,299	3,181	10.1	208	4,231,148	20,342
Montana	11	25.5	259,278	23,571	8.0	19	44.2	58,726	3,091	1.8	43	3,233,775	75,204
New Mexico	8	22.2	200,511	25,064	5.4	15	41.7	42,806	2,854	1.2	36	3,705,806	102,939
North Dakota	9	16.4	158,940	17,660	33.2	45	81.8	130,322	2,896	27.3	55	477,953	8,690
Ohio	142	21.3	3,309,223	23,304	9.2	336	50.4	1,108,970	3,300	3.1	667	35,962,825	53,917
Oklahoma	42	44.2	1,104,914	26,307	26.5	21	22.1	64,296	3,061	1.6	95	4,163,207	43,823
Oregon	1	14.3	16,462	16,462	36.2	6	85.7	29,026	4,838	63.8	7	45,488	6,498
Pennsylvania, bituminous	377	25.1	10,126,045	26,860	5.8	376	25.0	1,540,295	4,096	.9	1,503	173,634,531	115,525
Tennessee	62	46.6	1,704,018	27,484	24.9	23	17.3	111,587	4,852	1.6	133	6,856,548	51,553
Texas	24	51.1	683,218	28,467	28.1	5	10.6	31,800	6,360	1.3	47	2,429,144	51,684
Utah	2	7.4	38,757	19,379	1.2	13	48.2	21,212	684	.6	27	3,253,044	120,483
Virginia	22	36.6	694,315	31,560	7.9	7	11.7	36,906	5,272	.4	60	8,826,581	147,110
Washington	13	24.5	364,747	28,057	9.4	14	26.4	53,298	3,807	1.4	53	3,877,891	73,168
West Virginia	264	33.5	8,041,456	30,460	11.3	75	9.5	317,904	4,239	.4	787	71,191,484	90,459
Wyoming	4	6.6	129,202	32,301	1.7	14	23.0	34,187	2,442	.5	61	7,390,314	121,153
Total bituminous	1,558	27.0	42,292,052	27,145	8.9	1,728	29.9	6,280,271	3,635	1.3	5,776	477,529,591	82,675
Pennsylvania, anthracite	21	7.6	683,956	32,569	0.8	23	8.2	94,300	4,100	.1	278	88,171,634	317,164
Grand total	1,579	26.1	42,976,008	27,217	7.6	1,751	28.9	6,374,571	3,641	1.1	6,054	565,701,225	93,443

Production of coal in the United States in 1913 and 1914, according to classes of mines, in short tons—Continued.

1914.

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	15	7.2	4,995,244	333,016	32.1	37	17.9	4,851,555	131,123	31.1	49	23.7	3,617,972	73,836	23.2
Arkansas	1	1.8	207,619	207,619	11.3	4	7.2	532,222	133,056	29.0	9	16.1	622,266	69,141	33.9
California, Idaho, Nevada, and South Dakota															
Colorado	8	4.9	2,176,692	272,087	26.6	18	11.0	2,400,927	133,385	29.5	32	19.7	2,232,236	69,757	27.3
Georgia						1	50.0	165,098	165,098	99.2					
Illinois	97	19.7	37,836,524	390,067	65.7	85	17.2	12,339,989	145,176	21.6	59	12.0	4,424,619	74,994	7.7
Indiana	25	11.1	7,382,054	295,282	44.5	39	17.3	5,439,932	139,485	32.8	22	9.8	1,686,849	76,675	10.1
Iowa	1	0.5	294,766	294,766	4.0	24	12.6	3,240,268	135,011	43.6	31	16.3	2,259,217	72,878	30.6
Kansas						29	22.5	3,518,978	121,344	51.4	27	20.9	2,080,850	77,069	30.4
Kentucky	12	3.4	3,252,535	271,044	16.1	64	18.0	8,654,866	135,232	42.7	67	18.9	4,960,855	74,043	24.5
Maryland	5	7.8	1,897,017	379,403	46.0	5	7.8	675,763	135,153	16.4	9	14.0	769,862	85,540	18.7
Michigan						5	26.3	563,258	112,652	44.0	7	36.9	582,524	83,218	45.3
Missouri						6	3.4	884,736	147,456	23.1	15	8.4	1,081,516	72,101	28.3
Montana	3	6.8	1,643,719	547,906	58.8	6	13.6	746,650	124,442	26.7	2	4.6	102,440	51,220	3.6
New Mexico	7	20.0	2,559,816	365,688	66.1	7	20.0	1,059,197	151,314	27.3					
North Dakota						1	1.9	194,918	194,918	40.8					
Ohio	6	1.0	1,345,104	224,184	7.2	46	7.7	6,632,224	144,179	35.7	73	12.2	5,213,257	71,414	28.1
Oklahoma	1	1.0	205,815	205,815	5.2	10	10.5	1,305,867	130,587	32.8	20	21.0	1,419,575	70,979	35.6
Oregon															
Pennsylvania, bituminous	250	16.9	86,716,618	346,867	58.8	231	15.6	33,615,575	145,522	22.8	212	14.3	15,553,713	73,367	10.6
Tennessee	4	3.3	937,164	234,291	15.8	11	9.2	1,748,003	158,909	29.5	26	21.7	1,781,750	68,529	30.0
Texas						2	3.8	301,291	150,646	13.0	12	22.6	962,604	80,217	41.4
Utah	7	29.2	2,290,006	327,144	73.9	4	16.7	568,462	142,116	18.3	2	8.3	137,210	68,605	4.4
Virginia	11	17.4	5,174,840	470,440	65.0	9	14.4	1,272,196	141,355	16.0	14	22.2	917,376	65,527	11.5
Washington	3	5.2	663,390	221,130	21.7	11	19.0	1,458,008	132,546	47.6	5	8.6	363,198	72,640	11.8
West Virginia	71	8.6	21,709,095	305,762	30.5	189	23.0	26,353,138	139,435	36.7	210	25.6	14,802,790	70,490	20.6
Wyoming	12	21.4	2,932,924	244.410	45.3	17	30.4	2,604,805	153,224	40.3	9	16.1	692,212	76,912	10.7
Total bituminous	539	9.6	184,220,942	341,783	43.7	861	15.4	121,127,926	140,683	28.7	912	16.3	66,264,891	72,659	15.7
Pennsylvania, anthracite	178	65.7	79,127,235	444,535	90.0	37	13.7	6,284,198	169,843	7.2	24	8.8	1,928,040	80,335	2.2
Grand total	717	12.2	263,348,177	367,292	51.7	898	15.3	127,412,124	141,884	25.0	936	16.0	68,192,931	72,856	13.4

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	80	38.7	2,014,766	25,185	12.9	26	12.5	111,992	4,307	0.7	207	15,591,529	75,321
Arkansas	19	33.9	391,434	20,602	21.3	23	41.0	82,471	3,586	4.5	56	1,836,012	32,786
California, Idaho, Nevada, and South Dakota						6	100.0	20,307	3,385	100.0	6	20,307	3,385
Colorado	45	27.6	1,176,012	26,134	14.4	60	36.8	179,160	2,986	2.2	163	8,165,027	50,092
Georgia						1	50.0	1,400	1,400	.8	2	166,498	83,249
Illinois	95	19.3	2,373,872	24,988	4.1	156	31.7	515,853	3,307	.9	492	57,490,857	116,851
Indiana	62	27.6	1,795,573	28,961	10.9	77	34.2	277,153	3,599	1.7	225	16,581,561	75,029
Iowa	54	28.5	1,368,247	25,338	18.5	80	42.1	247,474	3,093	3.3	190	7,409,972	39,000
Kansas	36	27.9	1,093,979	30,388	16.0	37	28.7	151,921	4,106	2.2	129	6,845,728	53,068
Kentucky	114	32.1	3,028,692	26,567	14.9	98	27.6	362,999	3,704	1.8	355	20,259,947	57,070
Maryland	23	36.0	697,705	30,335	16.9	22	34.4	80,639	3,665	2.0	64	4,120,986	64,390
Michigan	4	21.0	124,565	31,141	9.7	3	15.8	12,582	4,194	1.0	19	1,282,929	67,523
Missouri	52	29.2	1,484,556	28,549	38.8	105	59.0	374,542	3,567	9.8	178	3,825,350	21,491
Montana	9	20.5	212,209	23,578	7.6	24	54.5	91,929	3,830	3.3	44	2,796,947	63,567
New Mexico	8	22.9	228,876	28,610	5.9	13	37.1	27,554	2,120	.7	35	3,875,443	110,727
North Dakota	9	17.3	144,122	16,014	30.2	42	80.8	138,732	3,303	29.0	52	477,772	9,188
Ohio	170	28.4	4,259,943	25,058	23.0	304	50.7	1,107,901	3,644	6.0	599	18,558,429	30,982
Oklahoma	37	39.0	940,979	25,432	23.6	27	28.5	111,612	4,134	2.8	95	3,983,848	41,935
Oregon	3	100.0	51,158	17,053	100.0						3	51,158	17,053
Pennsylvania, bituminous	377	25.4	10,227,250	27,128	6.6	412	27.8	1,697,275	4,120	1.2	1,482	147,810,431	99,737
Tennessee	55	45.8	1,355,581	24,647	22.8	24	20.0	116,700	4,863	1.9	120	5,939,198	49,493
Texas	35	66.0	1,029,089	29,403	44.3	4	7.6	30,789	7,697	1.3	53	2,323,773	43,845
Utah	3	12.5	93,142	31,047	3.0	8	33.3	11,484	1,436	.4	24	3,100,304	129,179
Virginia	19	30.1	554,781	29,199	7.0	10	15.9	39,239	3,924	.5	63	7,958,432	126,324
Washington	20	34.4	515,822	25,791	16.8	19	32.8	64,402	3,390	2.1	58	3,064,820	52,842
West Virginia	269	10.1	8,351,734	31,047	11.6	83	32.7	412,931	4,975	.6	822	71,629,688	87,141
Wyoming	6	10.7	190,574	31,762	2.9	12	21.4	51,385	4,282	.8	56	6,471,900	115,570
Total bituminous	1,604	28.7	43,704,661	27,247	10.4	1,676	30.0	6,320,426	3,771	1.5	5,592	421,638,846	75,400
Pennsylvania, anthracite	17	6.3	478,989	28,176	.5	15	5.5	59,779	3,985	.1	271	87,878,241	324,274
Grand total	1,621	27.7	44,183,650	27,257	8.7	1,691	28.8	6,380,205	3,773	1.2	5,863	509,517,087	86,904

LABOR STATISTICS.

The coal mines of the United States gave employment in 1914 to 763,185 men, of whom 179,679, or 23.6 per cent, were employed in the anthracite mines of Pennsylvania, and 583,506, or 76.4 per cent, in the bituminous mines. The average working time, 245 days, made by the anthracite workers, was only exceeded in two other years, 1911 (246 days) and 1913 (257 days). The average time in the bituminous mines (195 days) was 37 days less than in 1913 and the lowest, except in 1908 (193 days), since 1896. The average number of days of employment for all of the coal workers in the United States was 207 days in 1914, which was 31 days less than in 1913 and the lowest since 1908. The average yearly tonnage of bituminous coal per man in 1914 was 724, as compared with 837 in 1913, and the yearly tonnage of the anthracite workers was 505 against 520 in 1913. The daily average for bituminous coal and lignite, however, was the highest on record, 3.71 tons, as compared with 3.68 in 1912, the previous high record. The daily average for anthracite, 2.06 tons, except for that of 1913 (2.02 tons), was the lowest since 1891, or in 23 years.

The apparent efficiency of the anthracite workers as indicated by these statistics has shown a tendency to decline since 1899 when the maximum of 2.50 tons per day was obtained. On the contrary, the average daily production by each employee in the bituminous mines has increased more or less uniformly through the 25 years for which these statistics have been compiled from 2.56 tons in 1890 to 3.71 in 1914, a gain in 25 years of almost 45 per cent. The apparent increase in the efficiency of the employees in the bituminous mines has been due in large measure, as shown elsewhere in this report, to the steady increase in the use of mining machines and to the increased ratio that machine-mined coal bears to the total bituminous production.

The following table shows the number of men employed in the coal mines of the United States in 1910, 1911, 1912, 1913, and 1914, with the average number of days worked, by States:

Statistics of labor employed in coal mines of the United States, 1909–1914, by States.

State.	1910		1911		1912		1913		1914	
	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	249	22,210	227	22,707	245	22,613	255	24,552	226	24,042
Arkansas	128	5,568	133	5,657	157	4,536	174	a 4,652	143	4,339
California	189	19	a 265	a 60	a 184	a 52	a 302	a 40	b 291	b 43
Colorado	236	15,864	207	14,316	227	13,000	229	11,990	244	10,098
Georgia	265	386	c 277	c 514	c 254	c 450	261	500	207	355
Idaho	200	14	d 228	d 13	d 253	d 20	d 183	d 12	(b)	(b)
Illinois	160	72,645	188	76,600	194	78,098	189	79,529	173	79,499
Indiana	229	21,878	182	21,182	182	21,651	190	22,235	168	23,175
Iowa	218	16,666	203	16,599	188	16,370	195	15,757	204	16,057
Kansas	148	12,870	190	11,357	202	11,646	197	12,479	192	12,448
Kentucky	221	20,316	201	21,921	201	24,304	212	26,332	187	28,764
Maryland	270	5,809	243	5,881	259	6,162	248	5,645	241	5,403
Michigan	211	3,575	218	3,323	183	3,113	188	3,305	201	2,800
Missouri	154	9,691	182	10,259	206	9,704	187	10,418	179	9,549
Montana	239	3,837	220	3,866	220	3,440	228	3,630	209	3,350
New Mexico	283	3,585	230	4,007	274	3,928	289	4,329	283	4,178
North Dakota	207	534	229	640	232	622	221	641	216	558
Ohio	203	46,641	179	46,035	201	45,527	206	45,815	108	45,401
Oklahoma	144	8,657	156	8,790	174	8,785	197	9,044	205	8,078
Oregon	257	153	179	189	239	222	283	203	266	190
Pennsylvania bituminous	238	175,403	233	168,199	252	165,144	267	172,196	214	184,201
South Dakota							137	48	152	47
Tennessee	225	11,930	232	10,703	234	10,309	241	11,238	220	10,116
Texas	234	4,197	226	5,353	230	5,127	253	5,101	237	4,635
Utah	260	3,053	236	3,060	285	3,328	273	4,158	210	4,112
Virginia	241	7,264	261	7,392	251	8,678	280	9,162	235	9,183
Washington	256	6,314	225	6,498	226	5,519	260	5,794	191	5,805
West Virginia	228	68,663	221	66,730	266	68,248	234	74,746	201	78,963
Wyoming	248	7,771	230	7,924	238	8,036	232	8,331	192	8,117
Total bituminous	217	555,533	211	549,775	223	548,632	232	571,882	195	583,506
Pennsylvania anthracite	229	169,497	246	172,585	231	174,030	257	175,745	245	179,679
Grand total	220	725,030	220	722,360	225	722,662	238	747,627	207	763,185

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

In the following table is presented a statement of the number of men employed in the anthracite and bituminous mines, the average number of days worked, and the average production per man per day and per year, annually, since 1890, except in 1909, when the statistics of labor 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. The notable feature of this statement is the marked increase in the average tonnage, both per day and per year, by the bituminous coal workers, the average daily production in 1914 being the largest during this period and the increase being more than 1 ton, or practically 45 per cent more than in 1890. There has also been an increase in the average annual tonnage per man in the anthracite region, principally during the last few years, although the average daily tonnage has not shown any marked increase, and during the last decade has shown a declining tendency. The increased annual tonnage per man in the anthracite mines has been due to the policy adopted by the operators in 1902 and 1903 of allowing discounts from the circular prices during the spring and summer months with the idea of encouraging customers to make their cellars storage places for the winter supply of fuel. It will be observed that in the five years from 1897 to 1901, inclusive, the average working times in the anthracite region ranged from 150 to 196 days, with a mean average of 167. In the eight years from 1906 to 1914, inclusive, leaving out 1909, the average time has ranged from 195 to 257 days, with a mean average of 228 days. The shortest year, 1906, in the latter period was only a day less than the longest year of the earlier period. The difference in the mean averages in the two periods is 61 days, or 36 per cent in favor of the latter period. The average number of days in the bituminous regions has not shown the same increase. In fact, the tendency has been in the other direction. The average working time in the bituminous mines from 1897 to 1901 ranged from 196 to 234 days, with a mean average of 220 days. In the period from 1906 to 1914 the average time of the bituminous miners ranged from 193 to 234 days, with a mean average of 214 days. The increased production per man in the bituminous mines has been due largely to the increased use of mining machinery. In 1891, the first year for which the statistics of machine-mined coal were given, this production represented only a little more than 5 per cent of the total output, and the average production per man was 2.57 short tons for each working day and 573 tons for the year. In 1911, of the total production of bituminous coal, 43.9 per cent was machine mined, and the average production by each employee was 3.5 tons for each day and 738 tons for the year; in 1914, 51.7 per cent was mined by machines, and the average production by each employee was 3.71 tons for each day and 724 tons for the year.

Production of coal according to number of persons employed, 1890–1914.

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
1913	175,745	257	2.02	520	571,882	232	3.61	837
1914	179,679	245	2.06	505	583,506	195	3.71	724

In most of the bituminous coal mines of the United States the length of the working-day is 8 hours. In 1914, out of a total of 5,189 mines for which the number of hours worked per day were reported, 3,120, or 60 per cent, worked 8 hours; 905, or 17.5 per cent, worked 9 hours; and 1,164, or 22.5 per cent, worked 10 hours. The corresponding percentages in 1913 were 62, 18, and 20. The 8-hour mines employed a total of 344,814 men; the 9-hour mines, 87,357 men; and the 10-hour mines, 135,876 men. When these figures are compared with those for 1913 it will be observed that there was a decrease in the number of mines that worked 8 hours, and an increase in the number of men who worked 9 and 10 hours. The decrease in the 8-hour days and the increase in the 9-hour and 10-hour days were due chiefly to idleness because of strikes at mines working 8 hours in 1913, in Ohio and Colorado. There was an increase in the number of 10-hour mines in Alabama, Kentucky, Missouri, Pennsylvania, Texas, and Washington. The States in which the 9-hour and 10-hour days prevailed are those of the southern Appalachian region, Maryland, Virginia, West Virginia, Alabama, Kentucky, and Tennessee, which are for the most part "open shop," or nonunion, and the 8-hour day prevails in the coal fields where the men are well organized.

It should be remembered, however, that when the length of the working-day is stated, reference is made to the number of hours the mines are supposed to have been in operation, and 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 an agreed rate per ton or other basis of payment. The miner is an independent contractor and is not obliged to put in a certain number of hours at his working place. The figures in the following table really indicate the number of hours the men were given opportunity to work, and do not mean that all the employees worked 8, 9, or 10 hours, as the case might be.

Since the settlement of the anthracite strike of 1902 the mines in that region have been operated on a 9-hour basis, with the exception of engineers and pumpmen, who work 8 hours, and of the miners, who work by contract.

In the following table is presented a statement of the number of mines and men working 8, 9, and 10 hours in the important bituminous coal-producing States in 1913 and 1914:

Number of hours to the working-day in 1913 and 1914, by States.

1913.

State.	8 hours.		9 hours.		10 hours.		All others.
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Men.
Alabama	13	420	36	2,496	135	18,185	3,451
Arkansas	53	4,652					
Colorado	146	11,175	3	75	5	128	612
Illinois	482	78,137	7	41	1	5	1,346
Indiana	199	21,637	3	42	6	121	435
Iowa	185	15,248	2	16	1	12	481
Kansas	138	12,240	1	5			234
Kentucky	68	5,754	84	7,389	147	12,390	799
Maryland	3	15	5	203	49	5,105	322
Michigan	24	3,305					
Missouri	179	10,200	4	79			139
Montana	40	3,416	1	4			210
New Mexico	16	2,335	8	401	10	1,590	3
North Dakota	13	61	5	51	24	472	57
Ohio	604	45,487	8	187	3	32	109
Oklahoma	87	8,725			2	109	210
Oregon	4	157					46
Pennsylvania (bituminous)	849	100,568	312	32,064	242	38,671	893
Tennessee	8	685	78	6,163	35	3,927	463
Texas	19	2,727	8	525	11	1,299	550
Utah	23	4,063	2	95			
Virginia	1	32	8	302	49	8,743	85
Washington	52	5,794					
West Virginia	29	1,864	369	35,123	364	37,054	705
Wyoming	56	8,321	2	6	1	4	
Total	3,291	347,018	946	85,267	1,085	127,847	11,150

1914.

State.	8 hours.		9 hours.		10 hours.		All others.
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Men.
Alabama	14	646	24	3,546	150	18,115	1,735
Arkansas	53	4,314					25
Colorado	137	9,496	1	198	1	55	349
Illinois	455	78,672	9	99			728
Indiana	193	21,172	3	14	1	85	1,904
Iowa	175	15,514	2	8	1	4	531
Kansas	121	12,240					208
Kentucky	63	5,438	64	5,856	206	17,120	350
Maryland	5	55	1	17	51	5,261	70
Michigan	15	2,070					730
Missouri	165	9,366	2	23	2	33	127
Montana	49	3,193					157
New Mexico	27	3,794	3	363	2	9	12
North Dakota	14	51	10	91	20	403	13
Ohio	531	43,718	11	189	3	19	1,475
Oklahoma	82	7,806			2	74	198
Oregon	4	169					21
Pennsylvania (bituminous)	819	103,291	291	32,293	263	44,643	3,974
Tennessee	7	280	77	6,612	33	3,166	58
Texas	25	2,707	2	160	17	1,229	539
Utah	22	4,112					
Virginia	3	109	11	1,276	49	7,798	
Washington	53	5,751			1	34	20
West Virginia	35	3,144	394	36,612	361	37,826	1,381
Wyoming	53	7,706			1	2	409
Total	3,120	344,814	905	87,357	1,164	135,876	15,014

STRIKES AND SUSPENSIONS.

Wage agreements in the organized bituminous coal mining regions signed in 1912 expired in 1914. Strikes or suspensions occurred in nearly every district following the expiration of the old agreements, but for the most part the men returned to work pending a settlement, and except in Ohio, these suspensions had little effect upon the total output.

In Ohio no agreement was reached in a part of the State during the year because of the complications imposed by an act of the State legislature, known as the Green antiscreen law, that required the payment for coal mined on a mine-run basis rather than, as previously, on a screened basis. Practically all of the Ohio miners were idle from April to July. The Hocking Valley district resumed operations in July, and the Cambridge district in August. In the Pittsburgh No. 8 district the mines were still idle at the end of the year. In respect to effect on output the Ohio strike was the most disastrous in recent years. Over 40,500 men were affected for an average of 159 days, and the total time lost was almost 6,500,000 days. A decrease of 48 per cent in the output of Ohio, from 36,000,000 tons in 1913 to 18,843,115 tons in 1914, is attributed almost entirely to the strike.

The labor trouble in Colorado, which began in September, 1913, and continued until December, 1914, arose from an attempt to force certain of the operators to recognize the union. A total of 4,418 men were affected for an average of 247 days. The statistics of this strike are given in detail in connection with the discussion of the production of Colorado, on page 667.

Of the States which reported strikes in 1913, Michigan, New Mexico, and Tennessee had none in 1914. In most of the States the time lost in 1914 was greater than in 1913, but Alabama, Montana, Oklahoma, and Washington reported a decrease in that respect. The number of men affected in Colorado, Kansas, and Maryland was less than in 1913, but the total time lost was greater. The total time lost in the bituminous mines was 10,833,924 days—135,605 men for an average of 80 days, or about 9.5 per cent of the total time made. In the anthracite mines the total time lost was 179,743 days—26,115 men for an average of 7 days, equivalent to 0.4 per cent of the total time made.

The statistics of labor troubles in the coal fields of the United States in 1913 and 1914 are presented in the following table. In computing the number of days lost, Sundays have not been included, only possible working days have been considered.

Statistics of labor strikes in the coal mines of the United States in 1913 and 1914.

State.	1913			1914		
	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	1,048	27,041	26	320	3,940	12
Arkansas	1,221	32,481	27	1,415	159,854	113
Colorado	7,324	552,082	75	4,418	1,090,025	247
Illinois	11,861	655,622	55	23,506	970,466	41
Indiana	2,657	44,143	17	8,052	302,855	38
Iowa	721	13,538	19	2,642	76,791	29
Kansas	3,178	28,936	9	2,673	45,257	17
Kentucky	1,029	18,638	18	2,250	82,919	37
Maryland	200	400	2	91	1,547	17
Michigan	180	1,260	7			
Missouri	918	31,251	34	1,162	56,536	49
Montana	1,094	6,682	6	171	1,271	7
New Mexico	8	1,040	130			
Ohio	10,029	263,234	26	40,577	6,452,762	159
Oklahoma	1,696	135,274	80	1,286	39,500	31
Oregon				21	798	38
Pennsylvania	17,244	274,296	16	36,613	1,052,005	29
Tennessee	857	42,966	50			
Texas				221	693	3
Utah	5	1,300	260	150	1,800	12
Washington	1,239	60,145	49	459	25,410	55
West Virginia	8,800	377,405	43	9,330	466,768	50
Wyoming				248	2,727	11
Total bituminous	71,309	2,567,734	36	135,605	10,833,924	80
Pennsylvania anthracite	64,086	481,678	8	26,115	179,743	7

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, 1899–1914.

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
1913	135,395	3,049,412	22.5
1914	161,720	11,013,667	68

[a] Bituminous mines only.

COAL MINED BY MACHINES.

The total production of bituminous coal in the United States decreased from 478,435,297 short tons in 1913 to 422,703,970 tons in 1914. The quantity of coal undercut or otherwise mined by the use of machines decreased from 242,421,713 tons to 218,399,287 tons. The decrease in the total production was 11.6 per cent, and the decrease in the output by the use of machines was 9.9 per cent. The percentage of machine-mined coal to the total output has increased each year since the first successful mining machines were installed. In 1903, 11 years prior to the period covered by the present report, the quantity of bituminous coal mined by machinery in the United

States represented 27.6 per cent of the total; in 1910 it was 41.7 per cent; in 1912, 46.8 per cent; and in 1914, 51.7 per cent. The total number of machines reported in use in the bituminous coal mines of the United States in 1914 was 16,507, an increase of 128 over the number of machines reported in 1913, which was 16,379. The average number of tons mined by each machine in 1914 was 13,231, against 14,801 in 1913, the average for that year being the largest tonnage per machine reported. The best record prior to 1913 was in 1899, when the average production per machine was 14,068 tons. Pennsylvania, the largest producer of bituminous coal, was also first in the total tonnage of coal mined by machines and in the total number of machines in use. West Virginia, the second State in coal-producing importance, ranks also second in the number of machines in use and in the tonnage won by them. The credit for the largest percentage of machine-mined coal to the total output belongs to Ohio, whose output of coal mined by machines in 1914 was 85.7 per cent of the production. Michigan's percentage of machine-mined coal increased from 52.7 per cent in 1912 to 70 per cent in 1913 and to 77.8 per cent in 1914, placing that State second in percentage of machine-mined output. Kentucky ranks third in the percentage of the total product mined by machines, with 77.2 per cent in 1914, against 73.2 per cent in 1913 and 66.4 per cent in 1912. Illinois, Indiana, Pennsylvania, Virginia, and West Virginia are each credited with more than half of its total production mined by machinery in 1914.

The statistics in regard to the coal mined by machines during 1913 and 1914 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, 1913 and 1914, by States.

State.	Number of machines in use.		Number of tons mined by machines.	
	1913	1914	1913	1914
Alabama	377	362	4,124,301	4,937,222
Arkansas	27	28	251,105	351,838
California	2	2	1,200	500
Colorado	300	306	2,311,493	2,502,558
Illinois	1,845	1,812	32,630,555	32,640,528
Indiana	732	751	9,737,425	9,360,683
Iowa	28	46	120,716	308,284
Kansas	9	9	22,120	39,194
Kentucky	1,263	1,383	14,353,583	15,731,332
Maryland	13	10	82,989	110,065
Michigan	130	107	862,700	998,935
Missouri	104	88	863,946	750,037
Montana	97	99	1,076,641	1,213,051
New Mexico	44	45	497,070	619,472
North Dakota	13	14	222,227	208,199
Ohio	1,681	1,669	32,642,848	16,147,630
Oklahoma	103	116	670,629	1,053,526
Pennsylvania	6,301	6,326	92,487,438	79,657,459
Tennessee	252	194	1,842,658	1,377,984
Texas	24	13	100,889	27,971
Utah	50	68	625,475	944,421
Virginia	187	182	4,206,988	4,092,810
Washington	63	72	280,515	328,043
West Virginia	2,539	2,607	39,355,418	42,263,394
Wyoming	195	198	3,050,784	2,734,151
Total	16,379	16,507	242,421,713	218,399,287

Bituminous coal mined by machines in the United States, 1913 and 1914, by States—Continued.

State.	Total tonnage of States using mining machinery.		Percentage of total product mined by machines.	
	1913	1914	1913	1914
Alabama	17,678,522	15,593,422	23.3	31.7
Arkansas	2,234,107	1,836,540	11.2	19.1
California	24,839	11,692	4.8	4.3
Colorado	9,232,510	8,170,559	25.0	30.6
Illinois	61,618,744	57,589,197	53.0	56.7
Indiana	17,165,671	16,641,132	56.7	56.2
Iowa	7,525,936	7,451,022	1.6	4.1
Kansas	7,202,210	6,860,988	.3	.6
Kentucky	19,616,600	20,382,763	73.2	77.2
Maryland	4,779,839	4,133,547	1.7	2.7
Michigan	1,231,786	1,283,030	70.0	77.8
Missouri	4,318,125	3,935,980	20.0	19.0
Montana	3,240,973	2,805,173	33.2	43.3
New Mexico	3,708,806	3,877,689	13.4	16.0
North Dakota	495,320	506,685	44.9	41.1
Ohio	36,200,527	18,843,115	90.2	85.7
Oklahoma	4,165,770	3,988,613	16.1	26.4
Pennsylvania	173,781,217	147,983,294	53.2	53.8
Tennessee	6,903,784	5,943,258	26.7	23.2
Texas	2,429,144	2,323,773	4.2	1.2
Utah	3,254,828	3,103,036	19.2	30.4
Virginia	8,828,068	7,959,535	47.6	51.4
Washington	3,877,891	3,064,820	7.2	10.7
West Virginia	71,254,136	71,707,626	55.3	58.9
Wyoming	7,393,066	6,475,293	41.3	42.2
Total	478,162,419	422,471,782	[a] 50.7	[a] 51.7

[a] Average.

The statistics regarding machine mining in Great Britain from 1900 to 1913, presented in the following table, were compiled by Mr. A. Y. Hoy, the London agent of the Sullivan Mining Machinery Co., and are given here through the courtesy of that company. Corresponding statistics for the bituminous mines of the United States are given for comparison. The percentage of coal mined by machines in Great Britain has shown a steady increase during the 13 years recorded, but is still far behind that of the United States. The coal output of the United States is less than twice that of Great Britain, but the quantity of machine-mined product is from nine to ten times greater. For the five years 1909 to 1913, inclusive, the average number of machines used in Great Britain was 2,226, and in the United States it was 14,362, or six times as many. During this five-year period the average annual output per machine in Great Britain was 9,379 short tons, and in the United States it was 13,196 short tons, or 41 per cent greater. These comparisons, all of which as regards the use of machines favor the United States, do not necessarily imply that the science of mine management in Great Britain is behind that of the United States or that the miners who operate the machines are less skillful. The average thickness of the coal beds worked in Great Britain is considerably less than in the United States, and to that circumstance is probably due the smaller output per machine. The natural disadvantages, such as character of roof and high dip of coal beds, and, further, the fact that the average British coal digger is probably more skillful than those employed in this country, have all operated to retard the use of mining machines in Great Britain.

Relative coal production and machine-mined coal of the United States and Great Britain, 1900–1913, in short tons.

Year.	United States (bituminous only).				Great Britain.			
	Total production.	Machine-mined.	Number of machines.	Percenttage of machine-mined.	Total production.	Machine-mined.	Number of machines.	Percentage of machine-mined.
1900....	212,316,112	52,784,523	3,907	24.86	252,203,056	3,719,533	311	1.47
1901....	225,828,149	57,843,335	4,341	25.61	245,332,578	3,409,640	345	1.39
1902....	260,216,844	69,611,582	5,418	26.75	254,346,447	4,660,546	483	1.83
1903....	282,749,348	77,974,894	6,658	27.58	257,974,605	5,875,047	643	2.28
1904....	278,659,689	78,606,997	7,663	28.21	260,319,665	6,433,329	755	2.47
1905....	315,062,785	103,396,452	9,184	32.82	264,464,408	9,074,461	946	3.43
1906....	342,874,867	118,847,527	10,212	34.66	281,195,743	11,426,807	1,136	4.06
1907....	394,759,112	138,547,823	11,144	35.11	299,970,677	14,483,007	1,493	4.83
1908....	332,573,944	123,183,334	11,569	37.04	292,887,144	15,221,201	1,659	5.20
1909....	379,744,257	142,496,878	13,049	37.52	295,427,229	15,422,049	1,691	5.22
1910....	417,111,142	174,012,293	13,254	41.72	296,007,699	17,784,257	1,959	6.01
1911....	405,907,059	178,158,236	13,829	43.89	304,518,927	20,907,428	2,146	6.87
1912....	450,104,982	210,538,822	15,298	46.80	291,666,299	22,707,035	2,444	7.79
1913....	478,435,297	242,421,713	16,379	50.70	321,922,130	27,562,414	2,894	8.56

The statistics relating to the use of mining machines were first collected by the Geological 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, which shows 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	138,547,823	12,432
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
1913	16,379	242,421,713	14,801
1914	16,507	218,399,287	13,231

It has already been shown in the discussion of the statistics of the labor employed in the coal mines of the United States that there has been in the last 25 years a marked increase in the average production per man of bituminous coal, which may be attributed directly to the increase in the use of mining machines.

In the following table the quantity and percentage of machine-mined production in 1900, 1913, and 1914, by States, are compared with the daily and yearly average production by each employee in the States where mining machines are used:

Average production per man compared with production by machines in 1900, 1913, and 1914, by States, in short tons.

State.	Average tonnage.						Production by machines.					
	Per year.			Per day.			Total tonnage by machines.			Percentage of machine coal to State total.		
	1900	1913	1914	1900	1913	1914	1900	1913	1914	1900	1913	1914
Alabama	601	720	649	2.34	2.82	2.87	370,150	4,124,301	4,937,222	4.4	23.3	31.7
Arkansas	517	480	423	2.36	2.76	2.96	219,085	251,105	351,838	14.8	11.2	19.1
California	454	710	325	1.47	2.14	1.11	....	1,200	500	.....	4.8	4.3
Colorado	703	770	809	2.66	3.36	3.32	756,025	2,311,493	2,502,558	14.4	25.0	30.6
Illinois	659	775	724	2.92	4.10	4.18	5,083,594	32,630,555	32,640,528	19.7	53.0	56.7
Indiana	553	772	718	2.78	4.06	4.27	1,774,045	9,737,425	9,360,683	27.4	56.7	56.2
Iowa	448	478	464	1.96	2.45	2.27	132,757	120,716	308,284	2.6	1.6	4.1
Kansas	528	577	551	2.28	2.93	2.87	46,164	22,120	39,194	1.0	.3	.6
Kentucky	551	745	709	2.43	3.51	3.79	2,339,944	14,353,583	15,731,332	43.9	73.2	77.2
Maryland	757	847	765	3.73	3.42	3.17	138,014	82,989	110,065	3.4	1.7	2.7
Michigan	499	373	458	1.91	1.98	2.28	191,577	862,700	998,935	22.6	70.0	77.8
Missouri	433	414	412	2.02	2.21	2.30	110,036	863,946	750,037	3.1	20.0	19.0
Montana	699	893	837	2.77	3.92	4.00	1,045,115	1,076,641	1,213,051	62.9	33.2	43.3
New Mexico	638	857	928	2.44	2.97	3.28	112,000	497,070	619,472	8.6	13.4	16.0
North Dakota	398	773	908	2.80	2.90	4.20	33,965	222,227	208,199	26.2	44.9	41.1
Ohio	687	790	415	3.20	3.83	3.84	8,835,743	32,642,848	16,147,630	46.5	90.2	85.7
Oklahoma (Indian Territory)	425	461	494	1.86	2.34	2.41	239,424	670,629	1,053,526	12.5	16.1	26.4
Pennsylvania, bituminous	861	1,009	803	3.56	3.78	3.75	26,867,053	92,487,438	79,657,459	33.7	53.2	53.8
Tennessee	459	610	588	1.90	2.53	2.67	176,872	1,842,658	1,377,984	4.8	26.7	23.2
Texas	340	476	501	1.38	1.88	2.11	....	100,889	27,971	.....	4.2	1.2
Utah	877	783	755	3.54	2.87	3.60	....	625,475	944,421	.....	19.2	30.4
Virginia	659	964	867	2.76	3.44	3.69	231,269	4,206,988	4,092,810	9.7	47.6	51.4
Washington	674	669	528	2.33	2.57	2.76	10,000	280,515	328,043	.4	7.2	10.7
West Virginia	777	953	908	3.36	4.07	4.52	3,418,377	39,355,418	42,263,394	15.1	55.3	58.9
Wyoming	753	887	798	2.83	3.82	4.16	653,314	3,050,784	2,734,151	16.3	41.3	42.2

MINING METHODS.

In the report for 1911 the first attempt was made to present statistics of the quantity of bituminous coal properly mined, either by hand or by machine, and of the quantity and percentage that was shot or blasted without having been previously undercut or sheared. In the method characterized as "shooting off the solid" the only preparation consists in drilling the holes necessary for the explosive charge. Opposition to this method of mining has developed because it is injurious to the mining property in that the unusual charges of powder weaken the roof and pillars, which increases the liability to falls of roof and coal, the most prolific cause of fatal accidents in coal mines. Furthermore, it is wasteful in that it materially reduces the quality of the product. The heavy charges of powder necessary to blow down the coal when it has not been previously undercut or sheared result in the production of a much higher proportion of fine coal and render the lump coal so friable that it disintegrates badly in handling and in transportation. This naturally creates dissatisfaction on the part of the consumer, who buys lump coal and gets at best mine-run.

Of the total quantity of coal shot off the solid (64,617,142 short tons), 34,962,241 tons, or 54 per cent, were produced in 1914 in the States of Arkansas, Illinois, Indiana, Iowa, Missouri, and Oklahoma. A slight improvement in this respect in these States was recorded in 1914, as compared with 1913, all except Iowa showing a decreased percentage of powder-mined coal. The entire production of Georgia, in 1914, and of Idaho and Nevada, was reported as shot off the solid, but in Georgia the fine coal is usable and is used in the manufacture of coke. In the other two States the combined production is very small. Less than 1 per cent out of the total production of over 71,000,000 tons was shot off the solid in West Virginia in 1914. Pennsylvania was a good second to West Virginia, with only 2 per cent of its bituminous product shot off the solid; Maryland came third, with 3 per cent; and Ohio was fourth, with 3.8 per cent. The percentage of machine-mined coal increased from 50.7 of the total in 1913 to 51.7 in 1914. The percentage of hand-mined coal increased from 29.6 to 29.7, and that of powder-mined coal decreased from 15.7 to 15.3.

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 1913 and 1914:

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

1913.

State.	Mined by hand.	Percentage.	Shot off the solid.	Percentage.	Mined by machines.	Percentage.	Not reported.	Percentage.	Total production.
Alabama	6,315,787	35.7	7,052,234	39.9	4,124,301	23.3	186,200	1.1	17,678,522
Arkansas	205,112	9.2	1,775,851	79.5	251,105	11.2	2,039	.1	2,234,107
California	....	......	23,639	95.2	1,200	4.8	....	......	24,839
Colorado	5,592,638	60.6	1,286,293	13.9	2,311,493	25.0	42,086	.5	9,232,510
Georgia	....	......	255,626	100.0	....	......	....	......	255,626
Illinois	8,069,361	13.1	20,469,139	33.2	32,630,555	53.0	449,689	.7	61,618,744
Indiana	1,862,729	10.9	5,175,229	30.1	9,737,425	56.7	390,288	2.3	17,165,671
Iowa	1,523,655	20.2	5,440,437	72.3	120,716	1.6	441,128	5.9	7,525,936
Kansas	1,068,039	14.8	5,796,689	80.5	22,120	.3	315,362	4.4	7,202,210
Kentucky	1,755,461	9.0	3,092,985	15.7	14,353,583	73.2	414,571	2.1	19,616,600
Maryland	4,373,920	91.5	293,950	6.2	82,989	1.7	28,980	.6	4,779,839
Michigan	2,370	.2	363,856	29.5	862,700	70.0	2,860	.3	1,231,786
Missouri	1,018,588	23.6	2,021,292	46.8	863,946	20.0	414,299	9.6	4,318,125
Montana	1,003,726	31.0	1,143,364	35.3	1,076,641	33.2	17,242	.5	3,240,973
New Mexico	2,548,243	68.7	652,969	17.6	497,070	13.4	10,524	.3	3,708,806
North Dakota	54,931	11.1	130,341	26.3	222,227	44.9	87,821	17.7	495,320
Ohio	1,600,605	4.4	1,323,793	3.7	32,642,848	90.2	633,281	1.7	36,200,527
Oklahoma	92,183	2.2	3,371,218	80.9	670,629	16.1	31,740	.8	4,165,770
Pennsylvania	61,509,942	35.4	4,481,956	2.6	92,487,438	53.2	15,301,881	8.8	173,781,217
Tennessee	2,464,970	35.9	2,511,882	36.6	1,842,658	26.9	40,674	.6	6,860,184
Texas	1,494,996	61.5	612,132	25.2	100,889	4.2	221,127	9.1	2,429,144
Utah	2,416,647	74.2	150,172	4.6	625,475	19.2	62,534	2.0	3,254,828
Virginia	1,740,485	19.7	2,879,108	32.6	4,206,988	47.6	1,487	.1	8,828,068
Washington	2,120,257	54.7	1,465,248	37.8	280,515	7.2	11,871	.3	3,877,891
West Virginia	31,079,190	43.6	596,184	.8	39,355,418	55.3	223,344	.3	71,254,136
Wyoming	1,618,696	21.9	2,719,884	36.7	3,050,784	41.3	3,702	.1	7,393,066
Other States	23,001	45.7	26,636	53.0	....	......	11,215	1.3	50,312
Total	141,555,532	29.6	75,112,107	15.7	242,421,713	50.7	19,345,945	4.0	478,435,297

Quantity and percentage of bituminous coal mined by different methods, by States, in short tons—Continued.

1914.

State.	Mined by hand.	Per cent-age.	Shot off the solid.	Per cent-age.	Mined by machines.	Per cent-age.	Not re-ported.	Per cent-age.	Total pro-duction.
Alabama	5,134,787	32.9	5,498,988	35.3	4,937,222	31.7	22,425	0.1	15,593,422
Arkansas	52,596	2.9	1,431,548	77.9	351,838	19.1	558	.1	1,836,540
Colorado	4,679,245	57.3	945,348	11.6	2,502,558	30.6	43,408	.5	8,170,559
Georgia	....	......	166,498	100.0	....	......	....	......	166,498
Illinois	6,029,477	10.4	18,362,240	31.9	32,640,528	56.7	556,952	1.0	57,589,197
Indiana	1,761,743	10.6	4,968,065	29.9	9,360,683	56.2	550,641	3.3	16,641,132
Iowa	1,449,026	19.5	5,545,842	74.4	308,284	4.1	147,870	2.0	7,451,022
Kansas	1,127,523	16.4	5,275,611	76.9	39,194	.6	418,660	6.1	6,860,988
Kentucky	2,001,410	9.8	2,362,404	11.6	15,731,332	77.2	287,617	1.4	20,382,763
Maryland	3,861,005	93.4	124,966	3.0	110,065	2.7	37,511	.9	4,133,547
Michigan	2,370	.2	281,624	21.9	998,935	77.8	101	.1	1,283,030
Missouri	872,897	22.2	1,834,017	46.6	750,037	19.0	479,029	12.2	3,935,980
Montana	679,822	24.2	895,279	31.9	1,213,051	43.3	17,021	.6	2,805,173
New Mexico	2,521,682	65.0	727,440	18.8	619,472	16.0	9,095	.2	3,877,689
North Dakota	32,215	6.3	193,497	38.2	208,199	41.1	72,774	14.4	506,685
Ohio	1,263,470	6.7	716,666	3.8	16,147,630	85.7	715,349	3.8	18,843,115
Oklahoma	81,227	2.0	2,820,529	70.7	1,053,526	26.4	33,331	.9	3,988,613
Pennsylvania	55,014,192	37.2	2,940,496	2.0	79,657,459	53.8	10,371,147	7.0	147,983,294
Tennessee	2,327,000	39.1	2,234,214	37.6	1,377,984	23.2	4,060	.1	5,943,258
Texas	1,683,644	72.5	612,158	26.3	27,971	1.2	....	......	2,323,773
Utah	1,972,029	63.6	183,454	5.9	944,421	30.4	3,132	.1	3,103,036
Virginia	1,439,121	18.0	2,426,501	30.5	4,092,810	51.4	1,103	.1	7,959,535
Washington	1,281,553	41.8	1,443,207	47.1	328,043	10.7	12,017	.4	3,061,820
West Virginia	28,963,391	40.4	371,844	.5	42,263,394	58.9	108,997	.2	71,707,626
Wyoming	1,532,987	23.7	2,204,762	34.0	2,734,151	42.2	3,393	.1	6,475,293
Other States	14,663	19.0	49,944	64.5	500	.6	12,275	15.9	77,382
Total	125,779,075	29.7	64,617,142	15.3	218,399,287	51.7	[a]13,908,466	3.3	422,703,970

[a] Includes 1,280,946 tons taken out by steam shovels in Illinois, Indiana, Missouri, Kansas, and Oklahoma.

STEAM-SHOVEL MINING.

The recovery of coal by digging in open pits along the outcrop or where the cover is thin is probably the oldest method of mining. This primitive method is used to-day in hundreds of "country banks" in the West, where the overburden is removed by teams and scrapers, each homesteader or rancher thus mining coal for his own use. In the anthracite region of Pennsylvania, where the product is of sufficient value to warrant the handling of a large amount of dirt to obtain a small amount of coal, strip-pit mining has been conducted on a large scale for many years. The advent of the modern steam shovel really marked the beginning of this system of mining because of the economy affected over the older method of horses and scrapers. Within comparatively recent years the steam shovel has been applied to mining bituminous coal, particularly in parts of Kansas, Oklahoma, Missouri, Indiana, and Illinois, where there are areas of flat-lying coal beds near the surface. The data in the following table, on steam-shovel mining of coal in those States, have been compiled from returns from a total of 35 operators, 9 in Illinois, 10 in Kansas, 9 in Missouri, 5 in Indiana, and 2 in Oklahoma. In the production of 1,280,946 short tons of coal, almost 7,000,000 cubic yards of dirt were removed by 40 steam shovels. For all operations the average ratio of cover to coal was 6.04—that is, 6 feet of dirt overburden were removed for each foot of thickness of coal bed. The ratio was lowest in Illinois, where for each cubic yard of coal 3.86 cubic yards of dirt were handled, and highest in Oklahoma, where the quantity of dirt was ten times that of the coal. The ratio was 8.14 in Kansas, 6.66 in Missouri, and 5.07 in Indiana. A total of 1,355 men was employed in the strip-pits for an average of 187 days. A smaller number of men is required for a given output in this method of mining, as is shown by the average yearly production per man employed, 945 tons in 187 days, as compared with an average of 724 tons in 195 days in all of the bituminous mines of the United States in 1914, and by the average daily output, 5.05 tons, against 3.71 tons for the United States. Steam shovels are now being used in coal mining that have a dipper capacity of from 5 to 8 cubic yards and that will handle under favorable conditions 3,500 or more cubic yards each working day. Not all of the shovels are as large as this, however, and as it is seldom that they are able to work to full capacity for any length of time, because of breakdowns, time lost in moving, flooded pits, lack of cars, and other causes, the average daily output is much lower. The 40 shovels removing dirt only for which statistics are presented handled an average of 930 cubic yards of solid dirt (clay, shale, and sand) for each day that the pits were in operation.

The statistics of 35 strip-pits using steam shovels for the recovery of coal are presented in the following table:

Steam-shovel mining of bituminous coal in 1914, in short tons.

State.	Quantity of coal produced.	Mean average thickness.		Cubic yards of solid coal handled.[a]	Cubic yards of solid dirt removed.	Ratio of cover to coal.	Average number of days active.	Average number of employees.	Number of shovels on coal only.	Number of shovels on cover only.	Total number of shovels.
		Coal.	Cover.								
		Ft. In.	Feet.								
Illinois	324,487	5 11	23	292,037	1,126,234	3.86	121	317	3	9	12
Kansas	363,165	2 11	24	326,901	2,661,308	8.14	231	417	1	12	13
Missouri	251,060	2 10	19	225,954	1,506,920	6.66	201	277	......	10	10
Indiana } Oklahoma }	342,234	5 2	26	307,960	1,673,094	5.07	185	344	4	9	13
		1 10	18			10.00					
Total.	1,280,946	4 0	24	1,152,852	6,967,556	6.04	187	1,355	8	40	48

[a] 1 ton of solid coal is considered to occupy 0.9 cubic yard.

COAL-WASHING OPERATIONS.

Since 1908 the schedules requesting information regarding the production of bituminous coal in the United States have included inquiries regarding the quantity of coal washed at the mines. Coal is washed to reduce the impurities, ash and sulphur, and to improve the quality of the product either for the market or for making coke. The larger part of the product so treated is slack used in the manufacture of coke, but in some States, notably in Illinois, where the coal is non-coking, the washed product is principally nut coal for domestic use. In 1914 the quantity of bituminous coal sent to the washeries operated in connection with the mines was 22,848,647 short tons, which yielded 20,264,141 tons of cleaned coal and 2,584,506 tons of refuse. In 1913 there were 25,051,801 tons of coal sent to the washeries, and the cleaned product obtained was 22,069,691 tons, with 2,982,110 tons of refuse. In the statement of the total production of coal in the United States the refuse is deducted and only the cleaned coal considered as the marketed product. Alabama leads in quantity of coal washed, nearly one-half of the total quantity so treated in 1914 being from that State. The total quantity of cleaned coal from the Alabama washeries in 1914 was 7,081,868 short tons, of which about 60 per cent was used in the manufacture of coke. Pennsylvania was second in the quantity of coal sent to the washeries, with 4,350,800 tons of cleaned coal. Practically all of it was used in the manufacture of coke, the reports from the coke operators showing that 4,252,072 tons of washed coal were used. In Illinois 3,957,895 tons were sent to the washeries, and the quantity of washed coal obtained was 3,484,660 short tons. A very small portion of this was used in the retort ovens, mixed with West Virginia coal, and the remainder was sized coal, used principally for household fuel. In the State of Washington 1,318,550 tons were sent to the washeries, and the cleaned coal obtained was 1,058,066 tons, of which about 10 per cent was used in the manufacture of coke and the remainder went into the regular market. Alabama, Pennsylvania, and Illinois reported that about 8 per cent of their combined production of coal was washed at the mines.

In the anthracite region of Pennsylvania considerable quantities of usable coal have for a number of years been recovered by washeries from old culm banks. This item amounted in 1914 to 2,525,008 long tons, or 2,828,009 short tons, as compared with 2,860,021 long tons, or 3,203,224 short tons, in 1913. 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 1913 and 1914:

Bituminous coal washed at the mines in 1913 and 1914, with quantity of washed coal and of refuse obtained from it, by States, in short tons.

State.	1913			1914		
	Quantity of coal washed.	Quantity of cleaned coal.	Quantity of refuse.	Quantity of coal washed.	Quantity of cleaned coal.	Quantity of refuse.
Alabama	8,149,082	7,210,588	938,494	7,913,030	7,081,868	831,162
Arkansas	46,346	32,985	13,361	....	....	....
Colorado	328,016	266,281	61,735	252,799	193,513	59,286
Georgia	124,306	82,943	41,363	101,932	75,952	25,980
Illinois	4,190,960	3,664,928	526,032	3,957,895	3,484,660	473,235
Indiana	76,132	65,499	10,633	142,558	119,685	22,873
Iowa	31,711	22,080	9,631	25,706	18,000	7,706
Kansas	48,423	39,343	9,080	21,295	16,236	5,059
Kentucky	183,396	162,880	20,516	393,558	353,166	40,392
Michigan	166,709	145,840	20,869	172,854	152,431	20,423
Missouri	160,487	118,681	41,806	153,449	118,256	35,193
Montana	601,176	547,674	53,502	592,246	550,833	41,413
New Mexico	587,853	487,473	100,380	495,127	410,955	84,172
Ohio	306,713	269,178	37,535	292,673	253,389	39,284
Oklahoma	17,850	14,307	3,543	19,643	15,123	4,520
Oregon	12,958	9,719	3,239	20,935	16,748	4,187
Pennsylvania	6,011,172	5,400,444	610,728	4,808,051	4,350,800	457,251
Tennessee	707,773	624,426	83,347	471,086	413,896	57,190
Texas	28,701	21,761	6,940	23,604	19,440	4,164
Virginia	47,936	45,638	2,298	59,397	54,971	4,426
Washington	1,643,282	1,343,120	300,162	1,318,550	1,058,066	260,484
West Virginia	1,580,819	1,493,903	86,916	1,612,259	1,506,153	106,106
Total	25,051,801	22,069,691	2,982,110	22,848,647	20,264,141	2,584,506

VALUES PER TON.

Lack of demand was responsible for the decrease in the average value per ton of both anthracite and bituminous coal in 1914. The decrease was general, 15 out of 30 States showing a decline in the average value of the coal at the mines as compared with 1913. The average value used in this report is obtained by dividing the total value at the mines, as reported by the operators, by the total number of tons. The average value for bituminous coal decreased from $1.18 to $1.17 and for Pennsylvania anthracite from $2.13 to $2.07. The average value for both bituminous coal and anthracite was, however, the same—$1.33—in both 1913 and 1914. This is explained by the proportionately greater quantity of anthracite produced in 1914. Compared with 1913, the bituminous output decreased 11.6 per cent and the anthracite 0.8 per cent in 1914, but the greater value of the anthracite maintained the average of 1913. Notwithstanding these decreases, the value of both anthracite and bituminous is well above the general average for the 35 years for which statistics are available. The average value per ton of anthracite was exceeded in but two years, 1912 and 1913, and that of bituminous coal was exceeded only in 1880, 1903, and 1913.

The following tables show the average value per ton, by States, for the last five years, with the advances and declines in 1914 as compared with 1913, and the general averages for anthracite and bituminous values for 35 years:

Average value per short ton for coal at the mines since 1908, by States.

State.	1908	1909	1910	1911	1912	1913	1914	Advance (+) or decline (−) in 1914.
Alabama	$1.26	$1.19	$1.26	$1.27	$1.29	$1.31	$1.34	−$0.03
Arkansas	1.68	1.48	1.56	1.61	1.71	1.76	1.72	− .04
California	[a] 3.19	2.21	[a] 2.74	[a] 2.00	[a] 2.33	[a] 3.54	[b] 2.85	− .69
Colorado	1.41	1.33	1.42	1.45	1.49	1.52	1.66	+ .14
Georgia	1.38	1.41	1.46	[c] 1.49	[c] 1.49	1.41	1.44	− .03
Idaho	4.02	4.27	3.92	[d] 2.68	[d] 3.14	[c] 2.43	(b)	(b)
Illinois	1.05	1.05	1.14	1.11	1.17	1.14	1.12	− .02
Indiana	1.06	1.02	1.13	1.08	1.14	1.11	1.10	− .01
Iowa	1.63	1.65	1.75	1.73	1.80	1.79	1.79	....
Kansas	1.49	1.44	1.61	1.53	1.62	1.67	1.64	− .03
Kentucky	1.01	.94	.99	.99	1.02	1.05	1.02	− .03
Maryland	1.17	1.11	1.12	1.11	1.18	1.24	1.27	+ .03
Michigan	1.81	1.79	1.91	1.78	1.99	1.99	1.99	....
Missouri	1.64	1.65	1.79	1.72	1.76	1.73	1.73	....
Montana	1.96	1.97	1.82	1.79	1.82	1.74	1.75	+ .01
New Mexico	1.37	1.29	1.39	1.44	1.42	1.46	1.61	+ .15
North Dakota	1.63	1.56	1.49	1.43	1.53	1.52	1.52	....
Ohio	1.06	.99	1.05	1.03	1.07	1.10	1.13	+ .03
Oklahoma	2.03	2.00	2.22	2.05	2.14	2.05	2.06	+ .01
Oregon	2.74	2.69	3.48	2.32	2.60	2.53	2.78	+ .25
Pennsylvania bituminous	1.01	.94	1.02	1.01	1.05	1.11	1.07	− .04
South Dakota	....	....	....	....	....	1.96	1.73	− .23
Tennessee	1.15	1.09	1.11	1.12	1.14	1.14	1.14	....
Texas	1.80	1.72	1.67	1.66	1.67	1.77	1.69	− .08
Utah	1.69	1.66	1.68	1.69	1.67	1.65	1.59	− .06
Virginia	.91	.89	.90	.91	.96	1.01	1.01	....
Washington	2.21	2.54	2.50	2.29	2.39	2.38	2.20	− .18
West Virginia	.95	.86	.92	.90	.94	1.01	.99	− .02
Wyoming	1.62	1.55	1.55	1.56	1.58	1.56	1.55	− .01
Total bituminous	1.12	1.07	1.12	1.11	1.15	1.18	1.17	− .01
Pennsylvania anthracite	1.90	1.84	1.90	1.94	2.11	2.13	2.07	− .06
General average	1.28	1.20	1.25	1.26	1.30	1.33	1.33	....

[a] Includes Alaska.
[b] Includes Idaho and Nevada.
[c] Includes North Carolina.
[d] Includes Nevada.

Average value per short ton of coal in the United States for 35 years.

Year.	Anthracite.	Bituminous.	Year.	Anthracite.	Bituminous.
1880	$1.47	$1.25	1898	$1.41	$0.80
1881	2.01	1.12	1899	1.46	.87
1882	2.01	1.12	1900	1.49	1.04
1883	2.01	1.07	1901	1.67	1.05
1884	1.79	.94	1902	1.84	1.12
1885	2.00	1.13	1903	2.04	1.24
1886	1.95	1.05	1904	1.90	1.10
1887	2.01	1.11	1905	1.83	1.06
1888	1.91	1.00	1906	1.85	1.11
1889	1.44	.99	1907	1.91	1.14
1890	1.43	.99	1908	1.90	1.12
1891	1.46	.99	1909	1.84	1.07
1892	1.57	.99	1910	1.90	1.12
1893	1.59	.96	1911	1.94	1.11
1894	1.51	.91	1912	2.11	1.15
1895	1.41	.86	1913	2.13	1.18
1896	1.50	.83	1914	2.07	1.17
1897	1.51	.81			

SHIPMENTS BY RAILROADS.

Since 1910 the schedules asking for the statement of the production of bituminous coal have included inquiries regarding the names of the railroads carrying the coal and the quantity shipped over each route. From the replies received to these inquiries the following tables have been prepared showing the initial shipments over each transportation route during 1913 and 1914. Corresponding statements were published in the reports for 1911, 1912, and 1913. The tables show not only the initial shipments taken by each railroad, but the State in which the coal originated. The quantities reported in these tables do not include the coal delivered from one road to another, and consequently do not represent the total quantity of coal carried by the various transportation routes. They do, however, represent almost accurately the total quantity of coal transported. For instance, the total shipments of bituminous coal in 1914 shown in these tables amounted to 364,294,862 short tons, whereas the total quantity reported as loaded at the mines for shipment was 364,505,279 tons, the difference in the two statements being less than one-tenth of 1 per cent. When the originating line is simply a side line of a few miles in length, operated for the purpose of delivering the coal to a regular carrier and not engaged in regular passenger and transportation business, the shipments are considered as originating on the railroad to which the coal is delivered. These tables having been compiled from the reports of the coal producers as to the railways or waterways over which the product was shipped and not from the transportation companies, some difference might be found in the tables presented in this report and those compiled by the railroad companies, but it is believed that such difference would not be material. All the shipments over any particular railroad system are grouped together. For instance, the Pennsylvania Railroad 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 Railway.

Almost 50 per cent of the total railroad shipments is taken by the five transportation systems penetrating the Appalachian coal field. These are the Pennsylvania, the Baltimore & Ohio, the New York Central, the Chesapeake & Ohio, and the Norfolk & Western, although the first three also received a considerable tonnage (nearly 17,000,000 tons in the aggregate in 1914) from the central coal field. All shipments of the Chesapeake & Ohio and Norfolk & Western railroads are from the Appalachian region. In 1914 over 18 per cent of the total shipments by railroad originated on the Pennsylvania system, and chiefly from the mines in Pennsylvania. The total quantity of coal reported as shipped over the Pennsylvania Railroad in 1914 was 67,534,352 short tons, out of a total of rail shipments of 364,294,862 tons. In 1913 the total shipments originating on the Pennsylvania Railroad were 79,005,844 short tons. The Baltimore & Ohio system is the second coal-carrying route in importance, with total original shipments in 1914 amounting to 33,060,946 short tons, about 700,000 tons less than half the shipments over the Pennsylvania system. West Virginia is the most important State contributing to the Baltimore & Ohio tonnage, the shipments from West Virginia mines over that system in 1914 amounting to 15,485,770 short tons; shipments from Pennsylvania mines were approximately 11,000,000 tons, and from Ohio mines a little over 3,600,000 tons. The New York Central system, third in importance as a coal carrier, originated shipments, amounting to 28,009,024 short tons, of which considerably more than one-half, or 15,045,519 tons, were from Pennsylvania mines, 7,700,000 tons from Illinois mines, and 3,400,000 tons from Ohio mines. The Chesapeake & Ohio and the Norfolk & Western—fourth and fifth, respectively, in importance as coal carriers—received about 80 per cent of their tonnage from the coal fields in the southern part of West Virginia. The Chesapeake & Ohio carried approximately 23,800,000 tons in 1914, of which over 19,000,000 tons were from the West Virginia mines; and the Norfolk & Western system transported a little over 23,000,000 tons, of which 18,600,000 were from West Virginia territory. The Louisville & Nashville Railroad, whose originating shipments in 1914 amounted to 14,000,000 tons, of which over 8,000,000 tons were from Kentucky mines and more than 3,600,000 tons from Alabama mines, ranked sixth among the coal-carrying roads. The Illinois Central system originated approximately 13,500,000 tons, 70 per cent of which was from Illinois mines and the remainder mainly from Kentucky. The Burlington Route handled 11,700,000 tons, of which 8,100,000 tons were from Illinois mines; the Chicago & Eastern Illinois handled 9,600,000 tons, of which 5,280,000 tons were from Illinois mines and 4,300,000 from Indiana mines. The Southern Railway received 9,293,000 tons of coal, chiefly from Alabama and Tennessee mines. Other systems carrying coal in excess of 5,000,000 tons, during 1914, were the Buffalo, Rochester & Pittsburgh, the Frisco lines, the Missouri Pacific, and the Union Pacific-Southern Pacific.

Shipments of bituminous coal in the United States, by railroads and waterways, in 1913.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Pennsylvania Railroad system	Pennsylvania	63,000,671	79,005,844
	Ohio	9,405,673	
	Indiana	4,614,203	
	Illinois	1,248,735	
	West Virginia	714,316	
	Maryland	22,246	
Baltimore & Ohio system	West Virginia	14,480,260	37,234,678
	Pennsylvania	10,964,609	
	Ohio	9,108,399	
	Illinois	1,416,393	
	Kentucky	857,093	
	Maryland	224,749	
	Indiana	183,175	
New York Central lines	Pennsylvania	19,663,538	35,666,594
	Illinois	8,054,996	
	Ohio	5,920,608	
	Indiana	1,371,830	
	Michigan	655,622	
Norfolk & Western	West Virginia	19,897,245	23,929,001
	Virginia	2,526,629	
	Kentucky	1,505,127	
Chesapeake & Ohio lines	West Virginia	16,261,479	22,101,495
	Ohio	3,980,034	
	Kentucky	1,859,982	
Louisville & Nashville	Kentucky	8,003,626	14,596,873
	Alabama	4,165,452	
	Tennessee	1,533,175	
	Illinois	608,722	
	Virginia	244,597	
	Indiana	41,301	
Illinois Central	Illinois	9,369,083	13,928,062
	Kentucky	3,857,623	
	Indiana	591,310	
	Alabama	110,046	
Burlington	Illinois	8,513,768	12,693,706
	Wyoming	1,757,640	
	Iowa	1,268,384	
	Missouri	802,702	
	Colorado	346,361	
	Kansas	4,851	
Chicago & Eastern Illinois	Illinois	6,419,637	11,247,352
	Indiana	4,827,715	
Southern	Alabama	4,464,297	10,387,624
	Tennessee	2,284,261	
	Virginia	1,259,651	
	Illinois	1,113,299	
	Indiana	943,505	
	Kentucky	322,611	
Buffalo, Rochester & Pittsburgh	Pennsylvania	8,662,836	8,662,836
Wheeling & Lake Erie	Ohio	4,199,972	7,402,798
	Pennsylvania	3,202,826	
Frisco lines	Kansas	2,442,819	5,856,856
	Alabama	2,037,729	
	Arkansas	736,330	
	Oklahoma	377,248	
	Missouri	262,230	
	Colorado	500	
Union Pacific-Southern Pacific lines	Wyoming	5,073,417	6,003,187
	Colorado	320,803	
	Texas	294,985	
	Washington	165,321	
	Utah	91,447	
	Oregon	23,821	
	Kansas	15,982	
	California	14,864	
	Missouri	2,547	
Missouri Pacific	Illinois	2,775,998	5,574,884
	Kansas	1,182,705	
	Missouri	913,260	
	Arkansas	702,335	
	Colorado	586	
Santa Fe	New Mexico	1,638,802	4,627,137
	Kansas	1,452,546	
	Colorado	693,772	
	Illinois	437,009	
	Missouri	368,138	
	Oklahoma	36,870	
Denver & Rio Grande	Utah	2,435,663	4,348,095
	Colorado	1,905,772	
	New Mexico	6,660	
Western Maryland	West Virginia	2,839,356	3,914,683
	Maryland	1,053,002	
	Pennsylvania	22,325	

Shipments of bituminous coal in the United States, by railroads and waterways, in 1913—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Rock Island lines	Iowa	1,410,235	3,896,778
	Oklahoma	1,197,226	
	Illinois	666,829	
	Arkansas	296,826	
	Missouri	185,281	
	Colorado	73,931	
	Texas	61,599	
	Kansas	4,851	
Chicago, Milwaukee & St. Paul	Illinois	1,551,666	3,890,030
	Iowa	1,334,907	
	Montana	928,295	
	Washington	72,710	
	North Dakota	2,452	
Northern Pacific	Washington	2,421,608	3,770,614
	Montana	1,194,245	
	North Dakota	154,761	
Wabash	Illinois	3,255,260	3,708,541
	Missouri	308,081	
	Iowa	126,000	
	Ohio	19,200	
Virginian	West Virginia	3,626,016	3,626,016
Cumberland & Pennsylvania	Maryland	3,366,521	3,366,521
Kanawha & Michigan	West Virginia	3,106,949	3,274,927
	Ohio	167,978	
Bessemer & Lake Erie	Pennsylvania	3,228,287	3,228,287
Missouri, Kansas & Texas	Oklahoma	1,398,868	2,865,353
	Kansas	997,467	
	Texas	314,384	
	Missouri	154,634	
Pittsburg, Shawmut & Northern	Pennsylvania	2,837,196	2,837,196
Colorado & Southern Railway lines	Colorado	2,612,040	2,668,340
	Texas	56,300	
Chicago & North Western line	Iowa	1,402,509	2,692,555
	Illinois	1,151,037	
	Wyoming	139,009	
Chicago & Alton	Illinois	2,554,444	2,663,875
	Missouri	109,431	
Chicago, Terre Haute & Southeastern	Indiana	2,492,248	2,492,248
Birmingham Southern	Alabama	2,185,750	2,185,750
Buffalo & Susquehanna	Pennsylvania	1,785,088	1,785,088
Carolina, Clinchfield & Ohio	Virginia	1,609,429	1,609,429
Erie	Pennsylvania	1,495,400	1,565,547
	Ohio	70,147	
Nashville, Chattanooga & St. Louis	Tennessee	1,289,906	1,302,406
	Alabama	12,500	
Mobile & Ohio	Illinois	838,414	1,295,795
	Alabama	457,381	
Minneapolis & St. Louis	Iowa	629,000	1,131,949
	Illinois	502,949	
Texas & Pacific	Texas	1,023,633	1,023,633
Great Northern Railway lines	Montana	898,508	959,828
	North Dakota	42,424	
	Washington	18,896	
Interstate	Virginia	933,290	933,290
Queen & Crescent	Tennessee	733,343	929,757
	Kentucky	104,836	
	Alabama	91,578	
Kansas City Southern	Kansas	785,691	902,235
	Missouri	70,905	
	Oklahoma	45,639	
Central of Georgia	Alabama	771,111	893,610
	Georgia	122,499	
Huntingdon & Broad Top Mountain	Pennsylvania	877,822	877,822
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	852,452	852,452
Monon	Indiana	839,282	839,282
Toledo, St. Louis & Western	Illinois	736,775	791,775
	Indiana	55,000	
St. Louis & O'Fallon	Illinois	790,563	790,563
Litchfield & Madison	Illinois	785,517	785,517
Coal & Coke	West Virginia	776,898	776,898
St. Louis, Troy & Eastern	Illinois	773,493	773,493
Columbia & Puget Sound	Washington	744,002	744,002
El Paso & Southwestern	New Mexico	724,754	724,754
Chicago & Illinois Midland	Illinois	669,557	669,557
Kanawha, Glen Jean & Eastern	West Virginia	641,876	641,876
Cambria & Indiana	Pennsylvania	641,456	641,456
Ligonier Valley	Pennsylvania	622,084	622,084
Morgantown & Kingwood	West Virginia	551,413	551,413
East St. Louis & Suburban	Illinois	541,477	541,477
Missouri & Louisiana	Missouri	523,571	523,571

Shipments of bituminous coal in the United States, by railroads and waterways, in 1913—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Chicago, Peoria & St. Louis Railway of Illinois	Illinois	522,556	522,556
Kentucky & Tennessee	Kentucky	512,088	512,088
Chicago Great Western	Iowa	455,733	470,771
	Missouri	10,187	
	Kansas	4,851	
Missouri, Oklahoma & Gulf	Oklahoma	432,175	432,175
Elgin, Joliet & Eastern	Illinois	431,890	431,890
Pere Marquette	Michigan	410,835	410,835
Midland Valley	Arkansas	300,560	390,984
	Oklahoma	90,424	
Peoria & Pekin Union	Illinois	387,812	387,812
International & Great Northern	Texas	368,112	368,112
Denver & Salt Lake	Colorado	315,235	315,235
East Broad Top Railroad & Coal Co	Pennsylvania	313,471	313,471
St. Louis, Rocky Mountain & Pacific	New Mexico	309,065	309,065
Illinois Traction system	Illinois	290,089	290,089
Union	Pennsylvania	284,447	284,447
St. Louis & Belleville Electric	Illinois	273,298	273,298
Colorado Midland	Colorado	273,279	273,279
Buffalo Creek & Gauley	West Virginia	271,916	271,916
Detroit, Toledo & Ironton	Ohio	269,325	269,325
Monongahela	Pennsylvania	251,288	251,288
Toledo, Peoria & Western	Illinois	234,315	234,315
Tennessee Central	Tennessee	233,536	233,536
Colorado & Wyoming	Colorado	211,666	211,666
Oklahoma Central	Oklahoma	205,719	205,719
Atlanta, Birmingham & Atlantic	Alabama	205,373	205,373
Cumberland	Kentucky	195,452	195,452
Marietta, Columbia & Cleveland	Ohio	193,700	193,700
Peoria Railway Terminal	Illinois	162,220	162,220
Kanawha & West Virginia	West Virginia	158,598	158,598
Pittsburgh & Susquehanna	Pennsylvania	156,851	156,851
Illinois Southern	Illinois	146,374	146,374
Denver and Intermountain	Colorado	142,953	142,953
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	136,603	136,603
West Virginia Northern	West Virginia	115,558	115,558
Evansville, Suburban & Newburgh	Indiana	108,296	108,296
Rio Grande Southern	Colorado	95,200	95,200
Seaboard Air Line	Alabama	90,468	90,468
St. Louis Southwestern	Texas	89,373	89,373
Fort Dodge, Des Moines & Southern	Iowa	87,438	87,438
Louisville, Henderson & St. Louis	Kentucky	82,476	82,476
Ashland Coal & Iron Co	Kentucky	81,704	81,704
Puget Sound Electric	Washington	78,036	78,036
Colorado & Southeastern	Colorado	77,308	77,308
St. Louis, Iron Mountain & Southern	Arkansas	76,689	76,689
Wichita Falls & Southern	Texas	76,223	76,223
Laramie, Hahn's Peak & Pacific	Colorado	61,355	61,355
San Antonio & Aransas Pass	Texas	41,985	41,985
Central Indiana	Indiana	31,644	31,644
Grand Trunk	Michigan	15,792	15,792
San Antonio, Uvalde & Gulf	Texas	14,984	14,984
Miscellaneous	Alabama	1,158,484	1,158,484
	Pennsylvania		
	Kentucky		
	Illinois		
	Ohio		
	Oklahoma		
	West Virginia		
	Virginia		
	Michigan		
	Missouri		
	Iowa		
	Washington		
	Kansas		
	Arkansas		
	Texas		
	Alaska		
	South Dakota		
	Nevada		
Total railroad shipments		392,374,304	392,374,304

Shipments of bituminous coal in the United States, by railroads and waterways, in 1913—Continued.

Waterway.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Monongahela River	Pennsylvania	8,528,547	8,592,418
	West Virginia	63,871	
Kanawha River	West Virginia	1,018,019	1,018,019
Ohio River	Kentucky	398,155	803,773
	West Virginia	151,323	
	Pennsylvania	133,081	
	Ohio	96,012	
	Indiana	25,202	
Allegheny River	Pennsylvania	133,081	133,081
Kentucky River	West Virginia	50,291	50,291
Warrior River	Alabama	47,729	47,729
Illinois River	Illinois	27,791	27,791
Various waterways	Kentucky, Oregon, Washington	17,732	17,732
Total waterway shipments		10,690,834	10,690,834
Grand total		403,065,138	403,065,138

Shipments of bituminous coal in the United States, by railroads and waterways, in 1914.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Pennsylvania Railroad system	Pennsylvania	56,708,880	67,534,352
	Ohio	4,487,484	
	Indiana	4,431,774	
	Illinois	959,517	
	West Virginia	936,547	
	Maryland	10,150	
Baltimore & Ohio system	West Virginia	15,485,770	33,060,946
	Pennsylvania	11,055,301	
	Ohio	3,698,830	
	Illinois	1,538,915	
	Kentucky	959,427	
	Indiana	173,868	
	Maryland	148,835	
New York Central lines	Pennsylvania	15,045,519	28,009,024
	Illinois	7,769,542	
	Ohio	3,419,670	
	Indiana	1,052,156	
	Michigan	722,137	
Chesapeake & Ohio lines	West Virginia	19,186,692	23,796,492
	Ohio	2,608,513	
	Kentucky	2,001,287	
Norfolk & Western	West Virginia	18,617,292	23,211,907
	Virginia	2,590,295	
	Kentucky	2,004,320	
Louisville & Nashville	Kentucky	8,335,221	14,027,041
	Alabama	3,645,763	
	Tennessee	1,340,140	
	Illinois	459,369	
	Virginia	196,154	
	Indiana	50,394	
Illinois Central	Illinois	9,507,298	13,592,304
	Kentucky	3,520,975	
	Indiana	471,904	
	Alabama	92,127	
Burlington	Illinois	8,108,882	11,707,000
	Wyoming	1,563,169	
	Iowa	1,196,630	
	Missouri	489,687	
	Colorado	348,632	
Chicago & Eastern Illinois	Illinois	5,280,522	9,612,368
	Indiana	4,331,846	
Southern	Alabama	3,530,842	9,293,093
	Tennessee	2,215,219	
	Virginia	1,338,257	
	Illinois	891,092	
	Indiana	800,858	
	Kentucky	513,825	
Buffalo, Rochester & Pittsburgh	Pennsylvania	7,232,974	7,232,974
Frisco lines	Kansas	2,210,711	5,427,508
	Alabama	1,819,845	
	Arkansas	635,740	
	Oklahoma	509,439	
	Missouri	251,773	

Shipments of bituminous coal in the United States, by railroads and waterways, in 1914—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Missouri Pacific	Illinois	2,779,005	5,378,809
	Kansas	1,160,369	
	Missouri	931,889	
	Arkansas	507,546	
Union Pacific-Southern Pacific lines	Wyoming	4,295,715	5,131,403
	Colorado	411,620	
	Texas	149,845	
	Utah	119,618	
	Washington	115,166	
	Oregon	32,022	
	California	4,200	
	Missouri	3,217	
Wheeling & Lake Erie	Pennsylvania	2,876,629	4,216,456
	Ohio	1,290,462	
	West Virginia	49,365	
Santa Fe	New Mexico	1,666,922	4,132,106
	Kansas	1,375,688	
	Illinois	372,036	
	Missouri	353,825	
	Colorado	222,572	
	Oklahoma	141,063	
Denver & Rio Grande	Utah	2,216,069	4,027,907
	Colorado	1,807,838	
	New Mexico	4,000	
Western Maryland	West Virginia	2,708,731	3,647,639
	Maryland	869,516	
	Pennsylvania	69,392	
Rock Island lines	Iowa	1,700,513	3,637,306
	Oklahoma	1,193,737	
	Arkansas	259,876	
	Illinois	192,911	
	Missouri	188,541	
	Texas	73,295	
	Colorado	28,433	
Virginian	West Virginia	3,597,232	3,597,532
	Virginia	300	
Chicago, Milwaukee & St. Paul	Illinois	1,425,463	3,512,103
	Iowa	1,232,104	
	Montana	815,035	
	Washington	34,080	
	North Dakota	5,421	
Chicago, Terre Haute & Southeastern	Indiana	3,201,851	3,201,851
Wabash	Illinois	2,739,131	3,049,925
	Missouri	247,683	
	Iowa	57,111	
	Ohio	6,000	
Cumberland & Pennsylvania	Maryland	2,991,121	2,991,121
Northern Pacific	Washington	1,942,213	2,910,677
	Montana	815,914	
	North Dakota	123,376	
	Wyoming	29,174	
Bessemer & Lake Erie	Pennsylvania	2,850,765	2,850,765
Kanawha & Michigan	West Virginia	2,659,601	2,869,340
	Ohio	209,739	
Chicago & North Western line	Iowa	1,430,365	2,632,482
	Illinois	1,034,545	
	Wyoming	167,572	
Missouri, Kansas & Texas	Oklahoma	1,081,114	2,456,420
	Kansas	904,130	
	Texas	373,239	
	Missouri	97,937	
Pittsburgh, Shawmut & Northern	Pennsylvania	2,408,659	2,408,659
Birmingham Southern	Alabama	2,404,263	2,404,263
Chicago & Alton	Illinois	2,194,421	2,369,310
	Missouri	174,889	
Colorado & Southern Railway lines	Colorado	1,849,452	1,919,508
	Texas	70,056	
Montour	Pennsylvania	1,700,562	1,700,562
Erie	Pennsylvania	1,470,873	1,526,141
	Ohio	55,268	
Carolina, Clinchfield & Ohio	Virginia	1,267,083	1,267,083
Mobile & Ohio	Illinois	899,965	1,211,058
	Alabama	311,093	
Buffalo & Susquehanna	Pennsylvania	1,189,810	1,189,810
Minneapolis & St. Louis	Illinois	635,706	1,103,994
	Iowa	468,288	

Shipments of bituminous coal in the United States, by railroads and waterways, in 1914—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Kansas City Southern	Kansas	891,619	1,066,064
	Oklahoma	88,958	
	Missouri	79,593	
	Arkansas	5,894	
Queen & Crescent	Tennessee	631,963	1,043,854
	Kentucky	329,672	
	Alabama	82,219	
Nashville, Chattanooga & St. Louis	Tennessee	1,000,973	1,018,473
	Alabama	17,500	
Interstate	Virginia	1,004,195	1,004,195
St. Louis, Troy & Eastern	Illinois	998,992	998,992
Coal & Coke	West Virginia	934,565	934,565
Chicago & Illinois Midland	Illinois	918,313	918,313
Texas & Pacific	Texas	868,431	868,431
Litchfield & Madison	Illinois	856,886	856,886
Monon	Indiana	761,265	761,265
Ligonier Valley	Pennsylvania	754,750	754,750
Central of Georgia	Alabama	661,251	746,896
	Georgia	85,645	
Great Northern Railway lines	Montana	685,373	736,349
	North Dakota	49,038	
	Washington	1,938	
Huntingdon & Broad Top Mountain	Pennsylvania	697,298	697,298
Toledo, St. Louis & Western	Illinois	653,956	690,847
	Indiana	36,891	
Morgantown & Kingwood	West Virginia	654,659	654,659
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	642,024	642,024
Denver & Salt Lake	Colorado	636,650	636,650
Chicago, Peoria & St. Louis	Illinois	521,251	521,251
Columbia & Puget Sound	Washington	501,940	501,940
Bevier & Southern	Missouri	497,968	497,968
Chicago Great Western	Iowa	467,348	480,215
	Missouri	12,867	
Kanawha, Glen Jean & Eastern	West Virginia	469,106	469,106
Colorado & Southeastern	Colorado	444,795	444,795
Missouri, Oklahoma & Gulf	Oklahoma	429,698	429,698
International & Great Northern	Texas	388,778	388,778
Elgin, Joliet & Eastern	Illinois	374,744	374,744
Pere Marquette	Michigan	371,216	371,216
Midland Valley	Arkansas	249,666	337,599
	Oklahoma	87,933	
Lake Erie, Franklin & Clarion	Pennsylvania	332,533	332,533
Illinois Traction System	Illinois	322,234	322,234
Cumberland	Kentucky	312,832	312,832
Monongahela	Pennsylvania	307,681	307,681
East Broad Top Railroad & Coal Co	Pennsylvania	298,538	298,538
Peoria & Pekin Union	Illinois	293,209	293,209
Montana, Wyoming & Southern	Montana	284,365	284,365
Colorado Midland	Colorado	270,477	270,477
Rock Island Southern	Illinois	263,879	263,879
Tennessee Central	Tennessee	261,779	261,779
Detroit, Toledo & Ironton	Ohio	259,947	259,947
Kentucky & Tennessee	Kentucky	248,704	248,704
East St. Louis & Suburban	Illinois	235,738	235,738
Peoria Railway Terminal	Illinois	198,558	198,558
Toledo, Peoria & Western	Illinois	190,685	190,685
St. Louis & Belleville Electric	Illinois	169,537	169,537
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	168,275	168,275
Illinois Southern	Illinois	160,853	160,853
Kanawha & West Virginia	West Virginia	150,929	150,929
Atlanta, Birmingham & Atlantic	Alabama	146,396	146,396
Marietta, Columbus & Cleveland	Ohio	136,101	136,101
Rio Grande & Eagle Pass	Texas	113,914	113,914
Colorado & Wyoming	Colorado	112,020	112,020
Rio Grande Southern	Colorado	97,877	97,877
Oklahoma Central	Oklahoma	96,505	96,505
Evansville, Suburban & Newburgh	Indiana	90,617	90,617
Pittsburgh & Susquehanna	Pennsylvania	78,613	78,613
St. Louis Southwestern of Texas	Texas	78,197	78,197
Ashland Coal & Iron Co	Kentucky	75,735	75,735
Puget Sound Electric	Washington	70,822	70,822
Fort Dodge, Des Moines & Southern	Iowa	68,737	68,737
Quincy, Omaha & Kansas City	Missouri	68,191	68,191
Seaboard Air Line	Alabama	64,881	64,881
West Virginia Northern	West Virginia	56,796	56,796

Shipments of bituminous coal in the United States, by railroads and waterways, in 1914—Continued.

Railroad.	State.	Quantity.	Total.
		Short tons.	*Short tons.*
Miscellaneous	Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, New Mexico, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Utah, Virginia, Washington, West Virginia, Wyoming	6,072,295	6,072,295
Total railroad shipments		355,855,510	355,855,510
Monongahela River	Pennsylvania	6,593,057	6,661,085
	West Virginia	68,028	
Ohio River	Kentucky	389,969	904,048
	West Virginia	313,736	
	Pennsylvania	130,361	
	Ohio	43,580	
	Indiana	26,402	
Kanawha River	West Virginia	665,917	665,917
Allegheny River	Pennsylvania	130,361	130,361
Warrior River	Alabama	54,487	54,487
Illinois River	Illinois	23,454	23,454
Total waterway shipments		8,439,352	8,439,352
Grand total		364,294,862	364,294,862

EXPORTS AND IMPORTS.

The European war, which for the time being has eliminated Germany as an exporter of coal, was expected so to restrict Great Britain's coal exports that the United States would be able to capture a large number of the foreign markets and build up a permanent export trade in coal. Beginning in August, when war was declared, exports of coal from the Atlantic seaboard increased, but not to the extent anticipated, for the reason that up to the end of 1914 England had not found it necessary to restrict the export of coal and for the further reason that a large number of the foreign coal users were temporarily out of the market. Shipments to South America and other countries increased about 40 per cent in 1914, but the exports to Canada, which country normally is the largest user of United States coal and takes from 70 to 80 per cent of our exports, fell off 30 per cent. The result was that the total exports of anthracite and bituminous coal from the United States decreased from 22,141,143 long tons in 1913 to 17,632,094 tons in 1914.

Imports of both anthracite and bituminous coal are unimportant. The imports, however, of Canadian anthracite received in the Northwest increased from 896 long tons in 1913 to 15,800 tons in 1914. The imports of bituminous coal and shale amounted to 1,380,204 long tons, valued at $3,902,881.

The following tables have been compiled from the official returns to the Bureau of Foreign and Domestic Commerce of the Department of Commerce and show the exports and imports of coal from 1909 to 1914, 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:

Coal of domestic production exported from the United States, 1909–1914, in long tons.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
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
1913	4,154,386	21,959,850	17,986,757	45,449,664
1914	3,830,244	20,211,072	13,801,850	34,104,903

Coal imported and entered for consumption in the United States, 1909–1914, in long tons.

Year.	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
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
1913	896	5,620	[a] 1,412,997	3,853,930
1914	15,800	25,380	[a] 1,380,204	3,902,881

[a] Includes 455,587 long tons of slack or culm (value, $901,051) passing ½-inch screen in 1912; 352,007 tons (value, $689,864) in 1913; and 164,672 tons (value, $303,348) in 1914.

WORLD'S PRODUCTION OF COAL.

The writer is indebted for the figures covering the production of coal in foreign countries, as shown in the following table, to Mr. Wm. G. Gray, statistician of the American Iron and Steel Institute, and Prof. G. A. Roush, editor of "Mineral Industry." For the sake of convenience and for purposes of comparison the quantities are reduced to the short ton of 2,000 pounds. The total world's production in 1911 was approximately 1,310,000,000 short tons, in 1912 approximately 1,377,000,000 tons, in 1913 approximately 1,478,000,000 tons, and it is estimated that in 1914 the total decreased to about 1,346,000,000 short tons. The United States in 1914 contributed 38 per cent, Great Britain 22 per cent, and Germany 20 per cent. In 1914 the United States decreased its production approximately by 56,000,000 tons, or 12 per cent, Great Britain by 24,000,000 tons, or 7 per cent, and Germany by 35,000,000 tons, or 11 per cent. Great Britain exceeded Germany in production in 1914 by 27,000,000 tons.

The world's production of coal, in short tons.

Country.	1911	1912	1913	1914
United States	496,371,126	534,466,580	569,960,219	513,525,477
Great Britain	304,518,927	291,666,299	321,922,130	297,698,617
Germany	258,223,763	281,979,467	305,714,664	270,594,952
Austria-Hungary	54,960,298	56,954,579	59,647,957	
France	43,242,778	45,534,448	45,108,544	
Russia	29,361,764	33,775,754	35,500,674	
Belgium	25,411,917	25,322,851	25,196,869	
Japan	19,436,536	21,648,902	23,988,292	21,700,572
India	13,494,573	16,471,100	18,163,856	
China	16,534,500	16,534,500	a15,432,200	
Canada	11,323,388	14,512,829	15,115,089	13,597,982
New South Wales	9,374,596	10,897,134	11,663,865	11,644,476
Transvaal	4,343,680	b8,119,288	5,225,036	
Spain	4,316,245	4,559,453	4,731,647	
Natal	2,679,551	(b)	2,898,726	
New Zealand	2,315,390	2,438,929	2,115,834	
Holland	1,628,097	1,901,902	2,064,608	
Chile	1,277,191	1,470,917	1,362,334	
Queensland	998,556	1,010,426	1,162,497	1,180,825
Mexico	a1,400,000	982,396		
Bosnia and Herzegovina	848,510	940,174	927,244	
Turkey	799,168	909,293		
Italy	614,132	731,720	772,802	
Victoria	732,328	664,334	668,524	
Orange Free State (Orange River Colony)	482,690		609,973	
Dutch East Indies	a600,000	622,669	453,136	
Indo-China	a460,000	471,259		
Servia	335,495	335,000		
Sweden	343,707	397,149	401,199	
Western Australia	a300,000	330,488	351,687	
Peru	a300,000	307,461	301,970	
Formosa	280,999	306,941		
Bulgaria	270,410	324,511		
Rhodesia	212,529	216,140	237,728	
Roumania	266,784			
Cape Colony (Cape of Good Hope)	89,023	(b)	67,481	
Korea	138,508			
Tasmania	a70,000	59,987	61,648	68,130
British Borneo	a100,000		49,762	
Spitzbergen	44,092			
Brazil	16,535			
Portugal	a10,000	16,938	27,653	
Venezuela	a10,000	a12,000	13,355	
Switzerland	8,267			
Philippine Islands	a2,000	2,998		
Unspecified	a1,016,947			
Total	1,309,565,000	c1,377,000,000	c1,478,000,000	c1,346,000,000

a Estimated. b Transvaal includes Natal and Cape of Good Hope. c Approximate.

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 report. 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 these conditions have had upon production. Acknowledgment of the service 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.]

GENERAL CONDITIONS.

The coal trade of New York City and the surrounding district in 1914 was not eventful and not especially encouraging to operators. It reflected the general course of business and, perhaps, showed once more that no great improvement in returns to sellers can be expected so long as there is a constant tendency to put supplies on the market without much question as to the real demand. All things considered, although 1914 was a disappointment to those operators who looked for an improvement over 1913 the trade very nearly held its own in spite of some adverse conditions.

Mild winter weather late in the year kept down consumption of anthracite for domestic use, and consumption of the steam sizes of anthracite and of bituminous coal was reduced by manufacturing inactivity. Of course there is a great consumption by the public utilities of various sorts, which does not vary greatly but tends to grow with the growth of the population from year to year. This natural increase allowed for, it is believed that there was no great change from 1913 in the quantity of coal marketed in the New York district in 1914. Whatever change there may have been was in the nature of a decrease. On these premises, it is estimated that about 22,000,000 long tons of coal reached New York Harbor in 1914, of which 13,500,000 tons were anthracite and 8,500,000 tons were bituminous coal.

Approximately 11,500,000 tons of anthracite were consumed in the district and 2,000,000 tons were shipped over the docks to New England points. Local consumption accounted for about 4,000,000 tons of bituminous coal and about 4,000,000 tons more were taken by the bunker trade. This bunker trade was very good up to July, but was severely curtailed by the war conditions in the later months of the year.

There were no material changes in the general system of supply and distribution, which have been described in previous reviews. The year, perhaps, has helped along the tendency to concentrate the retail or distributing trade in the hands of large concerns, which are able to command appliances for delivery on a large scale.

ANTHRACITE TRADE.

The anthracite market in New York is to a certain extent dependent upon weather conditions, and the year 1913 closed with the trade in rather depressed condition, owing to the unseasonable mildness of November and December. January, 1914, however, was a real winter month, and February and March were marked by extremely cold and stormy weather, which restored the balance of the winter and brought up the demand for the prepared and household sizes. Late in March trade began to fall off, but prices were well maintained at the schedule until the time for the spring discounts arrived on April 1. The winter schedule for the wholesale trade was, f. o. b. New York harbor ports: $5.10 a long ton for broken; $5.35 for egg and stove; $5.60 for chestnut; $4.05 for pea; $3.30 for buckwheat; $2.80 for rice; and $1.30 for barley. Pea coal, which has come to be regarded practically as one of the prepared sizes, was generally firm, but the three smaller sizes were somewhat variable, as offerings were made of independent and washery coal at 10 or 20 cents lower than the prices quoted.

During the first quarter there was some delay in deliveries owing to the weather, but supplies of prepared sizes were generally sufficient and at no time were premiums paid on any considerable quantity.

In February there was some shortage on steam sizes, and the stocks of the large companies were drawn down to a very low point. This did not last long, and by the end of March business was on a steady basis.

The spring discounts were announced as usual on April 1, prices being then as follows at the upper ports: Broken, \$4.60; egg and stove, \$4.85; chestnut, \$5.10; pea, \$3.55; buckwheat, \$2.80; rice, \$2.30; barley, \$1.80. Thereafter the discount was diminished—or prices advanced—10 cents each month until the winter schedule was reached on September 1. That schedule is the same which has prevailed for several years, with the addition of 10 cents a ton to meet the tax imposed by the State of Pennsylvania on all anthracite coal mined. This tax the operators promptly shifted to the consumers.

The trade continued steady through the summer and into the fall, with few variations from the circular prices. There was at times an unusual demand for stove coal in the prepared sizes, and at times small lots of coal were sold at 5 or 10 cents premium; later this changed to 5 or 10 cents discount when the special demand fell off. The object of the companies in putting 25 cents advance on nut coal two years ago seems to have been attained and the extra demand has been shifted from nut to stove size. Egg coal was in small demand for most of the year and was sold at times 25 to 40 cents below the schedule. The light demand is doubtless due to the increased use of pea coal for household purposes, the consumption of that size being made possible by the greater use of steam and hot-water heaters in place of the hot-air furnaces in which large coal is usually consumed. The year came to a close without special event. November and December passed with little severe cold, and the prospects as the year closed were for a mild winter.

BITUMINOUS COAL MARKET.

The New York market for bituminous coal followed general conditions and can hardly be said to have presented any special feature. The business improvement which was manifest to some extent in the closing months of 1913 did not continue. The year 1914 opened with general depression, January and February being months of dull trade. March was more active, owing to some apprehension of trouble over the wage scales, which led consumers to stock up rather freely. The early renewal of the old scales of wages in most of the districts from which New York draws its coal brought this improvement to an end in a short time. In May and June some improvement in business was manifest, but just as coal operators were beginning to be hopeful, the war in Europe broke out, the immediate result being the general disturbance of credit, from which the recovery was slow. The demand for bituminous coal for manufacturing plants decreased; at the same time the bunkering trade was decreased, when the sailings of the steamers of the German lines were abruptly stopped. There was, after a short time, an increase in the bunker sales to freight lines and tramp steamers, but for some time this did not by any means fully offset the loss from the regular liners.

The revival of trade after the first shock was slow, and it was not until October or November that the bituminous market began to assume anything like its usual dimensions. The depression in the iron and steel trades left free an unusual supply of bituminous for the seaboard, and there was at all times enough coal coming forward to prevent the usual fall and winter advances in price. On the whole, the year 1914 was not favorable for the bituminous trade, which depends largely upon manufacturing conditions for its prosperity.

There was less variation in prices through the year than might have been expected from the general condition. Occasionally, of course, there were offerings of demurrage coal and of off-grade coals at low prices, but for the greater part of the year sales were made of good grade Miller vein Clearfield at from $2.50 to $2.60 a ton, New York harbor ports, and this was about the contract price for the year. Cumberland coal brought a higher price, but that class of coal has its own special market and is chiefly a contract coal. West Virginia coal was not much in evidence at any time through the year. The demand for gas coal and gas slack, which at times was a feature in 1913, was not apparent in 1914 and the call was chiefly for good grade steam and low volatile coals. During a considerable part of the year high volatile or gas coals were hard to market at any price. Some sales were made as low as 80 to 90 cents a ton at mines for run-of-mine or slack.

The demand for bituminous coal, though subject to occasional drawbacks, as in 1914, is, on the whole, steadily increasing in the New York district. The gain is not wholly in the large manufacturing plants and public utility plants which, with improved methods of firing and combustion, are replacing anthracite by bituminous; the larger business buildings and apartment houses also are every year using an increased proportion of bituminous coal mixed with the smaller sizes of anthracite. With proper appliances and methods, this can be done without violating the city smoke ordinances and with a considerable gain in economy. On the whole, the year closed with improving prospects.

COASTWISE TRADE.

The coastwise trade is never so prominent a feature in the New York market as in Philadelphia, Baltimore, or Hampton Roads. A considerable quantity of coal is forwarded from New York Harbor docks to points on Long Island Sound and east of Cape Cod. Each year an increasing part of this coal, especially the anthracite, is handled by the barges owned by the railroad companies. In fact, the barge rates have come to be the controlling factor in the trade. The Philadelphia & Reading Coal Co. opened the year with the barge rates from Philadelphia to eastern ports on the basis of 90 cents a ton; but in March this was cut to 80 cents and in July to 75 cents. For the greater part of the year the rate from New York Harbor was 30 to 35 cents to the Sound ports, 35 to 40 cents to Providence, and 40 to 45 cents to other ports. In November these rates were increased by about 10 cents a ton.

The high rates reached on ocean traffic did not much affect this trade, as the vessels engaged in it are not as a rule adapted to over-sea work. Some of the larger schooners were taken off in the fall to carry deep-sea cargoes, but the barges and smaller schooners stayed in the coal trade, and the supply of vessels was sufficient.

Much discussion was caused when, in October, the New York, New Haven & Hartford Co. placed a contract for 200,000 tons with Boston interests representing the Dominion Coal Co. The Boston & Maine Railroad followed suit with a contract for 75,000 tons. These contracts have heretofore gone to Pennsylvania coal interests, and the trade did not relish their transfer to Nova Scotia coal.

PHILADELPHIA, PA.

[From FREDERICK E. SAWARD's annual volume, The Coal Trade.]

The anthracite market.—The anthracite market had a prosperous year during 1914, while the conditions in the bituminous market were just the reverse. Anthracite was favored with good coal-burning weather at the proper periods, and the widespread business depression did not have an effect on the trade so serious as on the bituminous trade. The latter being dependent on general business conditions, went to low ebb early in the year and failed to recover at any time to its close.

For anthracite the year opened with moderately mild weather, interspersed from time to time with colder blasts during January, and then came the real winter weather in February and March that sent prices to circular and beyond. An unusually late spring, with long-continued cold weather, made frequent replenishment necessary. Coal-burning weather continued even into April, so that many of the stocks laid in by the consumer under the April reduction had to be drawn on to tide over immediate needs. This proved a double blessing to the anthracite trade, as the loss on account of the business depression was more than overbalanced by the extra demand for coal required to meet the unusual weather conditions in the spring. During the summer months business went along on an even keel. After the breaking out of the European war came a scare over a shortage of labor because of the possibility of aliens returning home, which fear caused a rush of orders to fill bins for the winter. In addition persistent rumors were current that retailers would boost the price of coal 25 cents a ton. All this made a busy season in the early fall. Fairly seasonable weather held the market buoyant to the end of the year.

One of the features of the local market during the summer and autumn and well into the winter was a persistent shading of price on pea coal. For the greater part of this period pea coal was cut 25 cents below circular and at times even more.

The ruling circular price per long ton for prepared sizes during the year was as follows: Broken, \$3.50; egg, \$3.75; stove, \$4; chestnut, \$4.15; pea, \$2.50; buckwheat, \$1.50. On the 1st of April the usual reduction of 50 cents a ton was made on all sizes except pea and buckwheat. Thereafter 10 cents a ton was added each month until the regular circular price was again in force. To these prices was added the Pennsylvania State tax of 2½ per cent.

The ruling retail price for anthracite was as follows: Egg, \$7; stove, \$7.25; chestnut, \$7.25; pea, \$5.50. The same reduction of 50 cens a ton for all sizes except pea prevailed during April, with an increase of 10 cents each month in the price until the regular rate was reached. A discount of 25 cents a ton was allowed for cash.

The bituminous market.—The bituminous market at the opening of the year faced the biennial readjustment of the scale of wages, with every prospect of labor disturbances on April 1. Efforts to induce users of coal to stock up in anticipation seemed to fail. Notwithstanding this condition and a threatened suspension of operations, business during the first three months of the year remained about normal. Meantime, the general business depression had set in and much of the coal delivered on contract was left unburned and stored for use during the April shutdown.

The suspension at the mines failed to bring the expected flurry in the market. Prices remained normal and even went lower while wages were in process of adjustment. When work at the mines was resumed a large quantity of coal was shipped to tide, and then came a glut in the market which sent prices to their lowest point.

Short-time operations at the mines in central Pennsylvania were necessary to clear the loading piers of the accumulated stock, some of which had been on long-time demurrage. Profiting by their experience, no operator would ship coal to tide in any material quantity unless on order. During the last six months of the year conditions continued at low ebb, with no spot market to speak of.

The general run of prices per ton after April was as follows: Latrobe, 95 cents to $1; B-vein, $1 to $1.15, and best grades of Clearfield, $1.15 to $1.25; South Fork, $1.40 to $1.60; Western Maryland Railway, 70 to 80 cents; Fairmont mine-run, 80 cents; three-quarter lump, 90 cents; and slack, 55 to 70 cents.

BOSTON.

[By ROBERT S. COFFIN, secretary of the committee on fuel supply, Boston Chamber of Commerce.]

Receipts and shipments.—The receipts of coal at the port of Boston in 1914 were almost as great as in 1913, which were the highest in the history of the port, the receipts in each year amounting to more than 7,000,000 tons. The aggregate of anthracite and bituminous coal in 1914 amounted to 7,089,390 long tons, as against 7,115,993 long tons in 1913, a decrease for 1914 of 26,603 tons. Of the receipts for 1914, 1,911,525 tons were anthracite, 4,919,218 tons were domestic bituminous, and 258,647 tons were foreign bituminous. This was an increase of 57,075 tons of anthracite, but a decrease of 72,666 tons of domestic bituminous and of 11,012 tons of foreign bituminous.

The coal trade during the year was very dull, owing in part to the general economy which resulted from the outbreak of the European war. Some large dealers reported that in 1914, for the first time for several years, part of their distributing equipment was idle during the summer and fall months. There was a plentiful supply of coal throughout the year, and ample means of transportation.

The net receipts of coal for local consumption in Boston in 1914 amounted to 1,732,054 tons of anthracite and 4,016,955 tons of bituminous. In addition to the coal for local consumption, Boston is the distributing center for a considerable tonnage of coal that is forwarded over the railroads to interior New England points. In 1914, 179,471 tons, or about 9 per cent of the anthracite tonnage, and 1,160,910 tons, or about 22 per cent of the bituminous tonnage received at Boston, were reshipped to interior points.

The following table shows the receipts of both anthracite and bituminous coal at Boston by months, for 1914, the quantity forwarded to interior points, the net receipts for local consumption, and the total for 1914 as compared with the totals for the four preceding years:

Receipts and shipments of coal at and from Boston in 1914, by months, in long tons.

1914.	Receipts from all points.		Quantity forwarded to New England points.		Net receipts (for local consumption).	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.
January	109,719	411,985	6,740	70,514	102,979	341,471
February	93,859	410,237	10,079	68,256	83,780	341,981
March	142,834	450,481	19,040	113,960	123,794	336,521
April	180,198	455,247	21,178	98,584	159,020	356,663
May	210,078	488,342	15,973	112,705	194,105	375,637
June	183,264	398,647	12,739	107,418	170,525	291,229
July	161,018	400,098	14,735	97,546	146,283	302,552
August	191,345	454,218	18,832	96,351	172,513	357,867
September	197,156	469,916	15,068	81,739	182,088	388,177
October	160,030	388,068	19,033	114,168	140,997	273,900
November	148,033	472,777	13,076	97,057	134,957	375,720
December	132,991	377,849	11,978	102,612	121,013	275,237
Total, 1914	1,911,525	5,177,865	179,471	1,160,910	1,732,054	4,016,955
1913	1,854,450	5,261,543	98,244	1,073,832	1,756,206	4,187,711
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

The following table shows the receipts of domestic and foreign coals at the port of Boston for a period of 11 years, in long tons. It is interesting to note that during the last decade the receipts of bituminous coal have practically doubled. This may be cited as one of the evidences of industrial growth in the Boston district and in New England generally. On the other hand, the receipts of anthracite coal have remained practically unchanged. The only receipts of foreign coal, as usual, were from the bituminous mines of the Dominion Coal Co., Cape Breton Island, Nova Scotia. Practically the entire imports were consigned to the by-product coking plant at Everett, a suburb of Boston.

Receipts of coal at Boston, Mass., in 1904–1914, in long tons.

Year.	Domestic.				Foreign, bituminous.	Total.
	By water.		By rail.			
	Anthracite.	Bituminous.	Anthracite.	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
1913	1,676,311	4,944,687	178,139	47,197	269,659	7,115,993
1914	1,719,099	4,866,778	192,426	52,440	258,647	7,089,390

Anthracite.—The retail prices of anthracite at Boston in 1914 were normal. The dull season and the plentiful supply of coal had a tendency to keep prices down. The winter prices for practically all sizes were 25 cents lower than the high prices of the winter of 1913. The summer prices went into effect on April 6, when all sizes were reduced 75 cents a ton, except egg, which was reduced 50 cents a ton. The summer prices were in effect until July 6, when all sizes were advanced 25 cents a ton. A further advance of 25 cents a ton was made on August 10, and these prices were maintained through the remainder of the year.

Retail prices, per short ton, of anthracite at Boston in 1914, by kinds.

Kind.	Apr. 6.	July 6.	Aug. 10.
Furnace	$6.50	$6.75	$7.00
Egg	7.25	7.50	7.75
Stove	7.25	7.50	7.75
Nut	7.50	7.75	8.00
Pea	5.50	5.75	6.00
Shamokin	7.50	7.75	8.00
Franklin	8.50	8.75	9.00

Coastwise freight rates.—The coastwise freight rates in 1914 were the lowest for several years. This was largely owing to the fact that it was a comparatively dull year industrially and to the plentiful supply of steam vessels, all of which had a tendency to reduce rates materially. There was also a large fleet of sailing vessels, which had practically no other business open to them, and these were obliged to carry coal at low rates in order to get any business at all.

The situation during the early months of 1915 indicates that conditions this year are likely to be the reverse of those of 1914. Sailing vessels of 800 or 900 tons and upward have almost all chartered offshore at lucrative rates, and the result is that coastwise carrying is being done almost exclusively either in steamers or in barges. As it happens, the supply of these is just about enough to take care of current needs. If the demand were to increase even to a slight degree, freights would undoubtedly show a marked advance, and it is expected that before the close of the year they will be considerably higher.

From Hampton Roads the minimum rate in 1914 was 55 cents a ton and the maximum rate 80 cents a ton, as compared with rates ranging from 70 cents to $1 a ton in 1913; the rates from Philadelphia in 1914 ranged from 55 cents to 90 cents a ton, as compared with 70 cents to $1.25 in 1913; the rates from Baltimore in 1914 ranged from 60 cents to 85 cents a ton, as against 75 cents to $1.10 in 1913.

Coal freights to Boston during 1913 and 1914.

1913.

From—	Minimum.		Maximum.	
	Rate.	Date.	Rate.	Date.
New York	$0.50-$0.55		$1.25	Jan. 30.
Philadelphia	.70- .80	Mar. 15-Nov. 1	1.25	Jan. 15-Jan. 30.
Baltimore	.75	June 1-Aug. 1	1.10	Jan. 15.
Norfolk and Newport News	.70- .75	June 15-Sept. 1	1.00	Jan. 1-Mar. 1

1914.

From—	Minimum rate.	Minimum date.	Maximum rate.	Maximum date.
New York	[a]$0.50-$0.55		$0.70	Jan. 15.
Philadelphia	[b].55	July 15	.90	Jan. 1-Mar. 1.
Baltimore	[b].60	July 15-Aug. 1	.85	Jan. 15-Jan. 30.
Norfolk and Newport News	[b].55	June 15-Aug. 1	.80	Jan. 25.

[a] 50 to 55 cents was season rate on anthracite coal-carrying railroad transportation from New York and 75 cents from Philadelphia. 65 cents was the minimum rate on sail (sailing vessels) tonnage from New York to Boston.

[b] These rates apply to sail tonnage. As in 1913 there was a large number of season charters; that is, for 8 to 10 to 12 trips at 70 cents, most of the sail transportation being closed on that basis rather than from trip to trip. In June and July several steam colliers chartered Hampton Roads to Boston at 50 cents. A number of them and toward the end of the year several sailing vessels left the coastwise trade to take high freights to European and South American points.

BALTIMORE, MD.

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

Although the bituminous coal trade at the port of Baltimore during the year 1914 displayed a considerable decline in volume as compared with the very busy twelvemonth immediately preceding, business was generally normal and prices were fairly steady. There was an active demand for the best grades of steam coal, which has continued into the present year, yet this has been accompanied lately by not a little price cutting in local trade by the smaller merchants. Exports are the only shipments that did increase in 1914, although there was an unimportant gain of 10 per cent in the coastwise tonnage of anthracite. The export trade is practically all in the hands of large operators, and it is understood that fair prices have been had and are being obtained for this business.

The anthracite trade was also less in volume in 1914 than in 1913, but generally it was good, although collections were slow. This fuel is used in Baltimore almost wholly for domestic purposes, and the demand was satisfactory. There was some increase in the use of very small sizes, buckwheat, for instance, for heating in improved, self-feeding furnaces—both in private dwelling houses and in apartment houses. As anthracite is used so largely in households, as a business it soon feels the effects of general commercial and industrial depression, so that, although the trade was good in 1914, the first few months of the current year (1915) have exhibited a sagging tendency, which was emphasized by the mildness of the winter as well as by the lessened incomes of numerous families. Therefore 1915 promises, apparently, to repeat the depression which was consequent in 1909 upon the panic of 1907 and 1908. The extension of the use of gas for cooking is also tending to check the advance in the domestic use of coal.

The receipts of bituminius coal for 1914 were 5,097,005 long tons, or 12.75 per cent less than in 1913, and the receipts of anthracite, 910,233 long tons, were 12.5 per cent less. There was a much lessened demand for coke in consequence of industrial depression, and receipts declined about 30 per cent. Coastwise shipments of bituminous coal dropped 11.5 per cent, or from 3,655,796 tons in 1913 to 3,238,892 tons in 1914, a decline of 416,904 tons; but exports of this kind of coal increased in volume 7.5 per cent, the total being 940,706 tons, an increase of 70,055 tons, and there is prospect that the current year will witness a much greater increase in exports, as the first months of 1915 show large gains over the corresponding months of 1914.

The following tables display the receipts and shipments of both bituminous coal and anthracite, as well as of coke at the port of Baltimore, the coastwise and the export shipments being separated. These figures include the coal and coke received and used at the plants of the Maryland Steel Co., at Sparrows Point, and of the Central Foundry Co., at Dundalk, Md., both of which are on Patapsco River near Baltimore, and as they are large purchasers and consumers of fuel their figures are necessarily to be included in a review of the local trade.

Receipts and shipments of coal and coke at Baltimore, Md., 1913–1914, in long tons.

Kind.	1913			1914		
	Receipts.	Tidewater shipments.		Receipts.	Tidewater shipments.	
		Coastwise.	Exports.		Coastwise.	Exports.
Bituminous	5,842,437	a 3,655,796	870,651	5,097,005	3,238,892	940,706
Anthracite	1,039,965	a 261,316	2,662	910,233	287,557	4,602
Total	6,882,402	3,917,112	873,313	6,007,238	3,526,449	945,308
Coke (short tons)	345,898		63,377	244,935		20,540

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

Coastwise shipments of coal from Baltimore, 1903–1914, 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
1913	261,316	3,655,796	3,917,112
1914	287,557	3,238,892	3,526,449

The exports of bituminous coal from Baltimore have been increasing for several years and it may be said that the trend of this business has been almost invariably upward for the last decade, as is shown by the following table:

Exports of bituminous coal and coke from Baltimore in 1914, by months, in long tons.

Month.	Coal.	Coke.
January	62,009	794
February	59,537	575
March	72,030	....
April	75,907	908
May	80,124	....
June	112,970	404
July	85,303	259
August	52,786	125
September	128,178	4,718
October	85,152	5,418
November	75,998	3,084
December	50,712	4,255
Total 1914	940,706	20,540
1913	870,651	63,377
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 receipts and consumption of bituminous coal and coke at the two large industrial plants mentioned are shown in the following statements:

Maryland Steel Co.—Bituminous coal used in 1914 amounted to 170,112 long tons, and the coke purchased to 141,345 tons. The coke manufactured in the company's own ovens at Sparrows Point was 79,219 tons. In 1913 the company used 518,130 long tons of bituminous coal and also bought 191,740 tons of coke; it made 206,582 tons of coke also in its own ovens.

Central Foundry Co.—At the plant of the Central Foundry Co. 2,992 long tons of bituminous coal and 2,246 short tons of coke were used during 1914. In 1913 the consumption amounted to 2,836 tons of bituminous coal and 3,185 tons of coke.

Thanks are due to these two companies as well as to the Baltimore & Ohio, the Pennsylvania, and the Western Maryland railroad companies for courteously and promptly furnishing figures necessary to the preparation of this review.

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 quantity of coal, entirely bituminous, handled at the Hampton Roads ports in 1914 was the greatest on record, being 248,130 long tons more than in 1913, and 103,946 tons more than in 1912, when the high record of 11,850,706 long tons was made. Coastwise and local trade decreased from 7,811,554 tons in 1913, to 7,661,990 tons in 1914, but the increase in both export and bunker coal more than offset the decrease in coastwise trade. Shipments over the Virginian Railway to Sewall Point decreased from 3,283,926 long tons to 2,841,369 tons; shipments over the Norfolk & Western Railway to Lambert Point increased from 5,410,060 tons to 5,820,882 tons; and shipments over the Chesapeake & Ohio to Newport News increased from 3,012,536 to 3,292,401 tons.

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

The coal receipts at Hampton Roads in 1913 and 1914 are shown in the following table:

Coal receipts at Hampton Roads in 1913 and 1914, in long tons.

Destination.	Norfolk & Western Ry.	Chesapeake & Ohio Ry.	Virginian Ry.	Total.
1913.				
Coastwise	3,407,592	1,714,691	2,683,271	7,811,554
Export	1,362,639	911,368	235,873	2,503,880
Bunker	639,829	386,477	364,782	1,391,088
Total	5,410,060	3,012,536	3,283,926	11,706,522
1914.				
Coastwise	3,365,686	1,928,450	2,367,854	7,661,990
Export	1,707,626	881,711	154,960	2,744,297
Bunker	747,570	482,240	318,555	1,548,365
Total	5,820,882	3,292,401	2,841,369	11,954,652

The monthly shipments over the Virginian Railway in 1914, as reported by Mr. Young, were as follows:

Statement of coal dumped over Sewall Point pier, 1914, by months, in long tons.

Month.	Coastwise.	Export.	Bunker.	Total.
January	187,099	7,092	36,679	230,870
February	160,529	11,745	28,588	200,862
March	188,567	6,314	27,922	222,803
April	213,382	9,839	38,187	261,408
May	223,970	15,600	23,581	263,151
June	188,124	3,602	31,111	222,837
July	189,572	11,634	15,585	216,791
August	236,051	32,218	15,610	283,879
September	210,844	18,928	20,563	250,335
October	197,719	18,869	32,342	248,930
November	195,964	15,866	22,472	234,302
December	176,033	3,253	25,915	205,201
Total	2,367,854	154,960	318,555	2,841,369

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, 1914, by months, in long tons.

Month.	Coastwise.	Export.	Bunker.	Total.
January	301,695	135,102	58,940	495,737
February	278,734	106,348	48,700	433,782
March	306,414	141,255	71,949	519,618
April	290,712	166,452	67,757	524,921
May	298,845	131,367	67,417	497,629
June	277,140	143,126	74,202	494,468
July	250,743	125,214	50,985	426,942
August	293,086	171,260	52,432	516,778
September	305,854	304,867	76,690	687,411
October	271,247	88,249	57,993	417,489
November	259,773	97,225	59,437	416,435
December	231,443	97,161	61,068	389,672
Total	3,365,686	1,707,626	747,570	5,820,882

The monthly shipments of coal over the Chesapeake & Ohio Railway in 1914 at Newport News, as reported by Mr. Hotchkiss, were as follows:

Shipments of coal to Newport News, 1914, by months, in long tons.

Month.	Coastwise.	Export.	Bunker.	Total.
January	146,415	76,775	31,185	254,375
February	169,307	71,873	32,290	273,470
March	196,726	87,974	37,964	322,664
April	164,264	77,336	44,443	286,043
May	178,131	75,319	37,737	291,187
June	156,447	75,803	40,622	272,872
July	175,627	45,423	44,500	265,550
August	147,622	86,508	50,037	284,167
September	162,661	125,789	36,305	324,755
October	163,103	86,897	38,890	288,890
November	128,406	48,754	38,260	215,420
December	139,741	23,260	50,007	213,008
Total	1,928,450	881,711	482,240	3,292,401

PITTSBURGH, PA.

Statistics compiled by the United States Geological Survey show that the quantity of coal consumed in the Pittsburgh district in 1914 was 15,118,918 short tons, a decrease of 3,419,758 tons compared with 1913. The shipments from the Pittsburgh district to points west of Pittsburgh were 26,496,059 short tons, a decrease of 2,137,510 tons. The total quantity of coal shipped by rail and water to the Pittsburgh district and through Pittsburgh to points west in 1914 was 41,614,977 short tons, as compared with 47,172,245 tons in 1913. The shipments to Pittsburgh by rail in 1914 were 6,501,759 short tons; by slack-water navigation, 8,617,159 tons. The shipments from the Pittsburgh district to eastern points, which go all rail and do not pass through the city, amounted in 1914 to 13,592,539 short tons, against 17,127,692 tons in 1913.

The author is indebted to Capt. Harold C. Fiske, Corps of Engineers, United States Army, for the statement of the movement of coal through the locks of Monongahela River and at Davis Island Dam, and to the following railroad officials for the shipments by rail from which the foregoing figures and the following table have been compiled: Messrs. R. H. Large, general coal freight agent, Pennsylvania Railroad Co., Philadelphia; W. L. Cromlish, coal and coke agent, Baltimore & Ohio Railroad, Pittsburgh; J. C. Venning, general ore and coal agent, Pennsylvania lines west of Pittsburgh, Pittsburgh; J. B. Nessle, general freight agent, Pittsburgh & Lake Erie Railroad, Pittsburgh; J. B. Safford, superintendent, Pittsburgh, Chartiers & Youghiogheny Railway, Pittsburgh; S. B. Woodside, general freight agent, Wabash-Pittsburgh Terminal & Westside Belt Railway, Pittsburgh.

The rail and water shipments to and from the Pittsburgh district during the last six years have been as follows:

Movement of coal to and through Pittsburgh, 1909–1914, in short tons, showing totals by rail and water.

Destination.	1909	1910	1911	1912	1913	1914
By rail:						
To Pittsburgh district	4,654,249	6,139,959	5,142,412	7,778,450	8,203,091	6,501,759
To west of Pittsburgh	18,981,995	[a]22,683,276	[a]22,474,289	24,086,001	26,044,234	24,513,234
Total by rail	23,636,244	28,823,235	27,616,701	31,864,451	34,247,325	31,014,993
By Monongahela River locks:						
To Pittsburgh district	9,737,505	9,460,695	9,207,232	9,943,333	10,335,585	8,617,159
To west of Pittsburgh	2,463,385	1,770,305	2,816,975	1,993,350	2,589,335	1,982,825
Total by water	12,200,890	11,231,000	12,024,207	11,936,683	12,924,920	10,599,984
Total shipments	35,837,134	40,054,235	39,640,908	43,801,134	47,142,245	41,614,977

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

Movement of coal to and through Pittsburgh, 1909–1914, in short tons, showing totals to Pittsburgh district and west of Pittsburgh.

Destination.	1909	1910	1911	1912	1913	1914
To Pittsburgh district:						
By rail	4,654,249	6,139,959	5,142,412	7,778,450	8,203,091	6,501,759
By water	9,737,505	9,460,695	9,207,232	9,943,333	10,335,585	8,617,159
Total to Pittsburgh district	14,391,754	15,600,654	14,349,644	17,721,783	18,538,676	15,118,918
To west of Pittsburgh:						
By rail	18,981,995	22,683,276	22,474,289	24,086,001	26,044,234	24,513,234
By water	2,463,385	1,770,305	2,816,975	1,993,350	2,589,335	1,982,825
Total to west of Pittsburgh	21,445,380	24,453,581	25,291,264	26,079,351	28,633,569	26,496,059
Total shipments to Pittsburgh and points west.	35,837,134	40,054,235	39,640,908	43,801,134	47,172,245	41,614,977
Shipments, all rail, to points east of Pittsburgh	11,300,162	10,781,544	13,169,866	15,349,045	17,127,692	13,592,539

BUFFALO, N. Y.

[By John W. Chamberlin, trade journal correspondent.]

The coal trade in all its branches has been very hard hit by the dull turn of business generally, and Buffalo has felt the depression fully, although only one concern of much size has been carried down by it. This condition of the coal trade has a somewhat varied result as applied to the anthracite and the bituminous trades separately, but it has a doubly depressing effect on Buffalo, which is the only Lake city that does a large shipping business in both.

The leading anthracite companies have been able to maintain former prices, but the volume of business has fallen off, and besides there is a steadily increasing quantity of independent anthracite seeking this market, which is often sold at a reduction, thus injuring the entire market. This independent product is sold both through regular branch houses and by bituminous jobbers who commonly obtain a larger margin of profit from it than they do from the regular bituminous trade.

The dullness of the bituminous trade, which has been general, partly on account of light consumption and partly on account of the facility for overproduction, was still further intensified because of the industrial stagnation in a great part of Canada, which buys much of its coal from Buffalo shippers. All these conditions continue and promise to continue for some time to come. The margin of profit is very low, both to operator and to jobber.

Buffalo receives about 8,000,000 tons of bituminous by rail annually, an exact statement not being obtainable, though these figures are known to be substantially correct. The receipts were less in 1914 than in 1913, as all partial summaries agree. It would be hard to say how much of the total is consumed in the city, but the steady increase of manufacturing establishments has no doubt made the proportion greater than formerly.

The anthracite trade is more easily summarized. By examining gross figures (the bituminous trade is in net figures) it is found that shipments by Lake in 1914 were almost exactly 4,000,000 tons, to which quantity 800,000 tons from Lake Ontario ports and 200,000 tons from Erie, Pa., are to be added, with a resulting total of 5,000,000 gross tons as the Lake trade in anthracite. Of this total all but 600,000 tons of the Lake Ontario trade went to the upper Lakes. Buffalo consumes about 400,000 net tons of anthracite; the quantity received is never compiled. Competition from natural gas and water-generated electricity steadily increases.

Buffalo shipped 472,393 tons of anthracite to Canadian ports by Lake and about an even million tons was exported to that country by rail. The falling off from 1913 was a little more than 7 per cent. In bituminous coal the falling off was more than 29 per cent, and in coke it was nearly 29 per cent, which indicates that the decline in buying was much more pronounced in transportation and in manufacturing than in the family trade.

Export of coal and coke from Buffalo to Canada, 1907–1914, 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
1913	1,615,176	2,906,682	475,417	4,997,275
1914	1,495,467	2,536,888	338,527	4,370,882

There was some effort to secure a reduction of the rate by rail of $2 a ton on anthracite from the mines to Buffalo, but without success. Rates were $1.25 a ton on bituminous coal from the Pittsburgh district to Buffalo, and $1.10 from the Allegheny Valley; they were $1.85 a ton on Connellsville coke, and $1.75 a ton on coal by rail from Buffalo to Chicago. Lake rates to principal upper Lake ports continued at 30 cents per net ton.

CINCINNATI, OHIO.

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

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

Receipts of coal at Cincinnati, 1910–1914, in short tons.

Year.	By river.			By rail.	
	Pittsburgh.	Kanawha.	Other kinds.	Receipts.	Anthracite.
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
1913	428,737	1,507,257		6,210,832	13,689
1914	294,685	1,341,250		6,088,020	20,900

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, have been as follows:

Movements of coal at Cincinnati, 1910–1914, in short tons.

Year.	Receipts.			Shipments.		
	By river.	By rail.	Aggregate.	By river.	By rail.	Aggregate.
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
1913	1,935,994	6,224,521	8,160,515	357,313	4,341,462	4,698,775
1914	1,635,935	6,088,020	7,723,955	326,215	4,548,557	4,874,772

CLEVELAND, OHIO.

The total receipts of coal and coke at Cleveland, as reported by Mr. Munson A. Havens, secretary of the Cleveland Chamber of Commerce, decreased 3,442,522 short tons, as compared with 1913. About one-fourth of this decrease in business was in the local consumption and about three-fourths was in the decrease in shipments of coal through Cleveland by Lake and rail to other points. The total receipts in 1914 were 6,374,635 short tons, as compared with 9,817,157 tons in 1913. The decrease was general, the receipts of bituminous, anthracite, and coke all falling off. The consumption of bituminous coal was 3,304,911 tons, a decrease of 662,854 tons, as compared with 1913. The consumption of coke, including that manufactured in Cleveland, declined over 20 per cent.

The receipts and shipments of coal and coke at Cleveland, Ohio, for the last five years are shown in the following table:

Receipts and shipments of coal and coke at Cleveland, Ohio, 1910–1914, in short tons.

RECEIPTS.

Kind.	1910	1911	1912	1913	1914
Bituminous	7,097,170	6,242,910	6,673,940	8,822,355	5;658,769
Anthracite	400,425	168,208	150,647	140,227	88,913
Coke	937,714	911,477	1,753,247	854,575	626,953
Total	8,435,309	7,322,595	8,577,834	9,817,157	6,374,635

SHIPMENTS.

Kind.	1910	1911	1912	1913	1914
Anthracite by rail	18,020	....	....	46,409	....
Bituminous by rail	383,408	....	118,623	176,665	....
Bituminous by Lake	5,023,368	3,108,741	4,249,666	4,677,925	2,353,858
Coke by rail	197,784	273,313	288,238	85,303	71,513
Total	5,622,580	3,382,054	4,656,527	4,986,302	2,425,371

Total receipts and shipments of coal and coke and local consumption at Cleveland, Ohio, 1910–1914, in short tons.

Year.	Receipts.	Shipments.	Local consumption.
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
1913	9,817,157	4,986,302	4,830,855
1914	6,374,635	2,425,371	3,949,264

MILWAUKEE, WIS.

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

The total receipts of coal at Milwaukee in 1914 were 5,360,094 short tons, of which 409,516 tons were by rail and the remainder was by water from Buffalo, Toledo, and other Lake ports. This is a decrease of 500,000 tons, as compared with 1913. The shipments of coal from Milwaukee by rail and water were 1,486,250 tons, or 480,000 tons more than in 1913. The decrease in receipts and the increase in shipments indicate a decline in the consumption of coal in Milwaukee in 1914 of almost 1,000,000 tons, as compared with 1913.

The receipts and shipments of coal at and from Milwaukee during the last five years are shown in the following table:

Receipts of coal at Milwaukee, Wis., 1910–1914, in short tons.

Source.	1910	1911	1912	1913	1914
By lake from—					
Buffalo	810,409	909,080	834,131	1,028,491	950,701
Erie	82,072	90,342	367,527	153,602	191,646
Oswego	68,983	65,166	64,213	79,150	88,509
Cleveland	436,057	219,852	357,232	570,599	676,776
Ashtabula	520,376	446,330	242,297	486,739	354,149
Lorain	671,656	848,687	766,897	722,098	576,868
Sandusky	388,467	369,601	532,065	599,752	597,903
Toledo	1,311,786	1,453,631	1,180,596	1,228,153	1,237,635
Fairport	61,737	107,803	48,037	27,853	66,740
Huron, Ohio	86,046	64,780	144,966	129,068	173,953
Other ports	173,743	30,150	44,727	203,265	35,698
Total Lake	4,611,332	4,605,422	4,582,688	5,228,770	4,950,578
By railroad	[a] 449,869	[b] 409,489	589,569	631,493	409,516
Total receipts	5,061,201	5,014,911	5,172,257	5,860,263	5,360,094

[a] Including 327,415 tons by car ferry. [b] Including 265,572 tons by car ferry.

Shipments of coal from Milwaukee, Wis., 1910–1914, in short tons.

Shipped by—	1910	1911	1912	1913	1914
Chicago, Milwaukee & St. Paul Ry	1,019,330	765,980	248,768	394,734	763,132
Chicago & North Western Ry	530,010	543,840	577,225	495,100	581,908
Wisconsin Central Ry [a]	139,435	119,135	129,607	104,003	135,865
Lake	360	60	178	6,762	5,345
Total	1,689,135	1,429,015	955,778	1,000,599	1,486,250

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

Receipts of coal by lake at Milwaukee, Wis., 1910–1914, by kinds, in short tons.

Kind.	1910	1911	1912	1913	1914
Anthracite	930,472	1,013,907	973,388	1,153,406	1,061,704
Bituminous	3,680,860	3,591,515	3,609,300	4,075,364	3,888,874
Total	4,611,332	4,605,422	4,582,688	5,228,770	4,950,578

PANAMA CANAL.

The following table showing the shipments of coal through the Panama Canal in 1914 has been compiled from the "Canal Record," the official publication of the Panama Canal. The canal was opened for shipping in August, 1914, and the first cargo of coal recorded was from Norfolk to San Francisco, passing through the canal on September 27. The total quantity in 1914 was small, 100,503 long tons, and the individual cargoes, their source and destination, are given. This does not include coal shipped to the Canal Zone for bunker trade. All of the shipments were from the Atlantic to the Pacific Ocean, and more than one-half of the coal was from Europe.

Coal shipped through the Panama Canal in 1914.

Date.	From—	To—	Shipment.
			Long tons.
Sept. 27	Norfolk	San Francisco	8,340
Sept. 28	do	Valparaiso	6,010
Oct. 1	Baltimore	San Diego	6,000
Oct. 2	Norfolk	Guaymas, Mex	5,943
Oct. 3	do		4,252
Oct. 19	Glasgow	San Francisco	6,499
Do	Newport, England	Esquimault	4,659
Oct. 22	Cardiff	do	4,550
Nov. 1	New York	Seattle	3,995
Nov. 2	Cardiff	Balboa [a]	5,150
Do	Newport, Wales	do [a]	4,200
Nov. 8	Cardiff	Mollendo	2,000
Nov. 18	New York	Ecuador-Chile	7,000
Nov. 21	Spain	Valparaiso	4,006
Nov. 30	Cardiff	Pacific Ocean	4,221
Do	Newport, England	do	4,878
Dec. 2	Baltimore	San Pedro	1,700
Dec. 9	Barry	For sea	5,000
Dec. 11	Cardiff	Sealed orders	5,600
Dec. 12	do	do	6,500
Total			100,503

[a] For orders.

The following table, showing by months the quantity of coal received on the Isthmus of Panama, the quantity on hand the first of each month, and the quantity sold to ships for bunkering at Colon and at Balboa in 1914, was prepared by the superintendent of the Panama Railroad Co. at the Isthmus, and is published through the courtesy of that company. These statistics show that the stock of coal on hand at the beginning of the year was 83,370 long tons, and that 103,225 tons were supplied to ships for bunker purposes, 51,462 tons at Colon and 51,763 at Balboa. Approximately 177,000 tons were used by the Panama Railroad and the Canal.

Quantity of coal received, stock on hand the first of each month, and coal sold ships for bunkering at Panama Canal in 1914, in long tons.

Month.	Received.	Stocks.	Bunkered.	
			At Colon.	At Balboa.
January	31,991	83,370	....	
February	21,965	84,897	....	11,977
March	11,946	90,009	....	
April	29,434	76,368	....	
May	22,398	84,747	....	16,214
June	27,763	84,590	....	
July	25,221	89,035	....	
August	12,003	94,367	3,021	14,972
September	17,507	83,690	6,609	
October	22,472	77,668	12,467	
November	18,569	73,639	11,117	8,600
December	15,678	59,684	18,248	
Total	256,947	....	51,462	51,763

PRODUCTION OF COAL BY STATES.

ALABAMA.

Total production in 1914, 15,593,422 short tons; spot value, $20,849,919.

The coal production of Alabama decreased 2,085,100 tons, or 11.8 per cent, in quantity and $2,233,805, or 9.68 per cent, in value in 1914, compared with 1913. The decrease was general throughout the State, only a few counties showing a slight increase. The decrease is attributed to a number of causes, the principal one being the general business depression, which was felt particularly in Alabama because of its importance as an iron-making State, and because the iron interests more than any other branch of the mining industry suffered from the unsatisfactory trade conditions. In addition to the demoralization in the iron trade, the disturbed situation in Mexico resulted in a loss of market for Alabama coke. Alabama coal was also affected by the low price of petroleum in the Southwestern States; by increased water-power development; by the competition of coal from Kentucky and Illinois in the markets of Louisiana and Mississippi, which are normally supplied by Alabama; and by the smaller bunker trade resulting from the cessation of exports of cotton after the declaration of war in Europe. There was a plentiful supply of labor for coal-mining operations throughout the year, and no shortage of cars for transportation and no serious labor troubles were reported.

The average output of coal per man showed a decrease from 720 tons in 1913 to 649 tons in 1914, but there was a slight increase in the average output per man per day, from 2.82 tons in 1913 to 2.87 tons in 1914. The number of men employed in 1914 was 24,042, who worked an average of 226 days in the year, as compared with 24,552 men in 1913, who worked 255 days. There was a considerable increase in the quantity and percentage of coal mined by machines. In 1914 the machine-mined output increased from 4,124,301 tons, or 23.3 per cent, in 1913, to 4,937,222 tons, or 31.7 per cent. The number of machines in use, however, decreased from a total of 377 in 1913 to 362 in 1914. Of the latter, 223 were punchers, 88 short wall, 31 chain breast, and 20 long wall. The powder-mined coal in 1914 amounted to 5,498,988 tons, or 35.3 per cent, a marked decrease from the record of 1913, when more than 7,000,000 tons, or almost 40 per cent of the total, was shot off the solid. Hand-mined coal decreased from 6,315,787 tons, or 35.7 per cent, in 1913, to 5,134,787 tons, or 32.9 per cent, in 1914.

The total time lost by strikes in 1914 was 3,940 days, 320 men being idle for an average of 12 days.

About one-half of the coal mined in Alabama in 1914 was washed before being marketed or used in the manufacture of coke. The quantity of washed coal was 7,913,030 tons, yielding 7,081,868 tons of cleaned coal and 831,162 tons of waste.

The statistics of fatal accidents compiled by the Bureau of Mines show that 128 men were killed in the coal-mining operations of Alabama in 1914, all but one underground. Fifty-three of the fatalities were due to falls of roof, 37 to gas explosions and burning gas, 11 to shocks or burns caused by contact with electric wires, and 24 to haulage-way accidents. The death rate per thousand in 1914 was 5.3 against 5 in 1913, and the number of tons mined for each life lost was 121,823, against 142,569 in 1913.

The statistics of production of coal in Alabama in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Alabama in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Bibb	1,802,243	9,214	99,569	....	1,911,026	$2,979,240	$1.56	274	3,158
Blount	174,580	2,758	1,620	....	178,958	236,448	1.32	203	354
Etowah	135,815	725	1,252	....	137,792	171,600	1.25	256	209
Jefferson	7,149,844	83,353	412,891	1,382,746	9,028,834	11,790,737	1.31	266	11,643
St. Clair	861,579	2,909	25,891	....	890,379	1,150,457	1.29	277	798
Shelby	457,313	4,469	35,787	....	497,569	862,783	1.73	257	850
Tuscaloosa	699,690	13,891	68,836	134,888	917,305	1,172,227	1.28	271	1,183
Walker	3,671,708	42,809	101,760	150,986	3,967,263	4,481,373	1.13	223	6,031
Winston	24,841	60	50	....	24,951	36,724	1.47	228	67
Other counties[a]	116,423	2,162	5,030	....	123,615	200,059	1.62	233	259
Small mines	....	830	....	....	830	2,076	2.50	......	....
Total	15,094,036	163,180	752,686	1,668,620	17,678,522	23,083,724	1.31	255	24,552

[a] Cullman, Jackson, and Marion.

Production of coal in Alabama in 1913 and 1914, by counties, in short tons—Continued.

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Bibb	1,565,660	9,180	100,006		1,674,846	$2,576,057	$1.54	242	2,986
Blount	147,640	1,300	1,444		150,384	188,235	1.25	163	348
Etowah	153,402	1,293	2,214		156,909	222,239	1.42	241	279
Jefferson	6,515,079	46,527	292,071	1,082,468	7,936,145	10,486,552	1.32	236	11,343
St. Clair	726,132	1,816	24,640		752,588	978,196	1.30	229	896
Shelby	467,456	3,916	27,542		498,914	927,442	1.86	239	936
Tuscaloosa	428,387	13,355	59,562	357,595	858,899	1,177,473	1.37	226	1,491
Walker	3,037,567	51,284	112,704	248,630	3,450,185	4,124,363	1.20	199	5,416
Winston	31,035	525	58		31,618	46,787	1.48	248	101
Other counties [a]	73,496	1,704	5,841		81,041	119,496	1.47	187	246
Small mines		1,893			1,893	3,079	1.63		
Total	13,145,854	132,793	626,082	1,688,693	15,593,422	20,849,919	1.34	226	24,042

[a] 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 1914 as compared with 1913:

Production of coal in Alabama, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (−), 1914.
Bibb	1,580,564	1,633,197	1,781,335	1,911,026	1,674,846	− 236,180
Blount Cullman	[a] 235,456	[a] 210,070	[a] 276,429	[a] 300,092	[a] 228,146	− 71,946
Etowah	172,465	255,860	171,308	137,792	156,909	+ 19,117
Jefferson	8,298,702	7,776,390	8,174,849	9,028,834	7,936,145	− 1,092,689
St. Clair	428,409	529,211	749,753	890,379	752,588	− 137,791
Shelby	488,141	463,089	496,949	497,569	498,914	+ 1,345
Tuscaloosa	1,081,219	1,031,658	880,967	917,305	858,899	− 58,406
Walker	3,788,479	3,103,595	3,547,962	3,967,263	3,450,185	− 517,078
Winston	16,442	16,424	18,730	24,951	31,618	+ 6,667
Other counties and small mines	21,585	1,927	2,318	3,311	5,172	+ 1,861
Total	16,111,462	15,021,421	16,100,600	17,678,522	15,593,422	− 2,085,100
Total value	$20,236,853	$19,079,949	$20,829,252	$23,083,724	$20,849,919	−$2,233,805

[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 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 production of coal in the State had increased to nearly 2,500,000 tons. Then for two years there followed a period of relapse and liquidation, after which business settled down to a conservative and rational basis and has since developed steadily. In 1902 the production of coal was more than 10,000,000 tons, and it reached the maximum of 17,678,522 short tons in 1913.

The statistics of production in Alabama from 1840 to the close of 1914 are shown in the following table:

Production of coal in Alabama from 1840 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	946	1860	10,200	1880	323,972	1900	8,394,275
1841	1,000	1861	10,000	1881	420,000	1901	9,099,052
1842	1,000	1862	12,500	1882	896,000	1902	10,354,570
1843	1,200	1863	15,000	1883	1,568,000	1903	11,654,324
1844	1,200	1864	15,000	1884	2,240,000	1904	11,262,046
1845	1,500	1865	12,000	1885	2,492,000	1905	11,866,069
1846	1,500	1866	12,000	1886	1,800,000	1906	13,107,963
1847	2,000	1867	10,000	1887	1,950,000	1907	14,250,454
1848	2,000	1868	10,000	1888	2,900,000	1908	11,604,593
1849	2,500	1869	10,000	1889	3,572,983	1909	13,703,450
1850	2,500	1870	11,000	1890	4,090,409	1910	16,111,462
1851	3,000	1871	15,000	1891	4,759,781	1911	15,021,421
1852	3,000	1872	16,800	1892	5,529,312	1912	16,100,600
1853	4,000	1873	44,800	1893	5,136,935	1913	17,678,522
1854	4,500	1874	50,400	1894	4,397,178	1914	15,593,422
1855	6,000	1875	67,200	1895	5,693,775		
1856	6,800	1876	112,000	1896	5,748,697	Total	270,547,780
1857	8,000	1877	196,000	1897	5,893,770		
1858	8,500	1878	224,000	1898	6,535,283		
1859	9,000	1879	280,000	1899	7,593,416		

ARKANSAS.

Total production in 1914, 1,836,540 short tons; spot value, $3,158,168. The production of coal in Arkansas declined from 2,234,107 short tons, valued at $3,923,701, in 1913 to 1,836,540 tons, valued at $3,158,168, in 1914, a decrease of 397,567 tons, or 17.8 per cent, in quantity, and of $765,533, or 19.5 per cent, in value. The average value per ton decreased from $1.76 to $1.72. The decreased production in 1914 is attributed to a falling off in the demand for manufacturing purposes due to demoralization in the cotton industry after the beginning of the European war and to the decrease in domestic consumption because of mild weather during the winter months at the end of 1914. These causes were more than sufficient to offset the slight increase in railroad consumption resulting from the inability of the Colorado mines, because of strike conditions, to supply fully the demand made upon them.

Little or no difficulty was experienced by the operators in 1914 by reason of droughts or floods, and transportation facilities were satisfactory.

The number of men on strike for one cause or another in 1914 was 1,415, about one-third the total number employed in the State, and the average number of working days lost by each man on strike was 113, representing a loss on that account equal to about 25 per cent of the total time made. The total number of employees decreased from 4,652 in 1913 to 4,339 in 1914, and the average working time decreased from 174 to 143 days. The average quantity of coal produced by each man employed in 1914 was 2.96 tons a day and 423 tons during the year, against 2.76 and 480 tons, respectively, in 1913.

Both the quantity and the percentage of coal shot off the solid declined in 1914, the quantity thus mined being 1,431,548 tons, or 78 per cent of the total, as compared with 1,775,851 tons, or 79.5 per cent, in 1913.

The number of machines in use in 1914 was 28, all of the short wall type, and but one more than in 1913. The quantity of machine-mined coal was 351,838 tons, or 19 per cent of the total, in 1914, as compared with 251,105 tons in 1913. The quantity of coal undercut by hand in 1914 was 52,596 tons, or 3 per cent of the total. Two companies washed a part of their output in 1913, a total of 46,346 tons being treated in that way, but in 1914 no coal was washed in Arkansas.

According to the Bureau of Mines, there were 11 fatal accidents in the coal mines of Arkansas in 1914, as compared with 12 in 1913. The death rate per thousand in 1914 was 2.53, and 166,958 tons of coal was mined for each life lost. In 1913 the death rate was 2.58, and the quantity of coal mined for each life lost was 186,176 tons.

The statistics of production by counties for 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Arkansas in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Franklin	331,539	1,730	13,413	346,682	$591,766	$1.71	178	657
Johnson	156,517	2,095	7,596	166,208	397,198	2.39	111	711
Sebastian	1,547,695	2,980	84,704	1,635,379	2,681,657	1.64	185	2,930
Other counties [a] and small mines	81,607	1,182	3,049	85,838	253,080	2.95	198	354
Total	2,117,358	7,987	108,762	2,234,107	3,923,701	1.76	174	4,652

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Franklin	158,722	1,550	8,474	168,746	$294,652	$1.75	147	447
Johnson	140,133	1,804	6,908	148,845	330,256	2.22	102	639
Logan	6,030	766	376	7,172	13,974	1.95	212	26
Sebastian	1,353,443	3,472	66,287	1,423,202	2,342,563	1.65	150	2,897
Other counties [b] and small mines	77,541	6,013	5,021	88,575	176,723	2.00	151	330
Total	1,735,869	13,605	87,066	1,836,540	3,158,168	1.72	143	4,339

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

A statement of the production of coal in Arkansas, by counties, for the last five years, with increase and decrease in 1914 as compared with 1913, is shown in the following table:

Production of coal in Arkansas, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Franklin	296,725	421,591	373,314	346,682	168,746	− 177,936
Johnson	133,365	137,081	192,326	166,208	148,845	− 17,363
Logan	15,492	11,974	15,272	5,028	7,172	+ 2,144
Pope	13,240	45,935	64,216	79,608	75,938	− 3,670
Sebastian	1,425,347	1,484,532	1,454,128	1,635,379	1,423,202	− 212,177
Other counties and small mines	21,789	5,676	1,563	1,202	12,637	+ 11,435
Total	1,905,958	2,106,789	2,100,819	2,234,107	1,836,540	− 397,567
Total value	$2,979,213	$3,396,849	$3,582,789	$3,923,701	$3,158,168	−$765,533

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 Mississippi River in that year, and for the next 20 years these were the only States west of the Mississippi from which any production of coal 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 1903 production increased quite regularly, but for the last 11 years it has remained practically stationary. The production of 2,234,107 tons in 1913 was only 112,847 tons more than the average annual production from 1902 to 1913, inclusive. 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 1914 will be found in the following table:

Production of coal in Arkansas from 1840 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	220	1888	276,871	1898	1,205,479	1908	2,078,357
1860	200	1889	279,584	1899	843,554	1909	2,377,157
1880	14,778	1890	399,888	1900	1,447,945	1910	1,905,958
1881	20,000	1891	542,379	1901	1,816,136	1911	2,106,789
1882	25,000	1892	535,558	1902	1,943,932	1912	2,100,819
1883	50,000	1893	574,763	1903	2,229,172	1913	2,234,107
1884	75,000	1894	512,626	1904	2,009,451	1914	1,836,540
1885	100,000	1895	598,322	1905	1,934,673		
1886	125,000	1896	675,374	1906	1,864,268	Total	38,396,128
1887	129,600	1897	856,190	1907	2,670,438		

CALIFORNIA.

As there were only 2 mines in California from which an output of coal was reported in 1914 and only 1 mine in each of the States of Idaho and Nevada, the total combined production in the three

States in 1914 is given in order not to reveal individual outputs. This total production amounted to 13,974 short tons, valued at $39,821.

Coal mining and the coal trade generally in California has little claim to importance among the industries of the State, particularly since the beginning of the present century, when the production of petroleum began to exert such a powerful influence on the fuel consumption of the Pacific coast. From 1910 to 1912, inclusive, the production of coal in California was only a little more than 10,000 tons in each year, but in 1913 work was resumed on the Stone Canyon properties in Monterey County and the production increased to 24,839 short tons, valued at $84,073, from 10,978 tons, valued at $23,601, in 1912. There was, however, an appreciable decrease in the output of 1914. The only other production in 1914 was from the Ione mines in Amador County.

The production of petroleum in California in 1914 amounted to 99,788,525 barrels, and it is estimated by J. D. Northrop,[1] of the United States Geological Survey, that 75,000,000 barrels of this production, including both crude and topped, was used for fuel, mainly on the Pacific coast. It is also estimated that $3\frac{1}{2}$ barrels of petroleum is the equivalent of 1 short ton of ordinary bituminous coal, from which it appears that about 21,000,000 tons of coal would be required to perform the service rendered by California petroleum in the production of heat and power and the manufacture of gas. California oil is the principal fuel for locomotives as far north as Washington and across the Sierra 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 Seattle, Vancouver, Victoria, and other points having been equipped for burning oil. 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 and Australia, with small quantities of anthracite and high-grade bituminous coals from the Eastern States. The railroads entering California brought from the Rocky Mountains and Eastern States in 1914 a total of 258,264 short tons of coal; the receipts by water at San Francisco from Oregon, Washington, and the Eastern States were 72,929 long tons, or 81,680 short tons; and the foreign imports into San Francisco, Los Angeles, and San Diego reported by the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, were 315,422 short tons—a total of 655,366 short tons. The total consumption of coal in California, including that supplied to the bunker trade, which, including the vessels of the United States Navy, probably takes the larger part of the coal received by water, was only 3.5 per cent of the quantity of coal displaced by the use of California petroleum.

[1] See current report on production of petroleum: U. S. Geol. Survey Mineral Resources, 1914, 1915.

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

Distribution of the production of coal in California, 1910–1914, 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 value per ton.	Average number of days active.	Average number of employees.
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
1913	14,864	1,808	8,167	24,839	84,073	3.38	332	35
1914 [a]	4,200	9,174	600	13,974	39,821	2.85	291	43

[a] Includes Idaho and Nevada.

The records of the State Mining Bureau of California show a production of coal in that State as early as 1861. It was at that time one of the 16 coal-producing States and relatively of some importance as a coal producer. During the latter part of that decade and throughout the following decade the production of coal in California exceeded 100,000 tons annually and reached a maximum of 236,950 tons in 1880. Since 1881 the production has been irregular, having been influenced chiefly, up to the beginning of the present century, by the imports of coal from Australia and British Columbia, the receipts of Australian coals depending principally upon the production and shipments of wheat from the Pacific coast. Since 1900, along with the great increase in the production and use of petroleum, which began in that year, the production of coal in California has fallen to an insignificant quantity.

The production of coal in California from 1861 to the close of 1914 is shown in the following table:

Production of coal in California from 1861 to 1914, 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	1913	24,839
1872	190,859	1886	100,000	1900	171,708	1914	[a] 13,974
1873	186,611	1887	50,000	1901	151,079		
1874	215,352	1888	95,000	1902	84,984	Total	5,167,238

[a] Includes Idaho and Nevada.

COLORADO.

Total production in 1914, 8,170,559 short tons; spot value, $13,601,718.

Compared with 1913, when the production of coal in Colorado amounted to 9,232,510 short tons, valued at $14,035,090, the returns for 1914 show a decrease of 1,061,951 tons, or 11.5 per cent, in quantity and of $433,372, or 3.1 per cent, in value. The smaller production in 1914 was largely due to the continuation of the strike which began in September, 1913, and prevailed through nearly all of 1914, not being officially declared off until early in December. The production in 1914 was the smallest since 1904. The trouble arose from a demand for the recognition of the miners' union and eventuated in a contest which for bitterness, violence, and bloodshed has exceeded any conflict in the recent history of labor unions in this country, necessitating the presence, first of the State militia and, finally, of the Federal troops to restore and maintain order. Few of the mines were rendered entirely idle at any time during the strike, although 7,324 men, or more than 60 per cent of the average number employed during the year, were idle for an average of 75 days each in 1913 and the returns indicate that a total of 4,418 men were affected for an average of 247 days in 1914. Of that number, 1,165 men employed at mines operated in 1913 but idle in 1914 were out for an average of 284 days, and 3,253 men employed in 1913 at mines only partly affected in 1914 were on strike for an average of 233 days. The average number of days worked in 1914 was 244, as compared with 229 in 1913, and the average number of employees was 1,892 less in 1914 than in 1913—11,990 against 10,098. It is doubtful, however, if with no interruption by strikes the output would have exceeded that in 1913 or even equaled it, for, owing to the general falling off in the demand for coal, there was a decreased production in all of the Rocky Mountain States, except New Mexico, where the fields in Colfax and Santa Fe counties, lying immediately south of the strike area in Colorado, were in a position to benefit by the abnormal conditions in that State.

Returns to the Geological Survey show that 8 mines were idle throughout 1914 because of the strike. In 1913 these mines had a total production of 717,173 tons and employed 1,151 men for an average of 191 days. When the strike was called these mines were employing 1,165 men, all of whom were reported to have been out of employment for an average of 284 days in 1914 by reason of the strike. Reports from the operators indicate that the operation of 53 mines in Colorado was affected seriously or otherwise by the strike. Of that number there were 17 each in Huerfano and Las Animas counties; 9 in Fremont County, and a total of 10 in Routt, Jackson, Gunnison, Garfield, and El Paso counties. Five of the 53 mines, although reporting a small production, were practically closed throughout the year. The 53 mines thus affected had a production of 3,475,928 tons in 1913 and of 2,389,520 tons in 1914, their decrease in 1914 being 1,086,408 tons. It will be noted that this decrease is almost the same as that recorded for the State as a whole, 1,061,951 tons. The mines affected by the strike employed 3,471 men for an average of 239 days in 1914, as compared with 4,996 men for 226 days in 1913, the time made in 1914 being 27 per cent less than in 1913. The decrease in the number of men employed at these mines, as compared with 1913, was 1,525, as against a decrease of 1,892 in the State as a whole.

The miners of Colorado have a good record for efficiency, and a study of the statistics of the mining operations which were affected by the strike, as bearing on the efficiency of the labor employed, is interesting. In 1912 the average production per day by each man in Colorado was 3.7 tons, in 1913 it was 3.36 tons, and in 1914 it was 3.32 tons. In Las Animas County, where the strike was most effective, the average output per man per day was 3.67 tons, against 3.7 tons for the State, in 1912 (a no-strike year); 3.23 tons, against 3.36 tons for the State, in 1913, during the last one-fourth of which the strike was in effect; and 3.01 tons, against 3.32 tons for the State, in 1914, representing successively greater relative decreases in the rate of production per employee. The decrease in efficiency effected by the strike is more forcibly illustrated by comparing the average daily output of the men employed in the mines affected by the strike with corresponding figures at mines not affected. In the 17 mines in Las Animas County in which because of the strike less efficient labor was employed, the average daily output by each man was 2.98 tons, as compared with 3.01 tons for all mines in that county and with 3.32 tons in the State. The average daily output per employee in 1914 at the 53 mines affected by the strike was 2.87 tons, as compared with 3.53 tons in all other operating mines and with 3.32 tons for the whole State.

Ninety-eight companies or individuals operated commercial coal mines in Colorado in 1914. Thirty, or almost one-third of the number, reported operations affected by the strike.

The statistics of production and labor in 1913 and 1914 at the mines which were affected by or idle because of the strike in 1914, by counties, are shown in the following tables:

Production of coal in 1913 and labor statistics at mines idle in Colorado because of the strike in 1914.

County.	1914		Production in 1913.
	Number of men affected.	Estimated number of days on strike.	
			Short tons.
Las Animas (5 mines)	473	270	395,156
Other counties [a]	692	294	322,017
Total	1,165	284	717,173

[a] Fremont, Gunnison, and Huerfano (1 mine each).

Production of coal and labor statistics in 1913 and 1914 of mines in Colorado affected by the strike in 1914.

County.	Number of mines.	1913			1914			Strike.	
		Number of men employed.	Average number of days operated.	Production.	Number of men employed.	Average number of days operated.	Production.	Number of men on strike.	Average number of days lost per man.
				Short tons.			*Short tons.*		
Fremont	9	802	180	352,161	236	267	160,436	821	275
Gunnison	5	182	143	50,991	210	151	77,834	138	220
Huerfano	17	1,513	187	948,571	1,099	247	748,620	1,045	195
Las Animas	17	2,214	269	1,939,001	1,675	250	1,248,467	1,064	252
Other counties [a]	5	285	183	185,204	251	173	154,163	185	152
Total	53	4,996	226	3,475,928	3,471	239	2,389,520	3,253	233

[a] El Paso, Garfield, Jackson, and Routt.

Of the total output in Colorado in 1914 (8,170,559 tons), 4,679,245 tons, or 57.3 per cent, were undercut by hand, 2,502,558 tons, or 30.6 per cent, were mined by machines, and 945,348 tons, or 11.6 per cent, were shot off the solid. The last item showed a decrease both in quantity and percentage, as compared with 1913, when 1,286,293 tons, or 13.9 per cent, were powder-mined. There was an increase in the number of machines in use from 300 in 1913 to 306 in 1914. More than half of the machines in use were punchers, 168 being of that type. Of the remainder, 35 were chain breast, 87 short wall, 11 long wall, and 5 were of other types. The quantity of coal washed (most of which is slack used for making coke) was 252,799 tons, the cleaned coal amounting to 193,513 tons and the refuse to 59,286 tons.

Reports to the Bureau of Mines show that there were 75 fatal accidents in the coal mines of Colorado in 1914, a decrease of 33 as compared with 1913. Of the total deaths, 42 were due to falls of roof and coal, 13 to accidents in connection with mine cars and locomotives, 6 to electric shocks, and 14 (2 of which were on the surface) were due to other causes.

The statistics of production in Colorado in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Colorado in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Boulder	846,402	12,778	43,738	....	902,918	$1,539,062	$1.70	242	1,178
Delta	71,235	14,019	1,210	....	86,464	130,631	1.51	176	102
El Paso	169,660	141,128	16,111	....	326,899	487,419	1.49	240	415
Fremont	487,617	28,161	20,000	....	535,778	1,097,320	2.05	170	1,291
Garfield	148,545	2,523	7,594	....	158,662	211,664	1.33	220	179
Gunnison	412,263	2,380	22,730	35,380	472,753	726,846	1.54	195	622
Huerfano	1,626,739	10,599	67,902	....	1,705,240	2,822,242	1.66	208	2,351
La Plata	102,580	23,651	1,121	12,703	140,055	238,354	1.70	241	187
Las Animas	2,236,957	57,028	91,253	1,354,119	3,739,357	4,915,606	1.31	269	4,293
Mesa	101,527	28,346	4,565	....	134,438	197,182	1.47	232	127
Routt	315,325	5,183	14,453	....	334,961	578,195	1.73	160	431
Weld	363,392	26,667	19,072	....	409,131	667,622	1.63	224	468
Other counties [a]	254,391	4,404	18,500	210	277,505	406,716	1.47	218	346
Small mines	....	8,349	....	....	8,349	16,231	1.94	....	....
Total	7,136,633	365,216	328,249	1,402,412	9,232,510	14,035,090	1.52	229	11,990

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

Production of coal in Colorado in 1913 and 1914, by counties, in short tons—Continued.

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Mads into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Boulder	939,957	12,109	48,524	....	1,000,590	$1,596,305	$1.60	213	1,203
Delta	77,552	8,409	900	....	86,861	130,273	1.50	192	102
El Paso	150,435	121,535	8,607	....	280,577	438,092	1.56	249	349
Fremont	148,325	14,631	6,315	....	169,271	431,403	2.55	262	255
Garfield	101,546	2,136	9,160	....	112,842	188,130	1.67	249	135
Gunnison	379,923	2,596	19,526	....	402,045	632,945	1.57	208	531
Huerfano	1,661,063	9,912	53,290	....	1,724,265	3,200,729	1.86	259	2,244
La Plata	100,189	16,804	1,348	13,976	132,317	211,555	1.60	202	185
Las Animas	1,426,121	40,321	87,525	1,139,321	2,693,288	4,151,333	1.54	269	3,318
Mesa	122,997	34,797	6,100	....	163,894	250,980	1.53	221	196
Routt	636,650	7,804	21,930	....	666,384	1,298,428	1.95	246	681
Weld	428,134	29,236	18,364	....	475,734	697,682	1.47	180	563
Other counties [a]	229,898	8,326	18,556	179	256,959	363,831	1.42	207	336
Small mines	....	5,532	....		5,532	10,032	1.81	....	....
Total	6,402,790	314,148	300,145	1,153,476	8,170,559	13,601,718	1.66	244	10,098

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

Las Animas County was the scene of the greater part of the labor trouble in 1914 and sustained the heaviest loss of output. The decrease was 1,046,069 short tons, or almost 28 per cent, as compared with 1913, and the output of Las Animas County was the lowest since 1901, or in 13 years. The production of Fremont County decreased 366,507 tons, Gunnison 70,708 tons, El Paso 46,322 tons, and Garfield 45,820 tons. Of the 14 counties listed separately in the following table, 7 showed increase in 1914. The largest increase was in Routt County and amounted to almost 100 per cent. The completion of the Denver & Salt Lake Railroad (originally known as the "Moffat road"), in 1913, as far west as Craig and well into the center of the Routt County fields, has furnished an outlet at Denver for a large quantity of these coals.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are given in the following table:

Production of coal in Colorado, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (—), 1914.
Boulder	802,769	954,752	1,054,925	902,918	1,000,590	+ 97,672
Delta	63,590	71,399	75,043	86,464	86,861	+ 397
El Paso	336,780	332,155	334,904	326,899	280,577	— 46,322
Fremont	722,142	661,240	738,833	535,778	169,271	— 366,507
Garfield	189,755	165,908	185,452	158,662	112,842	— 45,820
Gunnison	640,982	575,648	557,685	472,753	402,045	— 70,708
Huerfano	2,387,090	1,786,654	1,899,538	1,705,240	1,724,265	+ 19,025
Jefferson	227,744	1,187	94,534	155,928	141,537	— 14,391
La Plata	147,755	96,749	132,487	140,055	132,317	— 7,738
Las Animas	5,548,085	4,458,753	4,708,698	3,739,357	2,693,288	—1,046,069
Mesa	129,530	92,881	114,493	134,438	163,894	+ 29,456
Pitkin	183,068	101,773	74,683	53,317	63,904	+ 10,587
Routt	258,452	317,791	448,261	334,961	666,384	+ 331,423
Weld	322,896	520,396	491,037	409,131	475,734	+ 66,603
Other counties [a]	13,098	20,097	67,251	76,609	57,050	— 19,559
Total	11,973,736	10,157,383	10,977,824	9,232,510	8,170,559	—1,061,951
Total value	$17,026,934	$14,747,764	$16,345,336	$14,035,090	$13,601,718	— $433,372

[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 for the first time reached 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 eight times altogether in 40 years. The largest decrease was in the "hard-times" year—1894. The production exceeded 3,000,000 tons in 1890; 10 years later it had grown to more than 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, and in 1913 and 1914 below the 10,000,000-ton mark.

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

Production of coal in Colorado from 1864 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1864	500	1878	200,630	1891	3,512,632	1904	6,658,355
1865	1,200	1879	322,732	1892	3,510,830	1905	8,826,429
1866	6,400	1880	462,747	1893	4,102,389	1906	10,111,218
1867	17,000	1881	706,744	1894	2,831,409	1907	10,790,236
1868	10,500	1882	1,061,479	1895	3,082,982	1908	9,634,973
1869	8,000	1883	1,229,593	1896	3,112,400	1909	10,716,936
1870	4,500	1884	1,130,024	1897	3,361,703	1910	11,973,736
1871	15,600	1885	1,356,062	1898	4,076,347	1911	10,157,383
1872	68,540	1886	1,368,338	1899	4,776,224	1912	10,977,824
1873	69,997	1887	1,791,735	1900	5,244,364	1913	9,232,510
1874	77,372	1888	2,185,477	1901	5,700,015	1914	8,170,559
1875	98,838	1889	2,597,181	1902	7,401,343		
1876	117,666	1890	3,077,003	1903	7,423,602	Total.	183,532,257
1877	160,000						

GEORGIA.

Total production in 1914, 166,498 short tons; spot value, $239,462.

The coal production in Georgia in 1914 was, with the exception of that of 1911, the smallest in 29 years, or since 1886. As compared with the output of 255,626 tons, valued at $361,319, in 1913, the production of 1914 decreased 34.8 per cent in quantity and 33.7 per cent in value.

The production of coal in Georgia has fluctuated greatly from year to year since 1876, when it first exceeded 100,000 tons. The years in which the production has reached temporary maxima, after which it suffered a temporary decrease, are 1881, with 168,000 tons; 1887, with 313,715 tons; 1890, with 228,337 tons; 1893, with 372,740 tons; 1898, with 244,187 tons; 1903 with the highest record for the State of 416,951 tons, and 1907 and 1913, with 362,401 and 255,626 tons, respectively. A noteworthy feature is that in nearly every instance the year following one of the high points has recorded the minimum for that period, succeeding which there has been a steady building up to the next high point.

The fluctuations have been due in the past for the most part to peculiar labor conditions. Prior to 1904 the principal labor employed in the coal mines of Georgia consisted of convicts leased from the State government. An act of the legislature prohibiting further leasing of convicts to industrial enterprises caused the gradual withdrawal from the coal mines of this labor as contracts expired, and operators in the somewhat isolated region where the mines are located were unable to supply the deficiency by free labor.

The influence of free labor on the efficiency record is shown by the fact that in 1907, when the principal labor was performed by convicts, it required 808 men, working an average of 262 days, to produce 362,401 tons, an average of 449 tons per man for the year, and of 1.71 tons for each working day. In 1908 under similar conditions, 670 men, working 261 days, produced 264,822 tons, the corresponding averages being respectively 395 tons and 1.51 tons. As compared with these figures it is interesting to note the increase in apparent efficiency in later years when free labor has been used. In 1913 only 500 men, working 261 days, produced 255,626 tons, and 355 men, working 207 days, produced 166,498 tons in 1914, the averages per man being 511 tons for the year and 1.96 tons a day in 1913 and 469 tons for the year and 2.27 tons a day in 1914.

No mining machines are used in the coal mines of Georgia. The reports to the Geological Survey show that the whole output in 1914 was shot off the solid. Almost one-half the entire production (75,952 tons in 1914) was washed coal. The total quantity of coal sent to the washeries in 1914 was 101,932 tons, of which 25,980 tons were discarded as refuse. Georgia "washed nut" has a high reputation as a steam and domestic fuel.

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

Production of coal in Georgia, 1910–1914, 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 at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
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
1913	122,499	1,303	7,518	124,306	255,626	361,319	1.41	261	500
1914	85,645	1,400	7,900	71,553	166,498	239,462	1.44	207	355

The Eighth United States Census contains the first authentic statement of the 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 production since 1860 is shown in the following table:

Production of coal in Georgia, 1860–1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	1,900	1875	80,000	1890	228,337	1905	351,991
1861	2,500	1876	110,000	1891	171,000	1906	332,107
1862	3,500	1877	120,000	1892	215,498	1907	362,401
1863	6,000	1878	128,000	1893	372,740	1908	264,822
1864	10,000	1879	140,000	1894	354,111	1909	211,196
1865	10,000	1880	154,644	1895	260,998	1910	177,245
1866	8,000	1881	168,000	1896	238,546	1911	165,210
1867	8,000	1882	160,000	1897	195,869	1912	227,503
1868	10,000	1883	155,000	1898	244,187	1913	255,626
1869	12,000	1884	150,000	1899	233,111	1914	166,498
1870	15,000	1885	150,000	1900	315,557		
1871	20,000	1886	223,000	1901	342,825	Total	9,591,796
1872	25,000	1887	313,715	1902	414,083		
1873	40,000	1888	180,000	1903	416,951		
1874	60,000	1889	225,934	1904	383,191		

IDAHO.

The production of coal in Idaho in 1914 was confined to 1 mine in the Teton Basin coal field, in the eastern part of the State. The output of this mine, which produces a fair grade of bituminous coal, is included in the statement of the production of California. The production in Idaho from 1908 to 1914 is given in the following table:

Production of coal in Idaho, 1908–1914, in short tons.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1908	5,429	$21,832	1912	2,319	$6,603
1909	4,553	19,459	1913	2,143	5,149
1910	4,448	17,426	1914	(a)	(a)
1911	1,805	4,808			

a Included with California.

ILLINOIS.

Total production in 1914, 57,589,197 short tons; spot value, $64,693,529.

Notwithstanding the fact that the coal output of Illinois in 1914 was less than in 1913 by 4,029,547 tons, or 6.5 per cent, in quantity and $5,620,076, or 8 per cent, in value, the record for 1914 was exceeded in the history of the State by those of only two other years, 1912 and 1913. Although 23,506 men (almost one-third of the total) were on strike for an average of 41 days, and the time thus lost represented over 7 per cent of the total time made, the decrease in output was in nowise due to that cause. The greater part of the lost time was occasioned by the biennial shutdown, which has now become a regular incident of the spring months of the "even" years in Illinois coal mining, and which began as usual on April 1 (1914) and lasted in certain districts from 30 to 60 days. This closing down of the mines was anticipated, and in January and February the coal output was above normal to supply orders for storage to tide over the expected shortage. Owing to the prevailing business depression in the latter part of 1914 railroad requirements fell off, and to a less extent the demands from industrial enterprises decreased.

A drought in southern Illinois and Indiana affected local business considerably and increased mining costs, as many mines had to ship in water in tank cars. The mild weather until December in the St. Louis district and the lack of purchasing power on the part of many householders in consequence of a period of unemployment resulted in a smaller demand than usual for domestic sizes. Except during the period of suspension, in April and May, the supply of labor was plentiful and transportation facilities were adequate throughout the year.

The average value per ton declined from $1.14 in 1913 to $1.12 in 1914. An increase in value per ton was recorded in nearly one-third of the coal-producing counties, all, however, having outputs of less than 400,000 tons, except Bureau, in the northern part of the State, Christian in the central, and Clinton and Franklin in the southern part. In the northern portion of Illinois a more or less general though slight increase in value was shown. In most instances, however, the counties reporting an increased value per ton decreased in production.

There are more coal-mining counties in Illinois than in any other State in the Union, half of the 102 counties being, or having been, producers. The two most important producing counties are in the southern part of the State, where the coal beds attain a greater thickness than in the northern districts. The principal increase in production in 1914 was in Franklin County where a large development has taken place during the last four years, advancing the county from eighth place in 1910 to first in 1914. In 1914 Franklin County produced 7,311,209 tons of coal, an increase over 1913 of 1,239,107 tons, or 20 per cent. Williamson County was second, with an output of 7,066,029 tons. Sangamon and Macoupin counties, which form the more important part of the Springfield-Belleville belt, were third and fourth in rank, respectively, Sangamon contributing 5,679,595 tons and Macoupin 4,555,834 tons in 1914. Saline County, on the southern border of the Illinois field, was fifth in importance, with a production of 3,746,656 tons; and Madison and St. Clair counties, with 3,546,256 and 3,246,322 tons, respectively, were sixth and seventh in rank. Vermilion, Perry, Montgomery, and Fulton counties each produced over 2,000,000 tons, and five other counties had outputs exceeding 1,000,000 tons in 1914. Perry County, whose output next to that of Franklin showed the largest increase in 1914, gained 223,352 tons. The principal decreases in production were in St. Clair (1,137,137 tons), Vermilion (1,107,799 tons), Williamson (578,368 tons), Macoupin (541,785 tons), Saline (442,347 tons), and Bureau (354,897 tons). Coal mining on a commercial scale was carried on in 50 counties of Illinois in 1914, as compared with 48 in 1913, Hancock and Johnson counties having reentered the list of producers in 1914.

Until 1909 Illinois ranked second in importance among the coal-producing States, although in one previous year, 1906, West Virginia temporarily displaced Illinois. In 1909 Illinois again dropped behind West Virginia, and has remained and will probably continue to remain indefinitely the third State in coal-producing importance. In 1914 West Virginia exceeded Illinois by approximately 14,000,000 tons.

The increased efficiency of the labor employed in the coal mines of Illinois, as noted in the reports of this series for 1912 and 1913, continued in 1914 and was due chiefly to the larger production obtained by the use of mining machinery. In 1914 the average production per man in the Illinois coal mines was 724 tons for the year and 4.2 tons for each working day, against 775 tons for the year and 4.1 tons for each day in 1913. The quantity of coal mined by machines increased from 32,630,555 tons, or 53 per cent of the total, in 1913 to 32,640,528 tons, or 56 per cent, in 1914. It is gratifying to note the corresponding decrease in the coal shot off the solid. In 1912 the quantity of coal mined by powder in the mines of Illinois was 24,136,940 tons, or 40 per cent of the total; in 1913 that item amounted to 20,469,139 tons, or 33 per cent of the total; and in 1914 it amounted to 18,362,240 tons, or 32 per cent of the total. The quantity of coal mined by hand, which increased from 7,675,805 tons in 1912 to 8,069,361 tons in 1913, decreased in 1914 to 6,029,477 tons, or 10.4 per cent of the total. The quantity of coal mined in open pits with steam shovels was 324,487 tons in 1914. The prevalence of shooting off the solid in the Illinois coal mines has been little short of criminal, for it adds materially to the hazardous character of the miner's occupation and seriously impairs the quality of the product. The trade on which the mines of Illinois depend demands principally screened coal, with little sale for the slack or screenings except at greatly reduced price. Shooting off the solid adds largely to the percentage of the slack coal and increases the friability of the product, which comes from the mines in lumps but breaks down rapidly in handling. With the increased use of coal-cutting machinery it is believed that within a few years little coal will be mined in Illinois without having been previously undercut or sheared. The flat-lying character of the Illinois coal beds is favorable to machine mining, and there appears to be no good reason for permitting shooting off the solid to continue. The number of machines in use in 1914 (1,812) was practically the same as in 1913 (1,845). There were fewer punchers in use in 1914 than in 1913, the number of that type of machine having decreased from 802 to 649. The number of chain breast machines, on the other hand, increased from 906 to 993, and the short wall machines from 82 to 122. The number of long wall machines decreased from 55 to 48. Considerable quantities of Illinois coal are washed in preparation for the domestic trade, and washed Illinois egg and nut coals have a distinctive place in the markets. Many of the operators who cater to the domestic trade in Illinois coal carefully size their product by screens, sometimes as many as half a dozen sizes being prepared. Certain types of washers are much more effective when the coal has been screened before washing, and usually the washed coal has also been sized. In 1914 the quantity of Illinois coal washed was 3,957,895 tons, which yielded 3,484,606 tons of cleaned coal and 473,235 tons of refuse.

The casualty record of the coal mines of Illinois, maintained by the Bureau of Mines, shows that there were 193 fatal accidents in 1914, as compared with 164 in 1913 and 159 in 1912. All but 9 of the fatalities occurred underground, and 69 of them were due to falls of roof and coal. Mine cars and locomotives were responsible for 38 deaths; explosions of gas killed 55; premature blasts and other accidents from explosives killed 9; electric shocks and burns killed 2, and 3 deaths were due to other causes. Eight men lost their lives in shafts, and 9 on the surface. The death rate per thousand was 2.43 in 1914, against 2.06 in 1913 and 2.04 in 1912. The quantity of coal mined for each life lost was 298,389 short tons in 1914, against 375,724 in 1913, and 376,637 in 1912.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Illinois in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Bureau	1,514,958	55,964	68,286	1,639,208	$2,614,561	$1.60	207	3,790
Christian	1,353,559	79,286	71,871	1,504,716	1,672,004	1.11	156	2,294
Clinton	1,001,903	11,601	36,071	1,049,575	1,021,262	.97	157	1,377
Franklin	5,872,038	42,254	157,810	6,072,102	7,007,904	1.15	220	5,662
Fulton	2,282,585	45,766	60,424	2,388,775	3,055,825	1.28	191	3,569
Gallatin	41,214	3,884	1,007	46,105	50,835	1.10	113	148
Grundy	361,221	23,598	16,708	401,527	663,649	1.65	153	1,148
Henry	320	41,388	1,675	43,383	79,015	1.82	180	113
Jackson	641,946	27,912	54,005	723,863	1,028,754	1.42	174	974
Knox	....	17,672	608	18,280	34,318	1.88	189	51
La Salle	1,125,740	364,790	73,929	1,564,459	2,738,704	1.75	237	2,893
Livingston	1,524	61,154	1,199	63,877	104,901	1.64	248	100
Logan	268,696	55,273	27,697	351,666	435,250	1.24	193	597
McDonough	1,682	10,921	....	12,603	27,656	2.19	161	35
Macoupin	4,908,004	71,020	118,595	5,097,619	5,057,710	.99	193	5,472
Madison	3,534,531	105,390	92,232	3,732,153	3,824,161	1.02	157	4,393
Marion	945,572	18,356	25,036	988,964	998,143	1.01	175	1,438
Marshall	340,639	62,174	23,677	426,490	776,171	1.82	217	1,078
Menard	77,673	35,577	6,924	120,174	151,633	1.26	148	281
Mercer	374,846	18,305	15,724	408,875	580,790	1.42	198	581
Montgomery	2,603,826	37,975	47,901	2,689,702	2,797,777	1.04	187	3,086
Peoria	1,048,737	91,910	22,426	1,163,073	1,432,687	1.23	206	1,519
Perry	1,918,763	30,146	64,219	2,013,128	2,055,441	1.02	190	2,267
Randolph	711,894	28,316	23,262	763,472	772,579	1.01	149	1,003
Rock Island	2,062	29,810	3,800	35,672	54,677	1.53	132	75
St. Clair	4,105,508	187,707	90,244	4,383,459	4,192,122	.96	175	4,785
Saline	4,065,766	33,728	89,509	4,189,003	4,739,217	1.13	200	4,911
Sangamon	5,457,986	255,273	162,594	5,875,853	6,277,960	1.07	164	7,775
Shelby	165,489	18,678	9,465	193,632	259,053	1.34	167	406
Stark	3,775	10,315	520	14,610	26,060	1.78	141	46
Tazewell	268,412	67,015	6,199	341,626	417,709	1.22	246	433
Vermilion	3,268,325	174,752	58,803	3,501,880	4,007,167	1.14	214	4,058
Will	130,668	14,358	4,900	149,926	285,640	1.91	187	387
Williamson	7,379,489	67,203	197,705	7,644,397	8,263,104	1.08	180	9,472
Other counties[a] and small mines	1,549,728	369,486	85,683	2,004,897	2,809,166	1.40	214	3,312
Total	57,329,079	2,568,957	1,720,708	61,618,744	70,313,605	1.14	189	79,529

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

Production of coal in Illinois in 1913 and 1914, by counties, in short tons—Continued.

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Bureau	1,211,076	37,035	36,200	1,284,311	$2,138,716	$1.67	186	3,404
Christian	1,365,081	75,474	45,498	1,486,053	1,677,143	1.13	164	2,007
Clinton	1,040,902	13,956	35,929	1,090,787	1,110,044	1.02	153	1,579
Franklin	7,023,068	79,782	208,359	7,311,209	8,533,516	1.17	199	7,661
Fulton	1,960,370	49,534	42,266	2,052,170	2,588,881	1.26	167	3,407
Gallatin	79,540	1,575	620	81,735	84,135	1.03	185	129
Greene	....	6,590	75	6,665	13,330	2.00	164	21
Grundy	352,299	23,657	12,412	388,368	686,992	1.77	147	1,264
Henry	....	45,232	1,778	47,010	75,791	1.61	213	92
Jackson	545,992	19,101	36,604	601,697	855,951	1.42	145	928
Knox	....	13,650	500	14,150	27,230	1.92	192	36
La Salle	849,159	371,963	58,470	1,279,592	2,242,493	1.75	188	2,810
Livingston	12,863	47,770	3,828	64,461	106,380	1.65	217	87
Logan	250,031	73,215	28,935	352,181	460,647	1.31	158	748
McDonough	....	5,251	....	5,251	10,695	2.04	181	26
Macoupin	4,387,704	80,537	87,593	4,555,834	4,363,318	.96	166	5,486
Madison	3,369,242	93,198	83,816	3,546,256	3,509,461	.99	167	3,824
Marion	871,319	12,243	23,275	906,837	904,590	.99	202	1,112
Marshall	301,152	60,231	21,948	383,331	708,250	1.85	235	918
Menard	40,409	33,780	2,414	76,603	103,206	1.35	95	266
Mercer	342,329	16,141	14,058	372,528	538,637	1.45	177	479
Montgomery	2,526,076	29,134	42,467	2,597,677	2,636,581	1.01	182	2,886
Peoria	950,300	86,474	18,549	1,055,323	1,267,777	1.20	183	1,540
Perry	2,148,936	40,688	46,856	2,236,480	2,173,488	.97	197	2,574
Randolph	895,995	31,466	29,121	956,582	937,564	.98	169	1,226
Rock Island	....	35,308	714	36,022	62,703	1.74	140	72
St. Clair	3,017,040	160,330	68,952	3,246,322	2,951,890	.91	132	4,696
Saline	3,640,096	28,451	78,109	3,746,656	4,034,121	1.08	171	5,667
Sangamon	5,284,214	258,576	136,805	5,679,595	5,955,278	1.05	168	7,150
Shelby	168,105	19,489	8,745	196,339	248,641	1.27	149	362
Stark	200	12,353	150	12,703	25,181	1.98	151	34
Tazewell	276,552	54,217	4,797	335,566	412,466	1.23	217	456
Vermilion	2,194,218	156,228	43,635	2,394,081	2,716,631	1.13	170	3,488
Will	117,347	13,551	5,860	136,758	240,192	1.76	178	379
Williamson	6,832,513	53,316	180,200	7,066,029	7,500,210	1.06	166	9,149
Other counties[a] and small mines	1,529,262	377,007	79,766	1,986,035	2,791,400	1.41	185	3,536
Total	53,583,390	2,516,503	1,489,304	57,589,197	64,693,529	1.12	173	79,499

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

The statistics of production, by counties, from 1910 to 1914, with increase or decrease in 1914, are shown in the following table:

Production of coal in Illinois, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (−), 1914.
Bond	139,398	119,250	232,571	223,786	123,730	− 100,056
Bureau	973,346	1,628,688	1,677,317	1,639,208	1,284,311	− 354,897
Calhoun	....	1,400	1,156	....	....	....
Christian	1,223,295	1,222,259	1,467,846	1,504,716	1,486,053	− 18,663
Clinton	950,243	921,225	1,040,479	1,049,575	1,090,787	+ 41,212
Franklin	1,778,768	3,555,586	4,442,284	6,072,102	7,311,209	+1,239,107
Fulton	1,721,527	2,133,029	2,453,424	2,388,775	2,052,170	− 336,605
Gallatin	70,091	63,008	64,244	46,105	81,735	+ 35,630
Greene	9,082	6,207	7,841	5,009	6,665	+ 1,656
Grundy	600,281	776,800	540,787	401,527	388,368	− 13,159
Hancock	640	230	....	....	1,678	+ 1,678
Henry	124,243	90,722	58,613	43,383	47,010	+ 3,627
Jackson	584,240	687,753	703,190	723,863	601,697	− 122,166
Jefferson	10,000	9,500	21,032	35,000	9,051	− 25,949
Knox	28,295	30,136	22,293	18,280	14,150	− 4,130
La Salle	1,178,885	1,610,470	1,537,591	1,564,459	1,279,592	− 284,867
Livingston	162,898	89,423	65,774	63,877	64,461	+ 584
Logan	409,244	334,860	466,528	351,666	352,181	+ 515
McDonough	26,338	8,027	14,446	12,603	5,251	− 7,352
McLean	83,982	96,517	89,781	88,777	79,008	− 9,769
Macon	235,361	236,203	291,590	206,140	217,217	+ 11,077
Macoupin	3,854,229	4,688,212	4,986,574	5,097,619	4,555,834	− 541,785
Madison	4,102,773	3,152,705	4,025,878	3,732,153	3,546,256	− 185,897
Marion	812,873	1,224,326	1,311,024	988,964	906,837	− 82,127
Marshall	267,447	423,984	449,660	426,490	383,331	− 43,159
Menard	332,557	190,477	177,578	120,174	76,603	− 43,571
Mercer	229,024	297,552	393,018	408,875	372,528	− 36,347
Montgomery	1,799,720	2,395,814	2,182,823	2,689,702	2,597,677	− 92,025
Morgan	1,300	1,268	1,000	1,222	[a] 906	− 316
Peoria	810,595	1,037,362	1,225,574	1,163,073	1,055,323	− 107,750
Perry	1,367,771	1,272,292	1,444,114	2,013,128	2,236,480	+ 223,352
Putnam	364,882	772,976	720,048	724,170	605,863	− 118,307
Randolph	1,025,557	777,746	798,163	763,472	956,582	+ 193,110
Rock Island	66,207	65,983	66,817	35,672	36,022	+ 350
St. Clair	5,788,567	3,931,479	4,734,840	4,383,459	3,246,322	−1,137,137
Saline	2,459,650	3,820,410	4,417,874	4,189,003	3,746,656	− 442,347
Sangamon	4,449,634	5,137,835	5,714,742	5,875,853	5,679,595	− 196,258
Schuyler	2,427	6,138	4,573	1,855	2,781	+ 926
Scott	2,400	464	460	600	1,000	+ 400
Shelby	135,672	81,615	185,501	193,632	196,339	+ 2,707
Stark	32,582	37,293	34,176	14,610	12,703	− 1,907
Tazewell	155,659	220,783	271,321	341,626	335,566	− 6,060
Vermilion	2,515,250	3,385,200	3,434,923	3,501,880	2,394,081	−1,107,799
Warren	10,275	9,044	5,021	3,383	1,510	− 1,873
Washington	22,500	25,000	244,879	319,370	497,000	+ 177,630
White	23,722	35,681	27,052	22,304	32,111	+ 9,807
Will	124,652	178,397	130,806	149,926	136,758	− 13,168
Williamson	4,620,372	6,614,029	7,354,507	7,644,397	7,066,029	− 578,368
Woodford	125,823	164,001	185,499	[b] 302,184	[b] 315,840	+ 13,656
Small mines	85,969	109,759	157,994	71,097	98,340	+ 27,243
Total	45,900,246	53,679,118	59,885,226	61,618,744	57,589,197	−4,029,547
Total value	$52,405,897	$59,519,478	$70,294,338	$70,313,605	$64,693,529	−$5,620,076

[a] Includes production of Johnson County. [b] Includes production of Moultrie County.

The first mention of coal in the territory which afterward became the United States has been attributed to Father Louis Hennepin. According to S. O. Andros,[1] however, the credit for this first mention of coal does not belong to Hennepin, as the discovery of coal in the United States by Europeans was made by Joliet and Marquette in 1673—according to Joliet's map (1674), probably near Utica on the Rock Island Railroad in La Salle County. After the discovery of coal in Illinois, however, nearly a century and a half elapsed before mining began. The Journal of the Franklin Institute for 1836

[1] Andros, S. O., Coal-mining practice in District IV: Illinois Coal-Mining Investigations Bull. 12, 1915.

states that the first actual mining operations conducted by white men were at the Mount Carbon mines, near Brownsville, in Jackson County, on the banks of Big Muddy River, a short distance from its junction with the Mississippi. These mines were opened in 1810 and were worked to a limited extent for many years.[1] Another region, said to have been opened about the same time, was near Belleville, in St. Clair County, opposite the present site of St. Louis. The outcrops of coal in the bluffs along the river banks first attracted attention, and naturally the first mining operations were started on these exposures. The earliest recorded production was in 1833, when an output of 6,000 tons is said to have been mined.

The production of coal in Illinois from 1833 to the close of 1914 is shown in the following table:

Production of coal in Illinois, 1833–1914, 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	1913	61,618,744
1851	320,000	1872	3,360,000	1893	19,949,564	1914	57,589,197
1852	340,000	1873	3,920,000	1894	17,113,576		
1853	375,000	1874	4,203,000	1895	17,735,864	Total.	1,023,105,520

INDIANA.

Total production in 1914, 16,641,132 short tons; spot value, $18,290,928.

The slight decrease in the production of coal in Indiana, in 1914 (524,539 short tons, or 3 per cent, in quantity and $710,953, or 3.7 per cent, in value), is attributable to general commercial inactivity, mainly on the part of the railroads, and in some degree to mild winter weather. Local business was affected in the southern part of the State by drought. Six out of 19 coal-producing counties showed an increase in 1914, all of the increases being small except that in Vigo County, which increased its output in 1914 over 1913 by more than 530,000 tons. The increase in Vigo County was greater than the total decrease in the State. On the other hand, Greene County, with a production of 2,230,085 tons, decreased 550,000 tons from the output in 1913, and Clay, Knox, and Parke counties each showed a decrease of 100,000 tons. The average price per ton for the State, which declined to $1.11 in 1913 from $1.14 in 1912, was further depressed in 1914 to $1.10.

[1] Macfarlane, James, Coal regions of America, p. 421, New York, 1873.

Notwithstanding the adverse conditions which prevailed in 1914, labor was in better supply than in 1913. The total number of employees in the coal mines of Indiana increased from 22,235 in 1913 to 23,175 in 1914, but the average working time decreased from 190 days to 168 days. The average annual production per man decreased from 772 tons to 718 tons, and the average daily production by each man increased from 4.06 tons to 4.27 tons.

The production of machine-mined coal in 1914 amounted to 9,360,683 short tons, or 56.2 per cent of the total, as compared with 9,737,425 tons, or 57 per cent, in 1913. There was not, however, any decrease in the proportion of coal shot off the solid—5,175,229 tons in 1913 and 4,968,065 tons in 1914, the percentage being approximately the same in both years (30 per cent). The quantity of hand-mined coal decreased from 1,862,729 tons, or 11 per cent, in 1913 to 1,761,743 tons, or 10.6 per cent, in 1914. The number of mining machines in use increased from 732 in 1913 to 751 in 1914. Chain breast machines were in the majority, 391, or over half, being of that type in 1914. Of the remainder, 176 were punchers, 69 were long wall, and 115 were short wall or continuous cutters.

The number of fatal accidents reported to the Bureau of Mines in 1914 was 44, a decrease from 66 in 1913. Of the 44 fatalities, 40 were underground, 2 in shafts, and 2 on the surface. Falls of roof and coal claimed 21 victims, explosions of gas and dust, 3, and other causes underground, 16. The death rate per thousand was 1.90, against 2.97 in 1913, and the quantity of coal mined for each life lost was 378,207 tons, against 260,086 tons in 1913.

Strikes and suspensions resulted in the loss of an average of 38 days by the 8,052 men affected, the time lost being 7.8 per cent of the total time made.

The statistics of the production of coal in Indiana in 1913 and 1914, by counties, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Indiana in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Clay	503,663	32,352	28,942	564,957	$746,940	$1.32	165	1,317
Daviess	71,411	6,634	5,985	84,030	108,826	1.30	207	160
Dubois and Martin	5,550	2,198	200	7,948	12,563	1.58	164	21
Fountain and Warren	55,000	7,202	2,700	64,902	83,930	1.29	156	90
Gibson	162,053	58,994	6,053	227,100	249,513	1.10	199	305
Greene	2,668,439	42,877	69,392	2,780,708	3,041,689	1.09	198	3,137
Knox	1,677,295	46,533	36,920	1,760,748	1,820,017	1.03	203	1,395
Owen	119,258	2,200	5,825	127,283	140,089	1.10	181	120
Parke	472,626	16,534	18,348	507,508	601,127	1.18	197	941
Perry	....	14,910	....	14,910	22,649	1.52	255	37
Pike	550,899	19,912	12,826	583,637	652,648	1.12	186	912
Spencer	....	8,429	50	8,479	12,037	1.42	225	22
Sullivan	2,955,243	42,751	86,425	3,084,419	3,390,549	1.10	159	4,376
Vanderburg	140,892	132,913	6,717	280,522	363,572	1.30	196	459
Vermilion	1,999,539	19,617	66,155	2,085,311	2,313,690	1.11	212	2,484
Vigo	4,023,703	109,951	103,620	4,237,274	4,653,657	1.10	203	5,556
Warrick	628,714	38,096	18,210	685,020	705,894	1.03	179	903
Small mines	....	60,915	....	60,915	82,491	1.35	....	....
Total	16,034,285	663,018	468,368	17,165,671	19,001,881	1.11	190	22,235

Production of coal in Indiana in 1913 and 1914, by counties, in short tons—Continued.

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Clay	398,886	36,407	18,716	454,009	$630,913	$1.39	141	1,172
Daviess	74,957	10,701	5,950	91,608	115,444	1.26	189	171
Dubois and Martin		5,100	300	5,400	8,250	1.53	230	10
Fountain and Warren	36,891	3,673	200	40,764	54,131	1.33	127	88
Gibson	240,993	30,404	9,239	280,636	300,602	1.07	202	340
Greene	2,118,620	46,901	64,564	2,230,085	2,451,122	1.10	157	3,108
Knox	1,528,826	36,073	54,184	1,619,083	1,626,663	1.00	185	1,638
Owen	110,317	1,038		111,355	148,309	1.33	293	105
Parke	308,365	13,836	9,644	331,845	381,309	1.15	178	513
Perry		13,800		13,800	17,550	1.27	238	26
Pike	538,015	29,748	10,930	578,693	645,145	1.11	149	1,115
Spencer		8,510		8,510	11,382	1.34	195	16
Sullivan	2,872,723	38,792	87,633	2,999,148	3,228,204	1.08	167	3,787
Vanderburg	150,172	129,922	8,097	288,191	387,255	1.34	199	439
Vermilion	2,057,129	13,334	65,373	2,135,836	2,342,775	1.10	159	2,968
Vigo	4,521,653	148,104	98,071	4,767,828	5,258,500	1.10	175	6,837
Warrick	540,451	63,143	21,176	624,770	598,267	.96	166	842
Small mines		59,571		59,571	85,107	1.43		
Total	15,497,998	689,057	454,077	16,641,132	18,290,928	1.10	168	23,175

In the following table are shown the statistics of production of coal in Indiana, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913:

Production of coal in Indiana, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Clay	980,016	779,372	700,323	564,957	454,009	−110,948
Daviess	87,374	79,466	105,079	84,030	91,608	+ 7,578
Dubois	[a] 8,290	[a] 4,119	[a] 16,500	[a] 7,948	[a] 5,400	− 2,548
Fountain	3,300	1,700	1,100	60,200	38,458	− 21,742
Gibson	296,753	247,128	228,557	227,100	280,636	+ 53,536
Greene	3,439,002	2,563,366	2,636,509	2,780,708	2,230,085	−550,623
Knox	1,003,909	879,323	1,212,596	1,760,748	1,619,083	−141,665
Owen	10,690	22,693	30,707	127,283	111,355	− 15,928
Parke	764,115	521,567	523,150	507,508	331,845	−175,663
Perry	26,317	16,683	15,904	14,910	13,800	− 1,110
Pike	697,385	467,623	559,337	583,637	578,693	− 4,944
Spencer	9,096	9,551	10,306	8,479	8,510	+ 31
Sullivan	4,035,934	3,261,787	3,091,368	3,084,419	2,999,148	− 85,271
Vanderburg	398,293	279,109	302,074	280,522	288,191	+ 7,669
Vermilion	1,635,623	1,673,621	1,547,126	2,085,311	2,135,836	+ 50,525
Vigo	4,181,799	2,793,352	3,564,046	4,237,274	4,767,828	+530,554
Warren	5,122	3,925	3,966	4,702	2,306	− 2,396
Warrick	768,706	545,132	691,475	685,020	624,770	− 60,250
Small mines	38,091	51,838	45,595	60,915	59,571	− 1,344
Total	18,389,815	14,201,355	15,285,718	17,165,671	16,641,132	−524,539
Total value	$20,813,659	$15,326,808	$17,480,546	$19,001,881	$18,290,928	−710,953

[a] Includes Martin County.

In 1840 the United States census reported that the production of coal in Indiana in that year was 9,682 tons The industry developed slowly until 1865, when it was ascertained that the block coal mined in the Brazil and Terre Haute districts made a satisfactory blast-furnace fuel in its raw condition. At about that time the construction of railroads throughout the State gave an impetus to the coal-mining industry, which has shown steady progress, except when interrupted by periods of depression and labor disaffections.

The statistics of the production of coal in Indiana from 1840 to the close of 1914 are given in the following table, the years for which no official statistics are available having been covered by estimates from the best information obtainable:

Production of coal in Indiana from 1840 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	9,682	1860	101,280	1880	1,454,327	1900	6,484,086
1841	10,000	1861	128,000	1881	1,984,120	1901	6,918,225
1842	18,000	1862	150,000	1882	1,976,470	1902	9,446,424
1843	25,000	1863	200,000	1883	2,560,000	1903	10,794,692
1844	30,000	1864	250,000	1884	2,260,000	1904	10,842,189
1845	35,000	1865	280,000	1885	2,375,000	1905	11,895,252
1846	40,000	1866	320,000	1886	3,000,000	1906	12,092,560
1847	45,000	1867	350,000	1887	3,217,711	1907	13,985,713
1848	50,000	1868	375,000	1888	3,140,979	1908	12,314,890
1849	56,000	1869	400,000	1889	2,845,057	1909	14,834,259
1850	60,000	1870	437,870	1890	3,305,737	1910	18,389,815
1851	60,000	1871	600,000	1891	2,973,474	1911	14,201,355
1852	75,000	1872	896,000	1892	3,345,174	1912	15,285,718
1853	75,000	1873	1,000,000	1893	3,791,851	1913	17,165,671
1854	80,000	1874	812,000	1894	3,423,921	1914	16,641,132
1855	80,000	1875	800,000	1895	3,995,892		
1856	85,000	1876	950,000	1896	3,905,779	Total	268,273,230
1857	85,000	1877	1,000,000	1897	4,151,169		
1858	87,000	1878	1,000,000	1898	4,920,743		
1859	95,000	1879	1,196,490	1899	6,006,523		

IOWA.

Total production in 1914, 7,451,022 short tons; spot value, $13,-364,070.

Since 1906, when the coal production of Iowa first passed the 7,000,000-ton mark, the annual output has varied up and down between 7,000,000 and 8,000,000 tons. The production in 1914 showed a decrease, as compared with 1913, of 74,914 tons, or 1 per cent, in quantity and of $132,640, or 1 per cent, in value. Iowa is largely an agricultural State and as its crops were plentiful in 1914, the local coal consumption was approximately normal. The general lack of demand for coal in the Eastern States, for both industrial and railroad use caused a larger tonnage of West Virginia and other eastern coals to seek markets in the Northwest, thereby displacing Iowa coal. Illinois coal also invaded the local Iowa markets, both in Iowa itself and in Missouri, Kansas, and Nebraska, with the result that there was a slight decline in the production in Iowa. The greatest increase was in Lucas County (267,738 short tons) and was due principally to one company, which nearly doubled the number of days and men in 1914. Monroe County, with the largest production in the State, declined 298,211 tons in output. Altogether, 8 out of 21 counties whose production is published showed increase and 13 showed decrease.

The number of men employed in coal mines of Iowa increased from 15,757 in 1913 to 16,057 in 1914, and the average number of working days increased from 195 to 204. Consequently there was a decrease in the average annual production per man from 478 to 464 tons and in the average daily production from 2.45 to 2.27 tons.

Iowa is no exception to the other States of the Interior Province in which shooting from the solid is practiced to a reprehensible degree, and the record in that respect in 1914 was worse than in either 1913 or 1912. The quantity of coal shot off the solid in 1914 was 5,545,842 tons, or 74.4 per cent of the total; 72.3 per cent in 1913, and 69 per cent in 1912 of the total was powder-mined. Forty-six machines were reported in use in 1914, and 308,284 tons of coal were machine-mined. Of these machines, 2 were punchers, 4 chain breast, 18 long wall, 21 short wall, and 1 of a type not specified. The quantity of coal mined by hand was 1,449,026 tons, or 19.5 per cent of the total.

The total number of men on strike was 2,642, and the average time lost by each was 29 days.

The total quantity of coal washed in Iowa in 1914 was 25,706 tons, which yielded 18,000 tons of cleaned coal and 7,706 tons of refuse.

According to reports to the Bureau of Mines, there were 37 fatal accidents in the coal mines of Iowa in 1914, an increase of 11 over 1913. All of the fatalities occurred underground or in shafts, and 18 were due to falls of roof or coal. Five deaths were due to mine cars and locomotives, and 5 to explosions of coal dust. The death rate per thousand was 2.3, against 1.65 in 1913, and the quantity of coal mined for each life lost was 201,378 tons, as compared with 289,459 tons in 1913.

The statistics of the production of coal in Iowa in 1913 and 1914, by counties, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Iowa in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Adams	....	6,971	....	6,971	$17,536	$2.52	182	48
Appanoose	1,130,383	64,104	12,900	1,207,387	2,436,279	2.02	170	4,186
Boone	216,189	35,243	4,780	256,212	522,929	2.04	179	754
Dallas	546,832	8,348	19,006	574,186	1,077,293	1.88	245	889
Guthrie	....	4,492	....	4,492	11,890	2.65	147	29
Jasper	255,200	8,867	3,500	267,567	567,211	2.12	156	800
Mahaska	327,655	21,748	6,334	355,737	568,314	1.60	199	698
Marion	276,064	16,249	6,239	298,552	487,151	1.63	193	581
Monroe	2,457,050	50,226	64,001	2,571,277	4,087,032	1.59	215	4,138
Polk	1,345,237	213,296	42,482	1,601,015	2,984,919	1.86	212	2,591
Van Buren	6,000	8,381	....	14,381	32,772	2.28	224	29
Wapello	124,845	25,969	2,891	153,705	259,099	1.69	240	309
Wayne	73,215	11,760	800	85,775	172,531	2.01	193	253
Webster	42,373	1,553	1,750	45,676	101,078	2.21	215	130
Other counties [a] and small mines	23,890	57,963	1,150	83,003	170,676	2.06	81	322
Total	6,824,933	535,170	165,833	7,525,936	13,496,710	1.79	195	15,757

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Adams	....	6,660	....	6,660	$16,650	$2.50	232	47
Appanoose	1,195,603	64,383	12,290	1,272,276	2,505,646	1.97	168	4,084
Boone	125,462	46,970	9,520	181,952	368,175	2.02	177	556
Dallas	449,092	7,794	9,811	466,697	877,565	1.88	228	861
Guthrie	....	3,925	....	3,925	10,793	2.75	136	31
Jasper	214,166	22,325	5,500	241,991	532,396	2.20	190	531
Mahaska	243,885	23,975	5,008	272,868	400,722	1.47	206	522
Marion	284,791	15,805	10,587	311,183	498,894	1.60	225	573
Monroe	2,147,252	61,719	64,095	2,273,066	3,646,662	1.60	211	4,165
Polk	1,413,350	262,863	30,566	1,706,779	3,219,218	1.89	228	3,188
Wapello	206,458	26,508	4,210	237,176	409,177	1.73	231	596
Wayne	70,420	4,904	1,200	76,524	151,096	1.97	192	243
Webster	31,569	873	1,250	33,692	76,614	2.27	208	109
Other counties [b] and small mines	294,344	69,064	2,825	366,233	650,462	1.78	238	551
Total	6,676,392	617,768	156,862	7,451,022	13,364,070	1.79	204	16,057

[a] Greene, Jefferson, Keokuk, Lucas, Page, Taylor, and Warren.
[b] Greene, Jefferson, Keokuk, Lucas, Page, Taylor, Van Buren, and Warren.

The production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, is shown in the following table:

Production of coal in Iowa, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Adams	12,745	7,472	9,868	6,971	6,660	− 311
Appanoose	1,413,896	1,104,723	1,252,666	1,207,387	1,272,276	+ 64,889
Boone	275,882	214,440	212,168	256,212	181,952	− 74,260
Dallas	255,085	385,588	436,206	574,186	466,697	− 107,489
Greene	10,150	11,800	9,590	9,600	2,000	− 7,600
Guthrie	17,324	10,390	5,870	4,492	3,925	− 567
Jasper	349,063	292,427	271,301	267,567	241,991	− 25,576
Jefferson	7,530	5,129	4,248	3,000	1,973	− 1,027
Keokuk	13,141	12,512	14,290	4,404	4,504	+ 100
Lucas	11,233	13,337	15,459	27,904	295,642	+ 267,738
Mahaska	848,199	777,189	578,843	355,737	272,868	− 82,869
Marion	215,281	171,329	182,068	298,552	311,183	+ 12,631
Monroe	2,184,030	2,259,239	2,393,412	2,571,277	2,273,066	− 298,211
Page	10,550	12,396	5,050	1,250	1,075	− 175
Polk	1,778,264	1,532,010	1,486,053	1,601,015	1,706,779	+ 105,764
Scott	400	....	300	....	....	....
Taylor	9,749	9,950	5,120	6,223	8,827	+ 2,604
Van Buren	10,284	8,656	9,154	14,381	6,672	− 7,709
Wapello	283,500	312,332	206,102	153,705	237,176	+ 83,471
Warren	1,992	1,500	3,595	3,430	4,490	+ 1,060
Wayne	135,439	116,382	99,168	85,775	76,524	− 9,251
Webster	49,973	46,026	48,074	45,676	33,692	− 11,984
Other counties and small mines	34,410	[a] 26,821	[a] 40,924	[a] 27,192	[a] 41,050	+ 13,858
Total	7,928,120	7,331,648	7,289,529	7,525,936	7,451,022	− 74,914
Total value	$13,903,913	$12,663,507	$13,152,088	$13,496,710	$13,364,070	−$132,640

[a] Small mines only.

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, 1840–1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	400	1860	41,920	1880	1,461,116	1900	5,202,939
1841	500	1861	50,000	1881	1,960,000	1901	5,617,499
1842	750	1862	53,000	1882	3,920,000	1902	5,904,766
1843	1,000	1863	57,000	1883	4,457,540	1903	6,419,811
1844	2,500	1864	63,000	1884	4,370,566	1904	6,519,933
1845	5,000	1865	69,574	1885	4,012,575	1905	6,798,609
1846	6,500	1866	99,320	1886	4,315,779	1906	7,266,224
1847	8,000	1867	150,000	1887	4,473,828	1907	7,574,322
1848	10,000	1868	241,453	1888	4,952,440	1908	7,161,310
1849	12,500	1869	295,105	1889	4,095,358	1909	7,757,762
1850	15,000	1870	263,487	1890	4,021,739	1910	7,928,120
1851	18,000	1871	300,000	1891	3,825,495	1911	7,331,648
1852	20,000	1872	336,000	1892	3,918,491	1912	7,289,529
1853	23,000	1873	392,000	1893	3,972,229	1913	7,525,936
1854	25,000	1874	799,936	1894	3,967,253	1914	7,451,022
1855	28,000	1875	1,231,547	1895	4,156,074		
1856	30,000	1876	1,250,000	1896	3,954,028	Total	194,054,119
1857	33,000	1877	1,300,000	1897	4,611,865		
1858	37,500	1878	1,350,000	1898	4,618,842		
1859	42,000	1879	1,400,000	1899	5,177,479		

KANSAS.

Total production in 1914, 6,860,988 short tons; spot value, $11,238,253.

Although the output of coal in Kansas in 1914 decreased 341,222 tons, or 4.7 per cent, in quantity and $798, 039, or 6.6 per cent, in value, as compared with 1913, the year is reported to have been in other respects satisfactory to the operators. There was no serious trouble with labor, although there were some local strikes due to minor misunderstandings, but they were not of long duration. Stripping operations were forced to discontinue occasionally because of the flooding of pits, but there was no serious interference with coal-mining operation in the State in 1914. The decreased output is attributed to a generally mild winter and in part to the decreased demand from the railroads.

Kansas continues to show a slight improvement with regard to the reprehensible practice of shooting off the solid. The coal mined by that method was 5,275,611 tons, or 76.9 per cent of the total output in 1914, compared with 5,796,689 tons, or 80.5 per cent of the total in 1913. Machine-mining has not made much progress in Kansas, the quantity of coal so produced in 1914 having been less than 40,000 tons. The coal reported as mined by hand was 1,127,523 tons, or 16.4 per cent of the total, and by steam shovels 363,165 tons, or 5.3 per cent, and there were 55,495 tons of which the method of mining was not reported. A small percentage of the product (21,295 tons) was washed, yielding 16,236 tons of cleaned coal and 5,059 tons of refuse.

The number of men employed in the coal mines of Kansas in 1914 was 12,448, and they worked an average of 192 days, against 12,479 men for an average of 197 days in 1913. The average production per man was 551 tons for the year and 2.87 tons for each working day in 1914, compared with 577 tons for the year and 2.93 tons per day in 1913.

The number of fatal accidents reported to the Bureau of Mines in 1914, was 33, as compared with 28 in 1913. The death rate in 1914 was 2.65, against 2.24 in 1913, and the quantity of coal mined for each life lost was 207,909 tons, as compared with 257,222 tons in 1913.

The statistics of the production of coal in Kansas in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Kansas in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Cherokee	2,192,766	21,802	44,451	2,259,019	$3,740,324	$1.66	204	3,385
Crawford	4,464,565	46,020	103,672	4,614,257	7,513,732	1.63	197	7,656
Leavenworth	116,774	11,900	32,535	161,209	375,285	2.33	210	725
Linn	22,341	2,121	750	25,212	42,628	1.69	136	91
Franklin and Osage	106,841	10,473	212	117,526	309,939	2.64	153	622
Small mines		24,987		24,987	54,384	2.18		
Total	6,903,287	117,303	181,620	7,202,210	12,036,292	1.67	197	12,479

Production of coal in Kansas in 1913 and 1914, by counties, in short tons—Continued.

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Cherokee	1,822,503	18,702	41,605	1,882,810	$3,039,897	$1.61	199	2,898
Crawford	4,584,951	57,537	109,626	4,752,114	7,686,133	1.62	190	8,474
Franklin and Leavenworth	58,644	45,909	7,400	111,953	231,704	2.07	247	467
Linn	4,800	5,680		10,480	17,840	1.70	252	21
Osage	82,345	5,840	186	88,371	228,966	2.59	135	588
Small mines		15,260		15,260	33,713	2.21		
Total	6,553,243	148,928	158,817	6,860,988	11,238,253	1.64	192	12,448

The statistics of production of coal in Kansas, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Kansas, 1910-1914, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Cherokee	1,477,525	2,036,052	2,332,944	2,259,019	1,882,810	− 376,209
Cloud	800					
Crawford	2,986,411	3,778,242	4,255,415	4,614,257	4,752,114	+ 137,857
Franklin	2,000	2,400	725	1,716	1,162	− 554
Leavenworth	275,377	206,049	204,523	161,209	110,791	− 50,418
Linn	24,298	27,366	33,588	25,212	10,480	− 14,732
Osage	116,769	104,479	135,796	115,810	88,371	− 27,439
Other counties and small mines	38,271	24,140	23,191	[a] 24,987	[a] 15,260	− 9,727
Total	4,921,451	6,178,728	6,986,182	7,202,210	6,860,988	− 341,222
Total value	$7,914,709	$9,473,572	$11,324,130	$12,036,292	$11,238,253	−$798,039

[a] Small mines only.

The earliest record of the production of coal 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 United States Geological Survey, as shown in the following table giving the production of coal in Kansas from 1869 to 1914, inclusive:

Production of coal in Kansas, 1869 to 1914, 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	1913	7,202,210
1878	375,000	1890	2,259,922	1902	5,266,065	1914	6,860,988
1879	460,000	1891	2,716,705	1903	5,839,976		
1880	771,442	1892	3,007,276	1904	6,333,307	Total.	136,557,749

KENTUCKY.

Total production in 1914, 20,382,763 short tons; spot value, $20,852,463.

A record in coal production in Kentucky was established in 1914, the output exceeding the previous high mark of 1913 by 766,163 tons, or 4 per cent, in quantity and $335,714, or 1.6 per cent, in value. This increase is all the more notable as it was in a year when nearly every other State showed a decrease. Increases were recorded in 11 counties, and decreases in 14. The greatest decline was in Muhlenberg (368,118 tons) the only county decreasing in output yet having a production of more than 1,000,000 tons. Three other counties, Ohio, Union, and Whitley, reported decreases of 100,000 tons. The greatest increases were in Harlan (513,799 tons), Letcher (322, 174 tons), and Pike (529,274) tons). The increase was due to activity in coal-mining operations in the eastern part of the State, particularly along the Virginia border, in the three counties just mentioned, which were opened for a big production by the construction of new railroads in the period from 1910 to 1913. The average value per ton decreased from $1.05 in 1913 to $1.02 in 1914, which latter was the average value also in 1912.

The number of men employed in the coal mines of Kentucky increased from 26,332 in 1913 to 28,764 in 1914, but the average working time decreased from 212 days to 187 days, the total working time showing a decrease of 3 per cent, as compared with an increase of 4 per cent in production. The average production by each man employed was 709 tons in 1914 against 745 in 1913. The average daily production per man increased from 3.5 tons in 1913 to 3.8 in 1914.

The increase in individual production was due in large part, if not entirely, to the extended use of mining machines. The quantity of coal mined by machines increased from 14,353,583 tons, or 73.2 per cent of the total, in 1913 to 15,731,332 tons, or 77.2 per cent, in 1914. The increase in the output by machines was 1,377,749 tons, or more than the total increase in the State. The number of machines in use increased from 1,263 in 1913 to 1,383 in 1914. Of the machines in use in 1914, 590 were punchers, 369 chain breast, 367 short wall, 40 long wall, 1 radialax[1] or post puncher, and 16 were of other types. The quantity of coal shot off the solid in 1914 was 2,362,404 tons, or 11.6 per cent, a decrease from 3,092,985 tons, or 15.7 per cent, in 1913. The quantity undercut by hand in 1914 was 2,001,410 tons, or 9.8 per cent of the total.

Coal-mining operations in Kentucky in 1914 were not seriously interfered with by strikes, 2,250 men being on strike for an average of 37 days, and the time lost being 1.5 per cent of the time made.

According to the Bureau of Mines, there was an increase in fatalities in the coal mines of Kentucky from 48 in 1913 to 61 in 1914. Thirty of the deaths were caused by falls of roof, 13 by mine cars and locomotives, 10 by other causes underground, and 8 by accidents in shafts and on the surface. The death rate per thousand men employed was 2.1, an increase from the record of 1913, when the rate was 1.8. The quantity of coal mined for each life lost was 334,144 tons, as compared with 408,679 tons in 1913.

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[1] Radialax, trade abbreviation for radial axial.

The statistics of production in 1913 and 1914, by counties, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Kentucky, 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Bell	2,357,173	79,019	52,346	....	2,488,538	$2,790,939	$1.12	242	3,721
Boyd	119,178	10,392	1,638	....	131,208	118,612	.90	237	197
Carter	57,656	52,412	527	....	110,595	108,307	.98	220	184
Christian	67,160	725	1,640	....	69,525	68,068	.98	166	160
Daviess	....	48,398	145	....	48,543	47,770	.98	252	67
Floyd	437,141	3,313	5,495	....	445,949	515,472	1.16	217	555
Hancock	....	6,280	....	....	6,280	8,170	1.30	179	14
Harlan	532,235	9,211	8,759	200,062	750,267	922,837	1.23	189	1,014
Henderson	127,634	85,765	7,183	....	220,582	240,703	1.09	155	361
Hopkins	2,287,435	64,955	102,692	79,739	2,534,821	2,133,964	.84	199	3,008
Johnson	826,127	7,750	27,312	....	861,189	1,187,661	1.38	204	1,179
Knox	928,895	11,912	20,685	....	961,492	1,018,566	1.06	222	1,602
Laurel	173,454	16,100	7,015	....	196,569	251,417	1.28	198	410
Lee	27,761	2,195	196	....	30,152	46,395	1.54	172	69
Letcher	1,079,554	7,933	17,965	....	1,105,452	1,377,464	1.25	258	1,143
McCreary	616,924	5,593	2,584	....	625,101	642,160	1.03	264	1,053
McLean	75,867	5,937	1,525	....	83,329	70,090	.84	151	197
Morgan	76,230	12,851	1,265	....	90,346	173,410	1.92	282	225
Muhlenberg	2,553,979	28,050	51,242	....	2,633,271	2,380,949	.90	180	3,545
Ohio	719,714	27,485	28,346	....	775,545	683,033	.88	167	1,117
Perry	17,433	7,470	50	....	24,953	28,165	1.13	109	113
Pike	1,955,611	18,483	37,314	112,633	2,124,041	2,155,837	1.01	239	2,310
Union	583,393	77,174	30,401	....	690,968	703,530	1.02	195	758
Webster	1,347,016	16,870	30,777	....	1,394,663	1,211,846	.87	210	1,356
Whitley	990,208	9,747	15,415	....	1,015,370	1,391,934	1.37	207	1,761
Other counties [a]	72,048	3,376	2,201	....	77,625	78,806	1.02	168	213
Small mines	....	120,226	....	....	120,226	160,644	1.34	......	......
Total	18,029,826	739,622	454,718	392,434	19,616,600	20,516,749	1.05	212	26,332

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Bell	2,485,928	63,840	29,243	....	2,579,011	$2,854,188	$1.11	208	4,095
Boyd	87,137	4,213	1,532	....	92,882	80,775	.87	174	174
Carter	64,936	19,169	370	....	84,475	90,963	1.08	183	141
Daviess	....	47,188	350	....	47,538	45,640	.96	231	65
Floyd	511,780	5,693	7,450	....	524,923	579,064	1.10	158	936
Hancock	....	7,000	....	....	7,000	10,400	1.49	200	11
Harlan	999,057	10,647	14,659	239,703	1,264,066	1,387,650	1.10	216	1,461
Henderson	80,895	72,141	8,030	....	161,066	177,757	1.10	151	243
Hopkins	2,356,392	54,100	97,105	44,123	2,551,720	2,050,066	.80	160	2,915
Johnson	896,345	9,268	30,017	....	935,630	1,260,252	1.35	215	1,476
Knox	856,788	23,825	24,071	....	904,684	980,562	1.08	208	1,396
Laurel	93,788	6,320	1,097	....	101,205	105,441	1.04	166	285
Letcher	1,400,624	10,725	16,277	....	1,427,626	1,769,298	1.24	241	1,694
McCreary	578,376	5,529	2,636	....	586,541	589,968	1.01	173	1,140
Morgan	61,519	14,253	256	....	76,028	167,308	2.20	241	272
Muhlenberg	2,178,262	38,720	48,171	....	2,265,153	1,961,844	.87	147	3,607
Ohio	616,991	17,592	25,690	....	660,273	516,181	.78	151	1,085
Perry	216,325	2,509	2,178	....	221,012	261,460	1.18	189	516
Pike	2,468,013	21,680	50,868	112,754	2,653,315	2,665,002	1.00	219	2,735
Union	509,875	40,358	35,510	....	585,743	567,065	.97	186	677
Webster	1,423,210	17,524	35,056	....	1,475,790	1,239,581	.84	188	1,471
Whitley	824,146	11,899	17,974	....	854,019	1,115,594	1.31	170	1,807
Other counties [b]	185,748	10,910	3,589	....	200,247	208,137	1.04	127	562
Small mines	....	122,816	....	....	122,816	168,267	1.37	......	......
Total	18,896,135	637,919	452,129	396,580	20,382,763	20,852,463	1.02	187	28,764

[a] Breathitt, Clay, Greenup, Lawrence, Letcher, and Pulaski.
[b] Breathitt, Christian, Knott, Lawrence, Lee, McLean, 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 1914 compared with 1913:

Production of coal in Kentucky, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Bell	2,051,106	2,002,508	2,200,077	2,488,538	2,579,011	+ 90,473
Boyd	103,051	109,255	100,758	131,208	92,882	− 38,326
Breathitt and Lee	92,125	57,102	84,180	36,152	43,002	+ 6,850
Butler	1,756	1,580				
Carter	67,400	39,006	87,333	110,595	84,475	− 26,120
Christian, Daviess, and Hancock	117,286	111,203	153,964	124,348	105,605	− 18,743
Floyd	137,330	250,883	446,774	445,949	524,923	+ 78,974
Greenup	290	513				
Harlan	1,440	17,860	332,392	750,267	1,264,066	+ 513,799
Henderson	241,281	223,957	236,159	220,582	161,066	− 59,516
Hopkins	2,554,620	2,156,021	2,549,113	2,534,821	2,551,720	+ 16,899
Johnson	468,609	801,464	932,230	861,189	935,630	+ 74,441
Knox	654,478	764,601	840,872	961,492	904,684	− 56,808
Laurel	275,224	242,728	226,990	196,569	101,205	− 95,364
Lawrence	100,895	52,146	67,234	69,157	67,960	− 1,197
Letcher			193,298	1,105,452	1,427,626	+ 322,174
McCreary			543,307	625,101	586,541	− 38,560
McLean	206,001	122,382	122,331	83,329	32,838	− 50,491
Morgan	70,061	75,581	89,958	90,346	76,028	− 14,318
Muhlenberg	2,738,427	2,243,193	2,368,037	2,633,271	2,265,153	− 368,118
Ohio	819,397	769,885	661,386	775,545	660,273	− 115,272
Perry				24,953	221,012	+ 196,059
Pike	953,605	1,136,997	1,406,462	2,124,041	2,653,315	+ 529,274
Pulaski	85,218	69,437	1,000	1,500	2,000	+ 500
Rockcastle	5,000		190		1,100	+ 1,100
Union	590,378	462,683	550,421	690,968	585,743	− 105,225
Webster	1,026,188	878,466	1,172,484	1,394,663	1,475,790	+ 81,127
Whitley	1,167,937	1,182,308	999,985	1,015,370	854,019	− 161,351
Other counties and small mines	94,216	277,944	123,586	121,194	125,096	+ 3,902
Total	14,623,319	14,049,703	16,490,521	19,616,600	20,382,763	+ 766,163
Total value	$14,405,887	$14,008,458	$16,854,207	$20,516,749	$20,852,463	+$335,714

In the following table the statistics of Kentucky's production of coal during the last five years are divided according to the counties in the eastern and the 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:

Production of coal in the eastern district of Kentucky, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Bell	2,051,106	2,002,508	2,200,077	2,488,538	2,579,011	+ 90,473
Boyd	103,051	109,255	100,758	131,208	92,882	− 38,326
Breathitt	24,432	11,245	36,436	6,000	36,750	+ 30,750
Carter	67,400	39,006	87,333	110,595	84,475	− 26,120
Floyd	137,330	250,883	446,774	445,949	524,923	+ 78,974
Greenup	290	513				
Harlan	1,440	17,860	332,392	750,267	1,264,066	+ 513,799
Johnson	468,609	801,464	932,230	861,189	935,630	+ 74,441
Knox	654,478	764,601	840,872	961,492	904,684	− 56,808
Laurel	275,224	242,728	226,990	196,569	101,205	− 95,364
Lawrence	100,895	52,146	67,234	69,157	67,960	− 1,197
Lee	67,693	45,857	47,744	30,152	6,252	− 23,900
Letcher			193,298	1,105,452	1,427,626	+ 322,174
McCreary			543,307	625,101	586,541	− 38,560
Morgan	70,061	75,581	89,958	90,346	76,028	− 14,318
Perry				24,953	221,012	+ 196,059
Pike	953,605	1,136,997	1,406,462	2,124,041	2,653,315	+ 529,274
Pulaski	85,218	69,437	1,000	1,500	2,000	+ 500
Rockcastle	5,000		190		1,100	+ 1,100
Whitley	1,167,937	1,182,308	999,985	1,015,370	854,019	− 161,351
Other counties and small mines	45,255	86,773	64,153	61,081	63,688	+ 2,607
Total	6,279,024	6,889,162	8,617,193	11,098,960	12,483,167	+1,384,207

Production of coal in the western district of Kentucky, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Butler	1,756	1,580	....	....	....	....
Christian	37,136	32,418	60,139	69,525	51,067	− 18,458
Daviess	73,786	78,135	90,025	48,543	47,538	− 1,005
Hancock	6,364	650	3,800	6,280	7,000	+ 720
Henderson	241,281	223,957	236,159	220,582	161,066	− 59,516
Hopkins	2,554,620	2,156,021	2,549,113	2,534,821	2,551,720	+ 16,899
McLean	206,001	122,382	122,331	83,329	32,838	− 50,491
Muhlenberg	2,738,427	2,243,193	2,368,037	2,633,271	2,265,153	−368,118
Ohio	819,397	769,885	661,386	775,545	660,273	−115,272
Union	590,378	462,683	550,421	690,968	585,743	−105,225
Webster	1,026,188	878,466	1,172,484	1,394,663	1,475,790	+ 81,127
Other counties and small mines	48,961	191,171	[a] 59,433	[a] 60,113	[a] 61,408	+ 1,295
Total	8,344,295	7,160,541	7,873,328	8,517,640	7,899,596	−618,044

[a] Small mines only.

So far as the records of the early production of coal in the United States are to be accepted, Kentucky was the third State to enter the list of regular 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 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 is shown in the table following, which gives the annual and total production from 1828 to the close of 1914.

Production of coal in Kentucky from 1828 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1828	328	1851	160,000	1874	360,000	1897	3,602,097
1829	2,000	1852	175,000	1875	500,000	1898	3,887,908
1830	2,000	1853	180,000	1876	650,000	1899	4,607,255
1831	2,100	1854	190,000	1877	850,000	1900	5,328,964
1832	2,500	1855	200,000	1878	900,000	1901	5,469,986
1833	2,750	1856	215,000	1879	1,000,000	1902	6,766,984
1834	5,000	1857	240,000	1880	946,288	1903	7,538,032
1835	6,000	1858	250,000	1881	1,232,000	1904	7,576,482
1836	8,000	1859	275,000	1882	1,300,000	1905	8,432,523
1837	10,000	1860	285,760	1883	1,650,000	1906	9,653,647
1838	11,500	1861	280,000	1884	1,550,000	1907	10,753,124
1839	16,000	1862	275,000	1885	1,600,000	1908	10,246,553
1840	23,527	1863	250,000	1886	1,550,000	1909	10,697,384
1841	35,000	1864	250,000	1887	1,933,185	1910	14,623,319
1842	50,000	1865	200,000	1888	2,570,000	1911	14,049,703
1843	60,000	1866	180,000	1889	2,399,755	1912	16,490,521
1844	75,000	1867	175,000	1890	2,701,496	1913	19,616,600
1845	100,000	1868	160,000	1891	2,916,069	1914	20,382,763
1846	115,000	1869	160,000	1892	3,025,313		
1847	120,000	1870	150,582	1893	3,007,179	Total.	228,511,417
1848	125,000	1871	250,000	1894	3,111,192		
1849	140,000	1872	380,800	1895	3,357,770		
1850	150,000	1873	400,000	1896	3,333,478		

MARYLAND.

Total production in 1914, 4,133,547 short tons; spot value, $5,234,796.

The production of coal in Maryland in 1914 was less than in 1913 by 646,292 short tons, or 13.5 per cent, in quantity and $692,250, or 11.7 per cent, in value. The annual production of coal in Maryland has been fairly constant for the last 19 years, the smallest production in that period having been in 1909, when it amounted to 4,023,241 tons, and the largest production in 1907, when it was 5,532,628 tons. The output in 1914 was below the average of the 19 years and was exceeded in every year since 1895 except in 1900 and 1909. It is not to be expected that the production will show any material increase in the future, as the great bed, the "Maryland Big Vein," from which the greater part of the output has been obtained, is approaching exhaustion, and although there is still a good supply remaining in the thinner and deeper beds, it is not at all probable that the future production from them will exceed the records of the past, if indeed it maintains the same importance.

Although by far the greater part (more than 90 per cent) of Maryland's production of coal is mined by hand, the record of individual efficiency by the miners is high. In 1914 there were 5,403 men employed in the coal mines of the State, and they worked an average of 241 days, as compared with 5,645 men for an average of 248 days in 1913. The average production by each man in 1914 was 765 tons for the year and 3.17 tons for each working day; in 1913 the average production per man for the year was 847 tons and the average daily production per man was 3.42 tons. These are exceptionally good averages, especially when it is considered that 3,861,005 tons, or 93.4 per cent of the total, was mined by hand in 1914 and that in 1913 nearly 92 per cent of the total was hand mined. The machine-mined product in 1914 was only 110,065 tons, or 2.66 per cent of the total. The quantity of coal shot off the solid was 124,966 tons.

Little time was lost on account of strikes or suspensions, 91 men having been affected for an average of 17 days each.

The Bureau of Mines reported 18 fatal accidents in 1914 in the coal mines of Maryland, as against 13 in 1913; but as there were fewer men employed and fewer tons mined in 1914, the ratio of deaths was increased and the tonnage per life lost was diminished. The death rate per thousand in 1914 was 3.33, against 2.3 in 1913, and the quantity of coal mined for each life lost was 229,641 tons, against 367,680 tons in 1913.

The statistics of the production of coal in Maryland in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Maryland in 1913 and 1914, 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 value per ton.	Average number of days active.	Average number of employees.
1913.								
Allegany	3,943,759	32,605	61,897	4,038,261	$5,277,261	$1.31	246	4,771
Garrett	722,999	6,255	1,835	731,089	638,028	.87	261	874
Small mines		10,489		10,489	11,757	1.12		
Total	4,666,758	49,349	63,732	4,779,839	5,927,046	1.24	248	5,645
1914.								
Allegany	3,363,914	28,210	57,241	3,449,365	$4,629,031	$1.34	251	4,430
Garrett	655,708	8,798	7,115	671,621	591,424	.88	196	973
Small mines		12,561		12,561	14,341	1.14		
Total	4,019,622	49,569	64,356	4,133,547	5,234,796	1.27	241	5,403

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 production of coal in Maryland, 1910–1914, 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 value per ton.	Average number of days active.	Average number of employees.
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
1913	4,666,758	49,349	63,732	4,779,839	5,927,046	1.24	248	5,645
1914	4,019,622	49,569	64,356	4,133,547	5,234,796	1.27	241	5,403

Comparisons of the total production, by counties, in 1912, 1913, and 1914, are shown in the following table:

Production of coal in Maryland, 1912, 1913, and 1914, by counties, in short tons.

County.	1912	1913	1914	Increase(+) or decrease (−), 1914.
Allegany	4,136,810	4,038,261	3,449,365	− 588,896
Garrett	810,319	731,089	671,621	− 59,468
Small mines	16,909	10,489	12,561	+ 2,072
Total	4,964,038	4,779,839	4,133,547	− 646,292
Total value	$5,839,079	$5,927,046	$5,234,796	−$692,250

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 1914 has been as follows:

Production of coal in Maryland from 1820 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1820	3,000	1859	833,349	1879	2,132,233	1899	4,807,396
1832	12,000	1860	438,000	1880	2,228,917	1900	4,024,688
1840	8,880	1861	287,073	1881	2,533,348	1901	5,113,127
1842	2,104	1862	346,201	1882	1,555,445	1902	5,271,609
1843	12,421	1863	877,313	1883	2,476,075	1903	4,846,165
1844	18,345	1864	755,764	1884	2,765,617	1904	4,813,622
1845	30,372	1865	1,025,208	1885	2,833,337	1905	5,108,539
1846	36,707	1866	1,217,668	1886	2,517,577	1906	5,435,453
1847	65,222	1867	1,381,429	1887	3,278,023	1907	5,532,628
1848	98,032	1868	1,529,879	1888	3,479,470	1908	4,377,093
1849	175,497	1869	2,216,300	1889	2,939,715	1909	4,023,241
1850	242,517	1870	1,819,824	1890	3,357,813	1910	5,217,125
1851	317,460	1871	2,670,338	1891	3,820,239	1911	4,685,795
1852	411,707	1872	2,647,156	1892	3,419,962	1912	4,964,038
1853	657,862	1873	3,198,911	1893	3,716,041	1913	4,779,839
1854	812,727	1874	2,899,392	1894	3,501,428	1914	4,133,547
1855	735,137	1875	2,808,018	1895	3,915,585		
1856	817,659	1876	2,126,873	1896	4,143,936	Total	179,787,226
1857	654,017	1877	1,939,575	1897	4,442,128		
1858	722,686	1878	2,068,925	1898	4,674,884		

MICHIGAN.

Total production in 1914, 1,283,030 short tons; spot value, $2,559,786.

Michigan did not participate in the general decrease in production of coal in 1914, but is one of the few States that reported an increase over 1913, though the gain both in quantity and in value was small and the total was less than that of any year from 1903 to 1911, inclusive. The increase, as compared with 1913, when the production amounted to 1,231,786 short tons, valued at $2,455,227, was 51,244 tons, or 4.16 per cent, in quantity and $104,559, or 4.26 per cent, in value. Michigan's production of coal has exceeded 2,000,000 tons in one year only, 1907; since then it decreased steadily until 1912, when it reached the minimum for the decade. The decrease is attributed to the competition of higher-grade coals from West Virginia and to the small demand for lump coal in the manufacturing plants of the State. Michigan is an important manufacturing State, particularly in furniture and in the evaporation of salt. The modern character of the State's manufacturing establishments is indicated by the fact that most of them are equipped with mechanical stokers and use slack coal obtained cheaply from West Virginia, which is of better quality than that from Michigan. Michigan slack thus becomes a drug on the market, and the coal mines are obliged to depend almost exclusively on the domestic trade, which requires lump coal. In winter the demand for lump coal exceeds the capacity of the mines and in summer the production exceeds the demand.

The coal operators of the State keep pace with the manufacturing interests in modern methods and equipment, as is shown by the large number of machines installed and the large proportion of coal undercut by them. In 1914 the machine-mined coal was 998,935 short tons, or 77.8 per cent of the total. The total number of machines in use was 107, a decrease of 23 from 1913. The 107 machines included 17 punchers, 18 chain breast, and 72 short wall or continuous cutters.

The record for 1914 shows some improvement in mining practice in that the coal shot from the solid amounted to 281,624 tons, or 22 per cent, as compared with 363,856 tons, or 29.5 per cent, in 1913. The quantity of coal sent to washeries in 1914 was 172,854 tons, which yielded 152,431 tons of cleaned coal and 20,423 tons of refuse.

Notwithstanding the fewer number of machines used in 1914, the tonnage per man was greater in 1914 than in 1913. In the latter year 3,305 men working an average of 188 days produced 1,231,786 tons of coal, or an average per man for the year of 373 tons and for each day of 1.98 tons. In 1914 there were 2,800 men employed for an average of 201 days, who produced 1,283,030 tons, or an average per man for the year of 458 tons, and for each day of 2.28 tons.

The mines were free from labor troubles and no time was lost because of strikes.

The fatalities in the coal mines, as reported by the Bureau of Mines, consisted of 1 death from fall of roof and 1 from accident in connection with mining machinery, a total of 2, as compared with 3 in 1913 and 8 in 1912. The death rate in 1914 was less than 1 per thousand, and there were 641,515 tons mined for each life lost.

The statistics of coal production in Michigan, by counties, during 1913 and 1914, with the distribution of the product for consumption, are shown in the following tables:

Production of coal in Michigan in 1913 and 1914, 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 value per ton.	Average number of days active.	Average number of employees.
1913.								
Bay	558,170	5,513	28,035	591,718	$1,176,095	$1.99	202	1,465
Saginaw	524,079	44,874	27,240	596,193	1,194,553	2.00	176	1,750
Other countries [a] and small mines	29,741	7,864	6,270	43,875	84,579	1.93	208	90
Total	1,111,990	58,251	61,545	1,231,786	2,455,227	1.99	188	3,305
1914.								
Bay	579,435	5,706	32,274	617,415	$1,215,469	$1.97	188	1,292
Saginaw	513,918	48,194	22,536	584,648	1,194,430	2.04	214	1,190
Other counties [b] and small mines	65,551	5,302	10,114	80,967	149,887	1.85	204	318
Total	1,158,904	59,202	64,924	1,283,030	2,559,786	1.99	201	2,800

[a] Clinton, Ingham, Shiawassee, and Tuscola.

[b] Genesee, Ingham, and Tuscola.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Michigan, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Bay	766,470	717,084	630,931	591,718	617,415	+25,697
Eaton	100	1,000				
Saginaw	667,282	667,954	504,612	596,193	584,648	−11,545
Tuscola	[a] 101,115	[a] 90,036	[a] 70,687	[b] 43,875	[c] 80,967	+37,092
Total	1,534,967	1,476,074	1,206,230	1,231,786	1,283,030	+51,244
Total value	$2,930,771	$2,791,461	$2,399,451	$2,455,227	$2,559,786	+$104,559

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

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

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, when 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 1901 it exceeded 1,200,000 tons. The maximum output of 2,035,858 tons was reached in 1907.

The record, by years, from 1860 to 1914, inclusive, is shown in the following table:

Production of coal in Michigan, 1860 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	2,320	1875	62,500	1889	67,431	1903	1,367,619
1861	3,000	1876	66,000	1890	74,977	1904	1,342,840
1862	5,000	1877	69,197	1891	80,307	1905	1,473,211
1863	8,000	1878	85,322	1892	77,990	1906	1,346,338
1864	12,000	1879	82,015	1893	45,979	1907	2,035,858
1865	15,000	1880	100,800	1894	70,022	1908	1,835,019
1866	20,000	1881	112,000	1895	112,322	1909	1,784,692
1867	25,000	1882	135,339	1896	92,882	1910	1,534,967
1868	28,000	1883	71,296	1897	223,592	1911	1,476,074
1869	29,980	1884	36,712	1898	315,722	1912	1,206,230
1870	28,150	1885	45,178	1899	624,708	1913	1,231,786
1871	32,000	1886	60,434	1900	849,475	1914	1,283,030
1872	33,600	1887	71,461	1901	1,241,241		
1873	56,000	1888	81,407	1902	964,718	Total	24,194,741
1874	58,000						

MISSOURI.

Total production in 1914, 3,935,980 short tons; spot value, $6,802,325.

Compared with 1913, when the production of coal in Missouri amounted to 4,318,125 short tons, valued at $7,468,308, the returns for 1914 showed a decrease of 382,145 tons, or 8.85 per cent, in quantity and of $665,983, or 8.92 per cent, in value. The decrease in production in 1914 was due primarily to the uniformly mild weather throughout the winter months and to the lessened demand from railroads, owing to the decreased amount of freight hauled. The demand for steam coal by the manufacturing interests was fairly well maintained during the year, the transportation facilities were ample and satisfactory, and there was little interruption in mining operations on account of labor troubles. There were occasional shutdowns, but no prolonged period of idleness, the time lost being less than 3 per cent of the total time made. All told, there were 1,162 men on strike during the year, and the average number of idle days was 49.

There was a decrease in the number of men employed, from 10,418, working during an average of 187 days in 1913 to 9,549, working an average of 179 days, in 1914. The average annual production per man was 412 tons, and 2.30 tons for each working day in 1914, as compared with 414 and 2.21 tons, respectively, in 1913. 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, 79 out of a total of 88 machines employed in 1914 being of that type. Of the other 9, 6 were long wall, 1 chain breast, and 2 punchers. In 1913 there were 104 machines reported. In spite of the decreased number of machines in 1914, the percentage of machine-mined coal was practically the same, being 19 per cent in 1914 against 20 per cent in 1913, but the quantity decreased from 863,946 tons to 750,037 tons. About one-half of Missouri's production of coal is "powder-mined," 1,834,017 tons, or 46.6 per cent of the total, having been shot off the solid in 1914, as against 2,021,292 tons, or 47 per cent of the total, in 1913. The hand-mined coal reported in 1914 amounted to 872,897 tons and that taken out with steam shovels to 251,060 tons. The method employed in mining 227,969 tons was not reported.

The number of fatal accidents in the coal mines of Missouri increased from 10 in 1913 to 19 in 1914, according to reports to the Bureau of Mines. The death rate per thousand was increased from a fraction less than 1 in 1913 to 2 in 1914. Of the 19 fatalities in 1914, 12 were due to falls of roof. The quantity of coal mined for each life lost in 1914 was 207,156 tons, against 431,813 tons in 1913.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Missouri in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines fro steam and heat.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Adair	407,358	21,475	11,158	439,991	$699,244	$1.59	139	1,031
Audrain	3,031	7,424	151	10,606	21,842	2.06	139	51
Barton	475,325	10,784	9,219	495,328	796,992	1.61	198	735
Bates	145,700	16,551	6,218	168,469	264,857	1.57	182	311
Boone	1,927	13,780	84	15,791	30,563	1.94	202	69
Callaway	729	31,860	300	32,889	69,907	2.13	185	166
Dade	120	5,630	....	5,750	9,762	1.70	122	19
Henry	182,900	76,176	2,120	261,196	437,194	1.67	226	474
Lafayette	666,343	45,441	17,822	729,606	1,347,090	1.85	201	2,073
Linn	97,100	17,699	2,826	117,625	276,455	2.35	199	369
Macon	743,783	21,745	12,736	778,264	1,255,417	1.61	172	1,681
Putnam	17,483	3,852	500	21,835	45,409	2.08	108	119
Randolph	443,099	29,778	9,005	481,882	769,802	1.60	220	1,074
Ray	312,123	22,389	8,773	343,285	651,227	1.90	152	1,261
Other counties [a]	268,513	45,553	14,565	328,631	613,528	1.87	224	985
Small mines	....	86,977	....	86,977	179,019	2.06	....	....
Total	3,765,534	457,114	95,477	4,318,125	7,468,308	1.73	187	10,418

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines fro steam and heat.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Adair	218,542	31,042	6,813	256,397	$406,776	$1.59	170	672
Audrain	4,936	5,166	258	10,360	21,579	2.08	168	57
Barton	486,992	7,112	11,178	505,282	824,974	1.63	201	643
Bates	126,447	13,645	4,939	145,031	231,146	1.59	184	244
Boone	1,165	11,301	48	12,514	27,030	2.16	137	57
Callaway	8,473	29,482	1,600	39,555	83,730	2.12	230	141
Henry	181,740	40,579	2,575	224,894	360,386	1.60	203	442
Lafayette	645,111	41,076	16,842	703,029	1,316,396	1.87	184	2,243
Linn	80,680	25,331	2,615	108,626	249,252	2.29	204	394
Macon	733,703	21,037	10,625	765,365	1,208,804	1.58	180	1,555
Putnam	7,080	3,087	200	10,367	16,613	1.60	58	103
Randolph	391,435	26,885	5,925	424,245	668,111	1.57	173	956
Ray	292,762	25,304	6,014	324,080	611,176	1.89	149	1,201
Vernon	41,688	1,177	300	43,165	72,303	1.68	181	99
Other counties [b]	196,386	45,357	10,697	252,440	481,128	1.91	188	742
Small mines	....	110,630	....	110,630	222,921	2.02	....	....
Total	3,417,140	438,211	80,629	3,935,980	6,802,325	1.73	179	9,549

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

[b] Caldwell, Clay, Cooper, Dade, Grundy, Harrison, Howard, Johnson, Moniteau, Platte, Ralls, Schuyler, and Sullivan.

The statistics of production during the last five years, by counties, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Missouri, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Adair	408,007	348,559	593,667	439,991	256,397	− 183,594
Audrain	40,662	29,673	25,512	10,606	10,360	− 246
Barton	222,595	295,236	382,082	495,328	505,282	+ 9,954
Bates	95,451	88,620	159,229	168,469	145,031	− 23,438
Boone	19,885	22,031	19,696	15,791	12,514	− 3,277
Caldwell	7,300	3,181	2,015	4,200	3,642	− 558
Callaway	28,954	36,411	22,962	32,889	39,555	+ 6,666
Grundy	9,640	8,000	10,000	10,000	10,000	....
Henry	145,644	240,571	143,584	261,196	224,894	− 36,302
Johnson	2,532	1,500	3,411	3,690	864	− 2,826
Lafayette	553,832	765,879	749,598	729,606	703,029	− 26,577
Linn	89,311	123,169	125,649	117,625	108,626	− 8,999
Livingston	200	....	500	....	....	....
Macon	613,949	675,933	818,170	778,264	765,365	− 12,899
Montgomery	1,500	1,000	1,200	665	....	− 665
Putnam	61,968	30,276	31,710	21,835	10,367	− 11,468
Ralls	12,761	16,158	13,799	15,022	14,900	− 122
Randolph	193,482	483,800	483,903	481,882	424,245	− 57,637
Ray	292,442	317,134	375,164	343,285	324,080	− 19,205
Vernon	7,208	2,658	2,340	10,073	43,165	+ 33,092
Other counties and small mines	175,110	346,318	375,665	377,708	333,664	− 44,044
Total	2,982,433	3,836,107	4,339,856	4,318,125	3,935,980	− 382,145
Total value	$5,328,285	$6,603,066	$7,633,864	$7,468,308	$6,802,325	−$665,983

The occurrence of coal in Missouri appears to have been known as early as 1806, when, according to "An account of expeditions to the sources of the Mississippi," by Z. M. Pike, it was noted on the banks of Osage River. The coal attracted the attention of the early settlers, and numerous small mines are reported to have been opened by them. No record is extant of the quantity of coal produced in those early days in Missouri, and the first statement regarding the quantity mined in the State is contained in the report of the United States Census for 1840, in which year a production of 9,972 tons is recorded. The annual output of coal in Missouri since 1840 is shown in the following table, the output from 1841 to 1869, inclusive, being covered by estimates:

Production of coal in Missouri from 1840 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	9,972	1860	280,000	1880	844,304	1900	3,540,103
1841	12,000	1861	300,000	1881	1,960,000	1901	3,802,088
1842	15,000	1862	320,000	1882	2,240,000	1902	3,890,154
1843	25,000	1863	360,000	1883	2,520,000	1903	4,238,586
1844	35,000	1864	375,000	1884	2,800,000	1904	4,168,308
1845	50,000	1865	420,000	1885	3,080,000	1905	3,983,378
1846	68,000	1866	450,000	1886	1,800,000	1906	3,758,008
1847	80,000	1867	500,000	1887	3,209,916	1907	3,997,936
1848	85,000	1868	541,000	1888	3,909,967	1908	3,317,315
1849	90,000	1869	550,000	1889	2,557,823	1909	3,756,530
1850	100,000	1870	621,930	1890	2,735,221	1910	2,982,433
1851	125,000	1871	725,000	1891	2,674,606	1911	3,836,107
1852	140,000	1872	784,000	1892	2,733,949	1912	4,339,856
1853	160,000	1873	784,000	1893	2,897,442	1913	4,318,125
1854	175,000	1874	789,680	1894	2,245,039	1914	3,935,980
1855	185,000	1875	840,000	1895	2,372,393		
1856	200,000	1876	1,008,000	1896	2,331,542	Total.	124,104,452
1857	220,000	1877	1,008,000	1897	2,665,626		
1856	240,000	1878	1,008,000	1898	2,688,321		
1859	260,000	1879	1,008,000	1899	3,025,814		

MONTANA.

Total production, in 1914, 2,805,173 short tons; spot value, $4,-913,191.

As compared with 1913, the production of coal in Montana in 1914 showed a decrease of 435,800 tons, or 13.45 per cent, in quantity and of $740,348, or 13.1 per cent, in value. The greater part of this decrease occurred in Carbon and Musselshell counties, whose coal is used mainly by railroads, and in the Great Falls field, in Cascade County, which supplies a large quantity of coal to the copper smelters of Anaconda and Great Falls. The decrease is attributed to a lack of demand from the railroads because of the general falling off of through freight handled during two-thirds of the year, and to the curtailment of copper production at the beginning of the European war. Other coal fields (as the Lewistown, in Fergus County, which supplies the domestic trade) showed a small increase, such as normally follows an increase in population due to an influx of settlers.

There were no serious interruptions to mining operations in 1914 because of labor troubles and there was no scarcity of labor. A total of 171 men were reported on strike for an average of seven days each.

The total number of machines in use in the coal mines of Montana in 1914 was 99, as compared with 97 in 1913, and the quantity of machine-mined coal increased from 1,076,641 tons, or 33.2 per cent of the total product, in 1913, to 1,213,051 tons, or 43 per cent of the total, in 1914. The percentage of coal shot off the solid decreased from 35 per cent (1,143,364 tons) in 1913 to 32 per cent (895,279 tons) in 1914. The quantity of coal mined by hand in 1914 was 679,822 tons. Of the 99 machines in use 57 were punchers, 21 chain breast, 20 short wall, and 1 radial ax or post puncher.

The number of men employed in the coal mines of the State in 1914 was 3,350, and they worked an average of 209 days, against 3,630 men for an average of 228 days in 1913. The mine workers of Montana have a good efficiency record, and in 1912 the State showed the best average production per man per day among the coal-producing States. In 1914 the average production per man for the year was less than in 1913 (837 tons against 893 tons), but the average daily output by each employee was 4 tons in 1914 as against 3.92 tons in 1913 and 4.03 tons in 1912.

The fatality record maintained by the Bureau of Mines showed a decrease from 20 in 1913 to 8 in 1914, with a decrease in the rate per thousand from 5.5 to 2.4, whereas the quantity of coal mined for each life lost increased from 162,049 tons to 350,646 tons.

The statistics of production, by counties, during 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Montana in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Carbon	1,208,363	30,986	65,175	1,304,524	$2,660,952	$2.04	228	1,561
Cascade	863,516	35,132	13,986	912,634	1,351,142	1.48	209	1,094
Fergus		5,348		5,348	16,044	3.00	252	8
Hill	3,000	6,335	70	9,405	20,743	2.21	138	29
Mussesshell	928,295	8,569	27,104	963,968	1,481,956	1.54	270	806
Other counties [a]	19,124	17,562	1,210	37,896	102,811	2.71	148	132
Small mines		7,198		7,198	19,891	2.76		
Total	3,022,298	111,130	107,545	3,240,973	5,653,539	1.74	228	3,630

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Carbon	1,120,807	26,537	65,597	1,212,941	$2,245,689	$1.85	206	1,516
Cascade	629,263	29,159	6,001	664,423	924,112	1.39	187	843
Fergus	13,838	4,202	5,064	23,104	69,285	3.00	174	98
Hill	2,272	13,934	50	16,256	36,590	2.25	238	21
Musselshell	815,035	8,927	26,078	850,040	1,533,662	1.80	247	774
Other counties [b]	19,472	9,530	1,181	30,183	84,678	2.81	167	98
Small mines		8,226		8,226	19,175	2.33		
Total	2,600,687	100,515	103,971	2,805,173	4,913,191	1.75	209	3,350

[a] Blaine, Custer, Missoula, Park, Rosebud, and Valley.
[b] Blaine, Missoula, Park, and Sheridan.

In the following table a statement is presented covering the coal production of Montana, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913:

Production of coal in Montana, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Carbon	1,211,028	1,185,189	1,187,270	1,304,524	1,212,941	− 91,583
Cascade	928,306	994,043	855,576	912,634	664,423	− 248,211
Chouteau	17,327	9,727	21,590			
Fergus	287,614	16,711	6,251	5,348	23,104	+ 17,756
Gallatin	22,465	8,515	1,406			
Hill			9,999	9,405	16,256	+ 6,851
Musselshell		706,364	913,904	963,968	850,040	− 113,928
Park	98,434	46,333	44,626	21,126	21,472	+ 346
Other counties and small mines	355,796	9,476	7,873	23,968	16,937	− 7,031
Total	2,920,970	2,976,358	3,048,495	3,240,973	2,805,173	− 435,800
Total value	$5,329,322	$5,342,168	$5,558,195	$5,653,539	$4,913,191	−$740,348

The first record of the production of coal in Montana was 34 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 3,240,973 tons in 1913.

The record by years, from 1880 to 1914, inclusive, is shown in the following table:

Production of coal in Montana from 1880 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	224	1890	517,477	1900	1,661,775	1910	2,920,970
1881	5,000	1891	541,861	1901	1,396,081	1911	2,976,358
1882	10,000	1892	564,648	1902	1,560,823	1912	3,048,495
1883	19,795	1893	892,309	1903	1,488,810	1913	3,240,973
1884	80,376	1894	927,395	1904	1,358,919	1914	2,805,173
1885	86,440	1895	1,504,193	1905	1,643,832		
1886	49,846	1896	1,543,445	1906	1,829,921	Total	44,205,232
1887	10,202	1897	1,647,882	1907	2,016,857		
1888	41,467	1898	1,479,803	1908	1,920,190		
1889	363,301	1899	1,496,451	1909	2,553,940		

NEVADA.

The first production of coal in Nevada of which there is any record was in 1911, a small output having been reported from the Coaldale field in T. 2 N., R. 37 E., in Esmeralda County, in the southwestern part of the State. The production and value for 1911, 1912, and 1913 are included with those of Idaho, and for 1914, with those of Idaho and California.

NEW MEXICO.

Total production in 1914, 3,877,689 short tons; spot value, $6,230,871.

New Mexico is the only one of the Rocky Mountain States in which the output of coal in 1914 exceeded that of 1913. The increase of 168,883 tons, or 4.55 per cent, in quantity and of $829,611, or 15.4 per cent, in value, was due to the greater output from Colfax and Santa Fe counties, which, being on the east front of the Rocky Mountains and not far distant from the larger Colorado fields, were able to supply a part of the demand normally supplied by coal from Colorado, but not supplied in 1914 because of the continued strike. The increase from that cause was, however, partly offset by the decreased demand from the smelters for coke following the general curtailment in production of copper in the latter part of the year and by the internal troubles in Mexico, which normally requires a fair percentage of New Mexico's output of coke. McKinley County, with an output of 706,731 tons in 1914, had the smallest production recorded since 1910. The decrease in that county, in which the Gallup district is the principal center of mining, was attributed to the falling off in the requirements of the railroads.

The number of men employed in the coal fields of New Mexico decreased from 4,329 in 1913 to 4,178 in 1914, and the average number of working days decreased from 289 to 283. The average production per man increased from 857 tons for the year and 2.97 tons per day in 1913 to 928 and 3.28 tons, respectively, in 1914. This increased tonnage per man was due to the greater employment of machines in undercutting the coal. Most of the coal mined in New Mexico is undercut by hand, 2,521,682 tons, or 65 per cent of the total, in 1914, being hand mined. The quantity shot off the solid was 727,440 tons, or 18.8 per cent of the total, and the machine-mined output was 619,472 tons, or 16 per cent, as against 497,070 tons, or 13.4 per cent of the total, in 1913. The number of machines in use increased from 44 in 1913 to 45 in 1914, of which 28 were short wall, 9 were punchers, and 8 were chain breast machines.

There was no time lost in the coal mines of New Mexico in 1914 because of strikes or other labor disaffection.

According to statistics compiled by the Bureau of Mines, there were 18 fatal accidents in the coal mines of New Mexico in 1914, of which 14 were due to falls of roof and 4 to other causes. The death rate per thousand for the year was 4.3, and the number of tons mined for each life lost was 215,427.

One company washes its slack coal used for coking, and 495,127 tons of slack were washed in 1914 and yielded 410,955 tons of cleaned coal and 84,172 tons of refuse.

The statistics of production, by counties, during 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in New Mexico in 1913 and 1914, 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 at the mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
1913.									
Colfax	1,774,776	12,345	24,212	938,432	2,749,765	$3,652,245	$1.33	288	3,200
McKinley	795,375	6,867	22,520	....	824,762	1,367,364	1.66	293	862
Other counties [a]	115,729	5,299	10,251	....	131,279	374,318	2.85	283	267
Small mines	....	3,000	....	....	3,000	7,333	2.44	....	....
Total	2,685,880	27,511	56,983	938,432	3,708,806	5,401,260	1.46	289	4,329
1914.									
Colfax	2,231,944	17,056	23,528	742,835	3,015,363	$4,627,978	$1.53	299	2,905
McKinley	677,687	10,090	18,954	....	706,731	1,146,539	1.62	237	972
Other counties [b]	137,697	4,749	10,903	....	153,349	448,493	2.92	276	301
Small mines	....	2,246	....	....	2,246	7,861	3.50	....	....
Total	3,047,328	34,141	53,385	742,835	3,877,689	6,230,871	1.61	283	4,178

[a] Bernalillo, Lincoln, Rio Arriba, San Juan, Santa Fe, and Socorro.
[b] Rio Arriba, 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 1914 as compared with 1913.

Production of coal in New Mexico, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (−), 1914.
Colfax	2,651,585	2,297,611	2,691,306	2,749,765	3,015,363	+ 265,598
Lincoln	2,476	1,658	435	124	....	− 124
McKinley	698,730	731,365	735,544	824,762	706,731	− 118,031
Rio Arriba	10,200	2,625	....	7,500	4,325	− 3,175
Santa Fe	73,106	58,726	57,239	67,852	87,361	+ 19,509
Other counties and small mines	72,224	56,173	52,300	58,803	63,909	+ 5,106
Total	3,508,321	3,148,158	3,536,824	3,708,806	3,877,689	+ 168,883
Total value	$4,877,151	$4,525,925	$5,037,071	$5,401,260	$6,230,871	+$829,611

The first record of the production of coal 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 1914, when the production of coal in New Mexico was 3,877,689 short tons. The production since 1882 is given in the following table:

Production of coal in New Mexico from 1882 to 1914, 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	1913	3,708,806
1887	508,034	1896	622,626	1905	1,649,933	1914	3,877,689
1888	626,665	1897	716,981	1906	1,964,713		
1889	486,943	1898	992,288	1907	2,628,959	Total.	45,374,295
1890	375,777	1899	1,050,714	1908	2,467,937		

NORTH DAKOTA.

Total production in 1914, 506,685 short tons; spot value, $771,379.

The entire production of mineral fuel in North Dakota is brown coal or lignite. The output of lignite in the State increased from 495,320 short tons, valued at $750,652, in 1913, to 506,685 tons, valued at $771,379, in 1914. The production in 1912 was 499,480 tons, and in 1911 it was 502,628 tons. The relatively small differences in production during the last four years indicate an absence of any fluctuating influences and that active development of lignite properties will wait upon increased population. At present the consumption of lignite is chiefly for domestic purposes, but when properly handled and with proper equipment it can be used with satisfaction as a fuel for boilers. A convincing example of what may be accomplished with lignite for such use is presented by the irrigation plant of the United States Reclamation Service at Williston. The lignite used is from a coal mine owned and operated by the Government. The Reclamation Service operates the mine and uses the lignite in the generation of steam for its pumping plant connected with the irrigation project at Williston.

At Kenmare, Scranton, and Dickinson lignite is successfully used in burning brick, for which purpose its smokeless and sootless qualities and its low cost make it adaptable. As the gas-producer and the internal-combustion engine 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 economic development of the State.

The successful utilization of lignite (unless briquetted) must be in the vicinity of the mine from which it is taken. When freshly mined, North Dakota lignite contains from 25 to 40 per cent of moisture. On exposure to the atmosphere it gives up a large part of the moisture and "slacks" or crumbles. Prolonged exposure reduces it to a rather fine powder with accompanying oxidation and loss of volatile combustible material. One company, at Minot, manufactured briquets from lignite on a commercial scale in 1914. The process, which is based on extensive experiments made through a number of years by

Dean Babcock, of the North Dakota School of Mines, consists of crushing and drying the lignite, as mined, and carbonizing the dried product in beehive retorts, by which operation the greater part of the moisture and volatile matter is driven off. The residue is mixed with about 7 per cent of binders of various sorts and about 5 per cent of bituminous coal and is compressed into briquets weighing from 2¼ to 2½ ounces each. It is reported that the cost of manufacturing briquets in this plant, which has a capacity of from 9 to 10 tons per hour, is approximately $4 a ton of briquets, and that the product is retailed as a domestic product at from $10 to $11 a ton in competition with Pennsylvania anthracite at $12 a ton. The gas given off in the carbonizing process is not utilized at this company's works.

The lignite mines of North Dakota gave employment in 1914 to 558 men, who worked an average of 216 days, as compared with 641 men for an average of 221 days in 1913. The average production per man was 908 tons for the year and 4.2 tons for each working day in 1914, against 773 tons and 2.9 tons, respectively, in 1913.

The mines were entirely free from strikes, suspensions, or lockouts in 1914. Fourteen chain-breast mining machines were reported in use in 1914, and the quantity mined by machines was 208,199 short tons, or 41 per cent of the total. The quantity of lignite shot off the solid was 193,497 tons, or 38 per cent of the total.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in North Dakota in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Adams	4,707	4,822	55	9,584	$13,368	$1.39	201	17
Burke	5,139	6,861	175	12,175	14,885	1.22	190	20
Burleigh	176,208	9,475	8,319	194,002	283,918	1.46	202	234
Hettinger	....	7,550	....	7,550	8,435	1.12	177	7
McLean	676	7,827	213	8,716	12,601	1.45	250	6
Morton	19,605	20,076	805	40,486	57,232	1.41	222	53
Stark	50,632	3,475	1,450	55,557	79,380	1.43	208	52
Ward	53,270	19,426	4,414	77,110	137,245	1.78	256	154
Williams	2,595	24,602	561	27,758	44,474	1.60	196	50
Other counties[a]	37,000	8,015	....	45,015	72,365	1.61	262	48
Small mines	....	17,367	....	17,367	26,749	1.54	....	....
Total	349,832	129,496	15,992	495,320	750,652	1.52	221	641

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Adams	2,951	8,111	....	11,062	$17,480	$1.58	280	14
Burke	4,060	7,690	....	11,750	14,910	1.27	247	15
Hettinger	....	5,100	....	5,100	6,474	1.27	200	7
McLean	....	10,161	....	10,161	14,797	1.46	271	14
Morton	12,086	21,277	960	34,323	46,672	1.36	258	41
Ward	47,463	15,600	5,094	68,157	121,952	1.79	214	128
Williams	7,258	31,348	144	38,750	59,666	1.54	262	39
Other counties[b]	273,988	15,597	8,884	298,469	442,924	1.48	199	300
Small mines	....	28,913	....	28,913	46,504	1.61	....	....
Total	347,806	143,797	15,082	506,685	771,379	1.52	216	558

[a] Bowman, Divide, Mercer, and Oliver.
[b] Billings, Bowman, Burleigh, Divide, Oliver, and Stark.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914, as compared with 1913, are shown in the following table:

Production of coal in North Dakota, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Adams	....	....	....	9,584	11,062	+ 1,478
Burke	....	16,585	11,950	12,175	11,750	− 425
Burleigh	142,597	173,214	187,008	194,002	197,318	+ 3,316
Hettinger	....	....	....	7,550	5,100	− 2,450
McLean	4,090	7,163	4,145	8,716	10,161	+ 1,445
Morton	23,250	20,034	36,326	40,486	34,323	− 6,163
Stark	56,700	58,377	59,785	55,557	44,025	−11,532
Ward	117,382	138,105	89,274	77,110	68,157	− 8,953
Williams	17,380	20,916	22,953	27,758	38,750	+10,992
Other counties and small mines	37,642	68,234	88,039	62,382	86,039	+23,657
Total	399,041	502,628	499,480	495,320	506,685	+11,365
Total value	$595,139	$720,489	$765,105	$750,652	$771,379	+$20,727

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 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	35,000	1893	49,630	1902	226,511	1911	502,628
1885	25,000	1894	42,015	1903	278,645	1912	499,480
1886	25,955	1895	38,997	1904	271,928	1913	495,320
1887	21,470	1896	78,050	1905	317,542	1914	506,685
1888	34,000	1897	77,246	1906	305,689		
1889	28,907	1898	83,895	1907	347,760	Total	5,930,201
1890	30,000	1899	98,809	1908	320,742		
1891	30,000	1900	129,883	1909	422,047		
1892	40,725	1901	166,601	1910	399,041		

OHIO.

Total production in 1914, 18,843,115 short tons; spot value, $21,250,642.

The coal production of Ohio in 1914 was the lowest since 1899, or in 15 years. The decrease from 1913 was nearly one-half, being 17,357,412 tons, or 48 per cent, in quantity and $18,697,416, or 47 per cent, in value. The decrease was general throughout the State; only two counties (Stark and Mahoning) showed increase, and Belmont County, which had the largest production in 1913, showed a decrease of 72 per cent. The principal cause for the decrease was labor trouble, but depressed business conditions, resulting in lack of demand from railroads and industrial plants and in curtailment of Lake shipments, contributed to the falling off. On April 1, 1914, all the coal miners in Ohio went on strike over the wage scale, the matter in dispute being primarily whether wages should be paid on a mine-run basis as provided by an act of the legislature. The law was bitterly opposed by the coal operators, and although during the first three months of 1914 the production of coal was greater than the production for the corresponding months in 1913, practically all the Ohio mines were idle from April to July. The Hocking Valley district then resumed operations, and in August the Cambridge district also resumed. In what is known as the No. 8 district (mines operating on the Pittsburgh No. 8 coal) the mines were still idle at the end of the year.

The number of men employed in the coal mines of Ohio in 1914 was 45,401, or but little less than the number (45,815) in 1913. On account of the strike the average number of working days fell from 206 in 1913 to 108 in 1914, a decrease of almost one-half. The average production by each man employed decreased from 790 tons in 1913 to 415 tons in 1914. The average production per man per day was 3.8 tons, remaining the same in both years. The time lost because of strikes was 6,452,762 days, 40,577 men being affected for an average of 159 days. The time thus lost was 30 per cent more than the time made during the year.

Of the total production of Ohio, 16,147,630 tons, or 85.7 per cent, was mined by machines in 1914. At the present time Ohio enjoys the excellent record of having less than 4 per cent of the total output reported as shot off the solid, the quantity thus mined in 1914 being 716,666 short tons, or 3.8 per cent of the total. In 1914, 1,263,470 tons, or 6.7 per cent of the total, was undercut by hand, and no method was reported for the mining of 715,349 tons, or 3.8 per cent of the total. The number of machines in operation in 1914 was 1,669, as compared with 1,681 in 1913. Of this number 1,461 were chain breast, 56 were punchers, 24 long wall, and 128 short wall.

Comparatively little of the output of coal in Ohio is washed. In 1914 that item amounted to 292,673 short tons, yielding 253,389 tons of cleaned coal and 39,284 tons of refuse.

Reports to the Bureau of Mines show that the fatalities in the coal mines numbered 64, of which 62 were underground and 2 on the surface. The principal causes were falls of roof and coal, which claimed 44 victims, and mine cars and locomotives, which caused the death of 10 men. The death rate per thousand was 1.4, and the number of tons mined for each life lost was 294,423.

The statistics of production by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Ohio in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Athens	4,801,707	37,559	125,067	4,300	4,968,633	$5,538,778	$1.11	186	7,143
Belmont	9,893,361	413,596	129,302	....	10,436,259	10,745,972	1.03	222	10,946
Carroll	329,160	44,404	5,500	....	379,064	424,546	1.12	217	623
Columbiana	471,425	34,467	16,912	....	522,804	632,682	1.21	226	747
Coshocton	292,782	63,114	8,515	....	364,411	473,401	1.30	247	621
Guernsey	4,215,033	44,497	62,462	....	4,321,992	4,405,009	1.02	202	4,749
Harrison	701,310	16,659	12,252	....	730,221	751,452	1.03	225	778
Hocking	1,605,021	35,308	38,294	....	1,678,623	1,914,339	1.14	205	2,218
Holmes	500	8,472	15	....	8,987	12,607	1.40	181	18
Jackson	473,187	94,386	19,471	....	587,044	935,420	1.59	135	1,718
Jefferson	4,739,434	352,654	86,373	461	5,178,922	5,693,434	1.10	232	5,763
Lawrence	129,280	45,624	1,194	....	176,098	216,058	1.23	200	388
Mahoning	4,875	10,771	140	....	15,786	29,678	1.88	154	72
Meigs	595,457	38,453	8,815	....	642,725	771,868	1.20	192	1,208
Muskingum	417,074	53,548	2,126	....	472,748	515,986	1.09	228	653
Noble	767,367	9,534	10,240	....	787,141	822,108	1.04	210	778
Perry	2,068,207	52,839	56,518	....	2,177,564	2,412,031	1.11	188	3,235
Stark	252,532	143,040	21,666	....	417,238	760,036	1.82	187	939
Tuscarawas	1,177,211	209,580	33,131	....	1,419,922	1,603,968	1.13	230	1,853
Vinton	96,946	22,597	2,949	....	122,492	140,771	1.15	171	248
Wayne	68,580	14,467	14,186	....	97,233	203,811	2.10	126	273
Other counties [a]	424,647	13,111	19,160	....	456,918	639,057	1.40	188	844
Small mines	....	237,702	....	....	237,702	305,046	1.28	......	......
Total	33,525,096	1,996,382	674,288	4,761	36,200,527	39,948,058	1.10	206	45,815

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Athens	3,142,588	46,776	108,825	....	3,298,189	$3,682,607	$1.12	125	6,596
Belmont	2,475,157	336,262	37,762	....	2,849,181	2,901,189	1.02	57	11,720
Carroll	178,473	48,474	8,533	....	235,480	268,055	1.14	155	533
Columbiana	292,226	40,700	9,440	....	342,366	416,904	1.22	135	810
Coshocton	118,278	32,894	1,874	....	153,046	211,733	1.38	100	566
Guernsey	2,823,801	42,804	70,102	....	2,936,707	2,953,506	1.01	152	4,355
Harrison	168,455	11,289	5,148	....	184,892	201,426	1.09	60	862
Hocking	1,135,997	65,437	29,906	....	1,231,340	1,382,360	1.12	138	2,301
Holmes	....	8,934	....	....	8,934	13,065	1.46	260	21
Jackson	407,166	100,403	25,262	....	532,831	834,092	1.57	126	1,645
Jefferson	1,817,355	312,430	42,665	431	2,172,881	2,453,846	1.13	100	5,762
Lawrence	119,736	39,491	850	....	160,077	202,753	1.27	166	377
Mahoning	7,000	8,684	219	....	15,903	27,746	1.74	172	56
Meigs	479,492	43,716	11,576	....	534,784	593,409	1.11	143	1,087
Muskingum	269,820	56,765	1,744	....	328,329	369,113	1.12	149	676
Noble	487,305	7,492	7,145	....	501,942	502,718	1.00	136	842
Perry	1,098,549	52,330	35,795	....	1,186,674	1,309,810	1.10	110	3,204
Stark	292,170	143,784	21,979	....	457,933	721,754	1.58	178	879
Tuscarawas	708,485	188,533	24,218	....	921,236	1,039,467	1.13	136	1,803
Vinton	24,907	56,929	2,536	....	84,372	99,839	1.18	114	258
Wayne	68,462	4,458	15,425	....	88,345	206,685	2.34	118	280
Other counties [b]	282,035	27,448	23,504	....	332,987	479,069	1.44	125	768
Small mines	....	284,686	....	....	284,686	379,496	1.33	......	......
Total	16,397,457	1,960,719	484,508	431	18,843,115	21,250,642	1.13	108	45,401

[a] Gallia, Medina, Morgan, Portage, Scioto, Summit, and Trumbull.
[b] Gallia, Medina, Morgan, Portage, Scioto, and Summit.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Ohio, 1910–1914, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (—), 1914.
Athens	5,593,560	4,292,527	4,819,774	4,968,633	3,298,189	— 1,670,444
Belmont	8,265,019	8,092,127	9,382,330	10,436,259	2,849,181	— 7,587,078
Carroll	313,517	269,167	322,969	379,064	235,480	— 143,584
Columbiana	715,252	660,196	448,778	522,804	342,366	— 180,438
Coshocton	427,341	390,812	371,399	364,411	153,046	— 211,365
Gallia	9,187	10,805	91,575	11,810	7,540	— 4,270
Guernsey	4,686,994	3,895,682	4,246,955	4,321,992	2,936,707	— 1,385,285
Harrison	560,937	559,267	812,953	730,221	184,892	— 545,329
Hocking	1,635,575	1,576,119	1,763,177	1,678,623	1,231,340	— 447,283
Holmes	10,157	10,930	10,257	8,987	8,934	— 53
Jackson	878,656	669,591	737,284	587,044	532,831	— 54,213
Jefferson	5,241,681	4,687,731	4,858,529	5,178,922	2,172,881	— 3,006,041
Lawrence	148,568	59,192	66,158	176,098	160,077	— 16,021
Mahoning	60,434	52,748	33,194	15,786	15,903	+ 117
Medina	24,148	14,187	6,679	5,445	5,112	— 333
Meigs	599,492	516,845	644,463	642,725	534,784	— 107,941
Morgan	124,336	174,513	193,745	279,481	194,743	— 84,738
Muskingum	238,795	376,446	465,629	472,748	328,329	— 144,419
Perry	2,283,257	2,086,799	2,145,916	2,177,564	1,186,674	— 990,890
Portage	101,826	109,727	84,903	91,940	65,571	— 26,369
Stark	496,509	450,256	414,452	417,238	457,933	+ 40,695
Summit	101,243	85,579	79,462	59,859	54,380	— 5,479
Trumbull	700	....	1,035	930	....	— 930
Tuscarawas	816,189	677,330	1,324,594	1,419,922	921,236	— 498,686
Vinton	86,801	104,338	97,938	122,492	84,372	— 38,120
Wayne	159,138	209,059	194,036	97,233	88,345	— 8,888
Noble, Scioto	438,398	477,294	633,944	794,594	507,583	— 287,011
Small mines	191,958	250,719	276,599	237,702	284,686	+ 46,984
Total	34,209,668	30,759,986	34,528,727	36,200,527	18,843,115	— 17,357,412
Total value	$35,932,288	$31,810,123	$37,083,363	$39,948,058	$21,250,642	—$18,697,416

One of the early reports published by Ohio states that in 1838 there were 119,952 short tons produced from the coal mines of the State. It is probable that some coal was mined in Ohio prior to that date, but 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 the production of coal 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 1914 will be found in the following table:

Production of coal in Ohio from 1838 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1838	119,952	1858	1,000,000	1878	5,500,000	1898	14,516,867
1839	125,000	1859	1,060,000	1879	6,000,000	1899	16,500,270
1840	140,536	1860	1,265,600	1880	6,008,595	1900	18,988,150
1841	160,000	1861	1,150,000	1881	9,240,000	1901	20,943,807
1842	225,000	1862	1,200,000	1882	9,450,000	1902	23,519,894
1843	280,000	1863	1,204,581	1883	8,229,429	1903	24,838,103
1844	340,000	1864	1,815,622	1884	7,640,062	1904	24,400,220
1845	390,000	1865	1,536,218	1885	7,816,179	1905	25,552,950
1846	420,000	1866	1,887,424	1886	8,435,211	1906	27,731,640
1847	480,000	1867	2,092,334	1887	10,300,708	1907	32,142,419
1848	540,000	1868	2,475,844	1888	10,910,951	1908	26,270,639
1849	600,000	1869	2,461,986	1889	9,976,787	1909	27,939,641
1850	640,000	1870	2,527,285	1890	11,494,506	1910	34,209,668
1851	670,000	1871	4,000,000	1891	12,868,683	1911	30,759,986
1852	700,000	1872	5,315,294	1892	13,562,927	1912	34,528,727
1853	760,000	1873	4,550,028	1893	13,253,646	1913	36,200,527
1854	800,000	1874	3,267,585	1894	11,909,856	1914	18,843,115
1855	890,000	1875	4,864,259	1895	13,355,806		
1856	930,000	1876	3,500,000	1896	12,875,202	Total	701,521,661
1857	975,000	1877	5,250,000	1897	12,196,942		

OKLAHOMA.

Total production in 1914, 3,988,613 short tons; spot value, $8,204,015.

Because of the increased quantity of coal required by the railroads to move the exceptionally heavy grain crops in Kansas, Oklahoma had a temporary advantage in 1914 in furnishing coal to markets normally supplied from the Colorado fields; but this advantage was more than offset by the displacement of coal as a fuel by petroleum and gas, consequent upon the remarkable increase in the production of oil in Oklahoma and Texas in 1914. The output of coal in Oklahoma in 1914 was 177,157 tons, or 4.25 per cent, less in quantity and $338,733, or 3.97 per cent, less in value than in 1913.

Less time was lost in 1914 by reason of strikes than in 1913, a total of 1,286 men having been affected in 1914 for an average of 31 days, as against 1,696 men in 1913 for an average of 80 days.

According to the Bureau of Mines, there were 31 fatal accidents in the coal mines of Oklahoma in 1914, as compared with 23 in 1913. Twenty fatalities were from falls of roof and coal and 11 were from all other causes.

Oklahoma continues to show a disgracefully high percentage of coal shot off the solid, a practice encouraged by the laws of the State, which compel payment of wages on a basis of mine-run coal. An increase in the production of machine-mined coal from 670,629 tons, or 16.1 per cent of the total, in 1913 to 1,053,526 tons, or 26.4 per cent of the total, in 1914 reduced the percentage of coal shot off the solid from 81 per cent to 71 per cent, and at the same time the quantity of "powder-mined" coal decreased from 3,371,218 tons in 1913 to 2,820,529 tons in 1914, so the record of the latter year may be considered somewhat of an improvement over that of 1913.

The number of days the men were able to work in 1914 showed a marked improvement over the two preceding years. The average time made by the 8,078 men employed was 205 days, as compared with 9,044 men for 197 days in 1913 and 8,785 men for 174 days in 1912. The average total production per man in 1914 was 494 tons, against 461 tons in 1913, and the average daily production by each employee was increased from 2.34 tons in 1913 to 2.41 tons in 1914.

The statistics of production in 1913 and 1914, by counties, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Oklahoma in 1913 and 1914, by counties, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Coal	828,158	10,434	50,707	889,299	$1,948,204	$2.19	232	2,049
Haskell and Latimer	673,077	4,930	60,672	738,679	1,455,810	1.97	171	1,491
Le Flore	185,303	4,141	12,409	201,853	321,857	1.59	161	358
Okmulgee	803,655	1,225	15,779	820,659	1,419,919	1.73	208	1,361
Pittsburg	1,295,560	8,418	125,372	1,429,350	3,225,836	2.26	188	3,556
Tulsa	27,168	24,972	160	52,300	101,905	1.95	208	108
Other counties[a]	28,175	2,792	100	31,067	63,634	2.05	195	121
Small mines		2,563		2,563	5,583	2.18		
Total	3,841,096	59,475	265,199	4,165,770	8,542,748	2.05	197	9,044

[a] Rogers and Wagoner.

Production of coal in Oklahoma in 1913 and 1914, by counties, in short tons—Contd.

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Coal	633,593	11,128	31,571	676,292	$1,486,371	$2.20	236	1,537
Latimer	606,446	4,394	55,434	666,274	1,338,194	2.01	200	1,217
Le Flore	248,446	3,916	11,661	264,023	436,729	1.65	214	469
Okmulgee	890,445	1,731	12,952	905,128	1,584,872	1.75	211	1,576
Pittsburg	1,227,512	12,881	133,378	1,373,771	3,155,357	2.30	186	3,024
Other counties [a]	94,055	3,755	550	98,360	189,458	1.92	201	255
Small mines	....	4,765	....	4,765	13,034	2.74	....	....
Total	3,700,497	42,570	245,546	3,988,613	8,204,015	2.06	205	8,078

[a] Rogers, Tulsa, and Wagoner.

The production of coal, by counties, during the last five years, with increase and decrease in 1914, as compared with 1913, is shown in the following table:

Production of coal in Oklahoma in 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Coal	498,658	778,546	816,155	889,299	676,292	− 213,007
Haskell and Latimer	675,953	701,374	766,798	738,679	[a] 666,274	− 72,405
Le Flore	87,628	122,468	150,511	201,853	264,023	+ 62,170
Okmulgee	227,107	408,202	629,989	820,659	905,128	+ 84,469
Pittsburg	1,083,243	1,018,742	1,234,334	1,429,350	1,373,771	− 55,579
Rogers and Wagoner	27,618	18,784	30,126	31,067	29,568	− 1,499
Tulsa	40,007	21,422	39,964	52,300	68,792	+ 16,492
Small mines	6,012	[b] 4,704	[c] 7,541	2,563	4,765	+ 2,202
Total	2,646,226	3,074,242	3,675,418	4,165,770	3,988,613	− 177,157
Total value	$5,867,947	$6,291,494	$7,867,331	$8,542,748	$8,204,015	− $338,733

[a] Latimer only. [b] Includes Atoka and Johnston Counties. [c] Includes Atoka County.

The Tenth United States Census (1880) contains the first published record of the production of coal 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 (4,165,770 short tons) was mined in 1913, although, as shown in the following table, the industry during the last 11 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 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	120,947	1890	869,229	1900	1,922,298	1910	2,646,226
1881	150,000	1891	1,091,032	1901	2,421,781	1911	3,074,242
1882	200,000	1892	1,192,721	1902	2,820,666	1912	3,675,418
1883	350,000	1893	1,252,110	1903	3,517,388	1913	4,165,770
1884	425,000	1894	969,606	1904	3,046,539	1914	3,988,613
1885	500,000	1895	1,211,185	1905	2,924,427		
1886	534,580	1896	1,366,646	1906	2,860,200	Total	63,462,777
1887	685,911	1897	1,336,380	1907	3,642,658		
1888	761,986	1898	1,381,466	1908	2,948,116		
1889	752,832	1899	1,537,427	1909	3,119,377		

OREGON.

Total production in 1914, 51,558 short tons; spot value, $143,556.

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 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 Yaquina field, in Lincoln County; the Eckley and Shasta Costa fields, in Curry County; the Eden Ridge and Squaw Basin fields, in Coos County; and the Rogue River Valley field, in Jackson County. All 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 the coal of these fields is either lignite or subbituminous in character, except that of the Eden Ridge and Squaw Basin fields, which is bituminous and in part probably coking. Transportation from the Coos Bay field is confined exclusively to Coos Bay and the Pacific Ocean, and San Francisco is the principal market.

The production of coal in Oregon has never been one of the important industries of the State, and has been of less importance during the last few years than formerly because of the large increase in the production of petroleum in California and in its use for fuel. Before the advent of the liquid fuel considerable quantities of Oregon coal were shipped to San Francisco, where it served to some extent as a moderator of prices, particularly for domestic fuel. In only four years, however, has the production exceeded 100,000 tons, and in each of the three years preceding 1914 it was below 50,000 tons. The production of 1914 of 51,558 tons was an increase of 5,495 tons over 1913, and was the largest since 1910.

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 production of coal in Oregon, 1910–1914, 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 value per ton.	Average number of days active.	Average number of employees.
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
1913	31,582	8,617	5,864	46,063	116,724	2.53	283	203
1914	37,152	5,798	8,608	51,558	143,556	2.78	266	190

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 which time the Beaver Hill mine has been more successfully managed and has become the chief producer. The first record of the production of coal in Oregon is contained in the census report of 1880, when 43,205 short tons were mined.

The total production of coal in Oregon to the close of 1914 has amounted to 2,217,379 short tons, as shown in the following table:

Production of coal in Oregon, 1880–1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	43,205	1890	61,514	1899	86,888	1908	86,259
1881	33,600	1891	51,826	1900	58,864	1909	87,276
1882	35,000	1892	34,661	1901	69,011	1910	67,533
1883	40,000	1893	41,683	1902	65,648	1911	46,661
1884	45,000	1894	47,521	1903	91,144	1912	41,637
1885	50,000	1895	73,685	1904	111,540	1913	46,063
1886	45,000	1896	101,721	1905	109,641	1914	51,558
1887	37,696	1897	107,289	1906	79,731		
1888	75,000	1898	58,184	1907	70,981	Total	2,217,379
1889	64,359						

PENNSYLVANIA.

Total production in 1914, 238,804,801 short tons; spot value, $347,187,695.

Anthracite.—Total production in 1914, 81,090,631 long tons (equivalent to 90,821,507 short tons); spot value, $188,181,399.

Bituminous.—Total production in 1914, 147,983,294 short tons; spot value, $159,006,296.

The production of both anthracite and bituminous coal in Pennsylvania in 1914 was less than in 1913, but, owing to the fact that anthracite no longer enters to any extent into the manufacturing industries, it was not so seriously affected by the industrial depression of 1914 as was the bituminous output. The aggregate production of anthracite and bituminous in 1913 amounted to 265,306,139 short tons, valued at $388,220,933, compared with which the production in 1914 showed a decrease of 26,501,338 short tons, or 10 per cent, in quantity and of $41,033,238, or 10.6 per cent, in value. Of the total decrease, 25,797,923 short tons in quantity and $34,033,510 in value were in the production of bituminous coal. The percentage of decrease in anthracite was 0.8 per cent in quantity and 3.6 per cent in value; that of bituminous coal was 14.9 per cent in quantity and 17.6 per cent in value. The output of anthracite in 1914, notwithstanding the decrease, was, with the exception of 1913, the largest ever obtained. The output of bituminous coal in 1914 was exceeded in the years 1907, 1910, 1912, and 1913. Notwithstanding the decreased output of both anthracite and bituminous coal, the number of men employed in the coal mines of Pennsylvania in 1914 showed an increase over 1913 and established a new record for that State. Of the total men employed in the coal mines of Pennsylvania in 1914 (363,880), 179,679 were in the anthracite mines and 184,201 in the bituminous mines. The average number of days worked was, however, less—in the anthracite mines 245 in 1914, against 257 in 1913, and in the bituminous areas 214 in 1914, against 267 in 1913.

PENNSYLVANIA ANTHRACITE.

The coal recovered from old culm banks by washeries and a small quantity dredged from Susquehanna River included, the production of anthracite in 1914 amounted to 81,090,631 long tons, valued at $188,181,399. Compared with 1913, when the record output of 81,718,680 long tons, valued at $195,181,127, was made, the production for 1914 declined 628,049 long tons, or 0.8 per cent, in quantity and $6,999,728, or 3.6 per cent, in value. The total shipments [1] from the anthracite region, exclusive of coal recovered by dredges, reported to the United States Geological Survey for 1914 were 70,447,022 long tons, of which 43,176,136 tons, or 61.3 per cent, consisted of prepared or domestic sizes and 27,270,896 tons, or 38.7 per cent, consisted of pea, buckwheat, and smaller sizes. In the last few years pea coal has become an important factor in the domestic trade, particularly for household furnaces, and probably should be included among the prepared sizes. It is no longer sold below the cost of production, as are the smaller sizes with which it has been customary to include it. The circular price per long ton for pea coal at the mines in 1912, 1913, and 1914 was $2.50; buckwheat was quoted at $1.50. The average price per ton for rice in 1914 was $1.05 and for barley 55 cents.

Of the total production in 1914 of 81,090,631 long tons, 70,464,046 tons, or 86.9 per cent, were loaded at the mines for shipment to distant points; 1,919,533 tons, or 2.4 per cent, were sold to local trade or used by employees, and 8,707,052 tons, or 10.7 per cent, were consumed in the generation of heat and power at the collieries. The number of men employed in the anthracite mines in 1914 was 179,679, as compared with 175,745 in 1913. The average number of days worked in 1914 (245) has been exceeded in only two other years, 1911 (246) and 1913 (257). In 1913 the average output per man for the year was 466 tons; in 1914 it was 451. The average daily output per man increased slightly, from 1.81 in 1913 to 1.84 in 1914.

The last general strike in the anthracite region was in April–May of 1912. When, about June 1, 1912, mining operations were resumed, it was under an agreement that reextended, with some modifications, the awards of the Anthracite Coal Strike Commission, which had been in force by renewal by mutual consent since the expiration of the original awards, March 31, 1906. In consequence of the miners and operators again extending the terms of the awards, this time for a period of four years, there were no serious interruptions to coal-mining operations by labor troubles in 1914, and industrial peace is assured in the anthracite region until 1916. There were, however, in 1914, the usual number of petty strikes, which affected a total of 26,115, or about one-seventh of the total number of men, for an average of 7 days each.

Reports to the Bureau of Mines show that there were 595 fatal accidents in the anthracite mines in 1914, the principal contributing causes and the number of deaths from them being falls of roof and coal, 228; mine cars and locomotives 76 under ground and 30 on the surface; gas explosions, 44; explosions of powder, 90; falls in shafts,

[1] Only shipments of anthracite are reported by sizes. Coal sold to local trade and the colliery consumption are not so reported.

47. The death rate per thousand employees was 3.31, and the coal mined for each life lost was 136,287 long tons. In 1913 the death rate was 3.52 and the quantity of coal for each death was 132,231 tons.

The statistics of anthracite production during the last seven years are presented in the following table:

Statistics of production of anthracite, 1908–1914.

Year.	Quantity (long tons).	Value.	Average value per ton.	Number of men employed.	Average number of days worked.
1908	74,347,102	$158,178,849	$2.13	174,174	200
1909	72,384,249	149,181,587	2.06	{a171,195 b166,801}	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
1913	81,718,680	195,181,127	2.39	175,745	257
1914	81,090,631	188,181,399	2.32	179,679	245

a State mining department figures. *b* U. S. Census figures.

The production, by counties, in 1913 and 1914, with the distribution of the product for consumption, is shown in the following table:

Production of anthractite in 1913 and 1914, by counties, in long tons.

1913.

County.	Shipped.	Sold to local trade and employees.	Used at mines for steam and heat.	Total.
Carbon	2,600,127	111,227	354,960	3,066,314
Columbia	922,532	16,136	139,813	1,078,481
Dauphin	712,349	20,048	214,273	946,670
Lackawanna	18,022,318	450,949	1,767,223	20,240,490
Luzerne	27,713,933	731,667	3,093,779	31,539,379
Northumberland	5,447,529	116,290	697,683	6,261,502
Schuylkill	14,859,215	252,526	2,216,925	17,328,666
Sullivan	537,404	7,509	48,000	592,913
Susquehanna and Wayne	480,309	7,865	42,105	530,279
River dredges	47,456	79,597	6,933	133,986
Total	71,343,172	1,793,814	8,581,694	81,718,680

1914.

County.	Shipped.	Sold to local trade and employees.	Used at mines for steam and heat.	Total.
Carbon	2,661,565	25,190	355,529	3,042,284
Columbia	773,635	17,568	140,802	932,005
Dauphin	645,423	25,122	223,194	893,739
Lackawanna	17,715,783	521,975	1,737,762	19,975,520
Luzerne	28,344,786	858,852	3,132,174	32,335,812
Northumberland	5,127,454	133,963	729,795	5,991,212
Schuylkill	14,147,427	234,247	2,291,156	16,672,830
Sullivan	516,689	8,889	49,950	575,528
Susquehanna and Wayne	514,260	10,663	43,870	568,793
River dredges	17,024	83,064	2,820	102,908
Total	70,464,046	1,919,533	8,707,052	81,090,631

The following table gives the circular prices of anthracite at the mines during the last five years. These prices are common for the region and are for the coals known as the Mahanoy, Shenandoah, Locust Mountain, and Schuylkill white ash. The figures through buckwheat size are those furnished by the Philadelphia & Reading Coal & Iron Co.'s circular; those covering rice and barley are Lehigh Coal & Navigation quotations. In addition to the prices given for 1914, a Pennsylvania State tax of 2½ per cent per ton was charged on the market value of the coal at the mines.

Circular prices for anthracite at the mines, 1910–1914, per long ton.

Size.	1910	1911	1912	1913	1914
Lump	$3.50	$3.50	$3.50	$3.50	$3.50
Steamboat	3.00	3.00	3.00	3.00	3.50
Broken (furnace) [a]	3.50	3.50	3.50	3.50	3.50
Egg [a]	3.75	3.75	3.75	3.75	3.75
Stove [a]	3.75	3.75	4.00	4.00	4.00
Chestnut [a]	3.75	4.00	4.15	4.15	4.15
Pea	2.00	2.00	2.50	2.50	2.50
Buckwheat	1.50	1.50	1.50	1.50	1.50
Rice	....	.538	.634	.654	1.05
Barley	....	.339	.388	.402	.55

[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, except in 1912, when discounts were omitted during April and May.

Circular prices of anthracite at New York Harbor ports and at Port Richmond (Philadelphia) in 1913 and 1914 were as follows:

Circular prices for free-burning, white-ash anthracite f. o. b. New York Harbor ports and Port Richmond in 1913 and 1914, per long ton.[a]

Size.	New York Harbor.		Port Richmond.	
	1913	1914	1913	1914
Broken [b]	$5.00	$5.00	$4.75	$4.75
Egg [b]	5.25	5.25	5.00	5.00
Stove [b]	5.25	5.25	5.00	5.00
Chestnut [b]	5.50	5.50	5.25	5.25
Pea	3.35	3.35	3.28	3.24
No. 1, buckwheat	2.45	2.45	2.25	2.27
No. 2, buckwheat	1.94	1.95	1.85	1.72
No. 3, buckwheat	1.62	1.58	1.45	1.39

[a] Philadelphia & Reading Coal & Iron Co.'s circular through chestnut size. Remainder of sizes are average prices f. o. b. by same company.
[b] Subject to 50 cents reduction in April, 40 cents in May, 30 cents in June, 20 cents in July, and 10 cents in August.

Since 1901 it has been customary to allow discounts from the circular prices in the spring in order to induce customers to buy their supplies for the following winter during the summer months, when ordinary demand is light and when operations and transportation are not liable to interruption by inclement weather. The wisdom of this policy has been clearly evinced by the marked increase in the number of working days the employees have been able to make and in the uniform distribution of the shipments throughout the 12 months of the year. As showing that employment in the anthracite region is evenly distributed throughout the year, it is noted that in 1914 railroad shipments reported to the Bureau of Anthracite Coal Statistics amounted to 68,342,601 long tons, of which 32,736,906 tons, or 48 per cent, were sent out during the winter months and 35,605,695 tons, or 52 per cent, in the summer months, the difference between the winter and the summer shipments being about 2,800,000 tons in a total exceeding 68,000,000 tons.

The following table shows the shipments, by months, during the last five years, as reported by the Bureau of Anthracite Coal Statistics. The table does not include the shipments from Sullivan County nor the shipments of coal recovered from Susquehanna River.

Monthly shipments of anthracite, 1910–1914, in long tons.

Months.	1910	1911	1912	1913	1914
January	5,306,618	5,904,117	5,763,696	6,336,419	5,175,732
February	5,031,784	5,070,948	5,875,968	5,674,169	4,121,451
March	5,174,166	5,996,894	6,569,687	4,909,288	5,164,703
April	6,224,396	5,804,915	266,625	5,966,189	6,072,164
May	5,679,661	6,317,352	1,429,357	5,995,742	6,281,553
June	5,398,123	6,215,357	6,191,646	5,970,047	6,130,186
July	4,202,059	4,804,065	6,285,153	5,487,852	5,391,857
August	4,996,044	5,531,796	6,576,591	5,369,900	5,483,743
September	4,967,516	5,730,935	5,876,496	5,572,279	6,246,192
October	5,622,095	6,269,179	6,665,321	6,338,194	6,644,476
November	6,071,746	6,193,314	6,165,536	5,786,931	5,928,286
December	6,231,578	6,115,427	5,944,502	5,662,618	5,702,258
Total	64,905,786	69,954,299	63,610,578	69,069,628	68,342,601

In the following table the shipments (not production) of anthracite are given for 1890, 1900, and 1910 to 1914, exclusive of the washery product obtained from the old culm banks:

Shipments of anthracite, excluding washery and dredge product, by sizes, 1890, 1900, and 1910–1914, in long tons.

Year.	Sizes above pea.		Pea and smaller.		Total shipments.
	Quantity.	Percentage.	Quantity.	Percentage.	
1890	28,154,678	77.0	8,419,181	23.0	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
1913	43,781,936	63.3	25,423,610	36.7	69,205,546
1914	43,112,545	62.7	25,614,930	37.3	68,727,475

The following table shows the quantities of the various sizes of freshly mined coal and of washery coal shipped in 1913 and 1914:

Shipments, by sizes, from mines and washeries in 1913 and 1914, in long tons.

Size.	1913		1914	
	From mines.	From washeries.	From mines.	From washeries.
Lump and steamboat	362,084	630	180,516	....
Broken	3,501,211	2,284	3,547,117	....
Egg	8,957,166	20,941	8,718,744	65
Stove	13,900,576	21,210	14,498,651	6,451
Chestnut	17,060,899	107,918	16,167,517	57,075
Pea	8,056,919	151,762	8,142,829	134,690
Buckwheat:				
No. 1	9,135,587	368,574	9,176,985	281,845
No. 2 and rice	5,081,314	552,723	4,165,823	450,496
No. 3 and barley	2,836,147	852,410	3,750,528	749,263
Screenings	313,643	11,718	378,765	39,662
Total	69,205,546	2,090,170	68,727,475	1,719,547

These figures represent shipments only. They do not include the dredge product, the coal sold locally, nor that used at the collieries, of which no record is made. The washery product described in this report is only that coal recovered from culm banks, and the figures showing washery product are not absolutely exact for the reason that a few washeries are operated at the mines. Small sizes of the freshly mined coal are washed to remove the slate, and no separate report of the coal so washed is made by the mining companies.

As shown in the preceding table, stove and chestnut sizes are in the greatest demand and make up over 43 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, rice, and barley for use as steam coal. The small sizes come directly into competition with bituminous, and sometimes they are used mixed with bituminous coal for steam, chiefly in hotels, apartment houses, and office buildings.

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	2¾-inch square.
Egg	2¾-inch square	2-inch square.
Stove	2-inch square	1⅜-inch square.
Chestnut	1⅜-inch square	¾-inch square.
Pea	¾-inch square	½-inch square.
Buckwheat No. 1	½-inch square	¼-inch square.
Buckwheat No. 2 or rice	¼-inch square	⅛-inch square.
Buckwheat No. 3 or barley	⅛-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 1913 and 1914, with the percentage that each size bears to the total shipments:

Quantity of each size of anthracite shipped from each county in 1913 and 1914, in long tons, and percentage of each to total.

1913.

County.	Lump and steamboat.	Broken.	Egg.	Stove.	Chestnut.
Carbon	15,358	134,842	298,758	390,827	551,536
Columbia	18,157	51,391	107,372	177,850	196,741
Dauphin		24,582	43,435	135,587	112,358
Lackawanna	12,563	504,002	2,304,933	3,790,759	4,386,779
Luzerne	109,915	1,745,626	3,680,454	5,784,859	7,181,114
Northumberland	30,798	170,648	567,634	1,039,617	1,326,782
Schuylkill	175,923	858,688	1,881,280	2,426,315	3,192,963
Sullivan		13,716	49,315	80,009	103,185
Susquehanna and Wayne			44,926	95,963	117,359
Total	362,714	3,503,495	8,978,107	13,921,786	17,168,817
Percentage of total	.51	4.92	12.59	19.53	24.08

Quantity of each size of anthracite shipped from each county in 1913 and 1914, in long tons, and percentage of each to total—Continued.

1913.

County.	Pea.	Buckwheat No. 1.	Buckwheat No. 2 and rice.	Buckwheat No. 3 and barley.	Screenings.	Total.
Carbon	372,972	359,128	299,760	176,946	....	2,600,127
Columbia	134,600	141,587	86,146	8,688	....	922,532
Dauphin	64,665	132,562	113,989	84,463	708	712,349
Lackawanna	2,096,974	2,225,647	1,439,209	1,247,806	13,646	18,022,318
Luzerne	2,912,235	3,100,103	1,733,441	1,435,449	30,737	27,713,933
Northumberland	622,441	976,798	582,045	117,677	13,089	5,447,529
Schuylkill	1,880,397	2,495,723	1,365,335	540,479	42,112	14,859,215
Sullivan	66,110	....	....	....	225,069	537,404
Susquehanna and Wayne	58,287	72,613	14,112	77,049	....	480,309
Total	8,208,681	9,504,161	5,634,037	3,688,557	325,361	71,295,716
Percentage of total	11.51	13.33	7.90	5.17	.46	100.00

1914.

County.	Lump and steamboat.	Broken.	Egg.	Stove.	Chestnut.
Carbon	17,416	246,908	337,848	441,747	491,621
Columbia	903	6,842	97,497	168,549	188,207
Dauphin	....	28,819	49,403	119,344	113,464
Lackawanna	8,533	496,351	2,201,098	3,854,857	4,276,308
Luzerne	83,417	1,743,231	3,693,425	6,242,676	6,908,139
Northumberland	8,492	183,837	531,103	1,036,637	1,193,671
Schuylkill	61,755	819,590	1,722,195	2,441,672	2,842,513
Sullivan	....	8,655	47,154	73,364	94,871
Susquehanna and Wayne	....	12,884	39,086	126,656	116,098
Total	180,516	3,547,117	8,718,809	14,505,502	16,224,892
Percentage of total	.26	5.03	12.37	20.59	23.03

County.	Pea.	Buckwheat No. 1.	Buckwheat No. 2 and rice.	Buckwheat No. 3 and barley.	Screenings.	Total.
Carbon	343,369	372,386	277,429	132,203	638	2,661,565
Columbia	97,357	131,422	75,976	6,882	....	773,635
Dauphin	63,598	120,783	91,155	63,683	794	651,043
Lackawanna	2,085,379	2,090,757	839,997	1,810,145	53,158	17,716,583
Luzerne	3,074,262	3,287,217	1,527,417	1,732,421	54,381	28,346,586
Northumberland	607,275	903,040	571,330	79,994	12,075	5,127,454
Schuylkill	1,871,504	2,495,925	1,211,798	612,023	77,256	14,156,231
Sullivan	69,519	....	....	....	223,126	516,689
Susquehanna and Wayne	65,356	58,258	27,287	68,635	....	514,260
Total	8,277,619	9,459,788	4,622,389	4,505,986	421,428	70,464,046
Percentage of total	11.75	13.42	6.56	6.39	.60	100.00

Distributed by trade regions, not including Sullivan County nor coal dredged from Susquehanna River, the shipments of anthracite in 1913 and 1914 were as follows:

Shipments of anthracite, by regions and sizes, 1913 and 1914, in long tons.

1913.

Size.	Lehigh region.	Schuylkill region.	Wyoming region.	Total.
Lump	33,299	222,884	106,531	362,714
Broken	395,795	986,679	2,107,305	3,489,779
Egg	1,262,448	2,264,762	5,401,582	8,928,792
Stove	1,797,062	3,397,668	8,647,047	13,841,777
Chestnut	2,311,631	4,282,944	10,471,057	17,065,632
Pea	1,291,412	2,366,797	4,484,362	8,142,571
Buckwheat No. 1	1,439,307	3,361,591	4,703,263	9,504,161
Buckwheat No. 2	1,044,988	1,912,700	2,676,349	5,634,037
Buckwheat No. 3	592,592	565,451	2,530,514	3,688,557
Screenings	11,487	55,909	32,896	100,292
Total	10,180,021	19,417,385	41,160,906	70,758,312

1914.

Size.	Lehigh region.	Schuylkill region.	Wyoming region.	Total.
Lump	30,837	69,787	79,892	180,516
Broken	528,801	929,388	2,080,273	3,538,462
Egg	1,314,479	2,107,015	5,250,161	8,671,655
Stove	1,941,366	3,400,734	9,089,638	14,431,738
Chestnut	2,127,689	3,855,616	10,146,416	16,129,721
Pea	1,288,108	2,333,258	4,586,634	8,208,000
Buckwheat No. 1	1,493,218	3,276,721	4,688,891	9,458,830
Buckwheat No. 2	1,031,502	1,732,599	1,852,218	4,616,319
Buckwheat No. 3	495,748	609,717	3,394,326	4,499,791
Screenings	20,560	87,327	87,414	195,301
Total	10,272,308	18,402,162	41,255,863	69,930,333

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 Scranton Pittston Wilkes-Barre Plymouth Kingston	Wyoming.
Eastern middle	Green Mountain Black Creek Hazleton Beaver Meadow Panther Creek	Lehigh.
Southern	East Schuylkill Western Schuylkill Lorberry Lykens Valley	Schuylkill.
Western middle	East Mahanoy West Mahanoy Shamokin	

The anthracite fields are reached by 11 so-called initial railroads, as follows:

Central Railroad of New Jersey.
Delaware & Hudson Railroad.
Delaware, Lackawanna & Western Railroad.
Erie Railroad.
Lehigh & New England Railroad.
Lehigh Valley Railroad.

New York, Ontario & Western Railway.
New York, Susquehanna & Western Railroad (part of Erie system).
Northern Central Railroad (part of Pennsylvania system).
Pennsylvania Railroad.
Philadelphia & Reading Railway.

PENNSYLVANIA BITUMINOUS COAL.

Total production in 1914, 147,983,294 short tons; spot value, $159,006,296.

The output of bituminous coal in Pennsylvania in 1914 was less by 25,797,923 tons, or 14.9 per cent, in quantity and $34,033,510, or 17.6 per cent, in value than in 1913. The quantity of output in 1914 was exceeded in 1907, 1910, 1912, and 1913; but the total value in 1914 was greater than the value in 1907 and 1910, and the average value per ton in 1914 has been exceeded in but three years, 1902 and 1903—when, because of the scarcity of all kinds of fuel, due to the great anthracite strike, the prices were abnormally high—and 1913, which was the banner year for coal in almost every respect. The most potent cause contributing to the decrease in output of bituminous coal in Pennsylvania in 1914 was the decline in the iron and steel industry. Fully half the decrease is accounted for in the quantity of coal made into coke in Pennsylvania in 1914, which was almost 13,000,000 tons less than in 1913. The demand for coal from the railroads and the manufacturers was considerably decreased by the business depression, and to that cause is attributed a large part of the decrease. There was plenty of labor available throughout the year, and transportation facilities were ample at all times. The time lost by strikes was more than 1,000,000 days, 36,613 men having been affected for an average of 29 days each. The time lost was 2.7 per cent of the time made, as compared with 0.6 per cent in 1913. The greatest loss of time occurred during the biennial suspension, beginning April 1, when the men went out pending the settlement of the new agreement. Strikes had little effect upon the total production, however, as labor was plentiful, and 12,000 more men were employed in the coal mines of Pennsylvania in 1914 than in the previous year.

Decreased production was well distributed over the bituminous fields, 21 out of 24 counties for which figures are published showing decrease. Of the 3 counties showing increase, only 1, Somerset, with a production of more than 10,000,000 tons in 1914, had an increase of more than 300,000 tons. The 2 counties which constitute the Connellsville coke region had the largest decrease—Fayette, 9,271,783 tons, and Westmoreland, 4,263,275 tons. The decrease in Allegheny County was 3,309,621 tons, and in Washington County it was 2,813,643 tons. Two additional counties had decreases of more than 1,000,000 tons, and three of more than 700,000 tons.

The quantity of powder-mined coal reported to the Geological Survey was 2,940,496 tons, or less than 2 per cent of the total, as compared with 3 per cent in 1913. The coal undercut by hand was 55,000,000 tons, or more than 37.2 per cent of the total, and that mined by machines was 79,657,459 tons, or 53.8 per cent of the total, practically the same percentage as in 1913. The number of machines in use increased from 6,301 in 1913 to 6,326 in 1914, of which almost half, or 3,140, were punchers. There were in use 1,927 chain breast, 1,156 short wall, 96 long wall, and 7 machines of other types.

The number of men employed in the bituminous mines of Pennsylvania in 1914 was 184,201, who worked for an average of 214 days, against 172,196 men for 267 days in 1913. The average production per man for the year 1913 exceeded any previous record of any State and amounted to 1,009 short tons, but in 1914 the yearly production decreased to 803 tons. The average daily production per man fell off slightly, from 3.78 tons in 1913 to 3.75 tons in 1914.

Only a small part of the bituminous output of Pennsylvania is washed, and practically all of the washed product is used in the manufacture of coke. In 1914 the quantity washed was 4,808,051 short tons, or about 3.25 per cent of the total production. It yielded 4,350,800 tons of cleaned coal and 457,251 tons of refuse. The quantity of washed coal used, as reported by the coke operators, was 4,252,072 tons.

The fatality record compiled by the Bureau of Mines shows that there was a decrease in the number of men killed in the bituminous coal mines of Pennsylvania from 609 in 1913 to 402 in 1914. As usual, the most prolific cause of accidents was falls of roof and coal, which in 1914 claimed 233 victims. Haulage-way accidents were responsible for 89 deaths, and electric shocks and burns for 25. Altogether 379 men out of a total of 402 were killed underground, and 23 were killed on the surface. The death rate per thousand was 2.18 in 1914, against 3.54 in 1913 and 2.65 in 1912. The quantity of coal mined for each life lost was 368,117 tons in 1914, against 285,355 tons in 1913 and 370,402 in 1912.

The statistics of production, by counties, with the distribution of the product for consumption in 1913 and 1914, are shown in the following table:

Production of bituminous coal in Pennsylvania in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Allegheny	19,014,187	786,049	315,166	2,421	20,117,823	$23,158,897	$1.15	252	21,650
Armstrong	5,068,536	102,739	150,347	....	5,321,622	5,476,228	1.03	260	6,134
Beaver	170,782	74,149	3,654	....	248,585	337,372	1.36	282	355
Bedford	589,949	139,988	15,146	105,709	850,792	927,379	1.09	244	1,154
Blair	323,030	317	9,354	59,016	391,717	463,225	1.18	217	553
Butler	1,033,292	17,578	29,132	....	1,080,002	1,210,524	1.12	263	1,368
Cambria	16,761,239	1,177,991	387,358	1,294,790	19,621,378	21,903,291	1.12	272	21,976
Center	1,475,751	17,271	4,249	....	1,497,271	1,499,395	1.00	260	1,833
Clarion	1,390,163	4,395	33,290	....	1,427,848	1,517,316	1.06	252	1,877
Clearfield	7,435,828	234,358	228,701	379,128	8,278,015	8,579,446	1.04	258	10,121
Clinton	330,028	11,578	1,448	....	343,054	441,249	1.29	281	290
Elk	1,140,364	30,455	30,246	....	1,201,065	1,251,090	1.04	270	1,721
Fayette	7,727,676	339,125	661,835	23,879,327	32,607,963	37,810,508	1.16	284	23,704
Greene	248,152	6,227	18,423	43,950	316,752	321,001	1.01	207	428
Huntingdon	882,040	5,936	16,761	31,037	935,774	1,060,367	1.13	268	1,262
Indiana	9,638,385	59,051	251,872	255,376	10,204,684	10,297,482	1.01	277	12,026
Jefferson	4,563,844	70,956	120,981	1,046,083	5,801,864	5,794,490	.99	271	5,790
Lawrence	78,478	2,701	13,104	....	94,283	118,835	1.26	259	220
Mercer	687,869	41,875	47,857	....	777,601	960,624	1.24	260	1,231
Somerset	9,601,406	77,348	250,022	....	9,928,776	11,119,355	1.12	270	9,666
Tioga	903,161	31,240	9,347	....	943,748	1,544,537	1.64	224	1,757
Washington	16,607,903	134,102	424,734	1,142,578	18,309,317	20,497,946	1.12	249	20,012
Westmoreland	22,240,531	598,925	780,723	9,638,523	33,258,702	36,490,802	1.10	281	26,847
Other counties [a] and small mines.	45,810	158,076	2,779	15,916	222,581	258,447	1.16	201	221
Total	127,958,404	4,122,430	3,806,529	37,893,854	173,781,217	193,039,806	1.11	267	172,196

[a] Cameron, Lycoming, and McKean.

Production of bituminous coal in Pennsylvania in 1913 and 1914, by counties, in short tons—Continued.

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Allegheny	15,901,275	634,679	270,203	2,045	16,808,202	$18,951,940	$1.13	206	22,326
Armstrong	4,374,737	65,530	139,122	....	4,579,389	4,777,354	1.04	192	6,904
Beaver	55,497	43,562	2,750	....	101,809	129,889	1.28	112	394
Bedford	452,523	11,812	10,701	159,183	634,219	648,582	1.02	205	1,078
Blair	287,856	244	8,223	12,622	308,945	392,380	1.27	178	610
Butler	938,979	18,358	24,367	....	981,704	1,019,680	1.04	210	1,412
Cambria	15,795,841	1,008,859	324,967	904,820	18,034,487	20,153,882	1.12	221	25,025
Center	1,242,084	20,019	1,972	....	1,264,075	1,331,250	1.05	211	1,820
Clarion	1,302,789	15,161	23,442	....	1,341,392	1,409,030	1.05	229	2,016
Clearfield	6,450,522	220,213	200,642	277,646	7,149,023	7,491,977	1.05	203	10,872
Clinton	309,747	15,914	884	....	326,545	451,643	1.38	225	438
Elk	896,475	37,581	29,182	....	963,238	1,013,558	1.05	211	1,579
Fayette	6,073,058	234,887	574,886	16,453,349	23,336,180	24,495,859	1.05	225	22,926
Greene	208,911	6,989	20,270	54,327	290,497	314,637	1.08	271	339
Huntingdon	793,074	6,449	16,171	35,434	851,128	1,025,434	1.20	230	1,362
Indiana	9,006,512	63,698	208,923	143,863	9,422,996	9,583,267	1.02	199	12,766
Jefferson	3,945,278	61,402	151,142	931,801	5,089,623	5,355,815	1.05	207	6,194
Lawrence	109,060	3,940	10,987	....	123,987	159,716	1.29	280	212
Mercer	666,655	8,446	41,894	....	716,995	889,288	1.24	211	1,216
Somerset	9,913,973	68,746	256,044	....	10,238,763	11,281,008	1.10	236	11,769
Tioga	638,320	32,384	8,517	....	679,221	1,111,421	1.64	162	1,729
Washington	14,375,346	149,338	382,493	588,497	15,495,674	17,073,814	1.10	194	22,351
Westmoreland	21,079,387	618,995	674,844	6,622,201	28,995,427	29,638,435	1.02	231	28,686
Other counties [a] and small mines.	58,996	189,394	1,385	....	249,775	306,437	1.23	220	177
Total	114,876,895	3,536,600	3,384,011	26,185,788	147,983,294	159,006,296	1.07	214	184,201

[a] Bradford, Cameron, Lycoming, and McKean.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of bituminous coal in Pennsylvania, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (−), 1914.
Allegheny	18,835,336	17,863,795	18,867,265	20,117,823	16,808,202	− 3,309,621
Armstrong	3,304,915	3,799,227	4,104,989	5,321,622	4,579,389	− 742,233
Beaver	228,226	203,556	247,465	248,585	101,809	− 146,776
Bedford	716,833	528,170	731,477	850,792	634,219	− 216,573
Blair	380,870	294,048	324,336	391,717	308,945	− 82,772
Butler	1,017,809	957,074	1,000,947	1,080,002	981,704	− 98,298
Cambria	16,629,461	16,928,628	17,585,130	19,621,378	18,034,487	− 1,586,891
Center	1,293,622	1,140,263	1,291,374	1,497,271	1,264,075	− 233,196
Clarion	1,156,697	1,057,390	1,199,322	1,427,848	1,341,392	− 86,456
Clearfield	8,463,910	7,852,426	7,938,337	8,278,015	7,149,023	− 1,128,992
Clinton	310,973	314,643	345,454	343,054	326,545	− 16,509
Elk	1,202,323	1,223,856	1,146,496	1,201,065	963,238	− 237,827
Fayette	31,097,233	26,610,162	32,366,567	32,607,963	23,336,180	− 9,271,783
Greene	77,321	31,743	35,839	316,752	290,497	− 26,255
Huntingdon	669,226	806,199	834,914	935,774	851,128	− 84,646
Indiana	8,954,366	8,780,983	9,174,927	10,204,684	9,422,996	− 781,688
Jefferson	5,668,883	5,550,816	5,416,536	5,801,864	5,089,623	− 712,241
Lawrence	95,102	90,151	75,823	94,283	123,987	+ 29,704
Lycoming	25,725	13,271	7,777	26,953	27,795	+ 842
Mercer	867,754	859,355	846,228	777,601	716,995	− 60,606
Somerset	8,837,682	9,177,421	9,888,144	9,928,776	10,238,763	+ 309,987
Tioga	1,037,417	830,330	997,787	943,748	679,221	− 264,527
Washington	16,638,677	15,343,772	16,645,127	18,309,317	15,495,674	− 2,813,643
Westmoreland	22,885,404	24,102,195	30,589,549	33,258,702	28,995,427	− 4,263,275
Small mines	[a] 125,761	[b] 201,783	[c] 203,678	[d] 195,628	[b] 221,980	+ 26,352
Total	150,521,526	144,561,257	161,865,488	173,781,217	147,983,294	−25,797,923
Total value	$153,029,510	$146,154,952	$169,370,497	$193,039,806	$159,006,296	−$34,033,510

[a] Includes production of Bradford and Cameron counties.
[b] Includes production of Bradford, Cameron, and McKean counties.
[c] Includes Cameron, Fulton, and McKean counties.
[d] Includes Cameron and McKean counties.

The statistics of the early production of bituminous coal in Pennsylvania, particularly as compared with the anthracite records, are sadly lacking. 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 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	464,826	1860	2,690,786	1879	16,240,000	1898	65,165,133
1841	475,000	1861	3,200,000	1880	18,425,163	1899	74,150,175
1842	500,000	1862	4,000,000	1881	22,400,000	1900	79,842,326
1843	650,000	1863	5,000,000	1882	24,640,000	1901	82,305,946
1844	675,000	1864	5,839,000	1883	26,880,000	1902	98,574,367
1845	700,000	1865	6,350,000	1884	28,000,000	1903	103,117,178
1846	760,000	1866	6,800,000	1885	26,000,000	1904	97,938,287
1847	399,840	1867	7,300,000	1886	27,094,501	1905	118,413,637
1848	500,000	1868	7,500,000	1887	31,516,856	1906	129,293,206
1849	750,000	1869	6,750,000	1888	33,796,727	1907	150,143,177
1850	1,000,000	1870	7,798,518	1889	36,174,089	1908	117,179,527
1851	1,200,000	1871	9,040,565	1890	42,302,173	1909	137,966,791
1852	1,400,000	1872	11,695,040	1891	42,788,490	1910	150,521,526
1853	1,500,000	1873	13,098,829	1892	46,694,576	1911	144,561,257
1854	1,650,000	1874	12,320,000	1893	44,070,724	1912	161,865,488
1855	1,780,000	1875	11,760,000	1894	39,912,463	1913	173,781,217
1856	1,850,000	1876	12,880,000	1895	50,217,228	1914	147,983,294
1857	2,000,000	1877	14,000,000	1896	49,557,453		
1858	2,200,000	1878	15,120,000	1897	54,417,974	Total	2,879,928,353
1859	2,400,000						

SOUTH DAKOTA.

Total production in 1914, 11,850 short tons; spot value, $20,456.

There has doubtless been some lignite produced in South Dakota for a number of years, and mining has been carried on in a small way by settlers in the northwestern portion of the State where there are small areas underlain at shallow depths by workable deposits of lignite; but the total quantity produced annually has not been large. The first reports of production of lignite in South Dakota obtained by the United States Geological Survey are for the years 1913 and 1914 and show 10,540 tons and 11,850 tons, respectively. Under ordinary circumstances lignite will not stand shipment for any great distance, and consequently any increase or decrease in production depends almost entirely upon local needs. The greater part of the output is taken from strip pits and small drift mines and is used by ranchers living in the northwestern part of the State at greater or less distances from railroads.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in South Dakota in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Dewey and Harding	503	537	1,040	$1,753	$1.69	81	11
Meade		575	575	2,200	3.83	126	9
Perkins		8,925	8,925	16,695	1.87	162	28
Total	503	10,037	10,540	20,648	1.96	137	48

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Dewey and Harding	4,274	868	5,142	$7,271	$1.41	179	14
Meade		625	625	2,400	3.84	128	9
Perkins		6,083	6,083	10,785	1.77	145	24
Total	4,274	7,576	11,850	20,456	1.73	152	47

The statistics of production by counties, with increase and decrease in 1914, compared with 1913, are shown in the following table:

Production of coal in South Dakota in 1913 and 1914, by counties, in short tons.

County.	1913	1914	Increase (+) or decrease (−), 1914.
Dewey	858	4,855	+3,997
Harding	182	287	+ 105
Meade	575	625	+ 50
Perkins	8,925	6,083	−2,842
Total	10,540	11,850	+1,310
Total value	$20,648	$20,456	− 192

TENNESSEE.

Total production in 1914, 5,943,258 short tons; spot value, $6,776,573.

The production of coal in Tennessee in 1914 fell below the 6,000,000 mark for the first time since 1905. The decrease from 1913 was 916,926 tons, or 13 per cent, in quantity and $1,063,148, or 13.6 per cent, in value. The principal market for steam coal from the Tennessee mines is with the transportation interests, and most of the railroads traversing the Southeastern States buy some of their coal from the Tennessee mines. The cotton industry of the South also takes a portion of its steam coal from Tennessee, and the demoralization of that industry and the general business depression prevailing throughout the last part of 1914, which resulted in the curtailment of railroad activity and demand for coal, were responsible for the decrease noted. The smaller output of pig iron, in the latter part of the year, is reflected in the notable decrease in the quantity of coal made into coke in Tennessee.

The coal mines of Tennessee were entirely free from labor troubles in 1914, and no difficulties were experienced by the operators by reason of drought, floods, or lack of transportation facilities. The total number of men employed in 1914 was 10,116, and the average working time made by each man was 220 days, as compared with 11,238 men for an average of 241 days in 1913. The average production per man in 1914 was 588 tons for the year and 2.67 tons for each working day, against 610 and 2.53 tons, respectively, in 1913. More than one-third of the total production of coal in Tennessee is shot off the solid. In 1914 that item amounted to 2,234,214 tons, or 37.6 per cent of the total. The quantity mined by machines was 1,377,984 tons, or 23 per cent of the total, and the hand-mined coal amounted to 2,237,000 tons, or 39 per cent. In 1913 the powder-mined product amounted to 2,511,882 tons, or 37 per cent of the total, and the machine-mined product to 1,842,658 tons, or 26.9 per cent of the total, both of these items showing decrease in quantity in 1914, although the percentage of powder-mined coal was practically the same in both years. The number of machines in use decreased from 252 in 1913 to 194 in 1914. The latter included 126 punchers, 9 chain breast, 5 long wall, and 54 short wall or continuous cutters.

The quantity of coal washed in Tennessee in 1914 was 471,086 tons, which yielded 413,896 tons of cleaned coal and 57,190 tons of refuse. Most of the coal washed is slack used in the manufacture of coke. The coal-mining fatalities in Tennessee in 1914, as reported to the Bureau of Mines, numbered 26, a decrease as compared with 35 in 1913. Falls of roof and coal claimed 21 victims in 1914; 3 deaths were due to other accidents underground, and 2 to mine cars and locomotives on the surface. The mortality rate per thousand was 2.6 and the quantity of coal mined for each life lost was 228,586 tons, compared with 3.1 per thousand and 196,005 tons mined in 1913.

The statistics of production, by counties, during 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Tennessee in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Anderson	641,363	5,864	12,118	....	659,345	$719,196	$1.09	235	913
Campbell	1,713,092	18,394	47,852	....	1,779,338	2,227,378	1.25	224	3,169
Claiborne	1,422,536	9,500	24,432	....	1,456,468	1,492,273	1.02	256	1,686
Grundy	263,796	5,084	1,751	49,105	319,736	344,209	1.08	273	495
Hamilton	238,398	6,077	14,623	107,447	366,545	432,971	1.18	225	704
Marion	640,673	6,652	5,853	24,327	677,505	853,570	1.26	263	1,029
Morgan	410,329	3,013	12,127	72,015	497,484	497,794	1.00	266	1,185
Overton	84,886	402	877	....	86,165	90,075	1.05	234	115
Scott	132,473	10,310	3,300	....	146,083	183,811	1.26	222	336
Other counties [a]	534,675	9,864	37,247	286,093	867,879	992,234	1.14	233	1,606
Small mines	....	3,636	....	....	3,636	6,210	1.71	....	....
Total	6,082,221	78,796	160,180	538,987	6,860,184	7,839,721	1.14	241	11,238

[a] Bledsoe, Cumberland, Fentress, Rhea, Roane, Sequatchie, and White.

Production of coal in Tennessee in 1913 and 1914, by counties, in short tons—Contd.

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Anderson	560,934	7,978	10,707		579,619	$615,429	$1.06	187	892
Campbell	1,611,843	22,005	41,673		1,675,521	2,080,823	1.24	210	3,276
Claiborne	1,345,045	3,873	22,134		1,371,052	1,414,112	1.03	246	1,331
Marion	519,413	5,921	6,332	6,499	538,165	673,880	1.25	228	1,112
Morgan	325,639	2,749	13,835	29,574	371,797	389,899	1.05	247	782
Scott	69,260	2,914	3,000		75,174	90,976	1.21	224	218
Other counties [a]	1,017,940	11,899	57,042	240,989	1,327,870	1,504,643	1.13	220	2,505
Small mines		4,060			4,060	6,811	1.68		
Total	5,450,074	61,399	154,723	277,062	5,943,258	6,776,573	1.14	220	10,116

[a] Bledsoe, Fentress, Grundy, Hamilton, Overton, Rhea, Roane, Sequatchie, and White.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Tennessee, 1910–1914, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (−), 1914.
Anderson	808,214	735,135	542,467	659,345	579,619	− 79,726
Campbell	1,705,537	1,703,666	1,763,918	1,779,338	1,675,521	− 103,817
Claiborne	1,495,814	1,287,708	1,251,650	1,456,468	1,371,052	− 85,416
Cumberland	49,982	28,852	36,165	3,588		− 3,588
Grundy	354,398	264,040	290,589	319,736	229,995	− 89,741
Hamilton	327,392	365,131	395,843	366,545	246,085	− 120,460
Marion	564,667	517,116	651,030	677,505	538,165	− 139,340
Morgan	482,313	458,097	427,256	497,484	371,797	− 125,687
Overton	74,035	75,669	57,472	86,165	75,900	− 10,265
Rhea	156,296	147,599	135,684	109,413	43,436	− 65,977
Roane	193,918	180,293	176,360	162,732	167,885	+ 5,153
Scott	359,374	128,728	145,131	146,083	75,174	− 70,909
White	346,206	324,339	364,112	347,878	288,291	− 59,587
Other counties and small mines	203,234	216,783	235,551	247,904	280,338	+ 32,434
Total	7,121,380	6,433,156	6,473,228	6,860,184	5,943,258	− 916,926
Total value	$7,925,350	$7,209,734	$7,379,903	$7,839,721	$6,776,573	−$1,063,148

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:

Production of coal in Tennessee from 1840 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1840	558	1860	165,300	1879	450,000	1898	3,022,896
1841	600	1861	150,000	1880	495,131	1899	3,330,659
1842	1,000	1862	140,000	1881	840,000	1900	3,509,562
1843	4,500	1863	100,000	1882	850,000	1901	3,633,290
1844	10,000	1864	100,000	1883	1,000,000	1902	4,382,968
1845	18,000	1865	100,000	1884	1,200,000	1903	4,798,004
1846	25,000	1866	100,000	1885	1,440,957	1904	4,782,211
1847	30,000	1867	110,000	1886	1,714,290	1905	5,766,690
1848	40,000	1868	125,000	1887	1,900,000	1906	6,259,275
1849	52,000	1869	130,000	1888	1,967,297	1907	6,810,243
1850	60,000	1870	133,418	1889	1,925,689	1908	6,199,171
1851	70,000	1871	180,000	1890	2,169,585	1909	6,358,645
1852	75,000	1872	224,000	1891	2,413,678	1910	7,121,380
1853	85,000	1873	350,000	1892	2,092,064	1911	6,433,156
1854	90,000	1874	350,000	1893	1,902,258	1912	6,473,228
1855	100,000	1875	360,000	1894	2,180,879	1913	6,860,184
1856	115,000	1876	550,000	1895	2,535,644	1914	5,943,258
1857	125,000	1877	450,000	1896	2,663,106		
1858	135,000	1878	375,000	1897	2,888,849	Total	129,693,623
1859	150,000						

TEXAS.

Total production in 1914, 2,323,773 short tons; spot value, $3,922,459.

The production of coal in Texas is nearly evenly divided between lignite and bituminous coal, with a balance slightly in favor of bituminous coal. Although both showed decrease in output in 1914, the total production is, with the exception of that of 1913, the largest on record. The total production in 1914 was less than in 1913 by 105,371 tons, or 4.34 per cent, in quantity and by $366,461, or 8.54 per cent, in value. Most of the decrease was in the output of lignite, which in 1914 was 1,105,613 tons and in 1913 was 1,181,156 tons, a difference of 75,543 tons; while the output of bituminous coal—1,218,160 tons in 1914 and 1,247,988 tons in 1913—decreased only 29,828 tons. In point of value, however, the bituminous coal decreased much more than the lignite. The value of the lignite decreased from $1,104,759 in 1913 to $1,041,006 in 1914, a loss of $63,753, while the value of the bituminous product decreased from $3,184,161 to $2,881,453, a loss of $302,708. The decrease in quantity of lignite was 2.5 times that of bituminous coal and the decrease in value of bituminous coal was 4.75 times that of lignite. In this respect the records for 1913 and 1914 are the reverse of those for 1912 and 1913, for in 1913 the increase in the production of lignite was 3.8 times that of bituminous coal as compared with 1912, and the increase in value of the bituminous product was 1.8 times that of the lignite. This variation is due not only to the greater average value per ton of the bituminous coal, but to the greater yearly fluctuation in these values.

The decreased production of both bituminous coal and lignite in 1914 was attributed to the great increase in Texas and Oklahoma in the production of petroleum, which because of its fall in price, following a record-breaking production, has displaced a considerable quantity of coal and lignite as fuel, both on the railroads and in the industries.

The coal mines of Texas were not entirely free from labor troubles in 1914, as there were 221 men on strike during the year, with an average of 3 days each of lost time.

Fewer men were employed in the coal mines of Texas in 1914 than in any year since 1910. In 1914 there were 4,635 men reported from the coal mines of the State, as compared with 4,197 in 1910 and with more than 5,000 in each of the years 1911, 1912, and 1913. The average number of days worked decreased from 253 in 1913 to 237 in 1914—a larger average, however, than 226 days in 1911 and 230 days in 1912. Most of the bituminous mines are operated on the basis of an 8-hour day, and the lignite mines are worked 9 and 10 hours daily. The decline in the number of men employed was confined entirely to the bituminous fields, 3,031 being employed in 1914 against 3,538 in 1913. The number of employees in the lignite mines increased from 1,563 in 1913 to 1,604 in 1914, but the average number of days worked decreased from 235 in 1913 to 220 in 1914. The average production per man in the bituminous mines was 402 tons for the year and 1.63 tons for each working day in 1914, against 353 and 1.35 tons, respectively, in 1913. In the lignite mines the average annual production per man in 1914 was 689 tons and 3.13 tons for each working day, against 756 and 3.22 tons, respectively, in 1913. The general average production per man was 501 tons per year and 2.11 tons per day in 1914, against 476 and 1.88 tons, respectively, in 1913.

Most of the lignite produced in Texas is mined by hand, and of the bituminous production nearly one-half is shot off the solid. The use of mining machines has not made much progress in the State, and those that are employed are in the bituminous mines. The production of machine-mined coal in 1914 was very much less than in 1913, the machine-mined output in 1914 being 27,971 tons, as compared with 100,889 tons in 1913. The quantity of coal shot off the solid in 1914 was 612,158 tons, or 26 per cent of the total, and the quantity mined by hand was 1,683,644 tons, or 72 per cent of the total. The number of machines reported for 1914 was 13, of which 9 were punchers, 2 long wall, and 2 short wall.

In order to improve the quality of coal sent to market from the mines at Eagle Pass, washing plants have been installed, and in 1914 the quantity of coal washed was 23,604 tons, which yielded 19,440 tons of cleaned coal and 4,164 tons of refuse, the latter amounting to a little over 20 per cent of the cleaned product. One company reports the washing of a quantity of fine material, which is the undersize from revolving screens with $\frac{1}{4}$-inch openings. This material, locally called "duff," ranges in size from fine dust to $\frac{1}{4}$-inch particles and contains a large amount of clay and "bone" mixed with coal. This is washed in Robinson washers and passed over a plate containing $\frac{1}{8}$-inch openings on which water is sprayed, and a final product representing 40 per cent of the original material is obtained.

According to statistics collected by the Bureau of Mines, there were 11 fatal accidents in the coal and lignite mines of Texas in 1914, all underground, and 6 of them were due to falls of roof and coal. This does not compare very favorably with the record of 1913, in which a greater number of men produced a larger output with only 4 fatal accidents.

The statistics of production, by counties, in 1913 and 1914, 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 counties producing lignite and bituminous coal, respectively, are combined.

Production of coal in Texas in 1913 and 1914, in short tons.

1913.

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 value per ton.	Average number of days active.	Average number of employees.
Bituminous:								
Eastland								
Erath								
Maverick								
Palo Pinto	1,214,063	7,700	26,225	1,247,988	$3,184,161	$2.55	261	3,538
Webb								
Wise								
Young								
Lignite:								
Bastrop								
Fayette								
Henderson								
Hopkins								
Houston								
Lee	1,144,515	4,488	32,153	1,181,156	1,104,759	.94	235	1,563
Leon								
Medina								
Milam								
Robertson								
Titus								
Wood								
Total	2,358,578	12,188	58,378	2,429,144	4,288,920	1.77	253	5,101

1914.

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 value per ton.	Average number of days active.	Average number of employees.
Bituminous:								
Eastland								
Erath								
Maverick								
Palo Pinto	1,179,698	7,299	31,163	1,218,160	$2,881,453	$2.37	246	3,031
Webb								
Wise								
Young								
Lignite:								
Bastrop								
Fayette								
Henderson								
Hopkins								
Houston								
Lee	1,068,075	4,004	33,534	1,105,613	1,041,006	.94	220	1,604
Leon								
Medina								
Milam								
Robertson								
Titus								
Wood								
Total	2,247,773	11,303	64,697	2,323,773	3,922,459	1.69	237	4,635

The first record of the production of bituminous coal in Texas is contained in Mineral Resources of the United States for 1884. The quantity reported was 125,000 tons. The total production of lignite and bituminous coal in 1914 was almost nineteen times the output of 1884, and the 31 years' growth of the coal-mining industry in Texas is exhibited in the following table:

Production of coal in Texas from 1884 to 1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	125,000	1893	302,206	1902	901,912	1911	1,974,593
1885	100,000	1894	420,848	1903	926,759	1912	2,188,612
1886	100,000	1895	484,959	1904	1,195,944	1913	2,429,144
1887	75,000	1896	544,015	1905	1,200,684	1914	2,323,773
1888	90,000	1897	639,341	1906	1,312,873		
1889	128,216	1898	686,734	1907	1,648,069	Total	28,973,063
1890	184,440	1899	883,832	1908	1,895,377		
1891	172,100	1900	968,373	1909	1,824,440		
1892	245,690	1901	1,107,953	1910	1,892,176		

UTAH.

Total production in 1914, 3,103,036 short tons; spot value, $4,935,454.

The production of coal in Utah in 1914 was less than in 1913 by 151,792 short tons in quantity and $448,673 in value. The percentage of decrease was 4.7 per cent in quantity and 8.3 per cent in value. The production in 1914 did not, however, fall below that of 1912, and with the exception of the output of 1913 (3,254,828 tons) it is the highest on record for the State. The returns for 1914 indicate a plentiful supply of labor, showing a decrease of only 46 men.

The decreased production of coal in Utah in 1914, as compared with 1913, appears to have been due in part to general depression of business in the last nine months of the year that resulted in a decrease in the quantity necessary to meet the requirements of the railroads, and, after the beginning of the European war, in the supply of coal and coke for the large copper smelters in Utah and Montana. Other causes contributing to the decrease in production in 1914 were the smaller demand for domestic sizes because of the generally mild weather in the territory served by Utah coal, and the displacement of a certain proportion of Utah coal in the Pacific coast markets by reason of the removal of the tariff on foreign coal and of the resumption of operation of the mines in British Columbia after the settlement of their labor troubles.

Notwithstanding the decrease in the total production for the year, the quantity of coal made into coke showed an increase of 33,224 tons. For the first months of the year the demand for coke was such that the coking plants were operated nearly to capacity, but with the curtailment in the smelting of copper after the beginning of the European war in August this demand fell off sharply.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are as follows:

Production of coal in Utah in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Carbon	2,134,669	29,442	95,804	570,187	2,830,102	$4,661,865	$1.65	279	3,545
Emery, Grand, and Sevier	300,994	7,774	6,147		314,915	537,083	1.71	253	460
Summit	91,447	2,202	8,893		102,542	166,521	1.62	192	138
Uinta		5,433	52		5,485	14,435	2.63	218	15
Small mines		1,784			1,784	4,223	2.37		
Total	2,527,110	46,635	110,896	570,187	3,254,828	5,384,127	1.65	273	4,158

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Carbon	1,950,149	30,046	85,905	603,411	2,669,511	$4,224,726	$1.58	214	3,516
Emery and Grand	345,920	5,198	6,650		357,768	592,114	1.66	193	452
Summit	59,618	444	8,084		68,146	100,371	1.47	162	131
Uinta		4,779	100		4,879	11,309	2.32	266	13
Small mines		2,732			2,732	6,934	2.54		
Total	2,355,687	43,199	100,739	603,411	3,103,036	4,935,454	1.59	210	4,112

The production by counties during the last five years, with increase and decrease in 1914 as compared with 1913, has been as follows:

Production of coal in Utah, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase (+) or decrease (−), 1914.
Carbon	2,311,749	2,264,038	2,684,731	2,830,102	2,669,511	− 160,591
Emery	40,657	*a* 120,256	*b* 212,818	*c* 314,915	*b* 357,768	+ 42,853
Summit } Uinta }	163,193	126,228	114,657	108,027	73,025	− 35,002
Small mines	2,210	2,653	3,943	1,784	2,732	+ 948
Total	2,517,809	2,513,175	3,016,149	3,254,828	3,103,036	− 151,792
Total value	$4,224,556	$4,248,666	$5,046,451	$5,384,127	$4,935,454	+$448,673

a Includes Sanpete County. *b* Includes Grand County. *c* Includes Grand and Sevier counties.

Nearly 90 per cent of the total production of coal in Utah is mined in Carbon County, which contains a large part of the great Uinta Basin. This county produced 2,669,511 short tons in 1914 out of a total for the State of 3,103,036 tons. Its loss in 1914 from 1913 was 160,591 tons. Carbon is the only county in the State in which coke is made. The combined output of Emery and Grand counties in 1914 was 357,768 tons, a gain of 42,853 tons over 1913.

The efficiency record of the Utah coal miners showed a considerable gain in 1914 as compared with other recent years in that the output per man per day was higher. There were 4,112 men employed in 1914 for an average of 210 days, and the average output per man was 755 tons for the year and 3.6 tons for each working day. In 1913 an average of 4,158 men worked 273 days and produced an average per man of 783 tons for the year and of 2.87 tons per day. In 1912 the average production was 906 tons and 3.18 tons, respectively. The increased production per man per day in 1914 is accounted for by the increase in the use of machines and in the quantity of coal mined by them. In 1913 there were 50 machines in use and machine-mined coal amounted to 625,475 tons, or nearly 20 per cent of the total. In 1914 there were 68 machines in use, and the coal mined by them amounted to 944,421 tons, or 30 per cent of the total. The number of short wall machines increased from 38 to 59 and of chain breast machines from 7 to 9. In 1912 and in 1913 there were 5 punchers in use in the State, which in 1914 were displaced by machines of the other types.

The industry was practically free from labor troubles in 1914, as only 150 men were on strike, with an average loss of time of 12 days each, during the year.

According to statistics collected by the Bureau of Mines there were 22 fatal accidents in the coal mines of Utah in 1914, an increase of 5 over 1913. Seventeen of the fatalities occurred underground and 5 on the surface. The death rate per thousand was 5.35, as against 4.1 in 1913, and the number of tons mined for each life lost was 141,047, against 191,460 in 1913.

The Ninth United States Census recorded the first production of coal in Utah with an output of 5,800 tons in 1870. 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 1,000,000-ton mark in 1900. In 1909 it exceeded 2,000,000 tons.

The annual production since 1870 has been as follows:

Production of coal in Utah, 1870–1914, 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	1913	3,254,828
1878	67,200	1890	318,159	1902	1,574,521	1914	3,103,036
1879	50,000	1891	371,045	1903	1,681,409		
1880	14,748	1892	361,013	1904	1,493,027	Total	37,355,870
1881	52,000	1893	413,205	1905	1,332,372		

VIRGINIA.

Total production in 1914, 7,959,535 short tons; spot value, $8,032,448.

Although the production of coal in Virginia in 1914 was 868,533 tons less than in 1913, with a decline in value of $920,205, the output was greater than in any year previous to 1913. The decrease in quantity was 9.8 per cent and in value 10.3 per cent. The principal decrease in 1914 was in Wise County, whose output showed a loss of 482,857 short tons, or 55 per cent of the total decrease. Russell County, the latest in which coal-mining operations have been developed (having been opened by the completion in 1908 of the Carolina, Clinchfield & Ohio Railway from Dante, Va., to Spartanburg, S. C.), and which in 1913 increased its output more than 200,000 tons over 1912, in 1914 dropped back almost to the output for 1912. Tazewell County, the oldest of the important coal-producing counties in southwestern Virginia, had a decrease of 123,821 tons in 1914, as against an increase in 1913 over 1912 of 145,308 tons. No production was reported in 1914 from the Richmond Basin, where for the four years embracing 1910 to 1913 a small output was recorded from the Gayton mines, in Henrico County.

The decrease in the production of coal in Virginia in 1914 is attributed to the smaller demand from the iron business for coke, as indicated by the fact that the decrease of coal made into coke at the mines represented 76 per cent of the total decrease for the State, and also to the smaller quantity needed to meet the requirements of the railroads and cotton mills normally supplied by Virginia coal.

In the reports for 1911 and 1912 mention was made of the unfavorable comparison of Virginia and the other States of the Appalachian province in the quantity and percentage of coal shot off the solid. A marked improvement in that respect was noted in the report for 1913 and is shown again in the returns for 1914. In 1912 the powder-mined coal amounted to 3,741,533 short tons, or 47.7 per cent of the total; in 1913, to 2,879,108 tons, or 32.6 per cent of the total; and in 1914 that item was reduced to 2,426,501 tons, or 30.5 per cent of the total. The percentage of machine-mined coal, on the other hand, increased from 40.8 per cent of the total (3,205,504 tons) in 1912 to 47.6 per cent (4,206,988 tons) in 1913 and to 51.4 per cent (4,092,810 tons) in 1914. The number of machines in use in 1914 was 182 (against 187 in 1913), of which 75 were chain breast, 98 short wall, 5 long wall, and 4 punchers. The quantity of coal mined by hand was 1,439,121 short tons, or 18 per cent of the total, in 1914, against 1,740,485 tons (19.7 per cent) in 1913.

No time was lost in the coal mines of Virginia in 1914 because of strikes or lockouts.

For several years Virginia has stood relatively high in the quantity of coal produced by each man employed, and 1914 was no exception to the rule. The number of men employed in the coal mines of the State increased from 9,162 in 1913 to 9,183 in 1914, and the average working time decreased from 280 days to 235. The average production per man in 1913 was 964 tons and in 1914 was 867 tons. The average daily production per man was greater in 1914, being 3.69 tons, against 3.44 tons in 1913.

The quantity of coal washed at the mines increased from 47,936 tons, yielding 45,638 tons of cleaned product and 2,298 tons of refuse, in 1913, to 59,397 tons treated, yielding 54,971 tons of cleaned coal and 4,426 tons of waste, in 1914.

As shown by the report of the Bureau of Mines, the number of fatal accidents in the coal mines of Virginia increased from 24 in 1913 to 27 in 1914. The death rate per thousand in 1913 was 2.6, and in 1914, 2.9. The quantity of coal mined for each life lost in 1914 was 294,797, against 367,836 tons in 1913.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Virginia in 1913 and 1914, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Lee	704,941	7,509	20,637	30,228	763,315	$874,674	$1.15	263	1,023
Tazewell	1,207,487	22,938	31,966	184,960	1,447,351	1,610,548	1.11	236	1,460
Wise	3,236,005	35,260	94,119	1,738,175	5,103,559	4,899,390	.96	291	4,933
Other counties [a] and small mines	1,467,048	17,725	29,070	....	1,513,843	1,568,041	1.04	296	1,746
Total	6,615,481	83,432	175,792	1,953,363	8,828,068	8,952,653	1.01	280	9,162

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Lee	708,072	6,557	18,306	....	732,935	$800,835	$1.09	251	1,005
Russell	1,198,267	13,450	24,397	....	1,236,114	1,276,828	1.03	244	1,515
Tazewell	1,169,997	23,380	20,823	109,330	1,323,530	1,520,085	1.15	179	1,144
Wise	3,325,156	34,949	77,804	1,182,793	4,620,702	4,345,204	.94	242	5,396
Other counties [b] and small mines	36,641	6,013	3,600	....	46,254	89,496	1.93	245	123
Total	6,438,133	84,349	144,930	1,292,123	7,959,535	8,032,448	1.01	235	9,183

[a] Henrico, Montgomery, Pulaski, and Russell. [b] Montgomery and Pulaski.

The statistics of production, by counties, for the last five years, with decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Virginia, 1910–1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Decrease, 1914.
Lee	797,096	720,695	751,276	763,315	732,935	30,380
Tazewell	1,187,146	1,281,224	1,302,043	1,447,351	1,323,530	123,821
Wise	3,730,992	3,754,360	4,500,174	5,103,559	4,620,702	482,857
Russell	[a] 790,066	[a] 1,107,056	[a] 1,292,365	[a] 1,512,356	[b] 1,281,265	231,091
Small mines	2,697	1,332	780	1,487	1,103	384
Total	6,507,997	6,864,667	7,846,638	8,828,068	7,959,535	868,533
Total value	$5,877,486	$6,254,804	$7,518,576	$8,952,653	$8,032,448	$920,205

[a] Includes Henrico, Montgomery, and Pulaski counties.
[b] Includes Montgomery and Pulaski counties.

The annual production of Virginia from 1822 to the close of 1914 is shown in the following table:

Production of coal in Virginia from 1822 to 1914, 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	1913	8,828,068
1842	373,640	1866	40,000	1890	784,011	1914	7,959,535
1843	370,000	1867	50,000	1891	736,399		
1844	365,000	1868	59,051	1892	675,205	Total	104,247,316
1845	350,000	1869	65,000	1893	820,339		

[a] West Virginia separated from Virginia.

WASHINGTON.

Total production in 1914, 3,064,820 short tons; spot value, $6,751,511.

With the exception of 1905 and 1908, the total output of coal in Washington in 1914 was the lowest since 1902. The output in 1914 was less by 813,071 tons, or 21 per cent, in quantity and by $2,491,626, or 27 per cent, in value than in 1913, the record of which year, however, was approximately 15 per cent greater in both quantity and value than in 1912. The average value per ton, which decreased from $2.38 in 1913 to $2.20 in 1914, was the lowest since 1907, when an average value of $2.09 was recorded.

The production of coal in Washington has been considerably reduced during recent years by the great output of petroleum in California and its use as a fuel for manufacturing, railroads, and steamers. It is estimated that the consumption of California oil for fuel on the Pacific coast is equivalent to about 21,000,000 tons of coal, or between six and seven times the output of coal in Washington, or, for that matter, in all the Pacific Coast States combined in 1914.

The main causes contributing to the decrease in 1914 were (1) the general industrial depression, particularly in the lumber business, after the beginning of the European war, and (2) the exceptionally mild weather during the winter months. The curtailment of lumber shipments affected the production of coal in two ways—by decreasing the requirements of railroads and steamships and by causing a scarcity of money among householders through unemployment which necessitated marked economy in the purchase of coal for domestic consumption. The smelters consumed a smaller quantity of coal as a result of curtailment in the production of copper during the last half of the year, and some Washington coal was displaced by coal from British Columbia after the tariff on foreign coal was removed.

The greater part of the decrease in output was in King and Pierce counties, which are in the western portion of the State adjacent to the seaports and in the midst of the lumbering districts. Kittitas County, whose output goes mainly to the Northern Pacific Railroad, was only slightly affected in 1914.

The number of men employed in the coal mines of Washington increased from 5,794 in 1913 to 5,805 in 1914, and the average working time decreased from 260 days to 191 days. The average production per man was 528 tons a year and 2.76 tons each working day in 1914, compared with 669 and 2.57 tons, respectively, in 1913.

There were 459 men on strike during 1914, with an average lost time of 55 days. The total time lost was about 2 per cent of the total time made. Of the total production of coal, 1,281,553 tons, or 42 per cent, were mined by hand; 1,443,207 tons, or 47 per cent, were powder-mined or shot off the solid; and 328,043 tons, or 11 per cent, were mined by machines, of which 72 were reported in use. Forty-six of the machines were of the puncher type; 25 were radialax or post punchers, and 1 was a short wall machine. Probably a larger percentage of coal is washed in the State of Washington than in any other coal-producing State. In 1914, 1,318,550 tons, or 43 per cent of the total, were washed and yielded 1,058,066 tons of cleaned coal and 260,484 tons of refuse.

Reports to the Bureau of Mines show that there were 17 fatalities among the coal miners of Washington in 1914, of which 16 were underground and 1 was on the surface. Eight of the accidents underground were due to falls of roof and coal, 3 to mine cars and locomotives, 3 to explosives, and 1 each to explosions of gas and of electricity. The death rate per thousand was 2.9, and there were 180,283 tons of coal mined for each life lost.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in Washington in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
King	1,278,813	22,659	72,227	....	1,373,699	$3,198,662	$2.33	277	2,280
Kittitas	1,273,353	16,831	43,971	....	1,334,155	3,600,900	2.70	228	1,587
Lewis	128,528	16,433	6,485	....	151,446	266,408	1.76	196	241
Pierce	681,534	6,104	50,089	118,698	856,425	1,919,254	2.24	286	1,499
Other counties [a]	158,326	675	3,165	....	162,166	257,913	1.59	209	187
Total	3,520,554	62,702	175,937	118,698	3,877,891	9,243,137	2.38	260	5,794

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
King	939,471	41,836	60,473	....	1,041,780	$2,153,702	$2.07	177	2,390
Kittitas	1,181,342	16,322	45,136	....	1,242,800	2,851,882	2.29	186	1,828
Lewis	82,171	16,030	5,659	....	103,860	168,021	1.62	128	211
Pierce	388,411	4,739	40,107	123,262	556,519	1,384,185	2.49	239	1,230
Other counties [a]	114,946	904	4,011	....	119,861	193,721	1.62	166	146
Total	2,706,341	79,831	155,386	123,262	3,064,820	6,751,511	2.20	191	5,805

[a] Thurston and Whatcom.

The statistics of production, by counties, during the last five years, with decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Washington, 1910–1914, in short tons.

County.	1910	1911	1912	1913	1914	Decrease (–), 1914.
King	1,242,340	1,259,521	1,063,110	1,373,699	1,041,780	– 331,919
Kittitas	1,661,650	1,256,745	1,237,427	1,334,155	1,242,800	– 91,355
Lewis	179,484	172,734	128,377	151,446	103,860	– 47,586
Pierce	786,096	783,196	788,293	856,425	556,519	– 299,906
Other counties	42,329	100,619	143,725	162,166	119,861	– 42,305
Total	3,911,899	3,572,815	3,360,932	3,877,891	3,064,820	– 813,071
Total value	$9,764,465	$8,174,170	$8,042,871	$9,243,137	$6,751,511	–$2,491,626

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 mine 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 made 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, began shipping again 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 67,524,260 short tons, as shown in the following table:

Production of coal in Washington, 1860–1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1860	5,374	1875	99,568	1890	1,263,689	1905	2,864,926
1861	6,000	1876	110,342	1891	1,056,249	1906	3,276,184
1862	7,000	1877	120,896	1892	1,213,427	1907	3,680,532
1863	8,000	1878	131,660	1893	1,264,877	1908	3,024,943
1864	10,000	1879	142,666	1894	1,106,470	1909	3,602,263
1865	12,000	1880	145,015	1895	1,191,410	1910	3,911,899
1866	13,000	1881	196,000	1896	1,195,504	1911	3,572,815
1867	14,500	1882	177,340	1897	1,434,112	1912	3,360,932
1868	15,000	1883	244,990	1898	1,884,571	1913	3,877,891
1869	16,200	1884	166,936	1899	2,029,881	1914	3,064,820
1870	17,844	1885	380,250	1900	2,474,093		
1871	20,000	1886	423,525	1901	2,578,217	Total.	67,524,260
1872	23,000	1887	772,601	1902	2,681,214		
1873	26,000	1888	1,215,750	1903	3,193,273		
1874	30,352	1889	1,030,578	1904	3,137,681		

WEST VIRGINIA.

Total production in 1914, 71,707,626 short tons; spot value, $71,-391,408.

Like its neighbor, Kentucky, West Virginia in 1914 had an increased production over 1913, although the adjacent fields in Pennsylvania, Ohio, Virginia, and Maryland suffered decrease. In 1914 the output of coal in West Virginia, which was the greatest recorded for that State, exceeded the output in 1913 by 453,490 tons, or 0.64 per cent. The increased production, however, was accompanied by a decrease in value, the average value per ton in 1914 being $0.99 against $1.01 in 1913, and the total decrease being $431,396, or 0.6 per cent. Business conditions during the last three-fourths of the year were unfavorable for the coal operators in some of the older districts, and decreases were recorded in the Fairmont (Harrison County) Elk Garden (Mineral and Grant counties), and Philippi (Preston, Barbour, and Randolph counties) fields, in the northern part of the State; and in the New River (Fayette and Raleigh counties) and Pocahontas (McDowell and Mercer counties) fields in the southern part of the State. These decreases were slightly more than offset by the increased output in the newer areas in which during the last two or three years development has progressed rapidly and many new mines have been opened. The unfortunate strike conditions in Ohio, which caused a decrease in 1914 of the output of coal in that State of almost one-half, enabled West Virginia operators to capture, for the time being, at least, markets normally supplied by Ohio coal.

The increases and decreases were scattered over the State. Out of 31 counties whose output is published 14 showed decreases and 17 increases. The principal gains were in Logan County (1,865,435 tons), Marion County (678,870 tons), and Kanawha County (616,102 tons). The greatest decrease was in McDowell County, in the Pocahontas field (1,909,883 tons), and Fayette County, in the New River field, had a decrease of 905,289 tons.

Labor was plentiful during the year. The average number of employees in 1914 was 78,963, exceeding that in 1913 by 4,217. The average working time, however, decreased from 234 to 201 days. The average production was 908 tons for the year and 4.52 tons per day for each employee, as compared with 953 tons and 4.07 tons, respectively, in 1913. The gain in daily efficiency was due in no small degree to the increased use of mining machines. The quantity of coal mined by machines increased from 39,355,418 tons in 1913 to 42,263,394 tons in 1914. The number of machines in use increased from 2,539 to 2,607. Chain breast machines constituted more than half of the total number, there being 1,407 of that type employed. Pick machines numbered 517; short wall, 460; long wall, 167; and radialax or post machines, 24; in addition to which there were 32 machines of other types.

Labor troubles caused a loss of 466,768 working days, or an average of 50 days for 9,330 men. The time lost by reason of strikes was 3 per cent of the time made, as compared with 2.1 per cent in 1913.

Only a small percentage of West Virginia coal is washed before being sold or used. In 1914 the quantity of coal reported as washed was 1,612,259 short tons, which yielded 1,506,153 tons of cleaned coal and 106,106 tons of refuse.

According to the Bureau of Mines, the number of fatal accidents in the coal mines of West Virginia showed an increase of 219, from 337 in 1913 to 556 in 1914. One hundred and eighty-one deaths were caused by a mine explosion at the Eccles mine, at Eccles, W. Va., on April 28. Two hundred and twenty deaths were due to falls of roof and coal, 73 to mine cars and locomotives, and 29 to electricity. Of the total of 556 fatalities, 524 were underground, 4 in shafts, and 28 on the surface. The death rate per thousand was 7, against 4.5 in 1913, and the quantity of coal mined for each life lost was 128,970 tons, against 211,437 tons in 1913.

The statistics of production, by counties, in 1913 and 1914, with the distribution of the product for consumption, are shown in the following table:

Production of coal in West Virginia in 1913 and 1914, by counties, in short tons.

1913.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Barbour	1,350,250	5,700	27,547	31,804	1,415,301	$1,102,649	$0.78	227	1,234
Boone	438,735	2,845	4,276	....	445,856	457,594	1.03	232	454
Braxton	277,281	1,919	3,317	....	282,517	248,702	.88	220	230
Clay	364,572	2,348	4,376	....	371,296	344,301	.93	241	287
Fayette	8,686,215	181,899	227,256	848,657	9,944,027	10,367,363	1.04	249	12,729
Gilmer	89,602	2,635	1,100	....	93,337	96,316	1.03	211	151
Grant	204,729	851	17,465	....	223,045	204,228	.92	242	264
Harrison	5,482,959	13,635	53,347	34,496	5,584,437	4,718,287	.84	209	5,128
Kanawha	5,165,027	110,134	97,792	....	5,372,953	5,304,644	.99	209	7,493
Logan	4,595,398	91,405	64,214	2,499	4,753,516	4,544,140	.96	208	4,384
McDowell	14,417,048	199,716	284,838	1,596,845	16,498,447	17,713,909	1.07	234	16,276
Marion	5,678,643	25,903	190,766	157,360	6,052,672	5,497,820	.91	235	5,185
Marshall	663,471	183,708	18,870	....	866,049	889,251	1.03	263	929
Mason	104,356	40,593	3,742	....	148,691	155,266	1.04	219	291
Mercer	2,815,111	33,390	50,018	418,493	3,317,012	3,635,080	1.10	236	2,894
Mineral	841,709	2,820	6,946	....	851,475	807,075	.95	236	932
Mingo	2,592,347	32,882	65,189	....	2,690,418	2,878,750	1.07	242	2,965
Monongalia	239,248	26,968	5,137	123,287	394,640	340,649	.86	231	428
Ohio	346,613	64,544	1,483	....	412,640	435,824	1.06	276	407
Preston	978,594	16,376	34,552	302,385	1,331,907	1,303,143	.98	265	1,420
Putnam	600,676	13,700	8,400	....	622,776	765,304	1.23	266	1,036
Raleigh	5,503,813	91,765	102,003	....	5,697,581	6,393,590	1.12	243	5,842
Randolph	333,670	6,623	9,135	244,097	593,525	532,833	.90	247	476
Taylor	1,011,155	5,207	10,053	20,355	1,046,770	839,822	.80	264	815
Tucker	1,200,705	12,075	34,444	46,265	1,293,489	1,214,094	.94	238	1,324
Upshur	76,399	3,470	1,407	15,546	96,822	80,854	.84	227	94
Other counties [a] and small mines	700,630	135,380	6,750	10,177	852,937	951,316	1.12	259	1,078
Total	64,758,956	1,308,491	1,334,423	3,852,266	71,254,136	71,822,804	1.01	234	74,746

[a] Brooke, Greenbrier, Hancock, Lewis, Lincoln, Nicholas, Wayne, Webster, and Wyoming.

Production of coal in West Virginia in 1913 and 1914, by counties, in short tons.—Contd.

1914.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke at mines.	Total quantity.	Total value.	Average value per ton.	Average number of days active.	Average number of employees.
Barbour	1,275,330	5,566	19,831	31,221	1,331,948	$1,063,552	$0.80	203	1,316
Boone	576,489	8,065	8,004	....	592,558	594,081	1.00	171	704
Braxton	300,826	2,152	3,630	....	306,608	245,630	.80	229	277
Brooke	537,318	12,153	5,399	....	554,870	608,745	1.10	235	981
Clay	551,915	3,039	8,607	....	563,561	462,922	.82	238	439
Fayette	8,267,536	143,873	218,017	409,312	9,038,738	9,776,601	1.08	198	12,956
Gilmer	109,036	3,612	2,228	....	114,876	108,538	.94	202	141
Grant	167,018	1,705	10,919	....	179,642	157,046	.87	229	218
Harrison	5,212,449	10,042	45,166	24,026	5,291,683	4,327,962	.82	187	5,088
Kanawha	5,835,189	63,978	89,888	....	5,989,055	5,759,916	.96	191	8,245
Logan	6,493,140	43,261	82,353	197	6,618,951	6,113,808	.92	195	5,474
McDowell	13,193,032	208,888	241,379	945,265	14,588,564	15,786,010	1.08	185	14,495
Marion	6,411,663	30,013	211,521	78,345	6,731,542	6,057,525	.90	210	6,526
Marshall	957,428	174,113	21,585	....	1,153,126	1,183,862	1.03	276	1,076
Mason	104,362	15,469	2,080	....	121,911	127,897	1.05	226	230
Mercer	2,627,554	32,374	48,125	253,088	2,961,141	3,173,931	1.07	183	3,022
Mineral	625,765	2,475	5,166	....	633,406	580,207	.92	187	999
Mingo	2,741,156	30,472	67,386	....	2,839,014	2,889,069	1.02	236	3,074
Monongalia	256,725	16,145	2,393	139,558	414,821	335,379	.81	208	418
Ohio	497,332	71,670	1,345	....	570,347	602,135	1.06	289	536
Preston	1,038,870	13,919	37,188	150,673	1,240,650	1,106,744	.89	216	1,550
Putnam	521,491	13,428	9,940	....	544,859	666,298	1.22	219	1,190
Raleigh	5,297,210	67,234	89,615	....	5,454,059	6,126,534	1.12	207	5,986
Randolph	355,884	8,395	10,591	145,490	520,360	425,928	.82	176	505
Taylor	1,237,748	4,978	11,378	54,600	1,308,704	1,013,575	.77	216	1,274
Tucker	1,442,402	14,673	34,229	12,911	1,504,215	1,538,019	1.02	247	1,597
Upshur	108,608	2,537	1,512	7,100	119,757	85,533	.71	211	128
Wyoming	72,771	2,287	....	....	75,058	86,078	1.15	148	108
Other counties [a] and small mines	207,942	127,654	3,350	4,656	343,602	387,883	1.13	229	410
Total	67,024,189	1,134,170	1,292,825	2,256,442	71,707,626	71,391,408	.99	201	78,963

[a] Greenbrier, Hancock, Lewis, Lincoln, Nicholas, Wayne, and Webster.

The statistics of production, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in West Virginia, by counties, 1910–1914, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (–), 1914.
Barbour	1,368,391	1,024,784	1,163,361	1,415,301	1,331,948	– 83,353
Boone	....	160,523	379,976	445,856	592,558	+ 146,702
Braxton	167,123	209,167	234,988	282,517	306,608	+ 24,091
Brooke	470,674	451,430	494,471	448,255	554,870	+ 106,615
Clay	44,602	146,713	212,125	371,296	563,561	+ 192,265
Fayette	10,410,983	9,976,784	9,636,230	9,944,027	9,038,738	– 905,289
Gilmer	45,190	53,580	76,735	93,337	114,876	+ 21,539
Grant	283,072	209,530	199,926	223,045	179,642	– 43,403
Hancock	71,211	49,200	2,980	7,435	4,928	– 2,507
Harrison	4,641,304	4,241,098	5,171,772	5,584,437	5,291,683	– 292,754
Kanawha	7,010,487	5,671,026	5,113,557	5,372,953	5,989,055	+ 616,102
Lincoln	71,917	81,770	67,212	58,740	54,821	– 3,919
Logan	2,896,328	3,149,671	4,196,744	4,753,516	6,618,951	+1,865,435
McDowell	13,488,076	13,386,749	15,809,289	16,498,447	14,588,564	–1,909,883
Marion	4,795,549	4,830,540	5,793,124	6,052,672	6,731,542	+ 678,870
Marshall	538,402	678,172	798,028	866,049	1,153,126	+ 287,077
Mason	221,217	201,943	131,303	148,691	121,911	– 26,780
Mercer	2,876,834	2,924,714	3,109,571	3,317,012	2,961,141	– 355,871
Mineral	883,586	610,727	726,316	851,475	633,406	– 218,069
Mingo	2,442,630	2,341,000	2,597,479	2,690,418	2,839,014	+ 148,596
Monongalia	554,073	495,657	409,579	394,640	414,821	+ 20,181
Nicholas	79,714	54,731	70,986	99,787	106,432	+ 6,645
Ohio	309,049	326,195	412,494	412,640	570,347	+ 157,707
Preston	1,164,382	870,447	1,167,758	1,331,907	1,240,650	– 91,257
Putnam	540,632	568,222	612,066	622,776	544,859	– 77,917
Raleigh	3,347,129	4,409,430	5,134,217	5,697,581	5,454,059	– 243,522
Randolph	600,907	553,935	616,410	593,525	520,360	– 73,165
Taylor	719,230	745,578	871,852	1,046,770	1,308,704	+ 261,934
Tucker	1,317,967	1,152,116	1,270,578	1,293,489	1,504,215	+ 210,726
Upshur	92,760	38,225	59,330	96,822	119,757	+ 22,935
Wyoming	....	....	....	14,560	75,058	+ 60,498
Other counties and small mines	217,600	217,923	246,230	224,160	177,421	– 46,739
Total	61,671,019	59,831,580	66,786,687	71,254,136	71,707,626	+ 453,490
Total value	$56,665,061	$53,670,515	$62,792,234	$71,822,804	$71,391,408	– $431,396

The statistics of coal production in West Virginia since 1863, when the State was formed out of Virginia, to the close of 1914, are shown in the following table:

Production of coal in West Virginia, 1863–1914, in short tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1863	444,648	1877	1,120,000	1891	9,220,665	1905	37,791,580
1864	454,888	1878	1,120,000	1892	9,738,755	1906	43,290,350
1865	487,897	1879	1,400,000	1893	10,708,578	1907	48,091,583
1866	512,068	1880	1,829,844	1894	11,627,757	1908	41,897,843
1867	589,360	1881	1,680,000	1895	11,387,961	1909	51,849,220
1868	609,227	1882	2,240,000	1896	12,876,296	1910	61,671,019
1869	603,148	1883	2,335,833	1897	14,248,159	1911	59,831,580
1870	608,878	1884	3,360,000	1898	16,700,999	1912	66,786,687
1871	618,830	1885	3,369,062	1899	19,252,995	1913	71,254,136
1872	700,000	1886	4,005,796	1900	22,647,207	1914	71,707,626
1873	1,000,000	1887	4,881,620	1901	24,068,402		
1874	1,120,000	1888	5,498,800	1902	24,570,826	Total	859,196,650
1875	1,120,000	1889	6,231,880	1903	29,337,241		
1876	896,000	1890	7,394,654	1904	32,406,752		

WYOMING.

Total production in 1914, 6,475,293 short tons; spot value, $10,033,747.

The production of coal in Wyoming decreased 917,773 tons in quantity and $1,476,298 in value in 1914, as compared with 1913, the decreases being 12.4 and 12.8 per cent, respectively. This is the smallest production for Wyoming since 1909, when the output was 6,393,109 short tons. The decrease is attributed mainly to a lessened demand for coal for domestic use by reason of the unusually mild weather and to the smaller quantity required by the railroads, which are reported to have handled a considerably smaller tonnage of through freight during the year. The resumption, late in the year, of shipments of coal from the Colorado mines, even before the final settlement of the strike in that State, into markets temporarily supplied in 1913 by Wyoming coal, accounts for a large part of the decrease in certain counties of Wyoming in 1914. Labor troubles did not seriously affect the coal-mining industry in the State in 1914, as only 248 men were affected for an average of 11 days each. There was an abundance of labor for coal mining and a plentiful supply of cars for transportation.

In 1912 a new county, Lincoln, was carved out of Uinta County, and in 1913 the portion of Big Horn County in which coal is mined was made into Hot Springs County, Big Horn ceasing to be a coal-producing county.

Wyoming continues to maintain a high record for efficiency in the rate of production per man employed, and although there was a falling off in the average tonnage for the year, the average per man per day was the highest on record in the State. The number of men employed in 1914 was 8,117, who worked an average of 192 days in the production of 6,475,293 tons of coal, against 7,393,066 tons produced by 8,331 men working an average of 232 days in 1913. The average tonnage per man decreased from 887 tons in 1913 to 798 tons in 1914, and the average per day for each man increased from 3.82 tons to 4.16 tons.

Wyoming continues to show a decreased percentage of "powder-mined" coal. In 1912, 3,180,067 tons, or more than 40 per cent of the total, and in 1913, 2,719,884 tons, slightly less than 37 per cent, were shot off the solid. In 1914 that part of the output amounted to 2,204,762 tons, or 34 per cent. The machine-mined production decreased in quantity from 3,050,784 tons in 1913 to 2,734,151 tons in 1914, but the percentage of machine-mined coal in 1914 was 42, against 41 in 1913. The coal mined by hand decreased from 1,618,696 tons, or 22 per cent, to 1,532,987 tons, or nearly 24 per cent. The number of machines in use increased from 195 to 198, the latter including 78 chain breast, 56 punchers, 48 short wall, 2 long wall, and 14 radialax or post machines.

The statistics of production by counties in 1913 and 1914, with the distribution of the product for consumption, are as follows:

Production of coal in Wyoming in 1913 and 1914, 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 value per ton.	Average number of days active.	Average number of employees.
1913.								
Converse	5,000	2,011	100	7,111	$13,158	$1.85	239	14
Lincoln	1,735,243	11,469	124,749	1,871,461	2,854,434	1.53	271	1,960
Sheridan	1,177,761	18,470	14,936	1,211,167	1,486,215	1.23	186	1,333
Sweetwater	2,738,822	14,234	79,419	2,832,475	4,693,775	1.64	224	3,424
Other counties [a]	1,347,164	34,737	86,199	1,468,100	2,455,528	1.67	239	1,600
Small mines	....	2,752	....	2,752	6,935	2.52	....	....
Total	7,003,990	83,673	305,403	7,393,066	11,510,045	1.56	232	8,331
1914.								
Lincoln	1,367,686	11,016	103,719	1,482,421	$2,345,196	$1.58	204	1,886
Sheridan	959,775	18,193	23,443	1,001,411	1,202,226	1.20	157	1,220
Sweetwater	2,416,982	13,788	78,601	2,509,371	4,013,648	1.60	185	3,300
Other counties [b]	1,349,361	41,946	87,390	1,478,697	2,465,766	1.67	215	1,711
Small mines	....	3,393	....	3,393	6,911	2.04	....	....
Total	6,093,804	88,336	293,153	6,475,293	10,033,747	1.55	192	8,117

[a] Carbon, Crook, Fremont, Hot Springs, Park, Johnson, Uinta, and Weston.
[b] Carbon, Converse, Fremont, Hot Springs, Johnson, Park, Uinta, and Weston.

The statistics of production of coal, by counties, during the last five years, with increase and decrease in 1914 as compared with 1913, are shown in the following table:

Production of coal in Wyoming from 1910 to 1914, by counties, in short tons.

County.	1910	1911	1912	1913	1914	Increase(+) or decrease (—), 1914.
Bighorn	181,259	172,884	194,105	....	....	....
Carbon	665,659	597,496	637,011	615,430	630,841	+ 15,411
Converse	8,950	16,992	14,881	7,111	8,095	+ 984
Lincoln	....	....	1,440,435	1,871,461	1,482,421	— 389,040
Sheridan	1,303,354	1,140,466	1,086,282	1,211,167	1,001,411	— 209,756
Sweetwater	2,875,449	2,628,202	2,969,601	2,832,475	2,509,371	— 323,104
Uinta	1,960,671	1,725,311	489,690	67,065	53,777	— 13,288
Weston	416,714	325,114	392,714	353,656	349,415	— 4,241
Other counties	[a] 118,803	[a] 135,932	[a] 137,092	[b] 431,949	[c] 436,569	+ 4,620
Small mines	2,229	2,467	6,313	2,752	3,393	+ 641
Total	7,533,088	6,744,864	7,368,124	7,393,066	6,475,293	— 917,773
Total value	$11,706,187	$10,508,863	$11,648,088	$11,510,045	$10,033,747	—$1,476,298

[a] Crook, Fremont, Johnson, and Park counties.
[b] Crook, Fremont, Hot Springs, Johnson, and Park counties.
[c] Fremont, Hot Springs, Johnson, and Park counties.

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 of the State since 1865 and up to the close of 1914, is shown in the following table:

Production of coal in Wyoming from 1865 to 1914, 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	1913	7,393,066
1875	300,808	1888	1,481,540	1901	4,485,374	1914	6,475,293
1876	334,550	1889	1,388,947	1902	4,429,491		
1877	342,853	1890	1,870,366	1903	4,635,293	Total.	125,216,211

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, pp. 54–62, 1912.

The mining industry in 1911, by Alfred H. Brooks. Bull. 520, pp. 42–43, 1912.

The Yentna district, Alaska, by Stephen R. Capps. Bull. 534, p. 72, map of coal distribution (Pl. III in pocket), 1913.

The Noatak-Kobuk region, Alaska, by P. S. Smith. Bull. 536, pp. 151–153, 1913.

COLORADO.

The coal resources of Gunnison Valley, Mesa and Delta counties, Colo., by E. G. Woodruff. Bull. 471, pp. 565–573, 1912.

Coal fields of Grand Mesa and the West Elk Mountains, Colo., by W. T. Lee. Bull. 510, 219 pp., 1912.

Geology and coal resources of North Park, Colo., by A. L. Beekly. Bull. 596, 121 pp., 1915.

IDAHO.

Coal at Horseshoe Bend and Jerusalem Valley, Boise County, Idaho, by C. F. Bowen. Bull. 531, pp. 245–251, 1913.

Lignite in the Goose Creek district, Cassia County, Idaho, by C. F. Bowen. Bull. 531, pp. 252–262, 1913.

The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho, by E. G. Woodruff. Bull. 541, pp. 379–388, 1914.

ILLINOIS.

Geology and mineral resources of the Peoria quadrangle, Illinois, by J. A. Udden, Bull. 506, pp. 80–89, 1912.

Murphysboro-Herrin folio, Illinois, description by E. W. Shaw and T. E. Savage. Geol. Atlas U. S., folio 185, pp. 13–15, 1912.

Tallula-Springfield folio, Illinois, description by E. W. Shaw and T. E. Savage. Geol. Atlas U. S., folio 188, pp. 11–12, 1913.

Belleville-Breese folio, Illinois, description by J. A. Udden and E. W. Shaw. Geol. Atlas U. S., folio 195, pp. 10–12, 1915.

KENTUCKY.

Kenova folio, Kentucky-West Virginia-Ohio, description by W. C. Phalen. Geol. Atlas U. S., folio 184, pp. 8–14, 1912.

The coal resources and general geology of the Pound quadrangle of Virginia and Kentucky, by Charles Butts. Bull. 541, pp. 165–221, 1914.

MISSOURI.

The coal resources of a part of northeastern Missouri, by F. C. Greene. Bull. 541, pp. 223–242, 1914.

MONTANA.

The southern extension of the Milk River coal field, Chouteau County, Mont., by L. J. Pepperberg. Bull. 471, pp. 359–383, 1912.

The electric coal field, Park County, Mont., by W. R. Calvert. Bull. 471, pp. 406–422, 1912.

The Livingston and Trail Creek coal fields, Park, Gallatin, and Sweetgrass counties, Mont., by W. R. Calvert. Bull. 471, pp. 384–405, 1912.

The Culbertson lignite field, Valley County, Mont., by A. L. Beekly. Bull. 471, pp. 319–358, 1912.

The Sidney lignite field, Dawson County, Mont., by Eugene Stebinger. Bull. 471, pp. 284–318, 1912.

The Terry lignite field, Custer County, Mont., by F. A. Herald. Bull. 471, pp. 227–270, 1912.

The Glendive lignite field, Dawson County, Mont., by J. H. Hance. Bull. 471, pp. 271–283, 1912.

The Baker lignite field, Custer County, Mont., by C. F. Bowen. Bull. 471, pp. 202–226, 1912.

Geology of certain lignite fields in eastern Montana, by W. R. Calvert. Bull. 471, pp. 187–201, 1912.

The Little Sheep Mountain coal field, Dawson, Custer, and Rosebud counties, Mont., by G. S. Rogers. Bull. 531, pp. 159–227, 1913.

Coal in the Tertiary lake beds of southwestern Montana, by J. T. Pardee. Bull. 531, pp. 229–244, 1913.

Lignite in the vicinity of Plentywood and Scobey, Sheridan County, Mont., by C. M. Bauer. Bull. 541, pp. 293–315, 1914.

Geology and coal resources of the area southwest of Custer, Yellowstone, and Big Horn counties, Mont., by G. S. Rogers. Bull. 541, pp. 316-328, 1914.

Coal discovered in a reconnaissance survey between Musselshell and Judith, Mont., by C. F. Bowen. Bull. 541, pp. 329–337, 1914.

The Cleveland coal field, Blaine County, Mont., by C. F. Bowen. Bull. 541, pp. 338–355, 1914.

The Big Sandy coal field, Chouteau County, Mont., by C. F. Bowen. Bull. 541, pp. 356–378, 1914.

NEVADA.

The Coaldale coal field, Esmeralda County, Nev., by J. H. Hance. Bull. 531, pp. 313–322, 1913.

NEW MEXICO.

The Tijeras coal field, Bernalillo County, N. Mex., by W. T. Lee. Bull. 471, pp. 574–578, 1912.

The Cerrillos coal field, Sante Fe County, N. Mex., by W. T. Lee. Bull. 531, pp. 285–312, 1913.

Geology and coal resources of the Sierra Blanca coal fields, Lincoln and Otero counties, N. Mex., by C. H. Wegemann. Bull. 541, pp. 419–452, 1914.

NORTH CAROLINA

Coal on Dan River, North Carolina, by R. W. Stone. Bull. 471, pp. 137–169, 1912.

NORTH DAKOTA.

Lignite in the Fort Berthold Indian Reservation, N. Dak., north of Missouri River, by M. A. Pishel. Bull. 471, pp. 170–186, 1912.

Bismarck folio, North Dakota, description by A. G. Leonard. Geol. Atlas U. S., folio 181, pp. 6–7, 1912.

The Williston lignite field, Williams County, N. Dak., by F. A. Herald. Bull. 531, pp. 91–157, 1913.

Geology of the Standing Rock and Cheyenne River Indian Reservations, by W. R. Calvert, A. L. Beekly, V. H. Barnett, and M. A. Pishel. Bull. 575, pp. 26–49, 1914.

The Cannonball River lignite field, Morton, Adams, and Hettinger counties, N. Dak., by E. R. Lloyd. Bull. 541, pp. 243–291, 1914.

OHIO.

Kenova folio, Kentucky-West Virginia-Ohio, description by W. C. Phalen. Geol. Atlas U. S., folio 184, pp. 8–14, 1912.

OREGON.

The Eden Ridge coal field, Coos County, Oreg., by C. E. Lesher. Bull. 541, pp. 399–418, 1914.

Mineral resources of southwestern Oregon, by J. S. Diller. Bull. 546, pp. 130–141, 1914.

PENNSYLVANIA.

Foxburg-Clarion folio, Pennsylvania, description by E. W. Shaw and M. J. Munn. Geol. Atlas U. S., folio 178, pp. 12–13 (field edition, pp. 97–103), 1911.

Claysville folio, Pennsylvania, description by M. J. Munn. Geol. Atlas U. S., folio 180, pp. 12–13, 1912.

Barnesboro-Patton folio, Pennsylvania, description by M. R. Campbell, F. G. Clapp, and Charles Butts. Geol. Atlas U. S., folio 189, pp. 10–11, 1913.

RHODE ISLAND.

Rhode Island anthracite, by George H. Ashley. Bull. 541, pp. 155–162, 1914.

SOUTH DAKOTA.

Coal near the Black Hills, Wyoming-South Dakota, by B. W. Stone. Bull. 499, 66 pp., 1912.

Geology of the Standing Rock and Cheyenne River Indian Reservations, by W. R. Calvert, A. L. Beekly, V. H. Barnett, and M. A. Pishel. Bull. 575, pp. 26–49, 1914.

UTAH.

The Deep Creek district of the Vernal coal field, Uintah County, Utah, by C. T. Lupton. Bull. 471, pp. 579–594, 1912.

The Blacktail (Tabby) Mountain coal field, Wasatch County, Utah, by C. T. Lupton. Bull. 471, pp. 595–628, 1912.

Coal near Thompson, Grand County, Utah, by F. R. Clark. Bull. 541, pp. 453–477, 1914.

Coal near Wales, Sanpete County, Utah, by F. R. Clark. Bull. 541, pp. 478–489, 1914.

The Coalville coal field, Utah, by C. H. Wegemann. Bull. 581, pp. 161–184, 1915.

VIRGINIA.

Coking coal in Powell Mountain, Scott County, Va., by M. R. Campbell. Bull. 541, pp. 163–164, 1914.

The coal resources and general geology of the Pound quadrangle of Virginia and Kentucky, by Charles Butts. Bull. 541, pp. 165–221, 1914.

WASHINGTON.

Coal resources of Cowlitz River Valley, Cowlitz and Lewis counties, Wash., by A. J. Collier. Bull. 531, pp. 323–330, 1913.

The Glacier coal field, Whatcom County, Wash., by E. G. Woodruff. Bull. 541, pp. 389–398, 1914.

WEST VIRGINIA.

Kenova folio, Kentucky-West Virginia-Ohio, description by W. C. Phalen. Geol. Atlas U. S., folio 184, pp. 8–14, 1912.

WYOMING.

The Sussex coal field, Johnson, Natrona, and Converse counties, Wyo., by C. H. Wegemann. Bull. 471, pp. 441–471, 1912.

The Little Powder River coal field, Campbell County, Wyo., by J. A. Davis. Bull. 471, pp. 423–440, 1912.

Coal fields of the Wind River region, Fremont and Natrona counties, Wyo., by E. G. Woodruff and D. E. Winchester. Bull. 471, pp. 516–564, 1912.

The Lost Spring coal field, Converse County, Wyo., by D. E. Winchester. Bull. 471, pp. 472–515, 1912.

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NATURAL GAS.

By John D. Northrop.

INTRODUCTION.

The term "production" as applied to the output of natural gas is used in this chapter in a restricted sense to designate only that portion of the natural gas that found commercial utilization during the year in review. No attempt has been made to compile data concerning the volume of gas, amounting to many millions of cubic feet, that reached the surface and escaped without performing any useful service. "Production" as here employed is, broadly considered, synonymous with "consumption," and were there no interstate transportation of natural gas the use of the former term would be unnecessary. As, however, the nature of natural gas permits its ready transportation from productive localities in one State to markets in adjacent States, production and consumption in a given civil area rarely balance and the necessity for a distinction becomes apparent, as is evident from the following example: The State of New York produced in 1914 nearly 9,000,000,000 cubic feet of natural gas, whereas its consumption in the same period was in excess of 18,000,000,000 cubic feet, showing that more than one-half the natural-gas supply of New York was obtained from fields outside the State. The term "consumption," as the name implies, designates the quantity of natural gas utilized within a specified area, usually a civil division, irrespective of the source of the gas.

Values unless otherwise specified represent money received for natural gas at the point of ultimate consumption without regard to intervening transactions. As a great part of the natural gas used in the United States is sold by the original owner at a flat rate per well, payable quarterly or annually, an attempt to determine the "spot" value, or value at the point of production, of the output of natural gas is impracticable. It is worthy of note in this connection that owners of natural-gas property are coming more and more to a realization that the flat rate rarely returns a compensation proportionate to the value of the gas furnished, and, as a consequence, there is a growing tendency toward the disposition of gas at the well on the more equitable royalty basis. The rapid development of the production of casing-head gasoline has undoubtedly had a marked influence in promoting the adoption of the royalty basis.

The growth of the natural-gas industry, particularly within the last 15 years, has been so uniform that few people aside from those directly interested realize its present magnitude. Contrasted with the violent fluctuations which have marked the stages of growth in the crude-petroleum industry, the expansion of the natural-gas industry has been fairly steady. In 1899 the value of the natural gas consumed in the United States was, in round numbers, $20,000,000. In 1905, six years later, the value had doubled, and in the seven succeeding years this value in turn more than doubled, amounting to approximately $84,000,000 in 1912. In 1913 it increased to nearly $88,000,000 and in 1914 it advanced to a little more than $94,000,000. At the normal rate of increase the value of the production in 1915 should be in excess of $100,000,000. This great increase in the value of natural gas in the United States has been due in the main to increased consumption, although an increase in price of nearly 4 cents per thousand cubic feet in the average retail price of natural gas since 1906, the only period for which complete data are available, has been a contributing factor of no small importance.

ACKNOWLEDGMENTS.

In the preparation of this chapter the author gratefully acknowledges his indebtedness to the producers, transporters, and distributors of natural gas and to the manufacturers of casing-head gasoline in the United States, whose cordial cooperation and assistance have made possible the compilation of the statistical data here presented.

For supplemental data relating to current developments in the natural-gas industry thanks are due to the Natural Gas Journal, Oil City Derrick, Oil and Gas Journal, Oklahoma Oil and Gas News, and California Oil World.

Especial acknowledgment is accorded to Miss Belle Hill, of the United States Geological Survey, author of a number of the preceding reports of this series, for valuable assistance and suggestions and for the compilation of the various statistical tables presented in this report.

MARKETED PRODUCTION.

The quantity of natural gas commercially utilized in the United States in 1914 exceeded that so utilized in any previous year in the history of the natural-gas industry. The quantity produced and used, which amounted to approximately 591,866,733,000 cubic feet, constitutes a new record, exceeding by nearly 10,000,000,000 cubic feet, or 1.7 per cent, the former record established in 1913.

Compared with 1913, increase in output was credited in 1914 to New York, Ohio, Oklahoma, Texas, Louisiana, Alabama, Iowa, and California, the last-named State alone recording a gain of nearly 7,000,000,000 cubic feet. Other gas-producing States recorded declines in output, the greatest decline, amounting to slightly more than 10,000,000,000 cubic feet, being noted in the returns from Pennsylvania.

The increased output of gas may be attributed in New York to increased activity in drilling stimulated by the advancing petroleum market in 1913 and in the early part of 1914; in Ohio to local extensions of the productive fields of the gas belt in the central part of the State and to the development of an important gas pool in and near Cleveland, Cuyahoga County; in Oklahoma to the development of gas reserves in the Cushing field, Creek County, and the Healdton field, Carter County, as well as to a decided expansion of the local casing-head gasoline industry; in Texas to a greater utilization of the gas supplies available in the Petrolia, Moran, and Mexia fields; in Louisiana to the greater development of the gas reserves in Caddo and De Soto parishes; and in California to increased demand for domestic consumption in Los Angeles and adjacent towns in the southern part of the State as well as for industrial consumption in the casing-head gasoline industry.

CONSUMPTION.

Of the record-breaking production of natural gas credited to 1914, it is estimated that a total of 203,104,358,000 cubic feet, or about 34 per cent, was supplied to domestic consumers at an average price of 28.04 cents a thousand cubic feet, and that 388,762,375,000 cubic feet, comprising the remaining 66 per cent, was supplied to industrial consumers at an average price of 9.56 cents a thousand cubic feet. During the last four years the ratio of domestic to industrial consumption has varied but slightly. Formerly, however, a relatively greater proportion of the annual yield was supplied to industrial consumers.

STATISTICS OF PRODUCTION AND CONSUMPTION.

The following table shows, by States, the value of the natural gas produced and used in the entire country from 1885 to 1914, inclusive:

Approximate value of natural gas produced and used in the United States, 1885–1914, by States.

State.	1885	1886	1887	1888	1889	1890
Pennsylvania	$4,500,000	$9,000,000	$13,749,500	$19,282,375	$11,593,989	$9,551,025
New York	196,000	210,000	333,000	332,500	530,026	552,000
Ohio	100,000	400,000	1,000,000	1,500,000	5,215,669	4,684,300
West Virginia	40,000	60,000	120,000	120,000	12,000	5,400
Illinois	1,200	4,000			10,615	6,000
Indiana		300,000	600,000	1,320,000	2,075,702	2,302,500
Kansas		6,000			15,873	12,000
Missouri					35,687	10,500
California					12,680	33,000
Kentucky and Tennessee					2,580	30,000
Texas and Alabama					1,728	
Arkansas and Wyoming					375	
Other	20,000	32,000	15,000	75,000	1,600,175	1,606,000
Total	4,857,200	10,012,000	15,817,500	22,629,875	21,107,099	18,792,725

State.	1891	1892	1893	1894	1895	1896
Pennsylvania	$7,834,016	$7,376,281	$6,488,000	$6,279,000	$5,852,000	$5,528,610
New York	280,000	216,000	210,000	249,000	241,530	256,000
Ohio	3,076,325	2,136,000	1,510,000	1,276,100	1,255,700	1,172,400
West Virginia	35,000	70,500	123,000	395,000	100,000	640,000
Illinois	6,000	12,988	14,000	15,000	7,500	6,375
Indiana	3,942,500	4,716,000	5,718,000	5,437,000	5,203,200	5,043,635
Kansas	5,500	40,795	50,000	86,600	112,400	124,750
Missouri	1,500	3,775	2,100	4,500	3,500	1,500
California	30,000	55,000	62,000	60,350	55,000	55,682
Kentucky and Tennessee	38,993	43,175	68,500	89,200	98,700	99,000
Texas and Alabama		100	50	50	20	
Arkansas and Wyoming	250	100	100	100	100	60
Utah			500	500	20,000	20,000
Colorado				12,000	7,000	4,500
Other	250,000	200,000	100,000	50,000	50,000	50,000
Total	15,500,084	14,870,714	14,346,250	13,954,400	13,006,650	13,002,512

Approximate value of natural gas produced and used in the United States, 1885–1914, by States—Continued.

State.	1897	1898	1899	1900	1901	1902
Pennsylvania	$6,242,543	$6,806,742	$8,337,210	$10,215,412	$12,688,161	$14,352,183
New York	200,076	229,078	294,593	335,367	293,232	346,471
Ohio	1,171,777	1,488,308	1,866,271	2,178,234	2,147,215	2,355,458
West Virginia	912,528	1,334,023	2,335,864	2,959,032	3,954,472	5,390,181
Illinois	5,000	2,498	2,067	1,700	1,825	1,844
Indiana	5,009,208	5,060,969	6,680,370	7,254,539	6,954,566	7,081,344
Kansas	105,700	174,640	332,592	356,900	659,173	824,431
Missouri	500	145	290	547	1,328	2,154
California	50,000	65,337	86,891	79,083	67,602	120,648
Texas	90,000	103,133	8,000	20,000	18,577	14,953
Alabama	....	765				
Kentucky	40	....	125,745	286,243	270,871	365,656
Tennessee	15,050	7,875				
Arkansas and Wyoming	4,000	3,300	....	....	....	....
Utah	....	....	1,480	....	....	....
Colorado	....	....	3,500	1,800	1,800	1,900
Oklahoma	....	....	....	....	....	360
South Dakota	20,000	20,000	....	9,817	7,255	10,280
Total	13,826,422	15,296,813	20,074,873	23,698,674	27,066,077	30,867,863

State.	1903	1904	1905	1906	1907	1908
Pennsylvania	$16,182,834	$18,139,914	$19,197,336	$18,558,245	$18,844,156	$19,104,944
New York	493,686	522,575	623,251	672,795	766,157	959,280
Ohio	4,479,040	5,315,564	5,721,462	7,145,809	8,718,562	8,244,835
West Virginia	6,882,359	8,114,249	10,075,804	13,735,343	16,670,962	14,837,130
Illinois	3,310	4,745	7,223	87,211	143,577	446,077
Indiana	6,098,364	4,342,409	3,094,134	1,750,715	1,572,605	1,312,507
Kansas	1,123,849	1,517,643	2,261,836	4,010,986	6,198,583	7,691,587
Missouri	7,070	6,285	7,390	7,210	17,010	22,592
California	104,521	114,195	133,696	134,560	168,397	307,652
Texas	13,851	14,082	14,409	150,695	178,276	236,837
Alabama						
Louisiana	....	....	1,500			
Kentucky	390,601	322,404	237,290	287,501	380,176	424,271
Tennessee			300	300	300	350
Arkansas and Wyoming	2,460	6,515	21,135	34,500	126,582	164,930
Colorado	14,140	14,300	20,752	22,800	....	....
Oklahoma	1,000	49,665	130,137	259,862	417,221	860,159
South Dakota	10,775	12,215	15,200	15,400	19,500	24,400
North Dakota	....	....	....	....	235	2,480
Oregon	....	....	....	....	100	250
Iowa	....	....	....	....	....	93
Total	35,807,860	38,496,760	41,562,855	46,873,932	54,222,399	54,640,374

State.	1909	1910	1911	1912	1913	1914
Pennsylvania	$20,475,207	$21,057,211	$18,520,796	$18,539,672	$21,695,845	$20,401,295
New York	1,222,666	1,678,720	1,418,767	2,343,379	2,425,633	2,600,352
Ohio	9,966,938	8,626,954	9,367,347	11,891,299	10,521,930	14,667,790
West Virginia	17,538,565	23,816,553	28,435,907	33,324,475	34,164,850	35,515,329
Illinois	644,401	613,642	687,726	616,467	574,015	437,275
Indiana	1,616,903	1,473,403	1,192,418	1,014,295	843,047	755,407
Kansas	8,293,846	7,755,367	4,854,534	4,336,635	3,288,394	3,340,025
Missouri	10,025	12,611	10,496	11,576	6,795	5,319
California	446,933	476,697	800,714	1,134,456	1,883,450	2,910,784
Texas	453,253	956,683	1,014,945	1,405,077	2,073,823	2,469,770
Alabama			858,145	1,747,379	2,119,948	2,227,999
Louisiana						
Kentucky	485,192	456,293	407,689	522,455	509,846	490,875
Tennessee	350	300	300	375	600	300
Arkansas, Wyoming, and Colorado	226,925	301,151	295,858	309,816	269,421	214,103
Oklahoma	1,806,193	3,490,704	6,731,770	7,334,599	7,436,389	8,050,039
South Dakota	16,164	31,999	16,984	30,412	31,166	27,220
North Dakota	3,025	7,010	5,738			
Oregon	50	....	....	....	....	....
Iowa	50	40	70	120	120	200
Michigan	255	820	1,330	1,470	1,405	1,442
Total	63,206,941	70,756,158	74,621,534	84,563,957	87,846,677	94,115,524

The following table shows the production and the consumption of natural gas in 1913 and 1914, by States:

Quantity and value of natural gas produced and consumed in the United States in 1913 and 1914, by States.

1913.

State.	Produced.			Consumed.		
	Quantity (M cubic feet).	Cents per M cubic feet.	Value.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
West Virginia	245,453,985	13.92	$34,164,850	96,645,438	7.59	$7,333,956
Pennsylvania	118,860,269	18.25	21,695,845	177,463,230	16.18	28,709,565
Ohio	50,612,211	20.79	10,521,930	128,204,722	21.10	27,055,824
Oklahoma	75,017,668	9.91	7,436,389	51,249,294	7.30	3,740,981
Kansas	22,884,547	14.37	3,288,394	[a] 46,652,921	14.97	6,983,802
New York	8,515,257	28.50	2,425,633	16,738,545	29.20	4,888,412
Louisiana, Alabama	26,652,626	7.95	2,119,948	[b] 26,652,626	7.95	2,119,948
Texas	12,159,755	17.05	2,073,823	12,159,755	17.05	2,073,823
California	11,034,597	17.07	1,883,450	11,034,597	17.07	1,883,450
Indiana	2,920,614	28.52	843,047	3,220,885	29.44	948,278
Illinois	4,767,128	12.04	574,015	4,767,128	12.04	574,015
Kentucky	1,821,526	27.99	509,846	5,911,042	20.73	1,225,116
Arkansas, Colorado, Wyoming	1,106,374	24.35	269,421	1,106,374	24.35	269,421
South Dakota, North Dakota	66,492	46.87	31,166	66,492	46.87	31,166
Missouri	20,865	32.57	6,795	20,865	32.57	6,795
Michigan	1,805	77.84	1,405	1,805	77.84	1,405
Tennessee	2,400	25.00	600	2,400	25.00	600
Iowa	120	100.00	120	120	100.00	120
Total	581,898,239	15.10	87,846,677	581,898,239	15.10	87,846,677

[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.

1914.

State.	Produced.			Consumed.		
	Quantity (M cubic feet).	Cents per M cubic feet.	Value.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
West Virginia	238,740,162	14.87	$35,515,329	95,147,247	7.71	$7,334,690
Pennsylvania	108,494,387	18.80	20,401,295	164,834,542	17.25	28,439,324
Ohio	68,270,174	21.48	14,667,790	138,388,914	21.63	29,936,642
Oklahoma	78,167,414	10.30	8,050,039	[a] 55,544,105	7.61	4,226,318
Kansas	22,627,507	14.76	3,340,025	[b] 45,250,816	15.83	7,163,746
California	17,828,928	16.33	2,910,784	17,828,928	16.33	2,910,784
New York	8,935,187	29.10	2,600,352	18,401,830	29.94	5,510,204
Texas	13,433,639	18.38	2,469,770	13,433,639	18.38	2,469,770
Louisiana, Alabama	26,774,695	8.32	2,227,999	[c] 26,774,695	8.32	2,227,999
Indiana	2,579,675	29.28	755,407	4,443,244	32.02	1,422,880
Kentucky	1,421,818	34.52	490,875	7,225,626	24.73	1,787,308
Illinois	3,547,841	12.32	437,275	[d] 3,547,841	12.32	437,275
Arkansas, Colorado, Wyoming	962,998	22.23	214,103	962,998	22.23	214,103
South Dakota, North Dakota	60,781	44.78	27,220	60,781	44.78	27,220
Missouri	18,085	29.41	5,319	18,085	29.41	5,319
Michigan	2,042	70.61	1,442	2,042	70.61	1,442
Tennessee	1,200	25.00	300	1,200	25.00	300
Iowa	200	100.00	200	200	100.00	200
Total	591,866,733	15.90	94,115,524	591,866,733	15.90	94,115,524

[a] Includes some gas piped from Oklahoma and consumed in Missouri.
[b] Includes some gas piped from Kansas and consumed in Missouri.
[c] Includes some gas piped from Louisiana to Texas and from Louisiana to Arkansas.
[d] Includes some gas piped from Illinois and consumed in Indiana.

The following tables show, by States, the quantities of natural gas distributed to domestic and to industrial consumers in the United States in 1913 and 1914:

Distribution of natural gas consumed in the United States in 1913, by States.

State.	Number of producers.	Consumers.		Gas consumed.		
				Domestic.		
		Domestic.	Industrial.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
Pennsylvania	1,174	400,823	4,373	46,699,256	26.82	$12,524,478
Ohio	2,056	685,956	5,010	64,732,832	28.82	18,658,295
West Virginia [a]	451	101,234	1,834	15,524,692	19.32	2,999,005
Kansas [b]	305	195,131	950	20,550,852	24.22	4,977,137
New York	366	136,830	639	15,050,594	30.41	4,577,469
Oklahoma	347	49,308	1,793	7,039,196	17.85	1,256,818
Louisiana [c]	57	26,424	550	3,231,608	27.71	895,524
Alabama	7	340	3			
Texas	50	37,350	393	3,359,854	38.30	1,286,667
California	48	164,358	141	1,632,337	67.43	1,100,702
Kentucky	93	54,446	146	2,873,530	32.26	926,950
Indiana [d]	1,100	39,776	239	2,588,120	31.85	824,430
Illinois [e]	231	10,423	279	898,677	25.69	230,851
Arkansas	6	5,836	11			
Colorado	15	1,212	9	650,768	36.39	236,826
Wyoming	11	353	7			
South Dakota	32	397	5	31,922	61.16	19,523
North Dakota	13	62				
Missouri	52	342	7	17,899	33.61	6,015
Michigan	19	19	1	1,005	100.00	1,005
Tennessee	7	4		2,400	25.00	600
Iowa	5	3		120	100.00	120
Total	6,445	1,910,627	16,390	184,885,662	27.33	50,522,415

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	130,763,974	12.38	$16,185,087	177,463,230	16.18	$28,709,565
Ohio	63,471,890	13.23	8,397,529	128,204,722	21.10	27,055,824
West Virginia [a]	81,120,746	5.34	4,334,951	96,645,438	7.59	7,333,956
Kansas [b]	26,102,069	7.69	2,006,665	46,652,921	14.97	6,983,802
New York	1,687,951	18.42	310,943	16,738,545	29.20	4,888,412
Oklahoma	44,210,098	5.62	2,484,163	51,249,294	7.30	3,740,981
Louisiana [c]	23,421,018	5.23	1,224,424	26,652,626	7.95	2,119,948
Alabama						
Texas	8,799,901	8.95	787,156	12,159,755	17.05	2,073,823
California	9,402,260	8.33	782,748	11,034,597	17.07	1,883,450
Kentucky	3,037,512	9.82	298,166	5,911,042	20.73	1,225,116
Indiana [d]	632,765	19.57	123,848	3,220,885	29.44	948,278
Illinois [e]	3,868,451	8.87	343,164	4,767,128	12.04	574,015
Arkansas						
Colorado	455,606	7.15	32,595	1,106,374	24.35	269,421
Wyoming						
South Dakota	34,570	33.68	11,643	66,492	46.87	31,166
North Dakota						
Missouri	2,966	26.30	780	20,865	32.57	6,795
Michigan	800	50.00	400	1,805	77.84	1,405
Tennessee				2,400	25.00	600
Iowa				120	100.00	120
Total	397,012,577	9.40	37,324,262	581,898,239	15.10	87,846,677

[a] Includes the consumption of gas piped from West Virginia to Maryland.
[b] Includes the consumption of gas piped from Kansas to Missouri and from Oklahoma to Kansas and Missouri.
[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., and from West Virginia to Indiana.
[e] Includes the consumption of gas piped from Illinois to Vincennes, Ind.

Distribution of natural gas consumed in the United States in 1914, by States.

State.	Number of producers.	Consumers.		Gas consumed.		
				Domestic.		
		Domestic.	Industrial.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
Ohio	2,268	733,284	6,102	71,873,699	29.11	$20,922,408
Pennsylvania	1,325	412,744	4,307	50,192,742	27.30	13,702,262
West Virginia [a]	475	107,820	1,850	17,023,701	18.64	3,173,931
Kansas [b]	353	187,714	1,079	19,214,194	25.49	4,898,314
New York	367	146,236	666	16,982,834	30.86	5,241,057
Oklahoma [c]	437	62,390	1,951	7,705,890	19.14	1,474,582
California	57	205,163	172	2,948,274	61.12	1,802,093
Texas	75	48,547	468	4,300,350	39.04	1,678,858
Louisiana [d]	54	29,751	618	3,762,874	26.96	1,014,467
Alabama	7	395	3			
Kentucky	101	78,505	128	4,222,495	34.99	1,477,530
Indiana [e]	1,029	43,410	344	3,404,551	33.74	1,148,683
Illinois [f]	235	8,952	153	771,191	27.33	210,787
Arkansas	7	5,830	6			
Colorado	15	1,206	11	657,680	29.28	192,592
Wyoming	17	543	12			
South Dakota	27	400	6	27,311	61.80	16,877
North Dakota	13	61	....			
Missouri	49	126	7	14,420	29.60	4,269
Michigan	20	16	3	842	100.00	842
Tennessee	7	3	....	1,200	25.00	300
Iowa	5	3	....	200	100.00	200
Total	6,943	2,073,099	17,886	203,104,358	28.04	56,960,052

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	66,515,215	13.55	$9,014,234	138,388,914	21.63	$29,936,642
Pennsylvania	114,641,800	12.85	14,737,062	164,834,542	17.25	28,439,324
West Virginia [a]	78,123,546	5.33	4,160,759	95,147,247	7.71	7,334,690
Kansas [b]	26,036,622	8.70	2,265,432	45,250,816	15.83	7,163,746
New York	1,418,996	18.97	269,147	18,401,830	29.94	5,510,204
Oklahoma [c]	47,838,215	5.75	2,751,736	55,544,105	7.61	4,226,318
California	14,880,654	7.45	1,108,691	17,828,928	16.33	2,910,784
Texas	9,133,289	8.66	790,912	13,433,639	18.38	2,469,770
Louisiana [d]	23,011,911	5.27	1,213,532	26,774,695	8.32	2,227,999
Alabama						
Kentucky	3,003,131	10.32	309,778	7,225,626	24.73	1,787,308
Indiana [e]	1,038,693	26.40	274,197	4,443,244	32.02	1,422,880
Illinois [f]	2,776,650	8.16	226,488	3,547,841	12.32	437,275
Arkansas						
Colorado	305,318	7.05	21,511	962,998	22.23	214,103
Wyoming						
South Dakota	33,470	30.90	10,343	60,781	44.78	27,220
North Dakota						
Missouri	3,665	28.65	1,050	18,085	29.41	5,319
Michigan	1,200	50.00	600	2,042	70.61	1,442
Tennessee	....	....	....	1,200	25.00	300
Iowa	....	....	....	200	100.00	200
Total	388,762,375	9.56	37,155,472	591,866,733	15.90	94,115,524

[a] Includes the consumption of gas piped from West Virginia to Maryland.
[b] Includes the consumption of gas piped from Kansas to Missouri.
[c] Includes some gas piped from Oklahoma to Missouri.
[d] Includes the consumption of gas piped to Texas from Louisiana and to Arkansas from Louisiana.
[e] Includes the consumption of gas piped from Indiana to Chicago, Ill., and from West Virginia to Indiana.
[f] Includes the consumption of gas piped from Illinois to Vincennes, Ind.

The following tables present a classification by States and by principal uses of the quantity of natural gas distributed to industrial consumers in the United States in 1913 and 1914:

Distribution of natural gas consumed for industrial purposes in the United States in 1913, by States.

State.	Industrial consumers.			Gas consumed.		
				Manufacturing.		
	Manufacturing.	Other industrial (power).	Total.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
Pennsylvania	2,134	2,239	4,373	117,073,829	12.25	$14,338,228
Ohio	3,523	1,487	5,010	49,663,270	13.03	6,472,271
West Virginia	694	1,140	1,834	57,366,691	5.17	2,965,776
Oklahoma	325	1,468	1,793	22,947,560	4.72	1,083,154
Kansas	225	725	950	17,110,874	6.64	1,136,007
Louisiana, Alabama	121	432	550	3,144,472	8.04	252,834
Texas	(a)	393	393	(a)		(a)
California		141	141			
Illinois	22	257	279	643,813	13.83	89,057
New York	100	539	639	364,395	20.14	73,387
Kentucky	20	126	146	2,253,057	8.28	186,520
Indiana	85	154	239	263,079	24.47	64,375
Arkansas, Colorado, Wyoming	(a)	27	27	(a)		(a)
South Dakota, North Dakota		5	5			
Missouri		7	7			
Michigan		1	1			
Total	7,249	9,141	16,390	270,831,040	9.84	26,661,609

State.	Gas consumed.					
	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.
Pennsylvania	13,690,145	13.49	$1,846,859	130,763,974	12.38	$16,185,087
Ohio	13,808,620	13.94	1,925,258	63,471,890	13.23	8,397,529
West Virginia	23,754,055	5.76	1,369,175	81,120,746	5.34	4,334,951
Oklahoma	21,262,538	6.59	1,401,009	44,210,098	5.62	2,484,163
Kansas	8,991,195	9.68	870,658	26,102,069	7.69	2,006,665
Louisiana, Alabama	20,276,546	4.79	971,590	23,421,018	5.23	1,224,424
Texas	8,799,901	8.95	787,156	8,799,901	8.95	787,156
California	9,402,260	8.33	782,748	9,402,260	8.33	782,748
Illinois	3,224,638	7.88	254,107	3,868,451	8.87	343,164
New York	1,323,556	17.95	237,556	1,687,951	18.42	310,943
Kentucky	784,455	14.23	111,646	3,037,512	9.82	298,166
Indiana	369,686	16.09	59,473	632,765	19.57	123,848
Arkansas, Colorado, Wyoming	455,606	7.15	32,595	455,606	7.15	32,595
South Dakota, North Dakota	34,570	33.68	11,643	34,570	33.68	11,643
Missouri	2,966	26.30	780	2,966	26.30	780
Michigan	800	50.00	400	800	50.00	400
Total	126,181,537	8.45	10,662,653	397,012,577	9.40	37,324,262

a Included in "Other industrial."

Distribution of natural gas consumed for industrial purposes in the United States in 1914, by States.

State.	Industrial consumers.			Gas consumed.		
				Manufacturing.		
	Manufacturing.	Other industrial (power).	Total.	Quantity (M cubic feet).	Cents per M cubic feet.	Value.
Pennsylvania	1,934	2,373	4,307	104,073,315	12.86	$13,328,188
Ohio	3,781	2,321	6,102	49,572,360	13.26	6,574,104
West Virginia	736	1,114	1,850	56,378,902	5.30	2,987,428
Oklahoma	579	1,372	1,951	23,135,719	5.21	1,205,673
Kansas	407	672	1,079	15,154,758	7.93	1,201,495
Louisiana	97	521	618	2,873,340	6.09	195,742
Alabama		3	3			
California		172	172			
Texas	174	294	468	4,298,637	8.55	367,572
Kentucky	22	106	128	2,040,404	8.28	168,854
Indiana	286	58	344	737,195	29.24	215,519
New York	116	550	666	267,228	20.20	53,978
Illinois	6	147	153	435,115	8.76	38,116
Arkansas	(a)	6	6			
Colorado		11	11	(a)		(a)
Wyoming		12	12			
South Dakota		6	6			
North Dakota						
Missouri		7	7			
Michigan		3	3			
Total	8,138	9,748	17,886	258,966,973	10.17	26,336,669

State.	Gas consumed.					
	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.
Pennsylvania	10,568,485	13.33	$1,408,874	114,641,800	12.85	$14,737,062
Ohio	16,942,855	14.40	2,440,130	66,515,215	13.55	9,014,234
West Virginia	21,744,644	5.40	1,173,331	78,123,546	5.33	4,160,759
Oklahoma	24,702,496	6.26	1,546,063	47,838,215	5.75	2,751,736
Kansas	10,881,864	9.78	1,063,937	26,036,622	8.70	2,265,432
Louisiana	20,138,571	5.05	1,017,790	23,011,911	5.27	1,213,532
Alabama						
California	14,880,654	7.45	1,108,691	14,880,654	7.45	1,108,691
Texas	4,834,652	8.76	423,340	9,133,289	8.66	790,912
Kentucky	962,727	14.64	140,924	3,003,131	10.32	309,778
Indiana	301,498	19.46	58,678	1,038,693	26.40	274,197
New York	1,151,768	18.68	215,169	1,418,996	18.97	269,147
Illinois	2,341,535	8.00	188,372	2,776,650	8.16	226,488
Arkansas						
Colorado	305,318	7.05	21,511	305,318	7.05	21,511
Wyoming						
South Dakota	33,470	30.90	10,343	33,470	30.90	10,343
North Dakota						
Missouri	3,665	28.65	1,050	3,665	28.65	1,050
Michigan	1,200	50.00	600	1,200	50.00	600
Total	129,795,402	8.34	10,818,803	388,762,375	9.56	37,155,472

a Included in "Other industrial."

The following table shows, by States, the value of natural gas consumed in the United States from 1909 to 1914, inclusive:

Value of natural gas consumed in the United States, 1909–1914, by States.

State.	1909	1910	1911	1912	1913	1914
Pennsylvania	$21,639,102	$23,934,691	$23,940,001	$26,486,302	$28,709,565	$28,439,324
Ohio	18,884,312	21,210,965	22,792,270	27,196,162	27,055,824	29,936,642
West Virginia	a 5,183,054	a 5,617,910	a 6,240,152	a 7,001,331	a 7,333,956	a 7,334,690
Kansas	b 8,356,076	b 9,335,027	b 9,493,701	b 8,521,858	b 6,983,802	b 7,163,746
New York	3,286,523	3,963,872	4,276,324	4,866,821	4,888,412	5,510,204
Oklahoma	1,743,963	1,911,044	2,092,603	3,149,376	3,740,981	4,226,318
Indiana	c 1,616,903	c 1,473,403	c 1,192,418	c 1,014,295	c 948,278	c 1,422,880
Texas			1,014,945	1,405,077	2,073,823	2,469,770
Louisiana	453,253	956,683	d 858,145	d 1,747,379	d 2,119,948	d 2,227,999
Alabama						
Kentucky	695,577	908,293	901,759	1,070,664	1,225,116	1,787,308
California	446,933	476,697	800,714	1,134,456	1,883,450	2,910,784
Illinois	e 644,401	e 613,642	e 687,726	e 616,467	e 574,015	e 437,275
Arkansas						
Colorado	226,925	301,151	295,858	309,816	269,421	214,103
Wyoming						
Missouri	10,025	12,611	10,496	11,576	6,795	5,319
South Dakota	16,164	31,999	16,984	30,412	31,166	27,220
North Dakota	3,025	7,010	5,738			
Michigan	255	820	1,330	1,470	1,405	1,442
Tennessee	350	300	300	375	600	300
Iowa	50	40	70	120	120	200
Oregon	50	......	......	......	......	......
Total	63,206,941	70,756,158	74,621,534	84,563,957	87,846,677	94,115,524

a Includes value of gas piped from West Virginia to Maryland.
b Includes value of gas piped from Kansas to Missouri in 1908, 1909, and 1914, and from Kansas and Oklahoma to Missouri in 1910, 1911, 1912, and 1913.
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 shows the value of natural gas and of petroleum and their combined value in 1913 and 1914, by States, arranged in the order of the value of the combined production:

Value of the natural gas and petroleum produced in the United States in 1913 and 1914, and their combined value, by States.

1913.

State.	Value of natural gas.	Value of crude petroleum.	Value of natural gas and crude petroleum.
Oklahoma	$7,436,389	$59,581,948	$67,018,337
West Virginia	34,164,850	28,828,814	62,993,664
California	1,883,450	45,661,400	47,544,850
Pennsylvania	21,695,845	19,805,452	41,501,297
Illinois	574,015	30,971,910	31,545,925
Ohio	10,521,930	17,538,452	28,060,382
Texas	2,073,823	14,675,593	16,749,416
Louisiana	2,119,948	12,255,931	14,375,879
Alabama		......	
Kansas	3,288,394	2,248,283	5,536,677
New York	2,425,633	2,169,357	4,594,990
Indiana	843,047	1,279,226	2,122,273
Arkansas		......	
Colorado	269,421	174,779	1,631,432
Wyoming		1,187,232	
Kentucky	509,846	675,748	1,185,594
Missouri	6,795		
Michigan	1,405	67,263	75,463
New Mexico	......		
Alaska	......		
South Dakota	31,166	......	31,166
North Dakota			
Tennessee	600	......	600
Iowa	120	......	120
Total	87,846,677	237,121,388	324,968,065

Value of the natural gas and petroleum produced in the United States in 1913 and 1914, and their combined value, by States—Continued.

1914.

State.	Value of natural gas.	Value of crude petroleum.	Value of natural gas and crude petroleum.
Oklahoma	$8,050,039	$57,253,187	$65,303,226
West Virginia	35,515,329	18,468,540	53,983,869
California	2,910,784	48,066,096	50,976,880
Pennsylvania	20,401,295	15,573,822	35,975,117
Ohio	14,667,790	13,372,729	28,040,519
Illinois	437,275	25,426,179	25,863,454
Texas	2,469,770	14,942,848	17,412,618
Louisiana	2,227,999	12,886,897	15,114,896
Alabama		....	
Kansas	3,340,025	2,433,074	5,773,099
New York	2,600,352	1,760,868	4,361,220
Indiana	755,407	1,548,042	2,303,449
Arkansas		....	
Colorado	214,103	200,894	2,094,189
Wyoming		1,679,192	
Kentucky	490,875	498,556	989,431
South Dakota	27,220	....	27,220
North Dakota			
Missouri	5,319		
Michigan	1,442	14,291	21,052
Alaska	....		
Tennessee	300	....	300
Iowa	200	....	200
Total	94,115,524	214,125,215	308,240,739

SUMMARY OF WELLS DRILLED.

The following table comprises a summary of natural gas wells in the United States in 1914, by States:

Number of wells drilled for natural gas in 1914, by States.

State.	Productive, Dec. 31, 1913.	Drilled in 1914.			Abandoned in 1914.	Productive, Dec. 31, 1914.
		Gas.	Dry.	Total.		
Alabama	18	2	4	6	4	16
Arkansas	99	1	4	5	1	99
California	72	8	1	9	7	73
Colorado	6	......	......	......	1	5
Illinois	455	38	114	152	76	417
Indiana	2,370	68	19	87	214	2,224
Iowa	6	......	......	......	......	6
Kansas	2,297	445	219	664	481	2,261
Kentucky	274	10	1	11	8	276
Louisiana	191	52	26	78	16	227
Michigan	18	2	2	4	3	17
Missouri	61	3	1	4	4	60
Montana	1	2	......	2	......	3
New York	1,929	178	55	233	76	2,031
North Dakota	18	......	......	......	5	13
Ohio	5,308	686	257	943	321	5,673
Oklahoma	1,052	388	182	570	235	1,205
Pennsylvania	12,438	998	236	1,234	413	13,023
South Dakota	35	1	......	1	7	29
Tennessee	8	......	......	......	1	7
Texas	126	89	23	112	18	197
West Virginia	6,534	856	154	1,010	196	7,194
Wyoming	29	9	8	17	1	37
Total	33,345	3,836	1,306	5,142	2,088	35,093

ACREAGE CONTROLLED BY NATURAL-GAS PRODUCERS.

The following table shows the number of acres of land held by natural-gas producers in 1913 and 1914, by States, and whether the acreage was owned in fee or leased:

Acreage controlled by natural-gas producers in the United States in 1913 and 1914, by States.

	1913				1914			
	In fee.	Leased.	Gas rights.	Total.	In fee.	Leased.	Gas rights.	Total.
Alabama	70	170,200		170,270	85	155,200		155,285
Arkansas	600	8,131		8,731	600	20,918		21,518
California	3,160	1,774	4,960	9,894	2,844	2,412	20,640	25,896
Colorado	1,080	35		1,115	2,326	300		2,626
Illinois	1,687	174,766	2,032	178,485	509	180,876	15,943	197,328
Indiana	117,141	177,436	1,758	296,335	106,053	135,504	508	242,065
Kansas	32,217	406,046	13,945	452,208	28,708	397,932	11,075	437,715
Kentucky	3,348	141,840	636	145,824	5,594	160,968	636	167,198
Louisiana	19,896	343,871	4,414	368,181	8,430	106,750	10,187	125,367
Missouri	1,403			1,403	1,405			1,405
New York	14,220	447,112	74,212	535,544	11,571	626,717	5,930	644,218
Ohio	20,026	1,393,073	102,463	1,515,562	21,385	1,249,532	90,861	1,361,778
Oklahoma	18,943	1,242,701	31,834	1,293,478	17,275	1,165,485	13,017	1,195,777
Pennsylvania	146,472	1,684,925	380,043	2,211,440	179,929	1,577,889	395,301	2,153,119
Tennessee	500			500				
Texas	14,857	508,776	16,910	540,543	64,463	636,094	62,030	762,587
West Virginia	111,712	2,521,253	522,786	3,155,751	103,636	2,281,117	706,753	3,091,506
Wyoming	2,328	16,368		18,696	3,158	20,808		23,966
Total	509,660	9,238,307	1,155,993	10,903,960	557,971	8,718,502	1,332,881	10,609,354

NATURAL-GAS INDUSTRY, BY STATES.

NEW YORK.

PRODUCTION.

Little change is noted from year to year in the quantity of natural gas produced and used in New York. Much of the production is derived from wells which likewise yield petroleum, and to an appreciable extent the natural-gas output of the State reflects local activity in the search for oil. Increased drilling for oil in 1913 and in the early part of 1914, justified by an advancing petroleum market, resulted in an increase in the output of natural gas in this State in 1914 in excess of the yield in 1913 by nearly 420,000,000 cubic feet. Returns for 1914 indicate that the total output of natural gas in the New York fields was 8,935,187,000 cubic feet. The average price received for this production was 29.10 cents a thousand cubic feet, and the total value of the output was $2,600,352, a sum greater than the value of New York's natural-gas yield in any previous year.

Natural gas in New York is derived from sandstone, shale, and limestone strata in the succession of rocks between the Potsdam sandstone of the Cambrian system and the Chemung formation of the Devonian system. In Allegany, Cattaraugus, and Steuben counties, where the gas is associated for the most part with petroleum, the supply is derived principally from the Chemung and the underlying Portage formations. In Chautauqua County gas is obtained from these formations, as well as from the lower-lying Medina group of the Silurian system, which is the principal source of gas in the northern part of that county and in Erie, Genesee, Niagara, Orleans, Monroe, and Livingston counties. In Wyoming, Ontario, Onondaga, and Oswego counties gas flows of value locally, though of no great importance commercially, are derived from the Trenton limestone of the Ordovician system.

In order to test the gas possibilities of the Potsdam sandstone in western New York a deep well was drilled near Lockport, Niagara County, in 1914. No gas was encountered, however, the formation in that locality being found to be saturated with salt water.

In Chemung County a shallow well drilled for water on lands of the Chemung Valley Dairy Products Co., at Big Flats, produced enough gas to light the plant. The discovery of gas in this locality is not of great importance, as the well is believed to have penetrated only a pocket of gas in the glacial drift, which is of considerable thickness beneath the floor of Chemung Valley at this point.

In the area of the Medina group gas wells are generally long lived and the rock pressure is well sustained, operators reporting that wells drilled in 1914 disclose pressures as high as the initial pressures in wells completed 10 and 20 years ago. In the fields which derive their gas from the sands of stratigraphically higher Devonian strata the rock pressure has shown a gradual decline for several years.

In the Trenton limestone of New York little variation in rock pressure is reported from year to year.

The number of productive gas wells in New York at the close of 1914 was 2,031, of which number 178 were completed during the year. Barren wells completed in 1914 numbered 55, and gas wells abandoned because of diminished output numbered 76.

Approximately 644,218 acres of developed and undeveloped gas land are controlled by natural-gas producers in the State of New York.

CONSUMPTION.

The total consumption of natural gas in New York in 1914 was approximately 18,401,830,000 cubic feet, valued at $5,510,204, or an average of 29.94 cents per thousand cubic feet. Of this quantity, 9,653,704,000 cubic feet (valued at $2,944,752), or a little more than one-half, was piped from Pennsylvania. Compared with 1913 the consumption of natural gas in New York increased more than 1,500,000,000 cubic feet in 1914.

Approximately 16,982,834,000 cubic feet, or about 92 per cent, of the natural gas distributed in New York in 1914 was supplied to domestic consumers at an average price of 30.86 cents per thousand cubic feet. At the end of 1914 domestic consumers in New York numbered 146,236, an increase of 9,406 over the number recorded for 1913.

The remaining 1,418,996,000 cubic feet of natural gas distributed in New York in 1914 was supplied to industrial consumers at an average price of 18.97 cents per thousand cubic feet. The number of industrial consumers supplied in 1914 was 666, as compared with 639 in 1913. The larger part of the gas supplied to industrial consumers in New York is utilized for the generation of power in gas engines and under boilers, a small quantity only being utilized in manufacturing.

The following table records the progress of the natural-gas industry in New York during the last 18 years:

Record of natural-gas industry in New York, 1897–1914.

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	1,736
1913	366	2,425,633	136,830	639	4,888,412	200	54	1,929
1914	367	2,600,352	146,236	666	5,510,204	178	55	2,031

a Number of fires supplied.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in the State of New York:

Depth and rock pressure of wells in New York, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Allegany	600–1,900	10–300	15–150	7–300	7–250	15–150
Cattaraugus	400–3,200	10–90	1–120	0–700	0–500	0–400
Chautauqua	150–3,250	1–700	0–700	0–*a* 900	0–700	0–800
Erie	360–3,200	22–610	10–700	25–*a* 950	42–*a* 1,000	15–750
Niagara	550	....	....	....	....	....
Genesee	1,150–1,905	500	500	500	400	450
Livingston	345–2,000	10–380	100–400	200–525	200–400	200–350
Monroe	440–1,300	....	....	50–400	160–400	160–205
Onondaga	1,000–3,000	300–500	300–600	3–300	400–600	300
Ontario Seneca	114–2,300 1,250–1,550	5–400	60–440	55–450	1–450	3–60
Oswego	700–1,700	20–200	11–200	8–75	25–145	3–300
Schuyler Yates	1,000–1,600 375–1,900	100–435	200–435	300–435	150–435	3–435
Steuben	279–1,200	50–100	....	75–200	75–400	75–200
Wyoming	1,100–2,000	50	125	110–140	140–400	250–300

a New well.

PENNSYLVANIA.

PRODUCTION.

Despite the unusual activity which characterized the search for oil and gas in Pennsylvania during the latter part of 1913 and the early part of 1914, the recorded output of natural gas from the State in 1914, which amounted to 108,494,387,000 cubic feet, showed a decrease in volume amounting to a little more than 10,000,000,000 cubic feet, compared with 1913. Sufficient new production was not developed during the year to offset the normal decline in yield of the old wells. The average price received by the distributing companies for this production was 18.80 cents per thousand cubic feet, an increase of 0.55 cent over the price received in 1913 and of 2.27 cents over the price received in 1912.

The increase in price noted is accounted for principally by the fact that, compared with previous years, a relatively greater part of the gas produced in Pennsylvania was retailed to domestic consumers than was wholesaled for industrial uses.

The natural-gas fields of Pennsylvania are essentially coincident with the oil fields of the State, being distributed over 23 counties lying west of the Appalachian Mountains and occupying the broad belt of gently folded strata making up the Allegheny Plateau. Much of the natural gas produced in Pennsylvania is obtained from active oil wells and is termed "casing-head" gas to distinguish it from that obtained from strictly gas-producing wells. In the Appalachian fields casing-head gas is generally "wet" gas—that is, it is rich in the paraffin hydrocarbons that make it suitable in a high degree for the manufacture of gasoline by compression and refrigeration, whereas gas that is not associated with oil or casing-head gas that is associated with asphaltic oils is generally "dry" gas and yields little or no gasoline on compression.

Natural gas in Pennsylvania is obtained commercially from a great number of productive sandstone layers or sands included in the stratigraphic range between the Kane sand in the lower division of the Devonian system to the Hurry-up sand at the base of the Conemaugh formation of the Pennsylvanian series of the Carboniferous system. The principal gas-yielding sands in the State are as follows: Northwestern Pennsylvania—Kane, Elk (Waugh and Porter), Bradford, Cherry Grove, Speechley, Tiona, Warren Second, Warren First, and Elizabeth, of the Devonian system; western Pennsylvania—Gordon, Bowlder, and 30-foot, of the Devonian (?) system; and 50-foot, Gantz, and Berea (Butler County gas sand), of the Mississippian series; southwestern Pennsylvania—Fifth, Fourth, Gordon, Bowlder, 30-foot, 50-foot, Gantz, Murrysville, Berea, Big Injun, and Maxton sands, and the Homewood and Mahoning sandstones of the Devonian and the lower part of the Carboniferous.

Adjacent to Lake Erie in Erie County in Pennsylvania and for some distance to the west in Ohio shallow wells sunk in the dark carbonaceous shale in the upper part of the Devonian system produce light flows of natural gas. A well in this locality may produce a few hundred or even a few thousand feet of gas a day and will sometimes maintain its production for a score or more of years. The pressure is low, rarely more than 35 pounds to the square inch, the flow being utilized for domestic purposes by one or two families.

In practically all the gas fields of Pennsylvania a decline in volume of gas as well as in rock pressure was recorded in 1914. In the Elk County pool, referred to in the preceding report of this series as having been opened in 1913, the volume of gas obtained is said to have declined at least one-third and the rock pressure to have fallen from 1,000 pounds to 400 pounds per square inch in one year.

Owing more or less to increased interest in the utilization of casing-head gas for gasoline manufacture, the number of natural-gas producers in Pennsylvania increased from 1,174 in 1913 to 1,325 in 1914. The number of gas wells in service at the end of 1914 aggregated 13,023, of which number 998 were completed during the year. At the end of 1914 a total of 2,153,119 acres of land in Pennsylvania was controlled by natural-gas producers.

CONSUMPTION.

The total quantity of natural gas consumed in Pennsylvania in 1914 amounted to approximately 164,834,542,000 cubic feet, a volume more than one-half greater than the entire gas production of the State during that year. The value of this quantity of gas at the point of consumption was $28,439,324, or a price per unit of 17.25 cents per thousand cubic feet. Compared with the gas consumption of the State in 1913 these statistics record a decline of 12,628,688,000 cubic feet in quantity and of $270,241 in value but an increase of 1.07 cents in price per unit.

Domestic consumers of natural gas in Pennsylvania increased from 400,823 in 1913 to 412,744 in 1914, whereas the number of industrial consumers decreased from 4,373 to 4,307.

Of the quantity of natural gas distributed in Pennsylvania in 1914 a total of 50,192,742,000 cubic feet was furnished domestic consumers at an average price of 27.30 cents per thousand cubic feet, and 114,641,800,000 cubic feet was furnished industrial consumers at an average price of 12.85 cents per thousand cubic feet. The average unit price for natural gas for domestic consumption increased 0.48 of a cent and that for industrial consumption 0.47 of a cent in 1914 as compared with 1913. As regards quantity of gas involved, domestic consumption in 1914 exceeded that in 1913 by 3,493,486,000 cubic feet, or more than 7 per cent, whereas industrial consumption declined 16,122,174,000 cubic feet, or a little more than 12 per cent.

The principal area of industrial consumption of natural gas in Pennsylvania is the Pittsburgh district, where an enormous volume of this fuel is required annually in the blast furnaces, foundries, rolling mills, glass factories, and other industries that have made Pittsburgh an important manufacturing center.

Of its own production of natural gas Pennsylvania consumed 95,889,861,000 cubic feet, the remaining 12,604,526,000 cubic feet, valued at $3,576,605, being marketed in New York, West Virginia, and Ohio. Of its enormous total consumption, 68,944,681,000 cubic feet, valued at $11,614,634, was piped into Pennsylvania from adjoining States, almost entirely from West Virginia, though a small quantity was furnished by New York to domestic consumers residing on the Pennsylvania side of the State boundary.

The greatest prospect for the future development of natural gas in Pennsylvania lies in drilling to deeper sands, as it does not appear that there is much probability that strictly new gas fields of importance will be found in the State. In recent years deeper drilling in western and southwestern Pennsylvania has resulted in the successful rejuvenation of a number of gas fields threatened with extinction because of the exhaustion of the gas in the upper sands, and, as the limit of possibilities in this direction has by no means been reached, it is probable that Pennsylvania is destined to be an important producer of natural gas for many years.

An example of successful drilling of this type is at hand in the results of two wells drilled in 1914 in Jackson and Cranberry townships, in Butler County, where at depths of 1,600 to 1,625 feet large volumes of gas under pressure of 640 to 740 pounds to the square inch were developed in the Snee and Gordon sands, production in that locality having been derived formerly from the Berea and Gantz (100-foot) sands.

The following table summarizes the progress of the natural-gas industry in Pennsylvania during the last 18 years:

Record of natural-gas industry in Pennsylvania, 1897–1914.

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] 232,000	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
1913	[b] 1,174	21,695,845	400,823	4,373	28,709,565	1,011	259	[c] 12,438
1914	[b] 1,325	20,401,295	412,744	4,307	28,439,324	998	236	[c] 13,023

[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, 1913, and 1914.

[c] Includes 350 shallow wells in Erie County in 1908, 429 in 1909, 429 in 1910, 476 in 1911, and 492 in 1912, 1913, and 1914.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in Pennsylvania:

Depth and rock pressure of wells in Pennsylvania, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Allegheny	750–3,265	10–600	10– 800	10– 500	15–a1,000	10– 700
Armstrong	702–3,600	3–800	3– 435	5– 900	1– 500	1– 800
Beaver	700–2,000	4– 75		30– 70	30– 510	40– 560
Butler	700–3,384	6–700	4– 800	2– 700	4– 850	8– 450
Clarion	600–3,000	25–900	5– 900	1– 900	2– 800	0– 700
Elk	500–3,200	50–990	40– 900	60– 840	50– a980	60–a1,000
Crawford	550–1,200	0– 85	0– 100	2– 100	10– 50	5– 40
Erie	300–1,600					
Fayette	1,200–2,772	100–650	40– 600	35– 700	35– 700	35– 550
Cambria	2,350–2,500					
Forest	700–2,900	10–850	6– 150	5– 800	17– 700	25– 600
Greene	680–3,600	40–400	40– 900	60– 575	39– 750	50– 650
Indiana	1,100–1,860				600	500
Jefferson	700–3,360	100–700	60–1,200	90–1,000	100– 960	15–a1,100
McKean	750–3,000	6–600	5– 850	1– 950	3– 800	2– 525
Mercer	700–1,500		160– 250	190	51– 300	26– 450
Lawrence						
Potter	750–2,200	50–300	35– 500	10– 360	20– 600	50– 385
Tioga	700–1,400	300	13– 350			
Venango	350–2,700	10– 85	10– 500	15– 200	10– 200	24– 450
Warren	500–3,290	10–190	3– 200	10– 350	5– 280	5– 300
Washington	606–3,304	5–800	5– 600	5– 550	5– 400	5– 400
Westmoreland	1,675–3,600	10– 25	60– 250	15– 20	6–a1,000	15–a1,000

a New well.

WEST VIRGINIA.

PRODUCTION.

A production of 238,740,162,000 cubic feet of natural gas in 1914 was more than sufficient to retain for West Virginia its rank of first among the natural-gas producing States, a position it has held, without serious competition, for the last six years. Although less by about 7,000,000,000 cubic feet than the record production in 1913 and by about 300,000,000 cubic feet than the output in 1912, the production in 1914 was greater in quantity than that of any year prior to 1912, and represents a little more than 40 per cent of the production of natural gas of the entire United States in 1914.

The marked decline in gas production in 1914 was due less to exhaustion of supply than to the curtailment of activity in the productive fields brought about by the depressed condition of the oil market during much of the year. As in the other portions of the Appalachian region the production of natural gas in West Virginia is closely associated with the production of oil, and activity in search of the latter is generally reflected by an increase in the former.

In spite of the appreciable decline in the quantity of production credited to West Virginia in 1914, the total value of that production exceeded the value of any previous year's output by a margin of more than $1,000,000. The total value of the production of natural gas in West Virginia in 1914 is placed at $35,515,329, or an average of 14.87 cents per thousand cubic feet. The estimated value of the record production in 1913 was $34,168,850, or an average of 13.92 cents per thousand cubic feet. The gain of nearly 1 cent in the unit price of the West Virginia production is accounted for by the relatively greater proportion of the gas distributed at retail prices to domestic consumers in 1914.

The productive gas fields of West Virginia, of which the number is legion, are scattered over 32 counties of the State lying west of the

Appalachian Mountains in the maturely dissected Allegheny plateau province. In West Virginia natural gas is found more abundantly than in Pennsylvania, not only as "wet" gas in association with oil, but as "dry" gas accumulated under favorable conditions in sandstone or limestone strata that contain no oil.

Stratigraphically the rocks of West Virginia bearing oil and gas range from the base of the Catskill (?) formation in the upper part of the Devonian (?) system to the lower part of the Monongahela formation of the Pennsylvanian series of the Carboniferous system, production being found in a great number of sandstone layers and one limestone layer (Greenbrier limestone member or Big lime) between the Elizabeth or Seventh sand at the base and the Carroll sand or Uniontown sandstone member at the top. Although gas is found at numerous horizons within the stratigraphic limits above defined, the principal gas production of the State is derived from the Gas (Second Cow Run), Salt, Maxton, Big lime, Big Injun, Berea, and Gordon sands.

The most prolific gas fields in West Virginia are located in Lewis, Harrison, and Ritchie counties, where there are many wells of large volume in which the pressure shows little decline from year to year. Throughout the State many gas wells are capped or shut in on top of the sand for lack of an immediate market for the product, and from present indications the potential gas supply of West Virginia is ample for many years for its own needs as well as for the needs of adjacent States within the limits of practicable transportation.

Producers of natural gas in West Virginia numbered 475 in 1914 as compared with 451 in 1913, and productive gas wells increased from 6,534 at the end of 1913 to 7,194 at the end of 1914, 856 gas wells having been completed during the year and 196 exhausted wells having been abandoned.

The total area owned or leased or on which gas rights are held by natural-gas producers in West Virginia amounted to 3,091,506 acres at the end of 1914 as compared with 3,155,751 acres at the end of 1913.

CONSUMPTION.

Although West Virginia stands first among the States in production of natural gas, it attains no higher than third in rank in consumption of natural gas. In 1914 it is estimated that 95,147,247,000 cubic feet of natural gas, representing only about 40 per cent of the year's production, was consumed within the State. In 1913 the ratio of local consumption to total production was about the same, though the quantity so consumed amounted to 96,645,438,000 cubic feet. Owing, however, to the relatively greater distribution of this gas to domestic consumers, the total value of the local consumption in 1914 amounted to $7,334,690, or 7.71 cents per thousand cubic feet, as compared with the $7,333,956, or 7.59 cents per thousand cubic feet in 1913.

Of the total quantity of natural gas consumed in West Virginia in 1914, only 17,023,701,000 cubic feet, or about 18 per cent, was retailed to domestic consumers, the remaining 78,123,546,000 cubic feet being wholesaled to industrial consumers. In 1913, with a larger volume of gas consumed in the State, the percentage supplied to domestic consumers was a little more than 16.

Intrastate consumers of West Virginia natural gas for domestic purposes, including a few consumers in Maryland, increased in number from 101,234 in 1913 to 107,820 in 1914, and industrial consumers increased in number from 1,834 to 1,850 in the same period. The average rate to domestic consumers in 1914 was 18.64 cents per thousand cubic feet of gas supplied, a decrease of 0.68 cent from the average rate prevailing in 1913, and the average rate to industrial consumers was 5.33 cents per thousand cubic feet, a decrease of 0.01 cent from the 1913 rate. The abundance of natural gas in West Virginia results in a lower average price to domestic consumers than is maintained in any other State in the Union, and, with the exception of Louisiana-Alabama, in a lower average price to industrial consumers.

One industry which is almost entirely confined to this State is the manufacture of carbon black, for which large quantities of gas are required and to which the gas is well adapted. During the year 1914 it is estimated that a total of 20,704,191,000 cubic feet of natural gas was used by the carbon-black factories of the State, the value of which was approximately $428,954, an average price of 2.07 cents per thousand cubic feet.

Six plants were installed in West Virginia during 1914 for the extraction of gasoline from natural gas, making the total number of such plants in operation in the State at the end of the year 121. Statistics of consumption of gas and of output of gasoline from these plants may be found in another section of this report.

Of its own natural gas production, West Virginia consumed 92,398,311,000 cubic feet, the remaining 146,341,851,000 cubic feet, valued at $28,754,263, being marketed in Pennsylvania, Ohio, Indiana, and Kentucky. Of its total consumption of natural gas in 1914, a considerable quantity was piped into the State from Pennsylvania and Ohio as a matter of convenience to supply consumers adjacent to the State boundaries.

The following table summarizes the progress of the natural-gas industry in West Virginia during the last 18 years:

Record of natural-gas industry in West Virginia, 1897–1914.

Year.	Gas produced.		Gas consumed.			Wells.		
	Number of producers.	Value.	Number of consumers. Domestic.	Number of consumers. Industrial.	Value.	Drilled. Gas.	Drilled. Dry.	Productive Dec. 31.
1897	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	441	80	2,511
1909	183	17,538,565	70,853	1,907	[b] 5,183,054	801	65	3,232
1910	241	23,816,553	86,778	2,659	[b] 5,617,910	1,002	69	4,052
1911	340	28,435,907	87,438	1,566	[b] 6,240,152	905	117	4,790
1912	406	33,324,475	94,273	1,953	[b] 7,001,331	870	149	5,533
1913	451	34,164,850	101,234	1,834	[b] 7,333,956	1,038	128	6,534
1914	475	35,515,329	107,820	1,850	[b] 7,334,690	856	154	7,194

[a] Number of fires supplied. [b] Includes gas consumed in Maryland.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in West Virginia:

Depth and rock pressure of wells in West Virginia, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds. 1910	1911	1912	1913	1914
Boone	1,060-2,700	....	....	350- 520	400- 525	130- 550
Braxton	1,200-3,000		840	....	....	400
Clay	1,400-2,000	125- 535	200- 400	300- 600	200- 450	300- 500
Taylor	1,453-2,800		80- 800	100- 600	400- 1,000	110- 800
Brooke	1,200-1,905	100- 400	0- 50	0- 270	0- 640	0- 180
Cabell	900-2,325	250- 540	250- 500	350- 400	350- 500	400
Calhoun	824-4,000	18-1,500	35- 655	20- 760	60- 400	10-*a*1,200
Doddridge	1,400-3,100	10- 760	100- 750	5- 700	75- 900	50- 465
Gilmer	1,148-3,181	350- 630	640	130- 210	100- 180	100- 600
Hancock	700-1,880	3- 100	1- 60	20- 150	40- 100	20- 75
Harrison	800-3,300	50- 900	50-1,040	40- 900	50- 900	100- 900
Kanawha	715-2,585	480- 560	400- 500	250- 600	50- 500	225- 500
Lewis	1,127-3,000	125- 800	60- 950	45-*a*1,100	50-*a*1,100	20-*a*1,000
Lincoln	900-2,720	400- 500	400- 650	200- 600	400- 560	300- 540
Logan	1,200-2,200	....	....	550- 560	75- 540	75- 540
Marion	1,280-3,478	50- 600	90-1,200	75- 805	40- 500	75- 600
Marshall	1,000-2,927	10- 295	50- 300	6- 300	125- 300	110- 300
Mingo Wayne	800-2,600	....	300- 600	375- 550	250- 600	200- 500
Monongalia	1,350-3,500	70- 450	60- 700	60- 825	60- 820	60- 800
Nicholas	1,200-1,300	....				
Ohio	1,500-2,000	....	40- 125	15- 350	25	15- 20
Pocahontas	2,000-2,500	....				
Pleasants	900-2,150	100- 150	150- 400	50- 300	30- 500	30- 250
Putnam	900-2,400	300- 800	300- 800	....	....	....
Upshur	1,934-2,800		25- 740	480- 600	460	350- 360
Ritchie	725-2,925	20- 800	250- 275	20- 700	30- 700	20- 600
Roane	1,472-2,579	275- 600		320- 465	350- 750	240- 600
Tyler	1,600-2,800	35- 440	50- 100	50- 750	50- 650	150- 685
Wetzel	1,300-3,560	70- 300	0- 200	50- 113	5- 150	5- 150
Wirt	500-1,875	35- 500	10- 450	30- 500	18- 275	70- 125
Wood	1,030-1,850	250- 540	160- 350	300- 520	150- 500	198- 400

a New well.

OHIO.

PRODUCTION.

The quantity of natural gas produced in the State of Ohio in 1914 is estimated at 68,270,174,000 cubic feet, a volume which exceeds by 17,657,963,000 cubic feet the estimated output of the State in 1913 and establishes a new State record.

The total value of this production of Ohio is estimated at $14,667,790, or an average of 21.48 cents per thousand cubic feet, as compared with a total value of $10,521,930, or an average of 20.79 cents per thousand cubic feet, assigned to the output in 1913.

The increase in the volume of gas produced in 1914 may be attributed directly to the successful development of a gas field of considerable importance in and adjacent to the city of Cleveland, Cuyahoga County, following discoveries of gas in fair volume and under high pressure late in 1913. The drilling boom which featured 1914, however, started in February following the completion of a well estimated at 10,000,000 cubic feet a day on the property of the J. H. & L. Stadtler Fertilizer & Rendering Co. A total of 345 productive gas wells were completed before the end of December with initial volumes ranging from 50,000 to 6,000,000 cubic feet a day and initial pressures as high as 1,200 pounds to the square inch. Unfortunately for the life and value of the field, the nature of the development was such that wells were crowded close together, on town lots for the most part, with the inevitable result that individual wells declined rapidly in two or three weeks to only a fraction of their initial output. In parts of the city and in the suburbs acreage property was available to protect some of the wells which will doubtless contribute to the city's supply of gas for some time. The greater proportion of the gas was obtained from the so-called Clinton sand of the Silurian system, penetrated at depths of 2,750 to 3,000 feet, although some production was obtained in the so-called Newburg sand encountered at depths of 2,450 to 2,600 feet. Practically all the gas developed in the new field was purchased by the East Ohio Gas Co. and turned into the mains which supply the city of Cleveland.

The natural-gas fields of Ohio are scattered over 50 counties lying mainly in the eastern half and the northwestern quarter of the State. The principal gas field, generally referred to as the central Ohio gas belt, lies a little east of the center of the State and extends from the southern part of Hocking County on the south to Lake Erie on the north, with an average width of about 25 miles. The continuity of the field is disrupted, however, by unproductive areas in northern Knox and southern Ashland counties and in northern Ashland and southern Lorain counties. Production in this field is derived principally from the so-called Clinton sand of the Silurian system, reached at depths of 2,500 to 3,300 feet.

Throughout the oil fields of southeastern Ohio gas is found in association with petroleum, the flow being obtained from a number of productive "sands" lying between the Berea sandstone at the base of the Mississippian series and the Goose Run sand in the upper part of the Monongahela formation of the Pennsylvanian series. Much of the gas found in southeastern Ohio is casing-head gas, which is utilized in the manufacture of gasoline by compression and refrigeration.

In northeastern Ohio shallow wells penetrating the black Ohio shale of the Devonian system yield low but persistent flows of natural gas, sufficient in the case of individual wells to supply the domestic requirements of one or more families.

In northwestern Ohio the principal source of natural gas is the "Trenton" limestone of the Ordovician system. After the discovery of natural gas at Findlay, in November, 1884, the "Trenton" gas fields were rapidly and wastefully developed, and during the last decade their contribution to the natural-gas supply of the State has been practically negligible.

Activity in 1914 was centered in the northern end of the central Ohio gas belt, where, aside from the development in Cleveland and its suburbs, appreciable additions were made to the productive gas fields in Ashland, Wayne, and Medina counties.

Producers of natural gas in Ohio numbered 2,268 at the end of 1914, an increase of 212 over 1913, and the number of active gas wells in the State increased from 5,308 at the end of 1913 to 5,673 at the end of 1914, some 686 productive wells having been completed in the latter year, as opposed to 321 exhausted wells that were abandoned.

The area controlled by gas producers in Ohio amounted to 1,361,778 acres at the end of 1914, as compared with 1,515,562 at the end of 1913.

CONSUMPTION.

Although Ohio takes fourth rank as a producer of natural gas, it is preceded only by Pennsylvania as a consumer. The quantity of gas consumed in the State in 1914 is estimated at 138,388,914,000 cubic feet, valued at $29,936,642, or an average of 21.63 cents per thousand cubic feet, an increase of 10,184,192,000 cubic feet in volume, of $2,880,818 in value, and of 0.53 cent in average unit price in 1914 as compared with 1913.

Of the total quantity of gas distributed in Ohio in 1914, approximately 71,873,699,000 cubic feet was distributed to 733,284 domestic consumers, at an average price of 29.11 cents per thousand cubic feet, and approximately 66,515,215,000 cubic feet was distributed to 6,102 industrial consumers, at an average price of 13.55 cents per thousand cubic feet.

Compared with 1913, the statistics of gas consumed for domestic purposes in 1914 show an increase of 7,140,867,000 cubic feet in volume, of $2,264,113 in total value, and of 0.19 cent in unit price. Similarly compared, the statistics of gas consumed for industrial purposes in 1914 show increases of 3,043,325,000 cubic feet in volume, of $616,705 in total value, and of 0.32 cent in unit price.

The number of domestic consumers supplied with natural gas in Ohio in 1914 was 47,328 greater than in 1913, and the number of industrial consumers exceeded the total in 1913 by 92.

Of the volume of natural gas produced wholly within its own borders in 1914, a small quantity was supplied to consumers on the east side of Ohio River in West Virginia. Of the total consumption of natural gas in Ohio in 1914, approximately 70,407,247,000 cubic feet, valued at $15,333,806, was piped into the State from West Virginia, Pennsylvania, and Indiana, the bulk of the imported supply coming from West Virginia.

The following table records the progress in the natural-gas industry in Ohio during the last 18 years:

Record of natural-gas industry in Ohio, 1897–1914.

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] 5,163
1913	[c] 2,056	10,521,930	685,956	5,010	27,055,824	408	235	[d] 5,308
1914	[c] 2,268	14,667,790	733,284	6,102	29,936,642	686	257	[d] 5,673

[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, 1,579 in 1912, 1,600 in 1913, and 1,561 in 1914.
[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, 1,773 in 1912, 1,778 in 1913, and 1,733 in 1914.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in Ohio:

Depth and rock pressure of wells in Ohio, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Allen	1,200–1,470	....	....	....	....	....
Ashland	2,500–2,800	663	670	250–650	90–500	105–300
Ashtabula	400–2,200	5–300	0–275	0–410	....	30–250
Athens	440–1,500	25–350	25–350	10–350	50–350	10–170
Auglaize	1,100–1,300	12–30	2–90	5–110	3–140	7–70
Belmont	778–1,970	60–600	40–150	20–50	60–140	125
Carroll	500–1,434	185–350	90–300	100–150	90–150	....
Clinton	715–	....	160–190	160	95	100
Columbiana	500–2,000	55–240	25–240	25–350	16–300	16–350
Cuyahoga	337–3,000	2–80	0–97	0–[a]800	0–[a]1,000	0–[a]1,200
Darke	850–1,300	15–185	2–250	2–300	2–200	2–250
Erie	350–650	....	20–40	18–40	....	....
Fairfield	240–2,800	50–280	40–500	40–350	16–320	25–325
Guernsey	700–1,500	50–300	350–400	250	300	300
Muskingum	800–3,350	....				
Hancock	800–1,800	2–50	0–200	2–400	2–150	1–200
Hardin	1,200–1,600	20–300	25–300	75–300	20–300	20–350
Harrison	400–1,650	30–345	10–110	10–150	5–225	8–300
Hocking	750–3,300	....	....	....	....	430
Huron	400–800	....	10–25	0–40	....	....
Holmes	600–1,160	....	135–220	100–170	80–165	80–165
Jefferson	600–2,026	40–250	0–400	12–[a]890	15–300	20–250
Knox	590–3,200	80–390	50–250	15–250	50–300	75–250
Lake	360–1,700	1–135	0–165	0–185	....	....

[a] New well.

Depth and rock pressure of wells in Ohio, 1910–1914, by counties—Continued.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Lawrence	1,750–1,834	....	....	....	750	425
Licking	1,950–3,000	80–600	60–700	80–400	30–450	30–*a*600
Logan	1,250–1,500	....	....	20–180	160	30–120
Lorain	338–2,590	0–500	0–*a*1,150	0–*a*900	0–675	0–150
Lucas	700–1,550	4–11	5–100	7–30	9–30	5–39
Mahoning	515–750	....	....	*a*160	150–158	70–187
Medina	185–3,000	3–30	5–875	4–*a*1,100	2–500	3–300
Mercer	1,020–1,400	1–150	3–120	1–100	1–105	5–75
Monroe	650–2,400	60–400	100–400	8–200	3–100	20–350
Morgan	240–1,650	20–450	20–450	20–450	15–450	20–350
Noble	484–2,000	100–500	200–650	100–620	150–620	40–380
Ottawa	1,250–1,600	200–450	85–450	40–450	30–350	125–350
Perry	650–3,620	40–740	50–250	150–800	150–600	50–80
Richland	1,950–2,800	250–400	150–300	200–250	....	....
Sandusky	440–1,451	5–175	5–165	5–160	5–150	10–160
Seneca	370–1,760	25–100	25–140	20–110	20–140	20–100
Summit	900–3,550	....	160	*a*980–1,020	....	....
Trumbull	370–388	....	....	....	10	10
Tuscarawas	850–5,050	325–385	260–325	180–350	160–475	120
Van Wert	1,200–1,285	40	40	40	....	....
Vinton and Jackson	520–800	....	....	....	....	....
Warren	275–1,000	....	....	....	....	....
Wayne	1,150–3,500	....	....	*a*800	300–*a*1,120	200–850
Washington	500–2,600	15–500	15–500	15–600	15–500	10–740
Wood	1,170–1,500	20–40	10–15	10–12	10–15	10–35

a New well.

KENTUCKY.

PRODUCTION.

The production of natural gas in Kentucky, though important locally, comprises less than three-tenths of 1 per cent of the total quantity of gas produced in the United States. The estimated production in 1914 was 1,421,818,000 cubic feet, valued at $490,875, or an average price of 34.52 cents per thousand cubic feet. In 1913 the production amounted to 1,821,526,000 cubic feet, having a total value of $509,846, or an average price of 27.99 cents per thousand cubic feet. The decline in natural gas output in 1914 was due in part to the decreased volume available in the developed fields and in part to the lessened activity in the search for petroleum which characterized the year, for in Kentucky, as in the other States of the Appalachian region, much of the gas produced is from wells which likewise yield petroleum.

The natural gas fields of Kentucky are widely distributed but lie mainly in the eastern third of the State. The principal producing field is the Menifee gas field in the county of the same name, where the production is obtained in the "Corniferous" limestone of the Devonian system at depths of 452 to 478 feet. Gas from this field is distributed by the Central Kentucky Natural Gas Co. to Lexington, Mount Sterling, and Winchester, by the Johnson County Gas Co. to Paintsville, by the Paris Gas & Electric Co. to Paris, and by the Blue Grass Natural Gas Co. to North Middletown.

In Morgan and Wolfe counties sufficient gas is produced to supply Hazel Green, Cannel City, and West Liberty from oil wells tapping the same formation that yields the gas in Menifee County. In Magoffin County a few shallow gas wells on Burning Fork of Licking

River supply consumers in Salyersville. In Martin County gas wells deriving their flow principally from the Big Injun sand contribute to the gas supply distributed by the United Fuel Gas Co. in Ashland, Buchanan, Catlettsburg, Chinnville, Greenup, Inez, Kavanaugh, Kinner, Louisa, Pollard, Russell, Warfield, and Worthington. In Lawrence County one gas well with an estimated capacity of 400,000 cubic feet was completed late in December, 1914. In Boyd, Floyd, and Knott counties a number of wells yield small quantities of gas sufficient to supply one or two families each. In the oil fields of Wayne and McCreary counties considerable gas is utilized in field development and mains are being laid to supply domestic consumers in the town of Monticello. Production in this locality comes mainly from the Beaver Creek "sand," a layer of cherty limestone near the base of the "Waverly" formation of the Mississippian series. In Knox County gas wells near Barboursville supply that town with gas obtained from erratic sands designated, in ascending order, the Big Injun, the Epperson, the Jones, and the Wages sands, the first named lying at the top of the "Waverly" group of the Mississippian series and the remaining three belonging in the Pottsville group of the Pennsylvanian series. Wells in Clay County supply gas to Cloverport, presumably from the same geologic horizons as yield production in Knox County.

In the central part of the State a small quantity of gas has been developed in the oil fields of Barren County, and in the new fields of Allen County some gas is shut in awaiting a market. In Hardin County local gas is supplied to domestic consumers in West Point. In Meade and Jefferson counties a small quantity of gas is produced and contributed toward the consumption in Louisville, which city is supplied principally with gas from West Virginia. The Meade County gas is obtained chiefly from wells in the black shale that forms the upper portion of the Devonian system in Kentucky. Farther west in Muhlenberg County gas wells deriving their supply from the No. 8 coal of the lower productive coal measures of the Pennsylvanian series supply domestic consumers at Central City.

Active producers of natural gas in Kentucky numbered 101 in 1914, and the wells contributing to the 1914 yield numbered 276 at the end of the year. The area controlled by the gas producers of this State amounted to 167,198 acres at the close of 1914, an appreciable increase over the 145,824 acres held at the close of 1913.

CONSUMPTION.

The quantity of natural gas consumed in Kentucky in 1914, amounting to approximately 7,225,626,000 cubic feet, showed a decided increase over that consumed within the State in any previous year. Compared with 1913 the increase in volume in 1914 was 1,314,584,000 cubic feet, or about 22 per cent. This increase is attributed to the greatly increased number of domestic consumers of natural gas in the cities and towns in the northern part of the State, which are supplied with gas from the West Virginia fields.

Owing to the fact that the greater part of the natural gas distributed in Kentucky goes to supply the needs of domestic consumers the value of the annual consumption is relatively high. The total value of the gas consumed in this State in 1914 is placed at $1,787,308, or an average price of 24.73 cents per thousand cubic feet.

Of the quantity of gas distributed in Kentucky in 1914, it is estimated that a total of 4,222,495,000 cubic feet was supplied to domestic consumers at an average price of 34.99 cents per thousand cubic feet. This quantity was an increase of 1,348,965,000 cubic feet over the domestic consumption in 1913, and the average retail price showed an increase of 2.73 cents in 1914 over that obtained in 1913. Domestic consumers of natural gas in Kentucky increased from 54,446 in 1913 to 78,505 in 1914.

The industrial consumption of natural gas in Kentucky showed a slight falling off in 1914. Industrial consumers declined in number from 146 to 128 and the volume of gas consumed declined from 3,037,512,000 cubic feet in 1913 to 3,003,131,000 cubic feet in 1914. The average price of gas supplied for industrial consumption was 10.32 cents per thousand cubic feet as compared with 9.82 in 1913, the total value, $309,778, of the gas industrially utilized in 1914 exceeding the value of the gas so utilized in 1913 by $11,612.

Aside from consuming its entire natural-gas production, Kentucky consumed in 1914 approximately 5,803,808,000 cubic feet of gas, valued at $1,296,433, which was piped in from West Virginia.

The following table shows the progress of the natural gas industry in Kentucky during the last nine years:

Record of natural-gas industry in Kentucky, 1906–1914.

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	522,455	45,603	103	1,070,664	22	27	267
1913	93	509,846	54,446	146	1,225,116	23	7	274
1914	101	490,875	78,505	128	1,787,308	10	1	276

TENNESSEE.

The production of natural gas in Tennessee in 1914 was limited to the output of four small wells in Franklin County which supplied gas for domestic use to three families. No completed wells were reported during the year. Two wells were abandoned in White County, and one small producing well in Perry County was reported as not in use during the year.

ALABAMA.

The statistics of production and consumption of natural gas in Alabama are included with those of Louisiana in order to avoid revealing data furnished by individual companies.

The commercial production of natural gas in Alabama is limited to Madison, Walker, and Fayette counties, in the northern part of the State, the gas produced being supplied to some 395 domestic and 2 industrial consumers in West Huntsville, Jasper, and Fayette. Compared with 1913, the number of consumers supplied with gas in 1914 was increased by 57, and the income derived from the sale of gas was proportionately increased.

In Winston County also, in the northern part of the State, a small quantity of natural gas produced from a single well was utilized in the field for drilling.

The small gas field in Fayette County is located in the western part of the Warrior coal field and obtains its production from sandstone layers in the lower part of the Pennsylvanian series of the Carboniferous system.

Two productive gas wells were completed in Alabama in 1914 and 4 exhausted wells were abandoned, there being 16 active gas wells in the State at the end of the year.

MICHIGAN.

The natural-gas situation in Michigan remained unchanged in 1914. At the close of the year there were 17 shallow wells in this State producing variable though light flows of natural gas generally accompanied by water.

Aside from a small quantity of natural gas from the oil wells in St. Clair County, which is utilized in field operations, consumption of this gas is entirely for domestic purposes, individual wells supplying the needs of one or at most three families. Two productive wells were completed in Michigan in 1914, and 3 exhausted wells were abandoned. Producers of natural gas in this State numbered 20 and consumers numbered 19 at the end of 1914.

The small quantity of natural gas produced in Michigan comes from Benzie, Hillsdale, Oakland, St. Clair, Washtenaw, and Wayne counties. The total value of the quantity produced in 1914 is estimated at $1,442.

INDIANA.

PRODUCTION.

As in the preceding years of the last decade the output of natural gas in Indiana recorded a moderate decline in 1914, the estimated production amounting to 2,579,675,000 cubic feet, valued at $755,407, or an average of 29.28 cents per thousand cubic feet. Compared with the statistics for 1913, these data disclose a decrease of 340,939,000 cubic feet in volume and of $87,640 in total value, despite an increase of 0.76 cent in the unit price.

This decline in production was due to the gradual exhaustion of supply in the "Trenton" limestone of the Ordovician system, from which practically all the gas in the State is derived, and is a heritage of the reckless waste of this valuable fuel which characterized the early years of oil and gas development in Indiana.

The developed fields lie mainly in the eastern half of the State, where the gas is obtained from oil wells in the Lima-Indiana or "Trenton" oil fields.

In the southwestern part of the State natural gas derived from the "Corniferous" limestone of the Devonian system accompanies oil in Pike County and in parts of Gibson County, and gas from a sandstone in the Chester group of the Mississippian series is found with oil in the Princeton field, Gibson County, in sufficient quantities for field use and partly to supply the town of Princeton.

Much of the natural gas produced in Indiana is consumed near the point of production, individual wells supplying the domestic requirements of one or more families. Rock pressure throughout the productive fields is notably low, and the volume of gas available is rarely sufficient to warrant the expense of installing compressors to expedite the yield.

The production of natural gas in Indiana in 1914 was supplied by 1,029 producers from 2,224 wells, 68 of which were completed during the year. The production in 1913 was supplied by 1,100 producers from 2,307 wells.

CONSUMPTION.

The quantity of natural gas consumed in Indiana in 1914 is estimated at 4,443,244,000 cubic feet, valued at $1,422,880, the average price per thousand cubic feet being 32.02 cents. Compared with the output of 1913, the volume of gas consumed in 1914 increased 1,222,359,000 cubic feet, the total value increased $474,602, and the average unit price increased 2.58 cents.

The increases noted were due to the increased utilization of natural gas piped in from West Virginia, the distribution of which in Indiana commenced in October, 1913, and amounted to approximately 300,271,000 cubic feet that year. It is estimated that the quantity of gas piped into Indiana from West Virginia in 1914 amounted to 1,865,569,000 cubic feet, the supply being distributed to a total of 22,758 domestic consumers and 273 industrial consumers in Alexandria, Anderson, Atlanta, Cicero, Elwood, Fairmount, Hartford City, Lynn, Marion, Muncie, Newcastle, Noblesville, Richmond, and Tipton.

Of the total quantity of natural gas distributed in Indiana in 1914 it is estimated that 3,404,551,000 cubic feet, valued at $1,148,683, was supplied to 43,410 domestic consumers at an average price of 33.74 cents per thousand cubic feet, and that 1,038,693,000 cubic feet was supplied to 344 industrial consumers at an average price of 26.40 per thousand cubic feet.

The following table records the progress of the natural-gas industry in Indiana during the last 18 years:

Record of natural-gas industry in Indiana, 1897–1914.

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	3,383
1908	823	1,312,507	42,054	216	[b] 1,312,507	187	41	3,226
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
1913	1,100	843,047	39,776	239	[b] 948,278	69	24	2,370
1914	1,029	755,407	43,410	344	[b] 1,422,880	68	19	2,224

[a] Number of fires supplied.
[b] Includes value of gas consumed in Chicago, Ill.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in Indiana:

Depth and rock pressure of wells in Indiana, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Adams	1,000–1,050	....	....	100	40– 50	6
Bartholomew	864– 990	50–250	150–175	75–125	85–165	80–150
Blackford	850–1,100	1– 10	0– 30	0– 12	0– 8	0– 20
Clark	128– 244	....	....	27	....	....
Daviess	300– 600	0– 60	9–160	7–150	5–165	25– 40
Martin						....
Decatur	700–1,200	0–315	0–325	5–330	5–350	5–350
Delaware	728–1,500	0– 70	0– 75	0– 60	0– 50	0– 60
Flanklin	728– 730	....	....	....	60	....
Grant	830–1,200	2– 50	0–180	2–180	5–200	0– 50
Hamilton	800–1,280	15–180	15–225	8–235	8–225	0–230
Hancock	700–1,100	0–100	3–280	5– 80	8–125	6– 80
Harrison	320– 764	....	60–110	112	50	0– 50
Henry	800–1,200	0– 90	0– 80	0–100	5–150	4–100
Howard	800–1,100	0–220	20–250	10–180	35–200	30–160
Jay	900–1,600	0– 40	0–110	0–220	0– 50	0– 40
Jefferson	1,360	....	10	....	20	....
Madison	800–1,200	0–190	0–180	1–175	0–175	0–100
Miami	900–1,000	0– 40	....	....	....	....
Marion, Ripley	880–1,050	40	180–285	150–250	100–160	70–300
Pike	1,000–1,400	125–500	100–480	60–300	25–450	50–225
Randolph	900–1,300	0–180	2–300	4–140	2–190	1–125
Rush	700–1,400	20–325	0–300	12–300	10–300	15–325
Shelby	650–1,020	1–375	1–300	10–366	15–300	20–300
Spencer	1,025	....	....	410	....	....
Sullivan	698– 795	200	50–100	40–110	30– 50	50–185
Tipton	750–1,100	10–230	15–190	3–180	5–125	3–100
Wayne	800–1,150	50–240	25–150	25– 70	45– 75	45

ILLINOIS.

PRODUCTION AND CONSUMPTION.

It is estimated that the quantity of natural gas produced in Illinois in 1914 amounted to 3,547,841,000 cubic feet and that its total value was $437,275, or 12.32 cents per thousand cubic feet at the point of consumption. With the exception of a small volume of gas supplied to domestic consumers in Vincennes, Ind., not differentiated in this report, this quantity likewise represents the consumption of natural gas in Illinois in 1914, as appreciable quantities of gas were not imported by Illinois from other States during the year.

Compared with recent years the quantity of natural gas utilized commercially in Illinois in 1914 showed a decrease which, with regard to the production in 1913, amounted to 1,219,287,000 cubic feet, or about 25 per cent. This decline was due in part to the decline in volume of the productive wells, but more, perhaps, to lack of activity in drilling in the Illinois fields occasioned by the depression which affected the petroleum market during 1914. The principal areas of commercial production of gas in Illinois are coincident with the oil fields, and the relation between gas production and activity in the search for oil is fairly close. The greater part of the gas came in 1914 as usual from the fields in Cumberland, Clark, Crawford, and Lawrence counties, where both oil and gas are derived from the shallow sands of the Pennsylvanian ("Coal Measures") series and from the deep sands of the Chester group of the Mississippian series. Sufficient gas is produced in the oil fields of these counties to operate the wells and in addition to supply domestic and industrial consumers in a number of adjacent cities and towns, including Vincennes across the State boundary in Indiana.

In the southwestern part of the State four wells about 1 mile south of Greenville, Bond County, furnish natural gas for domestic consumption in that town, the supply being derived from sands in the Chester group of the Mississippian series, penetrated at depths of 925 to 1,055 feet.

In the north central part of Illinois a single shallow well, believed to derive its flow from glacial drift, supplies natural gas for domestic consumption in the village of Heyworth, McLean County.

Aside from the commercial distribution of natural gas in Illinois in 1914 outlined above, a great number of shallow wells distributed among Bureau, Champaign, Dewitt, Edgar, Lee, Logan, Montgomery, Morgan, and Pike counties furnished gas for domestic consumption by one or two families each.

Of the quantity of natural gas produced in Illinois in 1914 it is estimated that 771,191,000 cubic feet, valued at $210,787, was supplied to 8,952 domestic consumers at an average price of 27.33 cents per thousand cubic feet and that 2,776,650,000 cubic feet was supplied to 153 industrial consumers at an average price of 8.16 cents per thousand cubic feet.

The production of gas credited to Illinois in 1914 was furnished by 235 producers having 417 producing wells at the end of the year, 38 of them having been drilled and 76 exhausted wells having been abandoned since 1913.

The following table records the progress of the natural-gas industry in Illinois during the last nine years:

Record of natural-gas industry in Illinois, 1906–1914.

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	453
1913	231	574,015	a 10,423	a 279	a 574,015	60	119	455
1914	235	437,275	a 8,952	a 153	a 437,275	38	114	417

a Includes number of consumers and value of gas consumed in Vincennes, Ind.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in Illinois:

Depth and rock pressure of wells in Illinois, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Bond	925–1,100	200–750	100–350	40–410	35–355	40–350
Lawrence	700–1,900					
Bureau	98– 357	0– 23	0– 42	0– 80	0– 42	0– 35
Champaign	80– 140	15– 32	15– 30	0– 20	0– 30	0– 30
Clark	250– 610	35– 45	10– 60	15–105	0– 30	....
Crawford	400–1,550	20–225	10–150	20–200	20–350	25–450
Cumberland	500–1,000	....	....	....	....	65
Dewitt	85– 127	25– 50	20– 50	0– 50	0– 25	0– 20
Edgar	230– 600	75–127	50– 90	75–130	50–135	80–135
Lee	126– 280	18– 28	19– 28	12– 28	12– 28	15– 28
Logan	84– 90	....	....	....	....	....
McHenry	160– 372	....	10– 22	....	....	....
McLean						
Macoupin						
Montgomery	55– 67	....	....	....	1– 2	....
Morgan	226– 400	....	0–100	0–100	0– 96	0– 20
Pike	89– 350	4– 10	1– 20	0– 10	0– 9	0– 53

MISSOURI.

The quantity of natural gas produced and consumed wholly within the State of Missouri in 1914 is estimated to have amounted to 18,085,000 cubic feet and its value to have been $5,319, representing an average price of 29.41 cents a thousand cubic feet.

Aside from the intrastate production a large volume of natural gas accounted for in the statistics for Kansas and Oklahoma was piped into Missouri from those States and consumed in the towns and smelters in the Joplin district.

The quantity of natural gas produced in Missouri in 1913 was estimated to have amounted to approximately 20,865,000 cubic feet, valued at $6,795, an average price of 32.57 cents per thousand cubic feet.

The production of natural gas in Missouri is derived from wells located in Bates, Cass, and Jackson counties. The wells are shallow, ranging in depth from 100 to 570 feet, and the volume of gas obtained from individual wells is rarely sufficient to supply the domestic needs of more than one or two families. Four wells in Jackson County supplied a total of 40 domestic and 4 industrial consumers in Martin City during 1914, and in Platte County 2 wells were completed that have sufficient gas to justify the laying of mains to supply consumers in the town of Parkville.

The total number of producers of natural gas in Missouri decreased from 52 in 1913 to 49 in 1914, and the number of consumers decreased from 342 domestic and 7 industrial in 1913 to 126 domestic and 7 industrial in 1914.

KANSAS.

PRODUCTION.

Despite the very active drilling campaign conducted in the search for natural gas in Kansas in 1914, final returns indicate that the total output was slightly less than in 1913. The decrease, which amounted to less than 2 per cent, is notably less than the decline recorded in recent years and speaks well for the results of the drilling activity during the year. It is estimated that the quantity of natural gas produced in Kansas in 1914 amounted to 22,627,507,000 cubic feet and that the total value of the output was $3,340,025, an average unit price of 14.76 cents per thousand cubic feet.

Owing to an increase of 0.39 cent in the average unit price received in 1914, the total value of the production in 1914 exceeded the value of the output in 1913 by $51,631.

The natural-gas fields of Kansas have been under commercial development since 1882, when Paola, Miami County, was first piped for natural gas, though the development was on a rather small scale until the early nineties. The greatest development took place from 1907 to 1910, since which time the volume of gas and the rock pressure have rapidly declined. More and more the cities of Kansas have come to depend on sources outside the State for their supply of natural gas, which fortunately is close at hand across the boundary in northern Oklahoma.

Interest in natural-gas development in Kansas in 1914 was centered in Butler County, where a promising gas field of considerable area was proved in the vicinity of Augusta, following discoveries made in 1913. Of 55 wells completed in this field in 1914 only 4 were barren, the remainder producing varying quantities of natural gas under pressure of 400 to 600 pounds to the square inch from sands penetrated at depths of 1,400 to 1,600 feet. The Wichita Natural Gas Co. extended its mains to the new field and purchases the gas at the wells for distribution to its domestic and industrial consumers in adjacent counties. Montgomery and Chautauqua counties recorded the usual active development, though the wells averaged low in volume and disclosed only fair staying qualities. The fields of Franklin and Labette counties were unable to supply the demands made upon them, the deficiency being made up in part from the more prolific fields in the southern part of the State and in part from Oklahoma sources.

Petroleum and natural gas in Kansas occur in sandstone or limestone layers in the Pennsylvanian series ("Coal Measures"), the most productive zone being that occupied by the Cherokee shale at the base of the series. Lenticular sandstone layers interbedded with the Cherokee shale constitute the reservoirs in which the oil and gas have collected and are now found.

At the end of 1914 producers of natural gas in Kansas numbered 353 and the area owned or leased for gas development amounted to 437,715 acres. Compared with statistics for 1913 the number of natural-gas producers shows an increase of 48, whereas the acreage controlled shows a decrease of 14,493 acres.

At the end of 1914 there were 2,261 productive gas wells in this State, 445 gas wells having been completed and 481 exhausted wells having been abandoned during the year.

CONSUMPTION.

Including a small quantity of natural gas piped from Kansas and consumed in adjacent portions of Missouri, the total quantity of natural gas consumed in Kansas in 1914 was approximately 45,250,816,000 cubic feet, valued at $7,163,746, the average price being 15.83 cents a thousand cubic feet. Compared with the corresponding statistics for 1913, these data show a decrease of 1,402,105,000 cubic feet, or 3 per cent, in volume, but an increase of $179,944, or about 2.5 per cent, in total value, resulting from an advance of 0.86 cent, or about six-tenths of 1 per cent, in the average unit price paid for the gas.

Of the total quantity of natural gas consumed in Kansas in 1914 it is estimated that 19,214,194,000 cubic feet, valued at $4,898,314, was distributed to 187,714 domestic consumers at an average price of 25.49 cents a thousand cubic feet, and that 26,036,622,000 cubic feet, valued at $2,265,432, was supplied to 1,850 industrial consumers at an average price of 8.70 cents a thousand cubic feet.

Compared with the available statistics for 1913, these data show with regard to domestic consumption a decrease of 1,336,658,000 cubic feet, or 6.5 per cent, in the quantity of gas distributed; of $78,823, or 1.6 per cent, in the total value of that gas; and of 7,417, or nearly 4 per cent, in the number of domestic consumers, but an increase of 1.27 cents, or about 5 per cent, in the average unit price paid. With regard to industrial consumption a comparison of statistics for the two years shows a decrease in 1914 of only 65,447,000 cubic feet, or about one-fourth of 1 per cent, in the quantity of gas distributed, whereas an increase is shown of $258,767, or nearly 13 per cent, in the total value of that gas; of 129, or a little more than 13 per cent, in the number of consumers; and of 1.01 cents, or about 13 per cent, in the average unit price paid for the gas.

A further classification of the distribution of natural gas to industrial plants in Kansas in 1914 shows that approximately 3,647,913,000 cubic feet, valued at $208,250, was supplied to cement plants at an average price of 5.7 cents a thousand cubic feet; that about 5,266,891,000 cubic feet, valued at $388,871, was supplied to zinc smelters at an average price of 7.4 cents a thousand cubic feet; and that approximately 3,551,049,000 cubic feet, valued at $291,031, was supplied to glass and brick plants at an average price of 8.2 cents a thousand cubic feet.

During 1914 gas mains were extended to supply domestic consumers in the towns of Labette, Elm, and Sedgwick.

Aside from the quantity of natural gas produced wholly within the borders of the State in 1914, there was consumed in Kansas a total of approximately 22,623,309,000 cubic feet of gas, valued at $3,823,721, which was piped in from Oklahoma.

The following table shows the progress of the natural-gas industry in Kansas during the last 18 years:

Record of natural-gas industry in Kansas, 1897–1914.

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	2,106
1913	305	3,288,394	195,131	950	[c] 6,983,802	506	253	2,297
1914	353	3,340,025	187,714	1,079	[b] 7,163,746	445	219	2,261

[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.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of gas wells in Kansas:

Depth and rock pressure of wells in Kansas, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Allen	600–1,300	15–350	5–351	10–300	5–260	6–240
Anderson	230–775	40–150	60–225	30–240	65–250	65–225
Bourbon	200–710	35–45	40	40	75	75
Chase	64–1,100	10–350	1–400	7–80	3–95	10–[a]160
Crawford	100–640	4–65	20–40	15–50	40–50	30–90
Cowley	1,400–1,500					
Chautauqua	290–1,300	40–500	25–250	50–300	35–410	40–210
Douglas	350–450	10–100	30–120	10–280	20–60	10–[a]130
Johnson	130–870					
Ellsworth	950–1,250	...	...	125–270	240–270	160–250
Elk	500–1,400	100–225	100–225	100	90–100	75
Butler	1,330–1,600	40–550	65–450	60–[a]525	550–[a]560	[a]400–[a]600
Woodson	960–1,150				...	90–250
Greenwood	350	...	...	...	...	...
Labette	335–1,000	50–160	25–235	23–185	20–240	50–200
Linn	85–750	12–130	22–110	6–70	20–100	20–100
Franklin	300–720	75–210	50–220	3–260	1–500	50–240
Miami	200–674					40–120
Montgomery	160–1,600	3–295	5–350	2–[a]515	5–700	15–400
Neosho	490–1,200	35–300	20–287	28–250	15–325	25–[a]360
Wilson	250–1,350	12–400	20–380	15–380	15–285	12–[a]350
Wyandotte	271–800	50–200	40–250	40–125	30–125	85

[a] New wells.

OKLAHOMA.

PRODUCTION.

The quantity of natural gas produced in Oklahoma in 1914 exceeded the record production in 1913 by more than 3,000,000,000 cubic feet and reached the estimated total of 78,167,414,000 cubic feet.

The value of this output is placed at $8,050,039, at an average price of 10.30 cents at the point of consumption. Compared with the output in 1913, the quantity of the production in 1914 recorded a gain of 4 per cent; the total value, a gain of 8 per cent; and the unit price, a gain of 4 per cent.

The causes contributing to the increase noted include a greater utilization of the enormous volume of gas uncovered at Cushing and Healdton for domestic and industrial consumption and a decided expansion of the casing-head gasoline industry.

Early in 1914 the Wichita Gas Co. completed a 50-mile pipe line from the Cushing field to its compressor station near Bigheart and began supplying Cushing gas to the Quapaw Gas Co. as well as to its own customers in northern Oklahoma, southeastern Kansas, and southwestern Missouri.

The waning supply of natural gas in the old Wheeler gas field and the abundance of gas going to waste in the Healdton field, a few miles to the southwest, led the Ardmore Gas Co., supplying domestic and industrial consumers in Ardmore, Carter County, to extend its mains in April, 1914, from the Wheeler field to the Healdton field and thereby assure its customers a gas supply more than ample for present needs.

Eighteen new plants for the extraction of gasoline from natural gas were installed in Oklahoma in 1914, increasing the total number of plants for this purpose in the State from 40 to 58 and increasing the daily capacity from 61,633 gallons in 1913 to 74,793 gallons in 1914. Statistics of gas consumed in these plants and of gasoline produced will be found elsewhere in this chapter.

Natural gas and petroleum in Oklahoma are found in sandstone and, less commonly, in limestone layers of variable thicknesses occurring at numerous horizons in the succession of strata between the base of the Mississippian series below and the lower portion of the Permian series above. By far the greater part of the production, both of petroleum and of natural gas, is derived from "sands" occurring in the intervening Pennsylvanian series.

Many of the gas fields in Nowata, Rogers, Washington, and Tulsa counties, comprising what is termed the Cherokee district, have declined to the point of exhaustion as far as piping the gas out is concerned, though sufficient low-pressure gas remains to supply local needs and to support a thriving casing-head gasoline industry. The Bird Creek and Owasso pools are the most prolific fields in this district.

Farther south in the Creek district practically the same conditions may be said to exist as far as the Glenn pool and the other pools in the eastern part of the district are concerned. In the western part of the district, however, natural gas is going to waste in certain parts of the Cushing field, whereas in other parts of the same field the successful application of the mud-laden process has resulted in the preservation underground of appreciable quantities of this valuable fuel. It is greatly to be deplored that the feverish development of the oil supply in this pool has blinded the few operators involved to the importance of concerted action in preventing, even at a slightly increased cost per well, the escape of the vast resources of natural gas incidentally uncovered.

In Pawnee County conditions in the Cleveland field with regard to the natural-gas supply are similar to those existing in the Glenn pool and throughout much of the Cherokee district.

One of the most important natural-gas reserves in Oklahoma is believed to exist in the Osage Nation, in the northern part of the State. The importance of this reserve lies not only in the large volume of undeveloped gas that is believed to be present but in the close supervision of its development by Federal authorities, which assures a careful conservation of the supply until legitimate markets exist for its consumption.

West of the Osage, in Kay County, more than enough gas is available for present needs, and structural features only partly tested indicate that much larger supplies than have yet been developed are present in this county.

In the southern part of Okmulgee and adjacent portions of Muskogee, McIntosh, and Okfuskee counties natural gas has been proved to exist in quantities far in excess of the requirements of available markets. If properly conserved these reserves, together with those in the Osage Nation, will doubtless supply the cities of eastern Oklahoma for many years.

Farther to the southeast in Le Flore County, adjacent to the Arkansas boundary, the geologic structure is favorable to the occurrence of natural gas and, although remote from present markets of consequence, this area constitutes a potential source of natural gas of no small proportions.

In Pontotoc County developments in 1914 revealed the presence of considerable natural gas near Ada, and steps were taken toward supplying that city with gas from local sources.

In Carter County almost unlimited quantities of natural gas are still available in the Healdton field though inconceivable volumes of this ideal fuel have already been wasted.

In Stephens County the Loco and Duncan fields, described in Bulletin 621 of the United States Geological Survey, constitute partly developed reserves of natural gas whose full value remains to be determined.

The total area owned or controlled by gas-producing companies in Oklahoma at the end of 1914 was 1,195,777 acres, a slight decrease from the 1,293,478 acres held at the end of 1913. The number of natural-gas producers increased from 347 in 1913 to 437 in 1914.

A total of 388 gas wells were completed and 235 exhausted wells were abandoned in 1914. Gas-yielding wells from which the product was utilized during the year numbered 1,205 at the end of 1914, a net increase of 153 wells over the returns of 1913.

CONSUMPTION.

It is estimated that the quantity of natural gas consumed in Oklahoma in 1914, including that piped from Oklahoma to Missouri, amounted to 55,544,105,000 cubic feet, valued at $4,226,318, at an average unit price of 7.61 cents a thousand cubic feet. Compared with the corresponding statistics for 1913, these data record an increase of 4,294,811,000 cubic feet, or about 8 per cent, in quantity; $485,331, or about 13 per cent, in total value; and 0.31 cent, or about 4 per cent, in average unit price.

Of the quantity of natural gas consumed in 1914, it is estimated that 7,705,890,000 cubic feet, valued at $1,474,582, was distributed to 62,390 domestic consumers at an average price of 19.14 cents a thousand cubic feet, and that 47,838,215,000 cubic feet, valued at $2,751,736, was distributed to 1,951 industrial consumers at an average price of 5.75 cents a thousand cubic feet.

Compared with available statistics for 1913 the domestic consumption of natural gas in Oklahoma in 1914 increased a little more than 9 per cent in quantity and nearly 17 per cent in total value, the number of consumers increasing by 13,082 and the average unit price advancing 1.29 cents in the same period. On the other hand, the statistics of industrial consumption recorded increase of about 8 per cent in quantity and 10 per cent in total value, with a gain of 158 in the number of consumers and 0.13 cent in average unit price.

Natural gas was supplied for the first time to the following towns in Oklahoma in 1914: Checotah, Garnett, Hominy, Red Oak, Schulter, and Yale.

About 27 per cent of the natural gas consumed for industrial purposes in Oklahoma in 1914 was supplied to smelting companies with plants located as follows: Bartlesville Zinc Co., Bartlesville and Collinsville; Lanyon-Starr Smelting Co., Bartlesville; National Zinc Co., Bartlesville; Tulsa Fuel & Manufacturing Co., Collinsville; Tulsa Spelter Co., Sand Springs.

These smelters consumed in 1914 approximately 13,029,718,000 cubic feet of natural gas, valued at $609,615, which was supplied at an average price of 4.67 cents a thousand cubic feet. Other industrial uses of natural gas in Oklahoma include the manufacture of brick, glass, and cement; oil-field development; and pipe-line, refinery, and cotton-gin operation. One plant for the manufacture of carbon black from natural gas was in operation in this State in 1914.

Of the total volume of natural gas produced in Oklahoma in 1914 it is estimated that 22,623,309,000 cubic feet, valued at $3,823,721, was supplied to consumers in Kansas, aside from an appreciable volume that was supplied to consumers in Missouri and included with the consumption of Oklahoma.

The following table records the progress of the natural-gas industry in Oklahoma during the last nine years:

Record of natural-gas industry in Oklahoma, 1906–1914.

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	936
1913	347	7,436,389	49,308	1,793	3,740,981	423	298	1,052
1914	437	8,050,039	62,390	1,951	[a] 4,226,318	388	182	1,205

[a] Includes some gas piped from Oklahoma to Missouri.

The following table shows by counties the range in depth and, for the last five years, the range in rock pressure of natural gas wells in Oklahoma:

Depth and rock pressure of wells in Oklahoma, 1910–1914, by counties.

County.	Depth, in feet.	Pressure, in pounds.				
		1910	1911	1912	1913	1914
Cherokee	600– 650					
Hughes	1,000–2,000			200	10– 350	
Carter	590–1,840	60–100	48–150			30– 325
Comanche	380– 790					286– 400
Craig	500– 520					
Latimer	1,575–1,600		40–470			151– 400
Sequoyah	1,200					
Creek	400–2,900	40–450	20–700	40–850	20– 900	40– 800
Kay	436–1,610	60–375	40–390	165–365	40– 650	35– 450
Kiowa	350– 825	35	10– 50			30
Le Flore	1,300–2,200	350	300–355	350–355	300– 375	385
McIntosh	962–2,740			150–600	150– 400	[a]900
Marshall	480– 576					150
Mayes	106– 640					
Muskogee	800–1,910	50–500	18–225	15–350	10– 350	20– 275
Nowata	450–1,700	70–100	60–450	25–150	25– 300	39– 150
Okfuskee	1,450–2,220					[a]790
Okmulgee	640–2,600	150–800	100–700	300	80–[a]800	80–[a]840
Osage	900–2,200	200–650	150–650	200–780	100– 700	150–[a]800
Pawnee	1,000–2,560	150–200	200–450	40–800		
Coal	400–1,300					110– 425
Pittsburg						
Pontotoc	1,000–1,100					
Greer	390					
Payne	3,000–3,150					[a]800
Rogers	380–1,800	125–530	90–480	40–525	25– 500	145– 400
Stephens	702–1,200			300–325	250– 330	240– 345
Tulsa	580–2,000	50–650	80–400	50–625	100– 650	70– 525
Wagoner	550–1,700	90–120	100–300			165– 405
Washington	315–2,260	80–740	15–620	10–250	19– 350	25–[a]635

[a] New wells.

ARKANSAS.

The production of natural gas on a commercial scale in Arkansas was limited in 1914 to Sebastian and Scott counties, though natural gas in sufficient quantity to provide fuel for additional drilling was obtained in a test well put down during the year by the Ozark Oil & Gas Co. near the town of Ozark, Franklin County.

The natural gas field in northern Sebastian County, which supplies gas to consumers in Fort Smith and Van Buren, is located about 5 miles southeast of the former city and occupies the crest of an elongated dome known as the Massard Prairie anticline. Wells in this field range in depth from 1,100 to 2,000 feet and derive their gas from sandstone layers which occur in the Atoka formation of the Pennsylvanian series.

The gas field in southern Sebastian and northwestern Scott counties, which furnishes the gas consumed at Mansfield and Huntington, lies about 1 mile southeast of Mansfield along the axis of the Hartford anticline. The range in depth of the productive wells is about the same as in the Massard Prairie field, and the gas is derived from sandstone layers in the Atoka formation, lying, however, stratigraphically lower in the formation than the productive sands tapped in the northern field.

Producers of natural gas in Arkansas numbered 7, and there were 5,830 domestic and 6 industrial consumers of intrastate gas at the close of 1914. The number of productive gas wells in this State at the end of 1914 was 99, 1 productive and 4 barren wells having been completed and 1 exhausted well abandoned during the year.

In addition to consuming the entire quantity of natural gas produced wholly within the State considerable natural gas was piped in from Louisiana for consumption in cities and towns adjacent to the southern boundary of Arkansas, statistics of which are included with those relating to Louisiana.

Statistics of the production of natural gas wholly within the State of Arkansas are combined with those relating to Colorado and Wyoming.

TEXAS.

PRODUCTION.

The quantity of natural gas produced in Texas in 1914, which is estimated to have amounted to 13,433,639,000 cubic feet, constitutes a gain of 1,273,884,000 cubic feet, or a little more than 10 per cent over the estimated volume of the record output in 1913. As no new gas fields were commercially developed in Texas in 1914, the gain noted is ascribed to the increased utilization of the gas obtained from fields previously discovered and partly developed, notably from the Moran field, Shackelford County, and the Mexia field, Limestone County.

The value of the natural gas produced in Texas in 1914, estimated at $2,469,770, shows a gain of $395,947, or nearly 19 per cent over the computed value of the output in 1913, due in part to the increased quantity of gas and in part to an increase of 1.33 cents in the average price per thousand cubic feet received during 1914. The average unit price received in 1914 was 18.38 cents, as compared with 17.05 cents in 1913.

The principal gas-producing district in Texas is the Petrolia oil and gas field in Clay County, from which gas is piped to consumers in Henrietta, Dallas, Fort Worth, Gainesville, Eagle Ford, Grand Prairie, Dalworth Park, Arlington, Byers, Petrolia, Electra, Wichita Falls, Bellevue, Bowie, Sunset, Alvord, Decatur, Rhome, Bridgeport, Irving, Denison, Denton, Sherman, and Whitesboro. The rock pressure in this field is declining steadily, and in order to supply the distributing companies in Dallas and Fort Worth with gas the Lone Star Gas Co. was compelled to install a 5,200 horsepower compressor plant at Petrolia during the year.

Second in importance is the Mexia field in Limestone County, which, though only partly tested, shows capabilities of developing into a gas field of considerable importance. Gas flows of large volume and under rock pressure of 260 to 280 pounds to the square inch are obtained in this field at depths of less than 1,000 feet. At this stage in the development of the field the wells are well protected by acreage and the pressure shows no appreciable decline from the slight drain on the source necessary to supply the towns of Mexia, Teague, and Groesbeck. During 1914 mains were laid from this field to Waco and Corsicana, which cities will be supplied in part at least with Mexia gas in 1915. This additional drain on the field will doubtless result in additional drilling in the area and will furnish some index to the rate of decline of the wells.

A considerable quantity of natural gas has been developed in the last two years in the Moran field, Shackelford County, and supplied to the adjacent towns of Albany and Moran. In 1914, however, the quantity of gas available rendered a wider distribution justified and the Pioneer Natural Gas Co., which wholesales the gas output from this field, extended its mains to supply consumers in Baird, Clyde, and Putnam direct and through distributing companies to consumers in Abilene and Cisco.

Natural gas from wells in the Corsicana field has supplied this fuel to the city of Corsicana for a number of years.

In Webb County six wells, in what is known as the Reiser gas field, supply natural gas to Laredo, the county seat.

In Brown County, a few wells supply natural gas for domestic consumption at Bangs, and a pipe line for gas has been projected from this field to Brownwood, the county seat.

Near Strawn, in Palo Pinto County, a number of gas wells were drilled by the Texas & Pacific Coal Co. in 1914. Aside from supplying fuel for additional drilling in the locality, no commercial utilization of the gas was attempted during the year.

The town of Crowther, McMullen County, is supplied with gas from a few wells in the Crowther field, and Santa Anna, in Coleman County, is supplied with gas from 3 wells in the Trickham field in the same county.

Natural gas is used locally for field operations in practically all the oil fields of Texas and locally for domestic purposes in Atacosa, Bexar, Goliad, and McCulloch counties.

As bearing on the future supply of natural gas in Texas two discoveries made in 1914 are worthy of mention. In the southeastern part of Texas near the Mexican boundary in Zapata County a flow of natural gas estimated at more than 20,000,000 cubic feet the first day, under a rock pressure of 450 pounds to the square inch, was obtained at a depth of 1,410 feet in a well drilled for water on the ranch of J. D. Jennings in September, 1914. No market for natural gas exists in the locality and the well was successfully capped pending arrangements not yet perfected for piping the gas to a market. Additional drilling has been begun in the locality in an effort to determine the extent of the prospective field.

The other important discovery, also in southern Texas, was made in November at White Point, on Nueces Bay, about 12 miles south of Sinton, in Patricio County. The following description of this discovery prepared by Alexander Deussen, of the United States Geological Survey, is quoted from the Manufacturers Record, issue of February 11, 1915:

The well was drilled by the White Point Oil & Gas Co., composed of local capitalists. It probably produced as much as 30,000,000 cubic feet of gas per day shortly after the sand was penetrated. The gas is said to have been encountered at depth of 2,255 feet.

The pressure at first was so great that 200 feet of 4-inch drill pipe was blown from the hole and twisted together like so much wire. The gas issued in enormous volume for three or four days and could not be capped. The subsurface material at the point where the well is located is a medium soft yellow clay. A crater was excavated by the outrushing gas, and into it the derrick was drawn and battered to pieces. * * *

It is claimed that a deposit of sulphur outcrops close to the first well drilled by the White Point Oil & Gas Co. At this spot the writer picked up a number of fragments of sulphur, but it is not certain that these fragments were not blown from the well. In either event—whether blown from the well or outcropping at the surface—the occurrence of the sulphur probably indicates that the structure with which the gas is associated is a salt dome, similar to the ones in which the oil was found at Spindletop, Jefferson County; Sour Lake, Hardin County; and elsewhere in the Coastal Plain of Texas. This salt dome, in turn, probably is associated with two concealed faults which intersect each other beneath White Point or very close thereto. That local uplift has occurred in this immediate vicinity is suggested by the constriction in Nueces Bay which exists at this point, the uplift here apparently having narrowed the bay.

It is probable that the gas sand itself belongs to the upper Eocene or the Oligocene, though it may possibly be a part of the Miocene. Among the materials blown from the well, the writer collected some subangular black flint pebbles, which are similar to ones that occur in the base of the Pleistocene and possibly also in the Pliocene, and some fragments of green calcareous clay and siliceous limestone, which have a strong resemblance to similar materials in the Frio clay at the top of the Eocene.

If the structure is a true salt dome, as it appears to be on the basis of present information, the conclusion seems valid that the field, like the other fields of the Coastal Plain associated with salt domes, will not prove to be very extensive but will cover only a comparatively small area. On the other hand, the great gas pressure suggests that gushing wells with large individual yields similar to those secured in the early history of Spindletop may be found.

A number of additional wells were started in the vicinity of the "blow out" in November and December, but to the end of the year had failed to reach the zone from which No. 1 White Point derived its flow.

Natural-gas producers in Texas numbered 75 at the end of 1914, as compared with 50 at the end of 1913, and active gas wells in this State increased in number during 1914 from 126 to 197, a total of 89 new gas wells having been completed and 18 exhausted wells abandoned.

CONSUMPTION.

Aside from the quantity of natural gas consumed in the towns of Atlanta, Bloomburg, Cass, Leigh, Marshall, and Texarkana, which is obtained from Louisiana and included with the statistics relating to that State, the quantity of natural gas consumed in Texas is equivalent to the quantity produced in the State.

Of the quantity of natural gas produced wholly within the State it is estimated that 4,300,350,000 cubic feet, valued at $1,678,858, was distributed to 48,547 domestic consumers at an average price of 39.04 cents per thousand cubic feet, and that 9,133,289,000 cubic feet, valued at $790,912, was distributed to 468 industrial consumers at an average price of 8.66 cents per thousand cubic feet. Compared with the corresponding statistics for 1913, the domestic consumption of natural gas in Texas in 1914 showed increase of 940,496,000 cubic feet, or nearly 28 per cent, in quantity; of $392,191, or about 30 per cent, in value; of 11,197 in the number of consumers; and of 0.74 cent in the average unit price; the industrial consumption showed increase of 333,388,000 cubic feet, or about 4 per cent, in quantity; of $3,756, or about one-half of 1 per cent, in value; and of 75 in the number of consumers; and a decrease of 0.29 cent in the average unit price to consumers.

In addition to the towns previously supplied with natural gas in Texas, the following towns were supplied for the first time in 1914: Abilene, Baird, Cisco, Clyde, Electra, Groesbeck, and Putnam.

The following table records the progress of the natural-gas industry in Texas during the last six years:

Record of natural-gas industry in Texas, 1909–1914.

Year.	Number of producers.	Number of consumers.		Total value of gas produced.	Wells.		
					Drilled.		Productive Dec. 31.
		Domestic.	Industrial.		Gas.	Dry.	
1909	17	5,035	130	$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
1913	50	37,350	393	2,073,823	43	29	126
1914	75	48,547	468	2,469,770	89	23	197

LOUISIANA.

PRODUCTION.

The quantity of natural gas produced in Louisiana and Alabama in 1914 is estimated to have amounted to 26,774,695,000 cubic feet, as compared with 26,652,626,000 cubic feet in 1913, the gain in output being credited wholly to Louisiana and resulting from an increased utilization of this fuel for field operations in De Soto and Red River parishes and for domestic consumption in a few towns in Bossier, Caddo, and De Soto parishes, which were not supplied in 1913. The total value of the natural gas produced in Louisiana and Alabama in 1914 was $2,227,999, as compared with $2,119,948 in 1913.

The production of natural gas in Louisiana is incidental to the development of its oil fields and, as a consequence, the areas in which gas is found are essentially coextensive with the petroleum fields. The principal area of natural-gas production is in Caddo Parish, and extends from near Vivian on the north to Shreveport on the south, the gas occurring mainly in the Nacatoch sand, penetrated at an average depth of 800 feet, but being present also particularly along the crests of the anticlines in the prolifically oil-bearing Woodbine sand, penetrated at depths of 2,100 feet or more. In certain parts of this field natural gas is also found in the Annona chalk at a depth of about 1,575 feet and in the Blossom sand member of the Eagle Ford clay at an average depth of 1,800 feet. Lesser areas of natural-gas production, in which the sequence of productive sands is essentially the same as in the Caddo district, exist in the Naborton pool about 12 miles east of Mansfield, De Soto Parish, and in the Marston and Crichton pools a few miles northeast of Naborton, in Red River Parish. Practically all the commercially utilized gas produced in Louisiana is obtained from the relatively shallow Nacatoch sand. Individual wells producing from this sand range in initial capacity up to 7,000,000 cubic feet of gas a day and rock pressures range from 50 to 400 pounds to the square inch. A few wells in the Naborton pool, which supplies the gas consumed at Mansfield and Naborton, produce gas from the "deep pay" penetrated below 2,700 feet. Wells completed in this sand range in initial capacity up to 15,000,000 cubic feet of gas a day and rock pressures range between 700 and 800 pounds to the square inch. The greater part of the utilized gas produced in this field is, however, derived from the Nacatoch sand.

Isolated wells in Lafourche, Ouachita, and Terrebonne parishes produce small quantities of natural gas, which is utilized locally by the owners of the wells.

Producers of natural gas in Louisiana in 1914 decreased in number from 57 to 54 and active gas wells increased in number from 191 on January 1 to 227 on December 31, a total of 52 productive gas wells having been completed and 16 exhausted wells having been abandoned during that period.

The total area held for gas development purposes in Louisiana decreased from 368,181 acres at the end of 1913 to 125,367 acres at the end of 1914.

CONSUMPTION.

Including the natural gas piped from Louisiana to portions of southern Arkansas and eastern Texas, which are not distinguished in these statistics, the quantity of natural gas consumed in Louisiana in 1914 was equivalent to the quantity produced, and, as no gas is piped from Alabama, the total quantity of gas consumed in the two States was equivalent to their combined production.

Classified as to type of consumers involved, the distribution of natural gas produced in Louisiana in 1914 included 29,751 domestic and 618 industrial consumers, as compared with 26,424 domestic and 550 industrial consumers in 1913.

The following table records the progress of the natural-gas industry in Louisiana during the last six years:

Record of natural-gas industry in Louisiana, 1909–1914.

Year.	Number of producers.	Number of consumers.		Total value of gas produced.[a]	Wells.		
					Drilled.		Productive Dec. 31.
		Domestic.	Industrial.		Gas.	Dry.	
1909	11	4,034	164	$326,245	26	10	70
1910	21	8,547	320	509,408	23	4	91
1911	27	[b] 17,964	442	858,145	36	18	116
1912	41	[b] 24,087	474	1,747,379	50	20	155
1913	57	[b] 26,424	550	2,119,948	53	24	191
1914	54	[b] 29,751	618	2,227,999	52	26	227

[a] Includes the production of Alabama.
[b] Includes consumers supplied with gas piped from Louisiana to Arkansas and Texas.

The following table shows by parishes the range in depth and, for the last three years, the range in rock pressure of gas wells in Louisiana:

Depth and rock pressure of wells in Louisiana, 1912–1914, by parishes.

Parish.	Depth, in feet.	Pressure, in pounds.		
		1912	1913	1914
Caddo	750–2,800	80–910	60–850	20–325
De Soto	746–2,799	400–450	350–450	338–716
Lafourche	80– 100	25	20	5– 10
Ouachita	1,200–3,240			Small.
Terrebonne	105			50

IOWA.

As in previous years the production of natural gas in Iowa in 1914 came from half a dozen shallow wells in Louisa County, where sufficient gas is obtained from deposits of glacial drift partly to supply the domestic needs of three families.

NORTH DAKOTA.

In North Dakota shallow wells, deriving their flow in part from glacial deposits and in part from poorly consolidated Tertiary strata, furnished natural gas for domestic use to consumers in and near Lansford, Bottineau County, and in Renville County. In the southeastern part of the State natural gas in small quantities, utilized locally, accompanies artesian water in a few wells in Lamoure County.

At the end of 1914 there were 13 wells in North Dakota from which gas was being utilized. Statistics of production are included with those of South Dakota.

SOUTH DAKOTA.

No new developments were reported in the natural-gas districts of South Dakota in 1914. Natural gas in this State is produced from artesian wells ranging from 1,250 to 1,785 feet in depth, located in the following counties: Hughes, Stanley, Potter, and Sully. With the exception of the cities of Pierre and Fort Pierre, where gas is utilized commercially, the yield of individual wells is consumed locally by the well owners. Some of the producers reported that their wells are producing more gas than can be utilized, whereas others reported that the supply was wholly insufficient for their needs. In Pierre and Fort Pierre about 370 domestic consumers are supplied with natural gas, this fuel being utilized also at the electric-light and water plants of the former city.

At the close of 1914 there were 29 wells in South Dakota from which gas was utilized.

Statistics of the natural-gas industry in North Dakota are included with those of South Dakota.

MONTANA.

A test well drilled for oil near Glendive, Dawson County, Mont., by the Eastern Montana Oil & Gas Co. (formerly the Consolidated Oil & Gas Co.), yielded at moderate depths a flow of gas the volume of which is estimated at 1,000,000 cubic feet a day. The only use made of this gas in 1914 was for fuel in drilling operations, but further utilization is proposed, the developing company having secured from the board of county commissioners a franchise to lay gas mains into the city of Glendive.

In Hill County the Havre Natural Gas Co. completed two wells, one in June and one in December, 1914, near the city of Havre and obtained fair volumes of gas under a rock pressure of 550 pounds to the square inch. Other wells are being drilled in the locality, and steps have been taken toward the commercial distribution of this gas in the city of Havre.

WYOMING.

The natural-gas industry of Wyoming is still undeveloped, the development being retarded by the absence of markets in proximity to the productive gas fields.

The only exception to this general condition is in Bighorn County where the towns of Greybull and Basin are supplied with natural gas from the Basin field near the latter town and the town of Byron in the northern part of the county is supplied with natural gas from the adjacent Byron field, which latter field supplied in 1914 sufficient gas in addition to operate the refinery of the Northwestern Refining Co. at Cowley.

During 1914 an oil and gas field of considerable promise was discovered on the western side of Bighorn Basin along the crest of an eroded anticline near the headwaters of Grass Creek, in western Hot Springs County, about 35 miles northwest of Thermopolis. In this field, which occupies the eastern parts of secs. 12 and 13, T. 46 N., R. 99 W., sixth principal meridian, and adjacent parts of secs. 7, 18, 19, and 20, T. 46 N., R. 98 W., the oil and gas thus far produced are derived from a succession of sandstone layers assigned to the Frontier formation of the Cretaceous system. Along the axis of the fold the productive zone is penetrated at depths of 700 to 800 feet, the depth increasing with distance from the axis of the dominating fold. The natural gas present in this field is utilized only in field operations and for fuel and light at the drilling camps.

A few miles northwest of the Grass Creek field wildcat operations in 1914 revealed the presence of enormous quantities of natural gas in Little Buffalo Basin, in the northeast corner of T. 47 N., R. 100 W., sixth principal meridian, and in the adjoining southeastern portion of T. 48 N., R. 100 W. The discovery well in this field, located near the center of sec. 2, T. 47 N., R. 100 W., was completed by the Ohio Oil Co. in September, 1914, at a reported depth of 1,792 feet and produced a flow of gas estimated at 20,000,000 to 40,000,000 cubic feet a day. Other wells completed in the locality about the same time developed equally large volumes of natural gas. No market exists for the gas produced in this field, and the wells, which are capped, are reported to be yielding several gallons of gasoline a day from the pipe connections to the Braden heads.

The Grass Creek and the Little Buffalo Basin fields are described in detail by F. F. Hintze, jr., in Bulletin 11, issued in 1915, from the office of the State geologist, Cheyenne, Wyo.

Natural-gas producers in Wyoming in 1914 numbered 17, as compared with 11 in 1913, and active gas wells increased in number from 29 at the beginning of 1914 to 37 at the end of the year, 9 productive wells having been completed and 1 exhausted well abandoned.

A total of 543 domestic and 12 industrial consumers were supplied with natural gas in Wyoming in 1914, as compared with 353 domestic and 7 industrial consumers in 1913.

Statistics of the natural gas produced and consumed in Wyoming are combined with those for Arkansas and Colorado in order to avoid revealing individual returns.

COLORADO.

The production of natural gas in Colorado in 1914 was chiefly from the Boulder field in Boulder County, where a number of oil wells produce gas for field operations after the gasoline content is extracted and where one well has supplied some 1,200 domestic consumers in the town of Boulder for a number of years. On November 20, 1914, the latter well, owned by the Federal Gas Co., ceased flowing as the result of water breaking in, and to the end of the year efforts to restore it to the status of a producer were unsuccessful.

In Fremont County, oil wells in the Florence field produced small quantities of natural gas, which was consumed in field operations. In Las Animas County two wells supplied gas for domestic consumption by the owners of the ranches on which they are located.

In Mesa County wells put down for oil in the De Beque field yielded more than enough gas for the domestic requirements of their owners. The "spouter" well, on the Myers Bros.' ranch near De Beque, which was drilled in 1912, continued to flow gas and water throughout 1914, no effort having been made to bring it under control.

A total of 13 wells, 8 of which were primarily oil wells, were producing natural gas in Colorado at the end of 1914.

CALIFORNIA.

It is estimated that a total of 17,828,928,000 cubic feet of natural gas was produced and utilized in the State of California in 1914. This quantity exceeded by 6,794,331,000 cubic feet, or nearly 62 per cent, the volume of natural gas produced in this State in 1913. The gain was due largely to an increase in domestic consumption, but in part to increased utilization of gas in the local casing head gasoline industry. Natural gas from the Buena Vista Hills subdivision of the Midway field in San Joaquin Valley was first supplied to the cities and towns south of the Tehachapi Range in 1913, though this service was not in operation the entire year. In 1914, however, not only was service maintained throughout the year, but the distributing system was extended to include additional towns in the vicinity of Los Angeles.

The estimated value of the natural gas produced in California in 1914 was $2,910,784 and the average price received per thousand cubic feet was 16.33 cents. Compared with the production in 1913, these data show an increase of $1,027,334, or 54 per cent, in value and a decrease of 0.74 cent in average unit price.

The only natural-gas field of consequence thus far developed in California is located in the Midway field along the crest of the Buena Vista Hills anticline extending from sec. 22, T. 31 S., R. 23 E., Mount Diablo meridian, southeastward to sec. 14, T. 32 S., R. 24 E. Deep wells in the eastern portion of this field have registered closed pressures up to 1,260 pounds to the square inch with open flow measurements as high as 50,000,000 cubic feet a day. Wells in this district range in depth from 900 to 2,600 feet, and rock pressures average between 250 pounds in the shallower wells to 650 pounds in the deeper ones. The principal productive zone in the Buena Vista Hills is believed to be at the base of the McKittrick formation, of Tertiary and Quaternary age.

The gas produced in this field is handled by two wholesaling companies. The California Natural Gas Co. delivers natural gas to a number of industrial consumers in the Midway field and to local distributing companies supplying both domestic and industrial consumers in Fellows, Taft, Maricopa, and Bakersfield. The Southern California Gas Co. operates a 12-inch transmission line from the Midway field to Los Angeles, a distance of 107 miles, and furnishes gas to local distributing companies supplying domestic and industrial consumers in Los Angeles and vicinity.

In order to maintain a delivery pressure of 50 pounds to the square inch at the Glendale terminal near Los Angeles an intake pressure of approximately 400 pounds to the square inch is required at the field terminal. Many of the wells in the Buena Vista Hills, particularly when first completed, have closed pressures in excess of this requirement and as long as such pressure is sustained the wells are permitted to deliver their gas directly into the line. As soon, however, as the pressure declines below 400 pounds to the square inch, the flow is diverted through a 3,000-horsepower compressor station located near Taft and after compression is delivered into the line at the required pressure. The capacity of the line is about 1,000,000 cubic feet of gas per hour.

More or less unmetered gas is obtained from oil wells in various parts of the Sunset, Midway, McKittrick, and Coalinga fields and consumed in field operations on the leases where it is produced. In the Coalinga district one casing-head gasoline plant is in operation.

In the Santa Maria field, Santa Barbara County, sufficient natural gas is produced for the operation of a number of casing-head gasoline plants and also to supply consumers in Santa Maria, Betteravia, Guadalupe, Arroyo Grande, and Nipoma. Summerland, Santa Barbara County, is supplied with gas from abandoned oil wells in the old Summerland field.

The Santa Clara Valley fields, in Ventura County, supply natural gas for field operations, for manufacture of gasoline, and for mixing with artificial gas to supply consumers in Ventura, Santa Paula, and Oxnard.

In the fields of the Whittier-Fullerton district, in Los Angeles and Orange counties, the active development of petroleum has resulted in the discovery of large volumes of natural gas, much of which is handled by the Southern Counties Gas Co. and distributed to consumers in Santa Ana, Anaheim, Orange, Tustin, Garden Grove, Fullerton, and Placentia. Considerable gas is used in this district in field operations and in the manufacture of casing-head gasoline. In the old Sargent or Watsonville field, in Santa Clara County, a small quantity of natural gas is consumed in field operations.

Artesian wells in Sacramento and San Joaquin counties supply a large number of natural-gas consumers in Stockton and Sacramento.

In Solano County a well drilled in 1901 in sec. 24, T. 5 N., R. 1 W., Mount Diablo meridian, furnishes gas from depths of 1,520 feet and 1,820 feet in sufficient quantity to supply consumers in Suisun, Fairfield, and Cement.

In the northern part of California, in Humboldt County, a well 865 feet deep produces sufficient natural gas to supply a few domestic consumers in the town of Briceland.

The number of producers of natural gas in California increased from 48 in 1913 to 57 in 1914, and the number of productive gas wells increased from 72 to 73 in the same period, 8 gas wells having been completed and 7 exhausted wells abondoned.

Of the total quantity of natural gas consumed in California in 1914, it is estimated that 2,948,274,000 cubic feet, valued at $1,802,093, was distributed to 205,163 domestic consumers at an average price of 61.12 cents a thousand cubic feet, and that 14,880,654,000 cubic feet, valued at $1,108,691, was distributed to 172 industrial consumers at an average price of 7.45 cents a thousand cubic feet. The corresponding statistics for 1913 record a distribution of approximately 1,632,337,000 cubic feet, valued at $1,100,702, to 164,358 domestic consumers at an average unit price of 67.43 cents, and of approximately 9,402,260,000 cubic feet, valued at $782,748, to 141 industrial consumers at an average unit price of 8.33 cents.

The following table records the progress of the natural-gas industry in California during the last six years:

Record of natural-gas industry in California, 1909–1914.

Year.	Number of producers.	Number of consumers.		Total value of gas produced.	Wells.		
		Domestic.	Industrial.		Drilled. Gas.	Drilled. Dry.	Productive Dec. 31.
1909	35	7,612	104	$446,933	7	......	[a] 64
1910	30	8,292	217	476,697	3	2	[a] 65
1911	32	10,598	307	800,714	8	6	[a] 66
1912	43	18,171	232	1,134,456	6	1	[a] 71
1913	48	[b] 164,358	141	1,883,450	9	4	[a] 72
1914	57	[b] 205,163	172	2,910,784	8	1	[a] 73

[a] Includes some artesian wells from which gas was used.
[b] Includes some consumers who are using mixed gas.

NATURAL GAS IN FOREIGN COUNTRIES.

CANADA.

The preliminary report on the mineral production of Canada for the calendar year 1914 issued by the department of mines, mines branch, contains the following data relating to the output of natural gas:

The total production in 1914 was approximately 21,435,000,000 cubic feet, valued at $3,651,256, of which 426,000,000 cubic feet, valued at $54,249, was produced in New Brunswick; 14,063,000,000 cubic feet, valued at $2,346,687, in Ontario; and 6,946,000,000 cubic feet, valued at $1,250,320, in Alberta.

The production in 1913 was 20,487,000,000 cubic feet, valued at $3,309,381, of which 829,000,000 cubic feet, valued at $174,147, was produced in New Brunswick; 12,475,000,000 cubic feet, valued at $2,055,768, in Ontario; and 7,174,000,000 cubic feet, valued at $1,079,466, in Alberta.

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 cases where transmission is by separately operated pipe-line companies, such cost is not included.

The following table shows the value of natural gas produced in Canada each year since 1909, by Provinces:

Value of natural gas produced in Canada, by Provinces, 1909–1914.

Year.	New Brunswick.	Alberta.	Ontario.	Total Canada.
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	$36,549	289,906	2,036,245	2,362,700
1913	174,147	1,079,466	2,055,768	3,309,381
1914	54,249	1,250,320	2,346,687	3,651,256

The following table gives the statistics of production of natural gas in the Province of Ontario, Canada, since 1909:

Statistics of production of natural gas in the Province of Ontario, Canada, 1909–1914.

Year.	Wells bored in the year.		Producing wells.	Miles of gas pipe.	Workmen employed.	Gas production.		Wages for labor.
	Productive.	Nonproductive.				Quantity (cubic feet).	Value.	
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
1913	166	48	1,522	1,720	402	12,474,745,000	2,055,768	289,480
1914	108	18	1,550	1,380	479	14,063,000,000	2,346,687	256,139

In New Brunswick production of natural gas is from the Maritime oil fields in Albert County, and gas from these fields has been distributed during the last three years by the Moncton Tramways Electricity & Gas Co. (Ltd.) to consumers in Moncton and Hillsborough.

The following data are quoted from the annual report of the mineral production in Canada in 1913, issued 1914, by the Department of Mines, Mines Branch:

In Ontario the three principal producing fields are known as the Welland County, the Haldimand-Norfolk, and the Essex-Kent fields. During 1913 deep drilling disclosed the presence of natural gas under heavy pressure and apparently in large quantity below the oil-producing strata of the Petrolia oil field. Under the provisions of chapter 16, 6–7, Edward VII, entitled "An act to regulate the exportation of electric power and certain liquids and gases," assented to April 27, 1907, the export of natural gas is prohibited except under special license issued by the governor in council. No natural gas is now exported from Ontario, although formerly there was a considerable exportation to Detroit and Buffalo, adjacent, respectively, to the Essex and Welland fields.

In order to conserve the supply of natural gas and, as far as possible, prevent its waste, the Ontario legislature in 1908 passed an "act to prevent the wasting of natural gas and to provide for the plugging of all abandoned wells" (Edward VII, ch. 47), by which power was conferred upon inspectors appointed under the act to enforce the stopping of waste. The supplementary revenue act, 1907 (Ontario statutes), also contained provisions which have been even more effective than those of the first-mentioned act, and the enforcement of these laws has, according to the bureau of mines, reduced the waste of gas to a minimum.

In Alberta a great increase has been made in the marketing of natural gas from the Bow Island district, in Lethbridge, Calgary, and other towns of the district. The total production of natural gas in 1913 in this Province was reported as 7,174,000,000 cubic feet, valued at $1,079,466, as compared with a production in 1912 of 2,583,000,000 cubic feet, valued at $289,906.

The production of gas in the Province has been obtained altogether from the two fields, known as the Medicine Hat field, which has been producing since 1891, and the Bow Island district, the gas from which was first commercially utilized in 1912. There were 49 producing wells at the close of the year, of which 20 had been drilled during 1913, while 3 wells were in process of drilling on December 31.

Natural-gas rights in Manitoba, Saskatchewan, Alberta, the Northwest Territories, the Yukon, etc., are the property of the Crown, and their disposal is now subject to the regulations approved by order in council dated the 19th day of January, 1914.

These regulations provide for a rental of 25 cents an acre for the first year and 50 cents an acre each subsequent year, lease to be for 21 years, renewable on conditions, and no applicant to be allowed to lease the gas rights under an area of more than 1,920 acres.

ITALY.

The Rivista del Servizio Minerario gives the production and value of natural gas in Italy from 1909 to 1914 as follows:

Production and value of natural gas in Italy, 1909–1914.

Year.	Quantity (cubic meters).	Value.
1909	8,268,000	$42,287
1910	8,840,000	73,301
1911	9,021,000	74,174
1912	6,800,000	57,128
1913	6,015,000	48,974
1914	[a]	[a]

[a] Not available.

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 1909 to 1914 as follows:

Production and value of natural gas at Heathfield,[a] England, 1909–1914.

Year.	Quantity.	Value.
	Cubic feet.	
1909	236,800	[b]
1910	262,000	[b]
1911	221,400	[b]
1912	161,200	[b]
1913	87,450	[b]
1914	[c]	[c]

[a] Heathfield in Sussex County. [b] Not stated. [c] Not available.

COMPOSITION OF NATURAL AND ARTIFICIAL GASES.

The following table shows the general composition of coal gas, water gas, and producer gas from bituminous coals. The weight 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.

Analysis, weight, and heating quality, per 1,000 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.*	*Per 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°.

GASOLINE FROM NATURAL GAS.

GENERAL STATEMENT.

The casing head gasoline industry in the United States is a development of the decade ending with 1914. According to Burrell, Seibert, and Oberfell,[1] gasoline was made from the gas of oil wells near Titusville, Pa., in the fall of 1904 by Andrew Fasenmyer, whose output the first year aggregated 4,000 gallons, which was sold at the rate of 10 cents a gallon. Other plants were installed about the same time at Tidioute and Warren, Pa., but it was not until 1909 that the industry became important, and not until 1911 that the Geological Survey began compiling statistics of the annual gasoline output derived from natural gas.

The available statistics show a remarkable growth in the industry during the last four years. In 1911 the total number of plants in the

[1] Burrell, G. A., Seibert, F. M., and Oberfell, G. G., The condensation of gasoline from natural gas: U. S. Bur. Mines Bull. 88, 1915.

entire United States for the manufacture of casing-head gasoline was only 176 and their total daily capacity was only 37,100 gallons of gasoline. In 1912 the total number of plants increased to 250, a gain of 42 per cent, and the total daily capacity increased to 61,268 gallons, a gain of 64 per cent. In 1913 the number of plants increased to 351, a gain of 40 per cent, and the daily capacity increased to 152,415 gallons, a gain of 150 per cent. In 1914 the number of plants increased to 386, a gain of 10 per cent, and the daily capacity increased to 179,353 gallons, a gain of 17 per cent.

The actual output of the plants in operation in 1911 amounted to 7,425,839 gallons; in 1912 this output was increased to 12,081,179 gallons, a gain of 63 per cent; in 1913 the output increased to 24,060,817 gallons, or a gain of 100 per cent; and in 1914 the output increased to a total of 42,652,632 gallons, a gain of 77 per cent over 1913. Roughly, then, the quantity of gasoline produced from casing-head gas in the year 1914 amounted to 853,053 barrels of 50 gallons each, and constituted a very substantial addition to the supply of motor fuel available in the United States. Should the present rate of gain in production be maintained during 1915, the output of gasoline extracted from casing-head gas will be in excess of 1,500,000 barrels.

When the fact is considered that the average price received for casing-head gasoline in 1914 was only 7.28 cents a gallon, compared with 10.22 cents in 1913, the increase of 77 per cent in the quantity of gasoline produced is rather surprising. The reason for the depressed market in 1914 lies in the great increase in refinery stocks of gasoline derived from crude petroleum incident to a period of low prices for high-grade petroleum brought about by conditions of overproduction in the Cushing field, Oklahoma, and by a temporary curtailment of the export trade following the outbreak of the European war. The total value of the gasoline manufactured from casing-head gas in the United States in 1914 amounted to $3,105,909, an increase of $647,466, or a little more than 26 per cent over the total value of the production marketed in 1913.

The casing head gasoline industry was limited to nine States in 1914, as follows, named in the order of their rank in quantity of marketed production: Oklahoma, West Virginia, California, Pennsylvania, Ohio, Illinois, Kansas, New York, and Colorado, the only production in Kentucky coming from normal condensation in gas mains. West Virginia, which had led for the preceding three years, was superseded by Oklahoma in 1914, West Virginia taking second place, previously occupied by Pennsylvania, which in turn was relegated to fourth place by California, which advanced from fourth to third place. The principal gain in casing head gasoline output in 1914 is credited to Oklahoma, which exceeded its output of 6,462,968 gallons in 1913 by 10,814,587 gallons, constituting a gain of 167 per cent.

A complete description of the methods employed in the manufacture of casing-head gasoline and a discussion of tests to determine whether or not sufficient gasoline is present in a given type of natural gas to warrant the installation of an extracting plant is contained in Bulletin 88, The condensation of gasoline from natural gas, issued in 1915 by the United States Bureau of Mines.

MARKETED PRODUCTION.

The following tables show the growth of the casing head gasoline industry in the United States from 1911 to 1914, inclusive:

Marketed production of gasoline from natural gas in the United States from 1911 to 1914, inclusive, by States.

State.	Number of operators.	Plants.		Gasoline produced.			Gas used.		
		Number.	Daily capacity.	Quantity.	Value.	Price per gallon.	Estimated quantity.	Value.	Average yield in gasoline per M cubic feet.
1911.									
			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	8	7	3,358	a 231,588	20,258	8.75	82,343,000	6,320	2.81
New York									
Kentucky									
Total	132	176	37,100	7,425,839	531,704	7.16	2,475,697,263	176,961	3.00
1912.									
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	a 386,876	41,795	10.8	114,273,000	9,662	3.4
New York	1	1							
Kentucky	1	......							
Total	186	250	61,268	12,081,179	1,157,476	9.6	4,687,796,329	331,985	2.6
1913.									
West Virginia	63	115	31,930	7,662,493	$807,406	10.54	2,981,119,000	$181,337	2.57
Oklahoma	19	40	61,633	6,462,968	577,944	8.94	2,152,503,000	82,742	3.00
Pennsylvania	100	113	22,207	3,680,096	405,186	11.01	1,372,056,000	114,783	2.68
California	12	14	21,135	3,460,747	376,227	10.87	2,436,445,000	106,539	1.42
Ohio	25	41	8,142	2,072,687	212,404	10.25	744,226,000	63,233	2.79
Illinois	6	12							
Colorado	2	2							
New York	3	3	7,368	a 721,826	79,276	10.98	203,092,500	17,590	3.55
Kansas	1	1							
Kentucky	1	......							
Total	232	341	152,415	24,060,817	2,458,443	10.22	9,889,441,500	566,224	2.43
1914.									
Oklahoma	35	58	74,793	17,277,555	$1,113,059	6.44	5,738,549,000	$273,940	3.01
West Virginia	65	121	34,460	9,278,108	691,899	7.45	3,005,292,000	172,396	2.58
California	17	19	32,360	7,581,309	633,517	8.36	5,129,709,000	197,066	1.48
Pennsylvania	96	119	21,456	4,611,738	359,402	7.79	1,560,064,000	125,690	2.89
Ohio	25	47	9,319	2,440,171	184,097	7.54	852,277,000	68,935	2.86
Illinois	7	14	5,300	1,164,178	100,331	8.62	462,321,000	43,017	2.52
Kansas	3	3							
New York	3	3	1,665	a 299,573	23,604	7.88	146,345,000	8,862	2.03
Colorado	2	2							
Kentucky	1	......							
Total	254	386	179,353	42,652,632	3,105,909	7.28	16,894,557,000	889,906	2.43

a Includes gasoline produced in Kentucky which came from natural condensation in gas mains.

CASING HEAD GASOLINE INDUSTRY, BY STATES.

OKLAHOMA.

By increasing the marketed quantity of its casing-head gasoline more than 167 per cent, or from 6,462,968 gallons in 1913 to 17,277,555 gallons in 1914, Oklahoma took first rank among the States in which this industry has been developed and by a margin of nearly 9,000,000 gallons over its nearest competitor, West Virginia. Compared with its output in 1911, the first year for which statistics are available, the output credited to this State in 1914 is approximately 44 times greater.

This phenomenal gain in output is ascribed in part to the increase of 18 in the number of contributing plants and in part to the fact that many of the plants reported active in 1913 operated only a part of that year, whereas they were in operation throughout the whole of 1914.

The total value of the natural-gas gasoline marketed from Oklahoma plants in 1914 was $1,113,059 and the average price received for the output was 6.44 cents a gallon. Compared with corresponding statistics for 1913, these data show an increase of $535,115, or 92 per cent, in the value of the output in 1914, and a decrease of 2.5 cents, or nearly 28 per cent, in the average price per gallon.

The quantity of natural gas utilized in the manufacture of the gasoline credited to Oklahoma in 1914 is estimated at 5,738,549,000 cubic feet, valued at $273,940. Although the gasoline content of the gas used in Oklahoma ranges from 0.6 to 6.8 gallons to the thousand cubic feet, the average for the State in 1914 was 3.1 gallons.

Of the 58 plants contributing to the output of casing-head gasoline credited to Oklahoma in 1914, some 30 are located in Creek County, mainly in Glenn pool and its extensions, only 3 plants being in operation in the Cushing district during the year. The declining fields of the Cherokee district furnish casing-head gas for the operation of 8 plants in Nowata County, 4 in Washington County, and, with Glenn pool, 5 plants in Tulsa County. Local pools in Muskogee and Okmulgee counties supply gas to 10 plants equally divided between the two counties. In Pawnee County 1 plant manufactures gasoline from casing-head gas produced in the Cleveland field.

The following table shows the production of gasoline from natural gas in Oklahoma in 1914, by counties:

Marketed production of gasoline from natural gas in Oklahoma in 1914, by counties.

County.	Plants.		Gasoline produced.		Average yield in gasoline per M cubic feet of gas.	Average gravity of gasoline as produced and before blending.
	Number in operation.	Daily capacity.	Quantity.	Value.		
		Gallons.	*Gallons.*		*Gallons.*	*° Baumé.*
Creek	30	44,353	[a]11,458,811	$712,930	1.5-6.8	66-92
Nowata	8	18,268	2,411,819	188,024	1.5-4.5	72-95
Tulsa	5	3,922	1,048,361	58,136	2.0-4.0	80-88
Muskogee	5	3,354	1,020,935	64,474	2.5-3.5	80-92
Okmulgee	5	2,900	742,079	46,580	1.0-2.8	76-92
Washington Pawnee	4 1	1,996	595,550	42,915	0.6-2.5	70-90
Total	58	74,793	17,277,555	1,113,059	3.01	....

[a] Includes some gasoline produced in Tulsa County.

WEST VIRGINIA.

Although the quantity of natural-gas gasoline marketed from West Virginia plants in 1914 exceeded the output of previous years, the State was second in rank among the States manufacturing casing-head gasoline by reason of the phenomenal increase in the output of Oklahoma.

The marketed production of casing-head gasoline in West Virginia amounted in 1914 to 9,278,108 gallons, valued at $691,899, an increase of 1,615,615 gallons, or 21 per cent, in quantity but a decrease of $115,507, or nearly 17 per cent, in value. The loss in value despite increased output is accounted for by the depressed gasoline market which forced the average price of casing-head gasoline in West Virginia from 10.54 cents a gallon in 1913 to 7.45 cents a gallon in 1914.

In spite of the discouraging market conditions prevailing throughout much of the year, 7 new plants for the extraction of gasoline from natural gas were put into operation in this State in 1914. Shortage of gas caused the temporary shutdown of a few plants during a part of the year, and one plant in Marshall County was dismantled.

The principal seat of the casing head gasoline industry in West Virginia is Tyler County, where 50 plants produced more than one-third of the total output credited to the State in 1914. Wetzel County was second in 1914, its 5 plants contributing about 18 per cent of the State's production; Ritchie County took third place, its 15 plants supplying about 13 per cent, and the remainder of the output came from the following counties in order of their rank: Kanawha, Brooke, Pleasants, Hancock, Doddridge, Wood, Calhoun, Harrison, Marion, Wirt, and Roane.

The total daily capacity of all the casing head gasoline plants in West Virginia in 1914 was 34,460 gallons, whereas the actual average daily output during the year on the basis of 300 working days was 30,927 gallons.

The gasoline content of West Virginia gases utilized in manufacture of gasoline ranges from a minimum of 0.1 gallon to the thousand cubic feet reported by one plant in Kanawha County to a maximum of 10 gallons reported by one plant in Calhoun County. The average for the State in 1914 was 2.58 gallons per thousand cubic feet of gas used.

The following table shows, by counties, details of the casing head gasoline industry in West Virginia in 1913 and 1914:

Marketed production of gasoline from natural gas in West Virginia in 1913 and 1914, by counties.

1913.

County	Plants.		Gasoline produced.		Average yield in gasoline per M cubic feet of gas.	Average gravity of gasoline as produced and before blending.
	Number in operation.	Daily capacity.	Quantity.	Value.		
		Gallons.	*Gallons.*		*Gallons.*	*°Baumé.*
Tyler	47	13,011	3,228,641	$344,296	1.5–10.0	70 –97
Ritchie	15	6,710	1,440,531	146,804	1.0– 4.0	82 –96
Brooke	6	1,960	711,867	74,242	2.5– 3.0	85 –96
Wetzel	4	840	[a] 683,437	74,412	1.5– 2.0	60 –86
Pleasants	17	2,070	459,385	41,275	1.0– 4.0	80 –97
Hancock	5	1,825	301,125	37,471	2.0– 4.6	86 –92

[a] Includes drips.

Marketed production of gasoline from natural gas in West Virginia in 1913 and 1914, by counties—Continued.

1913.

County.	Plants. Number in operation.	Plants. Daily capacity.	Gasoline produced. Quantity.	Gasoline produced. Value.	Average yield in gasoline per M cubic feet of gas.	Average gravity of gasoline as produced and before blending.
		Gallons.	*Gallons.*		*Gallons.*	*°Baumé.*
Wood	9	660	198,232	$21,089	1.5- 5.5	80 -105
Kanawha	4	2,564	144,699	15,908	2.0- 6.0	85.2-91.5
Calhoun	2	550				
Clay	1					
Wirt	1					
Marion	1	1,740	494,576	51,909	1.0- 3.0	80 -91
Marshall	1					
Harrison	1					
Doddridge	1					
Total	115	31,930	7,662,493	807,406	2.57	....

1914.

County.	Number in operation.	Daily capacity.	Quantity.	Value.	Average yield.	Average gravity.
Tyler	50	13,455	3,687,992	$288,337	1.0- 4.0	75 -90
Wetzel	5	800	[a] 1,710,864	105,522	1.5- 2.0	83.2-86
Ritchie	15	6,915	1,266,117	95,007	1.0- 4.0	80 -90
Kanawha	6	5,464	673,757	46,167	0.1- 5.0	75 -92
Brooke	7	2,181	599,426	49,014	2.0- 5.0	85 -96
Pleasants	17	1,607	438,709	31,214	1.0- 3.0	74 -96
Hancock	7	1,696	398,930	35,012	2.0- 8.0	80 -90
Doddridge	3	725	172,084	13,452	2.0- 2.5	83.2-96
Wood	6	517	110,729	7,164	2.0- 3.0	80 -86
Calhoun						
Harrison						
Marion	5	1,100	219,500	21,010	2.0- 3.0	83.2-87
Wirt						
Roane						
Total	121	34,460	9,278,108	691,899	2.58	....

[a] Includes drips.

In the following table is shown the range in yield of gasoline from natural gas in West Virginia in 1911 and 1912, by counties:

Range in yield of gasoline from natural gas in West Virginia in 1911 and 1912, by counties.

County. Location of plant.	Number of operators. 1911	Number of operators. 1912	Number of plants in operation. 1911	Number of plants in operation. 1912	Yield in gasoline per thousand cubic feet of gas. 1911	Yield in gasoline per thousand cubic feet of gas. 1912	Average gravity of gasoline as produced and before blending. 1911	Average gravity of gasoline as produced and before blending. 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.

CALIFORNIA.

The marketed gasoline extracted from natural gas in California in 1914 amounted to 7,581,309 gallons, valued at $633,517, an increase of 4,120,562 gallons, or 119 per cent, in quantity and of $257,290, or 68 per cent, in value over the production credited to the State in 1913. The average price received for the output in 1914 was 8.36 cents a gallon, as compared with 10.87 cents in 1913, the decline in this respect being less in California than in the Appalachian and Mid-Continent States because of the fact that the California product is wholly absorbed by local markets, where competition with gasoline derived from crude petroleum is less keen than in the States east of the Rocky Mountains.

The gasoline plants of this State are situated for the most part in the Coastal and Southern fields, though one plant is operated at Coalinga and another at Taft in the San Joaquin Valley field. The industry is most active in the Santa Maria field, Santa Barbara County, where a total of 8 plants contributed more than 55 per cent of the output credited to the State in 1914. The output of casing-head gasoline in this county increased from 1,953,643 gallons in 1913 to 4,225,334 gallons in 1914, the latter quantity being greater than the output credited to the entire State in 1913. The following plants with a combined daily capacity of 16,378 gallons of gasoline were in operation in Santa Barbara County in 1914: American Gas Co., 1 plant; Pinal Dome Oil Co., 2 plants; Purity Gasoline Co., 1 plant; Rice Ranch Oil Co., 1 plant; Union Oil Co., 2 plants; Western Gasoline Co., 1 plant. The range in yield of gasoline per 1,000 cubic feet of gas in Santa Barbara County is from 0.7 to 2 gallons.

In the oil fields of Los Angeles and Orange counties a total of 8 casing head gasoline plants, having a combined daily capacity of 10,609 gallons, were operated in 1914. The plants in Los Angeles County include 1 owned by the Columbia Oil Producing Co. in the Puente Hills, 1 owned by the A. F. Gilmore Oil Co. at La Brea, 1 owned by Hurley, Smith & Collins at Sherman, and 1 owned by the Standard Oil Co. of California in the Coyote Hills. In Orange County plants are owned as follows: Brea Gasoline Co., plant at Brea; Hurley, Smith & Collins, plant at Oleo; Olinda Gasoline Co., plant at Olinda; Pacific Gasoline Co., plant at Brea. An experimental plant installed by the Standard Oil Co. of California in the Newhall field was dismantled in August, 1914.

In Ventura County the Montebello Oil Co. operates at Fillmore a plant having a capacity of 1,000 gallons of gasoline a day.

At Taft, in the Midway field, Kern County, a plant was installed late in 1914 by the Midway Gasoline Co., and, though operated less than a month in that year, it demonstrated that the gas is higher in gasoline content than that used in the manufacture of gasoline in any other part of the State. The large plant erected several years ago by the Honolulu Oil Co. for the extraction of gasoline from the gas produced on its Buena Vista Hills properties in the Midway field was not operated in 1914, as the available gas supply consists mainly of "dry" gas or gas too low in gasoline content to warrant treatment.

In Fresno County a gasoline plant was erected and successfully operated in 1914 by the Turner Oil Co. on its property in the Eastside field at Coalinga.

The total daily capacity of the casing head gasoline plants operated in California in 1914 was 32,360 gallons, whereas the actual daily output on the basis of 300 working days was 25,271 gallons, 5 plants not being in operation the entire year.

The average yield in gasoline per thousand cubic feet of gas used in California in 1914 was 1.48 gallons, as compared with 1.42 gallons in 1913.

The following table shows details of the casing head gasoline industry in California in 1914, by counties:

Marketed production of gasoline from natural gas in California in 1914, by counties.

County.	Plants.		Gasoline produced.		Average yield in gasoline per thousand cubic feet of gas.	Average gravity of gasoline as produced and before blending.
	Number in operation.	Daily capacity.	Quantity.	Value.		
		Gallons.	*Gallons.*		*Gallons.*	*° Baumé.*
Santa Barbara	8	16,378	4,225,334	$323,701	0.7 -2.0	75-80
Orange	4	10,609	2,403,059	222,334	1.0 -3.0	72-80
Los Angeles	4	1,839	570,104	59,453	.75-3.0	62-80
Fresno	1					
Ventura	1	3,534	382,812	28,029	1.25-5.0	72-86
Kern	1					
Total	19	32,360	7,581,309	633,517	1.48	....

PENNSYLVANIA.

Pennsylvania, which ranked second in the quantity of casing-head gasoline produced and marketed in 1912 and third in 1913, was fourth in 1914, having been displaced by California. This progressive displacement was by no means due to any decrease in the output of natural-gas gasoline in Pennsylvania, but was the result of more rapid increase in other States. The quantity of casing-head gasoline marketed from the Pennsylvania plants in 1914 amounted to 4,611,738 gallons, valued at $359,402, at an average price of 7.79 cents a gallon. Compared with the corresponding statistics for 1913, these data show an increase of 931,642 gallons, or 25 per cent, in quantity, but record a decrease of $45,784, or nearly 11 per cent, in the total value of the marketed product, and a decrease in average price per gallon in 1914 of 3.22 cents.

The casing head gasoline industry in Pennsylvania includes plants located in 11 counties, Elk County having been added to the list of gasoline-producing counties in 1914. The principal activity in 1914, however, was in Warren and Butler counties, which together had 81 plants and produced in 1914 a total of 2,149,354 gallons, or nearly one-half of the output of casing-head gasoline credited to Pennsylvania, Warren County contributing a slightly greater proportion of this quantity than Butler County. The remaining contributing counties were, in the order of their rank on the basis of quantity, McKean, Forest, Allegheny, Venango, Washington, Potter, Greene, Elk, and Crawford.

The number of casing head gasoline plants in Pennsylvania increased from 113 in 1913 to 119 in 1914, and their daily capacity at the end of 1914 was 21,456 gallons. The average daily output in 1914, on the basis of 300 working days to the year, was 15,372 gallons.

Although the range in gasoline content of gas used in the manufacture of gasoline in 1914 was from 1 to 8 gallons to the thousand cubic feet, the yearly average for Pennsylvania was 2.89 gallons. The average recovery of gasoline per thousand cubic feet of gas in 1913 was 2.68 gallons.

The following tables show the marketed production of gasoline from natural gas in Pennsylvania in 1913 and 1914, by counties:

Marketed production of gasoline from natural gas in Pennsylvania in 1913 and 1914, by counties.

1913.

County.	Plants.		Gasoline produced.		Average yield in gasoline per thousand cubic feet of gas.	Average gravity of gasoline as produced and before blending.
	Number in operation.	Daily capacity.	Quantity.	Value.		
		Gallons.	*Gallons.*		*Gallons.*	*°Baumé.*
Butler	52	4,986	944,009	$99,587	1.0-6.0	58-110
Warren	27	3,480	838,006	92,488	1.0-6.0	70- 96
McKean	10	7,298	573,466	69,179	2.0-4.5	86- 95
Allegheny	11	2,367	568,041	62,246	1.8-6.0	80- 90
Venango	5	1,345	265,982	24,293	1.0-4.0	70- 93
Forest	3	1,475	255,773	30,424	1.1-2.5	86- 90
Washington					6.0	87
Potter	5	1,256	234,819	26,969	1.25	84- 86
Greene					1.5	75
Crawford					1.0	80
Total	113	22,207	3,680,096	405,186	2.68	....

1914.

County.	Number in operation.	Daily capacity.	Quantity.	Value.	Average yield.	Average gravity.
Warren	27	3,320	1,126,873	$87,355	1.0-7.0	74-94
Butler	54	4,359	1,022,481	74,772	1.0-8.0	74-98
McKean	9	7,010	985,975	78,175	2.0-5.0	86-95
Forest	6	2,380	583,229	52,058	2.0-2.5	86-90
Allegheny	13	2,192	529,634	39,135	1.8-6.0	74-92
Venango	3	800	132,645	10,327	2.0-4.0	70-90
Washington					5.0-6.0	85
Potter					1.5	86
Greene	7	1,395	230,901	17,580	2.0-5.0	74-90
Elk					2.0	78
Crawford					1.0	80
Total	119	21,456	4,611,738	359,402	2.89	....

In the following table is shown the range in yield of gasoline from natural gas in Pennsylvania in 1911 and 1912, by counties:

Range in yield of gasoline from natural gas in Pennsylvania in 1911 and 1912, by counties.

County.					Yield in gasoline per thousand cubic feet of gas.		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 output of casing-head gasoline in Ohio in 1914, which amounted to 2,440,171 gallons, was sufficient to retain this State in its place as fifth in rank. Compared with the output credited to Ohio in 1913, the output in 1914 shows an increase of 467,484 gallons, or 22 per cent. The value of the production in 1914 was $184,097, a decrease of 13 per cent, compared with the value of the output in 1913. The retrogression in 1914 is accounted for by a decline of 2.71 cents a gallon in the average price received for the gasoline compared with the average price in 1913, the average price in 1914 being 7.54 cents a gallon.

Seven counties contributed to the output of casing-head gasoline in Ohio in 1914. The local casing head gasoline industry is centered in the oil fields of Monroe County, where the yield of both oil and gas from individual wells is light but where the gasoline content of the casing-head gas runs as high as 5 gallons to the thousand cubic feet. A total of 31 plants in this county contributed 1,645,821 gallons, or 67 per cent of the output credited to Ohio in 1914. Jefferson County stood second, its 3 plants producing 318,857 gallons, or about 13 per cent of the State total. Washington County, with 9 plants, produced 288,443 gallons in 1914, or 12 per cent of the State total, the remaining 8 per cent being supplied by 4 plants located 1 each in Columbiana, Hancock, Morgan, and Fairfield counties.

The total number of casing head gasoline plants in Ohio at the end of 1914 was 47, of which number 6 were placed in operation during that year. The combined daily capacity of these plants is 9,319 gallons, whereas the actual average daily output in 1914 was 8,134 gallons on the basis of 300 working days to the year.

The average recovery of gasoline per thousand cubic feet of gas used in Ohio in 1914 was 2.86 gallons, a slight increase over the average of 2.79 gallons attained in 1913.

The following table shows the production of gasoline from natural gas in Ohio in 1913 and 1914, by counties:

Marketed production of gasoline from natural gas in Ohio in 1913 and 1914, by counties.

1913.

County.	Plants.		Gasoline produced.		Average yield in gasoline per thousand cubic feet of gas.	Average gravity of gasoline as produced and before blending.
	Number in operation.	Daily capacity.	Quantity.	Value.		
		Gallons.	*Gallons.*		*Gallons.*	*°Baumé.*
Monroe	24	5,187	1,489,490	$156,184	0.5 -5.0	84-97
Washington	10	1,330	298,748	29,444	1.25-3.0	80-92
Jefferson	2	600			4.0 -5.6	....
Columbiana	2	250			3.0	92-95
Hancock	1		284,449	26,776		
Fairfield	1	775			2.0 -2.5	85-88
Morgan	1					
Total	41	8,142	2,072,687	212,404	2.79	....

Marketed production of gasoline from natural gas in Ohio in 1913 and 1914, by counties—Continued.

1914.

County.	Plants.		Gasoline produced.		Average yield in gasoline per thousand cubic feet of gas.	Average gravity of gasoline as produced and before blending.
	Number in operation.	Daily capacity.	Quantity.	Value.		
		Gallons.	*Gallons.*		*Gallons.*	*°Baumé.*
Monroe	31	6,115	1,645,821	$124,700	0.5-5.0	84-91
Jefferson	3	885	318,857	22,435	4.0-8.0	86-96
Washington	9	1,109	288,443	19,641	1.5-3.0	87-92
Columbiana	4	1,210	187,050	17,321	3.0	93
Hancock					2.5	85
Morgan					2.0	88
Fairfield					3.0	84-88
Total	47	9,319	2,440,171	184,097	2.86	....

The following table shows the range in yield of gasoline from natural gas in Ohio in the years 1911 and 1912, by counties:

Range in yield of gasoline from natural gas in Ohio in 1911 and 1912, by counties.

County.					Yield in gasoline per thousand cubic feet of gas.		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.

ILLINOIS.

The number of plants producing gasoline from natural gas in Illinois increased from 12 in 1913 to 14 in 1914, with a corresponding increase in gasoline output from 581,171 gallons in 1913 to 1,164,178 gallons in 1914, the increase amounting to 583,007 gallons, or slightly more than 100 per cent.

Although the quantity of casing-head gasoline produced in Illinois in 1914 was double that produced in 1913, the value of the production in 1914, which amounted to $100,331, recorded a gain of only 50 per cent over the value of the output in 1913. This condition was due to the general market depression which affected gasoline in 1914 and brought the average price per gallon for the Illinois product from 11.54 cents in 1913 down to 8.62 cents in 1914.

The casing head gasoline industry in Illinois is confined to the deep-sand low-pressure fields of Crawford and Lawrence counties, where the gasoline content of the gas ranges between 2 and 5.5 gallons to the thousand cubic feet, the average for the State in 1914 being 2.52 gallons.

KANSAS.

The casing head gasoline industry of Kansas is limited to Chautauqua County, where three plants were operated in 1914. Only one plant, that of the Vulcan Oil & Gas Co., which manufactured the entire output credited to Kansas in 1913, operated the whole year; the other two, owned respectively by the Riverside Western Oil Co. and the Sedan Gasoline Co., were installed and put into operation in 1914. The gasoline content of the natural gas used at the Kansas plants ranges from 0.5 to 2 gallons to the thousand cubic feet.

Statistics of output are included with those relating to gasoline production in New York, Colorado, and Kentucky.

NEW YORK.

No changes of importance took place in the condition of the casing head gasoline industry in New York. There are three plants of small capacity in this State, one, owned by D. V. McCarthy, located near Richburg, in Allegany County, and two in Cattaraugus County, one at Rock City, owned by Curtis & Moore, and one at Carrollton, owned by the Powers Gasoline Co.

Although small in quantity, the casing-head gas from the old wells of the Allegany and Bradford fields is rich in gasoline, the quantity recovered in 1914 ranging between 1.5 and 4 gallons to the thousand cubic feet.

Additional plants for casing head gasoline manufacture which were being installed in the New York fields at the end of 1914, will doubtless increase the output of that product in 1915.

COLORADO.

Two plants for the extraction of gasoline from natural gas are in operation in Colorado. Both are located at Boulder and both derive their supply of natural gas from the low-pressure wells in the Boulder field. Although the quantity of gas available in this field is very small, it is highly suitable for manufacture of gasoline, as the reported yield of gasoline per thousand cubic feet ranges between 4 and 5 gallons.

Statistics of manufacture of casing-head gasoline in Colorado are combined with those of Kansas, New York, and Kentucky to avoid revealing individual returns.

KENTUCKY.

No plants for the extraction of gasoline from natural gas were in operation in Kentucky in 1914, the small production of gasoline credited to the State consisting wholly, as in previous years, of drips resulting from the normal condensation of vapors in natural-gas mains.

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 1914:

ALABAMA.

Fayette.
Jasper.
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.

Alhambra.
Anaheim.
Athens.
Arroyo Grande.
Bakersfield.
Betteravia.
Burbank.
Cement.
Compton.
Cudahy.
Eagle Rock.
Fairfield.
Fellows.
Fullerton.
Gardena.
Garden Grove.
Glendale.
Guadaloupe.
Huntington Park.
Long Beach.
Los Angeles.
Los Berros.
Lynwood.
Maricopa.
Moneta.
Nipomo.
Orange.
Orcutt.
Oxnard.
Pasadena.
Placentia.
Redondo Beach.
Sacramento.
San Fernando.
San Gabriel.
Santa Ana.
Santa Maria.
Santa Monica.
Santa Paula.
Sawtelle.
South Pasadena.
South Taft.
Stockton.
Suisun City.
Summerland.
Taft.
Torrance.
Tustin.
Tropico.
Venice.
Ventura.
Vernon.

COLORADO.

Boulder.

ILLINOIS.

Annapolis.
Birds.
Bridgeport.
Carlinville.
Casey.
Duncanville.
East Chicago.
Eaton.
Flat Rock.
Greenville.
Heyworth.
Hutsonville.
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.
Clarksburg.
Connersville.
Converse.
Cowan.
Daleville.
Downeyville.
Dublin.
Dunkirk.
Dunreith.
Eaton.
Elwood.
Fairmount.
Falmouth.
Farmland.
Fortville.
Fountaintown.
Frankton.
Freeport.
Geneva.
Gentryville.
Germantown.
Gowdy.
Greenfield.
Greensburg.
Gwynneville.
Hagerstown.
Hartford City.
Herbst.
Homer.
Honey Creek.
Hope.
Hortonville.
Kennard.
Knightstown.
Kokomo.
La Fontaine.
Letts.
Lewisville.
Loogootee.
Lynn.
McCordsville.
Manilla.
Marion.
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.
Oakland City.
Oakville.
Ovid.
Pendleton.
Pennville.
Portland.
Powers.
Princeton.
Raleigh.
Raysville.
Redkey.
Richmond.
Ridgeville.
Rushville.
St. Paul.
Sandusky.
Sardinia.
Sharpsville.
Shelbyville.
Sheridan.
Shirley.
Spiceland.
Springport.
Straughn.
Sullivan.
Sweetsers.
Tipton.
Union City.
Vincennes.
Waldron.
Warrington.
West Liberty.
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.
Chanute.
Chautauqua Springs.
Cherokee.
Cherryvale.
Chetopa.
Coffeyville.
Colony.
Columbus.
Cottonwood Falls.
Coyville.
Deerfield.
Earleton.
Edgerton.
Edna.
Edwardsville.
Eldorado.
Elk City.
Elk Falls.
Elm.
Elmdale.
Elsmore.
Empire City.
Emporia.
Erie.
Eudora.
Eureka.
Fairhaven.
Fall River.
Fort Scott.
Fredonia.
Galena.
Gardner.
Garnett.
Gas.
Greeley.
Havana.
Hepler.
Howard.
Humboldt.
Hutchinson.
Independence.
Iola.
Jefferson.
Kansas City.
Labette.
La Harpe.
Lawrence.
Leavenworth.
Lenexa.
Liberty.
Merriam.
Moline.
Moran.
Mound City.
Mound Valley.
Neodesha.
New Albany.
Newton.
Niotaze.
North Altoona.
Olathe.
Osawatomie.
Oswego.
Ottawa.
Paola.
Parsons.
Peru.
Pittsburg.
Pleasanton.
Princeton.
Rantoul.
Richmond.
Roper.
Rose.
Savonburg.
Scammon.
Scipio.
Sedan.
Sedgwick.
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.
Cannel City.
Catlettsburg.
Central City.
Chinnville.
Clifton.
Cloverport.
Cold Spring.
Covington.
Dayton.
Diamond.
Dover.
Foster.
Greenup.
Hazel Green.
Inez.
Kenner.
Kavanaugh.
Lexington.
Louisa.
Louisville.
Ludlow.
Maysville.
Mount Sterling.
Newport.
North Middletown.
Paintsville.
Paris.
Pollard.
Rothwell.
Russell.
Salyersville.
Warfield.
Wayland.
West Covington.
West Liberty.
West Point.
Winchester.
Worthington.

LOUISIANA.

Belcher.
Blanchard.
Bossier.
Cedar Grove.
Dixie.
Hosston.
Ida.
Lewis.
Mansfield.
Mooringsport.
Mystic.
Naborton.
Oil City.
Rodessa.
Shreveport.
Vivian.

MARYLAND.

Barton.
Corinth.
Cumberland.
Deer Park.
Frostburg.
Kitzmillerville.
Klondike.
Loch Lynn.
Lonaconing.
Luke.
Midland.
Mountain Lake Park.
Mount Savage.
Oakland.
Western Port.

MISSOURI.

Carl Junction.
Carterville.
Carthage.
Deerfield.
Duenweg.
Joplin.
Kansas City.
Martin City.
Nevada.
Oronogo.
Prosperity.
Rich Hill.
St. Joseph.
Webb. City.
Weston.

NEW YORK.

Addison.
Akron.
Alden.
Alexander.
Alfred.
Alfred Station.
Allentown.
Almond.
Ambush.
Amherst.
Andover.
Angelica.
Angola.
Armor.
Attica.
Avon.
Baldwinsville.
Batavia.
Belfast.
Belmont.
Bergen.
Blasdell.
Blossom.
Bolivar.
Bowmansville.
Brant.
Bristol.
Bristol Center.
Brocton.
Buffalo.
Caledonia.
Canisteo.
Cattaraugus.
Ceres.
Chautauqua.
Chipmonk.
Churchville.
Clarence.
Clarence Center.
Collins.
Collins Center.
Corfu.
Corning.
Crittenden.
Cuba.
Deer Creek.
Depew.
Dunkirk.
East Aurora.
East Bloomfield.
East Hamburg.
East Pembroke.
Ebenezer.
Eden.
Ellicott.
Elma.
Elmira.
Evans.
Falconer.
Farnham.
Forestville.
Fredonia.
Friendship.
Gangloff.
Gardenville.
Genesee.
Getzville.
Gorham.
Gowanda.
Greenwood.
Hamburg.
Hanover.
Holcomb.
Holland.
Honeoye Falls.
Hornell.
Independence.
Irving.
Jamestown.
Jamieson Road.
Jewettville.
Lacona.
Lackawanna.
Lancaster.
Le Roy.
Lima.
Limestone.
Little Valley.
Millgrove.
Montour Falls.
Moscow.
Mount Morris.
Mumford.
Naples.
North Collins.
North Tonawanda.
Obi.
Olean.
Orchard Park.
Otto.
Pavilion.
Perry.
Petrolia.
Phoenix.
Pomfret.
Portland.
Portville.
Pulaski.
Reserve.
Rexville.
Richburg.
Riga.
Ripley.
Rushville.
Salamanca.
Sandy Creek.
Scio.
Sheridan.
Silver Creek.
Southport.
Springville.
Stanards.
Stockton.
Tonawanda.
Town Line.
Versailles.
Warsaw.
Watkins.
Webb Mills.
Wellsville.
West Bloomfield.
West Clarksville.
Westfield.
West Phoenix.
West Seneca.
Wheatland.
Williamsville.
Wyoming.
York.
Zoar.

NORTH DAKOTA.

Lansford.

OHIO.

Academia.
Ada.
Adelphi.
Akron.
Alexandria.
Alger.
Alliance.
Amanda.
Amboy.
Amesville.
Amherst.
Amsterdam.
Andover.
Antioch.
Appleton.
Arcanum.
Arlington.
Ashland.
Ashtabula.
Ashville.
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.
Berea.
Bergholz.
Berlin Heights.
Bethany.
Bethesda.
Bettsville.
Beverly.
Bexley.
Birmingham.
Bladensburg.
Bloomdale.
Bloomingburg.
Bloomington.
Bowerston.
Bowling Green.
Bradrick.
Bratenahl.
Bremen.
Bridgeport.
Brilliant.
Brink Haven.
Brookfield.
Brookville.
Buckeye City.
Buckeye Lake.
Buchtel.
Buckingham.
Bucyrus.
Buffalo.
Bullett Park.
Burbank.
Burgoon.
Butler.
Byesville.
Cadiz.
Caldwell.
Cambridge.
Canaanville.
Canal Dover.
Canal Winchester.
Canfield.
Canton.
Cardington.
Carey.
Carroll.
Carrollton.
Castine.
Cedarville.
Celina.
Centerburg.
Chatham.
Chauncey.
Chesapeake.
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.
Corryville.
Coshocton.
Covington.
Crestline.
Creston.
Cridersville.
Crooksville.
Croton.
Cuyahoga Falls.
Cygnet.
Dakes.
Danville.
Dayton.
Deavertown.
Delaware.
Dennison.
Derwent.
Dexter City.
Doylestown.
Drakes.
Dresden.
Dudley.
East Cleveland.
East Fultonham.
East Liverpool.
East Palestine.
East View.
East Youngstown.
Eaton.
Edison.
Elba.
Eldorado.
Elmore.
Elyria.
Empire.
Enterprise.
Etna.
Euclid.
Euphemia.
Fairfield.
Findlay.
Florence.
Flushing.
Fly.
Forest.
Fort Recovery.
Fostoria.
Franklin.
Frazeysburg.
Fredericktown.
Fremont.
French Creek (Avon).
Fulda.
Fultonham.
Gahanna.
Galena.
Galion.
Gallipolis.
Gambier.
Geneva.
Genoa.
Germantown.
Gibsonburg.
Girard.
Glenroy.
Glouster.
Gore.
Grandview.
Granville.
Graysville.
Greenville.
Grogan.
Groveport.
Guysville.
Hallsville.
Hamden.
Hamilton.
Hanging Rock.
Hannibal.
Hanover.
Hanoverton.
Harlem Springs.
Harpster.
Harriettsville.
Hayesville.
Hebron.
Helena.
Hemlock.
Homer.
Homeworth.
Hooker.
Hopedale.
Horns Mills.
Howard.
Hubbard.
Huntsville.
Irondale.
Ironton.
Jackson.
Jackson Center.
Jacksontown.
Jacksonville.
Jefferson.
Jeromesville.
Jerusalem.
Jewett.
Johnstown.
Jolly.
Junction City.
Kansas.
Kenmore.
Kent.
Kenton.
Kilgore.
Kilbuck.
Kingston.
Kingsville.
Kirkersville.
Lakeside.
Lakewood.
Lancaster.
Laurelville.
Leesville.
Leetonia.
Leonard.
Leroy.
Lewisburg.
Lewisville.
Lexington.
Lima.
Linden.
Lisbon.
Litchfield.
Lock.
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.
Mount Victory.
Moxahala.
Murray.
Nashport.
Negley.
Nelsonville.
Neptune.
Nevada.
New Albany.
New Alexandria.
Newark.

New Athens.
New Berlin.
New Boston.
New Bremen.
Newburgh.
Newburgh Heights.
New Carlisle.
New Castle.
Newcomerstown.
New Hagerstown.
New Knoxville.
New Lexington.
New Matamoras.
New Madison.
New Middletown.
New Paris.
New Philadelphia.
Newport.
New Riegel.
New Springfield.
New Straitsville.
Niles.
North Amherst.
North Baltimore.
North Georgetown.
North Hampton.
North Kingsville.
North Lima.
Norwalk.
Norwood.
Nottingham.
Oakfield.
Oakharbor.
Oberlin.
Orrville.
Osborn.
Osgood.
Outville.
Ozark.
Pataskala.
Pennsville.
Perrysburg.
Perrysville.
Petersburg.
Pickerington.
Piqua.
Pleasant City.
Pleasantville.
Plymouth.
Point Pleasant.
Poland.
Polk.
Pomeroy.
Portage.
Portsmouth.
Proctorville.
Quaker City.
Ravenna.
Reedurban.
Rendville.
Reno.
Rex Mills.
Reynoldsburg.
Richmond.
Rittman.
Rockbridge.
Rock Creek.
Rockyridge.
Rocky River.
Roseville.
Roxbury.
Rural.
Rushville.
Rutland.
St. Clairsville.
St. Henry.
St. Louisville.
St. Marys.
Salem.
Salineville.
Saltpetre.
Sandusky.
Sarahsville.
Sardis.
Scio.
Sciotoville.
Sebring.
Senecaville.
Seville.
Shadyside.
Shaker Heights.
Sharon.
Shawnee.
Shelby.
Shepard.
Sherodsville.
Shreve.
Sidney.
Simons.
Somerset.
Somerton.
South Charleston.
South Olive.
South Pleasantville.
South Zanesville.
Spencer.
Spencerville.
Springfield.
Stafford.
Sterling.
Steubenville.
Stewart.
Stockport.
Stoutsville.
Strasburg.
Struthers.
Sugar Creek.
Sugar Grove.
Summerfield.
Summerton.
Summit.
Sunbury.
Sycamore.
Tarlton.
Texas.
Thornville.
Thurston.
Tiffin.
Tippecanoe City.
Tiro.
Toledo.
Toronto.
Tremont City.
Trimble.
Trinway.
Troy.
Uhrichsville.
Union City.
Union Station.
Upper Sandusky.
Urbana.
Utica.
Vanburen.
Vanlue.
Vincent.
Wadsworth.
Wapakoneta.
Warner.
Warren.
Warsaw.
Washington Court House.
Washingtonville.
Waterford.
Watertown.
Waterville.
Wellington.
Wellston.
Wellsville.
West Alexandria.
West Bedford.
West Carrollton.
Westerville.
West Jefferson.
West Lafayette.
West Manchester.
West Millgrove.
West Park.
West Rushville.
West Salem.
Wheelersburg.
Whipple.
Wilberforce.
Williamsport.
Woodsfield.
Wooster.
Worthington.
Yellow Springs.
Youngstown.
Xenia.
Zanesville.
Zenz City.

OKLAHOMA

Arcadia.
Ardmore.
Avant.
Bartlesville.
Beggs.
Bigheart.
Bixby.
Blackwell.
Bluejacket.
Boynton.
Braman.
Bristow.
Broken Arrow.
Cameron.
Chandler.
Checotah.
Chelsea.
Choteau.
Claremore.
Cleveland.
Coalton.
Collinsville.
Copan.
Coweta.
Cross.
Cushing.
Davenport.
Dawson.
Delaware.
Depew.
Dewar.
Dewey.
Drumright.
Duncan.
Dustin.
Edmond.
Eufaula.
Garnett.
Gotebo.
Guthrie.
Hallett.
Haskell.
Hattonville.
Henryetta.
Hominy.
Inola.
Jenks.
Jennings.
Kellyville.
Kiefer.
Kildare.
Lawton.
Lenapah.
Luther.
Marlow.
Meeker.
Miami.
Midlothian.
Morris.
Mounds.
Muskogee.
Newkirk.
Nowata.
Ochelata.
Oglesby.
Okewah.
Oklahoma.
Okmulgee.
Oologah.
Osage.
Owasso.
Pawhuska.

Ponca.
Porter.
Poteau.
Pryor.
Ramona.
Red Fork.
Red Oak.
Sand Springs.
Sapulpa.
Schulter.
Shawnee.
Skiatook.
South Coffeyville.
Stroud.
Terlton.
Tonkawa.
Tulsa.
Turley.
Vinita.
Wagoner.
Wainwright.
Wann.
Welch.
Wellston.
Yale.

PENNSYLVANIA.

Adamsburg.
Aliquippa.
Altoona.
Alverton.
Ambridge.
Apollo.
Ardmore.
Argentine.
Arnold.
Austin.
Avalon.
Avonmore.
Baden.
Barnes.
Beallsville.
Beaver.
Beaver Falls.
Belle Vernon.
Bellevue.
Betula.
Bingham.
Blackstown.
Blairs Corners.
Blairsville.
Bloomster.
Bluff.
Bolivar.
Boston.
Bowerton.
Boyers.
Bradford.
Bradys Bend.
Branchton.
Brockport.
Brockwayville.
Brookville.
Brownsville.
Bruceton.
Bruin.
Bryant.
Buena Vista.
Buffalo.
Bullion.
Bully Hill.
Burdette.
Burgettstown.
Butler.
Cabot.
California.
Callensburg.
Callery.
Campbelltown.
Candor.
Canonsburg.
Carbon Center.
Carnegie.
Carnot.
Carrick.
Carrolltown.
Castle Shannon.
Cecil.
Centerville.
Ceres.
Charleroi.
Chicora.
Church.
Clairton.
Clarendon.
Clarendon Boro.
Clarington.
Clarion.
Clarksburg.
Claysville.
Clermont.
Clintonville.
Cochranton.
Colegrove.
Coleville.
Colona.
Connellsville.
Conoquenessing.
Conway.
Cooksburg.
Cooperstown.
Coraopolis.
Corry.
Corsica.
Coryville.
Costello.
Coudersport.
Courtney.
Cowanesque.
Craigsville.
Cresson.
Crosby.
Curllsville.
Dahoga.
Darlington.
Davistown.
Dawson.
Dayton.
Delmont.
Dempseytown.
Derrick City.
Derry.
Donora.
Dubois.
Duke Center.
Dunbar.
Dunkard.
East Brady.
East Hickory.
East McKeesport.
Easton.
East Sharon.
East Springfield.
East Titusville.
Edgewood.
Edgeworth.
Edinburg.
Eidenau.
Elbon.
Eldersville.
Eldora.
Eldred.
Elizabeth.
Elkland.
Ellwood City.
Emlenton.
Emporium.
Emsworth.
Endeavor.
Enon Valley.
Enterprise.
Erie.
Evans City.
Export.
Fairhope.
Fairmount City.
Fairhaven.
Fairview.
Falls Creek.
Farrell.
Fayette City.
Finleyville.
Fisher.
Florence.
Ford City.
Fosters Mills.
Foxburg.
Franklin.
Fredonia.
Freedom.
Freeport.
Frogtown.
Fryburg.
Gaines.
Galeton.
Garards Fort.
Garland.
Gastonville.
Genesee.
Geneva Hill.
Gibsonton.
Gill Hall.
Gilmore.
Ginger Hill.
Girard.
Glade Run.
Glassport.
Glendale.
Glenfield.
Glenhazel.
Glen Osborne.
Glenwillard.
Grand Valley.
Graysville.
Great Belt.
Greenfield.
Greenock.
Greensburg.
Greenville.
Gresham.
Grove City.
Guitonville.
Hackett.
Hadley.
Haffey (Milltown).
Halsey.
Harmony.
Harpers Corners.
Harrison City.
Harrison Valley.
Harrisville.
Hawthorn.
Haysville.
Hazel Hurst.
Heidelburg.
Hendersonville.
Henrys Bend.
Herman.
Hickory.
Highland.
Hilliards.
Hillsville.
Holbrook.
Hollidaysburg.
Homer.
Homer City.
Hooker.
Hopwood.
Houston.
Hydetown.
Imperial.
Indiana.
Industry.
Ingomar.
Instanter.
Irvineton.
Irwin.
Jackson Center.
Jacksonville.
James City.
Jamestown.
Jeannette
Jefferson.
Johnetta.
Johnsonburg.

Johnstown.
Jollytown.
Juniata.
Kane.
Kane Boro.
Kane City.
Karns City.
Kaylor.
Keisters.
Kellettsville.
Khedive.
Kingsville.
Kinzua.
Kittanning.
Knoxville.
Kushequa.
Lamont.
Langloth.
Larabee.
Larimer.
Lawrenceville.
Latrobe.
Leechburg.
Leeper.
Leesburg.
Leetsdale.
Lewis Run.
Lickingville.
Ligonier.
Limestone.
Livermore.
Logans Ferry.
Loretta.
Lucinda.
Ludlow.
McClellandtown.
McDonald.
McKees Rocks.
McKinley.
Manor.
Manorville.
Mapletown.
Marble.
Marianna.
Marienville.
Mars.
Marvindale.
Marwood.
Masontown.
Matildaville.
Mayburg.
Meadow Lands.
Meadville.
Mechanicsville.
Mercer.
Middle Fork.
Midland.
Millers Eddy.
Millport.
Mills.
Monaca.
Monaca Heights.
Monessen.
Monongahela.
Monroeville.
Monterey.
Mount Alton.
Mount Jewett.
Mount Morris.
Mount Oliver.
Mount Pleasant.
Murrysville.
Myonia.
Natrona.
Nedskey.
Nelson.
New Bethlehem.
New Brighton.
New Castle.
New Florence.
New Freeport.
New Galilee.
New Kensington.
New Mayville.
New Salem.
New Sheffield.
New Stanton.
Newton.
Newtown Mills.
New Wilmington.
Noblestown.
North Bessemer.
North Blackville.
North East.
North Girard.
North Irwin.
Norwich.
Oakdale.
Oakland.
Oak Ridge.
Oil City.
Ormsby.
Osceola.
Osgood.
Oswayo.
Otto.
Parkers Landing.
Petersville.
Petroleum Center.
Petrolia.
Philipston.
Pittsburgh.
Pittsfield.
Pleasantville.
Plummer.
Point Marion.
Polk.
Pollock.
Port Allegany.
Port Barnett.
Porter.
Portersville.
Poseytown.
Potter Brook.
Primrose.
Prospect.
Punxsutawney.
Queen.
Queenstown.
Rankin.
Ratigan.
Raymilton.
Red Fork.
Redman.
Red Rock.
Reidsburg.
Renfrew.
Reno.
Reynoldsville.
Richmond.
Ridgway.
Rimer.
Rimersburg.
Rixford.
Rochester.
Rockland.
Rockmere.
Rogersville.
Rolfe.
Roscoe.
Roseville.
Roulette.
Rouseville.
Rural Valley.
Russell.
Rynd Farm.
St. Marys.
St. Petersburg.
Sabinsville.
Salina, Venango County.
Salina, Westmoreland County.
Salem.
Saltsburg.
Sandy Lake.
Sankertown.
Saxonburg.
Scottdale.
Semples.
Seneca.
Sewickley.
Sharon.
Sharon Center.
Sharpsville.
Shawmut.
Sheffield.
Shinglehouse.
Shinglehouse Boro.
Sligo.
Slippery Rock.
Smethport.
Smiths Ferry.
Snowden.
South Brownsville.
South Heights.
South Jeannette.
South Sharon.
Spring Church.
Stoneboro.
Straight.
Strattonville.
Sturgeon.
Sugar Creek.
Summerville.
Summit.
Swissvale.
Tarentum.
Tarrs.
Taylorstown.
Tidal.
Tidioute.
Tiona.
Tionesta.
Titusville.
Townville.
Troutman.
Turtle Creek.
Tylersburg.
Ulysses.
Uniontown.
Unity.
Upper Middletown.
Utica.
Valley Station.
Van.
Vanderbilt.
Vandergrift.
Vanport.
Venetia.
Venus.
Verona.
Video.
Volant.
Walkers Mills.
Waltersburg.
Warren.
Warren Boro.
Washington.
Waters.
Waynesburg.
Webster.
West Alexander.
West Branch.
West End Boro.
West Elizabeth.
Westfield.
West Freedom.
West Hickory.
Westline.
West Middlesex.
West Middletown.
West Monongahela.
West Monterey.
Westmoreland City.
West Newton.
West Sunbury.
West Winfield.
Wetmore.
Wheatland.
Whiskerville.
Whitetown.
Wick.
Widnoon.
Wilcox.
Wilkinsburg.
Wilson.
Wireton.
Woodlawn.
Worthington.
Youngsville.
Youngwood.
Zelienople.

SOUTH DAKOTA.

Fort Pierre.
Pierre.

TEXAS.

Abilene.
Albany.
Alvord.
Arlington.
Atlanta.
Baird.
Bangs.
Bellevue.
Bloomburg.
Bowie.
Bridgeport.
Byers.
Cass.
Cisco.
Clyde.
Corsicana.
Crowther.
Dallas.
Dalworth.
Decatur.
Denison.
Denton.
Eagle Ford.
Electra.
Fort Worth.
Gainesville.
Grand Prairie.
Groesbeck.
Henrietta.
Irving.
Laredo.
Leigh.
Marshall.
Mexia.
Moran.
Petrolia.
Putnam.
Queen City.
Rhome.
Santa Anna.
Sherman.
Sunset.
Teague.
Texarkana.
Whitesboro.
Wichita Falls.

WEST VIRGINIA.

Adamston.
Adrian.
Alma.
Amma.
Arvilla.
Bannister.
Barboursville.
Barrackville.
Bayard.
Belington.
Belmont.
Bens Run.
Benwood.
Benson.
Beraman.
Big Bend.
Big Creek.
Big Isaac.
Big Springs.
Blacksville.
Blaine.
Blue Creek.
Blueville.
Boothsville.
Branchland.
Bridgeport.
Briscoe.
Bristol.
Broad Oaks.
Brookville.
Buckhannon.
Buffalo.
Burning Springs.
Burnsville.
Burton.
Cairo.
Cameron.
Cannelton.
Cedargrove.
Center Point.
Centerville.
Ceredo.
Charleston.
Chelyan.
Chester.
Clarington.
Clarksburg.
Clendenin.
Coalburg.
Coger.
Colfax.
Colliers.
Corinth.
Crawford.
Creston.
Crown Hill.
Culloden.
Danville.
Davis.
Daybrook.
Deanville.
Dobbin.
Dunbar.
Eastbank.
East Lynn.
Edgewood.
Elizabeth.
Elkins.
Elk Garden.
Elk View.
Ellenboro.
Elm Grove.
Elm Run.
Enterprise.
Erie.
Eureka.
Fairmont.
Fairview.
Farmington.
Farnum.
Finch.
Fink.
Flat Woods.
Flemington.
Follansbee.
Fort Gay.
French Creek.
Frenchton.
Friendly.
Fulton.
Gandeeville.
Gassaway.
Gaston.
Gay.
Glen Dale.
Glen Easton.
Glen Falls.
Glenova.
Glenville.
Glovergap.
Goose Creek.
Gormania.
Gould.
Grafton.
Grantsville.
Grasselli.
Griffithsville.
Hamlin.
Handley.
Hannahdale.
Hansford.
Harrisville.
Haymond Heights.
Haywood.
Heaters.
Henry.
Hepzibah.
Horner.
Hundred.
Huntington.
Hurricane.
Hutchinson.
Industrial.
Ireland.
Jacksonburg.
Janelew.
Jarvisville.
Johnstown.
Jordan Creek.
Kempton.
Kenova.
Kermit.
Keyser.
Kygar.
Lima.
Littleton.
Logan.
Longacre.
Lost Creek.
Loudenville.
Loveland.
Lumberport.
McMechen.
Madison.
Mahone.
Mannington.
Meadowbrook.
Metz.
Middlebourne.
Miletus.
Milton.
Monongah.
Montgomery.
Monticello Add.
Morgantown.
Moundsville.
Mount Clare.
Mount Zion.
Murphytown.
Myra.
Newark.
New Cumberland.
New Martinsville.
North View.
Norwood.
Ogdin.
Ona.
Orlando.
Paden City.
Palestine.
Parkersburg.
Parsons.
Patterson.
Peel Tree.
Pennsboro.
Peoria.
Petroleum.
Peytona.
Philippi.
Piedmont.
Pine Grove.
Pleasant Valley.
Poca.
Point Pleasant.
Pratt.
Proctor.
Pruntytown.
Pullman.

Racine.
Ravenswood.
Reedy.
Ripley.
Roanoke.
Rockcave.
Rockford.
Rowlesburg.
St. Albans.
St. Marys.
Salem.
Sandyville.
Schultz.
Sedalia.
Seth.
Sherrard.
Shiloh.
Shinnston.
Shirley.
Shrewsbury.
Silverton.
Simpson.
Sistersville.
Smithburg.
Smithers.
Smithfield.
Smithville.
South Buckhannon.
Spencer.
Spring Hill.
Star City.
Stealey Heights.
Summit Park.
Sutton.
Tanner.
Terra Alta.
Thomas.
Thornton.
Three Mile.
Troy.
Tyler City.
Volcano.
Walgrove.
Walkersville.
Wallace.
Walton.
Ward.
Warwood.
Waverly.
Wayne.
Wellsburg.
West Fork.
Weston.
West Union.
Wheeling.
Wileyville.
William.
Williamson.
Williamstown.
Wilsonburg.
Woodlawn.
Woodsdale.
Woodville.
Worthington.
Wyatt.

WYOMING.

Basin.
Byron.
Greybull.

STONE.

By G. F. Loughlin.

INTRODUCTION.

The present report on the stone industry contains, in addition to the usual statistical data on the production of the various commercial types of stone, a brief historical review of the stone industry since 1880 and short accounts calling attention to the domestic deposits of marble, lithographic stone, and basalt that are available to meet the demand heretofore supplied from Europe.

The statistical part of the report is, as in former years, entirely the work of Miss A. T. Coons, of the United States Geological Survey, who has nearly every year added new tables giving not only the value of the stone production but the quantity of stone quarried as well, thus increasing the value of the statistics from year to year by the inclusion of quantitative data. The present report contains a new table showing the export of marble to different countries.

The statistical work has been greatly hindered by the failure of many producers to report the quantity as well as the value of stone quarried and by the lack of uniform units of measurement. This lack of uniformity has been a source of trouble to many engaged in the use or purchase of stone, and the adoption of uniform units of measurement in all the States should be urged by everyone interested in the stone industry.

The figures presented in the following report, as in previous years, have to do with the stone produced and sold or used by the quarrymen and include only such manufactured product as is put on the market by the quarrymen themselves, comprising especially 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 therefore includes 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 cut-stone contractors for building purposes and stone sold as riprap, rubble, and flux; the value includes the cost 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 quarrymen free on board at point of shipment. If 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 delivery is made by the producer. In some places 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 statistics in this report are classified as granite, basalt and related rocks (trap rock), marble, limestone, and sandstone.

"Granite" includes true granite as well as such allied rocks as monzonite, syenite, and gneiss and certain other igneous and metamorphic rocks which are quarried by too few producers to permit their production to be shown separately. The varieties of igneous rocks thus occasionally included under "granite" are mostly of the light volcanic type, such as tuff, rhyolite, trachyte, and andesite, but from time to time small quantities of dark igneous rocks, such as diorite and gabbro, are necessarily included with granite.

"Basalt and related rocks," heretofore included under the term "trap rock," comprise, besides typical basalt and diabase, fine-grained diorite, gabbro, and other basic rocks which are less common in occurrence but are similar in chemical and physical properties and are used largely as crushed stone.

"Marble" includes a small quantity of serpentine quarried and sold as marble in California, Georgia, Maryland, Massachusetts, Pennsylvania, and Vermont, and also a small quantity of the so-called onyx marble or travertine obtained from caves and other deposits in Kentucky and other States.

"Limestone" does not include limestone burned into lime, bituminous limestone, nor limestone entering into the manufacture of Portland cement. It does include, however, a small quantity of stone sold locally as marble.

"Sandstone" includes the quartzites of South Dakota, Minnesota, and Wisconsin and the fine-grained sandstones of New York and Pennsylvania, known to the trade as bluestone. As bluestone is the product of a distinct local industry, its production is also shown separately 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 value of sandstone include that of sandstone crushed into sand and used in the manufacture of glass and as molding sand. The production of these materials is set forth in other chapters in Mineral Resources.

UNIT OF MEASUREMENT.

Owing to the variety of uses to which stone is put, there is no regular unit of measurement employed by the quarryman, the stone being sold by the cubic yard, cubic foot, ton, cord, perch, rod, square foot, square yard, square, or other unit. 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, or ton. Rubble and riprap, including stone for such heavy masonry as breakwater and jetty work, are generally sold by the cord or ton. Fluxing stone and stone for chemical use—as for alkali works, sugar factories, carbonic acid plants,

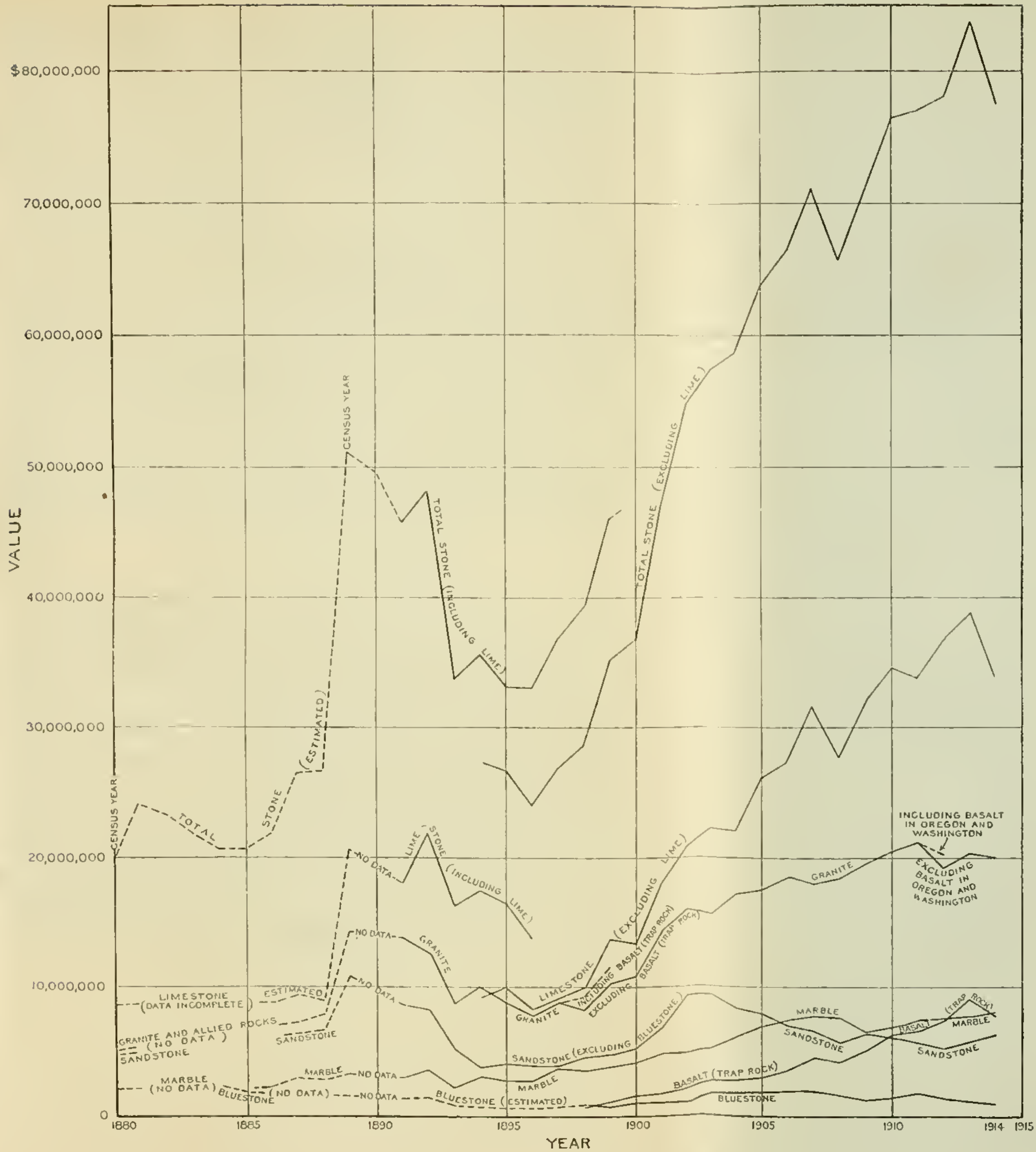

DIAGRAM SHOWING PRODUCTION OF STONE IN THE UNITED STATES FROM 1880 TO 1914, INCLUSIVE.

and paper mills—are sold by the long ton. Flagstone and curbstone are sold by the square yard or the square foot, the thickness being variable and dependent on the orders received. Granite paving blocks are sold invariably by the number of blocks, but the blocks are not of uniform size, the value depending on the size and the labor necessary to cut the block into the shape desired. Other paving material is sold by various units, such as the ton or cubic yard. Crushed stone is reported as sold by the cubic yard or ton, the short ton being more generally used.

The perch is legally defined in many older States as 24¾ cubic feet; in some States, and even within a single State, it varies from 16½ through 20, 22, 25, to 27 cubic feet, and in others it is defined as equivalent to 2,200, 2,500, 2,700, 2,800, and 3,000 pounds. The cord in some States is measured in feet—for instance, 128 cubic feet in the quarry or 100 feet in the wall; in others it denotes weight and is variously defined as equivalent to 11,000, 12,000, 12,500, and 13,000 pounds. The weight of a cubic yard of crushed stone 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. 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, the unit which represents the larger number of producers and is the most convenient.

HISTORICAL REVIEW.

Up to the year 1880, inclusive, the statistics of stone production had been published for certain years in the census reports. In 1882 the division of mineral resources of the United States Geological Survey was established, and it has collected and published the statistics for each successive year from 1881 to 1914, inclusive, cooperating with the Census Bureau in census years. The funds at the disposal of the division of mineral resources were at first very meager and it was impossible to give more than rough estimates of the production of stone. Since 1891, however, it has been possible to obtain reliable data on the value of the granite, sandstone, and marble produced, and since 1893 on the value of the limestone. The value of basalt and related rocks (trap rock), at first insignificant and included in that of granite, increased so rapidly that, beginning with 1898, it has been tabulated separately.

The available data on the value of stone produced from 1880 to 1914, inclusive, are given in the following table and are also represented in the accompanying diagram (Pl. V).

Value of the different kinds of stone produced and sold in the United States, 1880–1914.

Year.	Granite.	Basalt and related rocks (trap rock).[a]	Sandstone.	Marble.	Limestone.	Total.
1880	$5,188,998		$4,780,391	$2,041,225	$8,615,456	$20,626,070
1881					[b]4,100,000	24,100,000
1882					[b]2,310,000	23,310,000
1883					[b]1,907,136	21,907,136
1884			[c]2,500,000		[b]1,700,965	20,700,965
1885			[c]2,000,000		[b]1,678,478	20,678,478
1886				2,400,000	8,830,297	21,830,297
1887	7,440,000		6,500,000	3,100,000	9,476,200	26,516,200
1888	8,000,000		6,750,000	3,000,000	8,969,000	26,719,000
1889	14,464,095		12,505,663	3,488,170	20,684,867	51,142,795
1890						49,760,811
1891	13,867,000		10,200,000	3,610,000	18,092,000	45,769,000
1892	12,642,000		9,865,500	3,705,000	22,012,480	48,224,980
1893	8,808,934		6,195,151	2,411,092	16,322,056	33,737,233
1894	10,029,156		4,845,847	3,199,585	9,231,330	27,305,918
1895	8,894,328		4,961,314	2,825,719	9,967,922	26,649,283
1896	7,944,994		4,773,199	2,859,136	8,387,900	23,965,229
1897	8,905,075		4,965,445	3,870,584	9,152,843	26,893,947
1898	8,396,445	$927,961	5,724,412	3,629,940	9,956,417	28,635,175
1899	10,343,298	1,275,041	5,725,395	4,011,681	13,889,302	35,244,717
1900	10,969,417	1,706,200	6,471,384	4,267,253	13,556,523	36,970,777
1901	14,266,104	1,710,857	8,138,680	4,965,699	18,202,843	47,284,183
1902	16,083,475	2,181,157	10,594,483	5,044,182	20,895,385	54,798,682
1903	15,703,793	2,732,294	11,262,259	5,362,686	22,372,109	57,433,141
1904	17,191,479	2,823,546	10,273,891	6,297,835	22,178,964	58,765,715
1905	17,563,139	3,074,554	10,006,774	7,129,071	26,025,210	63,798,748
1906	18,562,806	3,736,571	9,169,337	7,582,938	27,327,142	66,378,794
1907	18,064,708	4,594,103	8,871,678	7,837,685	31,737,631	71,105,805
1908	18,420,080	4,282,406	7,594,091	7,733,920	27,682,002	65,712,499
1909	19,581,597	5,133,842	8,010,454	6,548,905	32,070,401	71,345,199
1910	20,541,967	6,452,141	7,930,019	6,992,779	34,603,678	76,520,584
1911	21,194,228	6,739,141	7,730,868	7,546,718	33,897,612	77,108,567
1912	19,223,302	7,560,049	6,893,611	7,786,458	36,729,800	78,193,220
1913	20,733,217	9,134,494	7,248,965	7,870,890	38,745,429	83,732,995
1914	20,028,919	7,865,998	7,501,808	8,121,412	33,894,155	77,412,292
Percentage of increase (+) or decrease (−) for 1914	−3.40	−13.89	+3.49	+3.18	−12.52	−7.55
Percentage of total	25.87	10.16	9.69	10.49	43.79	100.00

[a] As the meaning of the term "trap rock" has been variously interpreted and has been made in some localities to include a number of widely different rocks, it is here replaced by the title "basalt and related rocks." The reasons for this change are further discussed on pages 854–855. Prior to 1898 the value of basalt and related rocks was included in that of granite.
[b] Furnace flux only.
[c] Bluestone only.

The values for 1880 are taken from the Tenth Census report, which excluded most of the quarries producing stone valued at less than $1,000. The figures for 1881 to 1888 are rough estimates based on reports from only the larger quarrying companies and represent little else than building and monumental stone. They omit the value of much stone for local use and for small foundation work, for which there was probably a greater demand then than now, as there was less competition with cement and brick. The inaccuracy of the estimates, especially for the few years preceding 1889, is shown by the census figures of that year, which almost double the estimate for 1888. The census figures, on the other hand, appear rather high when compared with the figures for 1891, but that was a dull year in which the production of stone decreased because of less building than usual in the large cities and because of labor troubles, which continued in some places during 1892. The census figures furthermore probably include a larger quantity of manufactured stone than the figures for succeeding years.

The extraordinary rise in the value of limestone reported in 1889 is probably due for the most part to the thoroughness of the canvass made in the census year. The high figures for limestone in 1891, 1892, and 1893 are due to the fact that they include the value of lime, which has been separately tabulated in all succeeding years.

In 1893, a panic year, there was a decrease of $14,487,747 in total value of stone, from which the industry did not fully recover until 1900. The lowest annual value recorded during this period was $23,965,229, reported in 1896. From 1896 the value of the product rapidly increased, in spite of such disturbances as the Spanish war in 1898 and the widespread labor troubles in 1902 and 1903, until the close of 1907. Then unsettled financial conditions again caused a marked decrease, which was shown in the figures for 1908. From 1908 to 1913, inclusive, there was a continuous increase in total value, although most kinds of stone showed decrease in 1912. In 1914 depressed business conditions again caused a decrease in total value.

The stone industry as a whole has advanced with the development of the country, in spite of severe competition with Portland cement and certain other artificial stone products. The use of cement has seriously affected the production of the lower grades of stone for foundations, but it has not greatly affected the production of building stone of higher grade and has had little or no effect on the use of monumental and ornamental stone. On the other hand, the use of concrete and the extensive building of roads and railroads have caused an increase in the production of crushed stone so enormous as to more than offset the decline in other kinds. This increase is shown in the diagram (Pl. V) by the marked rise of the curves for limestone and basalt (trap rock) since 1900. It may also account in part for the general rise of the curve for granite, but the curves for granite and marble represent, as a whole, the increased use of building and monumental stone. Sandstone is the only kind to show a general decrease. Its production increased markedly from 1897 to 1903, owing largely to the building of a great number of railroad bridges and other structures in New York, Ohio, and Pennsylvania; but since 1903 its use as building stone has suffered from competition with cement, as well as with limestone, and, unlike other kinds of stone, it has not been proportionately used for crushed stone. The production of bluestone (included with that of sandstone in the preceding table) has fluctuated within moderate limits, as is shown in the diagram. As its production is more limited and localized than that of any other stone, the beginning or the completion of one or two large contracts may have a distinct effect on the rise or fall of its annual value, as is shown by the continuous decrease during the last three years, a period during which large operations in New York State involving its use have been completed.

MARKETED PRODUCTION IN 1914.

The total value of stone produced and sold in the United States in 1914 was $77,412,292, compared with $83,732,995 in 1913, a decrease of $6,320,703, or 7.55 per cent. The production in 1914 was also less by $780,928 than that of 1912, which was $78,193,220. It exceeded, however, that of 1911, which was $77,108,567, by $303,725, and was far greater than the production in any preceding year.

The decrease of production in 1914 compared with 1913 and 1912 was due to the general financial depression. All parts of the stone industry, however, were not equally affected, as will be shown in subsequent paragraphs; in fact, there was an increase of 3.49 per cent in sandstone and of 3.18 per cent in marble, but a decrease of 3.4 per cent in granite, of 13.89 per cent in trap rock, and of 12.52 per cent in limestone.

The table on page 822 shows the relations between the values of the various classes of stone and the changes that occurred in the totals for 1913 and 1914.

Granite.—Granite represented 25.87 per cent of the total value of stone for 1914. The decrease in value was $704,298, from $20,733,217 in 1913 to $20,028,919 in 1914, or 3.4 per cent. Granite for monumental work and also for paving, flagging, and crushed stone increased slightly in value; but granite for building and curbing decreased slightly and that for rubble and riprap decreased largely in value.

Basalt and related rocks (trap rock).—Basalt and related rocks, which represent 10.16 per cent of the total value of stone in 1914, decreased in value from $9,134,494 in 1913 to $7,865,998 in 1914, or 13.89 per cent. This was the largest decrease in value of any stone in 1914, a fact in striking contrast to the records of previous years, during which there were successive large increases in the value of "trap rock." The value of basalt and related rocks produced in 1914 for crushed stone, their chief use, decreased about 15 per cent, that for building stone more than 34 per cent, and that for paving stone more than 45 per cent. On the other hand, the output for rubble increased in value more than 6 per cent and that for riprap more than 10 per cent, in contrast to the decrease in the value of granite used for these purposes.

Marble.—Marble represented 10.49 per cent of the total value of stone in 1914. Its value increased from $7,870,890 in 1913 to $8,121,412 in 1914, a gain of $250,522, or 3.10 per cent. The increase was wholly in the output of marble for building, which more than offset a considerable decrease in monumental marble. The decrease in monumental marble is also in contrast to the increase in monumental granite.

Limestone.—Limestone represented 43.79 per cent of the total value of stone produced in 1914. It decreased from $38,745,429 in 1913 to $33,894,155 in 1914, a loss of $4,851,274, or 12.52 per cent. Losses were recorded in the value of limestone for all uses except curbing, which amounted to only $120,407 in 1914. The greatest losses were in limestone for furnace flux—$3,213,620—and in limestone for crushed stone—$1,010,343. Other conspicuous losses were in limestone for riprap, building, and paving.

Sandstone.—Sandstone, including quartzite and bluestone, increased in value from $7,248,965 in 1913 to $7,501,808 in 1914, a gain of $252,843, or 3.49 per cent. This gain, following an approximately equal gain in 1913, is especially noteworthy in view of the fact that the value of sandstone has been almost steadily decreasing since 1903. The gain in 1914 was chiefly in crushed stone, which, with small gains in stone for riprap and for "other uses," more than offset losses in stone for building, paving, curbing, flagging, and rubble.

Sandstone constituted 9.69 per cent of the total value of stone in 1914.

The value of bluestone, included with sandstone, decreased from $1,280,862 in 1913 to $1,086,699 in 1914, a decrease of $194,163, or 15.16 per cent. This continuous decrease in value since 1911 is due to the completion of large dams and other structures, principally in New York State, which brought the production temporarily above normal. The value of the production in 1914 is very near the values for 1900,1901, and 1902.

The table on page 826 shows the value of the stone used for various purposes in 1913 and 1914. Only such values are designated as are for uses common to two or more varieties of stone.

This table, besides showing the comparative value of the different kinds 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 1913 and 1914 shows a decrease in total value for all the different products.

Building stone decreased in value from $18,097,219 in 1913 to $17,796,552 in 1914, a loss of $300,667, or 1.66 per cent. The decrease in 1913 as compared with 1912 was 3.94 per cent, which shows that the total production of building stone in 1914 was not greatly affected by the general business depression. This condition was probably due to the fact that many contracts were made before the beginning of the period of depression and had not been completed at the close of the year. The effects of the depression on production of building stone will doubtless be much more conspicuous in the report for 1915, as many of the building-stone districts have shown very little activity during the first half of the year and report that since the completion of contracts made during 1914 almost no new contracts of any importance have been offered. Marble was the only kind of stone to show an increase in production for building purposes in 1914.

Monumental stone decreased in value from $7,212,648 to $7,047,572, a loss of $165,076, or 2.29 per cent. Granite for monumental stone made a small increase, but marble showed a large decrease. The total value of monumental stone in 1913 showed an increase of 6.71 per cent over that in 1912, and the relatively small decrease in 1914 is not at all discouraging in view of the unfavorable conditions of the year. Marble and granite are the only varieties of stone used extensively for monumental work. A small quantity of limestone is also used, and an inconsiderable quantity of sandstone is also reported as sold locally for tombstone bases.

Paving stone decreased in value from $3,936,448 in 1913 to $3,772,383 in 1914, a loss of $164,065, or 4.17 per cent. Granite was the only stone to show an increase. Trap rock decreased 45 per cent and limestone 52 per cent.

Curbstone decreased in value from $2,077,919 in 1913 to $1,869,676 in 1914, a loss of $208,243, or 10.02 per cent. Limestone for curbing increased, and granite and sandstone decreased considerably.

Value of granite, basalt and related rocks (trap rock), sandstone, limestone, and marble sold for various purposes in 1913 and 1914, by kinds and uses.

1913.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Paving.	Curbing.	Flagging.	Rubble.	Riprap.	Crushed.	Other.	Total.
Granite	$6,662,428	$4,715,084	$2,755,995	$814,290	$13,172	$566,343	$1,108,696	$3,851,621	$245,588	$20,733,217
Basalt and related rocks (trap rock)	68,690		204,346			381,069	951,544	7,303,259	225,576	9,134,494
Sandstone	1,874,299		736,767	1,154,836	553,129	200,822	813,184	1,450,767	465,161	7,248,965
Limestone	4,509,339		239,340	108,793	7,337	440,480	1,331,423	19,072,224	13,036,493	38,745,429
Marble [a]	4,982,463	2,497,564							390,863	7,870,890
Total	18,097,219	7,212,648	3,936,448	2,077,919	573,638	1,588,714	4,204,857	31,677,871	14,363,681	83,732,995

1914.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Paving.	Curbing.	Flagging.	Rubble.	Riprap.	Crushed.	Other.	Total.
Granite	$6,481,091	$4,744,088	$2,831,568	$760,952	$13,849	$322,371	$715,812	$3,975,575	$183,613	20,028,919
Basalt and related rocks (trap rock)	45,134		112,246			404,600	1,054,947	6,225,805	23,266	7,865,998
Sandstone	1,825,179		713,692	988,317	519,957	105,906	813,460	1,898,505	636,792	7,501,808
Limestone	3,896,854		114,877	120,407	7,134	423,336	1,123,123	18,061,881	10,146,543	33,894,155
Marble [a]	5,548,294	2,303,484							269,634	8,121,412
Total	17,796,552	7,047,572	3,772,383	1,869,676	540,940	1,256,213	3,707,342	30,161,766	11,259,848	77,412,292
Percentage of decrease (−) in 1914	−1.66	−2.29	−4.17	−10.02	−5.70	−20.93	−11.83	−4.79	−21.61	−7.55

[a] Includes stone used for both exterior and interior building.

Flagstone decreased in value from $573,638 in 1913 to $540,940 in 1914, a loss of $32,698, or 5.70 per cent. There was a very small increase in the value of granite for flagging, but the value of sandstone, which included that of bluestone and which formed over 96 per cent of the total value of flagstone, decreased $33,172. Limestone for flagging also decreased. The use of concrete for sidewalks has in recent years been the principal cause of the decreasing production of flagstone. It is noteworthy, however, that in 1914 the production of Portland cement also decreased.

Stone for rubble showed the largest relative decrease in value next to stone for "other uses," falling from $1,588,714 in 1913, to $1,256,213, a loss of $332,501, or 20.93 per cent. Basalt and related rocks (trap rock) for rubble increased in value, but the other kinds of stone decreased. The principal decreases were in the value of granite and sandstone, that of the latter decreasing nearly 50 per cent.

Stone for riprap also showed a large decrease in value, falling from $4,204,857 in 1913 to $3,707,342 in 1914, a loss of $497,515, or 11.83 per cent. Basalt and related rocks (trap rock) for riprap increased considerably and sandstone slightly, but limestone and granite declined sharply in value in 1914.

Crushed stone, which is the largest product common to more than one kind of stone, decreased in value from $31,677,871 in 1913 to $30,161,766 in 1914, a loss of $1,516,105, or 4.79 per cent. This was the second decrease noted since 1898, when the total production of crushed stone was first recorded. The first decrease recorded was in 1908 as compared with 1907. It is significant that both decreases correspond to years of general business depression. The value in 1914, however, was greater by $1,569,230, or 5.49 per cent, than that of 1912. Granite and sandstone for crushed stone made small gains in 1914, but basalt and related rocks (trap rock) and limestone each decreased more than $1,000,000.

Stone for "other uses" decreased from $14,363,681 in 1913 to $11,259,848 in 1914, a loss of $3,103,833, or 21.61 per cent.

The general decrease in value of stone according to uses but the increase in value of certain stones for certain uses are due to the great irregularity of the industry which, outside of regular quarry centers, is influenced largely by local demand. Construction of sea walls, river improvement work, ballasting of railroad tracks, construction of roads and reservoirs and dams, repairing and construction of locks on canals, and other similar structural work may call for the opening of a quarry and for the abandonment of this quarry as soon as the work is completed. This naturally causes a large increase and a 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. In 1914 marked increases, due to such causes and referred to in subsequent pages, were reported from California, Kentucky, New Mexico, New York, Virginia, and Washington.

The following table shows the rank of States and Territories in 1913 and 1914, according to value of marketed production of stone, and the percentage of the total produced by each State or Territory.

Rank of States and Territories in 1913 and 1914, according to value of marketed production of stone and percentage of total produced by each State or Territory.

1913.

Rank of State.	State or Territory.	Total value.	Percentage of total.	Number of plants.
1	Pennsylvania	$10,117,469	12.08	624
2	Vermont	7,313,355	8.73	57
3	New York	7,185,493	8.58	189
4	Ohio	6,261,338	7.48	234
5	Indiana	4,676,689	5.58	127
6	Illinois	4,140,953	4.94	109
7	California	4,118,935	4.92	150
8	Massachusetts	4,096,372	4.89	138
9	Missouri	2,538,699	3.03	179
10	Wisconsin	2,157,980	2.58	198
11	Georgia	2,105,366	2.51	36
12	Tennessee	2,062,686	2.46	76
13	Minnesota	1,952,686	2.33	93
14	Maine	1,792,079	2.14	71
15	New Jersey	1,772,832	2.12	90
16	Connecticut	1,603,663	1.91	65
17	Michigan	1,520,133	1.82	35
18	New Hampshire	1,482,771	1.77	36
19	Washington	1,399,475	1.67	36
20	Alabama	1,285,944	1.54	35
21	North Carolina	1,212,501	1.45	37
22	West Virginia	1,193,323	1.43	64
23	Maryland	1,153,115	1.38	63
24	Kentucky	1,150,205	1.37	92
25	Virginia	1,063,782	1.27	77
26	Colorado	985,817	1.18	52
27	Kansas	825,607	.99	84
28	Iowa	805,294	.96	83
29	Texas	725,106	.87	39
30	Rhode Island	643,995	.77	16
31	Arkansas	525,050	.63	17
32	Utah	415,471	.50	20
33	South Carolina	360,476	.43	14
34	Oregon	357,498	.43	24
35	Montana	343,516	.41	17
36	Nebraska	327,187	.39	15
37	Delaware	289,987	.35	6
38	Oklahoma	278,600	.33	25
39	Hawaii	249,390	.30	10
40	New Mexico	219,566	.26	9
41	Florida	207,420	.25	10
42	Alaska	(a)		
43	South Dakota	172,736	.21	19
44	Idaho	152,390	.18	13
45	Wyoming	109,784	.13	7
46	Arizona	107,989	.13	15
47	Louisiana	(a)		
	Other States [b]	272,272	.32	3
	Total	83,732,995	100.00	3,409

[a] Included in "Other States." [b] Includes Alaska and Louisiana.

Rank of States and Territories in 1913 and 1914, according to value of marketed production of stone, and percentage of total produced by each State or Territory—Contd.

1914.

Rank of State.	State or Territory.	Total value.	Percentage of total.	Number of plants.
1	Pennsylvania	$8,153,413	10.53	622
2	Vermont	6,635,477	8.57	58
3	New York	6,575,079	8.49	218
4	Ohio	5,655,713	7.31	223
5	California	4,610,781	5.96	142
6	Indiana	4,136,132	5.34	117
7	Massachusetts	3,438,556	4.44	135
8	Illinois	2,934,078	3.79	95
9	Wisconsin	2,413,435	3.12	193
10	Missouri	2,294,103	2.96	185
11	Georgia	2,238,789	2.89	37
12	Virginia	2,152,378	2.78	71
13	Tennessee	1,932,462	2.50	64
14	Maine	1,723,032	2.23	52
15	Washington	1,600,615	2.07	27
16	New Jersey	1,533,668	1.98	80
17	Minnesota	1,513,039	1.95	85
18	Michigan	1,500,910	1.94	30
19	North Carolina	1,407,671	1.82	46
20	New Hampshire	1,383,325	1.79	36
21	Colorado	1,322,609	1.71	56
22	Alabama	1,319,753	1.71	38
23	Kentucky	1,257,722	1.63	94
24	Maryland	1,110,506	1.43	61
25	Connecticut	1,063,184	1.37	57
26	West Virginia	921,208	1.19	61
27	Texas	870,224	1.12	46
28	Rhode Island	625,276	.81	19
29	Kansas	600,576	.78	82
30	Iowa	538,681	.70	71
31	Utah	498,819	.64	23
32	Oregon	435,066	.56	29
33	New Mexico	418,305	.54	5
34	Arkansas	360,735	.47	20
35	South Carolina	357,657	.46	11
36	Florida	343,779	.44	14
37	Nebraska	303,680	.39	21
38	Oklahoma	263,673	.34	26
39	Montana	242,030	.31	15
40	South Dakota	156,907	.20	19
41	Delaware	131,086	.17	6
42	Alaska	(a)	....	....
43	Hawaii	88,417	.11	6
44	Wyoming	62,331	.08	6
45	Idaho	57,909	.08	11
46	Louisiana	(a)	....	....
47	Arizona	50,251	.07	11
	Other States [b]	179,252	.23	2
	Total	77,412,292	100.00	3,326

[a] Included in "Other States." [b] Includes Alaska and Louisiana.

Pennsylvania has always held first rank among the stone-producing States—except in the year 1908 when Vermont reported the largest production—and in 1914 it produced 10.53 per cent of the total of the entire United States. Vermont was second, with 8.57 per cent. Other large stone-producing States following in order of rank of output were New York, Ohio, California, Indiana, Massachusetts, Illinois, Wisconsin, Missouri, Georgia, and Virginia, each of whose production was valued at more than $2,000,000. In 1913 the leading States were Pennsylvania, Vermont, New York, Ohio, Indiana, Illinois, California, Massachusetts, Missouri, Wisconsin, Georgia, and Tennessee. In 1914, California rose from seventh to fifth place, supplanting Indiana and Illinois; Massachusetts rose from eighth to seventh, also supplanting Illinois; Wisconsin rose from tenth to ninth, supplanting Missouri; and Virginia made the greatest gain, rising from twenty-fifth to twelfth place, and being credited for the first time with a production valued at more than $2,000,000. Tennessee, which ranked with these States in 1913, fell below the $2,000,000 mark in 1914, and dropped from twelfth to thirteenth place. Thirteen States in both 1913 and 1914 produced stone valued at between $1,000,000 and $2,000,000.

Of 47 States reporting in 1913, only 14 showed an increased production in 1914, and 33 a decrease. The District of Columbia, Mississippi, Nevada, and North Dakota reported no production in either 1913 or 1914.

The number of active operations in 1914 was 3,326, compared with 3,409 in 1913 and 3,637 in 1912. The decrease of operations in 1914 was only 83 when the value of output decreased 7.55 per cent, whereas the decrease in 1913 as compared with 1912 was 228, although the value of output increased 7.08 per cent. A number of causes contributed to the decrease in 1913, the chief of which was the tendency of small producers to abandon their quarries on account of lack of demand for foundation stone. The high cost and scarcity of labor was another strong factor against the small quarryman. In 1914 these same causes prevailed, in addition to the general business depression of the year. Combination of properties and the regular fluctuations of demand also have had considerable influence on the increase or decrease of operations.

The production of crushed stone has increased so rapidly that for several years special tables have been published showing its production by uses, by kinds of stone, and by States, and also giving a comparison between the value of its production and that of all exterior building stone. The following table shows the quantity and value of crushed stone produced and sold in the United States in 1913 and 1914, by uses and kinds of stone:

Quantity and value of crushed stone produced and sold in the United States in 1913 and 1914, by uses and by kinds of stone, in short tons.

1913.

Kind.	Road metal.		Railroad ballast.		Concrete.		Total.		Average price per ton.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
Granite	1,836,819	$1,585,566	1,188,332	$752,642	1,849,478	$1,510,353	4,874,629	$3,851,621	$0.79
Basalt and related rocks (trap rock)	4,986,255	3,617,978	2,171,534	1,399,954	3,346,770	2,288,387	10,504,559	7,303,259	.70
Limestone	13,296,377	7,353,665	11,774,121	5,551,415	10,099,030	6,167,144	35,169,528	19,072,224	.54
Sandstone	409,490	311,794	311,585	186,043	1,049,174	952,930	1,770,249	1,450,767	.82
Total	20,528,941	12,869,003	15,445,572	7,890,054	16,344,452	10,918,814	52,318,965	31,677,871	......
Average price per ton	....	$0.63	....	$0.51	....	$0.67	....	$0.61	......

1914.

Kind.	Road metal.		Railroad ballast.		Concrete.		Total.		Average price per ton.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
Granite	2,249,494	$1,567,374	852,181	$549,626	2,114,758	$1,858,575	5,216,433	$3,975,575	$0.76
Basalt and related rocks (trap rock)	3,844,039	2,780,022	2,322,958	1,473,367	2,860,131	1,972,416	9,027,128	6,225,805	.69
Limestone	14,763,318	8,300,516	8,493,830	3,967,348	9,410,193	5,794,017	32,667,341	18,061,881	.55
Sandstone	929,982	681,453	235,710	118,067	1,287,882	1,098,985	2,453,574	1,898,505	.77
Total	21,786,833	13,329,365	11,904,679	6,108,408	15,672,964	10,723,993	49,364,476	30,161,766	......
Average price per ton	....	$0.61	....	$0.51	....	$0.68	....	$0.61	......
Percentage of increase (+) or decrease (−) in 1914	+6.13	+3.58	−22.92	−22.58	−4.11	−1.78	−5.65	−4.79	......

As shown by this table, the quantity and value of the marketed output of crushed stone in 1914 was 49,364,476 short tons, valued at $30,161,766, as compared with 52,318,965 short tons, valued at $31,677,871, in 1913, a decrease of 2,954,489 tons, or 5.65 per cent, in quantity and of $1,516,105, or 4.79 per cent, in value. The decrease was principally in the production of railroad ballast. The average price per ton was 61 cents for both 1913 and 1914.

Crushed granite increased 341,804 short tons in quantity and $123,954 in value. The average price per ton decreased from 79 cents in 1913 to 76 cents in 1914.

Crushed basalt and related rocks (trap rock) decreased 1,477,431 short tons in quantity and $1,077,454 in value. The average price per ton was reported as 69 cents in 1914, compared with 70 cents in 1913.

Crushed limestone decreased 2,502,187 short tons in quantity and $1,010,343 in value. The average price per ton increased from 54 cents in 1913 to 55 cents in 1914.

Crushed sandstone increased 683,325 short tons in quantity and $447,738 in value. The average price per ton decreased from 82 cents in 1913 to 77 cents in 1914.

Crushed stone used for road metal increased 1,257,892 short tons in quantity and $460,362 in value. The average price per ton was 61 cents in 1914, compared with 63 cents in 1913.

Crushed stone for railroad ballast decreased 3,540,893 short tons in quantity and $1,781,646 in value. The average price per ton was 51 cents in both 1913 and 1914.

Crushed stone for concrete decreased 681,488 short tons in quantity and $194,821 in value. The average price per ton increased from 67 cents in 1913 to 68 cents in 1914.

The following table shows the quantity and value of crushed stone produced and sold in the United States in 1913 and 1914, by States and Territories and by uses, in short tons:

Marketed production of crushed stone in 1913 and 1914, by States and Territories and by uses, in short tons.

1913.

State or Territory.	Road metal.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	88,330	$47,237	14,633	$7,187	395,727	$255,695	498,690	$310,119
Arizona			1,200	265	7,169	5,735	8,369	6,000
Arkansas	207,110	177,476	103,879	74,961	98,303	80,051	409,292	332,488
California	1,409,976	853,990	845,641	514,120	1,185,017	763,627	3,440,634	2,131,737
Colorado	24,450	33,000			612	522	25,062	33,522
Connecticut	578,547	366,306	95,518	55,694	495,481	304,534	1,169,546	726,534
Delaware	39,837	37,522	30,467	21,327	12,552	10,496	82,856	69,345
Florida	34,664	32,632	96,882	40,006	152,286	117,874	283,832	190,512
Georgia	60,569	49,950	57,466	55,884	134,938	115,959	252,973	221,793
Hawaii	103,542	97,826	24,793	25,747	50,147	52,851	178,482	176,424
Idaho	7,858	15,043	110,250	70,560	18,000	27,000	136,108	112,603
Illinois	1,958,482	921,340	1,405,688	592,210	2,376,700	1,246,042	5,740,870	2,759,592
Indiana	1,736,744	956,284	514,745	203,431	53,876	29,985	2,305,365	1,189,700
Iowa	136,848	81,351	513,531	218,573	464,280	301,305	1,114,659	601,229
Kansas	64,130	49,074	511,370	283,435	350,799	264,854	926,299	597,363
Kentucky	468,135	286,407	995,908	422,864	201,498	104,615	1,665,541	813,886
Louisiana	9,733	7,787	22,455	17,964	50,030	40,240	82,218	65,991
Maine	2,745	2,055	432	324	18,852	16,262	22,029	18,641
Maryland	417,807	373,904	408,507	230,687	213,699	178,065	1,040,013	782,656
Massachusetts	952,707	794,415	112,944	71,882	940,691	824,320	2,006,342	1,690,617
Michigan	557,231	289,685	124,330	56,892	301,612	154,705	983,173	501,282
Minnesota	74,070	64,920	53,816	32,374	504,714	408,467	632,600	505,761
Missouri	488,325	342,849	605,441	405,665	779,846	636,148	1,873,612	1,384,662
Montana	11,410	2,812	1,307	485	27,306	14,480	40,023	17,777
Nebraska			68,938	38,178	275,693	231,626	344,631	269,804
New Hampshire	8,276	6,415	129	129	11,900	10,297	20,305	16,841
New Jersey	916,679	735,926	468,891	317,744	445,437	346,387	1,831,007	1,400,057
New Mexico			384,561	148,016	54,000	54,000	438,561	202,016
New York	2,674,209	1,608,083	1,768,306	951,672	2,372,771	1,509,244	6,815,286	4,068,999
North Carolina	77,071	73,062	137,331	67,828	242,316	235,887	456,718	376,777
Ohio	3,230,300	1,598,434	2,036,173	806,590	692,450	357,568	5,958,923	2,762,592
Oklahoma	5,171	4,384	208,021	98,134	121,316	77,702	334,508	180,220
Oregon	248,423	182,471	113,468	59,873	130,340	83,524	492,231	325,868
Pennsylvania	2,039,553	1,510,849	1,574,561	1,015,796	1,370,611	871,706	4,984,725	3,398,351
Rhode Island	48,500	58,500	1,500	3,000	8,660	7,996	58,660	69,496
South Carolina	56,989	47,776	60,412	43,950	68,298	61,757	185,699	153,483
South Dakota	2,600	1,670			62,169	48,630	64,769	50,300
Tennessee	298,226	212,004	339,768	142,289	199,678	123,945	837,672	478,238
Texas	244,267	145,747	294,476	132,699	324,156	255,782	862,899	534,228
Vermont	4,275	3,783	1,500	664	22,906	15,942	28,681	20,389
Virginia	207,728	151,395	570,517	291,876	248,751	157,470	1,026,996	600,741
Washington	170,952	122,579	11,706	9,998	9,134	4,508	191,792	137,085
West Virginia	104,752	55,882	588,995	284,364	180,451	90,255	874,198	430,501
Wisconsin	757,720	466,178	165,116	74,717	659,932	408,390	1,582,768	949,285
Wyoming					9,348	12,366	9,348	12,366
Total	20,528,941	12,869,003	15,445,572	7,890,054	16,344,452	10,918,814	52,318,965	31,677,871

Marketed production of crushed stone in 1913 and 1914, by States and Territories and by uses, in short tons—Continued.

1914.

State or Territory.	Road metal.		Railroad ballast.		Concrete.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	74,914	$75,528	1,341	$1,076	420,369	$372,261	496,624	$448,865
Arizona	2,600	4,000			2,484	1,961	5,084	5,961
Arkansas	199,417	140,442	79,277	55,536	87,700	63,895	366,394	259,873
California	1,707,230	982,321	598,057	317,733	1,403,178	936,705	3,708,465	2,236,759
Colorado	6,052	10,100	1,000	700	7,802	11,100	14,854	21,900
Connecticut	360,443	216,064	97,295	63,682	421,962	256,903	879,700	536,649
Delaware	53,430	33,501	8,500	5,950	42,885	40,932	86,815	80,383
Florida	159,524	84,911	158,428	82,596	64,680	90,986	382,632	258,493
Georgia	57,553	37,088	34,593	35,039	149,393	121,950	241,539	194,077
Hawaii	41,832	37,049	22,552	17,820	34,708	32,011	99,092	86,880
Idaho			9,000	5,760			9,000	5,760
Illinois	1,838,599	893,889	906,346	378,458	1,914,120	928,827	4,659,065	2,201,174
Indiana	2,089,103	1,065,360	181,849	69,089	83,426	43,767	2,354,378	1,178,216
Iowa	19,308	17,438	255,553	97,747	463,126	278,071	737,987	393,256
Kansas	27,248	20,135	560,013	274,000	296,813	222,302	884,074	516,437
Kentucky	545,878	323,075	1,472,254	615,621	104,166	56,739	2,122,298	995,435
Louisiana			14,760	11,070	45,604	34,203	60,364	45,273
Maine	5,950	4,650	9,709	6,667	12,841	9,781	28,500	21,098
Maryland	404,523	349,833	293,076	195,373	307,547	285,779	1,005,146	830,985
Massachusetts	649,144	594,666	151,274	76,470	622,425	519,167	1,422,843	1,190,303
Michigan	530,823	267,702	42,448	25,372	366,657	171,730	939,828	464,804
Minnesota	46,944	46,172	10,000	7,500	365,647	307,118	422,591	360,790
Missouri	466,143	363,302	218,895	137,428	775,621	622,305	1,460,659	1,123,035
Montana	4,590	1,271	258	56	90,842	36,521	95,690	37,848
Nebraska	32,137	27,300	4,776	2,626	239,208	216,189	276,121	246,115
New Hampshire	20,936	13,745			5,508	4,266	26,444	18,011
New Jersey	827,705	674,202	370,949	253,504	396,422	308,752	1,595,076	1,236,458
New Mexico					326,025	315,000	326,025	315,000
New York	2,267,264	1,408,490	1,574,107	916,952	2,164,735	1,503,453	6,006,106	3,828,895
North Carolina	65,700	65,128	166,166	91,187	374,382	317,959	606,248	474,274
Ohio	3,453,360	1,748,075	1,086,219	443,060	908,441	423,059	5,448,000	2,614,194
Oklahoma	15,802	7,441	170,928	75,947	129,568	85,314	316,298	168,702
Oregon	218,379	157,267	163,407	77,979	107,071	89,606	488,857	324,852
Pennsylvania	1,640,049	1,110,039	1,196,793	769,994	1,313,268	846,916	4,150,110	2,726,949
Rhode Island	61,373	72,255			32,095	29,013	93,468	101,268
South Carolina	28,425	27,684	69,131	58,019	70,392	77,354	167,948	163,057
South Dakota	14,120	11,300			85,434	61,994	99,554	73,294
Tennessee	345,765	264,288	628,979	220,333	150,830	85,467	1,125,574	570,088
Texas	196,051	119,218	75,799	43,510	345,443	281,389	617,293	444,117
Utah	16,000	19,200	3,000	1,500			19,000	20,700
Vermont	17,978	13,563			11,460	11,391	29,438	24,954
Virginia	1,931,852	1,185,271	679,119	395,180	218,015	147,900	2,828,986	1,728,351
Washington	162,777	87,259	20,459	12,269	24,029	20,668	207,265	120,196
West Virginia	197,245	113,525	464,044	222,952	72,641	46,042	733,930	382,519
Wisconsin	1,000,667	635,618	104,325	42,653	604,884	396,407	1,709,876	1,074,678
Wyoming					9,117	10,840	9,117	10,840
Total	21,786,833	13,329,365	11,904,679	6,108,408	15,672,964	10,723,993	49,364,476	30,161,766

According to this table, 11 States in 1914 produced and sold crushed stone valued at more than $1,000,000, as follows, by rank: New York, Pennsylvania, Ohio, California, Illinois, Virginia, New Jersey, Massachusetts, Indiana, Missouri, and Wisconsin. In 1913 there were 9 States, ranking as follows: New York, Pennsylvania, Ohio, Illinois, California, Massachusetts, New Jersey, Missouri, and Indiana. Virginia, which produced 1,026,996 short tons, valued at $600,741 in 1913, more than doubled its output in 1914, producing 2,828,986 tons, valued at $1,728,351, and rose from fifteenth to sixth place in value of production. This increase was due to great activity in making roads. Kentucky, Alabama, Wisconsin, New Mexico, and California each increased their value of production by more than $100,000. Florida and Maryland made gains of more than $50,000. Utah, which produced no crushed stone in 1913, reported 19,000 tons, valued at $20,700, in 1914. The greatest decreases were in Pennsylvania, which declined $671,402 and in Illinois and Massachusetts, each of which declined more than $500,000. Missouri, New York, and Iowa also each lost more than $208,000.

Besides the stone reported above as crushed for making roads, a large quantity of other material answering practically the same purpose as crushed stone is used in construction of roads. In almost all the States a large quantity of gravel, often crushed gravel, is used for road material. In Missouri a considerable amount of road material is obtained from the tailings of the concentrating mills at the zinc mines. This is put on the market as "chats" and consists of small angular fragments of chert and limestone. The zinc companies are very glad to get rid of this waste material, which is loaded on the cars by the various railroads of the district at a cost of about 6 or 8 cents a ton. It makes more than ordinarily good roads and is widely distributed all through the Middle West; it sells at prices ranging from 50 cents to $1 a ton. In the neighborhood of the mines the material sells for about 15 cents a ton. It is used for railroad ballast as well as for road metal. The annual output amounts to about 1,300,000 tons. In Tennessee and Alabama a quantity of chert is used for road metal, and crushed slag from the blast furnaces of the various States furnishes a valuable road material. In some of the large iron-producing States a large quantity of furnace slag is crushed and used as road metal, the average value of which is about 25 cents a ton. Crushed slag is also used as railroad ballast and for concrete and roofing material.

Crushed stone is the largest factor in the stone industry at the present time. In 1898 the first figures of the value of crushed stone were published and amounted to $4,031,445. Crushed stone, chiefly for road metal and railroad ballast, was reported previously to that time, but was not separated from other products. The growth of the crushed-stone industry is well shown in the following table, which gives the output of exterior building stone, monumental stone, and crushed stone from 1900 to 1914, the year 1900 being the first year for which exactly comparable tables are available. Prior to the advent of crushed stone, building and monumental stone were considered the chief stone products. The stone crushed for concrete and cement took the place of a large quantity of building and foundation stone.

Value of exterior building stone, monumental stone, and crushed stone sold in 1900-1914.

Year.	Monumental stone (rough and dressed).	Building stone (rough and dressed).	Crushed stone.	Year.	Monumental stone (rough and dressed).	Building stone (rough and dressed).	Crushed stone.
1900....	$3,618,316	$10,672,598	$6,525,368	1908....	$6,948,841	$16,040,630	$20,262,012
1901....	4,734,699	15,112,600	8,560,432	1909....	6,104,190	17,594,455	24,078,780
1902....	5,941,585	20,790,341	11,480,959	1910....	6,887,542	16,105,856	27,264,535
1903....	5,767,360	19,795,491	13,188,938	1911....	6,985,416	16,443,758	28,426,375
1904....	5,991,714	18,883,455	15,530,122	1912....	6,759,119	16,306,659	28,592,536
1905....	6,112,585	20,240,809	16,419,614	1913....	7,212,648	14,937,214	31,677,871
1906....	6,773,478	20,681,625	17,467,486	1914....	7,047,572	14,396,528	30,161,766
1907....	6,978,949	16,675,811	22,054,297				
Percentage of decrease (−) in 1914					−2.29	−3.62	−4.79

It is noticeable that whereas the values for building and monumental stone show considerable fluctuation, those for crushed stone show continued increase except for the year 1908—when a sharp decrease was shown, with entire recovery in 1909—and also for the year 1914.

EXPORTS.

Exports of stone have fluctuated from year to year, but on the whole have risen in value as shown by comparison of the value for 1900, which was $209,587, with that of 1913, which was $1,856,892. The rise in value has been continuous since 1908, and since 1911 the value of exports has exceeded that of 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 of stone for the calendar years 1913 and 1914:

Exports of stone from the United States in 1913 and 1914.

Kind.	1913	1914
Marble and stone, unmanufactured	$606,745	$559,556
All others	1,250,147	803,686
Total	1,856,892	1,363,242

Exports decreased $493,650 in value in 1914, as compared with 1913. The decrease was chiefly in the value of manufactured or dressed stone.

The following table shows for the first time the value of manufactured and unmanufactured stone exported to different countries:

Exports of stone (including marble) from the United States in 1914, according to countries.

Country.	Manufactured.	Unmanufactured.
Europe:		
Belgium	$2,867	$30
Denmark	3,274	
France	4,168	
Germany	22,651	5
Great Britain	39,356	1,948
Netherlands	4,915	10
Russia	50,108	
Sweden	2,485	
Other Europe	2,908	
Total	132,732	1,993
North America:		
Canada	448,989	533,113
New Foundland, etc	1,272	6,246
Mexico	5,118	12,338
Central America	4,499	
Panama	23,201	5,486
Cuba	67,311	224
Jamaica	4,471	
Barbados	2,467	
Trinidad and Tabago Islands	6,954	
Other West Indies	4,199	
Total	568,481	557,407
South America:		
Argentina	2,910	
Brazil	2,264	
Chile	2,926	
South America—Continued.		
Colombia	$7,277	
Other South America	2,580	$156
Total	17,957	156
Asia:		
China	4,284	
British India	9,864	
Japan	4,243	
Other Asia	806	
Total	19,197	
Oceania:		
Australia and Tasmania	44,342	
New Zealand	15,982	
Philippine Islands	1,773	
Other Oceania	265	
Total	62,362	
Africa:		
British South Africa	2,504	
Other Africa	453	
Total	2,957	
Total exports	803,686	559,556
Grand total	1,363,242	

Canada provided by far the largest market, receiving a total quantity of stone valued at $982,102. The next largest customers were, in order of rank, Cuba, Russia, Australia and Tasmania, Great Britain, Panama, Germany, New Zealand, and Mexico, with purchases valued at more than $10,000 each. Of the different continents, North America was, of course, the largest customer, with total purchases valued at $1,125,888, and Europe second, with total purchases valued at $134,725. The list of countries shows that American stone, in greater or less quantity, is finding its way to all parts of the world.

IMPORTS.

The value of imports increased greatly in the years 1900 and 1901. Since then it has fluctuated somewhat, but for the last 10 years it has shown little variation from $1,500,000. The following table, compiled from statistics furnished by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, gives the value of imports of stone for the calendar years 1913 and 1914:

Imports of stone into the United States in 1913 and 1914.

Kind.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Marble:				
In block, rough, etc. cubic feet	643,225	$1,024,595	567,306	$878,284
Sawed or dressed do	221	606		
Slabs or paving tiles sup. feet	275,888	50,788	279,028	62,828
All other manufactures		242,674		153,920
Mosaic cubes:				
Loose pounds	[a]3,660,280	48,944		30,566
Attached to paper do				1,541
Total		1,367,607		1,127,139
Onyx:				
In blocks, rough, etc. cubic feet	10,067	34,518	10,693	31,368
All other manufactures		1,803		2,026
Total		36,321		33,394
Granite:				
Dressed		110,451		155,777
Rough cubic feet	13,701	5,074	5,788	2,280
Total		115,525		158,057
Stone (other):				
Dressed		23,422		15,994
Rough (monumental or building stone) cubic feet	125,085	63,260	43,753	25,978
Rough (other)		9,017		28,911
Total		95,699		70,883
Grand total		1,615,152		1,389,473

[a] Quantity estimated for last three months of 1913.

Granite imports increased $42,532, or 36.8 per cent in value. As these imports came chiefly from Scotland, Sweden, and Canada, whose commerce in 1914 had not been materially affected by the European war, the increase in their value seemed to indicate the effects of the tariff act of 1913, which lowered the duty on dressed stone from 50 per cent to 25 per cent ad valorem. Imports of rough granite, however, decreased $2,794, or 55.1 per cent, in spite of a reduction in tariff from 10 cents to 3 cents a cubic foot. Imports in the years preceding the revision of the tariff fluctuated in value to so great an extent that the figures for 1914 alone are insufficient to give an adequate idea of the effects of the tariff act of 1913. The following table shows that during the last 10 years the value of the granite imported increased from 1905 to 1908 and then decreased until 1912, when it began to increase again.

Value of granite imported from 1905 to 1914, inclusive.

1905	$107,428	1910	$176,912
1906	166,075	1911	146,468
1907	175,303	1912	112,338
1908	193,613	1913	115,525
1909	190,418	1914	158,057

Imports of "other stone" decreased $24,816, or 25.9 per cent, in value, in spite of similar reductions in tariff.

The value of marble imports decreased $240,468, or 17.6 per cent, in 1914. This decrease was doubtless due in some measure to the European war, but more especially to labor troubles during the latter part of the year in Italy, which furnished 86.2 per cent of the total value of imports.

The value of imports of onyx marble decreased $2,927, or 8.1 per cent. More than 87 per cent by value of these imports came from Mexico in 1914.

The following table shows for the first time the value of marble and onyx, rough and manufactured, imported into the United States in 1914, by countries. The difference between the total values recorded in the two tables showing the value of imports of marble in 1914 is that the table below shows total general imports, whereas the table on page 836 shows total imports for consumption.

Value of marble and onyx, rough and manufactured, imported into the United States in 1914, by countries.

Country.	Value.	Country.	Value.
Austria-Hungary	$1,153	Canada	$976
Belgium	26,351	Mexico	29,122
Denmark	5,515		
France	45,974	Total North America	30,098
Germany	12,023		
Greece	22,163	Other countries	1,502
Italy	1,006,008		
Great Britain	13,968	Grand total	1,166,111
Other Europe	1,356		
Total Europe	1,134,511		

GRANITE.

MARKETED PRODUCTION.

The figures given in this report as representing the value of the granite produced and sold annually in the United States include also the value of small quantities of other crystalline and igneous rocks, such as syenite, gneiss, schist, tuff, rhyolite, trachyte, and andesite. The quantities of these rocks quarried are too small to tabulate separately, and 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 basalt and related rocks, commonly called "trap rock," in Arkansas, California, Connecticut, Hawaii, Massachusetts, northern Michigan, Minnesota, New Jersey, New York, Oregon, Pennsylvania, and Washington, represents, however, an industry sufficient by itself to make it practicable 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 1914 was $20,028,919, a decrease of $704,298, or 3.40 per cent, as compared with $20,733,217, the value in 1913. It was greater, however, by $805,617, or 4.19 per cent, than the value in 1912, which was $19,223,302, but was less than the value in both 1911 and 1910. That for 1911, $21,194,228, is the greatest value for the annual production of granite on record. The figures for 1914, in spite of the total decrease, show increases in the value of granite used for monumental stone, paving, flagging, and concrete aggregate. The largest decreases were for riprap and rubble.

Fourteen States reported each a production of granite valued at more than $500,000 in 1914 in the following order: Vermont, California, Massachusetts, Maine, New Hampshire, North Carolina, Wisconsin, Georgia, Maryland, Virginia, New York, Minnesota, Rhode Island, and Pennsylvania; in 1913 the order was as follows: Vermont, Massachusetts, Maine, New Hampshire, California, North Carolina, Pennsylvania, Wisconsin, Georgia, Minnesota, Maryland, Connecticut, New York, and Rhode Island. In 1914, as in 1913, the first seven States each produced granite valued at more than $1,000,000.

In 1914 California, Virginia, Wisconsin, North Carolina, Georgia, New York, and Maryland showed an increase in value of output; in 1913 these States were Vermont, Pennsylvania, New York, New Hampshire, North Carolina, Georgia, Maryland, Connecticut, and Massachusetts. California's large increase of $935,430 in 1914 was due especially to much greater production of building stone in Placer and Madera counties and to the harbor work in Humboldt Bay, which increased the demand for riprap. Monumental granite and crushed granite for concrete and roads also increased. Virginia's increase of $343,120 was due to great activity in the making of roads. Wisconsin's increase of $311,118 was due to a greater output of crushed granite and of paving blocks and to better labor conditions. Wisconsin's granite industry is just recovering from a depression that began in 1911. The large decrease of $661,778 in Vermont was due principally to a return to more nearly normal conditions from those of 1913, when a large contract caused an unusual production of granite for building. Pennsylvania's decrease of $591,193 marks a return to ordinary conditions from those of 1913 when an unusually large quantity of crushed granite was produced for building roads. In New York during 1914, as well as in 1913, a considerable quantity of stone from excavations in New York City was used for riprap and crushed for use in concrete work. Elsewhere in the State a large quantity of granite was used for heavy masonry and concrete work in the construction of dams for the New York City water supply.

The following table shows the value of the marketed production of granite, including a small output of other igneous rocks, in the United States from 1910 to 1914, inclusive:

Value of granite produced and sold in the United States, by States and Territories, 1910–1914.

State or Territory.	1910	1911	1912	1913	1914
Alabama	....	(a)	....	....	....
Arizona	(a)	$13,105	$26,501	$13,270	$8,741
Arkansas	$226,690	354,041	366,354	378,110	....
California	1,520,299	1,738,094	1,583,583	1,451,149	2,386,579
Colorado	93,679	137,356	55,010	84,497	74,774
Connecticut	410,535	574,673	761,757	765,334	405,655
Delaware	357,708	218,234	193,074	289,987	131,086
District of Columbia	....	(a)	....	....	....
Georgia	1,049,186	847,023	823,207	906,470	958,831
Hawaii	139,724	(b)	(b)	(b)	(b)
Idaho	(a)	(a)	30,300	113,710	(a)
Maine	2,315,730	2,257,034	1,803,679	1,790,279	1,717,110
Maryland	982,746	845,936	749,555	806,259	846,838
Massachusetts	1,567,754	2,361,624	2,220,279	2,220,630	2,091,417
Michigan	c 858,734	797,244	....	....	....
Minnesota			950,033	853,111	735,753
Missouri	120,663	139,070	97,776	42,484	77,971
Montana	(a)	29,670	28,666	31,520	25,977
Nevada	(a)	(a)	(a)	....	....
New Hampshire	1,239,656	1,017,272	1,311,488	1,482,771	1,383,325
New Jersey	80,105	167,112	142,515	62,637	74,808
New Mexico	(a)	(a)	(a)	(a)	(a)
New York	330,716	344,038	431,910	746,826	797,297
North Carolina	839,742	772,685	983,615	1,116,475	1,286,345
Oklahoma	102,566	20,244	14,460	30,678	24,695
Oregon	d 1,080,009	d 580,978	e 16,721	e 37,807	e 36,852
Pennsylvania	478,919	491,428	575,680	1,102,206	511,013
Rhode Island	521,490	957,743	767,507	642,375	621,620
South Carolina	369,448	335,617	263,905	360,476	357,657
South Dakota	....	(a)	(a)	(a)	(a)
Texas	66,909	70,488	67,613	76,067	115,857
Utah	6,783	5,209	8,975	(a)	(a)
Vermont	2,694,474	2,730,719	3,047,954	3,782,235	3,120,452
Virginia	503,106	420,611	470,657	462,162	805,287
Washington	d 642,992	d 1,345,551	e 140,581	e 140,279	e 72,079
Wisconsin	1,475,342	1,382,309	1,179,018	927,616	1,238,734
Other States	466,262	239,120	110,929	15,797	122,166
Total	20,541,967	21,194,228	19,223,302	20,733,217	20,028,919

a Included in "Other States."
b Basalt.
c Includes a small value for trap rock in Michigan and Minnesota.
d Includes basalt or trap rock.
e Exclusive of basalt or trap rock.

The following table shows the value of the granite, including small values for certain other igneous rocks, produced and sold in the United States in 1913 and 1914, by States and uses:

Value of granite produced and sold in the United States in 1913 and 1914, by States and uses.

1913.

State.	Sold in the rough.					Dressed for—		Made into paving blocks.
	Building.	Monumental.	Rubble.	Riprap.	Other.	Building.	Monumental.	
Arizona	$2,700	$3,570					$1,000	
Arkansas	63		$58,005	$37,000				
California	90,548	44,054	6,846	61,096	$1,204	$416,125	61,215	$109,902
Colorado	8,353	45,730	414			2,000		
Connecticut	35,292	40,352	3,375	340,080	952	141,214	94,456	46,640
Delaware	13,880	270	191,480	5,691		3,931		1,696
Georgia	14,446	29,043	30,266	21,141	50	200,496	42,886	172,831
Idaho	750		100			300		
Maine	208,028	39,224	26,526	18,707	21,104	633,140	27,189	702,318
Maryland	89,849	14,474	61,062	7,627	500	7,700	27,555	41,152
Massachusetts	198,974	400,652	27,619	46,251	52,631	730,404	30,246	395,390
Minnesota	14,279	76,644	2,493	5,453		146,352	490,564	85,150
Missouri	869	16,552		1,691		1,425	360	4,882
Montana	770	500	100			22,850	2,000	
New Hampshire	51,961	93,662	33,228	1,561	2,589	553,333	194,995	451,545
New Jersey	672	547	2,400	1,342	620		4,081	
New Mexico [a]								
New York	11,990	3,832	25,981	259,148	600	30,871	8,754	28,000
North Carolina	62,103	18,571	36,916		50	304,642	23,615	215,133
Oklahoma	6,200	18,150	128			600	2,000	
Oregon	80	1,500				200	10,015	
Pennsylvania	333,598	4,035	10,871	180,901	33,418	53,179	39,865	49,440
Rhode Island	38,631	154,453	279	1,014	100	67,041	230,440	66,018
South Carolina	440	86,247	2,752	37,883	150	690	59,589	8,844
South Dakota [a]								
Texas	6,453	33,946		28,918			6,000	
Utah. [a]								
Vermont	43,621	1,453,818	4,566	124	13,522	2,008,240	239,187	3,162
Virginia	47,980	11,797	38,854	42,000	58	4,200	3,294	73,795
Washington	2,211	1,674		9,568		29,167	9,335	20,632
Wisconsin	1,451	18,843	2,082	400	342	10,829	486,913	279,465
Other States [b]	7,057	1,167		1,100		250	6,223	
Total	1,293,249	2,613,307	566,343	1,108,696	127,890	5,369,179	2,101,777	2,755,995

State.	Curbing.	Flagging.	Crushed stone.			Other.	Total.
			Road metal.	Railroad ballast.	Concrete.		
Arizona				$265	$5,735		$13,270
Arkansas			$159,423	60,493	63,126		378,110
California	$92,745		222,259	186,125	156,143	$2,887	1,451,149
Colorado			28,000				84,497
Connecticut	25,265	$284	16,511		12,550	8,363	765,334
Delaware	3,659		37,522	21,327	10,496	35	289,987
Georgia	189,736	720	32,100	49,884	98,726	24,145	906,470
Idaho			15,000	70,560	27,000		113,710
Maine	84,686	6,754	2,055	324	16,262	3,962	1,790,279
Maryland	6,820	685	256,958	136,485	149,820	5,572	806,259
Massachusetts	132,646	1,870	86,812	14,008	84,440	18,687	2,220,630
Minnesota	18,976		13,110		40	50	853,111
Missouri					12,712	3,993	42,484
Montana	1,800		500		3,000		31,520
New Hampshire	70,498	1,175	6,415	129	10,297	11,383	1,482,771
New Jersey			7,680	44,373	922		62,637
New Mexico							(a)
New York			32,900		342,170	2,580	746,826
North Carolina	92,240		57,888	67,828	235,548	1,941	1,116,475
Oklahoma					3,600		30,678
Oregon			26,000		12		37,807
Pennsylvania	9,353	159	327,129	12,311	33,822	14,125	1,102,206
Rhode Island	11,000		58,500	3,000	7,996	3,903	642,375
South Carolina	9,560		47,776	43,950	61,757	838	360,476
South Dakota							(a)
Texas			750				76,067
Utah							(a)
Vermont	1,737		1,877	664	11,717		3,782,235
Virginia	11,681		86,618	34,916	94,969	12,000	462,162
Washington	51,478		6,980	6,000		3,234	140,279
Wisconsin	410	1,525	54,803		70,553		927,616
Other States [b]							15,797
Total	814,290	13,172	1,585,566	752,642	1,513,413	117,698	20,733,217

[a] Included in "Other States." [b] Includes New Mexico, South Dakota, and Utah.

Value of granite produced and sold in the United States in 1913 and 1914, by States and uses—Continued.

1914.

State.	Sold in the rough. Building.	Sold in the rough. Monumental.	Sold in the rough. Rubble.	Sold in the rough. Riprap.	Sold in the rough. Other.	Dressed for— Building.	Dressed for— Monumental.	Made into paving blocks.
Arizona	$3,130	$3,250					$1,000	
California	149,599	60,809	$2,724	$351,619	$1,229	$878,375	45,227	$106,516
Colorado	3,910	51,969	345	1,250		100		
Connecticut	25,124	30,948	59,170	89,584	1,310	84,279	30,661	43,174
Delaware	1,702		10,814	27,433		1,146		4,690
Georgia	23,982	14,261	42,107		4,550	250,843	20,252	221,563
Idaho [a]								
Maine	144,407	61,611	38,718	10,167	8,587	794,313	25,697	529,853
Maryland	119,606	9,781	12,877	3,934	88	11,530	8,825	24,394
Massachusetts	46,321	451,095	64,809	19,708	10,967	710,171	34,750	418,671
Minnesota	2,537	115,809	5,078	1,780		60,092	436,793	86,441
Missouri	1,737	24,172		1,541		6,750		26,323
Montana	1,240	11,960				8,895		
New Hampshire	84,680	93,466	3,857	1,787	703	491,483	211,503	391,480
New Jersey	1,600	2,000	948	2,243	600			
New Mexico [a]								
New York	127,495	10,059	5,000	66,636	100	221,413	8,133	10,909
North Carolina	68,417	4,681	11,675	1,012	100	375,925	34,710	243,314
Oklahoma		9,440	1,900			2,145	9,610	
Oregon	24	1,727				100	8,775	
Pennsylvania	192,428	8,474	10,309	3,958	55,615	41,288	42,000	77,018
Rhode Island	8,931	186,388	145		253	11,905	246,209	51,298
South Carolina	1,138	73,113	5,564	17,563	194	1,697	85,000	2,082
South Dakota [a]								
Texas	11,540	37,861		24,962	1,920		18,100	
Utah [a]								
Vermont	15,705	1,509,795	1,169		12,683	1,321,534	242,227	3,375
Virginia	57,400	8,894	44,689	59,700		5,187	6,500	41,750
Washington	953	2,049		25,921	1,800	13,252	8,177	617
Wisconsin	2,352	69,931	473	54	17,030	1,038	348,122	548,100
Other States [b]	91,280	660		4,960		392	17,614	
Total	1,187,238	2,854,203	322,371	715,812	117,729	5,293,853	1,889,885	2,831,565

State.	Curbing.	Flagging.	Crushed stone. Road metal.	Crushed stone. Railroad ballast.	Crushed stone. Concrete.	Other.	Total.
Arizona					$1,361		$8,741
California	$59,889	$164	$316,807	$117,376	295,124	$1,121	2,386,579
Colorado			8,600		8,600		74,774
Connecticut	26,142	100	4,401		2,550	8,212	405,655
Delaware	4,652	84	33,501	5,950	40,932	182	131,086
Georgia	226,739		2,888	35,039	110,330	6,277	958,831
Idaho							(a)
Maine	80,011	2,060	4,650	6,667	9,781	588	1,717,110
Maryland	3,000		231,149	165,312	249,436	6,906	846,838
Massachusetts	141,508	2,578	114,905	2,325	59,301	14,308	2,091,417
Minnesota	3,619		19,854		3,750		735,753
Missouri	2,500				8,546	6,402	77,971
Montana					3,882		25,977
New Hampshire	74,474	100	13,745		4,266	11,781	1,383,325
New Jersey			18,465	31,109	17,843		74,808
New Mexico							(a)
New York	4,502		12,525		330,450	75	797,297
North Carolina	86,986	300	56,443	89,515	308,884	4,383	1,286,345
Oklahoma		1,500				100	24,695
Oregon					22,000	4,226	36,852
Pennsylvania	1,709	5,563	28,874	350	43,127		511,013
Rhode Island	15,350		72,128		29,013		621,620
South Carolina	8,021		27,684	58,019	77,354	228	357,657
South Dakota							(a)
Texas	1,474		12,320	350	7,330		115,857
Utah							(a)
Vermont	1,135		3,953		8,876	5	3,120,457
Virginia	10,753		471,902	30,354	68,153		805,282
Washington	8,488		7,532		2,200	1,090	72,079
Wisconsin		1,400	105,048		145,186		1,238,734
Other States [b]				7,260			122,166
Total	760,952	13,849	1,567,374	549,626	1,858,575	65,884	20,028,919

[a] Included in "Other States."
[b] Includes Idaho, New Mexico, South Dakota, and Utah.

Building stone.—About 32 per cent of the value of the granite produced and sold in 1914 was represented by building stone, which, rough and dressed stone included, was valued at $6,481,091, of which less than one-fifth was the value of rough stone and over four-fifths the value of the dressed stone sold. In 1913 this value was $6,662,428, a decrease of $181,337 in 1914. Nearly 21 per cent of the value of the building stone in 1914 was represented by Vermont's output, which was chiefly dressed stone. In 1913 Vermont produced 30 per cent of the total. California, Maine, Massachusetts, and New Hampshire followed next in order, producing, respectively, 16, 14, 12, and 9 per cent of the granite used for building. The stone in these States also is sold chiefly as dressed stone. Pennsylvania contributes more rough stone than any other State.

Monumental stone.—Nearly 24 per cent of the value of granite produced and sold in 1914 was for monumental stone (rough and dressed), the total value of which was $4,744,088, an increase of $29,004, or 0.62 per cent, over the value for 1913, which was $4,715,084. Three-fifths of the total value was for rough and two-fifths for dressed stone, the rough increasing and the dressed decreasing in value in 1914. Vermont's output was nearly 37 per cent of the total rough and dressed monumental stone. The next State in rank was Minnesota, which produced, however, only 12 per cent.

Rubble.—Rubble decreased in value $243,972 in 1914, from $566,343 in 1913 to $322,371 in 1914.

Riprap.—Stone for riprap decreased in value $392,884 in 1914 from $1,108,696 in 1913 to $715,812.

Paving blocks.—Paving blocks represented over 14 per cent of the value of the granite output. Wisconsin, Maine, Massachusetts, New Hampshire, North Carolina, Georgia, and California, in the order named, were the largest producers of this material according to value. Wisconsin's output in 1914 nearly doubled in value that of 1913. Although Wisconsin ranked first in value, Maine and New Hampshire were first and second in quantity of paving blocks produced. Paving blocks in Wisconsin are generally of larger size and always bring a higher price than the average.

The following table shows the quantity and value of granite paving blocks produced and sold in the United States in 1913 and 1914, by States:

Number and value of granite paving blocks produced and sold in 1913 and 1914, by States.

State.	Paving blocks.			
	1913		1914	
	Number.	Value.	Number.	Value.
California	2,096,567	$109,902	1,904,153	$106,516
Connecticut	992,509	46,640	890,022	43,174
Delaware	46,430	1,696	118,143	4,690
Georgia	4,910,958	172,831	5,986,824	221,563
Maine	13,266,644	702,318	10,708,177	529,853
Maryland	681,000	41,152	389,400	24,394
Massachusetts	7,885,001	395,390	8,325,520	418,671
Minnesota	1,126,000	85,150	1,123,750	86,441
Missouri	104,175	4,882	587,220	26,323
New Hampshire	10,979,474	451,545	9,449,108	391,480
New York	400,000	28,000	218,184	10,909
North Carolina	4,415,311	215,133	4,473,259	243,314
Pennsylvania	1,041,718	49,440	1,571,700	77,018
Rhode Island	1,123,581	66,018	901,843	51,298
South Carolina	231,710	8,844	83,884	2,082
Vermont	70,654	3,162	75,000	3,375
Virginia	1,595,628	73,795	909,000	41,750
Washington	182,092	20,632	10,280	617
Wisconsin	5,308,092	279,465	9,351,707	548,100
Total	56,462,544	2,755,995	57,077,174	2,831,568
Average price per thousand		$48.81		$49.60
Percentage of increase in 1914 as compared with 1913			1.09	2.74

These figures give the quantity and value of paving blocks quarried and sold by the quarrymen. In some of the States, notably Vermont, a considerable quantity of stone is sold to manufacturers who manufacture the paving blocks and market them. As these firms have no connection with the quarries and as the stone purchased by them is already reported by the quarrymen as sold rough, the blocks manufactured are not included in the figures of the paving-block industry. This output in Vermont amounted to about 2,800,000 blocks, valued at about $109,000 in 1913, and about 2,000,000 blocks, valued at about $70,000 in 1914. (A change was made in the Vermont figures for 1913 to conform to those for 1914.) In Massachusetts the quarrymen themselves sell the paving blocks manufactured by the "motion" men, who manufacture the blocks from their stone, and these blocks are included in the total.

The paving-block business showed an increase in quantity and value in 1914, as compared with 1913. The average price per thousand also increased. The increase in quantity was from 56,462,544 blocks in 1913 to 57,077,174 blocks in 1914, a gain of 614,630 blocks, or 1.09 per cent. The increase in value was from $2,755,995 in 1913 to $2,831,568 in 1914, a gain of $75,573, or 2.74 per cent. The average price per thousand was $47.99 in 1911, $57.53 in 1912, $48.81 in 1913, and $49.60 in 1914. The value of the blocks varies with the size and with the dressing, and ranges from about $25 to $100 a thousand.

A large proportion of the output from Minnesota and Wisconsin supplies the Chicago market. The blocks for Baltimore, 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 $53,338, or from $814,290 in 1913 to $760,952 in 1914. The value in 1913 also decreased $83,919 as compared with that of 1912. Georgia, Massachusetts, North Carolina, Maine, and New Hampshire are the largest producers of this material.

Flagging.—Only a small part of the total granite output is used for flagstone. Flagstone increased $677 in value, or from $13,172 in 1913 to $13,849 in 1914.

Crushed stone.—Granite in the form of crushed stone represented nearly 20 per cent of the value of the total marketed output of granite and 13 per cent of the value of the crushed stone produced and sold in the United States in 1914.

There was an increase in 1914 of 341,804 short tons in quantity and of $123,954 in value of the crushed granite, or from 4,874,629 short tons, valued at $3,851,621, in 1913 to 5,216,433 short tons, valued at $3,975,575, in 1914. About 86 per cent of this crushed stone was used for road metal and for concrete—nearly equally divided between the two—and the remaining 14 per cent for railroad ballast. Road metal and railroad ballast decreased in output, but their combined decrease was more than offset by the increase in stone for concrete. The average value per short ton was 79 cents in 1913 and 76 cents in 1914, a decrease of 3 cents.

Other purposes.—Rough stone sold for a variety of purposes not given on the statistical card decreased from $127,890 in 1913 to $117,729 in 1914, a loss of $10,161; and worked stone sold for a variety of purposes decreased $51,814, or from $117,698 in 1913 to $65,884 in 1914.

GRANITE IN INDIVIDUAL STATES.

GENERAL STATEMENT.

It is always recognized that statistics are of much greater service when both the quantity and the value are given, and the Survey has endeavored to render the stone statistics as complete as possible by publishing such figures of quantity as can be compiled from the data reported by the quarrymen. Owing to the various units of measurement used and to the lack of uniformity of some of the units, and also because many operators give no unit, it is difficult to compile figures of quantity. However, the majority of producers in several of the larger granite States report quite conformable figures of quantity, and below is given the output of Maine, Minnesota, New Hampshire, Vermont, and Wisconsin, showing the quantity and the distribution of the output by counties. No county figures are published unless there are three or more producers in the county. As requests have been made for the output of Massachusetts according to the distribution of the output, the figures of value are given by counties as far as they can be made available. It is to be regretted that the quantities for this State can not also be published.

MAINE.

Much of the granite quarried in Maine is shipped in large blocks for cyclopean masonry. The largeness of this stone renders it somewhat difficult to handle, but on account of the nearness of much of it to water transportation and because of the fewer number of pieces to handle it does not command as high a price per cubic foot as some of the other granites. For the same reason, and because there is often so little carving on the larger blocks, the dressed stone does not show such a high average price per cubic foot. The dressed stone also varies considerably in average price, depending on the terms of the contract.

Maine, in 1914 as well as 1913, was one of the larger States which showed a decreased marketed production of granite. This decrease was $73,169, or from $1,790,279 in 1913 to $1,717,110 in 1914.

Building stone decreased in quantity but increased in value, owing to the greater quantity of dressed stone produced. The average price of both rough and dressed building stone decreased in 1914, as in 1913.

Monumental stone increased in both quantity and value in 1914, in contrast to 1913. The quantity of rough stone produced in 1914 was more than double that produced in 1913. The average price of rough stone decreased 15 cents and that of dressed stone increased 10 cents a cubic foot in 1914.

Paving blocks showed a larger decrease in value in 1914 than any other kind of granite. Their price per thousand decreased $3.46.

Crushed stone increased in both quantity and value in 1914, although its average price per ton decreased 11 cents. These conditions are exactly opposite to those of 1913.

Curbing and flagging decreased in quantity, value, and average price in 1914, as they did in 1913.

The figures in the table on page 846 show the marketed output by groups of counties rather than by individual counties, the small number of producers in each county rendering this necessary.

Marketed production of granite in Maine in 1913 and 1914 by counties and uses.

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 (linear feet).	Value.	Value.	
1913.																	
Cumberland, Franklin, Oxford, Somerset, and York	18	55,188	$10,322	31,866	$200,414	17,206	$11,827	3,885	$3,775	1,235,775	$61,730	21,891	$18,541	13,625	$5,335	$9,213	$321,157
Hancock	30	577,067	173,282	207,765	251,977	18,469	4,125	10,020	7,740	2,592,794	130,323	....	....	180,211	86,105	42,105	695,657
Kennebec, Knox, Lincoln, and Waldo	15	50,173	24,424	94,603	178,799	11,948	8,795	2,451	7,270	9,431,875	509,921	138	100	....	....	18,981	748,290
Washington and Aroostook	7	....	....	705	1,950	19,263	14,477	2,852	8,404	6,200	344	....	....	....	....	....	25,175
Total	70	682,498	208,028	334,939	633,140	66,886	39,224	19,208	27,189	13,266,644	702,318	22,029	18,641	193,836	91,440	70,299	1,790,279
Average price	....	....	$0.30	....	$1.89	....	$0.59	....	$1.42	Per M, $52.94		....	$0.85	....	$0.47	....	....
1914																	
Cumberland, Franklin, Oxford, Somerset, and York	11	79,300	$14,717	111,009	$281,418	17,998	$6,349	2,720	$3,184	448,012	$21,445	27,900	$20,618	12,309	$3,673	$3,014	$354,418
Hancock	24	411,779	128,190	192,782	212,723	67,963	20,982	8,100	8,200	1,284,040	58,284	....	....	171,040	78,398	24,621	531,398
Kennebec, Knox, and Waldo	7	....	....	152,577	298,572	40,021	19,056	3,189	8,151	8,973,010	449,987	....	....	....	....	30,425	806,191
Washington and Aroostook	8	4,500	1,500	480	1,600	15,500	15,224	2,875	6,162	3,115	137	600	480	....	....	....	25,103
Total	50	495,579	144,407	456,848	794,313	141,482	61,611	16,884	25,697	10,708,177	529,853	28,500	21,098	183,349	82,071	58,060	1,717,110
Average price	....	....	$0.29	....	$1.74	....	$0.44	....	$1.52	Per M, $49.48		....	$0.74	....	$0.45	....	....

MASSACHUSETTS.

Comparison with the report for 1913 will show some revision of the figures for that year. This revision was made because it was found that several quarries, especially in eastern Massachusetts, that had heretofore been reported as producers of trap rock were, in fact, producers of siliceous volcanic rocks (felsites), granite, and mica schist. These rocks are now classified in this report as granite, and changes were made in the figures for 1913 to correspond with those of 1914.

It has not been found possible to show the quantity of granite quarried in Massachusetts, but the figures given in the following table serve to show the distribution of the stone and its principal uses. Massachusetts, like Maine, was one of the larger granite-producing States that showed a decrease in marketed output in both 1913 and 1914. This decrease was from \$2,220,630 in 1913 to \$2,091,417 in 1914, and amounted to \$129,213, or nearly 6 per cent.

Value of granite produced and sold in Massachusetts in 1913 and 1914, by counties and uses.

1913.

County.	Number of operations.	Building.		Monumental.		Paving blocks.	Crushed stone.	Other.[a]	Total value.
		Rough.	Dressed.	Rough.	Dressed.				
Berkshire, Franklin, Hampden, and Hampshire	5	\$75	\$60,096	\$39,981	\$2,000	\$1,800	\$15,190	\$14,004	\$133,146
Bristol, Plymouth and Suffolk	14	56,300	13,583	400	250	11,896	44,239	27,153	153,821
Essex	16	84,003	128,296	34,228	....	285,843	40,525	77,698	650,593
Middlesex	22	3,082	61,368	80	4,681	85,335	13,195	75,639	243,380
Norfolk	15	45,174	4,310	325,763	23,265	4,000	49,600	47,395	499,507
Worcester	11	10,340	462,751	200	50	6,516	22,511	37,815	540,183
Total	83	198,974	730,404	400,652	30,246	395,390	185,260	279,704	2,220,630

1914.

County.	Number of operations.	Building.		Monumental.		Paving blocks.	Crushed stone.	Other.[a]	Total value.
		Rough.	Dressed.	Rough.	Dressed.				
Berkshire, Franklin, Hampden, and Hampshire	5	\$85	\$82,000	\$38,552	\$2,000	\$30,950	\$6,000	\$20,764	\$147,637
Bristol, Plymouth, and Suffolk	14	20,545	106,677	1,322	....	....	62,104	28,555	251,917
Essex	17	5,955	154,448	41,991	....	300,800	52,233	77,362	632,789
Middlesex	21	9,287	60,896	....	16,500	59,901	9,338	78,483	234,405
Norfolk	16	4,328	31,470	368,726	16,250	480	36,382	13,455	471,091
Worcester	10	6,121	274,680	504	....	26,540	10,474	35,259	353,578
Total	83	46,321	710,171	451,095	34,750	418,671	176,531	253,878	2,091,417

[a] Other includes stone sold for riprap, rubble, curbing, flagging, and other minor uses.

MINNESOTA.

Minnesota showed a decrease of \$117,358 in value of marketed output of granite, from \$853,111 in 1913 to \$735,753 in 1914. The decrease was largely in building stone, which declined in both quantity and value, although its average price per cubic foot increased. Monumental stone increased in quantity but decreased in value, owing to a decline of 17 cents in the average price per cubic foot. The average price per thousand of paving blocks, which in 1913 made a notable increase of \$6.55 from \$69.07 in 1912 to \$75.62

in 1913, made a further increase to $76.92 in 1914 and caused an increase in total value of paving blocks in spite of a small decrease in quantity.

To prevent publishing individual figures the productions of neighboring counties are combined, and for the same reason the rough and the dressed stone are given together. The dark igneous rock quarried for crushed stone in Lake and St. Louis counties and formerly included with granite, has been grouped in this report under basalt and related rocks (trap rock).

Quantity and value of granite produced and sold in Minnesota in 1913 and 1914, by counties and uses.

1913.

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.		
Benton, Redwood and Renville	5	2,880	$1,875	9,350	$27,419					$8,379	$37,673
Sherbourne	5	51,762	40,369	4,870	4,240	712,000	$54,350	10,628	$13,110	5,575	117,644
Stearns	18	61,354	118,387	193,327	535,549	414,000	30,800	80	40	13,018	697,794
Total	28	115,996	160,631	207,547	567,208	1,126,000	85,150	10,708	13,150	26,972	853,111
Average price			$1.38		$2.73	Per M,	$75.62		$1.23		

1914.

County.	Number of plants.	Building quantity.	Building value.	Monumental quantity.	Monumental value.	Paving number of blocks.	Paving value.	Crushed stone quantity.	Crushed stone value.	Other value.	Total value.
Benton, Lac qui Parle, Redwood, and Renville	6	2,490	1,725	11,532	32,982	63,000	4,725			381	39,813
Sherbourne	5	20,000	23,482	4,550	6,725	592,000	45,466	15,511	19,854	7,620	103,147
Stearns	18	15,300	37,422	199,565	512,895	468,750	36,250	5,000	3,750	2,476	592,793
Total	29	37,790	62,629	215,647	552,602	1,123,750	86,441	20,511	23,604	10,477	735,753
Average price			$1.66		$2.56	Per M,	$76.92		$1.15		

NEW HAMPSHIRE.

In compiling a detailed statement of the output of granite in New Hampshire it was found that Cheshire and Hillsboro were the only counties that could be published separately, and that for 1913 and 1914 it was necessary to combine all the others, although the counties were not in close proximity. The total value of the output decreased from $1,482,771 in 1913 to $1,383,325 in 1914, a loss of $99,446, or 6.7 per cent.

The following table shows the quantity and value of the granite produced and sold in New Hampshire in 1913 and 1914 by counties and uses.

The decreases in value were chiefly in building and paving stone, which together represent more than two-thirds of the State production. Monumental, curbing and flagging, and crushed stone made relatively small increases. The average price of rough building stone increased 21 cents, and that of dressed monumental stone decreased 43 cents a cubic foot. Prices for the other kinds of stone made only small changes.

Quantity and value of granite produced and sold in New Hampshire in 1913 and 1914, by counties and uses.

1913.

County.	Number of operators.	Building.				Monumental.				Paving.		Curbing and flagging.		Crushed stone.		Other value.	Total value.
		Rough.		Dressed.		Rough.		Dressed.									
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Number of blocks.	Value.	Quantity.	Value.	Quantity.	Value.		
		Cu. ft.		*Cu. ft.*		*Cu. ft.*		*Cu. ft.*				*Linear feet.*		*Short tons.*			
Carroll, Grafton, Merrimack, and Strafford	9	27,990	$10,351	146,592	$458,842	35,064	$18,199	13,838	$53,099	2,986,720	$124,700	8,989	$4,638	17,574	$15,468	$17,257	$702,754
Cheshire	9	77,079	24,102	33,534	85,786	24,345	19,794	6,917	19,851	1,425,475	56,572	175	44	731	373	26,654	233,176
Hillsboro	18	56,514	17,508	8,894	8,705	60,343	55,669	32,028	122,045	6,567,279	270,273	208,316	66,991	2,000	1,000	4,650	546,841
Total	36	161,583	51,961	189,020	553,333	119,752	93,662	52,783	194,995	10,979,474	451,545	217,480	71,673	20,305	16,841	48,761	1,482,771
Average price			$0.32		$2.93		$0.78		$3.69	Per M,	$41.13		$0.33		$0.83		

1914.

County.	Number of operators.	Building rough quantity.	Building rough value.	Building dressed quantity.	Building dressed value.	Monumental rough quantity.	Monumental rough value.	Monumental dressed quantity.	Monumental dressed value.	Paving number of blocks.	Paving value.	Curbing and flagging quantity.	Curbing and flagging value.	Crushed stone quantity.	Crushed stone value.	Other value.	Total value.
Carroll, Coos, Grafton, Merrimack, and Strafford	11	16,135	$6,777	132,250	$397,202	51,649	$25,903	16,300	$61,000	2,338,658	$98,666	16,372	$5,594	12,454	$10,082	$14,931	$617,043
Cheshire	8	84,296	57,828	27,594	88,631	16,042	13,447	13,751	43,002	1,855,938	75,678			4,990	3,429	1,442	282,015
Hillsboro	17	58,748	20,075	6,200	5,650	55,371	54,116	34,830	107,501	5,254,512	217,136	184,375	68,980	9,000	4,500	1,755	478,623
Total	36	159,179	84,680	166,044	491,483	123,062	93,466	64,881	211,503	9,449,108	391,480	200,747	74,574	26,444	18,011	18,128	1,383,325
Average price			$0.53		$2.96		$0.76		$3.26	Per M,	$41.43		$0.37		$0.68		

VERMONT.

The marketed output of granite in Vermont represented more than 15.6 per cent of the total granite produced in the United States in 1914, and was greater by $733,878 than its closest competitor, California. Vermont's output in 1914 was valued at $3,120,457 and that of California at $2,386,579. The total value for Vermont represented a decrease of $661,778, or 17.5 per cent, from the value for 1913, which was $3,782,235. It was, however, greater by $72,503, or 2.4 per cent, than the value for 1912, which was $3,047,954.

As the granite industry is one of the principal sources of the State's wealth, the following detailed statement of output is of interest. It has been already stated in this report and in former reports that the value represents the value of the stone as sold by the quarrymen, the value 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 granite is sold in the rough to granite manufacturers, 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 this manufacturing industry forms a distinct, though dependent, source of wealth to the State. Dressed stone, including monumental and building stone, as quarried and sold by the quarrymen, amounted in 1914 to only 468,676 cubic feet, compared with 1,519,190 cubic feet sold rough. The dressed stone, however, was valued at $1,563,761, or an average price of $3.34 a cubic foot, while the rough stone value was valued at $1,525,500, or $1 a cubic foot.

If the rough stone is 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, and crushed stone represents a production valued in 1914 at about $6,600,000.

The marketed production of building stone in Vermont, which increased notably in 1913, was marked by almost as great a loss in 1914, decreasing from 605,232 cubic feet, valued at $2,051,861, in 1913, to 409,246 cubic feet, valued at $1,337,239, a decrease of 195,986 cubic feet and of $714,622. Monumental stone, on the other hand, increased slightly from 1,553,545 cubic feet, valued at $1,693,005, in 1913, to 1,578,620 cubic feet, valued at $1,752,022, in 1914, a gain of 25,075 cubic feet and of $59,017.

The paving-block industry in Vermont has never been of especial importance when compared with this same industry in the near-by States of Maine, New Hampshire, and Massachusetts. The greater number of the blocks made in this State are not made by the quarrymen, but are made from stone sold by them to firms who manufacture and sell the finished blocks. For this reason the stone sold by the quarrymen for paving blocks is included under rough stone, and the table of production does not include the entire number of blocks manufactured in the State. Besides the blocks reported in the table of production, there were made by paving-block contractors in 1914 about 2,000,000 blocks, valued at about $70,000, and in 1913 about 2,800,000 blocks, with an approximate value of $109,000.

The following table shows the marketed production of granite in Vermont in 1913 and 1914, by counties and uses:

Marketed production of granite in Vermont in 1913 and 1914, by counties and uses.

1913.

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.	
Orange, Washington, and Windsor	24	44,803	$38,639	546,335	$2,004,724	1,377,974	$1,403,090	67,253	$235,087			$30,930	$3,712,465
Orleans	5	20	210	3,040	3,040	25,140	12,520	3,000	2,100			900	18,505
Windham	5	8,844	4,272	190	476	150	75			70,654	$3,162	2,647	10,632
Caledonia	6	2,000	500			79,228	38,133	800	2,000				40,633
Total	40	55,667	43,621	549,565	2,008,240	1,482,492	1,453,818	71,053	239,187	70,654	3,162	34,477	3,782,235
Average price			$0.78		$3.65		$0.98		$3.37	Per M,	$44.75		

1914.

County.	Number of active firms reporting.	Building rough quantity	Building rough value	Building dressed quantity	Building dressed value	Monumental rough quantity	Monumental rough value	Monumental dressed quantity	Monumental dressed value	Paving quantity	Paving value	Other uses value	Total value
Orange, Washington, and Windsor	22	13,037	$10,777	387,467	$1,321,434	1,387,893	$1,451,373	60,069	$195,387			$22,861	$3,001,832
Essex and Orleans	4	5,200	3,510			27,540	14,020	5,040	9,040			1,705	28,275
Windham	4			100	100	50	25			75,000	$3,375		3,500
Caledonia	9	3,442	1,418			82,028	44,377	16,000	37,800			3,255	86,850
Total	39	21,679	15,705	387,567	1,321,534	1,497,511	1,509,795	81,109	242,227	75,000	3,375	27,821	3,120,457
Average price			$0.72		$3.41		$1.01		$2.99	Per M,	$45.00		

WISCONSIN.

To prevent disclosure of individual figures, it was found necessary, in compiling a detailed statement of the production of granite in Wisconsin, to class together the counties of Douglas, Green Lake, Oconto, Polk, and Waupaca, although these counties are not in the same part of the State. It was also necessary to include under building and monumental stone both the rough and the dressed stone, although it will readily be seen that the figures for monumental stone represent mostly dressed stone.

The marketed production of granite increased in value in 1914 from $927,616 to $1,238,734, a gain of $311,118, or 33.5 per cent. This gain was in the value of paving blocks and crushed stone, which overshadowed the relatively small decrease in building and monumental stone.

The quantity of paving blocks made in 1914 was nearly double in number those made in 1913, but the price per thousand decreased $9.07, from $52.65 in 1913 to $43.58 in 1914. The quantity of crushed granite increased 62 per cent and its average price per ton increased 20 cents, or from 85 cents in 1913 to $1.05 in 1914.

The figures for building stone form a very small fraction of the total. The value in 1913 was nearly four times that in 1914. The average price in cubic feet of monumental stone decreased from $4.96 in 1913 to $3.24 in 1914, a loss of $1.72, which accounts for the decrease in total value in spite of an increase in quantity.

The following table shows the marketed output of granite in Wisconsin in 1913 and 1914, by counties and uses:

Quantity and value of granite produced and sold in Wisconsin in 1913 and 1914, by counties and uses.

1913.

County.	Number of operators.	Building (rough and dressed).		Monumental (rough and dressed).		Paving blocks.		Crushed stone.		Other.	Total value.
		Quantity.	Value.	Quantity.	Value.	Quantity (number of blocks).	Value.	Quantity.	Value.	Value.	
		Cubic feet.		*Cubic feet.*				*Short tons.*			
Douglas, Green Lake, Oconto, and Waupaca	6			1,000	$1,300	631,073	$31,423	72,766	$65,756	$685	$99,164
Marathon	5	794	$1,119	42,850	178,033						179,152
Marinette	3	10,720	6,600	25,343	89,676						96,276
Waushara and Marquette	10	5,120	4,561	32,745	236,747	4,677,019	248,042	74,535	59,600	4,074	553,024
Total	24	16,634	12,280	101,938	505,756	5,308,092	279,465	147,301	125,356	4,759	927,616
Average price			$0.74		$4.96	Per M, $52.65			$0.85		

1914.

County.	Number of operators.	Building Quantity.	Building Value.	Monumental Quantity.	Monumental Value.	Paving blocks Quantity.	Paving blocks Value.	Crushed stone Quantity.	Crushed stone Value.	Other Value.	Total value.
Douglas, Green Lake, Oconto, Polk, and Waupaca	7			800	$1,000	784,440	$38,127	147,979	$170,719	$120	$209,966
Marathon	5	200	$1,038	52,189	118,700			80	40	44	119,822
Marinette	3	9,400	564	33.809	111,150	500	20			203	111,937
Waushara and Marquette	11	1,952	1,788	42,227	187,203	8,566,767	509,953	90,802	79,475	1,680	797,009
Total	26	11,552	3,390	129,025	418,053	9,351,707	548,100	238,861	250,234	2,047	1,238,734
Average price			$0.29		$3.24	Per M, $43.58			$1.05		

BASALT AND RELATED ROCKS (TRAP ROCK.)

The name "trap rock" has been loosely and inconsistently used in different parts of the country. The name "trap," of Teutonic derivation and signifying "step," was originally applied to rocks of basaltic or diabasic character occurring in the form of dikes and possessing a characteristic columnar structure due to a series of joints or seams developed during the consolidation of the rock from the molten state. These columns mostly had five or six sides and lay at right angles to the walls of the dike. In places where erosion had left the dike protruding above the general level of the surface or had exposed it in the face of a cliff, the falling away of some of the columnar blocks gave a steplike appearance to the remainder, and the rock was called "trap rock" ("step rock"). The name originally denoting this particular structure, later became used as a synonym for diabase, whether occurring in vertical dikes with horizontal columnar structure or in horizontal or inclined intrusive bodies. It was also applied to diabase with no well-defined columnar structure, and in some places, notably in the Connecticut Valley, to old surface flows of basalt. Progress in microscopic and chemical study gradually proved the existence of other dark-colored igneous rocks, both dikes and surface flows, which were different in composition from diabase and basalt, but which were too fine grained to be distinguished from them in the field. Some of these had also been called "trap rock," and the name gained usage among geologists as a general field term to designate fine-grained or dense igneous rocks of dark color and usually containing relatively low percentages of silica and high percentages of iron oxides, magnesia, and lime.

When the peculiar adaptability of crushed diabase and basalt for road construction was appreciated, "trap rock" became a commercial term and implied crushed diabase or basalt. There could be no objection to this usage so long as diabase and basalt were the only kinds of stone crushed; but the name "trap rock" grew in many places to be a synonym for "crushed stone" in general and therefore lost its significance, both in scientific and in commercial usage.

The following examples will serve to illustrate the vagueness of the term in commercial usage. Among the quarries of Massachusetts reported to the Survey as producing trap rock, those in the Connecticut Valley are in basalt. Those in the eastern part of the State, however, include only one or two active quarries in typical diabase or basalt. Several quarries, especially those in Winchester, Lynn, Salem, and Peabody, are in dark-colored fine to coarse grained rock, some of which is altered diabase, some is diorite, and some is gabbro; but it all yields stone very similar to typical diabase so far as results of tests are concerned. Some of the quarries in Brighton and Brookline are in a basaltic or andesitic lava, which has been so softened by alteration that it has no longer the hardness or toughness of typical basalt or diabase. A few quarries are in granite or granodiorite, which in places incloses blocks of fine-grained dark rock. Several quarries in Malden, Medford, Melrose, Revere, and Lynn are in hard siliceous rhyolitic lava or felsite, which yields crushed stone that is good for general purposes but is distinctly different from crushed basalt or diabase. Other quarries in and near Boston are in the Roxbury "puddingstone" or conglomerate, and quarries in Somerville and Watertown are in a massive slate, cut by a number of small diabase dikes. The city quarry at Haverhill, now abandoned, is in mica schist.

A quarry in Marion County, Ohio, was recently reported to the Survey as producing trap rock. There are, however, no igneous rocks exposed in Ohio, and the rock in question must be a sedimentary rock, of Silurian or Devonian age, either sandstone, shale, or limestone.

Several samples were recently sent to the Survey from "trap rock" quarries in California. They were mostly basalt and diabase, but included a few specimens of granite and sandstone.

Some producers have evidently come to regard the term "trap rock" as a synonym for "crushed stone," and they furnish crushed sandstone when specifications call for "trap rock."

Many sedimentary rocks have such properties as to yield a good quality of crushed stone, but only in exceptional cases are they the equal of typical basalt or diabase. It would seem advisable, therefore, to drop the term "trap rock" in specifications for crushed stone and to call for rock whose properties are sufficient to withstand the uses for which it is intended. If specifications for crushed stone call for certain standards of hardness, toughness, cementation, coefficient of wear, and other properties, crushed stone fulfilling these requirements may be furnished regardless of its geologic name. It will be found, however, to judge from data published by the Office of Public Roads, that the most severe requirements will be satisfied by only a few rocks other than basalts, diabases, and closely related igneous rocks, and that there will be considerable variation in the qualities of basalts and diabases.

In this report the section formerly headed "trap rock" is now headed "basalt and related rocks" and includes besides basalt and diabase only those dark igneous rocks that are very similar to basalt and diabase in mineral and chemical composition and physical properties. Other rocks, formerly listed under trap rock, are now included under granite (and related rocks) and sandstone (including conglomerate or "puddingstone"). This revision is doubtless not quite complete at present, but the quantity of granite and sandstone still included constitutes only an insignificant part of the total.

The following table shows the value of basalt and related rocks (trap rock) produced and sold by States from 1910 to 1914, inclusive:

Value of basalt and related rocks (trap rock) produced and sold in the United States, 1910–1914, by States.

State or Territory.	1910	1911	1912	1913	1914
Arkansas	(a)	(a)	(a)	(a)	$233,987
California	$1,955,335	$2,055,930	$1,926,347	$2,132,245	1,589,821
Connecticut	500,229	472,461	581,070	713,323	549,156
Hawaii	(a)	339,519	231,351	249,390	88,417
Massachusetts	797,048	859,070	915,241	1,194,068	691,330
Michigan	(a)	51,000	36,206	92,201	34,406
Minnesota	(a)	(a)	(a)	147,806	77,338
New Jersey	1,257,712	1,136,385	1,202,397	1,359,931	1,164,529
New York	970,994	959,966	831,667	1,077,690	895,147
Oregon	(a)	(a)	250,767	316,007	397,824
Pennsylvania	970,823	864,810	916,383	1,218,918	1,076,001
Washington	(a)	(a)	668,620	632,915	1,068,042
Total	6,452,141	6,739,141	7,560,049	9,134,494	7,865,998

[a] Included under granite.

These figures show a steady increase in total value up to 1914, when the marketed output decreased from $9,134,494 in 1913 to $7,865,998 in 1914, a loss of $1,268,496, or 13.89 per cent. The value in 1914, however, was greater by $305,949, or 4.05 per cent, than the value in 1912. The production in different States varied considerably in value during the years 1910 to 1913, inclusive, some States increasing, others decreasing; but they mostly showed marked decrease in 1914, only three, Arkansas, Oregon, and Washington, showing increase. Four States produced rock valued at more than $1,000,000 in 1914, compared with five in 1913. The cause of decrease may be better realized after an inspection of the following table, which shows the value of basalt and related rocks (trap rock) produced and sold in the United States in 1913 and 1914, by States and uses:

Value of basalt and related rocks (trap rock) produced and sold in the United States, 1913–1914, by States and uses.

1913.

State.	Building.	Riprap and rubble.	Paving.	Crushed stone.			Other.	Total.
				Road metal.	Railroad ballast.	Concrete.		
California	$208	$626,477	$141,332	$507,258	$321,500	$531,009	$4,461	$2,132,245
Connecticut	9,152	7,967	1,759	349,795	55,694	288,629	327	713,323
Hawaii	750	66,478	483	97,826	25,747	52,851	5,255	249,390
Massachusetts	10,600	1,000	....	651,251	57,874	470,843	2,500	1,194,068
Michigan	....	51,600	....	23,369	8,492	8,740	....	92,201
Minnesota	....	62,330	....	6,696	600	78,180	....	147,806
New Jersey	18,856	4,976	50,949	701,494	250,571	322,598	10,487	1,359,931
New York	12,000	....	....	520,666	102,939	242,085	200,000	1,077,690
Oregon	2,265	6,228	7,658	156,471	59,873	83,512	....	316,007
Pennsylvania	5,731	1,175	2,165	492,183	512,666	202,452	2,546	1,218,918
Washington	9,128	504,392	....	110,969	3,998	4,428	....	632,915
Total	68,690	1,332,623	204,346	3,617,978	1,399,954	2,285,327	225,576	9,134,494

1914.

State.	Building.	Riprap and rubble.	Paving.	Road metal.	Railroad ballast.	Concrete.	Other.	Total.
Arkansas	....	$18,743	....	$134,708	$37,432	$43,104	....	$233,987
California	....	350,301	$95,990	443,970	191,508	507,657	$395	1,589,821
Connecticut	$14,105	3,955	1,800	211,663	63,682	253,441	510	549,156
Hawaii	684	....	853	37,049	17,820	32,011	....	88,417
Massachusetts	16,410	7,625	....	375,136	74,142	217,355	662	691,330
Michigan	....	....	....	24,863	4,772	4,771	....	34,406
Minnesota	....	9,144	....	4,761	....	62,661	772	77,338
New Jersey	1,335	9,664	11,645	625,536	222,395	276,821	17,133	1,164,529
New York	4,500	....	....	245,484	349,430	295,733	....	895,147
Oregon	1,355	92,924	....	157,267	77,979	67,606	693	397,824
Pennsylvania	6,445	9,913	1,958	439,858	421,938	192,788	3,101	1,076,001
Washington	300	957,278	....	79,727	12,269	18,468	....	1,068,042
Total	45,134	1,459,547	112,246	2,780,022	1,473,367	1,972,416	23,266	7,865,998

In California there was decrease in all uses, especially for riprap and paving blocks. In Connecticut the most marked decrease was in crushed stone for roads. In Hawaii all crushed stone decreased and production of riprap ceased owing to suspension of breakwater work. In Massachusetts the principal decrease was in crushed stone for roads and for concrete. In Michigan and Minnesota, as in Hawaii, the production of riprap ceased. In New Jersey and Pennsylvania all kinds of crushed stone decreased. In New York the great decrease in crushed stone for roads overbalanced the increase in stone for railroad ballast and for concrete. In Oregon and Washington, two of the three States whose value of production increased, the principal gain was in stone for riprap used in the construction of breakwaters. The industry was evidently affected by local conditions, such as the beginning or completion of large construction enterprises and varying activity in road and railroad building.

The production of basalt and related rocks (trap rock) in 1914 as a whole was marked by increase in stone for riprap and railroad ballast but by decrease in all other products. The greatest decrease in value was in crushed stone for roads, which decreased $837,957, or 23.16 per cent. Crushed stone for concrete decreased $312,911, and paving stone decreased $92,100.

The following table shows the quantity and value of basalt and related rocks (trap rock) for paving blocks produced and sold in the United States in 1913 and 1914, by States:

Number and value of paving blocks of basalt and related rocks (trap rock) produced and sold in the United States, 1913–14, by States.

State.	Paving blocks.			
	1913		1914	
	Number.	Value.	Number.	Value.
California	2,237,971	$141,332	2,127,143	$95,990
Connecticut	44,250	1,759	45,000	1,800
Hawaii	36,250	483	64,000	853
New Jersey	1,470,648	50,949	506,674	11,645
Oregon	218,800	7,658		
Pennsylvania	51,400	2,165	119,000	1,958
Total	4,059,319	204,346	2,861,817	112,246
Average price per thousand		50.33		39.22

BASALT IN PAPER-MAKING MACHINERY.

A minor use of basalt which appears never to have concerned domestic producers is for beater rolls and bedplates in the manufacture of certain kinds of paper. The demand for this use is very small, and the entire supply, averaging about 20 tons a year, has heretofore been imported from Germany. The exorbitant price paid for this German basalt and the cutting off of the supply during the European war have brought to the Survey inquiries regarding the existence of deposits of basalt in the United States suitable for this use.

The German basalt is said to be quarried from a surface flow, 150 yards in width, only the central part of which contains rock of suitable character. The quantity available is not known, but is obviously limited. The basalt, as seen in a few small specimens, is a rather dark gray vesicular rock, with no visible minerals except a few thinly scattered crystals of feldspar, pyroxene, and olivene, the largest of which does not exceed 2 millimeters, or about one-twelfth of an inch in length. The vesicles or "blow holes" comprise 25 or 30 per cent of the surface area and vary in size from the most minute pores to irregular cavities 5 or 6 millimeters (one-fifth of an inch) in diameter, but their prevailing diameters are between 1 and 3 millimeters. Their outlines are very irregular and their edges sharp. It is very exceptional to find a vesicle containing any secondary minerals or alteration products. Under the microscope the principal minerals are augite, ægirite-augite, and plagioclase, with minor quantities of brown hornblende, magnetite, and apatite crowded in a groundmass that is for the most part glassy. Obscure grains of feldspar in the groundmass have optical properties suggesting sodic orthoclase. This mineral and the ægirite-augite indicate a rock more alkaline than the average basalt.

Lavas of this general character are limited to the States west of the Rocky Mountains. Basalts occur extensively in some of the eastern States, but they have been subjected to alteration which, in most cases, has caused the filling of vesicles with secondary minerals, and has thus barred them from the use in question. Of the extensive basalt deposits in the Far West, many are too remote from transportation lines to be of present consequence and the others will doubtless have to be prospected for some time before stone fulfilling all the requirements is found. Samples submitted in reply to recent inquiries by the Survey have included specimens of very promising character, and it is hoped that material satisfactory in all respects will be found.

Costs of transportation to the Eastern States will be great, but perhaps not so great as to bring the final cost of the domestic stone above the price of the imported stone. If deposits can be found within short distances from Pacific ports, transportation via the Panama Canal may bring the final cost well below that of the imported stone.

The principal requirements for the stone are hardness, toughness, and a uniform vesicular texture. Hardness and toughness must be sufficient for the stone surface to withstand the incessant grinding action and the jarring of the machine and to maintain a minimum amount of wear without chipping or crumbling. The less polish the surface takes after prolonged usage the better. The boundaries of the vesicles must be sharp to act as cutting edges, which separate and bruise the fiber, so that the material will hydrate readily and at the same time be so drawn out that it will felt into a strong sheet. The more numerous the vesicles the less will be the tendency of the stone to wear to a polish; but if they are too numerous they will lessen the degree of hardness and toughness. The percentage of vesicles in the German stone is no doubt very near that which will give maximum efficiency, but some pieces of it have been observed after usage to wear to a distinct, though dull, polish, which lessens the "pulling" power. It would be a simple matter to roughen such worn surfaces but a great inconvenience to do so in mills operating continuously.

Opinions are not unanimous regarding the efficiency of basalt beater rolls and bedplates as compared with those of steel and bronze. It is said that in some cases the bedplates have not proved entirely satisfactory because the jumping of the rolls breaks the stone. It is also stated that basalt beater rolls and bedplates are especially efficient in the manufacture of only certain kinds of paper, such as imitation parchment and grease-proof paper. The opinion has also been expressed that the use of stone rolls will increase in the future. Comparative tests between basalt and steel beater rolls have shown that the stone beater rolls prepare the stock in at least half the time that the steel rolls do but consume more power. The following quotations give the opinions of different writers on the use of stone beater rolls:

According to Cross and Bevan[1]—

The use of stone beater rolls is not new; stone bedplates have been used for many years in conjunction with metal bars. The introduction of the basalt lava stone, however, marks a new departure. The use of a complete roll of this stone is now abandoned in favor of removable bars. Provided that the wear and tear on the stone is not excessive, it shows notable advantages over metal bars, the most marked being the getting off of the material in about one-half of the time. So far, however, this has not been accomplished without greater power consumption, and the cost of power per ton of beaten stock about the same as when metal bars are used. The explanation of the greater beating capacity of the stone is perhaps to be found in the fact that the innumerable pores in the stone present continuous beating surfaces independent of the width of the bar. In its action it may be regarded as a kind of combination of kollergang and beater roll. No doubt the stone roll requires different manipulation from ordinary rolls to avoid fracture or disintegration; under favorable circumstances it has shown only slight and uniform reduction in diameter in constant work.

According to Sindall[2]—

The substitution of stone for metal in the roll and bedplate of the engine brings about some remarkable changes in the nature of the beaten stuff. The fiber is submitted to the action of rough surfaces rather than that due to the contact of sharp edges, with the result that the disintegration is much more rapid and produces a "wet" working pulp suitable for imitation parchments and similar papers. The latest materials used for this purpose are basalt lava stone in Germany and carborundum in America.

Care is necessary in the manipulation of these beaters to prevent fracture of the stone parts. In the Wagg Jordan engine this danger is materially reduced by the construction of the working parts.

Beadle's conclusions,[3] based on comparative tests, are as follows:

With the stone roll the stuff is much less time in process of beating, but there appears to be no appreciable advantage in saving of power. A given number of beaters will give a much greater output. Therefore wear and tear, interest and depreciation, etc., per ton of stuff beaten should be much less with the stone roll provided that the maintenance of the stone roll compares favorably with that of the steel—a point upon which I have at present not sufficient information to form an opinion.

It is when producing special effects that the difference in the character of the beating may be noticed. Some paper makers have found it difficult to believe that imitation parchment and grease-proof papers can be produced without something being added to the pulp. On examining this class of paper, made by the aid of the stone beater roll, under the microscope, after merely moistening it in cold water and careful separation, the wood fibers of which the papers consist appear to be flattened and to possess longitudinal flutings, as though each fiber had been taken and pulled lengthwise.

Microscopic examination of stone rolled material shows that in addition to the intact wood fibers, there is a mass of débris. This is wood fiber rubbed to a kind of gelatinous mass by the action of the stone roll. The roll appears to be two-fold in its action. It appears to flatten some fibers and to rub others to pieces. The pieces occupy spaces in between the flattened fibers, and if the right kind of pulp be chosen, a transparent grease-proof paper is produced. This sort of behavior, I am informed, is greatly assisted by beating the stuff direct from the digesters.

Under equal conditions rags, ropes, woods, manilas, and jutes can be milled with the stone roll, and a rather better paper made in exactly half the time. The stone roll has quite the opposite effect of a steel roll; it bruises but does not cut. Provided that the life of the stone roll can be guaranteed it has a great many advantages over steel for the working of weaker fibers. It is possible to use greater freedom with the roll without spoiling the pulp. It can be put hard down on the plate without discoloring the pulp, and renders it possible to make a better sized paper with, say, 3 per cent less size and starch.

MARBLE.

The figures for marketed production of marble here presented include, for some of the States, the value of serpentine (verde antique marble) and "onyx" marble. The serpentine included is that variety

[1] Cross, C. F., and Bevan, E. J., A textbook of paper making, 3d ed., pp. 193–194, 1907.
[2] Sindall, R. W., The manufacture of paper, pp. 189–190, New York, D. Van Nostrand & Co.
[3] Beadle, Clayton, Chapters on paper making: Vol. 5, Concerning the theory and practice of beating, pp. 106–109, London, Crosby Lockwood & Son, 1908.

which, from its use as ornamental stone for interior decorative work in buildings, answers the purpose of marble. The California, Georgia, Massachusetts, Pennsylvania, and Vermont statistics in this report include this stone. Onyx marble, or cave onyx, is included in the production of Kentucky, New Mexico, and Utah.

The marketed output of marble in the United States was valued in 1913 at $7,870,890 and in 1914 at $8,121,412, an increase of $250,522, or 3.18 per cent. This increase was greater than that of 1913 over 1912, which was only $84,432, or 1.08 per cent, and greater in amount than that of 1912 over 1911, which was $239,740, or likewise 3.18 per cent. This continued gain in production of marble in a year of general depression is especially noteworthy. Most marble quarrymen report their output from year to year, using the same unit, so that a comparison both of the quantities sold annually by the cubic foot or the square foot, or the ton, and of their corresponding values is possible. The greater part of the marble quarried is sold by the cubic foot. In 1913 there were reported 3,606,818 cubic feet of marble, valued at $7,605,271, or $2.11 a cubic foot; in 1914, 3,461,997 cubic feet, valued at $7,942,826, or $2.29 a cubic foot, a loss for 1914 of 144,821 cubic feet, but a gain of $337,555. Besides this there was produced in 1914 50,127 square feet of sawed marble, valued at $4,008, and 194,207 short tons of marble, valued at $172,578; in 1913 the figures were 376,648 square feet, valued at $139,260, and 106,084 short tons, valued at $126,359.

Owing to the small number of producers in many of the marble-producing States, it is not possible to compile a satisfactory table showing the marble production by States. The figures are given, however, as far as they are available.

In 1914 the commercial output of marble came from the following States, arranged according to value of output:

VERMONT: Bennington, Chittenden, Franklin, Grand Isle, Rutland, and Washington counties.
TENNESSEE: Blount, Knox, Loudon, and Union counties.
GEORGIA: Cherokee and Pickens counties.
COLORADO: Gunnison County.
ALABAMA: Coosa and Talladega counties.
NEW YORK: Clinton, Dutchess, St. Lawrence, Warren, and Westchester counties.
MASSACHUSETTS: Berkshire and Hampden counties.
PENNSYLVANIA: Chester, Montgomery, and Northampton counties.
ALASKA: New Tokeen, Ketchikan mining district, southeastern Alaska.
CALIFORNIA: Amador, Inyo, Los Angeles, Tulare, and Tuolumne counties.
MISSOURI: Green County.
MARYLAND: Baltimore and Harford counties.
NORTH CAROLINA: Cherokee County.
UTAH: Tooele and Utah counties.
TEXAS: San Saba County.
VIRGINIA: Rockingham County.
KENTUCKY: Barren County.
NEW MEXICO: Otero County.
WASHINGTON, Stevens County.

The value of the marble produced and sold in Vermont in 1914 was $3,490,971, or 42.98 per cent of the total; in Tennessee, $1,253,-549, or 15.44 per cent of the total for the United States. With reference, however, to quantity, the total number of cubic feet reported was 3,461,997, to which Vermont contributed 1,100,802 cubic feet, or 31.80 per cent; Georgia, 929,209 cubic feet, or 26.84

per cent; and Tennessee, 646,354 cubic feet, or 18.67 per cent. The average price per cubic foot shown for Vermont was $3.17; for Tennessee, $1.94; for Georgia, $1.24. The differences in average price per cubic foot for these three leading marble States are due to the fact that most of the Vermont producers mill and sell their stone as dressed stone. The Tennessee producers sell much of their stone to mills in the vicinity or ship as finished or partly finished material from their own mills. The Georgia marble is practically all sold as rough stone.

The following table shows the value of the marble produced and sold in the United States from 1910 to 1914, by States:

Value of marble produced and sold in the United States, 1910–1914, by States and Territories.

State or Territory.	1910	1911	1912	1913	1914
Alabama	[a] $255,664	[b] $335,005	(c)	(c)	$370,766
Alaska	(a)	(b)	(c)	(c)	(c)
Arizona		(b)			
California	[a] 112,339	29,964	$76,424	$72,768	70,451
Colorado	[a] 488,173	[b] 1,010,840	(c)	(c)	(c)
Georgia	953,917	1,088,422	1,096,622	1,101,997	1,190,742
Kentucky	(a)	(b)	(c)		(c)
Maryland	(a)	[b] 73,300	(c)	(c)	(c)
Massachusetts	224,088	219,445	213,939	276,819	206,883
Missouri	(d)	(d)	(d)	(d)	(c)
New Mexico	(a)	(b)	(c)	(c)	(c)
New York	484,732	379,670	291,210	252,982	248,787
North Carolina	(a)	(b)	(c)	(c)	(c)
Oklahoma		(b)			
Oregon				(c)	
Pennsylvania	[a] 182,514	214,913	267,242	(c)	(c)
South Carolina		(b)			
Tennessee	728,502	700,229	974,733	1,416,952	1,253,549
Texas	(a)				(c)
Utah	(a)	(b)	(d)	(c)	(c)
Vermont	3,562,850	3,394,930	3,494,253	3,513,405	3,490,971
Virginia			(d)	(c)	(c)
Washington	(a)			(c)	(c)
West Virginia	(a)				
Other States			1,372,035	1,235,967	1,289,263
Total	6,992,779	7,546,718	7,786,458	7,870,890	8,121,412

[a] Alabama includes Kentucky, North Carolina, and West Virginia; California includes Alaska and Washington; Colorado includes Arizona and New Mexico; Pennsylvania includes Maryland.
[b] Alabama includes Kentucky and Oklahoma; Colorado includes Alaska, Arizona, New Mexico, Oregon, and Utah; Maryland includes North Carolina and South Carolina.
[c] Included in "Other States."
[d] Included in limestone.

The following table shows the value of marble quarried and sold from 1910 to 1914, according to uses:

Distribution and value of marketed output of marble, 1910–1914, among various uses.

Use.	1910	1911	1912	1913	1914
Sold by producer:					
Rough for—					
Monumental	890,966	3,186,620	1,364,736	1,361,906	1,168,493
Building, exterior	1,207,484		1,963,800	993,214	940,996
Building, interior				1,290,743	1,318,959
Dressed for—					
Monumental	1,279,985	1,368,430	720,464	1,135,658	1,134,991
Building, exterior	1,463,749	1,220,635	1,396,254	829,244	1,207,274
Building, interior	2,001,646	1,545,963	1,944,161	1,869,262	2,081,065
Ornamental	37,950	71,000	134,826	34,850	20,200
Other uses	110,969	158,070	232,217	356,013	249,434
Total	6,992,779	7,546,718	7,786,458	7,870,890	8,121,412

The chief uses of marble are as exterior and interior building stone and for monuments. Rough and dressed interior building stone and dressed exterior building stone were the products that had an increase in value in 1914, according to the preceding tables. A consideration of the figures, including both rough and dressed stone, shows the following results:

Building stone (exterior work).—Marble as building stone is sold for two different uses—one on the exterior of buildings and the other in the interior, as wainscoting, paneling, mantels, floors, stairs, and balustrades. The total value of building marble in 1914 was $5,548,294, or 68.3 per cent of the entire marble output. In 1914 this value included 1,561,050 cubic feet of rough stone, valued at $2,230,785, or $1.43 a cubic foot; also 34,979 short tons, valued at $27,714; and 3,649 square feet, valued at $1,456; 777,358 cubic feet of dressed stone, valued at $3,287,964, or $4.23 a cubic foot; also 250 square feet, valued at $375.

The value of marble produced in 1914 for exterior building purposes (including rough and dressed stone) and either sold or used by the producer was $2,148,270, an increase of $325,812, compared with 1913, when this value was $1,822,458. The total for 1914 included $940,996 for rough and $1,207,274 for dressed building stone; in 1913 the rough building marble sold was valued at $993,214, and the dressed building stone at $829,244, a decrease in 1914 of $52,218 for rough stock and a gain of $378,030 for dressed marble.

The quantity of marble sold in 1914 rough for exterior building was 713,283 cubic feet, valued at $913,247, or $1.28 a cubic foot; 3,000 square feet, valued at $840; and 32,679 tons, valued at $26,909. There were 343,592 cubic feet of dressed stone, valued at $1,207,274, or $3.51 a cubic foot.

In 1913 the quantity of marble sold rough for exterior building stone was 809,114 cubic feet, valued at $989,814, or $1.22 a cubic foot; and 4,000 tons, valued at $3,400. There was 288,754 cubic feet of dressed building stone quarried, valued at $829,244, with an average price of $2.87 a cubic foot.

Interior decoration work.—The total value of marble for interior work in buildings (including stone sold rough and dressed) in 1914 was $3,400,024, a gain of $240,019, when compared with $3,160,005 in 1913. The stone sold for this work in 1914 was 1,281,533 cubic feet, valued at $3,398,228, or $2.65 a cubic foot; 899 square feet, valued at $991; and 2,300 short tons, valued at $805.

The production of this stone, sold rough for interior work, in 1914 was 847,767 cubic feet, valued at $1,317,538, or $1.55 a cubic foot; 649 square feet, valued at $616; and 2,300 short tons, valued at $805. The production of dressed stone for interior work included 433,766 cubic feet, valued at $2,080,690, or $4.80 a cubic foot, and 250 square feet, valued at $375.

In 1913 the quantity sold rough for interior work included 858,611 cubic feet, valued at $1,287,938, or $1.50 a cubic foot; 1,000 square feet valued at $2,000, and 2,300 short tons, valued at $805. Dressed stone for interior work included 309,375 cubic feet, valued at $1,732,002, or $5.60 a cubic foot, and 375,648 square feet, valued at $137,260.

Monumental stone.—Monumental marble (including rough and dressed stone) was valued at $2,303,484 in 1914, and at $2,497,564 in 1913, a decrease of $194,080 in 1914. In 1913 the value of rough stock was $1,361,906 and of dressed monumental stone, $1,135,658; the corresponding figures for 1914 are $1,168,493 for rough monumental stock and $1,134,991 for dressed monumental stone, a decrease in 1914 of $193,413 in value of rough stock and of $667 for dressed stone. In 1914 the stone sold rough for monumental use was 814,905 cubic feet, valued at $1,168,493, or $1.43 a cubic foot. The dressed monumental stone sold amounted to 241,229 cubic feet, at $4.71 a cubic foot.

In 1913 the quantity of stone sold rough for monumental work was 912,792 cubic feet, valued at $1,361,592, or $1.49 a cubic foot, and 32 tons valued at $314, and that for dressed monumental work was 256,300 cubic feet, at $4.43 a cubic 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 making roads; the dressed stone includes stone for mosaics and electrical work.

The following statement of the output of marble in the United States shows the quantity and value of this material and the form in which it was sold by the producer in 1913 and 1914:

Total quantity and value of marble produced and sold in the United States in 1913 and 1914 according to the use for which the stone was intended.

Form in which sold by producer.		1913		1914	
		Quantity.	Value.	Quantity.	Value.
In rough blocks, rough sawed, or rough dressed:					
To dealers or manufacturers—					
For monumental work	cubic feet	889,048	$1,311,846	807,251	$1,148,373
	short tons	30	300	....	....
Building—Exterior work	cubic feet	759,910	928,226	701,583	880,847
	short tons	4,000	3,400	4,000	3,400
Building—Interior decorative work	cubic feet	682,611	1,087,938	812,178	1,264,698
	square feet	1,000	2,000	649	616
	short tons	2,300	805	2,300	805
Direct for—					
Monumental work	cubic feet	23,744	49,746	7,654	20,120
	short tons	2	14	....	....
Building—Exterior work	cubic feet	49,204	61,588	11,700	32,400
	square feet	....	....	3,000	840
	short tons	....	....	28,679	23,509
Building—Interior work	cubic feet	176,000	200,000	35,589	52,840
Dressed:					
Direct for—					
Monumental work	do	256,300	1,135,658	241,229	1,134,991
Building—Exterior work	do	288,754	829,244	343,592	1,207,274
Building—Interior work	do	309,375	1,732,002	433,766	2,080,690
	square feet	375,648	137,260	250	375
Ornamental purposes	cubic feet	2,650	34,850	1,700	20,200
As ground limestone or crushed stone	do	37,100	17,500	....	....
	short tons	22,529	57,215	70,146	94,398
For other purposes	cubic feet	132,122	216,673	65,755	102,393
	short tons	77,223	64,625	89,082	50,466
	square feet	....	....	46,228	2,177
Total	cubic feet	3,606,818	7,605,271	3,461,997	7,942,826
	square feet	376,648	139,260	50,127	4,008
	short tons	106,084	126,359	194,207	172,578
			7,870,890		8,121,412

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 and sold in California, Georgia, Massachusetts, New York, Tennessee, and Vermont in 1913 and 1914.

State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
California:				
Short tons	478	$2,990	840	$6,540
Cubic feet	37,155	69,778	30,059	62,730
Square feet			787	1,181
Total		72,768		70,451
Georgia:				
Short tons	20,293	35,484	21,241	35,000
Cubic feet	1,031,373	1,066,513	929,209	1,155,742
Total		1,101,997		1,190,742
Massachusetts:				
Short tons	9,557	13,014	9,539	13,290
Cubic feet	92,137	176,545	119,864	193,593
Square feet	342,648	87,260		
Total		276,819		206,883
New York:				
Short tons	49,014	50,301	45,953	40,176
Cubic feet	122,063	202,681	122,958	207,771
Square feet			3,000	840
Total		252,982		248,787
Tennessee:				
Short tons			2,000	634
Cubic feet	754,234	1,416,952	646,354	1,252,915
Total		1,416,952		1,253,549
Vermont:				
Short tons	6,300	4,205	6,300	4,205
Cubic feet	1,183,400	3,509,200	1,100,802	3,486,766
Total		3,513,405		3,490,971

SOME DOMESTIC MARBLES AND LIMESTONES AVAILABLE FOR DECORATIVE USES.

Present conditions in Europe have caused a decrease in imports of marble into the United States. Building activity in this country is also dull, but with the general revival of business it is to be expected that building operations will increase again and accordingly that there may arise a demand for domestic marble to supplement the decreased supply from abroad. There are several domestic marbles and limestones, suitable some for interior decorative work and some for exterior work also, that are entitled to broader recognition than they have heretofore received. Some of these marbles have been used for a considerable time and others have been quarried only during the last two or three years.

Among the marbles of the Eastern and Southern States, those of Vermont, Tennessee, and Georgia have been so extensively used throughout the country that no further reference to them is necessary. The white marbles of Massachusetts and Maryland have also been worked for many years, especially for buildings, and are well known. The marble in Cherokee County, N. C., has been quarried in increasing quantity during recent years. It includes a gray variety of medium grain and a white variety of fine grain. The marble of Alabama has also become well known in the eastern half of the country during recent years, but its extreme fineness of grain and its colors, which vary from pure white through cream and pink with more or less dark clouding, entitle it to recognition as a decorative stone, equal in appearance to any of the white or nearly white imported marbles. Other eastern marbles include the black marbles of Glens Falls, N. Y., and of Harrison County, W. Va., which may be used in place of the Belgian black marble.

Among the Central States west of Mississippi River limestone and marble suitable for interior decorative work are quarried in Arkansas, Missouri, Minnesota, and Texas. The limestone quarried at Pfeiffer, near Batesville, Ark., is a gray fine-grained oolitic limestone, so compact that it takes a good polish and justifies its trade name "oolitic marble." It has been used for exterior work in some important buildings in the Central States, and its color and susceptibility of polish adapt it also to interior decorative work such as wainscoting and balustrades. It lacks, however, the variety of coloring that gives beauty to many of the foreign marbles. Its superior hardness also adapts it to such uses as floor tiles and stair treads. The marble at St. Joe, Ark., has thus far been quarried only on a small scale. It is a medium-grained pink stone with blended shades of lavender and gray in places, with rather frequent wavy black suture lines, and closely resembles some of the pink Tennessee marble.

The Carthage stone of Missouri, although long known and used as a limestone in the Central States, has during the last 10 or 12 years been used in polished slabs for interior work and deserves recognition as a marble. It is also sold for marble floor tiles. It is a semicrystalline to crystalline gray stone, traversed parallel to the bedding by sutures or "crowfeet," and has an appearance somewhat like that of the gray Tennessee marble. Its suture lines, however, are mostly straight, rather than wavy, and are less attractive. For this reason slabs are usually sawn parallel to the sutures. The stone at Cassville, Mo., is of generally similar appearance, but has only been quarried to a small extent. The marble quarried at Phenix, Mo., is also generally similar to the Carthage stone, but its wavy suture lines give it a closer resemblance to the gray Tennessee marble. It is composed largely of shell fragments that have completely recrystallized and thus produced the texture of marble. It is known under the trade name of "Napoleon gray marble." It has already been used in many cities of the Central States and has been shipped as far east as New York.

The limestones quarried at Kasota and Mankato, Minn., have been used for both exterior and interior work. They are pink and yellow dolomitic limestones that take a dull and uneven polish and therefore do not conform to the definition of marble; but their appearance on dull polished surfaces is such that they have found favor for interior work in some very important buildings, including the new capitol at Madison, Wis. The pink stone is of uniform color, but the yellow is characterized by a mottling that adds greatly to its appearance. The yellow stone, although by no means comparing with the yellow Siena marble of Italy in degree of polish and variety of veining, is nevertheless adapted for many of the same uses as the Italian marble.

In Texas some marble has recently been quarried at San Saba, small samples of which have been sent to the writer. One of these is a very fine grained variety of creamy-white color mottled with pink spots and wavy veinlets, and, so far as the writer knows, does not resemble any foreign or domestic marble used in the United States. The other variety is a pale-brownish fossiliferous stone, somewhat similar to the Hauteville marble of France.

Another interesting deposit has been prospected at Lithograph City, Floyd County, Iowa, for lithographic stone and marble. The marble includes several varieties of very fine grained to dense stone, susceptible of a good polish, and with colors varying from delicately blended shades of light yellow and brown to darker brown and, in some cases, reddish tones. Some of these varieties when polished have a peculiar and very attractive mottling of darker and lighter shades. Different samples resemble the Eschaillon, Hauteville, and Numidian marbles from abroad. One variety suggests the lighter shades of Swanton (Vt.) marble, and one variety, consisting of brown concretions developed around gastropod shells and uniformly distributed in a light yellowish-brown matrix, has an appearance somewhat similar to the newly developed "bird's-eye marble" of Utah. Another variety, of yellow to yellowish brown, finely specked with white, is, so far as the writer knows, of unique appearance. The beds have been exposed in nearly horizontal position at a few small prospect openings along a low terrace. They are for the most part rather thin, few of them exceeding 2 feet in thickness, but if a demand should arise for stone from two or three different beds, there appears no good reason why the deposit should not be quarried successfully. The thinness of the bed would require a modification of working methods employed at most marble quarries, but this fact should be no serious obstacle to development. Polished sample slabs of the marble seen by the writer range up to 4 feet in length and 2 feet in width. Larger sizes can probably be obtained, but the present openings are not sufficient to demonstrate the prevailing sizes of quarriable blocks.

Among the Western States Colorado, Utah, and California contain marbles of striking appearance, which are being produced on a commercial scale. In Colorado the Colorado Yule marble is being quarried on a large scale, and has supplied stone for both exterior and interior work in central and even eastern cities. The stone as a whole is white and medium to fine-grained, with black and yellow veinings rather thinly scattered through it. Three varieties of marble are produced, the white, the "Colorado cloud" with black veining, and the "golden vein" with yellow veining. Rough hand specimens of the white variety are practically identical in appearance with those of the Pentelic marble of Greece.

In Utah several marble deposits have been prospected, but only one (not including "onyx marble") has been recently worked on a commercial scale. This deposit is known as the "bird's-eye marble" and has been quarried only about a year and a half near Clinton, in Utah County. The stone consists of a very fine grained to dense matrix containing varying quantities of rounded to irregular concretions ("bird's eyes"). The colors are reds, yellows, and browns, which blend into one another and which may all be present in a single slab. The concretions are all of brown color with conspicuous concentric rings. They may be very numerous in some slabs and scarce or absent in others. One variety of the marble is white with brown concretions, but no shipments of it had been made up to the fall of 1914. The stone has thus far found little use outside of Utah, but its appearance where used entitles it to much more than local consideration. It takes a very high polish and strongly resembles the darker shades of Numidian marble.

The marble property recently developed at Carrara, Nev., is said to produce stone of very fine and uniform grain, susceptible of a high polish, and of several varieties in color, including white, pink, yellow, cream with yellow veining, brown, green, blue, black and white, and jet black.

California contains, besides many extensive deposits of white to gray marble, two deposits of colored marble which have been worked on a commercial scale. These are the Columbia and Inyo marbles. The Columbia marble includes a number of fine-grained varieties of pale-pinkish, yellowish, and light to medium gray colors, and coarser-grained varieties of medium to dark gray color. The fine-grained varieties are especially attractive in appearance, and do not closely resemble any domestic or foreign marble known to the writer. Samples of the yellowish variety give some suggestion of the lighter shades of Siena marble. The Columbia marble has been shipped as far east as Chicago. The Inyo marble is generally fine grained and rather hard, and includes varieties of white, white mottled with yellow, gray and black, and yellow and black. The yellow variety is somewhat similar to the Siena marble, but more closely resembles the Estremoz or so-called Lisbon yellow marble of Portugal. No shipments of this marble have, so far as the writer has learned, gone outside of the State.

Alaskan marbles have been, in recent years, extensively used in the Pacific coast and other western cities and as far east as Ohio. They are for the most part white mottled or veined with dark-gray or black, and their polished surfaces have a soft tone resembling that of clouded white Italian marble. Since the opening of the Panama Canal conditions have been favorable for extending the market for Alaskan as well, perhaps, as of Californian marbles, to the larger eastern cities.

DOMESTIC "ONYX MARBLE."

Deposits of "onyx marble" in the United States have proved for the most part to be very small in extent and to yield sound blocks of small sizes. Deposits have been reported at different times, and some of them have been worked occasionally, from certain of the Eastern, Central, and Western States, but domestic stone of this type has heretofore attracted very little attention. The reasons for this condition are found in the small extent of the deposits and the small sizes of sound blocks obtainable from them and also in the unattractive appearance of the stone; but the principal cause of failure has evidently been ignorance of the proper methods for working the deposits, which are necessarily different from those employed in the quarrying of ordinary marble. There are deposits of promise, however, which apparently need only proper methods of working to be developed into successful quarries.

Specimens shown to the writer from a quarry at Willowton, W. Va., included one of translucent greenish-white color similar to the prevailing color in the Mexican onyx and one of coarse-grained light-brown stone crossed by lines and bands of darker brown.

This quarry has been idle for some time, but plans are now under way to renew development work.

There are several deposits in the vicinity of Cave City, Glasgow Junction, and Mammoth Cave, Ky., some of which have yielded small quantities of material for a number of years. These deposits are mostly in caves. Of the few visited by the writer in June, 1915, some are too small to be of much commercial promise; others are of sufficient size, provided material of attractive appearance can be obtained. The material seen in place is coarse grained and varies in color from white through shades of yellow to brown with typical parallel and concentric banding. Material of reddish color also is said to have been found.

"Onyx marble" has been produced from time to time near Rio Puerco station, in Valencia County, N. Mex. The stone, according to Merrill,[1] varies from whitish to deep smoky, almost black, and from translucent to opaque, and the better varieties show on a polished surface a silky luster and a radiating fibrous structure. It is distinctly banded, the bands varying from faintly whitish to nearly black. The material, though lacking in richness of color, is, owing to its luster and fibrous structure, very attractive.

One of the most extensive deposits in the country, so far as the writer knows, is a group of veins in Tooele County, Utah, near Low station, on the Western Pacific Railway. The veins range up to 200 feet and more in width and consist of parallel bands of fine-grained, light-colored stone. The colors of different layers include white, cream, yellow, orange, and pink, with more or less distinct parallel and concentric banding. Blocks of sufficient size for all general purposes can be obtained. In September, 1914, when the locality was visited by the writer only one of the smaller veins had been worked. The stone from this vein was used in the new State capitol in Salt Lake City, Utah.

The most promising deposits in Arizona are near Mayer, about 26 miles southeast of Prescott; at Cave Creek, about 45 miles northeast of Phoenix; and in Santa Cruz County, about 4½ miles south of Greaterville, Pima County. The deposit near Mayer is reported to cover about 200 acres and to vary from 1 to 25 feet in thickness. Small portions of it are of a quality suitable for decorative purposes. The stone is for the most part white or pale-green, with stains of brown and deep-red.[2] The deposit at Cave Creek is of similarly colored stone, but the extraction of large blocks is said to be difficult.[3] The deposit in Santa Cruz County is found in a limestone cave. The stone is said to possess considerable homogeneity of texture and of color, the latter including various shades of brown and to be so free from fractures that the size of blocks obtainable is limited only by the capacity of the equipment that may be installed and by transportation facilities.[4]

Several deposits have been worked or prospected in California, but most of them are of too slight extent to be profitably worked. The most important deposit is at Musick, in San Luis Obispo County. It forms layers from 1 to 30 inches thick, but mostly less than 10

[1] Merrill, G. P., Stones for building and decoration, 3d ed., p. 274, 1903.
[2] Merrill, G. P., idem, pp. 263–266. Blake, W. P., Rept. Governor of Arizona for 1899, pp. 132–133. Jaggar, T. A., jr., and Palache, Charles, U. S. Geol. Survey Geol. Atlas, Bradshaw Mountains folio (No. 126), pp. 3, 11, 1905.
[3] Merrill, G. P., op. cit., pp. 266–267. Blake, W. P., op. cit., p. 133.
[4] Willis, C. F., Arizona (magazine published at Phoenix), November, 1913, pp. 14–15.

inches. It is a translucent stone, partly banded and variegated, partly white and massive, and it takes a brilliant polish. Blocks from 3 to 6 feet square have been quarried and larger ones are said to be obtainable.

LIMESTONE.

The marketed production of limestone decreased in value from $38,745,429 in 1913 to $33,894,155 in 1914, a decline of $4,851,274, or 12.52 per cent. This was the largest proportionate decrease in all kinds of stone, except that in basalt and related rocks, and was by far the largest decrease in actual value. Compared with the production in years prior to 1913, it was the smallest in value since that of 1909, though only slightly less than that of 1911. A glance at the diagram (Pl. V) shows that the decrease in the total value of all kinds of stone in 1914 was due principally to the decrease in value of limestone, as was also the case in 1908, another year of general business depression. The great decrease in limestone was caused by the depressed condition in 1914 of nearly all the industries in which it was used. The most extreme case is shown by furnace flux, which decreased $3,213,620 in value. The next largest decrease was in the value of railroad ballast, which declined $1,584,067. Limestone for construction work, including the higher grades of building stone, as well as crushed stone for concrete, riprap, rubble, and paving stone, also decreased, as did limestone for sugar factories. The only kinds of limestone to show gains in value were crushed stone for roads, which increased $946,851; pulverized limestone for agricultural use, which increased $195,243; curbing, which increased $11,614; and total stone for "other" uses, which include principally the manufacturing industries, as alkali works, glass factories, paper mills, and carbonic-acid plants.

A large quantity of limestone used in the manufacture of Portland cement is not included in the marketed production of limestone. 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. A large quantity of limestone burned into lime and sold as a manufactured product is also excluded from these figures except in the cases of alkali works, sugar factories, and, to a small extent, of those steel works and smelting plants at which lime instead of stone is used as a flux. In these cases the only record kept is that of stone used rather than of lime burned, and the value is therefore included in that of limestone. A quantity also of stone sold to manufacturers of lime who may require a certain kind of stone that they do not produce is here included, as well as a small quantity of 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.

The chief States producing limestone in 1914, according to rank in value, were Pennsylvania, Ohio, Indiana, New York, Illinois, Missouri, Michigan, Kentucky, Virginia, and Wisconsin—the first six producing more than $2,000,000 each, and the last four more than $1,000,000 each. In 1913 the rank was, Pennsylvania, Ohio, Indiana, Illinois, New York, Missouri, Michigan, Kentucky, West Virginia, and Wisconsin. New York took fourth place from Illinois in 1914; Virginia joined the States having a production of limestone valued at more than $1,000,000; and West Virginia dropped from that list. Each of these leading States except Kentucky, Michigan, and Virginia showed decrease in 1914. The largest decrease was that of Illinois, more than $1,250,000. Pennsylvania and Ohio decreased more than $900,000 and $800,000, respectively. These three States produced mostly crushed stone and furnace flux, both of which decreased in 1914. Virginia showed the largest increase, nearly $600,000 in 1914, an increase due to great activity in the building of roads.

Pennsylvania, the largest producer of limestone, produced 15.5 per cent of the total output. Nearly 68 per cent of the stone from Pennsylvania was fluxing and the rest was chiefly crushed stone. Ohio produced more than 12 per cent of the total output, of which more than 63 per cent was for crushed stone and most of the remainder for flux. The production in Indiana represented more than 12 per cent of the total, and more than 65 per cent of the output of this State was for building stone.

The following table shows the value of limestone produced and sold, by States, from 1910 to 1914, inclusive:

Value of limestone produced and sold from 1910 to 1914, by States.

State.	1910	1911	1912	1913	1914
Alabama	$714,516	$571,798	$531,085	$812,664	$787,214
Arizona	(a)	8,676	19,099	6,328	(b)
Arkansas	84,280	c 136,007	66,952	52,220	47,390
California	590,990	576,701	245,235	323,287	286,273
Colorado	415,523	341,798	365,004	428,736	340,059
Connecticut	a 9,062	c 21,040	17,924	(b)	(b)
Florida	a 84,457	97,520	60,524	156,589	343,779
Georgia	24,236	31,632	53,187	83,899	89,216
Idaho	19,423	c 19,497	19,791	18,569	28,032
Illinois	3,847,715	3,436,977	3,808,784	4,112,172	2,861,340
Indiana	4,472,241	4,406,577	5,066,337	4,649,597	4,115,557
Iowa	543,600	679,895	944,885	803,682	537,362
Kansas	768,739	789,448	757,197	824,005	598,302
Kentucky	978,809	1,124,170	1,160,148	1,069,034	1,196,046
Louisiana	(a)	(c)	(b)	(b)	(b)
Maine	(a)	(c)	(b)	(b)	(b)
Maryland	151,370	218,636	228,713	282,241	204,276
Massachusetts	(a)	(c)	(b)	(b)	(b)
Michigan	842,126	1,001,535	1,139,560	1,408,708	1,457,961
Minnesota	654,833	612,915	546,650	636,620	489,849
Missouri	2,360,604	2,179,767	2,373,725	2,486,020	2,160,958
Montana	169,836	148,126	154,133	260,915	207,821
Nebraska	338,731	263,459	335,369	326,287	302,862
Nevada	....	(c)	(b)	....	....
New Jersey	224,709	138,148	205,334	280,680	240,937
New Mexico	a 227,657	243,119	237,543	148,266	....
New York	2,813,476	2,857,797	3,208,911	3,539,043	3,158,617
North Carolina	(a)	30,278	39,864	67,132	58,754
Ohio	4,357,432	4,461,882	4,885,088	4,945,310	4,131,917
Oklahoma	509,344	594,664	409,994	246,912	237,044
Oregon	3,594	(c)	(b)	(b)	(b)
Pennsylvania	5,394,611	5,243,045	6,017,308	6,189,145	5,270,458
Rhode Island	(a)	(c)	(b)	(b)	(b)
South Carolina	(a)	(c)	....	....	....
South Dakota	17,150	6,250	10,628	4,098	12,488
Tennessee	a 747,162	c 798,369	673,329	643,586	678,068
Texas	447,239	490,289	530,251	590,289	549,567
Utah	389,603	168,145	208,245	368,007	303,081
Vermont	25,250	19,702	12,644	17,715	24,049
Virginia	471,903	369,872	403,069	598,032	1,194,261
Washington	36,186	32,478	20,370	62,913	10,008
West Virginia	841,064	902,077	981,467	1,046,625	778,749
Wisconsin	979,522	848,363	853,477	1,017,135	1,007,106
Wyoming	43,687	36,960	64,749	108,234	50,500
Other States	....	....	73,227	130,734	134,254
Total	34,603,678	33,897,612	36,729,800	38,745,429	33,894,155

a New Mexico includes Arizona; Connecticut includes Maine, Massachusetts, and Rhode Island; Florida includes Louisiana; Tennessee includes North Carolina and South Carolina.

b Included in "Other States."

c Arkansas includes Louisiana; Connecticut includes Maine, Massachusetts, and Rhode Island; Idaho includes Nevada and Oregon; Tennessee includes South Carolina.

Value of the marketed production of limestone in the United States in 1913 and 1914, by States and uses.

1913.

State.	Rough building.	Dressed building.	Paving.	Curbing.	Flagging.	Rubble.	Riprap.
Alabama	$9,517	$27,020	$189			$188	$58,850
Arizona							
Arkansas	5,901	39,384				408	1,627
California							
Colorado							
Connecticut							
Florida							
Georgia	360		1,875			175	
Idaho						200	
Illinois	14,806	11,911	9,734	$262	$205	131,194	113,083
Indiana	1,265,323	1,842,682	2,463	73,050	1,660	7,520	19,797
Iowa	33,266	8,155	16,713	750	238	30,723	97,619
Kansas	24,112	32,879	17,280	4,198	30	13,873	95,273
Kentucky	69,673	75,230	37	6,014		4,358	73,197
Louisiana							
Maine							
Maryland	7,024	125	4,350			3,400	145
Massachusetts							
Michigan	8,274					3,511	610
Minnesota	46,477	155,592	218	750		32,408	46,839
Missouri	110,080	268,970	14,596	9,296	3,328	127,683	473,399
Montana	2,874					25	17
Nebraska	1,008					1,121	52,080
New Jersey	185						
New Mexico	250						
New York	75,278	29,737	7,750	2,861		16,600	10,594
North Carolina							
Ohio	47,127	4,587	2,650			23,187	83,358
Oklahoma	985	50,030				64	16,066
Oregon							
Pennsylvania	106,690	840	129,440	3,170	85	8,600	8,391
Rhode Island							
South Dakota	40						788
Tennessee	7,292	4,208	15,100	153		2,100	59,429
Texas	36,508	11,979	7,800	547		698	8,824
Utah	23,188	1,278				50	26,057
Vermont	665					2,500	425
Virginia	771	1,668				197	
Washington							
West Virginia			800			750	
Wisconsin	40,840		8,345	7,742	1,791	28,947	68,189
Wyoming	950						
Other States	3,600						16,766
Total	1,943,064	2,566,275	239,340	108,793	7,337	440,480	1,331,423

Value of the marketed production of limestone in the United States in 1913 and 1914, by States and uses—Continued.

1913.

State.	Road metal.	Railroad ballast.	Concrete.	Flux.	Sugar factories.	Agricultural.	Other.	Total value.
Alabama	$47,237	$7,187	$168,195	$487,078		$7,203		$812,664
Arizona				3,628	$2,700			6,328
Arkansas			4,000			900		52,220
California	95,793	3,971	68,645	42,274	93,950	1,500	$17,154	323,287
Colorado				333,609	93,875		1,252	428,736
Connecticut								(a)
Florida	29,749	37,500	72,432			16,908		156,589
Georgia	17,850	6,000	17,233	7,056		30,850	2,500	83,899
Idaho	43				18,326			18,569
Illinois	895,352	592,210	1,245,829	979,303	2,000	78,278	38,005	4,112,172
Indiana	956,234	203,431	29,985	199,955	1,554	20,124	25,819	4,649,597
Iowa	81,351	218,573	300,767	4,866	5,900	3,089	1,672	803,682
Kansas	49,074	283,435	264,854	170		1,500	37,327	824,005
Kentucky	286,407	422,864	101,948	12,368		10,582	6,356	1,069,034
Louisiana								(a)
Maine								(a)
Maryland	116,946	94,202	28,245	23,723			4,081	282,241
Massachusetts								(a)
Michigan	266,316	48,400	145,965	494,495	38,215	7,048	395,874	1,408,708
Minnesota	32,771	31,774	283,947	540	720	2,287	2,297	636,620
Missouri	338,849	405,665	623,436	35,874	3,992	8,297	62,555	2,486,020
Montana	2,312	485	11,480	230,097	13,625			260,915
Nebraska		38,178	231,626		2,274			326,287
New Jersey	15,377	22,800	12,579	178,233		44,844	6,662	280,680
New Mexico		148,016						148,266
New York	1,047,216	804,296	759,814	562,669		67,441	154,787	3,539,043
North Carolina	15,174		339	11,269		40,350		67,132
Ohio	1,596,796	790,004	318,097	1,934,734	15,393	29,255	100,122	4,945,310
Oklahoma	4,384	98,134	74,102			60	3,087	246,912
Oregon								(a)
Pennsylvania	585,004	419,579	531,889	4,206,797		51,416	137,244	6,189,145
Rhode Island								(a)
South Dakota	1,670		1,400				200	4,098
Tennessee	212,004	142,289	123,945	64,825		9,413	2,828	643,586
Texas	138,747	132,699	218,282	29,928		500	3,777	590,289
Utah				317,316			118	368,007
Vermont	1,906		4,225	677			7,317	17,715
Virginia	64,327	256,960	62,201	185,052		19,236	7,620	598,032
Washington	4,630		80	47,107		696	10,400	62,913
West Virginia	51,129	250,082	76,202	663,892		550	3,220	1,046,625
Wisconsin	391,230	74,717	329,723	42,119		4,704	18,788	1,017,135
Wyoming			12,084		95,200			108,234
Other States	7,787	17,964	43,595	4,335		36,687		130,734
Total	7,353,665	5,551,415	6,167,144	11,103,989	387,724	493,718	1,051,062	38,745,429

a Included in "Other States."

Value of the marketed production of limestone in the United States in 1913 and 1914, by States and uses—Continued.

1914.

State.	Rough building.	Dressed building.	Paving.	Curbing.	Flagging.	Rubble.	Riprap.
Alabama	$20,992	$20,558					$3,882
Arizona							
Arkansas	4,923	33,369				$176	1,812
California	385						
Colorado							
Connecticut [a]							
Florida	60,000						974
Georgia	187						
Idaho	180						
Illinois	15,129	29,706	$9,600	$140		73,643	127,394
Indiana	965,439	1,717,951	4,801	84,188	$160	21,764	15,967
Iowa	21,747	10,585	5,519	905		26,871	69,611
Kansas	16,526	12,060		325	124	28,741	6,573
Kentucky	59,804	60,805	40	7,132		4,115	21,666
Louisiana [a]							
Maine [a]							
Maryland	6,722	15	9,750		25		420
Massachusetts [a]							
Michigan	3,537					1,651	6,727
Minnesota	25,166	136,479		450	685	20,440	48,801
Missouri	168,984	148,037	7,350	500	3,967	126,172	482,753
Montana	3,916						724
Nebraska	1,416					761	43,355
New Jersey							1,000
New York	60,227	13,708		3,340	38	3,620	30,891
North Carolina							
Ohio	48,543	5,528	97			50,403	38,902
Oklahoma	1,850	45,134	450			300	19,815
Oregon [a]							
Pennsylvania	67,869	1,215	70,420	3,073		6,970	2,436
Rhode Island [a]							
South Dakota	8					800	600
Tennessee	6,760		4,500	80		3,200	17,159
Texas	28,853	17,434		243	6	935	81,424
Utah	7,300					13,588	6,381
Vermont	4,194					400	
Virginia	2,049	715				120	
Washington							
West Virginia	300		1,800	900		1,500	90
Wisconsin	39,621	928	550	19,131	2,129	37,166	69,959
Wyoming							
Other States [b]							23,807
Total	1,642,627	2,254,227	114,877	120,407	7,134	423,336	1,123,123

[a] Included in "Other States."
[b] Includes Connecticut, Louisiana, Maine, Massachusetts, Oregon, and Rhode Island.

Value of the marketed production of limestone in the United States in 1913 and 1914, by States and uses—Continued.

1914.

State.	Crushed stone.			Flux.	Sugar factories.	Agricultural.	Lime burners.	Other.	Total value.
	Road metal.	Railroad ballast.	Concrete.						
Alabama	$75,528	$1,076	$287,119	$360,691		$17,368			$787,214
Arizona									(a)
Arkansas	432		4,460			2,218			47,390
California	66,948	904	67,252	43,766	$75,736	3,597		$27,685	286,273
Colorado				277,355	58,193		$1,987	2,524	340,059
Connecticut									(a)
Florida	84,911	82,596	90,986			24,312			343,779
Georgia	34,200		11,620	2,722		37,172		3,315	89,216
Idaho					27,852				28,032
Illinois	828,863	372,843	928,827	283,398		88,763		103,034	2,861,340
Indiana	1,065,360	69,089	43,767	85,047	2,120	27,436		12,468	4,115,557
Iowa	17,438	97,747	278,071	1,200		7,352		316	537,362
Kansas	20,135	274,000	222,302	455		3,205		13,856	598,302
Kentucky	323,075	615,621	56,739	21,287		23,468		2,294	1,196,046
Louisiana									(a)
Maine									(a)
Maryland	116,284	30,061	36,343	1,380		1,200	735	1,341	204,276
Massachusetts									(a)
Michigan	242,839	20,600	166,959	565,012	69,477	11,104		370,055	1,457,961
Minnesota	21,557	7,500	216,903	180	2,100	925		8,663	489,849
Missouri	363,302	137,428	613,759	29,866	2,673	7,958	75	68,034	2,160,958
Montana	1,271	56	32,639	158,801	10,414				207,821
Nebraska	27,300	2,626	216,089	9,000	2,300			15	302,862
New Jersey	13,701		9,838	136,038		74,760		5,600	240,937
New York	1,085,982	564,863	765,673	407,543		81,035		141,697	3,158,617
North Carolina	8,685		1,075	10,552		38,442			58,754
Ohio	746,400	442,060	419,970	1,072,754	1,506	33,947	45,898	255,909	4,131,917
Oklahoma	7,441	75,947	83,714	630		1,274		489	237,044
Oregon									(a)
Pennsylvania	547,712	291,977	524,175	3,563,571		72,789	21,197	97,054	5,270,458
Rhode Island									(a)
South Dakota	8,800		2,270					10	12,488
Tennessee	264,288	220,333	85,467	62,893		13,388			678,068
Texas	104,898	42,360	241,559	30,780			438	637	549,567
Utah	19,200			235,487	21,125				303,081
Vermont	9,610		2,515	400				6,930	24,049
Virginia	576,869	355,404	75,685	134,287		29,543	10,559	9,030	1,194,261
Washington						1,800		8,208	10,008
West Virginia	108,490	208,534	32,005	391,017		33,251	862		778,749
Wisconsin	508,870	42,653	240,921	28,341		3,293	3,141	10,403	1,007,106
Wyoming			200		50,300				50,500
Other States [b]	127	11,070	35,115	5,916		49,361		8,858	134,254
Total	8,300,516	3,967,348	5,794,017	7,890,369	323,796	688,961	84,892	1,158,525	33,894,155

[a] Included in "Other States."
[b] Includes Connecticut, Louisiana, Maine, Massachusetts, Oregon, and Rhode Island.

Building stone.—More than 11 per cent of the limestone output is represented by building stone, which, including both rough and dressed stone, decreased in value from $4,509,339 in 1913 to $3,896,854 in 1914, a decline of $612,485, or 13.6 per cent. In 1913, as compared with 1912, there was a decrease of $542,557, or 10.7 per cent. Indiana is by far the largest producer of building limestone, and the next States, in order of rank, are Missouri, Minnesota, and Kentucky, each of whose production is valued at more than $100,000.

Indiana's output in 1914 amounted in value to $2,683,390, and represented 68.9 per cent of the building limestone, as well as 15 per cent of the total of all kinds of building stone quarried in the United States during the year. This was a decrease of $424,615 from the value in 1913, which was $3,108,005, and which also represented 68.9 per cent of the total production of building limestone in that year. Most of the product of this State 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, 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 tables are given to show the details of the marketed production of Bedford oolitic limestone in Lawrence and Monroe counties, from 1901 to 1914, and by uses and counties in 1913 and 1914:

Quantity and value of Bedford oolitic limestone quarried and sold in Lawrence and Monroe counties, Ind., 1901–1914.

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	2,321,892
					b 256,960	110,525
1908	a 5,199,996	1,498,822	a 3,147,097	880,218	a 8,347,093	2,379,040
	b 93,085	42,150	b 8,260	1,719	b 101,705	43,869
1909	a 6,441,483	1,678,195	a 2,970,388	801,436	a 9,411,871	2,479,631
	b 145,672	71,637	b 106,600	56,925	b 252,272	128,562
1910	a 5,778,660	1,841,233	a 3,960,148	1,265,287	a 9,738,808	3,106,520
	b 131,590	75,906	b 70,655	44,224	b 202,245	120,130
1911	a 6,612,988	2,171,148	a 2,915,444	859,580	a 9,528,442	3,030,728
	b 53,242	27,842	b 50,914	45,112	b 104,156	72,954
1912	a 7,066,496	2,622,648	a 3,375,808	824,594	a 10,442,304	3,447,242
	b 71,124	37,894	b 76,532	60,629	b 147,656	98,523
1913	a 5,737,303	2,095,461	a 3,273,369	992,286	a 9,010,672	3,087,747
	b 91,034	50,092	b 67,035	41,508	b 158,069	91,600
1914	a 5,249,651	1,920,904	a 2,679,355	750,311	a 7,929,006	2,671,215
	b 83,590	30,384	b 21,860	17,010	b 105,450	47,394

a Cubic feet. b Short tons.

Marketed production of Bedford oolitic limestone in Lawrence and Monroe counties, Ind., in 1913 and 1914, by uses.

1913.

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	3,881,072	$915,001	1,856,231	$1,180,460	5,737,303	$2,095,461	91,034	$50,092	$2,145,553
Monroe	1,948,892	344,097	1,324,477	648,189	3,273,369	992,286	67,035	41,508	1,033,794
Total	5,829,964	1,259,098	3,180,708	1,828,649	9,010,672	3,087,747	158,069	91,600	3,179,347
Average price	....	$0.22	....	$0.57	....	$0.342	....	$0.58	....

1914.

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	3,118,470	$692,381	2,131,181	$1,228,523	5,249,651	$4,920,904	83,590	$30,384	$1,951,288
Monroe	1,562,191	279,095	1,117,164	471,216	2,679,355	750,311	21,860	17,010	767,321
Total	4,680,661	971,476	3,248,345	1,699,739	7,929,006	2,671,215	105,450	47,394	2,718,609
Average price	....	$0.21	....	$0.52	....	$0.336	....	$0.45	....
Percentage of increase (+) or decrease (−) in 1914	−19.71	−22.84	+2.13	−7.05	−12.00	−13.49	−33.28	−48.25	−14.49

a Includes stone used for rubble, riprap, curbstone, flagstone, glass making, sugar factories, ground limestone, etc.

These tables show a continuous decrease in value during the years 1913 and 1914. Most of the operators reported conditions better in the early part of 1914 than during 1913, but these conditions were changed by the depression that characterized the last half of 1914 and that has lasted well into 1915. The total decrease for both Lawrence and Monroe counties was $460,738, or 14.49 per cent, from $3,179,347 in 1913 to $2,718,609 in 1914. The decrease in 1913, as compared with 1912, was $366,418, or 10.33 per cent. Building stone decreased from 9,010,672 cubic feet, valued at $3,087,747, in 1913 to 7,929,006 cubic feet, valued at $2,671,215, in 1914, a decrease of 1,081,666 cubic feet in quantity and of $416,532 in value. The average price per cubic foot decreased from 22 cents in 1913 to 21 cents in 1914 for stone in rough blocks, and from 57 cents in 1913 to 52 cents in 1914 for milled stone.

Missouri, which ranked next to Indiana in the production of building limestone, had an output valued at $317,021 in 1914, in comparison with $379,050 for 1913, a decrease in 1914 of $62,029. The decrease in 1913, as compared with 1912, was $70,642.

About 66 per cent of the Missouri building stone produced in 1914 was the strong, light-gray, crystalline limestone from Carthage, Jasper County. This stone for the most part takes a good polish, and especially in recent years has been used for monumental and interior decorative work, thus conforming to the commercial definition of marble, although the greater part of it is used for building in competition with limestone. The following table shows the details of the marketed production in the Carthage district for the last seven years:

Marketed production of limestone at Carthage, Jasper County, Mo., in 1908–1914, 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
1913	7	346,421	236,524	....	2,367	1,500	18,564	258,955
1914	7	280,046	206,554	....	2,883	1,951	21,426	232,814

[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 marketed production of limestone in 1914 for the Carthage district decreased $26,141, or 10 per cent. The decrease in 1913, as compared with 1912, was $46,495, or 15 per cent. Stone for building decreased in quantity and value, but stone for flagging, rubble, and other uses increased in value in 1914. The average price per cubic foot for building stone was 68.6 cents in 1911, 66.5 cents in 1912, 68 cents in 1913, and 73.8 cents in 1914.

The most important district producing building limestone in Minnesota is that of Kasota. Mankato also is an important limestone district, but its production of the better grades of building stone is small. It is impossible to give the details of production of these districts without disclosing individual figures for certain kinds of stone.

The greater part of Kentucky's production of building limestone comes from quarries of oolitic limestone near Bowling Green, in Warren County. The following table shows the quantity and value of this limestone produced and sold from 1909 to 1914:

Marketed production of limestone in Warren County, Ky., by uses, 1909–1914.

Year.	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
1913	110,576	36,388	95,915	74,250	37,972	20,476	2,045	133,159
1914	104,895	36,043	80,427	60,292	39,906	22,344		118,679
Average price		$0.34		$0.75		$0.56		

[a] Curbing, flagging, fluxing, and monumental stone.

Building stone, as shown in this table, represented nearly 80 per cent of the total production of building limestone in Kentucky. Building stone in this, as in the other important districts, suffered a decrease in output. The average price per cubic foot for rough stone increased from 33 cents in 1913 to 34 cents in 1914; that for dressed stone decreased from 77 cents in 1913 to 75 cents in 1914. Limestone sold as crushed stone increased both in quantity and in value. This stone occurs as overburden on the stratum of high-grade building stone, and is quarried as a by-product.

Paving.—The total production of limestone for paving decreased in value from $239,340 in 1913 to $114,877 in 1914, a decrease of $124,463, or 52 per cent. Nearly two-thirds of the total production was from Pennsylvania. This State, however, which produced $129,440 in 1913, yielded only $70,420 in 1914. Kansas, whose production in 1913 was valued at $17,280, reported no production of limestone for paving in 1914. Iowa, Tennessee, and Missouri, each of which produced paving stone valued at more than $14,000 in 1913, reported values from one-half to less than one-third as much in 1914. Texas and New York, which, respectively, reported paving stone valued at $7,800 and $7,750 in 1913, reported no production in 1914. Wisconsin and Ohio also showed marked decrease. Maryland and West Virginia were the only States to show substantial increase, the former from $4,350 in 1913 to $9,750 in 1914, and the latter from $800 in 1913 to $1,800 in 1914. The great decrease in so many States is very noteworthy.

Curbing.—The output of limestone for curbing increased in value from $108,793 in 1913 to $120,407 in 1914, a gain of $11,614. Indiana produced two-thirds of the total output. The value of this State's production increased from $73,050 in 1913 to $84,188 in 1914. Wisconsin was second, with a production valued at $19,131, as compared with only $7,742 in 1913.

Flagging.—The production of limestone for flagging is very small. Its value in 1914 was $7,134, a decrease of $203 from $7,337 in 1913. The principal producing State is Missouri, to which in 1914 was credited $3,967, more than half the total value. Wisconsin, with $2,129, was the only other State whose value was more than $1,000.

Rubble.—Limestone for rubble, which decreased greatly in 1913, continued to decrease in 1914. Its value in 1914 was $423,336, or $17,144 less than in 1913, when it was $440,480. Missouri, Illinois, Ohio, and Wisconsin were the principal producers in 1914, the first two showing decrease and the last two increase in value, as compared with 1913.

Riprap.—The value of limestone for riprap decreased $208,300 from $1,331,423 in 1913 to $1,123,123 in 1914. This decrease was greater than the increase for 1913 over 1912, which was $148,972. Missouri, with $482,753, and Illinois, with $127,394, were the two leading States and the only ones to report values greater than $100,000. Texas, Wisconsin, and Iowa were next in rank in 1914. Missouri's output is used principally in improvements along Mississippi River.

Crushed stone.—Crushed limestone used for road metal, railroad ballast, and concrete has a far larger value than any other limestone product. In 1914 this output was 32,667,341 short tons, valued at $18,061,881, a decrease of 2,502,187 short tons in quantity and of $1,010,343 in value for 1914, as compared with 1913, when the figures of output were 35,169,528 short tons, valued at $19,072,224. The production in 1914, however, exceeded that of 1912, which amounted to 33,122,642 short tons, valued at $17,619,599.

In 1914 the total output was divided into 14,763,318 short tons, valued at $8,300,516, for roads; 8,493,830 short tons, valued at $3,967,348, for railroad ballast; and 9,410,193 short tons, valued at $5,794,017, for concrete, which, compared with the itemized output for 1913—roads, 13,296,377 tons, valued at $7,353,665; railroad ballast, 11,774,121 tons, valued at $5,551,415; concrete, 10,099,030 tons, valued at $6,167,144—was an increase of 1,466,941 tons in quantity and $946,851 in value for roads, a decrease of 3,280,291 tons in quantity and $1,584,067 in value for railroad ballast, and a decrease of 688,837 tons in quantity and $373,127 in value for concrete. It is possible that the stone for roads 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. The average price per short ton was 55 cents in 1914, compared with 54 cents in 1913 and 53 cents in 1912.

Ohio, Illinois, New York, Indiana, Pennsylvania, Kentucky, Virginia, Missouri, Wisconsin, and Tennessee were ranking States in 1914 according to quantity of crushed limestone sold, and the rank according to value was Ohio, New York, Illinois, Pennsylvania, Indiana, Missouri, and Virginia, the value for each exceeding $1,000,000.

Furnace flux.—Next to crushed stone, limestone sold for furnace flux showed the largest value, but in 1914 it also showed the largest decrease among limestone products. The production in 1914 was 15,298,756 long tons, valued at $7,890,369; in 1913 it was 22,620,961 long tons, valued at $11,103,989, a decrease in 1914 of 7,322,205 tons in quantity and of $3,213,620 in value. The average price per ton was 52 cents in 1914, as compared with 49 cents in both 1913 and 1912.

Pennsylvania, Ohio, Michigan, New York, West Virginia, and Alabama were the principal producers. All these States, except Michigan, showed decrease in both quantity and value in 1914. Illinois, which ranked third in both quantity and value in 1913, with a production of 2,790,245 long tons, valued at $979,303, dropped to fifth place in quantity and to seventh place in value in 1914, with a production of 744,270 long tons, valued at $283,398. The decrease in the production of furnace flux in 1914 is comparable with the decrease in pig iron manufactured in 1914.

The following table shows the marketed production of limestone for smelter, open-hearth, and blast-furnace flux in 1913 and 1914, by States, in long tons:

Marketed production of furnace flux in 1913 and 1914, by States, in long tons.

State.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
Alabama	841,477	$487,078	637,049	$360,691
Arizona	3,596	3,628	(a)	(a)
California	39,520	42,274	38,561	43,766
Colorado	552,413	333,609	462,660	277,355
Connecticut	(a)	(a)	(a)	(a)
Georgia	10,813	7,056	3,419	2,722
Illinois	2,790,245	979,303	744,270	283,398
Indiana	407,414	199,955	183,645	85,047
Iowa	6,387	4,866	1,800	1,200
Kansas	241	170	540	455
Kentucky	19,117	12,368	33,845	21,287
Maine	(a)	(a)		
Maryland	46,860	23,723	2,108	1,380
Massachusetts	(a)	(a)		
Michigan	1,202,817	494,495	1,432,357	565,012
Minnesota	479	540	180	180
Missouri	40,757	35,874	31,666	29,866
Montana	782,017	230,097	528,675	158,801
Nebraska			12,000	9,000
New Jersey	330,352	178,233	286,826	136,038
New York	972,529	562,669	698,382	407,543
North Carolina	18,781	11,269	15,701	10,552
Ohio	3,822,762	1,934,734	2,110,665	1,042,754
Oklahoma			718	630
Pennsylvania	8,180,056	4,206,797	6,467,961	3,563,571
Rhode Island	(a)	(a)	(a)	(a)
Tennessee	117,156	64,825	114,738	62,893
Texas	44,427	29,928	45,679	30,780
Utah	499,406	317,316	353,920	235,487
Vermont	413	677	400	400
Virginia	343,382	185,052	229,000	134,287
Washington	35,546	47,107		
West Virginia	1,420,979	663,892	806,451	391,017
Wisconsin	85,589	42,119	49,344	28,341
Other States	5,430	4,335	6,196	5,916
Total	22,620,961	11,103,989	15,298,756	7,890,369
Average price per ton		$0.49		$0.52
Per cent of decrease (−)			−32.37	−28.94

[a] Included in "Other States."

Limestone for sugar refineries.—Limestone reported as sold to sugar refineries decreased in value from $387,724 in 1913 to $323,796 in 1914, a decline of $63,928. The value for 1914 was also less by $11,312 than that for 1912, which was $335,108, but exceeded by $23,079 the value for 1911, which was $300,717. These values represent only a part of the total production of limestone for sugar refineries, as a number of refiners quarry and burn their own limestone, and the value of their output is therefore included in the report on the production of lime. The total value of lime and limestone for sugar refineries in 1914 was $511,401, a decrease of $93,091 from the value in 1913, which was $604,492.

Limestone for agriculture.—Limestone for agriculture includes a small quantity sold to farmers who burn it into lime and also the limestone pulverized and applied to the soil without burning. This was one of the few products of limestone to show an increase in value in 1914. The output in 1914 amounted to 615,197 short tons, valued at $688,961, compared with $493,718 in 1913, a gain for 1914 of $195,243, or 39.5 per cent. It is interesting to note that burned lime sold by producers for agriculture also increased in value in 1914. These increases evidently indicate the growing appreciation throughout a large part of the country of the value of lime and limestone, especially of the latter, as fertilizers. Owing to this fact several producers of lime, limestone, and marble have recently added pulverizers to their plants.

The first recorded production of pulverized limestone for agricultural use was that of 1911, which amounted to 174,290 tons, valued at $205,006. The following table shows the rapid increase in the marketed production of this product during the last four years:

Quantity and value of pulverized limestone sold as fertilizer in 1911–1914, in short tons.

Year.	Quantity.	Value.
1911	174,290	$205,006
1912	200,000	311,702
1913	408,627	493,718
1914	615,197	688,961

Limestone sold to lime burners.—The value, according to States, of limestone sold to lime burners, is given for the first time in this report. It amounted in 1914 to $84,892, only an insignificant part of the total value of the lime produced in that year.

Other uses.—Limestone for other uses includes that 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. The total output for these various uses in 1914 was $1,158,525. In 1913, when it included stone sold to lime burners it was $1,051,062 or $107,463 less than in 1914. This increase in value of limestone is in contrast to the decreases in value of the lime produced for many of the same purposes.

LITHOGRAPHIC STONE.

No account of the lithographic stone industry has been published by the Survey since the paper by S. J. Kübel in Mineral Resources for 1900.[1] The industry has not changed materially since that date, but present conditions in Europe have cut off practically all imports of lithographic stone and afford an unusually favorable opportunity for the development of a steady domestic production.

[1] Mineral Resources U. S., 1900, pp. 869-873, 1901.

The imports of lithographic stone during the years 1903 to 1914, inclusive, are shown in the following table:

Value of imports (free) of lithographic stone (not engraved), 1903 to 1914.

Year.	Value.	Year.	Value.
1903	$146,114	1909	$89,764
1904	148,884	1910	97,502
1905	146,323	1911	106,232
1906	158,631	1912	88,994
1907	150,481	1913	70,984
1908	104,160	1914	46,043

These figures represent the value of the stone at the point of shipment and do not include ocean freight or other charges. The cost to the consumer in the United States is probably more than double the value given in the table. The figures, although fluctuating, show a general decrease in value, with the lowest amount, $46,043, recorded in 1914. This sum, however, represents only half a year of imports, as the principal source of import in the second half of 1914 was cut off by the European war. The total value of $70,984 for 1913 represents the minimum value recorded under ordinary conditions. From the fact that there has been almost no domestic production of lithographic stone during these years, it is concluded that the decrease in imports has been caused either by a decrease in supply of the stone or by the use of other materials, such as zinc and aluminum plates and rolls, instead of stone.

Over 90 per cent of the imports came from Germany and about 7 per cent from Belgium. Small quantities were also imported from Canada and from the Netherlands.

During 1913 and 1914 small quantities of lithographic stone were quarried and sold by the German Lithographic Stone Co., whose quarry was at Brandenburg, Meade County, Ky. This company was operating as early as 1900, and was intermittently active until March 1, 1915, when its holdings were taken over by the Kentucky Lithograph Stone Co., of Louisville, Ky. This company, when visited by the writer in June, 1915, was installing new equipment, and had one planer in operation. A large number of sawn and trimmed stones varying from less than a foot square to 42 by 62 inches in area were in the storeroom. These stones had been taken from a nearly horizontal bed which was 34 inches thick, where measured. Three other beds, possibly suitable for lithographic stone, were seen at intervals below the bed first mentioned. These ranged from 4 to 10 feet in thickness. Only portions of them considerably affected by the weather were exposed in openings along a cliff, but core drill samples of them, taken well back from the cliff exposures, were said to be of good quality.

At Lithograph City, Iowa, a deposit including beds with the characteristics of lithographic stone and of marble has been controlled by the Interstate Investment & Development Co. for several years. No production of either kind of stone, however, has thus far been reported to the Survey. The most promising bed of lithographic stone seen by the writer in July, 1915, measured, where exposed in a vertical cut, 22 inches in thickness. This exposure shows that blocks 6 feet long can be obtained, but gives no indication of their width. Loose blocks were seen in the ground near by large enough to yield trimmed stones 2 by 3 feet and possibly 2 by 4 feet in area. Prints shown the writer and said to have been made from samples of this stone, would indicate that these samples were of good quality. Other samples of lithographic stone from this vicinity and from the same formation have been submitted to the Survey for testing by different parties, and the tests have yielded varying results. Reference to the marble beds is made on page 866 of this report.

Small samples from a deposit of lithographic stone near Custer, S. Dak., have recently been tested by the Survey and include material both of very good and of fair quality. This deposit is owned by John F. Sidey, of Custer.

Prospects of lithographic stone have also been reported at different times from Alabama, Arizona, California, Colorado, Georgia, Illinois, Missouri, Nevada, Tennessee, Texas, and Utah, but for one reason or another they have not been developed.

The foregoing paragraphs show that there are in the United States deposits of lithographic stone that have been proved to be of good quality, and it is reasonable to expect that the country's demand can finally be supplied from them. According to the table of imports, however, the demand is less than it was and is not such as to encourage extensive operations.

SANDSTONE.

The value of sandstone produced and sold in 1914 was $7,501,808. In 1913 it was $7,248,965. The increase in 1914, which was $252,843, or 3.49 per cent, was less than the gain of 1913 over 1912 which was $265,354, or 5.15 per cent. This increase in the last two years was in marked contrast to almost steady decline from 1903 to 1912, inclusive. The increase was principally in crushed stone for roads and for concrete and in stone for miscellaneous uses. Rough building stone and riprap also showed increase. The greatest decrease was in the value of curbstone. The marked increase in crushed stone was in contrast to conditions in previous years, in which the value of crushed sandstone did not make the rapid increase that characterized the values of other kinds of crushed stone. The largest increases in value of road metal were in California, Illinois, Massachusetts, New York, and Virginia. The gain in value of stone for concrete was chiefly in New Mexico, due to the construction of the Elephant Butte dam.

The gain in sandstone, as a whole, more than offsets a decrease in the output of ''bluestone,'' the dark-gray sandstone quarried in eastern New York and northeastern Pennsylvania. The decrease in production of bluestone in New York was caused in 1914, as in the two preceding years, by the curtailment or finishing of work done by the State on public construction, as well as by decreased output of the regular products. This stone forms such an importnt industry in these two States that a separate table is given to it.

The figures here presented do not include the value of a considerable quantity of sandstone, chiefly from Ohio and Michigan, that is manufactured into grindstones, scythestones, and other abrasives, and is included in the report on abrasives. Some sandstone also is ground into sand for the manufacture of glass and for other purposes and is included in the report on sand and gravel. The figures for sandstone in this report, however, include the value of crushed conglomerate ("puddingstone") and slate in Massachusetts, and of small quantities of crushed sandstone in certain other States which were formerly reported as trap rock. They also include, as formerly, the values of quartzite and bluestone. The figures for 1913 have been revised to correspond in arrangement to those for 1914.

The following table shows the value of the sandstone produced and sold in the United States from 1910 to 1914, inclusive, by States:

Value of sandstone (including quartzite and bluestone) produced and sold in the United States, 1910–1914, by States.

State.	1910	1911	1912	1913	1914
Alabama	$109,063	$73,195	$27,596	$151,111	$161,773
Arizona	131,716	[a] 57,100	21,524	88,391	23,760
Arkansas	71,641	85,529	80,538	89,395	79,358
California	113,488	176,213	70,724	139,486	277,657
Colorado	189,603	135,673	108,169	96,964	97,029
Connecticut	([b])	([a])	([c])	([c])	([c])
Florida	....	([a])	([c])	([c])	....
Georgia	....	....	([c])	([c])	....
Idaho	34,070	40,097	13,883	20,111	22,837
Illinois	5,710	30,953	32,720	28,781	72,738
Indiana	4,141	7,078	([c])	([c])	([c])
Iowa	14,456	56,312	1,551	1,612	1,319
Kansas	25,691	13,774	6,031	1,602	2,274
Kentucky	90,729	97,439	114,650	81,171	60,926
Maryland	18,226	10,097	15,950	16,435	8,128
Massachusetts	[b] 424,485	[a] 406,072	307,838	404,817	428,926
Michigan	31,233	12,985	16,438	19,224	([c])
Minnesota	483,578	292,366	349,063	315,149	210,099
Missouri	39,398	19,748	15,004	10,195	3,588
Montana	59,019	34,437	33,280	51,081	([c])
Nebraska	....	([a])	([c])	([c])	([c])
Nevada	([b])	....	....	....	....
New Jersey	112,650	155,765	166,583	69,584	53,394
New Mexico	1,402	4,085	([c])	66,700	412,845
New York	[d] 1,810,770	[d] 2,353,995	[d] 1,651,317	[d] 1,568,952	[d] 1,475,231
North Carolina	([b])	[a] 10,385	([c])	([c])	([c])
Ohio	1,402,131	1,334,947	1,312,300	1,316,028	1,523,796
Oklahoma	19,801	90,971	5,334	1,010	1,934
Oregon	[b] 30,375	[a] 1,668	....	([c])	([c])
Pennsylvania	[d] 1,595,070	[d] 1,333,309	[d] 1,367,601	[d] 1,359,533	[d] 1,140,182
South Dakota	156,576	141,615	139,167	163,165	126,413
Tennessee	([b])	([a])	([c])	([c])	([c])
Texas	40,471	28,000	82,501	58,750	197,800
Utah	43,589	41,953	32,562	23,965	67,578
Virginia	25,080	31,315	4,020	([c])	150,469
Washington	438,581	301,843	344,476	560,468	450,436
West Virginia	[b] 212,308	203,935	183,410	146,698	142,459
Wisconsin	189,654	144,430	179,352	213,229	167,595
Wyoming	5,314	3,584	3,730	([c])	11,831
Other States	....	....	206,299	185,358	129,433
Total	7,930,019	7,730,868	6,893,611	7,248,965	7,501,808

[a] Arizona includes Florida; Massachusetts includes Connecticut; Oregon includes Nebraska; North Carolina includes Tennessee.
[b] Massachusetts includes Connecticut; Oregon includes Nevada; West Virginia includes Tennessee and North Carolina.
[c] Included in "Other States."
[d] Includes bluestone.

Ohio, New York, and Pennsylvania, in the order named, were the leading States in 1914, the value for each exceeding $1,000,000. The order in 1913 was New York, Pennsylvania, and Ohio. Ohio's production made a substantial increase of $207,768 in 1914, while that of the other two States decreased. New Mexico, because of the Elephant Butte dam, as already stated, had the largest increase, which was $346,145. Texas and California made increases of more than $100,000 each. Pennsylvania, Washington, and Minnesota declined in value more than $100,000 each.

The following table shows the value of the marketed production of sandstone in 1913 and 1914, by States and uses:

Value of marketed production of sandstone (including quartzite and bluestone) in the United States in 1913 and 1914, by States and uses.

1913.

State.	Rough building.	Dressed building.	Ganister.	Paving.	Curbing.	Flagging.	Rubble.
Alabama	$37,500						$9,055
Arizona	2,275	$8,520					7,356
Arkansas	325			$2,035	$8,240	$39	1,030
California	7,514	69,220		16,000	435		1,050
Colorado	10,808	23,746	$10,353	31,509	9,995	2,088	2,931
Connecticut							
Florida							
Georgia							
Idaho	12,979	6,859					273
Illinois	428	120	2,000				32
Iowa	500	450			6		80
Indiana							
Kansas	916					322	364
Kentucky	16,022	56,135				1,264	80
Maryland	450		782	1,480			3,805
Massachusetts	47,443	30,111					1,874
Michigan	5,580	7,380					3,125
Minnesota	1,379	47,629		184,573	9,863		7,808
Missouri	2,070	2,839		185	74		970
Montana	3,992	44,139					800
Nebraska							
New Jersey	32,848	5,487		325	350	450	1,520
New Mexico	800	200					11,700
New York	65,254	212,000		288,648	525,209	211,047	9,326
North Carolina							
Ohio	102,413	345,638	4,200		450,839	239,675	11,616
Oklahoma							1,000
Oregon							
Pennsylvania	188,986	210,192	283,056	49,174	144,725	95,479	70,744
South Dakota	17,179	19,377		65,708			708
Tennessee							
Texas	4,250						
Utah	1,861	4,073		15,659			2,372
Virginia							
Washington	1,410	58,626		20,672			5,240
West Virginia	25,347	27,663		12	3,800	660	11,871
Wisconsin	10,478	23,261	63,384	60,287		13	23,928
Wyoming							
Other States	64,205	5,522	13,000	500	1,300	2,092	10,164
Total	665,212	1,209,087	376,775	736,767	1,154,836	553,129	200,822

Value of the marketed production of sandstone (including quartzite and bluestone) in the United States in 1913 and 1914, by States and uses—Continued.

1913.

State.	Riprap.	Road metal.	Railroad ballast.	Concrete.	Other.	Total value.
Alabama	$17,056			$87,500		$151,111
Arizona	60,240				$10,000	88,391
Arkansas	32,205	$18,053	$14,468	12,925	75	89,395
California	813	28,680	2,524	7,830	5,420	139,486
Colorado	12	5,000		522		96,964
Connecticut						(a)
Florida						(a)
Georgia						(a)
Idaho						20,111
Illinois		25,988		213		28,781
Iowa	38			538		1,612
Indiana						(a)
Kansas						1,602
Kentucky	5,003			2,667		81,171
Maryland	2,698				7,220	16,435
Massachusetts		56,352		269,037		404,817
Michigan	3,127				12	19,224
Minnesota		12,343		46,300	5,254	315,149
Missouri	57	4,000				10,195
Montana	50				2,100	51,081
Nebraska						(a)
New Jersey	4,648	11,375		10,288	2,293	69,584
New Mexico				54,000		66,700
New York	19,676	7,301	44,437	165,175	20,879	1,568,952
North Carolina						(a)
Ohio	82,862	1,638	16,586	39,471	21,090	1,316,028
Oklahoma					10	1,010
Oregon						(a)
Pennsylvania	28,126	106,533	71,240	103,543	7,735	1,359,533
South Dakota	12,423			47,230	540	163,165
Tennessee						(a)
Texas	10,750	6,250		37,500		58,750
Utah						23,965
Virginia						(a)
Washington	474,520					560,468
West Virginia	23,507	4,753	34,282	14,053	750	146,698
Wisconsin	2,873	20,145		8,114	746	213,229
Wyoming						(a)
Other States	32,500	3,383	2,506	46,024	4,262	185,348
Total	813,184	311,794	186,043	952,930	88,386	7,248,965

a Included in "Other States."

Value of the marketed production of sandstone (including quartzite and bluestone) in the United States in 1913 and 1914, by States and uses—Continued.

1914.

State.	Rough building.	Dressed building.	Ganister.	Paving.	Curbing.	Flagging.	Rubble.
Alabama	$57,079		$2,300				$1,558
Arizona	10,050						10
Arkansas	375	$177			$3,539	$203	250
California	2,502	21,414					502
Colorado	8,085	13,428	8,267	$38,487	4,762	2,357	3,795
Idaho	16,291	6,330					125
Illinois	525		1,563				
Iowa	453						80
Kansas	960	241			50	349	674
Kentucky	3,277	55,407					
Maryland	1,000		2,008				2,720
Massachusetts	62,973	17,894					920
Minnesota	3,221	59,522		100,071	8,340		4,738
Missouri	695	1,964					600
New Jersey	29,794	200		325	275	300	
New Mexico	208	137					1,200
New York	53,461	176,116		361,850	375,601	112,014	1,989
Ohio	113,193	452,198	725	19,175	478,574	354,475	19,522
Oklahoma	326						
Pennsylvania	222,122	176,083	239,211	44,105	113,147	48,963	44,689
South Dakota	10,153	15,379		24,680			545
Texas				8,000	2,000		3,000
Utah	2,709			60,786		1,240	1,043
Virginia							135
Washington	2,372	15,674		13,213			263
West Virginia	9,315	66,147		6,000	1,854	11	5,700
Wisconsin	19,891	35,481	34,170	37,000			6,861
Wyoming	272						
Other States [a]	67,007	13,078			175	45	4,987
Total	698,309	1,126,870	288,244	713,692	988,317	519,957	105,906

State.	Riprap.	Road metal.	Railroad ballast.	Concrete.	Other.	Total value.
Alabama	$15,694			$85,142		$161,773
Arizona		$4,000		600	$9,100	23,760
Arkansas	35,077	5,302	$18,104	16,331		79,358
California	22,408	154,596	7,945	66,672	1,618	277,657
Colorado	9,546	1,500	700	2,500	3,602	97,029
Connecticut						(b)
Idaho					91	22,837
Illinois		65,026	5,615		9	72,738
Indiana						(b)
Iowa	96				690	1,319
Kansas						2,274
Kentucky	2,242					60,926
Maryland		2,400				8,128
Massachusetts		104,625	3	242,511		428,926
Michigan						(b)
Minnesota	128			23,804	10,275	210,099
Missouri	16				313	3,588
Montana						(b)
Nebraska						(b)
New Jersey	950	16,500		4,250	800	53,394
New Mexico	1,800			315,000	94,500	412,845
New York	6,227	64,499	2,659	111,597	209,218	1,475,231
North Carolina						(b)
Ohio	80,155	1,675	1,000	3,089	15	1,523,796
Oklahoma				1,600	8	1,934
Oregon						(b)
Pennsylvania	9,131	93,595	55,729	86,526	6,881	1,140,182
South Dakota	13,432	2,500		59,724		126,413
Tennessee						(b)
Texas	149,500	2,000	800	32,500		197,800
Utah					1,800	67,578
Virginia	200	136,500	9,422	4,062	150	150,469
Washington	418,914					450,436
West Virginia	19,892	5,035	14,418	14,037	50	142,459
Wisconsin	2,181	21,700		10,300	11	167,595
Wyoming	919			10,640		11,831
Other States [a]	24,952		1,672	8,100	9,417	129,433
Total	813,460	681,453	118,067	1,098,985	348,548	7,501,808

[a] Includes Connecticut, Indiana, Michigan, Montana, Nebraska, North Carolina, Oregon, and Tennessee.
[b] Included in "Other States."

Building stone.—The largest product of the sandstone industry is building stone, and this showed a decrease in value of $49,120, or 2.6 per cent, in 1914, as compared with 1913. This slight decrease followed the large decrease for 1913, as compared with 1912, which was $388,990, or more than 17 per cent. The value in 1914, including rough and dressed stone, was $1,825,179; in 1913 it was $1,874,299; in 1912, $2,263,289. Ohio, Pennsylvania, and New York produced most of the building stone.

Ganister.—Ganister reported from Pennsylvania, Wisconsin, Colorado, Alabama, Illinois, Maryland, and Ohio was valued at $288,244, a decrease of $88,531 as compared with the value in 1913. This decrease was common to all products used in the iron and steel industry. The decrease in value in 1914 from 1913 was slightly greater in amount than the increase in 1913 over 1912, which was $86,840.

Paving.—The total value of paving stone (blocks and slabs) decreased $23,075, from $736,767 in 1913 to $713,692 in 1914. The value in 1914, however, was greater by $128,417 than the value in 1912, which was $585,275. New York and Minnesota were the principal producers.

Curbing.—Sandstone for curbing was valued at $988,317 in 1914, a decrease of $166,519 from the value in 1913, which was $1,154,836. It was also $120,228 less than the value for 1912, which was $1,108,545. Ohio, New York, and Pennsylvania were the principal producers, Ohio in 1914 taking the lead formerly held by New York.

Flagging.—Sandstone flagging decreased in value $33,172 from $553,129 in 1913 to $519,957 in 1914. This decrease marks a continuation in the decline in production which was indicated in 1913 by a decrease of $167,940 from $721,069 in 1912. Ohio and New York were the only States whose production was valued at more than $100,000. Pennsylvania was third. Ohio's production increased in value from $239,675 in 1913 to $354,475 in 1914, New York's declined from $211,047 to $112,014, and Pennsylvania's from $95,479 to $48,963. The product in the two latter States was chiefly bluestone.

Rubble.—The value of rubble decreased $94,916 from $200,822 in 1913 to $105,906 in 1914. The value in 1912 was $200,305, practically the same as in 1913. Pennsylvania had the largest production, which was valued at $44,689.

Riprap.—Sandstone sold for riprap made a slight increase of $276—from $813,184 in 1913 to $813,460 in 1914. Over half this output in both 1913 and 1914 was produced in Washington and was used for the protection of the Northern Pacific Railway tracks in the vicinity of Tacoma. Texas was the only other State whose production was valued at more than $100,000.

Crushed stone.—The total production of crushed sandstone continued to increase in value. In 1914 it was valued at $1,898,505, a gain of $447,738 over 1913, when it was $1,450,767. The quantity increased from 1,770,249 short tons in 1913 to 2,453,574 short tons in 1914, a gain of 683,325 tons. The average price per ton decreased from 82 cents in 1913 to 77 cents in 1914. The increase was in crushed sandstone for concrete, whose value rose from $952,930 in 1913 to $1,098,985 in 1914, and in road metal, whose value more than doubled, rising from $311,794 in 1913 to $681,453 in 1914.

BLUESTONE.

The fine-grained compact dark blue-gray argillaceous sandstone quarried in eastern and southeastern New York and in northeastern Pennsylvania is generally known as "bluestone." The figures of production for this stone are included in those of sandstone, but on account of the local importance of the material, the value is also given separately. This stone is marketed under peculiar conditions. Almost all the owners of land in this district have small deposits of the stone on their property and quarry small quantities of it annually, which they sell to agents of large dealers who market the stone. As many of these dealers also quarry the stone, it has been found that the best figures of production are obtained from the dealers, who are better able to give the entire quantity of stone bought and sold than are the small producers. This stone is used chiefly for flagging, curbing, and for sills, lintels, steps, and house copings. In recent years, however, much of this stone for these purposes has been replaced by cement concrete. For the last few years some of this stone has been crushed and used in the concrete work of the New York City water-supply system. The marketed output in 1913 was valued at $1,280,862, in 1912 at $1,505,763, a decrease of $224,901, or 14.9 per cent, in 1913. This decrease continued in 1914, when the value was $1,086,699, a decline of $194,163 from the value in 1913.

The following table shows the marketed value of the bluestone produced from 1907 to 1914:

Value of bluestone produced and sold from 1907 to 1914.

Year.	Value.	Year.	Value.
1907	$2,117,916	1911	$1,876,473
1908	1,762,860	1912	1,505,763
1909	1,446,402	1913	1,280,862
1910	1,535,187	1914	1,086,699

The following table shows the value and uses of the bluestone produced and sold in New York and Pennsylvania in 1913 and 1914:

Value and uses of bluestone produced and sold in New York and Pennsylvania in 1913 and 1914.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
1913.						
New York	$201,032	$200,588	$327,694	$199,210	$15,775	$944,299
Pennsylvania	118,988	93,198	94,625	23,306	6,446	336,563
Total	320,020	293,786	422,319	222,516	22,221	1,280,862
1914.						
New York	$190,084	$111,394	$231,590	$161,522	$206,336	$900,926
Pennsylvania	49,078	48,239	67,590	14,738	6,128	185,773
Total	239,162	159,633	299,180	176,260	212,464	1,086,699

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, 1912, and 1913, contain besides the statistics of stone production 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. A descriptive price list of folios may be obtained from the Survey.

MISCELLANEOUS PUBLICATIONS.

Alden, W. C., The stone industry in the vicinity of Chicago, Ill.: Bull. 213, pp. 357–360, 1903. 25c.

Bain, H. F., Notes on Iowa building stones: Sixteenth Ann. Rept., pt. 4, pp. 500–503, 1895. $1.20.

Bastin, E. S. (See Leighton, Henry, and Bastin, E. S.)

Burchard, E. F., Concrete materials produced in the Chicago district: Bull. 340, pp. 383–410, 1908. 30c.

——— Structural materials near Austin, Tex.: Bull. 430, pp. 292–316, 1910.

——— Structural materials near Minneapolis, Minn.: Bull. 430, pp. 280–291, 1910.

——— Stone resources east of Mississippi River: Mineral Resources, 1911, pt. 2, pp. 782–834, 1912. $1.10.

——— Stone resources of Great Plains and Rocky Mountain States: Mineral Resources, 1912, pt. 2, pp. 734–818, 1913.

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——— Marble resources of Juneau, Skagway, and Sitka districts, Alaska: Bull. 592, pp. 95–107, 1914.

Butts, Charles, Variegated marbles southeast of Calera, Shelby County, Ala.: Bull. 470, pp. 237–239, 1911.

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, pp. 153–200, 1899. $2.25.

——— The slate industry of Slatington, Pa., and Martinsburg, W. Va.: Bull. 213, pp. 361–364, 1903. 25c.

——— Notes on Arkansas roofing slates: Bull. 225, pp. 414–416, 1904. 35c.

——— Slate investigations during 1904: Bull. 260, pp. 486–488, 1905 (out of print).

——— Note on a new variety of Maine slate: Bull. 285, pp. 449–450, 1906. 60c.

——— Recent work on New England granites: Bull. 315, pp. 356–359. 1907. 50c.

——— The granites of Maine: Bull. 313, 202 pp., 1907. 35c.

——— The chief commercial granites of Massachusetts, New Hampshire, and Rhode Island: Bull. 354, 228 pp., 1908.

——— The granites of Vermont: Bull. 404, 138 pp., 1909.

——— Supplementary notes on the granites of New Hampshire: Bull. 430, pp. 346–372, 1910.

——— Supplementary notes on the commercial granites of Massachusetts: Bull. 470, pp. 240–290, 1911.

——— The commercial marbles of western Vermont: Bull. 521, 170 pp., 1912.

——— The calcite marble and dolomite of eastern Vermont: Bull. 589, 67 pp., 1915.

——— and Gregory, H. E., The granites of Connecticut: Bull. 484, 137 pp., 1911.

——— and others, Slate deposits and slate industry of the United States: Bull. 275, 154 pp., 1906. 15c.

Darton, N. H., Marble of White Pine County, Nev., near Gandy, Utah: Bull. 340, pp. 377–380, 1908. 30c.

——— Structural materials near Portland, Oreg., and Seattle and Tacoma, Wash.: Bull. 387, 36 pp., 1909.

DILLER, J. S., Limestone of the Redding district, California: Bull. 213, pp. 365, 1903.
ECKEL, E. C., Slate deposits of California and Utah: Bull. 225, pp. 417–422, 1904. 35c.
——— Cement materials and industry of the United States: Bull. 243, 395 pp., 1905. Edition exhausted. (Treats of limestone.)
ECKEL, E. C., BURCHARD, E. F., and others, Portland cement materials and industry of the United States: Bull. 522, 401 pp. (Treats of limestone.) 65c.
GARDNER, JAMES H., Oolitic limestone at Bowling Green and other places in Kentucky: Bull. 430, pp. 373–378, 1910.
HILLEBRAND, W. F., Chemical notes on the composition of the roofing slates of eastern New York and western Vermont: Nineteenth Ann. Rept., pt. 3, pp. 301–305, 1899. $2.25.
HOPKINS, T. C., The sandstones of western Indiana: Seventeenth Ann. Rept., pt. 3 (continued), pp. 780–787, 1896.
——— Brownstones of Pennsylvania: Eighteenth Ann. Rept., pt. 5 (continued), pp. 1025–1043, 1897.
——— and SIEBENTHAL, C. E., The Bedford oolitic limestone of Indiana: Eighteenth Ann. Rept., pt. 5 (continued), pp. 1050–1057, 1897.
HUMPHREY, R. L., the fire-resistive properties of various building materials: Bull. 370, 99 pp., 1909. 20c.
HUNTER, J. F., The Aberdeen granite quarry, near Gunnison, Colo.: Bull. 540, pp. 359–362, 1913.
KEITH, A., Tennessee marbles: Bull. 213, pp. 366–370, 1903. 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, 158 pp., 1912.
PACK, ROBERT W., Ornamental marble near Barstow, Cal.: Bull. 540, pp. 363–368, 1913.
PAIGE, SIDNEY, Marble in Chiricahua Mountains, Arizona: Bull. 380, pp. 299–311, 1909. 40c.
PURDUE, A. H., The slates of Arkansas: Bull. 430, pp. 317–334, 1910.
RIES, H., The limestone quarries of eastern New York, western Vermont, Massachusetts, and Connecticut: Seventeenth Ann. Rept., pt. 3 (continued), pp. 795–811, 1896.
SHALER, N. S., Preliminary report on the geology of the common roads of the United States: Fifteenth Ann. Rept., pp. 259–306, 1895. $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, pp. 277–341, 1895. $1.25.
SIEBENTHAL, C. E., The Bedford oolitic limestone [Indiana]: Nineteenth Ann. Rept., pt. 6 (continued), pp. 292–296, 1898.
——— (See also Hopkins, T. C., and Siebenthal, C. E.)
SMITH, G. O., The granite industry of the Penobscot Bay district, Maine: Bull. 260, pp. 489–492, 1905. (Out of print.)
UDDEN, JON A., Oolitic limestone industry at Bedford and Bloomington, Ind.: Bull. 430, pp. 335–345, 1910.
WATSON, T. L., Granites of the Southeastern Atlantic States: Bull. 426, 282 pp., 1910.

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 if the free copies are out of print:

1882. Structural materials, pp. 450–464. 50c.
1883–84. 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.
Stone, by Wm. C. Day, pp. 759–811.

1896. Eighteenth Ann. Rept., U. S. Geol. Survey, pt. 5 (continued), Nonmetallic products, except coal.
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, with maps showing location of quarries of stone, by classes, and limekilns in the United States east of Mississippi River.
Lime (Analysis of various limestones and limes), by E. F. Burchard, pt. 2, pp. 645–718. $1.10.

1912. Slate, by A. T. Coons, pt. 2, pp. 669–692; The commercial qualities of slates of the United States and their localities, by T. Nelson Dale, pt. 2, pp. 693–707; Stone, by E. F. Burchard, pt. 2, pp. 709–818, with maps showing location of quarries of stone, by classes, and limekilns in Mississippi Basin and Rocky Mountain States.

1913. Slate, by A. T. Coons, pt. 2, pp. 71–84.
Stone, by E. F. Burchard, pt. 2, pp. 1285–1410, with maps showing location of stone quarries, by classes, and limekilns in the Pacific Slope States.

PETROLEUM.

By JOHN D. NORTHROP.

INTRODUCTION.

It is the purpose of this report to furnish a concise and impartial review of the developments in the crude-petroleum industry in the calendar year 1914. Developments in the United States are treated in considerable detail, and brief reviews are added that summarize the trend of developments in foreign oil fields so far as conditions can be ascertained.

Terms used.—To the lay reader who is unfamiliar with the terminology of the petroleum industry as well as to the reader who possesses more than a superficial knowledge of the subject the precise meaning of terms familiar enough to the oil operator is often obscure, hence literal interpretations have often resulted in wrong conclusions. In view of these misconceptions, it has been deemed advisable to explain the usage of several terms as applied in this report.

From its extended use throughout reports of this type the word "production" has led perhaps to more misapprehension than any other commonly used term. In the preceding reports of this series the term has been used to designate only the quantity of oil actually disposed of by the producer during the year under review, including both the oil entering the markets through purchasing agencies and that consumed in field developments, no consideration being given to the oil brought to the surface and placed in temporary storage by the producer during the year or to the unsold oil remaining in storage on his premises at the end of the preceding year. In normal years producers' field storage is essentially a constant quantity and can therefore be disregarded as having no particular influence on future markets or future supplies. In years like 1914, however, when vast quantities of oil far in excess of existing market demands, are brought to the surface, a record merely of the quantity of oil disposed of by the producer fails as a true index to the condition and future prospects of the petroleum industry. In recognition of these considerations as well as of the tendency of readers to interpret the term "production" as denoting total yield or total oil brought to the surface, the expression "marketed production" has been introduced into this report to denote what has formerly been termed "production"—that is, the quantity of oil disposed of by the producer during the year either by sale or by consumption on the property for operating purposes. The new term is not wholly satisfactory, as it fails to indicate the inclusion of field fuel, an objection equally applicable, however, to the less specific term it replaces.

The term "stocks," when used without qualification, denotes only the quantity of crude petroleum in the possession of pipe-line companies within a designated area and on a specified date and includes neither the oil held in producers' storage nor the unrefined oil in storage at refineries. The term "runs" designates the quantity of crude oil handled by a given pipe-line company or group of companies within a specified period, including oil transported not only by pipe line but by rail as well, and, as applied in this report, oil utilized in field operations wherever the quantity so used can be determined. "Runs from wells," as the term implies, designates that portion of the "runs" moving directly from operating properties as distinguished from the portion removed from stock accumulations.

The term "deliveries" relates also to the transportation phase of the petroleum industry and designates the quantity of crude oil turned over by pipe-line companies, irrespective of mode of transportation, to the trade—that is, the refiners—and to other markets or connecting lines. "Shipments" alone is used synonymously with "deliveries." "Rail shipments," however, constitute a specialized type of "runs" and may or may not include petroleum transported throughout a portion of its journey by pipe.

Marketed production.—Measured by marketed production the year 1914 was the greatest in the history of the crude-petroleum industry, the quantity involved being 265,762,535 barrels, as compared with the previously established record of 248,446,230 barrels attained in 1913. This phenomenal increase of nearly 7 per cent over the former record is attributed to the extraordinary success that attended the country-wide drilling campaign stimulated by the high prices which prevailed in 1913 and the early part of 1914.

More specifically the factors contributing to the new record include the spectacular results of deeper drilling in the Mid-Continent and Gulf Coastal Plain regions; the development of a number of prolific pools in Oklahoma, northern Texas, and northwestern Louisiana, in areas little tested at the end of 1913; the successful extension and highly efficient operation of many of the older fields in the Appalachian region; the discovery of new fields and the increased development of the old fields in Wyoming; and the large number of gusher wells completed in California.

Producers' field storage.—In addition to the marketed production more than 24,550,000 barrels of crude petroleum, exceeding in quantity the entire marketed production of West Virginia, Ohio, Kentucky, New York, and Indiana combined, was placed in producers' storage in the Cushing and Healdton fields, Oklahoma, and in the Sunset field, California. This figure does not represent the total oil going into field storage throughout the United States in 1914, as no systematic effort was made to obtain statistics on the subject. It is intended merely as a moderate estimate, based on reports from reliable sources, of the quantity of oil in excess of transportation facilities brought to the surface in 1914 at the principal points of excess production. The introduction of this estimate has been found necessary, not only to supplement the statistics of marketed production in an attempt to approximate the total yield of the oil fields of the United States, but to assist in explaining the market conditions which constituted a notable feature of the year.

That the quantity of oil available in producers' field storage is destined to affect petroleum markets in the future more than it has in the past is apparent from the results after a few months of placing the trunk pipe lines under the common-carrier act, which, as now enforced, necessitates a considerable accumulation of oil by the small producer before transportation is practicable.

It is hoped that with the cooperation of the petroleum producers of the country the Survey may be able to present more definite and complete statistics on field storage in future reports of this series.

Total yield.—Combination of the figures for marketed production and of the estimated quantity of oil placed in producers' storage gives more than 290,000,000 barrels as the total yield of the oil wells of the United States in 1914. This total is, of course, only approximate, as complete data are not available regarding the quantity of petroleum going into producers' storage during the year, the excess not reported being assumed to balance that portion of the marketed production credited to 1914, which was in reality taken from storage held by producers at the end of 1913.

Prices.—Second in importance to the phenomenal yield of petroleum in 1914 was the trend of the crude-petroleum market during the year, which was characterized by a depreciation in price affecting in varying degrees every type of high-grade oil produced in the United States. In the fields east of the Mississippi the maximum decline was $1.15 a barrel, affecting the Corning (Ohio) grade, whereas the minimum was 5 cents, affecting the Ragland (Ky.) grade. Pennsylvania grade, the thermometer of market conditions in the crude-petroleum industry, recorded declines amounting to $1.05 a barrel.

In the Mid-Continent field Healdton (Okla.) grades suffered a maximum decline of 53 cents a barrel, whereas Caddo (La.) light (32° B. or over) was the least affected, declining only 25 cents a barrel. It is of interest to note the slight advance of 2 cents a barrel which was made effective as to Kansas and Oklahoma grades on February 2, 1914, in the face of an increasing output of oil, the ultimate effect of which on prices for crude had been clearly recognized for several months. The result was to engender a false security from the threatened overproduction, with a consequent increase in field activities that tended to hasten the impending market collapse.

Prices of Mid-Continent oil began to decline on April 8, 1914; and as the ever-increasing flood of high-grade Cushing oil began to invade the markets of the Appalachian grades they, too, began a retrograde movement on April 17.

Coincident with or slightly in advance of the depression in the market for high-grade oil, fuel grades in the Gulf fields began a decline, resulting from the greatly augmented output of the Sourlake and Edgerly pools and from a sharp competition with crude petroleum of similar grade produced in Mexico. The resulting cuts in price affected the marketed production of coastal oils less than would appear from casual inspection of the credit-balance quotations, because of the fact that much of the product in this region was marketed on long-time contracts entered into before the depressing influences became effective.

Late in the summer the influence of the Cushing overproduction on the crude-petroleum market was accentuated by a curtailment of exports of petroleum to certain of the European belligerents, which, however, proved only temporary in its effect, as exports to other points increased notably in the succeeding months.

Price declines in Colorado and Wyoming petroleum were slight, as the cost of transportation precluded any serious competition by eastern grades in the markets supplied by these oils.

California markets, though exempt from the specific influences affecting markets in the Eastern States, were, however, subjected to depressing influences of local origin, resulting from an increased output of lighter gravity oils in the Whittier-Fullerton district. The net decline in prices for the grades having a gravity above 21° Baumé did not exceed 35 cents a barrel and averaged considerably less. The market for oils below 21° Baumé, on the other hand, showed a stiffening tendency, due to the increased demand for fuel grades, coupled with a decrease in stocks of this particular type of oil; and consequently the prices for heavy oils averaged higher at the end than at the beginning of the year.

ACKNOWLEDGMENTS.

In presenting this report the author gratefully acknowledges his indebtedness to the 16,000 or more producers, transporters, and refiners of crude petroleum in the United States, for their cordial cooperation and assistance have made possible the compilation of the statistical data here given. Credit is also due to the State geological surveys of Illinois, Pennsylvania, and Michigan for cooperation in the collection of petroleum statistics in those States.

For much of the general information included in the text of this report acknowledgment is tendered to the contemporary historians represented by the petroleum press, whose efficiency and promptness in recording current developments in the various phases of the crude-petroleum industry have attained a high degree of perfection. Acknowledgment in this respect is particularly due to the Oil City Derrick, the Petroleum Gazette, and the National Petroleum News for data relating to the Appalachian and the Lima-Indiana fields; the Oil and Gas Journal and the Oklahoma Oil and Gas News for information concerning Mid-Continent happenings; the Fuel Oil Journal for reports of Gulf Coastal Plain developments; and the California Oil World, the California Derrick, and the Oil Age for news of California developments. Service has also been rendered by the Petroleum Age, Oil and Gas, Oildom, the Standard Oil Bulletin, and the Oil, Paint, and Drug Reporter.

For data and statistics relating to foreign petroleum production acknowledgment is made to the statistical bureaus of a number of foreign Governments, to the officials of many foreign oil companies, to the Pan American Union, and to the Bureau of Foreign and Domestic Commerce, as well as to the following foreign publications relating to the petroleum industry: The Petroleum Review, the Petroleum World, Le Moniteur du Pétrole Roumain, Le Pétrole, Die Rohölindustrie, Petroleum Zeitschrift, and Mine, Quarry, and Derrick.

By no means the least of the writer's acknowledgments are due to the efficient service of Miss Anne B. Coons, of the United States Geological Survey, in preparing the statistical compilations presented in this chapter.

MARKETED PRODUCTION.

The marketed production of petroleum in 1913 and 1914 and in 1859 to 1914 is given in detail by States in the following tables:

Total quantity and value of marketed production of petroleum in the United States and the average price per barrel in 1913 and 1914, by States, in barrels.

State.	1913			State.	1914		
	Quantity.	Value.	Average price per barrel.		Quantity.	Value.	Average price per barrel.
Alaska	(a)	(a)		Alaska	(a)	(a)	
California	97,788,525	$45,709,400	$0.467	California	99,775,327	$48,066,096	$0.482
Colorado	188,799	174,779	.926	Colorado	222,773	200,894	.902
Illinois	23,893,899	30,971,910	1.296	Illinois	21,919,749	25,426,179	1.160
Indiana	956,095	1,279,226	1.337	Indiana	1,335,456	1,548,042	1.159
Kansas	2,375,029	2,248,283	.947	Kansas	3,103,585	2,433,074	.784
Kentucky	524,568	675,748	1.288	Kentucky	502,441	498,556	.992
Louisiana	12,498,828	12,255,931	.981	Louisiana	14,309,435	12,886,897	.901
Michigan	(a)	(a)		Michigan	(a)	(a)	
Missouri	(a)	(a)		Missouri	(a)	(a)	
New Mexico	(a)	(a)		New Mexico			
New York	948,191	2,284,307	2.409	New York	938,974	1,760,868	1.875
Ohio	8,781,468	17,538,452	1.997	Ohio	8,536,352	13,372,729	1.567
Oklahoma	63,579,384	59,581,948	.937	Oklahoma	73,631,724	57,253,187	.778
Pennsylvania	7,917,302	19,690,502	2.487	Pennsylvania	8,170,335	15,573,822	1.906
Texas	15,009,478	14,675,593	.978	Texas	20,068,184	14,942,848	.745
West Virginia	11,567,299	28,828,814	2.492	West Virginia	9,680,033	18,468,540	1.908
Wyoming	2,406,522	1,187,232	.493	Wyoming	3,560,375	1,679,192	.472
Other States	b 10,843	b 19,263	1.777	Other States	c 7,792	c 14,291	1.834
Total	248,446,230	237,121,388	.954	Total	265,762,535	214,125,215	.806

a Included in other States.
b Includes Alaska, Michigan, Missouri, and New Mexico.
c Includes Alaska, Michigan, and Missouri.

Total marketed production of petroleum and percentage of increase or decrease, by States, in 1914, as compared with 1913, in barrels.

State.	Marketed production.		Increase.	Decrease.	Percentage.	
	1913	1914			Increase.	Decrease.
Alaska	(a)	(a)				
California	97,788,525	99,775,327	1,986,802		2.03	
Colorado	188,799	222,773	33,974		17.99	
Illinois	23,893,899	21,919,749		1,974,150		8.26
Indiana	956,095	1,335,456	379,361		39.68	
Kansas	2,375,029	3,103,585	728,556		30.68	
Kentucky	524,568	502,441		22,127		4.22
Louisiana	12,498,828	14,309,435	1,810,607		14.49	
Michigan	(a)	(a)				
Missouri	(a)	(a)				
New Mexico	(a)					
New York	948,191	938,974		9,217		.97
Ohio	8,781,468	8,536,352		245,116		2.79
Oklahoma	63,579,384	73,631,724	10,052,340		15.81	
Pennsylvania	7,917,302	8,170,335	253,033		3.20	
Texas	15,009,478	20,068,184	5,058,706		33.70	
West Virginia	11,567,299	9,680,033		1,887,266		16.32
Wyoming	2,406,522	3,560,375	1,153,853		47.95	
Other States	b 10,843	c 7,792		3,051		28.14
Total	248,446,230	265,762,535	17,316,305		6.97	

a Included in other States.
b Includes Alaska, Michigan, Missouri, and New Mexico.
c Includes Alaska, Michigan, and Missouri.

Marketed production of petroleum in the United States,

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	[f] 727,767	379,653	3,283,629	33,686,238
1909	10,434,300	10,632,793	10,745,092	55,471,601	[f] 639,016	310,861	2,296,086	30,898,339
1910	9,848,500	9,916,370	11,753,071	73,010,560	[f] 468,774	239,794	2,159,725	33,143,362
1911	9,200,673	8,817,112	9,795,464	81,134,391	[f] 472,458	226,926	1,695,289	31,317,038
1912	8,712,076	[a] 8,969,007	12,128,962	[g] 87,272,593	[f] 484,368	206,052	970,009	28,601,308
1913	8,865,493	8,781,468	11,567,299	97,788,525	[f] 524,568	188,799	956,095	23,893,899
1914	9,109,309	8,536,352	9,680,033	99,775,327	[f] 502,441	222,773	1,335,456	21,919,749
Total	754,180,213	432,762,004	260,232,815	741,273,559	9,095,970	10,649,143	102,823,800	232,326,616

[a] Includes the production of Michigan.
[b] Includes the production of Oklahoma.
[c] Included with Kansas.
[d] Estimated.
[e] Includes production of Utah.

1859–1914, by years and by States, in barrels of 42 gallons.

Kansas.	Texas.	Missouri.	Oklahoma.	Wyoming.	Louisiana.	United States.	Total value.	Year
...	...	...	...	...	...	2,000	$32,000	1859
...	...	...	...	...	...	500,000	4,800,000	1860
...	...	...	...	...	...	2,113,609	1,035,668	1861
...	...	...	...	...	...	3,056,690	3,209,525	1862
...	...	...	...	...	...	2,611,309	8,225,663	1863
...	...	...	...	...	...	2,116,109	20,896,576	1864
...	...	...	...	...	...	2,497,700	16,459,853	1865
...	...	...	...	...	...	3,597,700	13,455,398	1866
...	...	...	...	...	...	3,347,300	8,066,993	1867
...	...	...	...	...	...	3,646,117	13,217,174	1868
...	...	...	...	...	...	4,215,000	23,730,450	1869
...	...	...	...	...	...	5,260,745	20,503,754	1870
...	...	...	...	...	...	5,205,234	22,591,180	1871
...	...	...	...	...	...	6,293,194	21,440,503	1872
...	...	...	...	...	...	9,893,786	18,100,464	1873
...	...	...	...	...	...	10,926,945	12,647,527	1874
...	...	...	...	...	...	8,787,514	7,368,133	8175
...	...	...	...	...	...	9,132,669	22,982,822	1876
...	...	...	...	...	...	13,350,363	31,788,566	1877
...	...	...	...	...	...	15,396,868	18,044,520	1878
...	...	...	...	...	...	19,914,146	17,210,708	1879
...	...	...	...	...	...	26,286,123	24,600,638	1880
...	...	...	...	...	...	27,661,238	23,512,051	1881
...	...	...	...	...	...	30,349,897	23,631,165	1882
...	...	...	...	...	...	23,449,633	25,740,252	1883
...	...	...	...	...	...	24,218,438	20,476,924	1884
...	...	...	...	...	...	21,858,785	19,193,694	1885
...	...	...	...	...	...	28,064,841	20,028,457	1886
...	...	...	...	...	...	28,283,483	18,856,606	1887
...	...	...	...	...	...	27,612,025	17,950,353	1888
500	48	20	...	...	...	35,163,513	26,963,340	1889
1,200	54	278	...	...	...	45,823,572	35,365,105	1890
1,400	54	25	30	...	...	54,292,655	30,526,553	1891
5,000	45	10	80	...	...	50,514,657	25,906,463	1892
18,000	50	50	10	...	...	48,431,066	28,950,326	1893
40,000	60	8	130	2,369	...	49,344,516	35,522,095	1894
44,430	50	10	37	3,455	...	52,892,276	57,632,296	1895
113,571	1,450	43	170	2,878	...	60,960,361	58,518,709	1896
81,098	65,975	19	625	3,650	...	60,475,516	40,874,072	1897
71,980	546,070	10	...	5,475	...	55,364,233	44,193,359	1898
69,700	669,013	132	...	5,560	...	57,070,850	64,603,904	1899
74,714	836,039	[a] 1,602	6,472	5,450	...	63,620,529	75,989,313	1900
179,151	4,393,658	[a] 2,335	10,000	5,400	...	69,389,194	66,417,334	1901
331,749	18,083,658	[a] 757	37,100	6,253	548,617	88,766,916	71,178,910	1902
932,214	17,955,572	[a] 3,000	138,911	8,960	917,771	100,461,337	94,694,050	1903
4,250,779	22,241,413	[a] 2,572	1,366,748	11,542	2,958,958	117,080,960	101,175,455	1904
[b] 12,013,495	28,136,189	[a] 3,100	(c)	8,454	8,910,416	134,717,580	84,157,399	1905
[b] 21,718,648	12,567,897	[a] 3,500	(c)	[d] 7,000	9,077,528	126,493,936	92,444,735	1906
2,409,521	12,322,696	[a] 4,000	43,524,128	[e] 9,339	5,000,221	166,095,335	120,106,749	1907
1,801,781	11,206,464	[a] 15,246	45,798,765	[e] 17,775	5,788,874	178,527,355	129,079,184	1908
1,263,764	9,534,467	[a] 5,750	47,859,218	[e] 20,056	3,059,531	183,170,874	128,328,487	1909
1,128,668	8,899,266	[a] 3,615	52,028,718	[e] 115,430	6,841,395	209,557,248	129,899,688	1910
1,278,819	9,526,474	[a] 7,995	56,069,637	[e] 186,695	10,720,420	220,449,391	134,044,752	1911
1,592,796	11,735,057	(h)	51,427,071	1,572,306	9,263,439	222,935,044	164,213,247	1912
2,375,029	15,009,478	[i] 10,843	63,579,384	2,406,522	12,498,828	248,446,230	237,121,388	1913
3,103,585	20,068,184	[j] 7,792	73,631,724	3,560,375	14,309,435	265,762,535	214,125,215	1914
54,901,592	203,799,381	72,712	435,478,958	7,964,944	89,895,433	3,335,457,140	2,789,829,745	

[f] No production in Tennessee recorded.
[g] Includes small production of Alaska.
[h] No production in Missouri; Michigan included in Ohio.
[i] Includes production of Alaska, Michigan, and New Mexico.
[j] Includes production of Alaska and Michigan.

RANK OF OIL-PRODUCING STATES.

QUANTITY.

Despite a greatly increased output of petroleum in certain States, as well as a notable decline in others, no important changes in rank based on quantity of marketed production alone were recorded. Among the States having a low output unimportant changes were noted. Thus, compared with 1913, New Mexico disappeared entirely, its position being taken by Michigan, whose forward move relegated Missouri to last place.

Rank of vetroleum-producing States, with quantity of marketed production and percentage of total contributed by each in 1913 and 1914, in barrels.

State.	1913 Rank.	1913 Quantity.	1913 Percentage.	State.	1914 Rank.	1914 Quantity.	1914 Percentage.
California	1	97,788,525	39.356	California	1	99,775,327	37.54
Oklahoma	2	63,579,384	25.59	Oklahoma	2	73,631,724	27.71
Illinois	3	23,893,899	9.62	Illinois	3	21,919,749	8.25
Texas	4	15,009,478	6.04	Texas	4	20,068,184	7.55
Louisiana	5	12,498,828	5.03	Louisiana	5	14,309,435	5.39
West Virginia	6	11,567,299	4.66	West Virginia	6	9,680,033	3.64
Ohio	7	8,781,468	3.53	Ohio	7	8,536,352	3.21
Pennsylvania	8	7,917,302	3.18	Pennsylvania	8	8,170,335	3.07
Wyoming	9	2,406,522	.97	Wyoming	9	3,560,375	1.34
Kansas	10	2,375,029	.96	Kansas	10	3,103,585	1.17
Indiana	11	956,095	.39	Indiana	11	1,335,456	.50
New York	12	948,191	.38	New York	12	938,974	.35
Kentucky	13	524,568	.21	Kentucky	13	502,441	.19
Colorado	14	188,799	.08	Colorado	14	222,773	
Alaska	15			Alaska	15		.09
New Mexico	16	10,843	.004	Michigan	16	7,792	
Missouri	17			Missouri	17		
Michigan	18						
Total		248,446,230	100.000	Total		265,762,535	100.00

VALUE.

Changes in rank, based on the value of the marketed production in 1914, affected only Ohio and Texas among the more important oil-producing States. The reversal of position by these States is accounted for by the greatly increased output of both refining and fuel grades of petroleum in Texas in 1914 rather than by any extraordinary decline in output in Ohio. Among the less important States, Kansas superseded New York in ninth place and Wyoming superseded Indiana in eleventh. The elimination of New Mexico from sixteenth place permitted Missouri and Michigan to advance one place each, without, however, affecting their relation to the other States.

Rank of petroleum-producing States with regard to value of marketed production and percentage of total value credited to each in 1913 and 1914.

State.	1913			State.	1914		
	Rank.	Value.	Percentage.		Rank.	Value.	Percentage.
Oklahoma	1	$59,581,948	25.13	Oklahoma	1	$57,253,187	26.74
California	2	45,709,400	19.28	California	2	48,066,096	22.45
Illinois	3	30,971,910	13.06	Illinois	3	25,426,179	11.87
West Virginia	4	28,828,814	12.16	West Virginia	4	18,468,540	8.63
Pennsylvania	5	19,690,502	8.30	Pennsylvania	5	15,573,822	7.27
Ohio	6	17,538,452	7.40	Texas	6	14,942,848	6.98
Texas	7	14,675,593	6.19	Ohio	7	13,372,729	6.25
Louisiana	8	12,255,931	5.17	Louisiana	8	12,886,897	6.02
New York	9	2,284,307	.96	Kansas	9	2,433,074	1.14
Kansas	10	2,248,283	.95	New York	10	1,760,868	.82
Indiana	11	1,279,226	.54	Wyoming	11	1,679,192	.78
Wyoming	12	1,187,232	.50	Indiana	12	1,548,042	.72
Kentucky	13	675,748	.28	Kentucky	13	498,556	.23
Colorado	14	174,779	.07	Colorado	14	200,894	.09
Alaska	15			Alaska	15		
New Mexico	16	19,263	.01	Missouri	16	14,291	.01
Missouri	17			Michigan	17		
Michigan	18						
Total		237,121,388	100.00	Total		214,125,215	100.00

WORLD'S PRODUCTION OF PETROLEUM.

The following table shows the marketed production of petroleum in the principal oil-producing countries of the world in 1914, in barrels and metric tons, with percentage of the total contributed by each country for the year, together with the total marketed production credited to each country from 1857 to 1914, inclusive, with percentage of the grand total contributed by each country:

World's production of crude petroleum in 1914 and in 1857–1914, by countries, in barrels and metric tons.

Country.	Production, 1914.		Percentage of total.	Total production, 1857–1914.		Percentage of total.
	Barrels.	Metric tons.		Barrels.	Metric tons.	
United States	265,762,535	35,435,005	66.36	3,335,457,140	444,727,619	59.63
Russia	67,020,522	8,936,070	16.74	1,622,233,845	213,631,179	29.00
Mexico	21,188,427	2,825,124	5.29	90,359,869	12,031,940	1.62
Roumania	12,826,579	1,783,947	3.20	117,982,474	15,804,733	2.11
Dutch East Indies	12,705,208	1,634,403	3.17	138,278,392	18,377,494	2.47
India	[a] 8,000,000	1,066,667	2.00	73,979,919	9,863,989	1.32
Galicia	5,033,350	[a] 700,000	1.26	131,873,601	18,339,976	2.36
Japan	2,738,378	365,117	.68	27,051,158	3,606,821	.48
Peru	1,917,802	255,707	.48	14,306,972	1,907,596	.26
Germany	995,764	[a] 140,000	.25	12,965,569	1,735,974	.23
Egypt	777,038	103,605	.19	1,086,728	144,897	.02
Trinidad	643,533	85,804	.16	2,069,430	275,924	.04
Canada	214,805	28,641	.05	23,493,610	3,132,481	.42
Italy	39,548	[a] 5,500	.01	802,229	107,173	.01
Other countries	620,000	82,667	.16	1,322,000	175,751	.03
Total	400,483,489	53,448,257	100.00	5,593,262,936	743,863,547	100.00

[a] Estimated.

Changes in rank during 1914 affected only Japan and Peru, the statistics available indicating that the former supersedes the latter by a narrow margin.

The following table shows by years the marketed production of petroleum in the principal oil-producing countries of the world from 1857 to 1914, inclusive, in barrels of 42 gallons:

World's marketed production of crude petroleum, 1857–1914,

Year.	Roumania.	United States.	Italy.	Canada.	Russia.	Galicia.	Japan and Formosa.	Germany.
1857	1,977	...	...	...	...	...	...	...
1858	3,560	...	...	...	...	...	...	...
1859	4,349	2,000	...	...	...	...	...	...
1860	8,542	500,000	36	...	...	...	...	...
1861	17,279	2,113,609	29	...	...	...	...	...
1862	23,198	3,056,690	29	11,775	...	...	...	...
1863	27,943	2,611,309	58	82,814	40,816	...	...	...
1864	33,013	2,116,109	72	90,000	64,586	...	...	...
1865	39,017	2,497,700	2,265	110,000	66,542	...	...	...
1866	42,534	3,597,700	992	175,000	83,052	...	...	...
1867	50,838	3,347,300	791	190,000	119,917	...	...	...
1868	55,369	3,646,117	367	200,000	88,327	...	...	...
1869	58,533	4,215,000	144	220,000	202,308	...	...	...
1870	83,765	5,260,745	86	250,000	204,018	...	...	...
1871	90,030	5,205,234	273	269,397	165,129	...	...	...
1872	91,251	6,293,194	331	308,100	184,391	...	...	...
1873	104,036	9,893,786	467	365,052	474,379	...	...	...
1874	103,177	10,926,945	604	168,807	583,751	149,837	...	...
1875	108,569	8,787,514	813	220,000	697,364	158,522	4,566	...
1876	111,314	9,132,669	2,891	312,000	1,320,528	164,157	7,708	...
1877	108,569	13,350,363	2,934	312,000	1,800,720	169,792	9,560	...
1878	109,300	15,396,868	4,329	312,000	2,400,960	175,420	17,884	...
1879	110,007	19,914,146	2,891	575,000	2,761,104	214,800	23,457	...
1880	114,321	26,286,123	2,035	350,000	3,001,200	229,120	25,497	9,310
1881	121,511	27,661,238	1,237	275,000	3,601,441	286,400	16,751	29,219
1882	136,610	30,349,897	1,316	275,000	4,537,815	330,076	15,549	58,025
1883	139,486	23,449,633	1,618	250,000	6,002,401	365,160	20,473	26,708
1884	210,667	24,218,438	2,855	250,000	10,804,577	408,120	27,923	46,161
1885	193,411	21,858,785	1,941	250,000	13,924,596	465,400	29,237	41,360
1886	168,606	28,064,841	1,575	584,061	18,006,407	305,884	37,916	73,864
1887	181,907	28,283,483	1,496	525,655	18,367,781	343,832	28,645	74,284
1888	218,576	27,612,025	1,251	695,203	23,048,787	466,537	37,436	84,782
1889	297,666	35,163,513	1,273	704,690	24,609,407	515,268	52,811	68,217
1890	383,227	45,823,572	2,998	795,030	28,691,218	659,012	51,420	108,296
1891	488,201	54,292,655	8,305	755,298	34,573,181	630,730	52,917	108,929
1892	593,175	50,514,657	18,321	779,753	35,774,504	646,220	68,901	101,404
1893	535,655	48,431,066	19,069	798,406	40,456,519	692,669	106,384	99,390
1894	507,255	49,344,516	20,552	829,104	36,375,428	949,146	171,744	122,564
1895	575,200	52,892,276	25,843	726,138	46,140,174	1,452,999	141,310	121,277
1896	543,348	60,960,361	18,149	726,822	47,220,633	2,443,080	197,082	145,061
1897	570,886	60,475,516	13,892	709,857	54,399,568	2,226,368	218,559	165,745
1898	776,238	55,364,233	14,489	758,391	61,609,357	2,376,108	265,389	183,427
1899	1,425,777	57,070,850	16,121	808,570	65,954,968	2,313,047	536,079	192,232
1900	1,628,535	63,620,529	12,102	913,498	75,779,417	2,346,505	866,814	358,297
1901	1,678,320	69,389,194	16,150	756,679	85,168,556	3,251,544	1,110,790	313,630
1902	2,059,935	88,766,916	18,933	530,624	80,540,044	4,142,159	1,193,038	353,674
1903	2,763,117	100,461,337	17,876	486,637	75,591,256	5,234,475	1,209,371	445,818
1904	3,599,026	117,080,960	25,476	552,575	78,536,655	5,947,383	1,419,473	637,431
1905	4,420,987	134,717,580	44,027	634,095	54,960,270	5,765,317	1,472,804	560,963
1906	6,378,184	126,493,936	53,577	569,753	58,897,311	5,467,967	1,710,768	578,610
1907	8,118,207	166,095,335	59,875	788,872	61,850,734	8,455,841	2,001,838	756,631
1908	8,252,157	178,527,355	50,966	527,987	62,186,447	12,612,295	2,070,145	1,009,278
1909	9,327,278	183,170,874	42,388	420,755	65,970,350	14,932,799	1,889,563	1,018,837
1910	9,723,806	209,557,248	50,830	315,895	70,336,574	12,673,688	1,930,661	1,032,522
1911	11,107,450	220,449,391	74,709	291,096	66,183,691	10,519,270	1,658,903	1,017,045
1912	12,976,232	222,935,044	53,778	243,336	68,019,208	8,535,174	1,671,405	1,031,050
1913	13,554,768	248,446,230	47,256	228,080	62,834,356	7,818,130	1,942,009	a 995,764
1914	12,826,579	265,762,535	a 39,548	214,805	67,020,522	a 5,033,350	2,738,378	a 995,764
Total	117,982,474	3,335,457,140	802,229	23,493,610	1,622,233,845	131,873,601	27,051,158	12,965,569

a Estimated.

by years and by countries, in barrels of 42 gallons.

India.	Dutch East Indies.	Peru.	Mexico.	Trinidad.	Egypt.	Other countries.	Total.	Year.
							1,977	1857
							3,560	1858
							6,349	1859
							508,578	1860
							2,130,917	1861
							3,091,692	1862
							2,762,940	1863
							2,303,780	1864
							2,715,524	1865
							3,899,278	1866
							3,708,846	1867
							3,990,180	1868
							4,695,985	1869
							5,799,214	1870
							5,730,063	1871
							6,877,267	1872
							10,837,720	1873
							11,933,121	1874
							9,977,348	1875
							11,051,267	1876
							15,753,938	1877
							18,416,761	1878
							23,601,405	1879
							30,017,606	1880
							31,992,797	1881
							35,704,288	1882
							30,255,479	1883
							35,968,741	1884
							36,764,730	1885
							47,243,154	1886
							47,807,083	1887
							52,164,597	1888
94,250							61,507,095	1889
118,065							76,632,838	1890
190,131							91,100,347	1891
242,284							88,739,219	1892
298,969	600,000						92,038,127	1893
327,218	688,170						89,335,697	1894
371,536	1,215,757						103,662,510	1895
429,979	1,427,132	47,536					114,159,183	1896
545,704	2,551,649	70,831					121,948,575	1897
542,110	2,964,035	70,905					124,924,682	1898
940,971	1,795,961	89,166					131,143,742	1899
1,078,264	2,253,355	274,800					149,132,116	1900
1,430,716	4,013,710	274,800				[a] 20,000	167,424,089	1901
1,617,363	2,430,465	286,725				[a] 26,000	181,965,876	1902
2,510,259	5,770,056	278,092				[a] 36,000	194,804,294	1903
3,385,468	6,508,485	345,834	220,653			[a] 40,000	218,299,419	1904
4,137,098	7,849,896	447,880	320,379			[a] 30,000	215,361,296	1905
4,015,803	8,180,657	536,294	1,097,264			[a] 30,000	214,010,124	1906
4,344,162	9,982,597	756,226	1,717,690			[a] 30,000	264,958,008	1907
5,047,038	10,283,357	1,011,180	3,481,610	169		[a] 30,000	285,089,984	1908
6,676,517	11,041,852	1,316,118	2,488,742	57,143		[a] 20,000	298,373,216	1909
6,137,990	11,030,620	1,330,105	3,332,807	142,857		[a] 20,000	327,615,603	1910
6,451,203	12,172,949	1,368,274	14,051,643	285,307	9,150	[a] 45,000	345,685,081	1911
7,116,672	10,845,624	1,751,143	16,558,215	436,805	205,905	[a] 105,000	352,484,591	1912
7,930,149	11,966,857	2,133,261	25,902,439	503,616	94,635	[a] 270,000	384,667,550	1913
[a] 8,000,000	[b] 12,705,208	1,917,802	21,188,427	643,533	777,038	[c] 620,000	400,483,489	1914
73,979,919	138,278,392	14,306,972	90,359,869	2,069,430	1,086,728	1,322,000	5,593,262,936	Total

[b] Includes British Borneo. [c] Includes 600,000 barrels produced in Argentina.

CLASSIFICATION BY FIELDS.

For convenience of discussion the oil pools of the United States are grouped in certain major areas or fields based originally on geographic position alone. As these fields have been extended areally, the geographic boundaries have become in many cases less distinct, and the separation has come to be based more and more on fundamental differences in the type of oil produced and its adaptability to refining needs. Thus the oils of the Appalachian field are in the main of paraffin base, free from asphalt and objectionable sulphur, and they yield by ordinary refining methods high percentages of gasoline and illuminating oils—the products in greatest demand. Contrasted with them is the petroleum of the Lima-Indiana field, which contains some asphalt, though consisting chiefly of paraffin hydrocarbons, and is contaminated with sulphur compounds which necessitate special treatment for their elimination.

Illinois oils contain varying proportions of both asphalt and paraffin and differ considerably as to specific gravity and distillation products. Sulphur is generally present, but rarely in such form as to necessitate special treatment for its removal.

Mid-Continent oils vary in composition within wide limits, ranging from asphaltic oils, poor in gasoline and illuminants, to oils in which the asphalt content is negligible and the paraffin content relatively high and which yield correspondingly high percentages of the lighter products on distillation. Sulphur is present in varying quantities in the lower grade oils, in certain of which, Healdton grade, for example, it exists in the form requiring special treatment for its elimination.

Oils from the Gulf field are characterized by relatively high percentages of asphalt and low percentages of the lighter gravity distillation products. Considerable sulphur is present, much of which, however, is in the form of sulphureted hydrogen and is easily removed by steam before refining or utilizing the oil as fuel.

Oils from Wyoming and Colorado are in the main of paraffin base, suitable for refining by ordinary methods. Heavy asphaltic oils of fuel grade are also obtained in certain of the Wyoming fields. The California oils are generally characterized by much asphalt and little or no paraffin and by varying proportions of sulphur. The chief products are fuel oils, lamp oils, lubricants, and oil asphalt, though low percentages of naphthas may be derived from certain of the lighter oils, notably those of the Santa Maria, Sespe, and Santa Paula fields, in the southern part of the State.

MARKETED PRODUCTION BY FIELDS.

The following tables summarize by fields the statistics of marketed production of petroleum in the last five years.

Marketed production of petroleum in the United States, 1910–1914, by fields, in barrels.

Field.	1910	1911	1912	1913	1914
Appalachian	26,892,579	23,749,832	26,338,516	25,921,785	24,101,048
Lima-Indiana	7,253,861	6,231,164	[a] 4,925,906	4,773,138	5,062,543
Illinois	33,143,362	31,317,038	28,601,308	23,893,899	21,919,749
Mid-Continent	59,217,582	66,595,477	65,473,345	84,920,225	97,995,400
Gulf	9,680,465	10,999,873	8,545,018	8,542,494	13,117,528
California	73,010,560	81,134,391	[b] 87,272,593	97,788,525	99,775,327
Colorado and Wyoming	[c] 358,839	[c] 421,616	1,778,358	2,595,321	3,783,148
Other fields				[d] 10,843	[e] 7,792
Total	209,557,248	220,449,391	222,935,044	248,446,230	265,762,535

[a] Includes Michigan.
[b] Includes Alaska.
[c] Includes Michigan and Missouri.
[d] Includes Alaska, Michigan, Missouri, and New Mexico.
[e] Includes Alaska, Michigan, and Missouri.

Percentages of total marketed production in the several fields, 1910–1914.

Field.	1910	1911	1912	1913	1914
Appalachian	12.83	10.77	11.81	10.430	9.07
Lima-Indiana	3.46	2.83	2.21	1.930	1.90
Illinois	15.82	14.21	12.83	9.620	8.25
Mid-Continent	28.26	30.21	29.37	34.180	36.87
Gulf	4.62	4.99	3.83	3.440	4.94
California	34.84	36.80	39.15	39.356	37.54
Colorado and Wyoming	.17	.19	.80	1.040	1.43
Other fields				.004	
Total	100.00	100.00	100.00	100.000	100.00

Marketed production of petroleum in the United States in 1913 and 1914, by fields, showing percentage of increase or decrease, in barrels.

Field.	Marketed production.		Increase.	Decrease.	Percentage.	
	1913	1914			Increase.	Decrease.
Appalachian	25,921,785	24,101,048		1,820,737		7.02
Lima-Indiana	4,773,138	5,062,543	289,405		6.06	
Illinois	23,893,899	21,919,749		1,974,150		8.26
Mid-Continent	84,920,225	97,995,400	13,075,175		15.40	
Gulf	8,542,494	13,117,528	4,575,034		53.56	
California	97,788,525	99,775,327	1,986,802		2.03	
Colorado and Wyoming	2,595,321	3,783,148	1,187,827		45.77	
Other fields	[a] 10,843	[b] 7,792		3,051		28.14
Total	248,446,230	265,762,535	17,316,305		6.97	

[a] Includes Alaska, Michigan, Missouri, and New Mexico.
[b] Includes Alaska, Michigan, and Missouri.

Quantity, total value, and average price per barrel received at wells for petroleum produced in the United States in 1913 and 1914, by fields, in barrels.

Field.	1913			1914		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
Appalachian	25,921,785	$63,708,981	$2.458	24,101,048	$45,239,201	$1.877
Lima-Indiana	4,773,138	6,588,068	1.380	5,062,543	5,983,356	1.182
Illinois	23,893,899	30,971,910	1.296	21,919,749	25,426,179	1.160
Mid-Continent	84,920,225	80,767,758	.951	97,995,400	78,671,902	.803
Gulf	8,542,494	7,993,997	.936	13,117,528	8,844,104	.674
California	97,788,525	45,709,400	.467	99,775,327	48,066,096	.482
Colorado and Wyoming	2,595,321	1,362,011	.525	3,783,148	1,880,086	.497
Other fields	[a] 10,843	[a] 19,265	1.227	[b] 7,792	[b] 14,291	1.834
Total	248,446,230	237,121,388	.954	265,762,535	214,125,215	.800

[a] Includes Alaska, Michigan, Missouri, and New Mexico.
[b] Includes Alaska, Michigan, and Missouri.

DELIVERIES BY FIELDS.

Deliveries to trade of petroleum and purposes for which shipped in 1913 and 1914, by fields, in barrels.

Field.	1913			1914		
	Delivered for—		Total.	Delivered for—		Total.
	Refining.	Fuel.		Refining.	Fuel.	
Appalachian	[a]25,333,879	....	25,333,879	[b]22,994,777	....	22,994,777
Lima-Indiana	5,419,533	[c]26,791	5,446,324	5,149,155	[d]11,128	5,160,283
Illinois	31,316,426	[e]43,790	31,360,216	16,589,703	[f]9,724	16,599,427
Kansas-Oklahoma	[g]56,697,071	3,893,693	60,590,764	[h]72,122,979	335,668	72,458,647
Louisiana	10,946,262	1,818,766	12,765,028	13,481,837	887,208	14,369,045
Texas	[i]9,227,608	4,438,723	13,666,331	[i]14,227,235	4,727,185	18,954,420
California	67,934,167	[j]29,104,358	97,038,525	50,829,203	41,587,530	92,416,733
Colorado and Wyoming	[i]2,299,055	13,180	2,301,392	[i]4,010,643	51,421	4,054,272
Other fields			10,843			7,792
Total	209,174,001	39,339,301	248,513,302	199,405,532	47,609,864	247,015,396

[a] Includes 40,268 barrels of lubricating oil.
[b] Includes 44,318 barrels of lubricating oil.
[c] Includes 3,221 barrels used for street sprinkling.
[d] Includes 116 barrels used for street sprinkling.
[e] Includes 2,155 barrels used for hog dip and street sprinkling.
[f] Includes 1,542 barrels used for hog dip and street sprinkling.
[g] Includes 1,927,688 barrels shipped by rail that can not be classified.
[h] Includes 4,766,409 barrels shipped by rail that can not be classified.
[i] Includes small amount of lubricating oil.
[j] Estimated.

STOCKS.

The marketed production of crude petroleum in 1914 amounted to 265,762,535 barrels. The deliveries to trade in the same period amounted to 247,015,396 barrels, existing stocks held by pipe-line companies being increased by the difference, or 18,647,139 barrels. At the end of 1914 the total stocks held by pipe-line companies amounted to 141,549,769 barrels, representing a quantity more than one-half the entire marketed production credited to 1914. Were the crude supply to be abruptly terminated, the reserve of petroleum held by pipe-line companies alone would be sufficient to satisfy the demands of the trade for about six months.

As indicated in the introduction to this chapter under the definition of the term "stocks," this quantity does not represent the total above-ground reserve of crude petroleum, as it does not include the quantities of unrefined oil stored at 200 or more refineries in the United States or that stored by producers in the field.

Increase in pipe-line stocks constituted the rule for practically all grades of petroleum in 1914, with decrease the exception. The decline in output of the Lima-Indiana field necessitated a slight drain on stocks accumulated prior to 1914, whereas increased refining capacity in Louisiana and Wyoming account for the similar requisitions on reserves in those States.

The following table summarizes the reserves of crude petroleum held by pipe-line companies at the close of 1913 and 1914:

Stocks of all grades of petroleum at the close of 1913 and 1914, by States, in barrels.

Grade of oil.	Held by eastern pipe lines[a] and refineries.		In pipe-line storage outside of eastern field.		Total.		Increase.	Decrease
	1913	1914	1913	1914	1913	1914		
Pennsylvania[b]	4,387,718	5,436,576	....	....	4,387,718	5,436,576	1,048,858	....
Lima	1,746,355	1,648,615	....	....	1,746,355	1,648,615	....	97,740
Illinois[c]	1,079,468	1,016,937	7,163,953	12,546,806	8,243,421	13,563,743	5,320,322	....
Kentucky	230,706	288,119	....	....	230,706	288,119	57,413	....
Kansas, Oklahoma	2,569,305	2,772,821	51,179,952	55,253,098	53,749,257	58,025,919	4,276,662	....
Texas	....	....	3,830,291	4,944,055	8,830,291	4,944,055	1,113,764	....
Louisiana	....	....	1,871,074	1,811,464	1,871,074	1,811,464	....	59,610
California	....	....	48,302,392	55,660,986	48,302,392	55,660,986	7,358,594	....
Colorado and Wyoming	....	....	441,416	170,292	441,416	170,292	....	271,124
Total	10,013,552	11,163,068	112,789,078	130,386,701	122,802,630	141,549,769	18,747,139	....

[a] These pipe lines connect with the delivering lines of the 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.

SUMMARY OF WELLS DRILLED, BY FIELDS.

The following tables show in condensed form the results of drilling activity in the United States in 1913 and 1914, by fields:

Wells drilled in the United States in 1913 and 1914, by fields.

1913.

Field.	Wells completed.				Initial daily production (barrels).	
	Oil.	Gas.	Dry.	Total.	Total.	Average per well.
Appalachian:						
Pennsylvania and New York	3,420	310	521	4,251	8,958	2.6
Central and southeastern Ohio	1,246	342	603	2,191	16,302	13.1
West Virginia	1,285	441	339	2,065	34,835	27.1
Kentucky	133	8	69	210	2,215	16.7
Total	6,084	1,101	1,532	8,717	62,310	10.2
Lima, Ohio	873	9	90	972	11,181	12.8
Indiana	213	12	86	311	7,393	34.7
Total	1,086	21	176	1,283	18,574	17.1
Illinois	1,363	80	278	1,721	47,405	34.8
Mid-Continent:						
Kansas	1,422	334	260	2,016	22,467	15.8
Oklahoma	6,965	578	1,308	8,851	334,050	48.0
Northern Texas	581	10	208	799	57,435	98.9
Northern Louisiana	356	70	92	518	151,955	426.8
Total	9,324	992	1,868	12,184	565,907	60.7
Gulf:						
Coastal Texas	325	12	255	592	38,978	119.9
Coastal Louisiana	81	1	57	139	55,740	618.1
Total	406	13	312	731	94,718	233.3
Alaska	2	....	....	2	....	....
California	789	....	67	856	....	....
Colorado	8	....	13	21	....	....
Wyoming and Utah	34	....	25	59	....	....
Michigan	4	....	1	5	....	....
Miscellaneous	1	....	10	11	....	....
Total for 1913	19,101	2,207	4,282	25,590	....	....

Wells drilled in the United States in 1913 and 1914, by fields—Continued.

1914.

Field.	Wells completed.				Initial daily production (barrels).	
	Oil.	Gas.	Dry.	Total.	Total.	Average per well.
Appalachian:						
Pennsylvania and New York	2,247	284	338	2,869	6,627	3.0
Central and southeastern Ohio	863	664	517	2,044	12,047	14.0
West Virginia	1,043	368	347	1,758	24,474	23.5
Kentucky	119	4	55	178	1,568	13.2
Total	4,272	1,320	1,257	6,849	44,716	10.5
Lima, Ohio	765	16	69	850	9,329	12.2
Indiana	470	13	259	742	8,436	18.0
Total	1,235	29	328	1,592	17,765	14.4
Illinois	1,191	32	356	1,579	39,268	33.0
Mid-Continent:						
Kansas	1,753	317	270	2,340	18,932	10.8
Oklahoma	6,410	539	1,343	8,292	976,244	152.3
Northern Texas	497	26	221	744	25,003	50.3
Northern Louisiana	302	52	91	445	102,193	338.4
Total	8,962	934	1,925	11,821	1,122,372	125.2
Gulf:						
Coastal Texas	323	11	130	464	160,695	497.5
Coastal Louisiana	72	1	48	121	82,914	1,151.6
Total	395	12	178	585	243,609	616.7
Alaska	1	....	....	1	....	....
California	512	....	47	559	....	....
Colorado	12	....	10	22	....	....
Wyoming and Utah	86	....	29	115	....	....
Michigan	2	....	....	2	....	....
Miscellaneous	....	....	12	12	....	....
Total for 1914	16,668	2,327	4,142	23,137	....	....

FUEL OIL.

GENERAL STATEMENT.

During the three-year period ending with 1913 the market for fuel oil underwent a gradual constriction reflecting directly the upward trend of fuel-oil prices and less directly the restriction of domestic supply resulting from improvements in refining methods, whereby greater percentages of crude petroleum and of refinery residuals, formerly thrown into the waste tanks and sacrificed as fuel oil, were converted into the light-gravity products which are in greater demand.

In 1914, however, a reversal of conditions was brought about as the result of an increased output of natural fuel oils in the Gulf field of Louisiana and Texas and of increased imports of suitable fuel oils from Mexico, which caused a decline in prices and a consequent increase in consumption of fuel oil. The greatly increased output of relatively high-grade oils from northern Oklahoma in 1914 contributed also to this condition by forcing the heavier oils of the Gulf region to find an outlet for consumption chiefly as fuels, because they could not compete with the Oklahoma oil in refineries manufacturing light-gravity products.

The increased consumption of fuel grades of petroleum is particularly noticeable along the Atlantic seaboard, where Mexican oil can be delivered at a lower cost than suitable oils of domestic origin, owing essentially to the greater cost of the domestic oils at the point of production. The costs of transportation from Texas and Louisiana ports to New York are approximately the same as from Tampico to New York, including bar dues and other taxes at the Mexican port. The initial cost of the domestic fuel oil itself is, however, greater because it contains appreciable quantities of light-gravity hydrocarbons that enhance its value at the wells.

Under existing conditions the future expansion of the fuel-oil market along the Atlantic seaboard appears to depend on the certainty of an adequate supply of the Mexican oil for a term of years, and also at a price which will assure the consumers a relatively permanent economy in the use of oil instead of coal.

In order to arrive at any conclusion with regard to the future of fuel oil, a number of variable and interdependent factors must be taken into consideration. Among these, from the standpoint of the American consumer, are adequacy of supply, rate of production, competition among producers, control and adequacy of land and river transportation, extent and cost of treatment required, adequacy of ocean transport service, taxes, bar dues, duties, and customs. Until a stable government is established in Mexico and the extent of its control over the various phases of that country's petroleum industry is known, an assignment of values to these and other factors having a bearing on the subject must involve uncertainties tending to vitiate any conclusions that might be drawn.

Aside from the matter of governmental control, the question of adequate facilities for ocean transportation appears to be the most pertinent from the viewpoint of the prospective consumer who will obtain oil through one of the Atlantic ports. Statistics compiled by the Petroleum Review (London, issue of Feb. 20, 1914) show the world's fleet of tankers engaged in the transportation of petroleum and its products to number less than 500. Of these the number available for service between Mexican and United States ports in the exclusive transportation of fuel oil is small, and beyond these limits consumption obviously can not expand. In consideration of the present outlook for an abundance of fuel oil in Mexico to supply all demands for a number of years, the situation with regard to ocean transportation seems to offer a most attractive opportunity for the investment of American capital in tank steamers.

That the demand for fuel oil on the Atlantic seaboard is a growing one is evidenced by the announcement late in 1914 that the marine department of the Long Island Railroad Co. had decided to convert its harbor fleet of 17 tugs and lighters into oil burners, followed early in 1915 by the successful conversion of the United Fruit Co.'s passenger steamer *Metapan* from a coal burner to an oil burner for service in the coastwise trade. The results of these experiments are being watched closely, and the outcome is likely to be a general adoption of liquid fuel along the Atlantic seaboard, as has for some time been the case along the Pacific coast for both passenger and cargo vessels.

CONSUMPTION.

Complete statistics of the consumption of fuel oil in the United States are not available. Data compiled from reports by pipe-line companies show that in 1914 a total of 47,609,864 barrels of domestic crude petroleum was delivered for use as fuel in the United States. In addition more than 15,000,000 barrels of oil, the greater part of which was used as fuel, was imported from Mexico, and indeterminate quantities of refinery products of domestic crude petroleum found the same use. In California alone it is estimated that the crude petroleum consumed as fuel, outside of that consumed in field operations, amounted to more than 41,000,000 barrels, whereas the quantity of topped oil contributed by the refineries amounted to at least 34,000,000 barrels additional. Much of this was consumed in the State, but a large quantity entered the export trade.

RAILROADS.

The influence of low prices for fuel oil was slow to affect the principal domestic consumers—the railroads—whose conservative attitude has been justified by the experience of the last five years, which has taught them that fuel prices remain low only when available supply is a little in excess of demand. There was apparent, however, in the latter part of 1914 a growing tendency toward the increased use of petroleum for locomotive fuel, which will doubtless be strongly reflected in the statistics for consumption in 1915.

Consumption of fuel oil by the railroads of the United States, 1906–1914.

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
1913	29,145	33,004,815	118,672,162	3.60
1914	29,595	31,093,266	118,737,469	3.82

[a] Some of these lines also used coal.

The following railroad companies used fuel oil on their lines in 1914:

Arizona:
- Atchison, Topeka & Santa Fe Railway System.
- Pacific System (excluding Sonora Railway) of the Southern Pacific Co.

Arkansas:
- Kansas City Southern Railway Co. (partly).

California:
- Atchison, Topeka & Santa Fe Railway System.
- Northwestern Pacific Railroad Co.
- Pacific System (excluding Sonora Railway) of the Southern Pacific Co.
- San Diego & Arizona Railway Co.
- San Diego & South Eastern Railway Co.
- San Pedro, Los Angeles & Salt Lake Railroad Co.
- Tonopah & Tidewater Railroad Co.
- Western Pacific Railway Co.

Georgia:
- Central of Georgia Railway Co. (on Tybee district).

Idaho:
- Chicago, Milwaukee & St. Paul Railway Co.
- Great Northern Railway Co.
- Idaho & Washington Northern Railroad.
- Oregon Short Line Railroad Co.
- Washington, Idaho & Montana Railway Co.

Kansas:
- Atchison, Topeka & Santa Fe Railway System.

Louisiana:
- Atchison, Topeka & Santa Fe Railway System.
- Houston, East & West Texas Railway Co.
- Houston & Shreveport Railroad Co.
- Iberia & Vermilion Railroad Co.
- Kansas City Southern Railway Co.
- Louisiana Western Railroad Co.
- Morgan's Louisiana & Texas Railroad & Steamship Co.
- New Orleans, Texas & Mexico Railroad.
- Texas & Pacific Railway Co.

Montana:
- Chicago, Milwaukee & St. Paul Railway Co. (west of Deer Lodge to the Idaho State line).
- Great Northern Railway Co.
- Oregon Short Line Railroad Co.

Nebraska:
- Chicago & North Western Railway Co.

Nevada:
- Atchison, Topeka & Santa Fe Railway System.
- Bullfrog Goldfield Railroad Co.
- Las Vegas & Tonopah Railroad Co.
- Pacific System of the Southern Pacific Co.
- San Pedro, Los Angeles & Salt Lake Railroad Co.
- Tonopah & Goldfield Railroad Co.
- Tonopah & Tidewater Railroad Co.
- Western Pacific Railway Co.

New Mexico:
- Atchison, Topeka & Santa Fe Railway System.
- El Paso & Southwestern System.
- Pacific System (excluding Sonora Railway) of the Southern Pacific Co.

New York:
- Delaware & Hudson Co. (in the Adirondacks).
- New York Central & Hudson River Railroad Co. (in the Adirondacks, including Old Forge and the Fulton Chain).

Oklahoma:
- Atchison, Topeka & Santa Fe Railway System.
- Kansas City Southern Railway Co. (partly).

Oregon:
- Corvallis & Eastern Railroad Co.
- Great Northern Railway Co.
- Northern Pacific Railway Co.
- Oregon Trunk Railway Co.
- Oregon-Washington Railroad & Navigation Co.
- Pacific Railway & Navigation Co.
- Pacific System of Southern Pacific Co.
- Spokane, Portland & Seattle Railway Co.

South Dakota:
- Chicago, Burlington & Quincy Railroad Co.
- Chicago & North Western Railway Co.

Texas:
- Artesian Belt Railroad Co.
- Atchison, Topeka & Santa Fe Railway System.
- Galveston, Harrisburg & San Antonio Railway Co.
- Galveston, Houston & Henderson Railroad Co.
- Houston, East & West Texas Railway Co.

Texas—Continued.
- Houston & Texas Central Railroad Co.
- International & Great Northern Railway Co.
- New Orleans, Texas & Mexico Railroad Co.
- St. Louis, Brownsville & Mexico Railway.
- San Antonio & Aransas Pass Railway Co.
- Texarkana & Fort Smith Railway Co.
- Texas & New Orleans Railroad Co.
- Texas & Pacific Railway Co.
- Trinity & Brazos Valley Railway Co.

Utah:
- Pacific System of Southern Pacific Co.
- San Pedro, Los Angeles & Salt Lake Railroad Co.

Washington:
- Bellingham & Northern Railway Co.
- Chicago, Milwaukee & St. Paul Railway Co.
- Great Northern Railway Co.
- Idaho & Washington Northern Railroad.
- Northern Pacific Railway Co.
- Oregon-Washington Railroad & Navigation Co.
- Spokane, Portland & Seattle Railway Co.
- Washington, Idaho & Montana Railway Co.

Wyoming:
- Chicago, Burlington & Quincy Railroad Co.
- Chicago & North Western Railway Co.
- Wyoming & Northwestern Railway.

UNITED STATES NAVY.

The consumption of fuel oil by the United States Navy during the fiscal year ended June 30, 1915, was approximately 21,000,000 gallons. All battleships and torpedo vessels now being built and authorized are designed to use oil fuel exclusively, and it is estimated that the requirements of fuel oil during the current fiscal year (1915–16) will amount to at least 30,000,000 gallons.

Fuel oil, to be acceptable to the Bureau of Steam Engineering of the Navy Department must comply with the following specifications:

(*a*) Fuel oil shall be a hydrocarbon oil of best quality, free from grit, acid, and fibrous and other foreign matter likely to clog or injure the burners or valves.

(*b*) The unit of quantity to be the barrel of 42 gallons of 231 cubic inches at a standard temperature of 60° F. For every variation of temperature of 10° F. from the standard, 0.4 of 1 per cent shall be added or deducted from the measured or gaged quantity for correction.

(*c*) Flash point never under 150° F. as a minimum (Abel or Pennsky-Marten's closed cup), or 175° F. (Tagliabue open cup), and not lower than the temperature at which the oil has a viscosity of 8 Engler (water=1 Engler). (Example: If an oil has a viscosity of 8 Engler when heated to 186° F., then 186° F. is the minimum flash point at which this oil will be accepted.)

(*d*) Viscosity at 100° F. not greater than 200 Engler.

(*e*) Water and sediment not over 1 per cent. If in excess of 1 per cent, the excess to be subtracted from the volume; or the oil may be rejected.

Note.—If an Engler viscosimeter is not available, the Saybolt standard universal viscosimeter may be used, and 280 seconds Saybolt will be considered equivalent to 8 Engler, and 7,000 seconds Saybolt will be considered equivalent to 200 Engler. Water at 60° F.=30 seconds Saybolt.

Although the minimum flash point of 150° F. adopted by the United States Navy for fuel oil, is lower than that prescribed by any other country for naval purposes, no trouble has been experienced in the storage or bunkering of oil fulfilling the minimum requirement.

Storage tanks of the capacity indicated are in service, building, or authorized at the following Atlantic and Pacific ports:

Storage tanks for fuel oil for United States Navy.

Port.	In service.	Building or authorized.
	Barrels.	*Barrels.*
Boston, Mass	50,000	....
Melville, R. I	84,000	50,000
Norfolk, Va	34,000	250,000
Charleston, S. C	34,000	....
Key West, Fla	34,000	....
Guantanamo, Cuba	214,000	50,000
Pearl Harbor, Hawaii	236,000	100,000
San Diego, Cal	....	50,000
Mare Island, Cal	....	250,000
Puget Sound, Wash	....	250,000

LIQUID PETROLATUM.

Among the opportunities presented to American refiners of crude petroleum in 1914 was the substitution of certain pharmaceutical preparations, imports of which were abruptly terminated at the outbreak of the European war, by corresponding preparations derived from petroleum of domestic origin. One product of this type which promptly attracted the attention of American refiners was liquid petrolatum, or medicinal oil, the use of which as a vehicle for protective sprays in nose and throat work, but more especially for internal administration as an efficient laxative, has attained considerable popularity in this country during the last two or three years.

For a number of years a very carefully refined oil having about the consistency of light lubricating oil has been imported principally for medicinal purposes from Russia, and some has been manufactured in the United States from petroleum distillates imported from that country. The development of the market for this type of oil on the basis of the Russian product was largely a matter of convenience rather than of necessity, inasmuch as oils of essentially the same character can be produced from American petroleum and in fact have been produced on a small scale for many years. The fact that foreign oil of this type has met no serious competition in the domestic market in the past has been due in part to the ample and satisfactory supply from external sources but in greater measure to the absorption of American refiners in efforts to increase the output of more easily refined products, such as gasoline and naphtha, for which an ever-increasing market was obvious.

As soon as it became apparent that imports of liquid petrolatum were no longer possible American refiners with characteristic promptness set about to supply the established market, and before the close of 1914 a score of refiners were experimenting in the new field and at least 10 sources of domestic white oil for medicinal purposes had been developed, the product being retailed under 50 or more different trade names.

Statistics collected by the Geological Survey from importers and refiners show that in 1914 the total quantity of medicinal oil marketed in the United States was not less than 435,950 gallons, and that at least 87,400 gallons, amounting to 20 per cent of this quantity, was obtained from petroleum of domestic origin. This showing is most gratifying when the fact is considered that it is the result for the most part of only a few months' work. What the future holds out to American refiners in this field depends largely in their own efforts.

In order to determine the relative efficiency of Russian and American medicinal oils, the committee on therapeutic research of the council on pharmacy and medicine of the American Medical Association submitted samples of the different oils ("Russian" light, gravity 0.860 at 20°C.; "Russian" heavy, gravity 0.885 at 20° C.; and "American," gravity 0.857 at 20° C.) to various clinicians for testing. The results as summarized by W. A. Bastedo, M. D.,[1] are of more than passing interest.

> The results of this clinical investigation appear to warrant the conclusion that so far as therapeutic results are concerned the differences in the action of the three varieties of liquid petrolatum—namely, light Russian liquid petrolatum, heavy Russian liquid petrolatum, and American liquid petrolatum—are too slight to be of importance. Hence the choice between the lighter and the heavier oils, and between the Russian and the American is an open one, to be determined not by therapeutic difference, but by palatability, dependent on the degree to which the refinement of the oil is carried out. The United States Pharmacopœia, the revision of which is now nearing completion, no doubt will furnish standards which will insure a suitable product. From the findings of the foregoing report it would appear that a satisfactory standard might permit the use of either Russian or American oil, if suitably refined so as to be as nearly as possible devoid of odor and taste.

The National Standard Dispensatory (2d edition, 1908) describes liquid petrolatum or liquid paraffin as a colorless (or very slightly yellowish, U. S. P.) oily, transparent liquid without odor or taste. Its specific gravity varies between 0.870 and 0.940 at 25° C.—U. S.; from 0.885 to 0.880 at 15.5° C.—British; about 0.875 at 15° C.—French, and not less than 0.885 at 15° C.—German. The British and German pharmacopœias require that the boiling point shall not be below 360° C., (680° F.) and the British pharmacopœia prescribes a further test for sulphur.

The United States Pharmacopœia (eighth edition, 1905) describes liquid petrolatum as a mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off most of the lighter and more volatile portions from petroleum and purifying the liquid residue. In the United States oils of Pennsylvania grade have been found to be the most satisfactory for this purpose. After the lighter hydrocarbons have been removed, the residual liquid is subjected to careful distillation between 330° and 390° C. The distillate is treated with sulphuric acid and later with caustic alkali, after which it is filtered hot through animal charcoal. The filtrate is then subjected to chilling to remove solid paraffins, which readily crystallize out, and is subsequently redistilled, the fraction distilling above 360° C. being collected.

Aside from the question of therapeutic value, which has been decided by the disinterested testimony of Dr. Bastedo and his associates, the objections advanced against the medicinal oils of American origin are chiefly of an esthetic nature, based in certain oils

[1] Bastedo, W. A., Clinical experience with liquid paraffin (liquid petrolatum); Am. Med. Assoc. Jour., vol. 64, p. 809, 1915.

on the presence of florescence or "bloom," in others on a faint petroleum taste or odor, and in still others on the presence of sulphur. The fact, however, that these objections do not hold at all for certain brands of American oil and that they do hold in different degrees for other brands is evidence that no insurmountable difficulties prevent the popularizing of the American product, but that careless manipulation in a few cases, due perhaps to overanxiety for an early place in the market, has blinded certain refiners to the high standard set by the foreign product. A popular fancy which will warrant a price of $5 a gallon for what little guaranteed Russian oil is now (July, 1915) available in the market as against $1.50 to $2 a gallon for an equally efficient American product may not be wholly dispelled, but it can not be long maintained with the intelligent public. With care and attention to refining details there appears to be no reason why the market for medicinal oils in this country, at least, turned over to American refiners as the result of no effort on their part, should ever be permitted to return to foreign control.

PETROLEUM OPERATORS' STATISTICS.

The statistics presented in the following tables are those obtained directly from the oil producers. The object of this investigation, in addition to determining the marketed production as reported by pipe-line and other transporting companies, is to avoid, by comparison, any serious errors in arriving at the accepted total, to obtain a record of the oil utilized in field operations, and to obtain also details available in no other way concerning drilling activity and acreage held for development purposes.

Discrepancies between the output here recorded and that stated elsewhere in this report may be accounted for (1) by the failure of all producing companies in a given State to furnish the information requested; (2) by lack of uniform practice among operators in reporting oil brought to the surface and placed in field storage; (3) by the absence of a basis for separating, in the case of pipe-line runs, oil actually brought to the surface during the year from that accumulated by producers prior to the year under review.

On the whole the two sets of figures agree fairly closely, with the exception of Oklahoma, for which the total output compiled from the producers' statistics considerably exceeds that obtained by tabulating the returns from transporting agencies. The explanation of this discrepancy is believed to lie in the failure of certain transporting agencies to report as runs large quantities of oil turned over to them by producers, but retained on tank farms adjacent to the point of production and also to the action of certain operators in reporting to the Survey total above-ground yields as distinguished from the quantity of oil disposed of during the year.

Marketed production and value of petroleum, well records, and acreage for the United States in 1913 and 1914, by States, from statistics furnished by producers.

1913.

State.	Production (in barrels). Placed to credit of— Producer.	Production (in barrels). Placed to credit of— Land-owner.	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.
Alaska			(a)	(a)		5	2			7		160	9,500	9,660
Arkansas								5					28,381	28,381
California	93,692,611	4,095,914	97,788,525	$45,709,400	$0.467	6,321	789	67	293	6,817	39.3	293,332	209,611	502,943
Colorado	187,902	897	188,799	174,779	.926	112	8	13	28	92	5.6	9,733	5,605	15,338
Illinois	19,896,114	3,669,105	23,565,219	31,038,378	1.317	13,238	1,356	187	494	14,100	4.6	3,368	244,327	247,695
Indiana	758,603	115,650	874,253	1,150,875	1.316	4,171	202	37	559	3,814	.6	7,570	99,705	107,275
Kansas	1,994,108	248,725	2,242,833	2,123,586	.947	1,812	1,336	87	94	3,054	2.0	20,566	182,438	203,004
Kentucky	428,510	51,072	479,582	584,269	1.218	936	112	51	80	968	1.3	27,579	141,479	169,058
Louisiana	10,368,537	2,008,263	12,376,800	11,897,422	.960	780	355	64	149	986	34.4	56,294	410,552	466,846
Michigan			(a)	(a)		27	4	1	5	26		15	3,240	3,255
Mississippi								2					1,000	1,000
Missouri			(a)	(a)		12		1		12			16,292	16,292
New Mexico			(a)	(a)		1	1	2		2			2,860	2,860
New York	807,969	62,386	870,355	2,116,679	2.432	10,516	393	17	228	10,681	.2	44,261	85,571	129,832
Ohio	6,908,361	1,039,546	7,947,907	14,951,993	1.881	30,739	2,206	335	1,737	31,208	.7	64,733	845,240	909,973
Oklahoma	50,909,222	7,245,483	58,154,705	54,971,500	.945	18,715	6,111	669	741	24,085	6.6	36,414	1,486,417	1,522,831
Pennsylvania	6,443,953	658,794	7,102,747	17,823,687	2.509	53,562	b 3,538	318	1,806	55,294	.35	317,766	773,351	1,091,117
Tennessee								1						
Texas	13,065,046	1,652,388	14,717,434	14,216,115	.966	3,084	877	299	419	3,542	11.4	61,388	628,703	690,091
Utah			(c)	(c)		13		9	4	9		23,197		23,197
Washington							1			1				
West Virginia	9,770,887	1,420,927	11,191,814	27,935,262	2.496	13,725	1,320	180	501	14,544	2.1	66,520	1,878,599	1,945,119
Wyoming	1,608,120	798,402	2,406,522	1,187,232	.493	189	34	16	25	198	33.3	18,220	35,230	53,450
Other States	10,813	30	d 10,843	d 19,263	1.777									
Total	216,850,756	23,067,582	239,918,338	225,800,440	.941	157,958	18,645	2,361	7,163	169,440	3.9	1,051,116	7,088,101	8,139,217

a Included in "Other States."
b Includes many wells previously abandoned and but cleaned out and made productive during 1913.
c No production.
d Includes Alaska, Michigan, Missouri, and New Mexico.

Marketed production and value of petroleum, well records, and acreage for the United States in 1913 and 1914, by States, from statistics furnished by producers—Continued.

1914.

State.	Production (in barrels).			Value.	Average price per barrel.	Wells.					Average daily production (in barrels) per well.	Acreage.		
	Placed to credit of—		Total.			Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.		Fee.	Lease.	Total.
	Producer.	Land-owner.					Oil.	Dry.						
Alabama								3				3,049		3,049
Alaska			(a)	(a)		7	1			8		148	9,000	9,148
Arkansas								1				800	43,258	44,058
California	95,118,988	4,656,339	99,775,327	$48,066,096	$0.482	6,817	512	47	197	7,132	38.3	348,592	127,249	475,841
Colorado	222,591	182	222,773	200,894	.902	92	12	10	14	90	6.8	17,065	28,165	45,230
Illinois	18,228,181	3,445,235	21,673,416	24,775,050	1.143	14,100	953	227	253	14,800	4.0	3,479	293,095	296,574
Indiana	1,134,943	183,357	1,318,300	1,291,077	.979	3,814	434	119	852	3,396	1.1	11,139	88,842	99,981
Kansas	2,167,376	267,569	2,434,945	1,823,050	.749	3,054	552	156	194	3,412	2.0	21,450	261,386	282,836
Kentucky	430,374	52,738	483,112	483,930	1.002	968	125	41	61	1,032	1.3	8,778	200,302	209,080
Louisiana	11,885,301	2,106,320	13,991,621	12,497,059	.893	986	327	110	137	1,176	32.6	18,726	491,416	510,142
Michigan			(a)	(a)		26	2		2	26		14	4,040	4,054
Mississippi								2				19,080	47,000	66,080
Missouri			(a)	(a)		12		3		12			17,812	17,812
New Mexico			(b)	(b)		2		1	1	1		80	4,700	4,780
New York	851,402	62,737	914,139	1,588,261	1.737	10,681	658	9	214	11,105	.2	39,062	78,039	117,101
Ohio	5,813,151	1,421,208	7,234,359	10,918,741	1.509	31,208	1,731	292	1,176	31,763	.6	56,693	948,947	1,005,640
Oklahoma	70,954,984	10,463,970	81.418,954	60,268,824	.740	24,085	4,492	1,071	783	27,794	8.0	222,599	1,825,874	2,048,473
Pennsylvania	6,945,584	713.083	7,658,667	15,789,754	2.061	55,294	[c]3,645	265	609	58,330	.4	306,229	695,245	1,001,474
Texas	17,459,728	2,134,074	19,593,802	13,057,412	.666	3,542	656	310	347	3,851	13.9	226,478	586,468	812,946
Utah			(b)	(b)		9		1	4	5		14,717	1,680	16,397
Washington						1		3		1		6,285	6,000	12,285
West Virginia	8,458,861	1,219,746	9,678,607	17,735,464	1.832	14,544	1,130	218	742	14,932	1.8	98,863	2,508,663	2,607,526
Wyoming	3,547,899	16,476	3,564,375	1,679,192	.472	198	86	28	21	263	37.1	21,496	74,752	96,248
Other States [d]	7,738	54	7,792	14,291	1.834						.5			
Total	243,227,101	26,743,088	269,970,189	210,189,095	.779	169,440	15,296	2,917	5,607	179,129	4.1	1,444,822	8,341,933	9,786,755

[a] Included in "Other States."
[b] No production.
[c] Includes many wells previously abandoned but cleaned out and made productive during 1914.
[d] Includes Alaska, Michigan, and Missouri.

The following tables summarize, by States and counties, the results of drilling activity in 1913 and 1914:

Summary of wells drilled in 1913 and 1914, by counties.

NEW YORK.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allegany	7,515	290	12	148	7,657	27,446	44,799	72,245
Cattaraugus	2,782	97	5	72	2,807	15,285	39,768	55,053
Steuben	219	6		8	217	1,530	1,004	2,534
Total	10,516	393	17	228	10,681	44,261	85,571	129,832

1914.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Allegany	7,657	215	7	158	7,714	22,826	36,937	59,763
Cattaraugus	2,807	423	2	21	3,209	14,736	40,292	55,028
Steuben	217			35	182	1,500	810	2,310
Total	10,681	638	9	214	11,105	39,062	78,039	117,101

Summary of wells drilled in 1913 and 1914, by counties—Continued.

PENNSYLVANIA.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allegheny	1,664	62	18	46	1,680	2,957	68,777	71,734
Armstrong	170	25	3	27	168	2,411	3,174	5,585
Beaver	609	29	14	48	590	2,059	12,821	14,880
Butler	5,268	434	80	233	5,469	21,229	59,626	80,855
Clarion	1,749	138	25	136	1,751	11,768	21,414	33,182
Crawford	597	47	4	76	568	983	4,909	5,892
Elk	1,118	36	2	4	1,150	12,169	55,433	67,602
Forest	1,612	145	17	95	1,662	36,864	40,988	77,852
Greene	496	34	28	23	507	1,327	78,494	79,821
Jefferson	135	7	7		142	9,540	32,717	42,257
Lawrence	617	302	6	1	918	97	15,470	15,567
McKean	14,970	613	14	528	15,055	91,394	120,475	211,869
Mercer	276	10		11	275	230	2,995	3,225
Potter	78	14			92	36,337	8,861	45,198
Tioga	24				24		247	247
Venango	15,552	1,320	72	232	16,640	49,548	65,571	115,119
Warren	6,899	290	12	248	6,941	34,811	43,585	78,396
Washington	1,728	32	16	98	1,662	2,172	131,480	133,652
Total	53,562	a 3,538	318	1,806	55,294	315,896	767,037	1,082,933

1914.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Allegheny	1,680	84	31	35	1,729	5,808	64,003	69,811
Armstrong	168	27	4	10	185	1,872	2,909	4,781
Beaver	590	81	11	8	663	2,599	15,731	18,330
Bradford			1				3,000	3,000
Butler	5,469	201	58	65	5,605	29,099	67,664	96,763
Clarion	1,751	172	8	19	1,904	13,293	52,431	65,724
Crawford	568	115		3	680	4,597	1,009	5,606
Elk	1,150	6	1	16	1,140	32,940	57,534	90,474
Forest	1,662	42	25	12	1,692	40,839	27,104	67,943
Greene	507	20	10	12	515	846	78,115	78,961
Jefferson	142	11	1		153	557	33,569	34,126
Lawrence	918	223	5	2	1,139	906	15,889	16,795
McKean	15,055	446	15	125	15,376	83,472	127,287	210,759
Mercer	275	14	1	11	278	234	2,033	2,267
Potter	92				92	256	87	343
Tioga	24				24		367	367
Venango	16,640	1,673	53	209	18,104	42,035	49,803	91,838
Warren	6,941	358	23	66	7,233	39,777	39,952	79,729
Washington	1,662	172	16	16	1,818	7,099	56,533	63,632
Westmoreland			2				225	225
Total	55,294	a 3,645	265	609	58,330	306,229	695,245	1,001,474

a Includes many wells previously abandoned but cleaned out and made productive during 1914.

Summary of wells drilled in 1913 and 1914, by counties—Continued.

WEST VIRGINIA.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Braxton	1	3		1	3		56,772	56,772
Brooke	273	9	4	19	263	824	6,310	7,134
Cabell	24	1	2	2	23		5,973	5,973
Calhoun	290	24	5	11	303	73	17,440	17,513
Clay	12	18	1	4	26	234	58,586	58,820
Doddridge	570	39	16	15	594	2,324	57,527	59,851
Gilmer	84	9	3	6	87	646	12,852	13,498
Greenbrier			1					
Hancock	348	16	3	36	328	1,371	5,100	6,471
Harrison	1,156	85	9	27	1,214	4,691	76,257	80,948
Jackson		1			1		90,830	90,830
Kanawha	410	184	11	22	572	733	323,056	323,789
Lewis	255	17	4	1	271	6,835	82,571	89,406
Lincoln	559	76	1	3	632	1,182	249,644	250,826
Logan	1			1			33,591	33,591
Marion	644	46	5	6	684	1,307	51,910	53,217
Marshall	135	3	1	4	134	250	6,741	6,991
Mason	1	2	4		3		10,225	10,225
Monongalia	684	34	4	14	704	15,498	80,503	96,001
Ohio	2	5			7	20	9,005	9,025
Pleasants	1,516	156	19	79	1,593	1,441	35,406	36,847
Putnam		2	2		2		3,972	3,972
Ritchie	1,847	164	30	94	1,917	6,882	122,623	129,505
Roane	826	216	18	5	1,037	4,462	257,330	261,792
Tyler	1,553	43	11	38	1,558	5,039	48,753	53,792
Wayne	1	2	1	1	2	4,400	63,075	67,475
Wetzel	1,180	23	12	20	1,183	2,259	88,829	91,088
Wirt	477	57	2	41	493	4,578	9,600	14,178
Wood	876	85	11	51	910	1,471	14,118	15,589
Total	13,725	1,320	180	501	14,544	66,520	1,878,599	1,945,119

1914.

Braxton	3	2	1	1	4	2	2,291	2,293
Brooke	263	16	5	28	251	1,524	11,072	12,596
Cabell	23	1		4	20	2,000	9,336	11,336
Calhoun	303	11	1	28	286	313	49,932	50,245
Clay	26	22	1	1	47		41,488	41,488
Doddridge	594	19	16	34	579	4,384	102,808	107,192
Fayette			3				7,200	7,200
Gilmer	87	7	1		94	1,552	60,248	61,800
Hancock	328	45	11	41	332	2,619	5,298	7,917
Harrison	1,214	140	24	43	1,311	5,125	136,427	141,552
Jackson	1				1		56,008	56,008
Kanawha	572	130	22	17	685	4,658	511,182	515,840
Lewis	271	10	1	4	277	42,634	139,691	182,325
Lincoln	632	68	4	27	673	1,321	442,933	444,254
Marion	684	54	10	32	706	1,474	60,746	62,220
Marshall	134	10		4	140	300	14,518	14,818
Mason	3				3		701	701
Monongalia	704	20	6	15	709	2,653	51,083	53,736
Nicholas		2		2			891	891
Ohio	7			3	4		5	5
Pleasants	1,593	129	34	37	1,685	1,702	30,541	32,243
Putnam	2				2		32,008	32,008
Ritchie	1,917	134	25	110	1,941	2,022	126,469	128,491
Roane	1,037	126	14	22	1,141	4,210	360,370	364,580
Summers			2					
Tyler	1,558	33	9	103	1,488	1,196	82,638	83,834
Wayne	2	2			4		47,048	47,048
Wetzel	1,183	19	3	53	1,149	2,485	84,117	86,602
Wirt	493	56	16	40	509	13,899	27,648	41,547
Wood	910	74	9	93	891	2,790	13,966	16,756
Total	14,544	1,130	218	742	14,932	98,863	2,508,663	2,607,526

Summary of wells drilled in 1913 and 1914, by counties—Continued.

KENTUCKY.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allen	6	6	2	......	12	......	4,232	4,232
Barren	7	3	2	......	10	31	1,514	1,545
Bath	90	......	......	......	90	......	800	800
Cumberland	......	......	1	......	......	......	......	......
Floyd	20	......	1	......	20	......	6,175	6,175
Knott	2	......	......	......	2	......	568	568
Knox	......	......	1	......	......	......	......	......
Lawrence	18	11	2	2	27	1,500	21,325	22,825
Logan	8	......	1	2	6	......	8,000	8,000
Martin	......	......	1	......	......	......	3,600	3,600
Morgan	4	30	10	1	33	2,000	2,394	4,394
Ohio	2	2	1	......	4	......	6,200	6,200
Rowan	35	......	......	......	35	......	350	350
Shelby	......	......	1	......	......	......	......	......
Wayne	615	44	21	62	597	24,048	67,821	91,869
Wolfe	129	16	7	13	132	......	18,500	18,500
Total	936	112	51	80	968	27,579	141,479	169,058

1914.

Allen	12	23	7	7	28	12	10,058	10,070
Barren	10	......	......	3	7	31	514	545
Bath	90	......	......	......	90	......	800	800
Daviess	......	......	1	......	......	......	6,000	6,000
Estill	......	4	......	......	4	......	4,000	4,000
Floyd	20	......	......	......	20	......	2,675	2,675
Hopkins	......	......	1	......	......	200	25,000	25,200
Knott	2	......	......	......	2	......	578	578
Lawrence	27	11	......	3	35	1,233	10,958	12,191
Lewis	......	6	3	......	6	......	12,000	12,000
Logan	6	1	1	1	6	......	578	578
Morgan	33	6	5	2	37	200	49,240	49,440
Nicholas	......	......	1	......	......	......	......	......
Ohio	4	2	1	......	6	......	10,000	10,000
Rowan	35	......	......	......	35	2,250	2,250	4,500
Wayne	597	65	16	45	617	4,852	50,151	55,003
Wolfe	132	7	5	......	139	......	15,500	15,500
Total	968	125	41	61	1,032	8,778	200,302	209,080

Summary of wells drilled in 1913 and 1914, by counties—Continued.

OHIO.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allen	1,579	105	7	115	1,569	2,193	26,622	28,815
Athens	125	11	2	12	124	1,270	10,551	11,821
Auglaize	530	23	1	23	530	1,458	2,229	3,687
Belmont	152	31	4	1	182	527	25,185	25,712
Carroll	47	16		3	60	329	8,790	9,119
Clermont			2					
Columbiana	266	62	10	7	321	116	6,155	6,271
Coshocton	19	15	5	4	30		52,040	52,040
Cuyahoga		1			1			
Erie		1			1		325	325
Fairfield	280	32	6	19	293	234	18,183	18,417
Guernsey	14	11		7	18		785	785
Hancock	3,226	156	12	125	3,257	2,099	33,222	35,321
Hardin	2	1			3	326		326
Harrison	746	61	5	91	716	3,530	10,159	13,689
Hocking	97	57	11	8	146	3,110	90,956	94,066
Holmes	31	3			34	140	6,571	6,711
Jackson		1			1		2,000	2,000
Jefferson	435	59	39	15	479	2,805	13,336	16,141
Knox	9	2	7	1	10	192	23,003	23,195
Lake	1				1		1,000	1,000
Lawrence	3				3		1,868	1,868
Licking	24	29	3		53		36,491	36,491
Logan	3	3	1		6		10,000	10,000
Lorain	8				8			
Lucas	485	34	1	44	475	1,993	4,687	6,680
Mahoning		6			6		3,900	3,900
Medina	3				3		84,359	84,359
Meigs	1	4		1	4		2,291	2,291
Mercer	656	96	5	50	702	1,699	12,301	14,000
Monroe	2,633	85	18	185	2,533	6,431	62,875	69,306
Morgan	875	145	35	29	991	1,079	8,995	10,074
Muskingum	162	19	4	3	178	320	15,967	16,287
Noble	447	82	10	34	495	1,452	9,998	11,450
Ottawa	480	12		55	437	2,376	6,897	9,273
Perry	499	170	25	36	633	2,345	78,394	80,739
Richland			1					
Sandusky	4,011	172	3	75	4,108	6,814	37,412	44,226
Seneca	637	35	3	46	626	1,700	5,049	6,749
Shelby	19			4	15		200	200
Summit			1			76		76
Trumbull	15				15	728	210	938
Van Wert	730	34	6	73	691	1,006	14,586	15,592
Vinton	6				6	60	3,501	3,561
Washington	3,733	349	55	287	3,895	4,940	46,356	51,296
Wayne	11	24	7	1	34		10,570	10,570
Wood	7,629	258	46	477	7,410	12,495	54,921	67,416
Wyandot	110	1		6	105	890	2,300	3,190
Total	30,739	2,206	335	1,737	31,208	64,733	845,240	909,973

Summary of wells drilled in 1913 and 1914, by counties—Continued.

OHIO—Continued.

1914.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allen	1,569	29	2	145	1,453	846	34,207	35,053
Ashland		6	2		6		78,139	78,139
Athens	124	7	1	4	127	1,597	9,492	11,089
Auglaize	530	11	4	24	517	1,551	18,140	19,691
Belmont	182	9	17	5	186	2,540	38,054	40,594
Carroll	60	14	22	18	56		35,846	35,846
Columbiana	321	92	14	19	394	116	11,224	11,340
Coshocton	30	7	1		37	5	15,032	15,037
Cuyahoga	1	1	2		2	3	91	94
Delaware			1					
Erie	1			1				
Fairfield	293	22	9	12	303	650	30,964	31,614
Guernsey	18			10	8		505	505
Hancock	3,257	113	10	87	3,283	2,529	31,109	33,638
Hardin	3				3	400		400
Harrison	716	30	2	28	718	3,221	12,107	15,328
Hocking	146	70	17	5	211	29	59,333	59,362
Holmes	34	9			43	370	847	1,217
Jackson	1				1			
Jefferson	479	49	24	10	518	2,588	21,507	24,095
Knox	10	1		1	10	192	16,871	17,063
Lake	1				1			
Lawrence	3	15			18	175	353	528
Licking	53	23	1	8	68	200	32,920	33,120
Logan	6		1		6		10,025	10,025
Lorain	8				8			
Lucas	475	42	1	22	495	1,677	5,639	7,316
Mahoning	6	57			63	127	1,230	1,357
Medina	3			1	2		72,794	72,794
Meigs	4	5	3		9	20	1,768	1,788
Mercer	702	8	4	35	675	2,084	15,973	18,057
Monroe	2,533	90	24	20	2,603	4,439	55,195	59,634
Morgan	991	113	29	49	1,055	801	11,684	12,485
Muskingum	178	18	5	6	190	400	58,709	59,109
Noble	495	50	9	13	532	1,610	10,324	11,934
Ottawa	437	24		16	445	769	8,806	9,575
Perry	633	70	14	34	669	723	63,406	64,129
Richland			1				40	40
Sandusky	4,108	174	3	134	4,148	6,741	34,590	41,331
Seneca	626	20	4	9	637	748	4,912	5,660
Shelby	15	2			17		360	360
Trumbull	15	5	1		20	632	310	942
Van Wert	691	34	1	78	647	903	13,910	14,813
Vinton	6	2			8	60	1,075	1,135
Washington	3,895	279	40	62	4,112	5,798	54,788	60,586
Wayne	34	6	3		40		10,266	10,266
Wood	7,410	224	20	282	7,352	11,255	64,102	75,357
Wyandot	105			38	67	894	2,300	3,194
Total	31,208	1,731	292	1,176	31,763	56,693	948,947	1,005,640

Summary of wells drilled in 1913 and 1914, by counties—Continued.

INDIANA.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Adams	551	10	....	58	503	1,570	9,932	11,502
Blackford	184	5	2	21	168	45	5,069	5,114
Daviess	1	2	....	....	3	....	3,500	3,500
Delaware	128	40	3	26	142	610	7,206	7,816
Gibson	114	18	....	....	132	1	5,038	5,039
Grant	612	1	....	97	516	200	10,637	10,837
Greene	4	2	2	....	6	....	799	799
Hamilton	....	1	....	....	1	....	1,200	1,200
Harrison	3	....	2	....	3	....	10,000	10,000
Huntington	422	4	....	68	358	216	5,411	5,627
Jay	830	26	3	105	751	3,802	12,894	16,696
Knox	....	....	1	....	....	....	....	....
Miami	....	....	1	....	....	....	....	....
Montgomery	....	....	....	....	....	....	....	....
Pike	148	9	5	8	149	40	1,287	1,327
Randolph	44	8	....	....	52	....	8,600	8,600
Sullivan	8	70	17	....	78	122	8,299	8,421
Vigo	9	....	....	....	9	....	179	179
Wabash	....	....	....	....	....	....	....	....
Wells	1,113	6	1	176	943	964	9,654	10,618
Total	4,171	202	37	559	3,814	7,570	99,705	107,275

1914.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Adams	503	3	1	53	453	1,240	8,525	9,765
Blackford	168	15	7	50	133	200	4,576	4,776
Daviess	3	....	....	....	3	140	260	400
Delaware	142	10	2	9	143	140	7,171	7,311
Gibson	132	5	....	17	120	140	4,380	4,520
Grant	516	....	....	268	248	200	8,748	8,948
Greene	6	....	....	....	6	....	570	570
Hamilton	1	....	....	....	1	....	....	....
Harrison	3	....	....	....	3	4,000	16,000	20,000
Huntington	358	....	....	132	226	210	3,948	4,158
Jay	751	24	2	16	759	3,435	11,934	15,369
Knox	....	....	1	....	....	....	800	800
Montgomery	....	....	1	....	....	....	6,000	6,000
Pike	149	11	5	....	160	260	1,579	1,839
Randolph	52	4	....	5	51	100	8,400	8,500
Sullivan	78	361	99	5	434	61	4,342	4,403
Vigo	9	....	....	....	9	....	516	516
Wabash	....	....	....	....	....	....	160	160
Wells	943	1	1	297	647	1,013	933	1,946
Total	3,814	434	119	852	3,396	11,139	88,842	99,981

Summary of wells drilled in 1913 and 1914, by counties—Continued.

ILLINOIS.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Clark	2,226	104	14	125	2,205	948	25,487	26,435
Clinton	134	15		1	148		36,120	36,120
Coles	64	5			69	56	740	796
Crawford	6,842	612	95	150	7,304	901	77,722	78,623
Cumberland	662	20	2	46	636		5,725	5,725
Douglas			1					
Edgar	6	3	2		9	955		955
Edwards			2					
Fulton			1					
Jackson			2					
Jasper	4		2	1	3		150	150
Jefferson			1				2,000	2,000
Lawrence	3,220	547	56	168	3,599	166	60,715	60,881
Macoupin	4	2	4		6		4,780	4,780
Madison	2				2	342		342
Marion	62	35			97		19,278	19,278
Morgan		3			3		390	390
Perry			1					
Randolph	3			3			460	460
St. Clair			1					
Wabash	9	10	1		19		2,760	2,760
Washington			1					
White			1				8,000	8,000
Total	13,238	1,356	187	494	14,100	3,368	244,327	247,695

1914.

County.	Productive Jan. 1.	Oil.	Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Alexander			1					
Cass			2				4,000	4,000
Clark	2,205	93	17	39	2,259	1,248	24,953	26,201
Clinton	148	2	1		150		36,000	36,000
Coles	69	16		1	84	200	720	920
Crawford	7,304	328	106	152	7,480	822	74,716	75,538
Cumberland	636	47			683	27	5,234	5,261
Edgar	9		1		9	470	485	955
Hancock		1	3		1			
Jasper	3	5			8		724	724
Lawrence	3,599	309	62	60	3,848	134	62,051	62,185
McDonough		145	24	1	144	236	49,905	50,141
Macoupin	6	3	2		9		3,780	3,780
Madison	2		1		2	342	8,000	8,342
Marion	97	3			100		19,212	19,212
Morgan	3				3		555	555
Pike			2					
St. Clair			1					
Schuyler			1					
Union			1					
Wabash	19	1	2		20		2,760	2,760
Total	14,100	953	227	253	14,800	3,479	293,095	296,574

Summary of wells drilled in 1913 and 1914, by counties—Continued.

KANSAS.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Allen	172	142	9	5	309	1,126	13,117	14,243
Chautauqua	811	292	27	27	1,076	12,459	49,754	62,213
Coffey	2	1	....	2	1	....	158	158
Cowley	....	....	2	....	....	....	10,622	10,622
Elk	6	....	....	....	6	....	160	160
Franklin	12	47	2	....	59	....	1,137	1,137
Greenwood	....	1	....	....	1	....	2,107	2,107
Labette	1	....	2	....	1	60	3,000	3,060
Miami	27	15	4	14	28	510	6,733	7,243
Montgomery	444	558	25	35	967	5,647	55,203	60,850
Neosho	168	244	15	7	405	724	24,823	25,547
Wilson	169	33	....	4	198	40	15,624	15,664
Woodson	....	3	1	....	3	....	....	....
Total	1,812	1,336	87	94	3,054	20,566	182,438	203,004

1914.

County.	Productive Jan. 1.	Completed Oil.	Completed Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Allen	309	66	5	10	365	2,008	12,735	14,743
Butler	....	1	....	....	1	....	60,108	60,108
Chase	....	....	1	....	....	....	....	....
Chautauqua	1,076	193	25	36	1,233	9,154	44,691	53,845
Coffey	1	....	....	....	1	....	80	80
Cowley	....	1	....	....	1	....	13,965	13,965
Elk	6	....	....	....	6	160	160	320
Franklin	59	54	9	....	113	1,170	3,397	4,567
Greenwood	1	....	8	1	....	....	....	....
Labette	1	6	4	....	7	400	710	1,110
Miami	28	69	19	11	86	613	20,125	20,738
Montgomery	967	127	54	60	1,034	5,301	67,271	72,572
Neosho	405	26	21	47	384	1,844	21,075	22,919
Sumner	....	....	3	....	....	....	....	....
Wilson	198	7	5	28	177	800	15,989	16,789
Woodson	3	2	2	1	4	....	1,080	1,080
Total	3,054	552	156	194	3,412	21,450	261,386	282,836

Summary of wells drilled in 1913 and 1914, by counties—Continued.

OKLAHOMA.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Atoka			1				1,052	1,052
Caddo			1				4,000	4,000
Canadian			2					
Carter	48	18	4		66	1,900	7,923	9,823
Cherokee			2				7,040	7,040
Choctaw			1					
Coal			1				8,500	8,500
Comanche	5	2	1		7		6,980	6,980
Cotton			2				8,000	8,000
Craig			3				2,720	2,720
Creek	1,979	903	102	95	2,787	461	37,128	37,589
Garfield			1					
Grady			1				320	320
Hughes			1				4,220	4,220
Jackson			1					
Kay	35	28	11	1	62		27,022	27,022
Kiowa	11	10	1	4	17	160	5,540	5,700
Le Flore			2				2,410	2,410
Lincoln			1				10,343	10,343
Logan			1				5,000	5,000
McIntosh			4				5,920	5,920
Marshall	3		2		3	20	1,064	1,084
Murray			2					
Muskogee	303	58	15	20	341	458	14,468	14,926
Noble			2				320	320
Nowata	5,905	929	51	248	6,586	4,732	74,407	79,139
Okfuskee		6	2		6		27,410	27,410
Okmulgee	396	380	89	30	746	5,386	140,804	146,190
Osage	1,868	464	45	60	2,272	60	552,426	552,486
Pawnee	391	271	15	24	638	266	44,919	45,185
Payne		15	3		15	124	7,609	7,733
Pittsburg			2			2,240	2,434	4,674
Pontotoc		1	1		1		8,500	8,500
Pushmataha			1				7,000	7,000
Rogers	1,705	467	48	110	2,062	1,755	31,059	32,814
Seminole			1				28,861	28,861
Stephens			1				6,790	6,790
Tillman			3				11,500	11,500
Tulsa	1,917	879	123	51	2,745	9,855	209,451	219,306
Wagoner	6	7	14	3	10	560	3,418	3,978
Washington	4,143	1,673	105	95	5,721	8,437	169,859	178,296
Total	18,715	6,111	669	741	24,085	36,414	1,486,417	1,522,831

Summary of wells drilled in 1913 and 1914, by counties—Continued.

OKLAHOMA—Continued.

1914.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Atoka			5				4,750	4,750
Beckham			1				20,000	20,000
Bryan			1				2,000	2,000
Caddo			2				4,400	4,400
Carter	66	387	46	16	437	2,606	49,523	52,129
Coal			3				15,000	15,000
Comanche	7	9	5	3	13	500	17,180	17,680
Craig			1				2,000	2,000
Creek	2,787	686	72	126	3,347	10,778	225,879	236,657
Garvin			3				19,500	19,500
Grady			1				480	480
Greer			1				2,160	2,160
Hughes			4			320	8,724	9,044
Jefferson		1	4		1		8,640	8,640
Kay	62	72	50	6	128	540	80,990	81,530
Kiowa	17	1	1	4	14	640	800	1,440
Le Flore			1				135	135
Logan			1					
McIntosh		4			4		4,690	4,690
Marshall	3	1	9		4	1,373	8,691	10,064
Muskogee	341	66	51	46	361	518	21,606	22,124
Nowata	6,586	521	53	172	6,935	4,565	90,242	94,807
Okfuskee	6	7		1	12		33,789	33,789
Oklahoma		2	2	1	1	160	5,440	5,600
Okmulgee	746	570	312	58	1,258	12,015	178,181	190,196
Osage	2,272	470	82	50	2,692	167	560,700	560,867
Pawnee	638	61	19	9	690	410	33,074	33,484
Payne	15	3	10	6	12	5,080	17,830	22,910
Pittsburg			4			530	4,980	5,510
Pontotoc	1	6	1	1	6	1,120	17,714	18,834
Rogers	2,062	345	81	66	2,341	2,796	37,078	39,874
Seminole		2	3		2	80	18,713	18,793
Sequoyah			2				2,500	2,500
Stephens		1	1		1		15,300	15,300
Tillman			1					
Tulsa	2,745	692	174	45	3,392	63,813	147,726	211,539
Wagoner	10	25	17	2	33	362	7,190	7,552
Washington	5,721	560	47	171	6,110	114,226	158,269	272,495
Total	24,085	4,492	1,071	783	27,794	222,599	1,825,874	2,048,473

Summary of wells drilled in 1913 and 1914, by counties—Continued.

TEXAS.

1913.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Angelina			2					
Archer	1		6		1		1,202	1,202
Atascosa		4	7		4		18,874	18,874
Baylor			2					
Bee			1					
Bexar	3		3		3	1,249	2,528	3,777
Brazoria	4		2	4		3,005	5,325	8,330
Brazos			1					
Brewster	2				2			
Brown	5	1		1	5	1	8,000	8,001
Burleson		1		1				
Callahan			1					
Cass		1	1	1		13,565	3,112	16,677
Chambers			1				1,227	1,227
Clay	201	108	15	8	301	13,123	24,320	37,443
Coleman	1	4	12	4	1	2,200	35,242	37,442
Comanche			1					
Cottle			1				3,500	3,500
Delta		1			1	2,000	1,000	3,000
Duval	1		1		1		200	200
Eastland			3			10	580	590
Ellis			1				240	240
Freestone		2	2		2		3,200	3,200
Gonzales			1				1,047	1,047
Hall			1			800	800	1,600
Hardin	941	101	33	116	926	2,628	1,532	4,160
Harris	418	110	77	91	437	4,789	8,425	13,214
Hopkins			2				1,000	1,000
Houston			1					
Jack	2	14	2		16		11,323	11,323
Jasper			1				450	450
Jefferson	103	28	14	25	106	2,022	1,017	3,039
Liberty	4	3	2	1	6	383	1,500	1,883
Limestone			3				800	800
McCulloch	5	3	5	8		80	206	286
McLennan	11				11		365	365
McMullen	20				20		16,388	16,388
Madison			1					
Marion	11	14	3	1	24	6,655	19,019	25,674
Matagorda	37	7	6	5	39	1,103	1,103	2,206
Nacogdoches		2			2		5,031	5,031
Navarro	932	63	26	124	871	545	20,185	20,730
Orange		1			1	1	1,467	1,468
Panola			2			150	15,103	15,253
Polk			1					
Robertson	1			1				
Rusk	2			2			3,000	3,000
Shackelford		1	4		1		3,000	3,000
Shelby			2				5,800	5,800
Stephens			2					
Tarrant	1				1		12,000	12,000
Titus			2					
Tyler			4			640		640
Wichita	378	408	27	26	760	5,319	348,700	354,019
Wilbarger			2			960	16,902	17,862
Wilson			1				767	767
Wise			6				20,000	20,000
Wood			3			160	3,000	3,160
Young			2				223	223
Total	3,084	877	299	419	3,542	61,388	628,703	690,091

Summary of wells drilled in 1913 and 1914, by counties—Continued.

TEXAS—Continued.

1914.

County.	Wells.					Acreage.		
	Productive Jan. 1.	Completed. Oil.	Completed. Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Archer	1	3	1		4	8	6,736	6,744
Atascosa	4		1	4			20,000	20,000
Bexar	3	3		3	3	2,227	100	2,327
Brewster	2				2	1		1
Brown	5	2	4	2	5	3,001	9,500	12,501
Clay	301	63	17	41	323	5,968	13,531	19,499
Coleman	1				1	2,200	19,009	21,209
Comanche			2				6,000	6,000
Cottle			1				3,500	3,500
Delta	1			1				
Duval	1				1		800	800
Ellis			1			200	200	400
Erath			15			1,000		1,000
Foard			1					
Freestone	2		8	2			2,250	2,250
Gonzales			5				12,397	12,397
Grayson			2			160	5,600	5,760
Hardin	926	149	42	71	1,004	4,120	4,691	8,811
Harris	437	44	18	121	360	5,032	8,742	13,774
Hardeman			1				10,000	10,000
Haskell			2			675	1,676	2,351
Hill			2			80	80	160
Hopkins			2				3,700	3,700
Jack	16	44	11	2	58		5,370	5,370
Jefferson	106	10	5	23	93	15	2,199	2,214
Jones			1			20	8,000	8,020
Kaufman			2				1,750	1,750
Kent			1			2,000		2,000
Liberty	6	1	3	3	4	983	3,325	4,308
Limestone			3				7,500	7,500
McCulloch			1				1,126	1,126
McLennan	11	1			12		320	320
McMullen	20	2			22		7,000	7,000
Madison			1				7,000	7,000
Marion	24	10	6		34	3,101	9,043	12,144
Matagorda	39	1	3	7	33	577	1,119	1,696
Milam			1				500	500
Montgomery			1				300	300
Nacogdoches	2	1	1	1	2	231	2,000	2,231
Navarro	871	29	15	44	856	145	16,866	17,011
Nueces			1			25	1,100	1,125
Orange	1		10		1		770	770
Panola			1			6,000	80	6,080
Red River			1				28,000	28,000
Reeves			1			5,695	2,500	8,195
San Patricio			1			19	2,514	2,533
Shackelford	1	5	3		6	177,332		177,332
Tarrant	1		4	1		160	5,000	5,160
Tyler			1				646	646
Titus			1			60	10,000	10,060
Wichita	760	285	103	20	1,025	5,203	326,978	332,181
Wilbarger		3	3	1	2	240	6,950	7,190
Total	3,542	656	310	347	3,851	226,478	586,468	812,946

Summary of wells drilled in 1913 and 1914, by counties—Continued.

LOUISIANA.

Parish.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
1913.								
Acadia	107	20	3	45	82	791	3,186	3,977
Bossier			2			1,200	2,096	3,296
Caddo	586	297	34	69	814	48,817	344,901	393,718
Calcasieu	71	30	12	21	80	464	6,008	6,472
Cameron			2				40	40
De Soto		5			5		23,295	23,295
Evangeline	1		3	1		4,000	1,224	5,224
Jefferson Davis	2	1	2		3		1,455	1,455
Rapides			1				301	301
Sabine			1			220	6,784	7,004
St. Martins	13	2		13	2	2	25	27
St. Tammany			1				1,200	1,200
Terrebonne			3			800	20,037	20,837
Total	780	355	64	149	986	56,294	410,552	466,846
1914.								
Acadia	82	13	2	25	70	802	1,712	2,514
Caddo	814	186	44	86	914	16,990	214,074	231,064
Calcasieu	80	25	16	14	91	304	74,116	74,420
Cameron			1				40	40
Catahoula			4				5,600	5,600
De Sota	5	81	31	8	78	289	98,294	98,583
Jefferson Davis	3	5	3	2	6	91	339	430
Rapides			3				295	295
Red River		10	2		10		36,190	36,190
Sabine		1	1		1	196	28,013	28,209
St. Martins	2	6		2	6	54	43	97
Terrebonne			1					
Vermilion			1				2,700	2,700
Winn			1				30,000	30,000
Total	986	327	110	137	1,176	18,726	491,416	510,142

PIPE-LINE STATISTICS.

Under this heading are included statistics furnished by pipe-line and other transporting agencies, with which are incorporated, whereever appropriate and without differentiation, supplemental data, including statistics of fuel consumed in field operations and statistics of local sales of crude petroleum by producers, concerning which the transportation companies would have no record.

APPALACHIAN OIL FIELD.

GENERAL STATEMENT.

The Appalachian field embraces all oil pools east of central Ohio and north of central Alabama, including those of New York, Pennsylvania, West Virginia, southeastern Ohio, Kentucky, Tennessee, and northern Alabama.

MARKETED PRODUCTION.

In 1914 the Appalachian field recorded a decrease of 7 per cent in its output, a decrease due almost entirely to the notable falling off in the contribution of West Virginia. The total marketed production in the field in 1914 was 24,101,048 barrels. The value of this production was $45,239,201, or an average of $1.88 a barrel. This field, which yielded the entire petroleum output of the United States from 1859 to 1875, inclusive, and more than half of the country's output from the latter year to 1900, inclusive, contributed only a little more than 9 per cent of the marketed production in 1914.

Marketed production of the Appalachian oil field, by States and months, 1913–1914, in barrels.

1913.

Month.	Pennsylvania.	New York.	Southeastern Ohio.	West Virginia.	Kentucky.	Total.
January	669,134	80,906	407,538	978,401	42,074	2,178,053
February	577,763	66,969	364,307	936,733	36,843	1,982,615
March	637,250	74,592	324,699	970,900	39,391	2,046,832
April	703,829	82,580	456,072	1,026,129	39,036	2,307,646
May	700,585	83,742	420,757	1,003,425	42,932	2,251,441
June	661,542	77,819	414,698	995,098	39,285	2,188,442
July	688,055	83,237	424,588	1,009,383	48,211	2,253,474
August	653,090	78,005	410,459	939,479	49,908	2,130,941
September	651,046	78,594	425,023	928,610	52,538	2,135,811
October	693,996	84,480	456,364	956,772	46,301	2,237,913
November	609,033	74,437	406,018	839,274	44,137	1,972,899
December	671,979	82,830	453,902	983,095	43,912	2,235,718
Total	7,917,302	948,191	4,964,425	11,567,299	524,568	25,921,785

1914.

Month.	Pennsylvania.	New York.	Southeastern Ohio.	West Virginia.	Kentucky.	Total.
January	677,284	78,983	444,426	855,886	46,930	2,103,509
February	532,826	62,424	363,537	770,300	44,545	1,773,632
March	726,605	80,660	464,675	919,377	53,860	2,245,177
April	782,378	88,268	448,909	900,998	50,465	2,271,018
May	701,685	84,548	436,266	864,519	44,903	2,131,921
June	724,172	84,110	428,753	872,074	44,361	2,153,470
July	731,080	84,783	456,139	897,065	42,630	2,211,697
August	646,412	75,512	195,617	272,098	26,758	1,216,397
September	688,761	76,102	299,372	675,518	21,177	1,760,930
October	704,024	81,569	507,031	985,724	51,625	2,329,973
November	614,126	71,593	373,117	799,728	36,900	1,895,464
December	640,982	70,422	391,423	866,746	38,287	2,007,860
Total	8,170,335	938,974	4,809,265	9,680,033	502,441	24,101,048

The following table shows, by years, the quantity of petroleum marketed from the Appalachian field from 1859 to 1914, inclusive:

Marketed production of petroleum in the Appalachian field, 1859–1914, by years, in barrels.

Year.	Quantity.	Percentage of total production.	Increase or decrease.	Percentage of increase or decrease.	Value.	Yearly average price per barrel.
1859	2,000	100			$32,000	$16.000
1860	500,000	100	+ 498,000	+24,900.00	4,800,000	9.590
1861	2,113,609	100	+1,613,609	+ 322.72	1,035,668	.490
1862	3,056,690	100	+ 943,081	+ 44.62	3,209,525	1.050
1863	2,611,309	100	− 445,381	− 14.57	8,225,663	3.150
1864	2,116,109	100	− 495,200	− 18.96	20,896,576	8.060
1865	2,497,700	100	+ 381,591	+ 18.03	16,459,853	6.590
1866	3,597,700	100	+1,100,000	+ 44.04	13,455,398	3.740
1867	3,347,300	100	− 250,400	− 6.96	8,066,993	2.410
1868	3,646,117	100	+ 298,817	+ 8.93	13,217,174	3.625
1869	4,215,000	100	+ 568,883	+ 15.60	23,730,450	5.638
1870	5,260,745	100	+1,045,745	+ 24.81	20,503,754	3.860
1871	5,205,234	100	− 55,511	− 1.06	22,591,180	4.340
1872	6,293,194	100	+1,087,960	+ 20.90	21,440,503	3.640
1873	9,893,786	100	+3,600,592	+ 57.21	18,100,464	1.830
1874	10,926,945	100	+1,033,159	+ 10.44	12,647,527	1.170
1875	8,787,514	100	−2,139,431	− 19.58	7,368,133	1.350
1876	9,120,669	99.87	+ 333,155	+ 3.79	22,952,822	2.563
1877	13,337,363	99.90	+4,216,694	+ 46.23	31,756,066	2.420
1878	15,381,641	99.90	+2,044,278	+ 15.33	18,009,346	1.190
1879	19,894,288	99.90	+4,512,647	+ 29.34	17,164,836	.859
1880	26,245,571	99.85	+6,351,283	+ 31.93	24,506,963	.945
1881	27,561,376	99.64	+1,315,805	+ 5.01	23,281,324	.859
1882	30,221,261	99.58	+2,659,885	+ 9.65	23,334,016	.781
1883	23,306,776	99.39	−6,914,485	− 22.88	25,410,252	1.059
1884	23,956,438	98.92	+ 649,662	+ 2.79	19,871,704	.835
1885	21,533,785	98.51	−2,422,653	− 10.11	18,442,944	.879
1886	26,549,827	94.60	+5,016,042	+ 23.29	18 714,054	.713
1887	22,878,241	80.90	−3,671,586	− 13.83	16,259,483	.668
1888	16,941,397	61.36	−5,936,844	− 25.95	14,839,434	.876
1889	22,355,225	63.57	+5,413,828	+ 31.96	24,485,407	.941
1890	30,066,560	65.61	+7,711,335	+ 34.50	30,121,968	.868
1891	35,848,777	66.03	+5,782,217	+ 19.23	24,219,863	.670
1892	33,432,377	66.19	−2,416,400	− 6.74	18,830,773	.556
1893	31,365,890	64.76	−2,066,487	− 6.18	20,327,232	.640
1894	30,783,424	62.38	− 582,466	− 1.86	26,030,125	.839
1895	30,960,639	58.54	+ 177,215	+ .58	42,206,898	1.359
1896	33,971,902	55.73	+3,011,263	+ 9.73	40,203,418	1.179
1897	35,230,271	58.25	+1,258,369	+ 3.70	27,877,213	.786
1898	31,717,425	57.29	−3,512,846	− 9.97	29,096,057	.911
1899	33,068,356	57.94	+1,350,931	+ 4.26	43,041,677	1.294
1900	36,295,433	57.05	+3,227,077	+ 9.76	49,235,298	1.353
1901	33,618,171	48.45	−2,677,262	− 7.38	40,796,827	1.210
1902	32,018,787	36.07	−1,599,384	− 4.76	40,451,593	1.238
1903	31,558,248	31.41	− 460,539	− 1.44	49,905,813	1.590
1904	31,408,567	26.83	− 149,681	− .47	50,598,184	1.628
1905	29,366,960	21.80	−2,041,607	− 6.50	40,279,635	1.394
1906	27,741,472	21.93	−1,625,488	− 5.54	43,633,601	1.598
1907	25,342,137	15.26	−2,399,335	− 8.65	43,766,686	1.745
1908	24,945,517	13.97	− 396,620	− 1.57	43,888,020	1.780
1909	26,535,844	14.49	+1,590,327	+ 6.38	43,237,233	1.646
1910	26,892,579	12.83	+ 356,735	+ 1.33	35,841,749	1.336
1911	23,749,832	10.77	−3,142,747	− 11.37	30,830,354	1.308
1912	26,338,516	11.81	+2,588,684	+ 10.90	42,818,384	1.626
1913	25,921,785	10.43	− 416,731	− 1.58	63,708,981	2.458
1914	24,101,048	9.07	−1,820,737	− 7.02	45,239,201	1.877
Total	1,125,635,327	33.75			1,480,996,295	1.316

Marketed production of petroleum in the Appalachian field in 1913 and 1914, by States, showing increase or decrease and percentage of increase or decrease, in barrels.

State.	Production.		Increase.	Decrease.	Percentage.	
	1913	1914			Increase.	Decrease.
Pennsylvania	7,917,302	8,170,335	253,033		3.20	
New York	948,191	938,974		9,217		0.97
Southeastern Ohio	4,964,425	4,809,265		155,160		3.13
West Virginia	11,567,299	9,680,033		1,887,266		16.32
Kentucky	524,568	502,441		22,127		4.22
Total	25,921,785	24,101,048		1,820,737		7.02

Marketed production, value, and average price per barrel of petroleum in the Appalachian field, 1905–1914, by States, in barrels.

Year.	Pennsylvania.			New York.			Southeastern Ohio.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905	10,437,195	$14,653,278	$1.404	1,117,582	$1,557,630	$1.393	5,016,736	$6,992,885	$1.393
1906	10,256,893	16,596,943	1.618	1,243,517	1,995,377	1.605	4,906,579	7,839,359	1.597
1907	9,999,306	17,579,706	1.758	1,212,300	2,127,748	1.755	4,214,391	7,344,408	1.742
1908	9,424,325	16,881,194	1.791	1,160,128	2,071,533	1.786	4,110,121	7,316,617	1.780
1909	9,299,403	15,424,554	1.658	1,134,897	1,878,217	1.655	4,717,436	7,773,880	1.648
1910	8,794,662	11,908,914	1.354	1,053,838	1,414,668	1.342	4,822,234	6,469,939	1.342
1911	8,248,158	10,894,074	1.321	952,515	1,248,950	1.311	4,281,237	5,591,423	1.306
1912	7,837,948	12,886,752	1.644	874,128	1,401,880	1.604	5,013,110	8,177,189	1.631
1913	7,917,302	19,690,502	2.487	948,191	2,284,307	2.409	4,964,425	12,229,610	2.463
1914	8,170,335	15,573,822	1.906	938,974	1,760,868	1.875	4,809,265	8,937,415	1.858

Year.	West Virginia.			Kentucky-Tennessee.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905	11,578,110	$16,132,631	$1.393	1,217,337	$943,211	$0.775	29,366,960	$40,279,635	$1.371
1906	10,120,935	16,170,293	1.005	1,213,548	1,031,629	.850	27,741,472	43,633,601	1.573
1907	9,095,296	15,852,428	1.743	820,344	862,396	1.051	25,342,137	43,766,686	1.729
1908	9,523,176	16,911,865	1.776	[a] 727,767	706,811	.971	24,945,517	43,888,020	1.759
1909	10,745,092	17,642,283	1.642	[a] 639,016	518,299	.811	26,535,844	43,237,233	1.629
1910	11,753,071	15,723,544	1.338	[a] 468,774	324,684	.692	26,892,579	35,841,749	1.332
1911	9,795,464	12,767,293	1.303	[a] 472,458	328,614	.695	23,749,832	30,830,354	1.298
1912	12,128,962	19,927,721	1.643	[a] 484,368	424,842	.877	26,338,516	42,818,384	1.625
1913	11,567,299	28,828,814	2.492	[a] 524,568	675,748	1.288	25,921,785	63,708,981	2.458
1914	9,680,033	18,468,540	1.908	[a] 502,441	498,556	.992	24,101,048	45,239,201	1.877

[a] No production in Tennessee recorded.

In the following table is recorded by months the marketed production of petroleum in the Appalachian field for the last five years:

Marketed production of petroleum in the Appalachian oil field, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	2,274,236	1,974,600	1,694,048	2,178,053	2,103,509
February	2,019,229	1,884,336	1,834,665	1,982,615	1,773,632
March	2,494,868	2,097,333	2,227,769	2,046,832	2,245,177
April	2,296,566	1,974,035	2,276,208	2,307,646	2,271,018
May	2,349,595	2,162,836	2,462,881	2,251,441	2,131,921
June	2,382,097	2,031,071	2,360,533	2,188,442	2,153,470
July	2,239,118	1,914,966	2,413,806	2,253,474	2,211,697
August	2,325,953	2,033,142	2,442,319	2,130,941	1,216,397
September	2,208,040	1,907,771	2,133,327	2,135,811	1,760,930
October	2,148,205	1,964,172	2,253,291	2,237,913	2,329,973
November	2,046,835	1,834,182	2,033,801	1,972,899	1,895,464
December	2,107,837	1,971,408	2,205,868	2,235,718	2,007,860
Total	26,892,579	23,749,832	26,338,516	25,921,785	24,101,048

The following table records by months the average daily output of petroleum in the Appalachian field for the last five years:

Average daily output of petroleum in the Appalachian oil field, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	73,362	63,697	54,647	70,260	67,855
February	72,115	67,298	63,264	70,808	63,344
March	80,480	67,656	71,864	66,027	72,425
April	76,552	65,801	74,259	76,921	75,701
May	75,793	69,769	82,029	72,627	68,772
June	79,403	67,702	76,684	72,948	71,782
July	72,230	61,773	77,865	72,693	71,345
August	75,031	65,585	78,784	68,740	39,239
September	73,601	63,592	71,111	71,194	58,698
October	69,297	63,360	72,687	72,191	75,160
November	68,228	61,139	67,793	75,763	63,182
December	67,995	63,594	71,157	72,120	64,770
Average	73,678	65,068	71,963	71,024	66,030

RUNS, STOCKS, AND DELIVERIES.

RUNS.

In the following tables are given the runs of Appalachian oil made by the principal pipe lines in the Appalachian fields in 1913 and 1914, together with the stocks of oil at the close of each month:

Pipe-line runs of Appalachian oil in 1913, by lines and months, in barrels.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	New York Transit.	Tidewater.
January	232,522	112,656	912,474	41,982	16,490	108,701
February	185,868	99,833	873,681	36,751	14,017	91,662
March	215,895	110,962	906,441	39,194	14,867	100,991
April	255,401	116,693	958,267	38,795	17,440	109,987
May	241,235	119,006	933,113	42,716	17,453	109,932
June	227,623	111,617	929,857	39,069	15,668	104,516
July	236,553	114,617	942,294	48,119	17,494	111,650
August	218,931	112,786	873,104	49,766	15,939	105,442
September	226,499	109,337	866,056	52,328	16,294	104,504
October	238,832	117,589	889,954	46,082	18,129	109,926
November	207,024	99,321	771,387	43,929	15,894	98,493
December	221,142	116,100	907,714	43,822	16,825	111,445
Total	2,707,525	1,340,517	10,764,342	522,553	196,510	1,267,249

Month.	Producers and Refiners.	Emery.	Buckeye Macksburg.	Franklin.	Other lines.	Total.
January	212,519	27,208	289,530	3,002	220,969	2,178,053
February	191,944	23,855	256,638	2,349	206,017	1,982,615
March	190,278	25,880	224,756	3,023	214,545	2,046,832
April	207,788	29,156	342,599	3,423	228,097	2,307,646
May	219,848	28,536	306,088	3,106	234,108	2,251,441
June	198,268	27,890	306,680	3,158	224,095	2,188,442
July	197,774	29,586	313,968	3,402	238,017	2,253,474
August	197,462	29,450	297,418	2,861	227,782	2,130,941
September	201,008	28,269	302,820	3,155	225,441	2,135,811
October	214,376	29,587	324,425	3,196	245,817	2,237,913
November	198,023	26,756	281,991	2,890	227,191	1,972,899
December	221,843	29,762	313,049	3,396	250,620	2,235,718
Total	2,451,131	335,935	3,559,962	36,961	2,739,100	25,921,785

Pipe-line runs of Appalachian oil in 1914, by lines and months, in barrels.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	New York Transit.	Tidewater.
January	221,853	112,692	792,025	45,091	17,411	105,207
February	169,817	91,767	716,046	42,737	13,645	84,593
March	242,875	121,903	855,596	52,135	17,365	112,549
April	268,840	122,671	836,707	48,555	19,140	122,902
May	233,442	123,342	805,100	43,018	18,521	115,585
June	244,053	122,384	814,366	42,464	18,215	116,619
July	242,813	126,259	832,107	40,698	18,125	118,370
August	226,878	116,372	233,037	24,985	17,773	98,065
September	227,084	116,875	621,755	19,249	15,671	117,830
October	239,048	119,033	921,542	49,494	17,398	116,267
November	200,170	101,975	746,688	34,960	15,359	102,393
December	205,645	109,846	811,632	36,224	15,234	105,624
Total	2,722,518	1,385,119	8,986,601	479,610	203,857	1,316,004

Pipe-line runs of Appalachian oil in 1914, by lines and months, in barrels—Continued.

Month.	Producers and Refiners.	Emery.	Buckeye Macksburg.	Franklin.	Other lines.	Total.
January	211,056	28,883	312,343	2,869	254,079	2,103,509
February	174,701	24,667	250,718	1,409	203,532	1,773,632
March	218,802	29,900	333,010	3,868	257,174	2,245,177
April	218,754	33,892	319,231	4,046	276,280	2,271,018
May	199,085	30,002	312,580	2,916	248,330	2,131,921
June	186,741	30,839	317,154	3,191	257,444	2,153,470
July	212,253	32,474	328,286	3,692	256,620	2,211,697
August	124,627	29,317	124,196	2,791	218,356	1,216,397
September	166,329	30,435	206,858	3,405	235,439	1,760,930
October	205,548	30,211	379,182	2,702	249,548	2,329,973
November	174,871	26,652	268,374	3,652	220,370	1,895,464
December	178,871	29,991	282,329	2,302	230,162	2,007,860
Total	2,271,638	357,263	3,434,261	36,843	2,907,334	24,101,048

STOCKS.

Stocks held by eastern[a] *pipe lines and refineries in the Appalachian field at close of each month in 1913 and 1914, in barrels.*

1913.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	Southern.	Crescent.
January	908,334	584,821	1,516,769	130,015	542,471	70,940
February	819,841	538,377	1,672,659	127,827	482,092	63,470
March	911,573	590,253	1,425,056	134,667	528,003	54,488
April	948,189	585,328	1,465,267	119,553	554,293	69,650
May	1,016,316	614,375	1,597,633	90,505	574,943	66,310
June	1,026,373	598,138	1,423,023	69,450	619,540	84,902
July	1,016,054	713,190	1,621,131	61,753	509,805	144,145
August	1,021,246	931,360	1,567,997	74,766	621,581	152,734
September	1,062,998	884,470	1,619,751	82,315	693,024	145,609
October	1,084,617	822,227	1,562,704	93,425	750,172	149,980
November	1,066,294	742,656	1,349,754	96,980	760,959	126,903
December	995,843	688,801	1,596,501	85,107	681,649	62,409

Month.	New York Transit.	Tidewater.	Northern.	Producers and Refiners.	Emery.	Buckeye Macksburg.
January	982,526	236,694	764,454	280,289	25,897	386,633
February	1,093,300	277,971	650,356	275,146	18,127	402,421
March	914,520	244,941	599 164	272 637	14 818	411,354
April	738.626	254,972	768,128	283,399	16,581	378,585
May	698,219	231,215	635,819	271,770	17,305	329,778
June	673,314	230,944	535,306	284,821	16,596	396,723
July	643,068	219,944	675,394	287,528	16,896	402,789
August	641,373	272,061	592,229	276,350	19,826	363,288
September	740,480	247,887	635,902	297,120	16,595	348,266
October	883,814	261,607	739,086	328,447	18,628	347,057
November	762,718	244,798	583,978	333,598	18,354	351,262
December	710,769	330,265	595,555	359,730	16,789	369,687

Month.	Buckeye Lima.	Indiana.	Franklin.	Other lines.	Total.
January	2,984,167	976,297	46,815	134,732	10,571,854
February	3,093,215	909,049	45,783	105,062	10,574,696
March	3,297,015	849,428	48,806	114,621	10,411,344
April	3,316,909	809,724	49,583	126,167	10,484,954
May	2,980,576	794,842	52,689	138,559	10,110,854
June	3,218,981	844,830	55,846	152,368	10,231,155
July	2,871,264	798,754	59,249	166,498	10,207,462
August	2,817,825	867,482	62,110	156,857	10,439,085
September	2,728,819	818,690	65,019	173,455	10,560,402
October	2,362,961	912,670	63,683	141,630	10,522,708
November	2,208,108	956,283	55,478	164,070	9,822,193
December	2,177,747	965,099	58,391	196,321	9,890,658

[a] These pipe lines connect with the delivering lines of the 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[a] pipe lines and refineries in the Appalachian field at close of each month in 1913 and 1914, in barrels—Continued.

1914.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	Southern.	Crescent.
January	1,127,661	733,347	1,486,059	65,572	731,646	83,930
February	1,135,148	657,483	1,536,586	74,720	606,027	108,811
March	1,164,164	637,841	1,691,961	82,080	757,806	139,831
April	1,208,151	745,112	1,957,151	111,186	738,647	139,456
May	1,198,170	822,172	2,139,878	136,924	910,047	178,143
June	1,196,361	987,685	2,215,571	184,973	1,012,470	158,723
July	1,132,875	808,226	2,349,260	188,118	865,384	145,395
August	1,221,133	841,382	2,112,931	190,208	930,281	168,439
September	1,128,972	749,656	1,993,544	198,249	813,883	165,545
October	943,637	653,555	1,910,074	199,644	913,368	158,330
November	904,971	679,807	1,697,302	189,306	819,551	102,805
December	956,538	780,698	1,783,682	172,375	710,731	73,963

Month.	New York Transit.	Tidewater.	Northern.	Producers and Refiners.	Emery.	Buckeye Macksburg.
January	762,818	309,750	615,170	367,418	17,432	389,586
February	810,724	312,048	663,242	372,895	15,938	411,145
March	847,049	327,103	734,934	438,892	16,217	436,541
April	854,826	373,713	733,333	520,403	9,192	467,133
May	933,594	375,755	512,891	568,197	9,576	458,039
June	1,247,617	381,435	568,461	599,024	9,336	539,000
July	1,589,268	405,547	684,972	672,950	11,409	541,162
August	1,518,780	373,631	944,625	675,924	15,784	637,202
September	1,019,070	428,347	614,455	652,097	21,497	607,923
October	791,470	415,876	576,769	648,443	11,743	587,305
November	826,876	391,144	598,528	671,612	12,025	624,794
December	743,821	335,601	553,937	694,855	13,282	655,476

Month.	Buckeye Lima.	Indiana.	Franklin.	Other lines.	Total.
January	2,197,467	874,459	51,842	679,347	10,493,504
February	2,269,440	875,452	46,231	672,744	10,568,634
March	1,975,677	935,761	47,036	699,887	10,932,780
April	1,986,567	887,902	51,082	736,003	11,519,857
May	2,091,565	980,194	53,998	704,137	12,073,280
June	2,108,760	979,504	57,189	727,216	12,973,325
July	2,188,854	964,662	60,881	684,975	13,293,938
August	2,055,083	989,535	63,182	679,536	13,417,656
September	2,213,788	1,048,003	66,098	660,226	12,381,353
October	2,228,181	1,092,504	64,443	640,221	11,835,563
November	1,983,571	1,129,443	68,091	614,454	11,314,280
December	1,830,616	1,176,566	65,353	615,574	11,163,068

[a] These pipe lines connect with the delivering lines of the 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 of all grades of petroleum held by eastern[a] pipe lines and refineries in the Appalachian field at close of each month in 1913 and 1914, in barrels.

1913.

Month.	Pennsylvania.[b]	Lima.	Illinois.	Kentucky.	Mid-Continent.	Total.
Dec. 31, 1912	3,804,483	2,297,861	2,368,271	226,035	2,034,695	10,731,345
January	3,936,422	2,338,451	1,908,683	262,970	2,125,328	10,571,854
February	4,102,809	2,239,049	1,866,847	214,398	2,151,593	10,574,696
March	4,126,030	2,132,306	1,744,862	249,358	2,158,788	10,411,344
April	4,166,479	2,229,721	1,559,509	224,365	2,304,880	10,484,954
May	4,203,768	2,045,213	1,544,526	230,079	2,087,268	10,110,854
June	4,121,276	1,955,272	1,903,773	127,941	2,122,893	10,231,155
July	4,184,097	2,031,608	1,792,585	184,862	2,014,310	10,207,462
August	4,249,284	1,943,838	2,068,928	147,891	2,029,144	10,439,085
September	4,484,194	2,026,513	1,638,927	191,487	2,219,279	10,560,400
October	4,552,557	1,778,509	1,680,136	211,477	2,300,029	10,522,708
November	4,373,575	1,645,457	1,093,294	192,177	2,517,690	9,822,193
December	4,387,718	1,623,461	1,079,468	230,706	2,569,305	9,890,658

1914.

Month.	Pennsylvania.[b]	Lima.	Illinois.	Kentucky.	Mid-Continent.	Total.
January	4,482,439	1,831,827	1,456,253	232,090	2,490,895	10,493,504
February	4,470,816	1,881,800	1,419,369	225,872	2,570,777	10,568,634
March	4,941,110	1,718,887	1,487,104	177,760	2,607,919	10,932,780
April	5,646,948	1,759,829	1,165,935	249,564	2,697,581	11,519,857
May	5,949,379	1,714,716	1,161,763	208,713	3,038,709	12,073,280
June	6,428,702	1,818,457	1,015,977	273,525	3,436,664	12,973,325
July	6,550,281	1,833,687	974,675	309,762	3,625,533	13,293,938
August	6,454,886	1,884,896	992,796	327,891	3,757,187	13,417,656
September	6,063,005	1,919,635	928,276	345,504	3,124,933	12,381,353
October	5,721,833	1,889,850	864,867	398,642	2,960,371	11,835,563
November	5,445,718	1,762,658	824,571	336,951	2,944,382	11,314,280
December	5,436,576	1,648,615	1,016,937	288,119	2,772,821	11,163,068

[a] These pipe lines connect with the delivering lines of the 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.

DELIVERIES TO TRADE.

Pipe-line runs and deliveries to trade of petroleum from the Appalachian field, by months, in barrels, in 1913 and 1914, and stocks at end of each month.

	1913			1914		
	Runs.	Deliveries.	Stocks.	Runs.	Deliveries.	Stocks.
Dec. 31, 1912			4,030,518			
January	2,178,053	2,009,179	4,199,392	2,103,509	2,239,494	4,482,439
February	1,982,615	1,864,800	4,317,207	1,773,632	1,785,255	4,470,816
March	2,046,832	1,988,651	4,375,388	2,245,177	1,774,883	4,941,110
April	2,307,646	2,292,190	4,390,844	2,271,018	1,565,180	5,646,948
May	2,251,441	2,208,438	4,433,847	2,131,921	1,829,490	5,949,379
June	2,188,442	2,373,072	4,249,217	2,153,470	1,674,147	6,428,702
July	2,253,474	2,133,732	4,368,959	2,211,697	2,090,118	6,550,281
August	2,130,941	2,102,725	4,397,175	1,216,397	1,311,792	6,454,886
September	2,135,811	1,857,305	4,675,681	1,760,930	2,152,811	6,063,005
October	2,237,913	2,149,560	4,764,034	2,329,973	2,671,145	5,721,833
November	1,972,899	2,171,181	4,565,752	1,895,464	2,171,579	5,445,718
December	2,235,718	2,183,046	4,618,424	2,007,860	2,017,002	5,436,576
Total	25,921,785	25,333,879		24,101,048	23,282,896	

Pipe-line deliveries to trade of eastern[a] pipe lines in 1913 and 1914, by lines and months, in barrels.

1913.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	Southern.	Crescent.
January	1,552,099	1,130,864	1,877,513	5,645	560,684	153,530
February	1,248,553	806,234	1,346,751	4,070	512,211	139,194
March	1,366,476	934,991	1,778,912	5,138	477,243	138,710
April	1,569,347	1,056,217	1,822,396	4,253	458,974	111,072
May	1,523,498	995,079	1,651,699	6,731	516,293	158,982
June	1,724,225	990,236	1,888,633	6,546	491,629	132,085
July	1,659,852	1,222,957	1,763,218	6,340	400,655	95,570
August	1,686,383	1,241,033	1,997,891	6,309	455,691	148,123
September	1,536,042	1,088,071	1,761,384	6,035	404,676	147,776
October	1,801,939	1,185,241	1,914,394	2,016	323,350	142,436
November	1,671,363	1,031,435	1,812,578	2,128	418,888	108,325
December	1,478,092	1,013,789	1,510,240	3,112	489,590	116,927
Total	18,817,869	12,696,147	21,125,609	58,323	5,509,884	1,592,730

Month.	New York Transit.	Tidewater.	Producers and Refiners.	Emery.	Buckeye Macksburg.	Franklin.
January	1,035,053	146,819	207,150	24,876	7,854	6,768
February	1,233,939	104,704	197,087	31,625	6,586	3,381
March	1,028,170	181,633	192,734	29,190	7,226	....
April	1,281,569	168,434	196,702	27,393	51	2,646
May	1,484,141	166,865	220,831	27,812	721	....
June	1,352,281	159,029	185,241	28,241	1,270	....
July	1,328,813	185,651	195,068	29,286	242	....
August	1,396,158	99,260	208,614	26,519	11	....
September	1,151,096	179,971	180,236	31,500	242	246
October	1,269,135	161,263	183,004	27,554	....	4,531
November	1,332,253	157,635	192,917	27,030	....	11,095
December	1,027,792	79,786	195,711	31,327	....	482
Total	14,920,400	1,791,050	2,353,981	342,353	24,203	29,149

[a] These pipe lines connect with the delivering lines of the 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.

Pipe-line deliveries to trade of eastern[a] *pipe lines in 1913 and 1914, by lines and months, in barrels*—Continued.

1914.

Month.	National Transit.	Southwest Pennsylvania.	Eureka.	Cumberland.	Southern.	Crescent.
January	1,199,081	109,880	69,565	1,098	548,833	130,246
February	1,048,592	107,945	59,711	2,681	326,174	97,343
March	1,198,689	130,730	72,932	3,510	207,704	....
April	1,098,369	105,220	65,432	3,090	139,499	26,198
May	969,837	124,084	70,950	6,972	189,326	104,181
June	1,262,292	158,812	62,081	6,497	55,341	171,481
July	1,262,047	128,188	80,832	4,016	108,181	178,003
August	651,395	93,761	81,637	3,033	8,966	....
September	847,135	132,379	80,716	1,386	345,708	39,138
October	566,846	155,135	80,217	6,950	429,386	138,603
November	361,781	138,419	70,460	423	318,985	178,267
December	371,276	125,604	78,851	1,643	359,885	181,474
Total	10,837,340	1,510,157	873,384	41,299	3,037,988	1,244,934

Month.	New York Transit.	Tidewater.	Producers and Refiners.	Emery.	Buckeye Mocksburg.	Franklin.
January	996,759	168,411	197,947	28,241	....	9,419
February	984,701	152,732	169,331	26,160	....	7,019
March	1,241,650	152,348	158,119	29,622	....	3,104
April	1,162,945	154,178	137,373	40,926	....	....
May	1,078,402	141,701	153,562	29,609	244	....
June	704,942	152,754	154,851	31,078	....	....
July	785,606	139,505	135,655	30,402	1,689	....
August	392,457	145,725	117,788	24,942	....	489
September	844,232	93,840	191,785	24,721	....	489
October	1,103,741	200,361	213,860	39,965	....	4,357
November	623,827	242,728	261,373	26,371	....	4
December	312,654	182,892	154,163	28,734	....	5,040
Total	10,231,916	1,927,175	2,045,807	360,771	1,933	29,921

[a] These pipe lines connect with the delivery lines of the 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 oil in the Appalachian field in 1912, 1913, and 1914:

Range of prices paid at wells by the Seep Purchasing Agency for petroleum produced in the New York, southeastern Ohio, Pennsylvania, West Virginia, and Kentucky oil regions during 1912, 1913, and 1914, per barrel of 42 gallons.

Date.	Pennsylvania and Tiona, Pa.	Mercer black, Pennsylvania.	Corning, Ohio.	New Castle, Ohio.	Wooster, Ohio.	Cabell, W. Va.	Somerset, Ky. (light).	Ragland, Ky. (heavy).
1912								
Jan. 1	$1.35	$0.92	$0.82	$0.89		$0.99	$0.79	$0.48
Jan. 8	1.40	.97	.87	.94		1.04		
Jan. 22	1.45	1.02	.92	.99		1.09	.81	
Jan. 29	1.50	1.05	.95	1.02		1.12	.83	
Apr. 19	1.55	1.08	.98	1.05		1.15	.86	.50
May					$1.02			
June 5	1.60	1.13	1.03	1.10		1.20	.91	.53
June 15			1.13	1.13				
July 12					1.13			
Oct. 28					1.16			
Oct. 29	1.65	1.18	1.18	1.18		1.25	.96	.56
Nov. 8	1.70	1.23	1.23	1.23		1.30	1.00	.60
Nov. 9					1.18			
Nov. 14	1.75	1.28	1.28	1.28		1.35	1.05	.65
Nov. 15					1.23			
Nov. 18	1.80	1.33	1.33	1.33		1.40	1.07	
Nov. 23	1.85	1.38	1.38	1.38		1.45	1.10	
Nov. 25					1.28			
Dec. 2	1.90	1.43	1.43	1.43	1.33	1.50		
Dec. 9	1.95	1.48	1.48	1.48	1.38	1.55	1.12	
Dec. 14	2.00	1.53	1.53	1.53	1.43	1.60	1.15	
Dec. 16					1.53			
1913								
Jan. 1	2.00	1.53	1.53	1.53	1.53	1.60	1.15	.65
Jan. 6	2.05	1.58	1.58	1.58		1.65	1.20	.68
Jan. 7					1.58			
Jan. 27	2.12	1.65	1.65	1.65	1.65	1.72	1.25	
Jan. 28	2.19	1.72	1.72	1.72		1.79	1.30	
Jan. 29	2.26	1.79	1.79	1.79	1.72	1.86	1.32	.70
Jan. 30	2.33	1.86	1.86	1.86	1.79	1.93		
Jan. 31					1.86			
Feb. 1	2.40	1.93	1.93	1.93		2.00		
Feb. 4	2.47	2.00	2.00	2.00		2.07	1.35	
Feb. 5	2.50							
Apr. 15					1.91			
1914								
Jan. 1	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
Apr. 17	2.40	1.90	1.75	1.90		1.97		
Apr. 18					1.81			
Apr. 20	2.30	1.80	1.50	1.80		1.87	1.30	
Apr. 22	2.20	1.70	1.35	1.70		1.77	1.25	.65
Apr. 25					1.71			
Apr. 27	2.10	1.60	1.25	1.60		1.67	1.20	
Apr. 28					1.61			
Apr. 29							1.10	
Apr. 30	2.00	1.50	1.15	1.50		1.57		
May 1					1.51			
May 11	1.90	1.40	1.05	1.40	1.46	1.47	1.05	
June 1	1.80	1.35	1.00	1.35		1.40		
June 16	1.75	1.30		1.30		1.35		.70
June 17					1.43			
July 15	1.70	1.27		1.27		1.32	1.02	
July 28	1.65	1.22		1.22		1.25	1.00	
July 29					1.38			
Aug. 1					1.33			
Aug. 7					1.28			
Aug. 8	1.60	1.17	.95	1.17		1.20	.95	
Aug. 12	1.55	1.12	.90	1.12		1.15	.90	.67
Aug. 17	1.50	1.07	.87	1.07		1.10	.87	
Aug. 20	1.45	1.02	.85	1.02		1.05	.85	.65
Sept. 15					1.23			
Sept. 23					1.18			
Oct. 26					1.15			

NOTE.—In addition to these prices bonuses ranging from 2 to 10 cents a barrel were paid by various pipe lines and refineries.

The following table shows the average price per month of the different oils of the Appalachian field during the years 1913 and 1914:

Average monthly prices of Appalachian petroleum in 1913 and 1914, per barrel.

Month.	Pennsylvania and Tiona, Pa.	Mercer black, Pennsylvania.	Corning, Ohio.	New Castle, Ohio.	Wooster, Ohio.	Cabell, W. Va.	Somerset, Ky.	Ragland, Ky.
1913.								
January	$2.07	$1.60	$1.60	$1.60	$1.60	$1.67	$1.21	$0.68
February	2.49	1.99	1.99	1.99	1.86	2.06	1.35	.70
March	2.50	2.00	2.00	2.00	1.86	2.07	1.35	.70
April	2.50	2.00	2.00	2.00	1.89	2.07	1.35	.70
May	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
June	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
July	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
August	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
September	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
October	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
November	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
December	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
Average	2.463	1.966	1.966	1.966	1.87	2.036	1.339	.699
1914.								
January	$2.50	$2.00	$2.00	$2.00	$1.91	$2.07	$1.35	$0.70
February	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
March	2.50	2.00	2.00	2.00	1.91	2.07	1.35	.70
April	2.37	1.87	1.73	1.87	1.84	1.94	1.30	.69
May	1.93	1.43	1.07	1.43	1.48	1.50	1.07	.65
June	1.78	1.33	1.00	1.33	1.45	1.38	1.05	.68
July	1.72	1.28	1.00	1.28	1.43	1.32	1.03	.70
August	1.54	1.11	.91	1.11	1.29	1.14	.90	.67
September	1.45	1.02	.85	1.02	1.24	1.05	.85	.65
October	1.45	1.02	.85	1.02	1.17	1.05	.85	.65
November	1.45	1.02	.85	1.02	1.15	1.05	.85	.65
December	1.45	1.02	.85	1.02	1.15	1.05	.85	.65
Average	1.88	1.43	1.26	1.43	1.49	1.47	1.07	.67

The average monthly and yearly prices per barrel of petroleum of Pennsylvania grade at wells in the years 1905–1914 are given in the following table:

Monthly and yearly average prices of pipe-line certificates of petroleum of Pennsylvania grade at wells in daily market, 1905–1914, per barrel.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
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
1913	2.07	2.49	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.463
1914	2.50	2.50	2.50	2.37	1.93	1.78	1.72	1.54	1.45	1.45	1.45	1.45	1.889

The following table shows the range of prices of crude oil of Pennsylvania grade each year since 1859:

Highest and lowest prices of crude petroleum of Pennsylvania grade each year, 1859–1914, 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
1913	March to December, inclusive.	2.50	do	2.00
1914	January to March, inclusive	2.50	September to December, inclusive	1.45

SUMMARY OF WELLS DRILLED IN APPALACHIAN FIELD.

Number of wells completed in the Appalachian field, 1910–1914, by States.

State.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Pennsylvania and New York	1,673	1,491	1,911	3,420	2,247	[a] 528	297	322	521	338	2,201	2,007	2,472	4,251	2,869
Southeastern and central Ohio	953	765	846	1,246	863	[a] 686	512	460	603	517	1,639	1,680	1,717	2,191	2,044
West Virginia	897	622	1,062	1,285	1,043	[a] 719	218	234	339	347	1,616	1,191	1,657	2,065	1,758
Kentucky	70	100	112	133	119	[a] 51	33	61	69	55	121	136	178	210	178
Total	3,593	2,978	3,931	6,084	4,272	[a] 1,984	1,060	1,077	1,532	1,257	5,577	5,014	6,024	8,717	6,849

[a] Including gas wells.

Number of oil wells and dry holes drilled in the Appalachian field in 1914, by States and months.

State.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Pennsylvania and New York	220	29	164	37	139	24	303	39	286	42	286	42	273	30
Southeastern and central Ohio	105	52	86	51	76	29	112	54	100	50	88	48	83	57
West Virginia	109	31	102	38	95	33	95	37	137	45	101	37	95	29
Kentucky	11	5	12	7	11	2	14	7	8	4	14	8	12	5
Total	445	117	364	133	321	88	524	137	531	141	489	135	463	121

State.	Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Pennsylvania and New York	209	22	115	24	94	18	83	17	75	14	2,247	338	3,420	521
Southeastern and central Ohio	70	56	27	28	42	37	32	35	42	20	863	517	1,246	603
West Virginia	82	29	48	20	58	11	54	15	67	22	1,043	347	1,285	339
Kentucky	14	6	8	4	3	4	8	2	4	1	119	55	103	60
Total	375	113	198	76	197	70	177	69	188	57	4,272	1,257	6,054	1,523

Number of oil wells drilled in the Appalachian field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	277	252	251	307	402	398	354	302	307	270	279	194	3,593
1911	188	180	168	196	249	277	274	288	290	292	300	276	2,978
1912	182	173	223	300	346	397	386	429	396	386	352	361	3,931
1913	317	318	394	466	541	632	569	595	580	601	565	506	6,084
1914	445	364	321	524	531	489	463	375	198	197	177	188	4,272

Number of dry holes drilled in the Appalachian field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	125	117	125	183	172	202	183	167	173	175	156	206	[a] 1,984
1911	81	86	90	82	82	91	101	115	77	90	83	82	1,060
1912	73	43	82	65	78	79	98	121	140	102	100	96	1,077
1913	96	111	106	126	112	139	139	155	142	132	121	153	1,532
1914	117	133	88	137	141	135	121	113	76	70	69	57	1,257

[a] Including gas wells.

Total number of wells completed in the Appalachian field, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	402	370	376	490	573	600	537	469	480	445	435	400	5,577
1911	347	345	326	352	405	440	459	472	459	483	491	435	5,014
1912	311	260	360	427	491	573	570	636	670	622	562	542	6,024
1913	513	528	585	675	727	829	786	846	814	855	793	766	8,717
1914	649	574	464	734	770	734	738	615	427	388	385	371	6,849

[a] Including gas wells.

Initial daily production of new wells completed in the Appalachian field in 1914, by States and months, in barrels.

State.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total, 1914.	Total, 1913.
Pennsylvania and New York	618	527	476	928	764	706	741	727	300	247	334	259	6,627	8,958
Southeastern and central Ohio	1,851	1,318	1,541	1,254	1,808	716	943	851	467	651	240	407	12,047	16,302
West Virginia	2,178	2,173	2,287	1,741	2,475	2,768	2,263	1,677	1,369	2,850	1,336	1,357	24,474	34,835
Kentucky	140	238	148	267	94	122	155	165	120	28	66	25	1,568	2,215
Total	4,787	4,256	4,452	4,190	5,141	4,312	4,102	3,420	2,256	3,776	1,976	2,048	44,716	62,310

Total and average initial production of new wells in the Appalachian field, 1910–1914, by States, in barrels.

State.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Pennsylvania and New York	6,683	4,912	6,771	8,958	6,627	3.99	3.29	3.54	2.62	2.95
Southeastern and central Ohio	18,116	10,923	24,193	16,302	12,047	19.01	14.28	28.60	13.08	13.96
West Virginia	26,194	10,443	109,804	34,835	24,474	29.20	16.79	103.39	27.11	23.47
Kentucky	829	1,822	1,943	2,215	1,568	11.84	18.22	17.35	16.65	13.18
Total	51,822	28,100	142,711	62,310	44,716	14.42	9.44	36.30	10.24	10.47

Total initial daily production of new wells in the Appalachian field, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	6,429	5,429	4,741	5,498	5,903	5,316	3,616	3,356	4,049	3,186	2,720	1,579	51,822	4,319
1911	1,916	2,349	1,694	2,036	2,708	1,933	2,222	2,444	2,470	2,417	3,354	2,557	28,100	2,342
1912	4,417	10,835	11,523	18,781	22,986	22,836	16,199	9,751	6,466	6,758	4,251	7,908	142,711	11,893
1913	4,768	5,816	5,223	6,283	4,510	7,464	4,412	5,162	4,423	5,626	4,557	4,066	62,310	5,193
1914	4,787	4,256	4,452	4,190	5,141	4,312	4,102	3,420	2,256	3,776	1,976	2,048	44,716	3,726

PENNSYLVANIA.

GENERAL STATEMENT.

The output of petroleum in Pennsylvania in 1914, which amounted to 8,170,335 barrels, registered an increase of 253,033 barrels, or 3.2 per cent, over the marketed production in 1913. This quantity is nearly equivalent to the production of the State in 1911 and constitutes an increase of 4.2 per cent over the production in 1912. This notable increase, coming from a State whose oil output prior to 1913 has registered a fairly steady decline of 5 or 6 per cent a year for 14 years or more, is worthy of especial notice, as it was accomplished without the discovery of new pools of consequence within the productive area. It represents rather the intensive and efficient development of an area in which the productive limits have long been fairly well defined and in which the prospect of finding new pools of importance or of making substantial additions to those already developed is practically nil. The underlying cause of the increase noted lies in the advancing market which was a feature of 1913 and the early part of 1914, and which rendered operations profitable in a region where wells yielding an initial production of more than 20 barrels are the exception and those yielding less than 5 barrels the rule.

The market price of petroleum in Pennsylvania averaged $1.906 a barrel at the wells in 1914. Except for 1913, when the yearly average was $2.487, this price exceeds that received for the State's product in any other single year since 1877, when the yearly average of pipe-line certificates was $2.42.

Pennsylvania has been a consistent and reliable factor in the petroleum industry since 1859, when the successful completion of Col. Drake's first oil well near Titusville established that industry in the United States. This has been due to the large aggregate area of the productive pools, the number and richness of the oil-yielding "sands," and the compact condition of those "sands," which has resulted in a low but steady yield per well of oil maintained over periods measured by decades rather than years.

The product of the Pennsylvania oil fields is practically free from sulphur and asphalt, is rich in paraffin wax, and yields a high percentage of gasoline and illuminating oil. For many years it has been in first demand by the refiners, and though modern refining methods have succeeded in remedying to a notable degree the deficiencies of crude petroleum from other parts of the United States, "Pennsylvania grade" still retains its rightful prestige and forms the criterion by which the merits of other crude oils are judged.

Oil in Pennsylvania is derived from sandstone or conglomerate layers occurring in an aggregate thickness of 2,000 feet or more of sedimentary strata belonging to the Devonian and Carboniferous systems.

The total number of active wells in the State at the end of 1914 was 58,330, as compared with 55,077 at the end of 1913.

DEVELOPMENT.

In consideration of the fact that during the later two-thirds of 1914 oil operators faced a declining market for their product the record of wells completed for the year is very creditable. Including a few wells in the New York end of the Bradford field, the wells completed for the year numbered 2,602, of which 2,032, or 78 per cent, produced oil; 249, or 10 per cent, produced gas; and the remaining 321, or 12 per cent, were barren. With the exception of 1913, when the wells completed in the same area numbered 3,742, the record for 1914 exceeds that of any preceding year since 1910, inclusive. For the two years 1913 and 1914 the ratio of producing oil wells to total wells completed in Pennsylvania has remained practically constant.

The total initial production obtained in the Pennsylvania fields, including the New York extension of the Bradford field, was 6,181 barrels, representing an average of 3 barrels per well and constituting a slight increase over the average of 2.7 barrels maintained during 1913.

Field work consisted as usual in keeping old wells producing to capacity by cleaning, deepening to lower sands, or plugging back to sands originally neglected because of low prospective yield, and in drilling new wells wherever lease conditions would permit. With the approach of winter the search for natural gas resulted in more activity than the search for oil.

Bradford field.—In the old Bradford field activity was nominal throughout the year and well distributed about the principal centers of Eldred, Derrick City, Rew, Rixford, Big Shanty, Mount Jewett, Watsonville, and Kane. Near Kane the completion of a 50-barrel well in October attracted considerable attention merely because of its unusual size. In all 455 oil wells were completed in this field in 1914, with a combined initial yield of 1,588 barrels, or an average yield of 3.5 barrels each.

Middle field.—In the middle field, which embraces Elk and Forest counties, interest was centered principally in the development of natural gas, which was accomplished with extraordinary success near Ridgway in Elk County. In all, 207 oil wells were completed in this district in 1914, having total initial production of 586 barrels, or an average of 2.8 barrels per well.

Venango-Clarion field.—More wells were completed in the Venango-Clarion division of the Pennsylvania field than in any other portion of the State. New work was fairly well distributed throughout the field and production was uniformly light. Of 936 wells completed during the year, 813, or 87 per cent, produced oil, though the total initial production amounted to only 1,263 barrels, or an average of about 1.5 barrels per well.

Butler-Armstrong field.—Activity in the Butler-Armstrong field was at a low ebb during 1914 and differed little, as far as results are concerned, from the previous years of the last decade. There were 284 wells completed, of which 183, or 64 per cent, produced oil and 81, or 28 per cent, were barren, the remainder being productive of gas alone. The total initial production was 684 barrels, or an average of 3.7 barrels per well.

Southwestern Pennsylvania.—In the oil fields of southwestern Pennsylvania activity was greater in 1914 than in any previous year since 1902. The number of wells completed was 621, of which 60 per cent, or 374, produced oil, the remaining 40 per cent being about equally divided between gas wells and barren holes. The reason for the exceptional activity in this division of the Pennsylvania field lies in the fact that the area is still capable of furnishing wells having a yield considerably above the average of the other fields of the State. Thus in 1914 this field had a total of 2,060 barrels of initial production, or an average of 5.5 barrels per well. In 1913 a promising lead was found from the north end of the old Carson field, Hanover township, Beaver County, near the West Virginia boundary, which developed into a fairly substantial extension of the field in 1914 and furnished a number of wells ranging in yield from 25 to 60 and even to 75 barrels on initial appearance. Toward the end of the year interest in this locality was transferred a few miles east to the vicinity of Hookstown, where a 10-barrel well gave incentive for further operations. In Lawrence County operations were particularly active in the shallow-sand Bessemer pool, where wells of low production could be completed at relatively small cost.

Aside from routine developments in other portions of the southwestern Pennsylvania field, especial activity was apparent at various times during the year in the McMurry district, Washington County; in the Milltown, Unity, McDonald, and Coraopolis districts, Allegheny County; in the Mount Morris district, Green County; and in German township, Fayette County.

NEW YORK.

GENERAL STATEMENT.

The impetus given to petroleum developments in southwestern New York by the advancing market of 1913 continued through the early part of 1914 and is reflected in the final statistics of the State's marketed production, which record an output of 938,974 barrels for the year. Although this quantity shows a slight decline—less than 1 per cent—from the 948,191 barrels credited to the State in 1913, it represents an increase of 7.2 per cent over the output for 1912 and illustrates clearly the remarkable productive capacity of the "Allegany" and Bradford sands and their ability to respond to intensive development.

The area which represents the northern termination of the broad oil-yielding belt of the Allegheny Plateau region has furnished a commercial output of petroleum since 1879. The productive sands which lie near the base of the Devonian system are reached at relatively shallow depths, a condition which renders their exploitation profitable despite the low average yield per well.

DEVELOPMENT.

Field work in the Allegany district and in the New York end of the Bradford district in 1914 consisted in keeping the old wells cleaned and producing to capacity, in redrilling a few wells long since plugged because of low yield, and in drilling new wells where lease conditions would permit. In the Allegany district, which lies wholly within New York, 267 wells were completed during the year, of which 215, or 80 per cent, yielded an average initial production of 2.07 barrels each. Thirty-five gas wells were drilled in this district and 17 barren holes were reported. The Alma and Bolivar divisions of this district led in completed work and new production.

For the purpose of this report a separation by States of field developments in the Bradford district is impracticable. In the New York portion of that district, however, the area adjacent to Limestone, Cattaraugus County, showed the greatest activity in 1914, as far as petroleum is concerned.

The following table shows by months the quantity of petroleum marketed from the Pennsylvania and New York fields from 1910 to 1914, inclusive:

Marketed production of petroleum in Pennsylvania and New York in 1910–1914, by months, in barrels.

Pennsylvania.

Month.	1910	1911	1912	1913	1914
January	721,627	697,290	562,665	669,134	677,284
February	621,467	637,719	575,180	577,763	532,826
March	851,225	722,755	686,178	637,250	726,605
April	766,700	701,489	699,856	703,829	782,378
May	759,585	765,470	728,127	700,585	701,685
June	790,520	704,082	657,545	661,542	724,172
July	723,646	668,324	678,789	688,055	731,080
August	763,273	704,627	675,848	653,090	646,412
September	720,165	661,775	634,114	651,046	688,761
October	708,453	690,360	686,184	693,996	704,024
November	678,132	622,543	610,314	609,033	614,126
December	689,869	671,724	643,148	671,979	640,982
Total	8,794,662	8,248,158	7,837,948	7,917,302	8,170,335

New York.

Month.	1910	1911	1912	1913	1914
January	90,027	83,160	64,850	80,906	78,983
February	71,699	73,007	63,080	66,969	62,424
March	101,406	83,226	73,371	74,592	80,660
April	92,245	81,239	79,188	82,580	88,268
May	90,581	88,594	82,035	83,742	84,548
June	92,064	84,442	73,950	77,819	84,110
July	89,457	75,885	75,875	83,237	84,783
August	89,650	81,368	74,663	78,005	75,512
September	86,428	76,263	68,884	78,594	76,102
October	86,659	78,469	76,766	84,480	81,569
November	79,519	70,101	68,045	74,437	71,593
December	84,103	76,761	73,421	82,830	70,422
Total	1,053,838	952,515	874,128	948,191	938,974

SUMMARY OF WELLS DRILLED.

The following tables record the results of activity in drilling in the Pennsylvania and New York fields:

Number of wells completed in the Pennsylvania and New York oil fields, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Bradford	316	260	335	675	455	6	16	14	31	28	344	298	371	755	531
Allegany	219	128	177	441	215	13	9	17	22	17	283	194	246	509	267
Middle	195	208	226	352	207	34	39	36	66	17	235	247	266	435	230
Venango and Clarion	635	642	853	1,352	813	70	93	90	141	68	790	805	1,019	1,578	936
Butler and Armstrong	152	124	138	354	183	89	65	59	110	81	263	219	216	497	284
Southwestern Pennsylvania	156	129	182	246	374	76	75	106	151	127	286	244	354	477	621
Total	1,673	1,491	1,911	3,420	2,247	288	297	322	521	338	2,201	2,007	2,472	4,251	2,869

[a] Including gas wells.

Number of oil wells and dry holes drilled in the Pennsylvania and New York oil fields in 1914, by districts and months.

District.	January.		February.		March.		April.		May.		June.		July.		August.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Bradford	51	2	34	3	21	2	56	4	58	5	61	2	53	2	40	4
Allegany	25	1	12	1	12	.....	27	4	33	1	31	3	23	2	17	1
Middle	13	1	9	2	8	.....	19	1	33	2	38	2	32	3	23	1
Venango and Clarion	78	5	67	13	58	8	117	8	99	5	99	8	111	7	70	3
Butler and Armstrong	24	10	13	10	6	3	29	11	14	12	18	14	17	8	19	3
Southwestern Pennsylvania	29	10	29	8	34	11	55	11	49	17	39	13	37	8	40	10
Total	220	29	164	37	139	24	303	39	286	42	286	42	273	30	209	22

District.	September.		October.		November.		December.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Bradford	16	......	24	......	18	1	23	3	455	28	675	31
Allegany	16	......	8	1	6	1	5	2	215	17	441	22
Middle	15	3	10	1	5	1	2	......	207	17	352	66
Venango and Clarion	29	2	28	4	27	4	30	1	813	68	1,352	141
Butler and Armstrong	16	3	8	3	11	2	8	2	183	81	354	110
Southwestern Pennsylvania	23	16	16	9	16	8	7	6	374	127	246	151
Total	115	24	94	18	83	17	75	14	2,247	338	3,420	521

Number of oil wells drilled in Pennsylvania and New York oil fields, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	153	129	204	248	303	375	352	344	335	356	341	280	3,420
1914	220	164	139	303	286	286	273	209	115	94	83	75	2,247

Number of dry holes drilled in the Pennsylvania and New York oil fields, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	26	27	36	48	37	49	53	57	56	45	37	50	[b] 521
1914	29	37	24	39	42	42	30	22	24	18	17	14	[b] 338

[a] Including gas wells. [b] Not including gas wells.

Total number of wells completed in the Pennsylvania and New York oil fields, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	205	183	268	329	363	439	431	427	416	431	406	353	4,251
1914	271	216	179	355	366	356	340	261	163	133	123	106	2,869

[a] Including gas wells.

Total daily output of new wells completed in Pennsylvania and New York in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Bradford	143	115	85	256	173	227	175	157	69	43	63	82	1,588	1,676
Allegany	43	20	15	48	70	71	34	51	40	21	16	17	446	820
Middle	39	42	11	82	80	100	55	90	48	27	10	2	586	649
Venango and Clarion	114	106	75	160	182	137	195	126	34	40	35	59	1,263	2,301
Butler and Armstrong	84	46	18	84	34	47	58	76	26	49	85	77	684	1,487
Southwestern Pennsylvania	195	198	272	298	225	124	224	227	83	67	125	22	2,060	2,025
Total	618	527	476	928	764	706	741	727	300	247	334	259	6,627	8,958

Total and average initial daily output of new wells in the Pennsylvania and New York oil fields, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Bradford	952	730	817	1,676	1,588	3.01	2.81	2.44	2.48	3.49
Allegany	368	201	278	820	446	1.68	1.57	1.57	1.86	2.07
Middle	442	541	511	649	586	2.27	2.60	2.26	1.84	2.83
Venango and Clarion	1,276	1,302	1,943	2,301	1,263	2.00	2.03	2.28	1.70	1.55
Butler and Armstrong	1,489	422	696	1,487	684	9.80	3.40	5.04	4.20	3.74
Southwestern Pennsylvania	2,156	1,716	2,526	2,025	2,060	13.82	13.30	13.88	8.23	5.51
Total	6,683	4,912	6,771	8,958	6,627	3.99	3.29	3.54	2.62	2.95

Total initial daily yield of new wells in the Pennsylvania and New York oil fields, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	572	320	211	584	1,355	621	604	924	353	395	448	296	6,683	557
1911	204	345	154	313	319	368	435	611	517	507	695	444	4,912	409
1912	548	621	613	657	531	588	482	637	720	530	474	370	6,771	564
1913	426	387	733	638	729	959	838	860	826	891	869	802	8,958	746
1914	618	527	476	928	764	706	741	727	300	247	334	259	6,627	552

WEST VIRGINIA.

GENERAL STATEMENT.

The year 1914 recorded an abrupt decline, not wholly unexpected, in the output of petroleum in West Virginia, final returns showing a total of 9,680,033 barrels credited to the State in that year. This was a decline of 1,887,266 barrels, or 16.3 per cent, from the marketed production of 1913 and represents the lowest yearly output since 1908. The causes which contributed to the decrease noted included a continued decline in the output of the Blue Creek pool, in Kanawha County, an unstable and falling market at the season of year when drilling activity is usually at its height, and the failure of the extensive wildcat campaign in many parts of the State, inspired by the soaring market of 1913, to discover sufficient new production to offset the normal decline of the old fields. Although the average market price, $1.908, received during 1914 for all crudes other than lubricating grades, was higher than the yearly average for any other year since 1877, except 1913, the total value of the State's production, $18,468,540, showed a net decrease of $10,360,274 from the value of the output of 1913.

Deprived of the spur of high prices, the State's output of natural lubricating oil from the famous Volcano pool, in Wood and Ritchie counties, declined from 4,569 barrels in 1913 to 2,480 barrels in 1914, the average price per barrel declining in the same period from $3.28 to $2.56.

The oil and gas fields of West Virginia occupy portions of 22 counties of the State and form a fairly continuous belt 40 to 60 miles in width lying on the west flank of the Appalachian Mountains and extending from the Pennsylvania boundary southwest to Wayne and Mingo counties on the Kentucky border. With the exception of that found in the Big lime (Greenbrier limestone), which is a calcareous stratum, all the oil and gas obtained in West Virginia comes from sandstone beds, or "sands," of which there are many ranging in stratigraphic position from the base of the Catskill formation of the Devonian system to the Monongahela formation of the Carboniferous system.

With the exception of a relatively small quantity of natural lubricating oil produced near Volcano, Wood County, the product of the State is classed as "Pennsylvania grade," being practically free from sulphur and asphalt, rich in paraffin wax, and yielding a large percentage of gasoline and illuminating oils.

DEVELOPMENT.

Prior to the depression in the petroleum market which commenced in April, field work was generally active throughout West Virginia, and operators gave considerable attention to the cleaning of old wells and the drilling of new in old territory where opportunity would permit and to the testing of promising areas along the trend of the productive formations in the southwestern part of the State. Under a declining market field activities were greatly curtailed and restricted for the most part to areas of proved productiveness.

Throughout the year interest was well sustained in the Elk and Big Sandy districts, Kanawha County, and though the productive limits of the Blue Creek pool have been fairly well defined, considerable "inside" territory capable of supplying wells of more than average size remains to be drilled. Production in this pool is derived from the Squaw and Weir sands, and though many of the wells are still completed as gushers, they do not possess the requisite staying qualities, and the output of the pool shows a steady yearly decline.

Another locality of sufficient value to sustain activity throughout the year was the Sardis district, in Harrison County, where a number of excellent producers were completed along Big Elk Creek and Little Elk Creek. Production is obtained chiefly from the Gordon sand, and the wells show better staying qualities than those now found in the Blue Creek pool. The productive limits of the pool are now fairly well defined, and a decline in production is noticeable.

The Birch district, in Braxton County, and the adjoining Center district, in Gilmer County, furnished a slight flurry of excitement, caused by the discovery of production at a moderate depth in the

Salt sand at Rosedale, in Braxton County. Considerable activity resulted, but because of the indifferent success obtained and of the depressed condition of the market during the summer and autumn the true value and extent of the pool was not determined before the close of the year.

Early in January a wildcat well on Painter Fork of Rock Run, in the Burning Springs district, Wirt County, attracted more than passing attention when completed as a small producer in the Keener sand. As the well was located several miles from other wells, it was believed to be the forerunner of a new pool. To the end of the year, however, the value of the find had not been determined, for of 6 additional wells completed in the locality only 3 produced oil, 1 yielded gas, and the remaining 2 were barren. The discovery is well protected by untested acreage practically under the control of a single company, and a thorough and conservative development of the area is to be expected.

Late in December the completion of a 90-barrel wildcat well near the mouth of Laurel Run, in the Cabin Creek district, Kanawha County, inspired hope of a small pool in the Berea sand. This discovery was likewise well protected by acreage under the control of a single company, but to the end of the year no more wells had been completed in the locality.

During 1914 there were 742 wells abandoned in West Virginia, and at the end of the year there were 14,932 active oil wells in the State, compared with 14,544 at the end of 1913.

MARKETED PRODUCTION.

In the following table is shown the marketed production of petroleum in West Virginia in the years 1910 to 1914, by months:

Total marketed production of petroleum in West Virginia, 1910–1914, by months, in barrels.

Month.	1910	1911	1912	1913	1914
January	1,026,438	814,743	694,619	978,401	855,886
February	935,252	800,712	801,699	936,733	770,300
March	1,050,163	881,172	983,502	970,900	919,377
April	962,657	810,661	1,018,955	1,026,129	900,998
May	1,001,746	882,093	1,153,945	1,003,425	864,519
June	1,018,694	832,920	1,172,331	995,098	872,074
July	984,813	787,171	1,174,367	1,009,383	897,065
August	1,020,317	838,922	1,190,552	939,479	272,098
September	976,220	773,024	981,052	928,610	675,518
October	935,166	795,687	1,013,980	956,772	985,724
November	906,521	757,029	918,313	893,274	799,728
December	935,084	821,330	1,025,647	983,095	866,746
Total	11,753,071	9,795,464	12,128,962	11,567,299	9,680,033

The quantity and value of the marketed production of petroleum in West Virginia from 1905 to 1914, inclusive, are shown in the following table:

Quantity and value of marketed production of petroleum in West Virginia, 1905–1914, in barrels.

Year.	Regular crude.			Lubricating.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
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
1913	11,562,730	28,813,822	2.492	4,569	14,982	3.28	11,567,299	28,828,814	2.492
1914	9,677,553	18,462,175	1.908	2,480	6,365	2.56	9,680,033	18,468,540	1.908

SUMMARY OF WELLS DRILLED.

Number of wells completed in West Virginia, 1910–1914, by counties.

County.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Brooke	7	1	5	28	15	19	2	4	6	16	26	3	9	38	40
Cabell	6	1	.....	.....	.....	11	2	.....	1	.....	17	5	.....	1	.....
Calhoun	11	11	19	18	5	13	2	12	6	6	24	33	38	32	17
Clay	.....	.....	.....	.....	9	.....	.....	.....	.....	4	.....	.....	.....	.....	16
Gilmer	.....	.....	.....	.....	12	.....	.....	.....	.....	8	.....	.....	.....	.....	23
Hancock	5	8	5	21	16	2	.....	11	7	6	7	8	16	33	23
Kanawha	.....	(b)	440	177	114	.....	(b)	11	20	17	.....	(b)	486	227	153
Lincoln	133	58	61	66	59	15	3	1	4	8	148	68	70	75	105
Marion	199	98	80	230	311	301	39	39	51	81	500	280	298	526	535
Marshall	.....	.....	.....	.....	7	.....	.....	.....	.....	3	.....	.....	.....	.....	18
Pleasants	97	60	59	108	74	44	29	31	42	25	141	90	91	150	102
Ritchie	105	93	79	129	125	54	45	20	39	49	159	170	121	191	190
Roane	188	160	147	253	115	81	8	13	21	15	269	194	169	295	152
Wetzel and Tyler	69	43	66	105	81	103	34	48	61	48	172	135	183	242	199
Wirt	22	22	17	49	53	8	5	3	8	24	30	31	21	60	78
Wood	44	49	61	71	47	31	31	20	36	16	75	80	81	108	63
Miscellaneous	11	18	23	30	.....	37	18	21	37	21	48	94	74	87	44
Total	897	622	1,062	1,285	1,043	[a] 719	218	234	339	347	1,616	1,191	1,657	2,065	1,758

a Including gas wells. b Included in "Miscellaneous."

Number of oil wells and dry holes drilled in West Virginia in 1914, by counties and months.

County.	January.		February.		March.		April.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Brooke	4	4	3	1	......	......	2	2	......	3	4	3	1	1
Cabell	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Calhoun	1	1	1	1	......	......	1	1	1	3	......	......	......	......
Clay	......	......	2	......	1	2	......	1	1	......	3	......	......	......
Gilmer	......	3	1	1	2	3	2	......	1	1	......	......	2	......
Hancock	1	1	......	1	1	......	3	1	1	1	......	......	1	......
Kanawha	12	1	10	......	11	4	8	2	12	3	13	4	10	3
Lincoln	9	......	7	......	7	......	7	1	6	2	8	1	5	2
Marion	27	4	30	14	28	7	25	8	43	8	24	11	32	6
Marshall	......	......	......	1	3	1	......	......	1	......	......	......	2	......
Pleasants	8	......	8	......	3	2	5	2	12	4	6	5	7	3
Ritchie	10	3	10	5	8	3	11	4	17	5	15	2	16	6
Roane	9	6	11	2	16	......	19	......	13	1	13	......	8	1
Wetzel and Tyler	9	2	8	7	7	3	4	3	10	7	8	6	6	4
Wirt	9	4	10	2	3	1	2	4	12	5	5	2	......	2
Wood	10	1	1	1	5	4	6	1	7	2	2	1	5	1
Miscellaneous	......	1	......	2	......	3	......	7	......	......	......	2	......	......
Total	109	31	102	38	95	33	95	37	137	45	101	37	95	29

County.	August.		September.		October.		November.		December.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Brooke	......	1	......	......	1	1	......	......	......	......	15	16	28	6
Cabell	......	......	......	......	......	......	......	......	......	......	......	......	......	1
Calhoun	......	......	......	......	......	......	......	......	1	......	5	6	18	6
Clay	2	1	......	......	......	......	......	......	......	......	9	4	......	......
Gilmer	......	......	1	......	1	......	......	......	2	......	12	8	......	......
Hancock	2	1	3	......	......	1	2	......	2	......	16	6	21	7
Kanawha	10	......	3	......	11	......	8	......	6	......	114	17	177	20
Lincoln	3	......	3	2	2	......	2	......	......	......	59	8	66	4
Marion	31	8	18	3	17	2	15	2	21	8	311	81	230	51
Marshall	......	1	1	......	......	......	......	......	......	......	7	3	......	......
Pleasants	3	3	7	1	5	1	4	2	6	2	74	25	108	42
Ritchie	11	5	4	4	7	1	7	5	9	6	125	49	129	39
Roane	8	......	1	1	8	2	5	1	4	1	115	15	253	21
Wetzel and Tyler	9	4	6	1	4	3	5	3	5	5	81	48	105	61
Wirt	2	3	1	1	......	......	3	......	6	......	53	24	49	8
Wood	1	......	......	3	2	......	3	2	5	......	47	16	71	36
Miscellaneous	......	2	......	4	......	......	......	......	......	......	......	21	30	37
Total	82	29	48	20	58	11	54	15	67	22	1,043	347	1,285	339

Number of oil wells drilled in West Virginia, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	100	81	73	69	89	89	81	65	78	70	54	48	897
1911	53	47	52	45	56	44	60	51	50	58	46	60	622
1912	54	50	71	75	74	90	103	113	117	96	111	108	1,062
1913	92	98	91	113	103	138	102	110	104	114	109	111	1,285
1914	109	102	95	95	137	101	95	82	48	58	54	67	1,043

Number of dry holes drilled in West Virginia, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	46	42	49	77	64	68	67	64	59	62	54	67	[a] 719
1911	19	24	21	14	10	12	20	28	19	17	12	22	218
1912	18	14	30	15	12	11	18	23	21	21	15	36	234
1913	21	26	30	25	25	34	30	32	30	28	31	27	339
1914	31	38	33	37	45	37	29	29	20	11	15	22	347

[a] Including gas wells.

Total number of wells completed in West Virginia, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	157	157	157	177	163	202	163	175	172	187	173	182	2,065
1914	165	174	151	165	202	174	156	154	108	97	104	108	1,758

[a] Including gas wells.

Initial daily production of new wells completed in West Virginia, 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Brooke	53	30	......	45	......	43	10	......	......	5	......	......	186	1,329
Cabell	......	......	......	......	......	......	......	......	......	......	......	......	......	12
Calhoun	2	3	......	5	2	......	......	......	......	......	......	10	22	199
Clay	......	40	3	......	1	25	......	15	......	......	......	......	84	......
Gilmer	......	2	10	6	5	......	15	......	10	8	......	15	71	......
Hancock	5	......	3	9	1	......	10	35	30	......	6	6	105	82
Kanawha	355	230	640	419	533	1,284	835	525	503	2,121	770	750	8,965	10,703
Lincoln	110	113	113	130	168	70	18	30	18	17	10	......	797	929
Marion	1,203	1,237	1,033	735	1,287	919	1,007	646	496	337	334	298	9,532	6,829
Marshall	......	......	65	......	10	......	7	......	10	......	......	......	92	......
Pleasants	71	97	35	42	52	41	20	8	28	15	32	14	455	2,045
Ritchie	89	184	81	99	146	183	112	232	53	140	67	159	1,545	968
Roane	133	75	132	195	105	63	59	47	10	64	26	22	931	9,185
Wetzel and Tyler	50	120	135	17	82	52	160	136	61	138	78	56	1,085	1,695
Wirt	72	37	20	15	43	79	......	2	150	......	3	16	437	212
Wood	35	5	17	24	40	9	10	1	......	5	10	11	167	482
Miscellaneous	......	......	......	......	......	......	......	......	......	......	......	......	......	165
Total	2,178	2,173	2,287	1,741	2,475	2,768	2,263	1,677	1,369	2,850	1,336	1,357	24,474	34,835

Total and average initial daily production of new wells in West Virginia, 1910–1914, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Brooke	59	3	19	1,329	186	8.43	3.00	3.80	47.46	12.40
Cabell	28	5	(a)	12	....	4.67	5.00	....	....	....
Calhoun	196	295	340	199	22	17.82	26.82	17.90	11.06	4.40
Clay	....	....	(a)	(a)	84	....	....	....	....	9.33
Gilmer	....	....	....	....	71	....	....	....	....	5.92
Hancock	7	29	21	82	105	1.40	3.63	4.20	3.90	6.56
Kanawha	....	(a)	98,870	10,703	8,965	....	....	224.70	60.47	78.64
Lincoln	2,397	1,087	1,058	929	797	18.02	18.74	17.34	14.08	13.51
Marion	12,426	2,180	2,001	6,829	9,532	62.44	22.24	25.01	29.69	30.65
Marshall	....	....	....	....	92	....	....	....	....	13.14
Pleasants	1,050	374	930	2,045	455	10.82	6.23	15.76	18.93	6.15
Ritchie	3,621	1,661	726	968	1,545	34.49	17.86	9.19	7.50	12.36
Roane	3,966	3,243	3,161	9,185	931	21.10	20.27	21.50	36.30	8.10
Wetzel and Tyler	1,893	661	1,292	1,695	1,085	27.43	15.37	19.58	16.14	13.40
Wirt	69	144	105	212	437	3.14	6.54	6.18	4.33	8.25
Wood	402	337	318	482	167	9.14	6.88	5.21	6.79	3.55
Miscellaneous	80	424	963	165	....	7.27	23.56	41.87	5.50	....
Total	26,194	10,443	109,804	34,835	24,474	29.20	16.79	103.39	27.11	23.47

[a] Included in "Miscellaneous."

Total initial daily production of new wells in West Virginia, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
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
1913......	3,428	3,988	3,144	4,121	2,360	5,085	1,846	2,527	1,846	2,452	1,795	2,243	34,835	2,903
1914......	2,178	2,173	2,287	1,741	2,475	2,768	2,263	1,677	1,369	2,850	1,336	1,357	24,474	2,040

KENTUCKY.

GENERAL STATEMENT.

The output of petroleum from Kentucky in 1914 amounted to 502,441 barrels. Although this quantity represents a decrease of 4.2 per cent below the 524,568 barrels credited to the State in 1913, it shows further a substantial increase over the production in any other preceding year since 1909. Eight counties contributed to this production, of which Wayne County alone yielded more than one-half.

Kentucky grades of petroleum were not exempt from the general market depression which began in April, and the average price received for the State's production in 1914 amounted to $0.99 a barrel, as compared with $1.29 in 1913. Exclusive of 1913, however, the average price maintained in 1914 exceeded that received in any previous year since 1907, when an excess of 6 cents was recorded. The total value of the State's oil production in 1914 was $498,556.

Oil and gas in Kentucky are derived from sandstone and dolomitic limestone layers occurring at various positions in the range of strata included between the "Calciferous" limestone of the Cambrian system and the top of the Pottsville group of the Pennsylvanian series (upper Carboniferous).

The oils of the State range in color from green to amber, and, with the exception of a heavy oil produced in the Ragland pool, they average above 35° Baumé in gravity.

At the end of 1914 there were 1,032 active oil wells in Kentucky, as compared with 968 at the end of 1913.

DEVELOPMENT.

During the early months of 1914 field activity was rather marked in Kentucky and embraced 16 counties in its scope. With the downward tendency of the petroleum market in the summer months, however, operations, particularly of the wildcat type, were greatly curtailed, and new work was confined for the most part to areas where drilling costs were relatively low and hazards were reduced to a minimum. The extent of the wildcat campaign inspired by the high prices prevailing in 1913 and in the early part of 1914 is indicated in the well record for the latter year, which shows, in a total of 178 wells completed, 55 total failures, or nearly 31 per cent. Of the remaining 123 wells completed, 4 yielded gas and 119 oil. The total initial production credited to the oil wells was 1,568 barrels, or an average of about 13.2 barrels per well.

Northeastern Kentucky.—In Lawrence County, on the West Virginia border, development in the Busseyville pool was nominal, interest being centered in the neighborhood of Fallsburg, a few miles to the north, where several good wells were completed in what appears to be a new pool. In Morgan County substantial additions were made to the productive area about Cannel City. In Wolfe County a few completions were made in the Campton pool, but activity was directed chiefly to the newer development along Stillwater Creek, 5 or 6 miles distant from the original pool. In Floyd and Knott counties the old Beaver Creek pool maintained its customary light yield, as did the Ragland pool, in Bath and Rowan counties. In Estill County revived activity was apparent in the all but abandoned shallow-sand Irvine pool, where a number of old wells were cleaned and a few new wells of characteristically small yield were completed.

Southern Kentucky.—As in previous years, the bulk of the State's oil output came from the pools in Wayne County, where substantial extensions of the Mount Pisgah pool were developed and slight additions to the Cooper, Steubenville, and Parmleysville pools were made. Work in this locality was somewhat hampered by inadequate field storage, necessitating the closing for a time of a number of the wells, a condition which was remedied to some degree before the close of the year. In the fields of Whitley and Knox counties a light output was maintained, though no new wells were recorded.

The scene of the most important developments of the year in Kentucky was Allen County, where the productive area about Petroleum and Rodemer was extended several miles northward to the vicinity of Scottsville, and a number of wells averaging 20 barrels a day on initial appearance were completed. Whether the discoveries near Scottsville represent an extension of the Rodemer pool or disclose the presence of a new pool was not determined, as operations in the region were practically at a standstill during the later part of the year because of the absence of pipe-line facilities and of the excessive cost of railway shipment.

The pioneer fields of the State in Barren County developed no new wells during the year and no developments of note resulted from the slight activity in the Ohio and Logan County fields.

Western Kentucky.—Wildcat activity in Hancock, Daviess, McLean, and Webster counties, in the western part of the State, failed to disclose more than slight showings of oil.

MARKETED PRODUCTION.

Marketed production of petroleum in Kentucky, by months, 1910–1914, in barrels.

Month.	1910	1911	1912	1913	1914
January	40,984	33,237	38,425	42,074	46,930
February	35,795	31,151	37,723	36,843	44,545
March	41,006	37,910	40,923	39,391	53,860
April	39,907	35,484	37,375	39,036	50,465
May	43,055	42,906	44,967	42,932	44,903
June	44,239	38,509	40,311	39,285	44,361
July	40,009	42,237	44,997	48,211	42,630
August	40,699	44,087	40,866	49,908	26,758
September	41,017	44,356	39,146	52,538	21,177
October	35,822	41,556	38,484	46,301	51,625
November	29,144	40,818	40,000	44,137	36,900
December	37,097	40,207	41,151	43,912	38,287
Total	468,774	472,458	484,368	524,568	502,441

Pipe-line runs in Kentucky in 1913 and 1914, by districts and months, in barrels.

1913.

Month ending—	Cooper and Slickford.	Griffin (Denney).	Mount Pisgah (Sandusky).	Parmleysville.	Steubenville.	Total, Wayne County.	Beaver Creek.	Busseyville.	Campton.
Jan. 25	5,298	11,525	3,445	3,016	1,913	25,197	1,469	943	1,695
Feb. 22	4,964	10,815	3,654	2,543	1,824	23,800	1,517	929	2,324
Mar. 29	6,546	14,080	1,519	4,554	1,956	28,655	885	1,296	2,858
Apr. 26	4,324	11,732	....	5,159	2,239	23,454	1,507	1,170	3,098
May 31	6,663	14,662	....	7,100	3,295	31,720	1,279	1,229	3,410
June 28	4,675	12,019	....	4,863	2,482	24,039	970	975	1,978
July 26	5,022	15,479	....	4,580	2,244	27,325	1,072	957	2,706
Aug. 30	6,124	18,698	....	5,566	3,235	33,623	1,043	1,542	2,883
Sept. 27	5,109	13,936	....	4,016	2,525	25,586	1,131	645	2,821
Oct. 25	4,570	12,114	....	4,195	2,629	23,508	754	1,233	1,894
Nov. 29	6,181	13,708	....	5,557	2,764	28,210	1,585	1,250	3,035
Dec. 27	4,557	10,157	....	3,255	2,180	20,149	1,172	515	2,535
Total	64,033	158,925	8,618	54,404	29,286	315,266	14,384	12,684	31,237

Month ending—	Lewis.	Meadow Branch.	Page Hollow.	Ragland.	Stillwater.	Watson.	Williamsburg.	Total.
Jan. 25	1,080	776	572	4,325	712	....	145	36,914
Feb. 22	4,999	326	....	2,860	394	208	299	37,656
Mar. 29	3,616	....	....	6,100	701	279	298	44,688
Apr. 26	3,494	....	....	2,881	1,401	....	149	37,154
May 31	4,566	....	....	4,861	1,318	....	159	48,542
June 28	2,806	....	....	2,896	519	....	181	34,364
July 26	5,860	....	....	3,649	1,084	....	149	42,802
Aug. 30	11,852	....	....	4,232	781	....	148	56,104
Sept. 27	12,747	....	....	3,823	897	....	149	47,799
Oct. 25	9,401	....	....	3,033	1,227	....	....	41,050
Nov. 29	11,826	....	....	5,002	1,376	....	....	52,284
Dec. 27	8,272	....	....	3,157	914	....	....	36,714
Total	80,519	1,102	572	46,819	11,324	487	1,677	516,071

1914.

Month ending—	Cooper.	Griffin (Denney).	Parmleysville.	Steubenville.	Total, Wayne County.	Beaver Creek.	Busseyville.
Jan. 31	6,427	15,578	5,393	2,898	30,296	1,256	1,574
Feb. 28	5,633	14,371	3,390	4,558	27,952	1,044	879
Mar. 28	5,677	15,157	3,254	5,650	29,738	1,565	840
Apr. 25	7,288	15,530	5,010	7,704	35,532	1,235	1,743
May 30	5,065	11,426	3,267	5,698	25,456	1,269	1,219
June 27	5,518	9,912	3,283	5,244	23,957	869	1,534
July 25	7,327	11,985	3,899	6,076	29,287	1,504	1,654
Aug. 29	3,707	6,106	2,131	3,398	15,342	365	963
Sept. 26	2,604	3,236	1,108	1,675	8,623	592	698
Oct. 31	7,814	11,211	4,695	6,796	30,516	1,455	3,262
Nov. 28	5,470	7,517	2,918	4,233	20,138	822	2,385
Dec. 26	5,550	6,549	2,367	4,839	19,305	1,284	1,719
Total	68,080	128,578	40,715	58,769	296,142	13,260	18,470

Month ending—	Page Hollow.	Campton.	Ragland.	Stillwater.	Cannel City and Lewis.	Williamsburg.	Total.
Jan. 31	....	3,741	4,615	327	10,866	....	52,675
Feb. 28	....	1,961	2,175	799	6,464	....	41,274
Mar. 28	....	2,674	4,255	457	6,921	....	46,450
Apr. 25	....	3,113	4,299	....	9,028	146	55,096
May 30	....	2,065	3,580	482	5,154	146	39,371
June 27	....	1,946	3,392	285	5,170	....	37,153
July 25	....	2,844	3,826	684	6,528	141	46,468
Aug. 29	....	841	3,016	137	1,727	....	22,391
Sept. 26	....	969	2,550	155	1,979	157	15,723
Oct. 31	....	3,616	5,549	999	7,906	147	53,450
Nov. 28	....	2,338	2,384	452	3,526	302	32,347
Dec. 26	530	990	3,011	157	2,872	149	30,017
Total	530	27,098	42,652	4,934	68,141	1,188	472,415

SUMMARY OF WELLS DRILLED.

In the following tables are shown the wells completed in Kentucky from 1910 to 1914, inclusive:

Number of wells completed in Kentucky, 1910–1914, by counties.

County.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Allen				7	16				1	1				8	19
Barren				3					3					6	
Cumberland			1						1				1	2	
Daviess					2					1					3
Estill					3										3
Floyd		2	4				1		1	1		3	4	1	1
Johnson					1										1
Lawrence	2		20	9	9	4	1	12	1		6	1	33	11	10
Logan	7	1				1					8	1			
Meade						1					1				
Morgan				32	10				13	5				48	15
Ohio					4					4					8
Wayne	61	94	75	67	68	38	27	44	31	34	99	121	119	98	102
Wolfe		1	9	12	6	4		2	10	4	4	2	11	22	10
Other		2	3	3		3	4	3	8	5	3	8	10	14	6
Total	70	100	112	133	119	51	33	61	69	55	121	136	178	210	178

[a] Including gas wells.

Number of oil wells and dry holes drilled in Kentucky in 1914, by counties and months.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	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.	Oil.	Dry.
Allen					1		1		2		2		1		4		3		2	1					16	1	7	1
Barren																											3	3
Cumberland																												1
Daviess																					2	1			2	1		
Estill											1				1		1								3			
Floyd																		1								1		1
Johnson	1																								1			
Lawrence			3		1						1		1		2				1						9		9	1
Morgan	4	2	1	1	2		1	1					1	1	1										10	5	32	13
Ohio		2					2	2					1				1								4	4		
Wayne	6	1	8	2	7	1	10	4	6	4	10	7	8	3	5	6	3	1		3	3	1	2	1	68	34	67	31
Wolfe				2		1						1			1						3		2		6	4	12	10
Other				2										1				2								5	3	8
Total	11	5	12	7	11	2	14	7	8	4	14	8	12	5	14	6	8	4	3	4	8	2	4	1	119	55	133	69

Number of oil wells drilled in Kentucky, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	6	15	4	11	12	9	11	10	19	11	10	15	133
1914	11	12	11	14	8	14	12	14	8	3	8	4	119

Number of dry holes drilled in Kentucky, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	3	4	......	4	2	9	10	6	5	5	1	2	[a] 51
1911	4	5	5	2	1	1	6	2	......	3	1	3	33
1912	3	1	5	1	3	7	2	7	17	4	7	4	61
1913	4	7	4	9	4	7	6	5	7	2	4	10	69
1914	5	7	2	7	4	8	5	6	5	3	2	1	55

[a] Including gas wells.

Total number of wells completed in Kentucky, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	11	23	9	21	17	16	18	17	26	13	14	25	210
1914	16	19	13	21	12	22	18	20	14	7	10	6	178

[a] Including gas wells.

Initial daily production of new wells completed in Kentucky in 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Allen	.....	.....	15	20	45	40	50	80	60	25	.....	.....	335	114
Barren	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
Daviess	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....	10	.....
Estill	.....	.....	.....	.....	.....	10	.....	3	10	.....	.....	.....	23	.....
Johnson	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....
Lawrence	.....	23	5	.....	.....	10	10	18	.....	3	.....	.....	69	65
Morgan	33	5	13	25	.....	.....	10	10	.....	.....	.....	.....	96	967
Ohio	.....	.....	.....	95	.....	.....	25	.....	30	.....	.....	.....	150	.....
Wayne	97	210	115	127	49	62	60	51	20	.....	40	12	843	723
Wolfe	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	16	13	32	107
Other	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	225
Total	140	238	148	267	94	122	155	165	120	28	66	25	1,568	2,215

Total and average initial daily production of new wells in Kentucky, 1910–1914, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Allen	......	......	......	114	335	......	......	......	16.28	20.93
Barren	......	......	......	14	......	......	......	......	4.66	......
Cumberland	......	......	3	......	......	......	......	3.0	......	......
Daviess	......	......	......	......	10	......	......	......	......	5.00
Estill	......	......	......	......	23	......	......	......	......	7.66
Floyd	......	45	35	......	......	......	......	......	......	......
Johnson	......	......	......	......	10	......	......	......	......	10.00
Lawrence	17	......	148	65	69	8.5	......	7.4	7.22	7.66
Logan	65	10	......	......	......	9.3	10.0	......	......	......
Morgan	......	......	......	967	96	......	......	......	30.22	9.60
Ohio	......	......	......	......	150	......	......	......	......	37.50
Wayne	747	1,729	1,481	723	843	12.2	18.4	19.7	10.79	12.39
Wolfe	......	25	196	107	32	......	25.0	21.8	8.92	5.33
Other	......	13	80	225	......	......	6.5	26.7	75.00	......
Total	829	1,822	1,943	2,215	1,568	11.8	18.2	17.3	16.65	13.17

Total initial daily production of new wells in Kentucky, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	15	110	50	73	149	97	69	60	33	54	81	38	829	69
1911	17	93	101	167	176	89	195	227	358	129	125	145	1,822	152
1912	122	35	341	255	216	255	112	213	121	128	75	70	1,943	162
1913	43	325	105	501	93	138	221	166	192	124	109	198	2,215	185
1914	140	238	148	267	94	122	155	165	120	28	66	25	1,568	131

OHIO.

GENERAL STATEMENT.

Following the precedent of recent years, broken in the last decade only in 1912, the production of petroleum in Ohio in 1914 registered a decline. The State's output of petroleum in 1914 amounted to 8,536,352 barrels, a decrease of less than 3 per cent from the output in 1913, and less than 5 per cent from the output in 1912. Of the year's output 3,727,087 barrels are credited to the Lima field in the northwestern part of the State, and 4,809,265 barrels to the field of the Appalachian province in the southeastern part, the rates of decline below the production in 1913 in these respective divisions being essentially equal, and therefore equivalent to the percentage decline for the State.

Although subject to numerous fluctuations resulting from the declining market of the midsummer months and from the great variety of crudes thus affected within the State, the market price for Ohio petroleum maintained the very satisfactory average of $1.57 a barrel for the year. This price represents a decline of only 43 cents below the State average for 1913, and is otherwise substantially higher than the average yearly price received for Ohio oil since 1877. Lima crudes averaged $1.19 a barrel in 1914, and the higher grades of oil from the southeastern part of the State averaged $1.86 a barrel.

DEVELOPMENT.

Field activity in Ohio in 1914 was distributed over 26 counties in the southeastern part of the State and 15 counties in the northwestern part. A total of 2,894 wells were completed during the year, including 1,628 oil wells, 680 gas wells, and 586 failures, the ratio of the failures to total completions being, for the entire State, approximately 1 to 5. Field work was most active in the spring and early summer, when an advanced market justified the expense of operations in the deep-sand districts and rendered profitable the drilling of low-production wells in the shallow-sand districts. In the face of an unstable and declining market during the summer field activity declined notably and at the end of the year was restricted chiefly to proved areas.

At the end of 1914 there were 31,763 active oil wells in the State of Ohio, compared with 30,947 at the end of 1913.

Southeastern Ohio.—In the many fields of eastern and southeastern Ohio 2,044 wells were completed in 1914, of which 863, or 42 per cent, were productive of oil, and 517, or 25 per cent, were barren. Initial oil production amounted to 12,047 barrels, or an average of approximately 14 barrels per well.

No new pools were discovered in this portion of the State in 1914, nor were notable extensions made in the boundaries of previously proved fields. The deep Clinton sand fields of Hocking, Logan, Fairfield, Perry, Licking, and Muskingum counties furnished the most prolific wells found in the State, and activity in these counties was well sustained throughout the year, interest being centered in the Union Furnace and Logan districts, Hocking County, at the south end of the field. Late in December activity in the search for natural gas resulted in the completion of a good oil well in Ashland County which aroused considerable speculation as to the possibilities of a new deep-sand pool, but the value of the discovery had not been determined up to the end of the year. In and near Cleveland, Cuyahoga County, at the north end of the Clinton sand fields, the year 1914 recorded the very active development of an important gas field in which about half a dozen wells yielded a low production of oil.

In the so-called shallow-sand fields where oil is obtained from various zones in strata of the Carboniferous system activity was nominal and especial interest was focused on no particular pool.

Northwestern Ohio.—In the Ohio division of the Lima field no developments of consequence were recorded. The wells completed numbered 850, of which 69, or only 8 per cent, were failures, and 765, or exactly 90 per cent, yielded oil. The initial production of these wells totaled 9,329 barrels, representing an average yield for the first day of 12.2 barrels a well. Activity was most apparent in Wood, Sandusky, Hancock, and Allen counties, where the drilling of new wells on leases long neglected or even abandoned furnished the bulk of the new production.

MARKETED PRODUCTION.

Marketed production of petroleum in Ohio in 1910–1914, by months and districts, in barrels.

Month.	Lima.				
	1910	1911	1912	1913	1914
January	430,261	395,132	254,382	336,665	341,162
February	389,171	364,706	245,764	275,831	229,310
March	488,017	413,321	316,946	279,117	343,414
April	444,837	380,454	366,846	349,204	338,745
May	443,865	405,705	380,394	333,866	329,256
June	436,721	393,385	354,165	317,476	331,060
July	416,649	367,216	365,227	327,556	337,431
August	436,568	383,440	358,260	319,486	319,529
September	407,103	365,586	322,245	319,443	312,202
October	400,640	376,118	353,881	332,992	314,526
November	397,553	330,800	313,361	296,090	275,469
December	402,751	360,032	[a] 324,426	329,317	254,983
Total	5,094,136	4,535,875	[a] 3,955,897	3,817,043	3,727,087

[a] Includes production of Michigan.

Marketed production of petroleum in Ohio in 1910–1914, by months and districts, in barrels—Continued.

Month.	Southeastern Ohio.				
	1910	1911	1912	1913	1914
January	395,160	346,170	333,489	407,538	444,426
February	355,016	341,747	356,983	364,307	363,537
March	451,068	372,270	443,795	324,699	464,675
April	435,057	345,162	440,834	456,072	448,909
May	454,628	383,774	453,807	420,757	436,266
June	436,580	371,118	416,396	414,698	428,753
July	401,193	341,329	439,748	424,588	456,139
August	412,014	364,138	460,361	410,459	195,617
September	384,210	352,353	410,131	425,023	299,372
October	382,105	358,100	437,877	456,364	507,031
November	353,519	343,691	397,129	406,018	373,117
December	361,684	361,385	422,560	453,902	391,423
Total	4,822,234	4,281,237	5,013,110	4,964,425	4,809,265

Month.	Total.				
	1910	1911	1912	1913	1914
January	825,421	741,302	587,871	744,203	785,588
February	744,187	706,453	602,747	640,138	592,847
March	939,085	785,591	760,741	603,816	808,089
April	879,894	725,596	807,680	805,276	787,654
May	898,493	789,479	834,201	754,623	765,522
June	873,301	764,503	770,561	732,174	759,813
July	817,842	708,545	804,975	752,144	793,570
August	848,582	747,578	818,621	729,945	515,146
September	791,313	717,939	732,376	744,466	611,574
October	782,745	734,218	791,758	789,356	821,557
November	751,072	674,491	710,490	702,108	648,586
December	764,435	721,417	746,986	783,219	646,406
Total	9,916,370	8,817,112	8,969,007	8,781,468	8,536,352

Quantity, value, and average price per barrel of petroleum produced in Ohio, 1905–1914, by districts, in barrels.

Year.	Lima.		Average price per barrel.	Southeastern Ohio.		Average price per barrel.	Total.		Average price per barrel.
	Quantity.	Value.		Quantity.	Value.		Quantity.	Value.	
1905	11,329,924	$10,061,992	$0.888	5,016,736	$6,992,885	$1.393	16,346,660	$17,054,877	$1.043
1906	9,881,184	9,157,641	.926	4,906,579	7,839,359	1.597	14,787,763	16,997,000	1.149
1907	7,993,057	7,425,480	.929	4,214,391	7,344,408	1.742	12,207,448	14,769,888	1.209
1908	6,748,676	6,861,885	1.016	4,110,121	7,316,617	1.780	10,858,797	14,178,502	1.305
1909	5,915,357	5,451,497	.921	4,717,436	7,773,880	1.647	10,632,793	13,225,377	1.243
1910	5,094,136	4,181,629	.821	4,822,234	6,469,939	1.341	9,916,370	10,651,568	1.074
1911	4,535,875	3,888,119	.857	4,281,237	5,591,423	1.306	8,817,112	9,479,542	1.075
1912	[a] 3,955,897	3,908,809	.988	5,013,110	8,177,189	1.628	8,969,007	12,085,998	1.347
1913	3,817,043	5,308,842	1.391	4,964,425	12,229,610	2.463	8,781,468	17,538,452	1.997
1914	3,727,087	4,435,314	1.190	4,809,265	8,937,415	1.858	8,536,352	13,372,729	1.567

[a] Includes production of Michigan.

SUMMARY OF WELLS DRILLED.

Number of wells completed in central and southeastern Ohio, 1911–1914, by counties.

County.	Oil.				Dry.				Total completed.[a]			
	1911	1912	1913	1914	1911	1912	1913	1914	1911	1912	1913	1914
Ashland			1	2	12	34	21	15	100	131	118	88
Athens		3	15	7		5	12	8		10	28	19
Belmont		9	21	15		3	29	24		13	58	55
Carroll	10	5	21	29	20	5	22	7	36	11	44	38
Columbiana	14	4	28	58	30	13	18	12	44	17	47	72
Coshocton	7	9	15	13	7	1		5	17	10	18	18
Cuyhoga	1	4		7		4	1	35	2	19	1	384
Delaware					1				1			
Erie								1	1			2
Fairfield	57	25	44	25	35	19	28	13	115	60	91	44
Guernsey			11				22	2			33	2
Harrison	10	11	19	17	4	7	10	7	17	23	29	25
Hocking	38	74	178	97	12	12	30	48	92	129	137	181
Holmes			1		3		2		4		3	
Jackson					1				1			
Jefferson	28	30	60	33	31	19	22	16	79	57	83	58
Knox			1		11	12	8	1	44	53	24	1
Lake										1		
Licking	6	37	38	16	34	35	26	18	164	169	144	92
Lorain	1	1	1		2	13	5	3	6	19	8	4
Madison						1				1		
Medina	1				4	5	8	7	14	23	28	29
Monroe	43	70	100	51	42	24	31	35	98	102	137	93
Morgan	117	118	142	91	55	78	50	45	172	196	192	136
Muskingum	9	18	21	15	12	11	8	5	28	30	33	23
Noble	95	19	62	45	62	21	37	40	163	43	101	90
Perry	[b] 107	188	172	112	[b] 31	23	40	34	[b] 140	219	220	151
Richland					1	4	8	16	3	21	31	33
Ross	1								1			
Summit						2	2			3	2	
Tuscarawas						2	1			2	1	
Vinton	4	1			2	1		2	8	5		6
Washington	215	206	370	221	98	94	151	104	324	303	533	333
Wayne	1	14	25	9	2	12	11	15	6	47	47	61
Total	765	846	1,246	863	512	460	603	517	1,680	1,717	2,191	2,044

[a] Includes gas wells. [b] Includes Athens County.

Number of oil wells and dry holes drilled in central and southeastern Ohio in 1914, by counties and months.

County.	January.		February.		March.		April.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Ashland		2		2						1		1		3
Athens	1	2	1				1		1			1		1
Belmont	4	1	2	3	2	4	1	4	1	2	1	2		3
Carroll	3		2	2	2	1	4	1	2		1	1	4	
Columbiana	3		1	1	8	1	5	1	4	1	4	1	15	2
Coshocton			1	1	2						3		3	
Cuyahoga							1	1	1	3		4		6
Erie														
Fairfield	3	4	3	2	2	1	3	1	4	3	3		2	1
Guernsey										1				
Harrison	3	1	2	1			1		2	1	2	2	5	1
Hocking	11	4	11	4	12	5	8	3	11	3	6	4	13	5
Holmes														
Jefferson	3		3	2	1		3	2	3	2	6	2	4	3
Knox		1												
Licking		4	3	2	3	1	1	1	4	1		1	1	4
Lorain		1				1		1						
Medina		2												
Monroe	9	6	4	4	4	2	6	2	5	2	5	3	3	3
Morgan	5	4	11	3	11	1	14	5	9	6	8	2	7	7
Muskingum	6	1	2	3	1		1		1		2			
Noble	4		6	6			6	3	8	4	5	5	4	7
Perry	19	3	9	6	11	4	18	3	21	4	12	3	6	3
Richland		3												
Summit														
Tuscarawas														
Vinton										1				
Washington	28	12	23	9	15	7	39	21	17	14	30	15	16	7
Wayne	3	1	2		2	1		5	2	1		1		1
Total	105	52	86	51	76	29	112	54	100	50	88	48	83	57

Number of oil wells and dry holes drilled in central and southeastern Ohio in 1914, by counties and months—Continued.

County.	August.		September.		October.		November.		December.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Ashland		1		1	1	3			1	1	2	15	1	21
Athens	1	1				2			2		7	7	15	12
Belmont	1	5			2		1				15	24	21	29
Carroll	2	1	2		1		2	1	4		29	7	21	22
Columbiana	8	1		1	5	1	4		1	2	58	12	28	18
Coshocton		2		2							13	5	15	
Cuyahoga	1	7	1	2	1	2		6	2	4	7	35		1
Erie						1						1		
Fairfield	2				1	1			2		25	13	44	28
Guernsey								1				2	11	22
Harrison	2									1	17	7	19	10
Hocking	7	3	6	4	7	6	1	4	4	3	97	48	78	30
Holmes													1	2
Jefferson	4	3	1		2		2	1	1	1	33	16	60	22
Knox												1	1	8
Licking	1	2	1		2			2			16	18	38	26
Lorain												3	1	5
Medina		3				2						7		8
Monroe	5	4	3	3	2	5	1	1	4		51	35	100	31
Morgan	11	5	3	2	3	3	6	4	3	3	91	45	142	50
Muskingum			2					1			15	5	21	8
Noble	3	4	1	4	4	1	1	4	3	2	45	40	62	37
Perry	6	2	2	2	4	2	2		2	2	112	34	172	40
Richland		5		1		5		2				16		8
Summit														2
Tuscarawas														1
Vinton		1										2		
Washington	16	6	5	4	7	3	12	5	13	1	221	104	370	151
Wayne				2				3			9	15	25	11
Total	70	56	27	28	42	37	32	35	42	20	863	517	1,246	603

Number of oil wells drilled in central and southeastern Ohio, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	62	71	93	86	89	108	96	76	85	58	71	58	953
1911	61	59	57	61	65	71	57	61	66	67	71	69	765
1912	45	49	48	65	79	89	86	81	71	94	65	74	846
1913	66	76	95	94	123	110	104	131	122	120	105	100	1,246
1914	105	86	76	112	100	88	83	70	27	42	32	42	863

Number of dry holes drilled in central and southeastern Ohio, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	43	33	49	57	53	67	54	44	79	62	59	95	[a] 686
1911	36	32	41	33	38	50	56	53	36	48	45	44	512
1912	31	17	28	26	33	32	50	49	65	51	41	37	460
1913	45	51	36	44	46	49	50	61	49	57	49	66	603
1914	52	51	29	52	50	48	57	52	28	37	35	20	517

[a] Including gas wells.

Total number of wells completed in central and southeastern Ohio, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	105	104	142	143	142	175	150	120	155	120	130	153	1,639
1911	138	121	121	114	129	151	149	133	144	162	142	146	1,680
1912	90	83	97	113	127	158	177	163	196	203	156	154	1,717
1913	140	165	151	148	184	172	174	227	200	224	200	206	2,191
1914	197	165	121	193	190	182	224	180	142	151	148	151	2,044

[a] Including gas wells.

Initial daily production of new wells completed in central and southeastern Ohio in 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Ashland	......	......	......	......	......	......	......	......	......	20	......	30	50	20
Athens	2	3	......	2	2	......	......	2	......	......	......	3	14	39
Belmont	112	27	20	5	4	60	......	20	......	60	10	......	318	710
Carroll	5	3	2	8	4	1	8	4	2	5	8	22	72	62
Columbiana	6	3	29	13	7	37	81	57	......	12	23	10	278	105
Coshocton	......	5	10	......	20	39	8	......	......	......	......	......	82	152
Cuyahoga	......	......	......	25	10	......	......	20	10	5	......	8	78	......
Fairfield	65	50	85	75	35	50	60	55	......	5	......	50	530	1,227
Guernsey	......	......	......	......	......	......	......	......	......	......	......	......	......	45
Harrison	17	2	......	5	8	10	11	4	......	......	......	......	57	86
Hocking	480	539	860	565	660	120	475	347	325	230	5	105	4,711	3,638
Holmes	......	......	......	......	......	......	......	......	......	......	......	......	......	2
Jefferson	12	17	2	8	10	19	9	4	10	4	5	1	101	218
Knox	......	......	......	......	......	......	......	......	......	......	......	......	......	10
Licking	......	55	15	18	140	......	75	5	5	17	......	......	330	857
Lorain	......	......	......	......	......	......	......	......	......	......	......	......	......	15
Monroe	65	20	19	32	33	29	5	104	12	8	10	11	348	912
Morgan	13	54	36	52	39	50	43	33	9	6	11	15	361	454
Muskingum	47	5	25	7	2	9	......	......	10	......	......	......	105	107
Noble	16	14	......	16	54	24	10	5	4	16	2	8	169	318
Perry	747	251	321	175	622	124	96	142	65	240	15	8	2,806	4,785
Washington	134	205	62	248	78	144	62	49	15	23	151	136	1,307	1,676
Wayne	130	65	55	......	80	......	......	......	......	......	......	......	330	864
Total	1,851	1,318	1,541	1,254	1,808	716	943	851	467	651	240	407	12,047	16,302

Total and average initial daily production of new wells in central and southeastern Ohio, 1911–1914, by counties, in barrels.

County.	Total initial production.				Average initial production per well.			
	1911	1912	1913	1914	1911	1912	1913	1914
Ashland	....	....	20	50	....	....	20.00	25.00
Athens	....	8	39	14	....	2.66	2.60	2.00
Belmont	....	553	710	318	....	61.44	33.81	21.20
Carroll	80	14	62	72	8.00	2.80	2.95	2.48
Columbiana	69	21	105	278	4.93	5.25	3.75	4.79
Coshocton	100	86	152	82	14.29	9.55	10.13	6.31
Cuyahoga	10	45	....	78	10.00	11.25	....	11.14
Fairfield	1,040	494	1,227	530	18.25	19.76	27.89	21.20
Guernsey	....	....	45	....	....	....	4.09	....
Harrison	35	59	86	57	3.50	5.36	4.53	3.35
Hocking	1,386	2,986	3,638	4,711	36.47	40.35	46.64	48.58
Holmes	....	....	2	....	....	....	2.00	....
Jefferson	91	135	218	101	3.25	4.50	3.63	3.06
Knox	....	....	10	....	....	....	10.00	....
Licking	143	734	857	330	2.38	19.84	22.55	20.62
Lorain	10	10	15	....	10.00	10.00	15.00	....
Medina	35	....	....	....	35.00	....	....	....
Monroe	393	784	912	348	9.14	11.20	9.12	6.82
Morgan	1,488	781	454	361	12.72	6.62	3.20	3.97
Muskingum	228	393	107	105	25.33	21.83	5.09	7.00
Noble	325	93	318	169	3.42	4.89	5.13	3.76
Perry	[a] 3,681	15,117	4,785	2,806	34.40	83.98	27.82	25.05
Ross	5	....	....	....	5.00	....	....	....
Vinton	77	5	....	....	19.25	5.00	....	....
Washington	1,702	1,290	1,676	1,307	7.91	6.26	4.53	5.91
Wayne	25	585	864	330	25.00	41.78	34.56	36.67
Total	10,923	24,193	16,302	12,047	14.28	28.60	13.08	13.96

[a] Includes Athens County.

Total initial daily production of new wells in central and southeastern Ohio, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	1,319	1,440	2,388	2,747	2,314	2,065	1,296	872	1,055	1,195	783	642	18,116	1,510
1911	882	973	666	687	1,222	709	577	772	895	916	1,526	1,098	10,923	910
1912	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	2,016
1913	871	1,116	1,241	1,023	1,328	1,282	1,507	1,609	1,559	2,159	1,784	823	16,302	1,359
1914	1,851	1,318	1,541	1,254	1,808	716	943	851	467	651	240	407	12,047	1,004

In the following tables are shown the number of wells completed in the Lima (Ohio) oil field from 1910 to 1914, inclusive:

Number of wells completed in the Lima (Ohio) district, 1910–1914, by counties.

County.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Allen	12	21	54	138	71	1	.....	2	5	4	13	21	56	143	75
Auglaize	17	12	7	19	24	5	4	4	7	6	22	18	11	27	30
Hancock	114	104	101	172	120	8	2	7	20	19	125	113	116	193	144
Hardin	2	2	.....	.....	2	.....	.....	.....	.....	2	5	2	.....	.....	4
Henry	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Lucas	7	21	18	29	39	.....	1	2	8	3	7	22	21	37	42
Mercer	4	9	11	40	15	1	2	1	5	2	5	12	12	45	17
Ottawa	23	14	7	24	17	1	3	2	3	.....	25	18	9	29	17
Putnam	1	2	.....	2	3	.....	.....	.....	.....	.....	1	2	.....	2	3
Sandusky	64	56	53	104	145	5	2	8	5	6	71	58	62	109	152
Seneca	47	35	29	35	23	7	8	9	7	6	54	44	40	43	29
Shelby	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Van Wert	18	23	19	38	41	2	1	1	4	2	20	24	21	42	45
Wood	189	179	177	271	263	26	9	18	23	19	217	191	196	298	288
Wyandot	3	2	4	1	.....	1	.....	.....	2	.....	5	2	4	3	2
Miscellaneous	.....	.....	2	.....	.....	.....	.....	1	1	.....	2	.....	3	1	.....
Total	501	480	482	873	765	57	32	55	90	69	572	527	551	972	850

[a] Including gas wells.

Number of oil wells and dry holes drilled in the Lima (Ohio) district in 1914, by counties and months.

County.	January.		February.		March.		April.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Allen	11	1	10	.....	7	.....	9	.....	11	2	9	.....	6	.....
Auglaize	4	.....	2	.....	4	.....	.....	1	4	.....	2	3	3	1
Hancock	19	2	14	3	9	.....	7	5	9	2	13	3	8	.....
Hardin	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Henry	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lucas	1	.....	6	1	2	.....	5	1	4	.....	2	.....	3	.....
Mercer	1	.....	1	.....	2	1	1	.....	2	1	2	.....	2	.....
Ottawa	3	.....	.....	.....	1	.....	.....	.....	3	.....	2	.....	2	.....
Putnam	.....	.....	1	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....
Sandusky	17	1	10	.....	9	.....	14	.....	11	1	12	1	17	.....
Seneca	.....	1	2	.....	.....	1	2	.....	4	1	2	.....	3	.....
Shelby	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Van Wert	4	.....	3	1	4	.....	5	.....	9	.....	4	.....	4	1
Wood	23	.....	24	1	27	1	19	4	36	2	27	7	27	2
Wyandot	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Miscellaneous	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	84	5	74	6	65	3	63	11	94	10	75	14	75	4

Number of oil wells and dry holes drilled in the Lima (Ohio) district in 1914, by counties and months—Continued.

County.	August.		September.		October.		November.		December.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Allen	5	1	3								71	4	138	5
Auglaize	2	1	2				1				24	6	19	7
Hancock	14	1	12	2	6		4		5	1	120	19	172	20
Hardin		1	1								2	2		
Henry											1			
Lucas	2		6		1	1	5		2		39	3	29	8
Mercer	2		1				1				15	2	40	5
Ottawa	2		3		1						17		24	3
Putnam											3		2	
Sandusky	17		11	3	13		6		8		145	6	104	5
Seneca	3		2		3	3			2		23	6	35	7
Shelby									1		1			
Van Wert	3		2				1		2		41	2	38	4
Wood	21		23		15	2	7		14		263	19	271	23
Wyandot													1	2
Miscellaneous														1
Total	71	4	66	5	39	6	25		34	1	765	69	873	90

Number of oil wells drilled in Lima (Ohio) district, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	48	39	57	41	70	73	98	102	83	88	86	88	873
1914	84	74	65	63	94	75	75	71	66	39	25	34	765

Number of dry holes drilled in the Lima (Ohio) district, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	5	2	4	4	6	6	7	5	5	4	5	4	57
1911	3	4	1		4	5	4	3		2	4	2	32
1912	1	1	4	3	5	5	5	7	10	5	7	2	55
1913	4	3	8	10	8	6	6	16	13	8	4	4	90
1914	5	6	3	11	10	14	4	4	5	6		1	69

Total number of wells completed in the Lima (Ohio) district, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	53	43	65	52	78	80	107	119	96	96	90	93	972
1914	91	82	70	74	104	89	80	76	72	49	26	37	850

[a] Including gas wells.

Initial daily production of new wells completed in the Lima (Ohio) district in 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total. 1913.
Allen	160	96	87	107	116	78	62	33	23	......	......	......	762	1,883
Auglaize	59	52	58	......	45	45	8	6	10	......	2	......	285	142
Hancock	185	215	112	119	120	168	166	207	99	53	24	75	1,543	2,924
Hardin	......	60	......	......	......	......	......	......	1	......	......	......	61	......
Henry	3	......	......	......	......	......	......	......	......	......	......	......	3	......
Lucas	20	91	30	87	33	13	206	55	115	5	42	95	792	373
Mercer	20	50	15	20	15	15	10	15	3	......	20	......	183	573
Ottawa	25	......	5	......	18	20	25	7	14	3	......	......	117	148
Putnam	......	18	......	15	10	......	......	......	......	......	......	......	43	7
Sandusky	99	43	72	85	43	54	55	106	44	74	46	43	764	625
Seneca	......	27	......	8	62	152	138	37	38	26	......	225	713	713
Shelby	......	......	......	......	......	......	......	......	......	......	......	10	10	......
Van Wert	95	55	57	90	118	18	34	20	8	......	20	15	530	379
Wood	293	209	621	228	387	525	413	171	342	116	67	151	3,523	3,404
Wyandot	......	......	......	......	......	......	......	......	......	......	......	......	......	10
Total	959	916	1,057	759	967	1,088	1,117	657	697	277	221	614	9,329	11,181

Total and average initial daily production of new wells in the Lima (Ohio) district, 1910–1914, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Allen	110	171	699	1,883	762	9.2	8.1	12.9	13.6	10.7
Auglaize	306	174	47	142	285	18.0	14.5	6.7	7.5	11.9
Hancock	1,505	1,546	1,379	2,924	1,543	13.2	14.9	13.7	17.0	12.9
Hardin	13	25	....	....	61	6.5	12.5	....	....	30.5
Henry	....	....	....	....	3	....	....	....	....	3.0
Lucas	116	412	172	373	792	16.6	19.6	9.5	12.9	20.3
Mercer	65	60	111	573	183	16.3	6.7	10.1	14.4	12.2
Ottawa	183	108	36	148	117	8.0	7.7	5.1	6.2	6.9
Putnam	3	12	....	7	43	3.0	6.0	....	3.5	14.3
Sandusky	422	312	266	625	764	6.6	5.6	5.0	6.0	5.3
Seneca	737	341	1,041	713	713	15.7	9.7	35.9	20.4	31.0
Shelby	....	....	....	....	10	....	....	....	....	10.0
Van Wert	192	369	272	379	530	10.7	16.0	14.3	10.0	12.7
Wood	3,003	2,836	3,153	3,404	3,523	15.9	15.8	17.8	12.6	13.4
Wyandot	90	15	37	10	....	30.0	7.5	9.3	10.0	....
Miscellaneous	....	....	16	....	....	....	....	8.0	....	....
Total	6,745	6,381	7,229	11,181	9,329	13.5	13.3	15.0	12.8	12.2

Total initial daily production of new wells in the Lima (Ohio) district, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	377	425	500	530	565	447	684	735	794	441	723	524	6,745	562
1911	508	599	323	483	460	559	498	630	470	793	465	593	6,381	532
1912	192	221	983	440	619	767	643	781	743	463	839	538	7,229	602
1913	709	439	599	632	871	1,206	1,243	1,414	898	923	1,222	1,025	11,181	932
1914	959	916	1,057	759	967	1,088	1,117	657	697	277	221	614	9,329	777

LIMA-INDIANA OIL FIELD.

GENERAL STATEMENT.

The Lima-Indiana field embraces all the oil pools lying in the northwestern part of Ohio and in the eastern part of Indiana. The field became a commercial factor in the crude petroleum industry in 1886, producing during the first year of its existence a little more than 4 per cent of the total petroleum output of the entire United States. Ten years later, in 1906, the field attained its maximum annual output, which was in excess of 25,000,000 barrels and which constituted more than 41 per cent of the total output of petroleum of the country in that year. Between 1904 and 1911 the field recorded a rapid decline, retarded considerably in 1912 and 1913 and reversed in 1914. In the last year the marketed production of the field represented only 1.9 per cent of the total for the entire United States.

MARKETED PRODUCTION.

Marketed production of petroleum in the Lima-Indiana field in 1913 and 1914, by months, in barrels.

Month.	1913			1914		
	Lima, Ohio.	Indiana.	Total.	Lima, Ohio.	Indiana.	Total.
January	336,665	73,237	409,902	341,162	109,891	451,053
February	275,831	70,336	346,167	229,310	97,045	326,355
March	279,117	57,204	336,321	343,414	120,508	463,922
April	349,204	78,764	427,768	338,745	126,670	465,415
May	333,866	77,379	411,245	329,256	128,493	457,749
June	317,476	73,056	390,532	331,060	129,855	460,915
July	327,556	73,838	401,394	337,431	121,122	458,553
August	319,486	72,467	391,953	319,529	109,939	429,468
September	319,443	81,462	400,905	312,202	110,299	422,501
October	332,992	91,368	424,560	314,526	105,969	420,495
November	296,090	98,444	394,534	275,469	88,272	363,741
December	329,317	108,540	437,857	254,983	87,393	342,376
Total	3,817,043	956,095	4,773,138	3,727,087	1,335,456	5,062,543

Marketed production of petroleum in the Lima-Indiana field, 1886–1914, in barrels.

Year.	Marketed production.	Percentage of total production.	Increase (+) or decrease (−) from preceding year.	Percentage of increase (+) or decrease (−).	Value.	Yearly average price per barrel.
1886	1,137,869	4.06			$444,198	$0.390
1887	4,650,375	16.44	+3,512,506	+308.69	953,327	.205
1888	9,682,683	35.07	+5,032,308	+108.21	1,452,402	.150
1889	12,186,564	34.66	+2,503,881	+ 25.86	1,833,859	.150
1890	15,078,378	32.91	+2,891,814	+ 23.73	4,536,927	.301
1891	17,452,612	32.15	+2,374,234	+ 15.75	5,333,797	.306
1892	15,867,575	31.41	−1,585,037	− 9.08	5,814,629	.366
1893	15,982,097	33.00	+ 114,522	+ .75	7,497,597	.469
1894	17,296,510	35.05	+1,314,413	+ 8.22	8,306,025	.480
1895	20,236,741	38.26	+2,940,231	+ 17.00	14,184,256	.700
1896	25,255,870	41.43	+5,019,129	+ 24.80	16,678,028	.660
1897	22,805,033	37.71	−2,450,837	− 9.70	10,848,097	.476
1898	20,321,323	36.71	−2,483,710	− 10.89	12,458,904	.613
1899	20,225,356	35.44	− 95,967	− .47	18,082,723	.894
1900	21,758,750	34.20	+1,533,394	+ 7.58	21,367,287	.982
1901	21,933,379	31.61	+ 174,629	+ .80	18,734,438	.854
1902	23,358,626	26.31	+1,425,247	+ 6.50	20,810,694	.890
1903	24,080,264	23.97	+ 721,638	+ 3.09	27,825,466	1.155
1904	24,689,184	21.09	+ 608,920	+ 2.53	26,970,803	1.092
1905	22,294,171	16.55	−2,395,013	− 9.70	19,466,901	.873
1906	17,554,661	13.88	−4,739,510	− 21.26	15,927,707	.907
1907	13,121,094	7.90	−4,433,567	− 25.26	11,962,410	.912
1908	10,032,305	5.62	−3,088,789	− 23.54	10,065,768	1.003
1909	8,211,443	4.48	−1,820,862	− 18.15	7,449,107	.907
1910	7,253,861	3.46	− 957,582	− 11.66	5,750,104	.793
1911	6,231,164	2.83	−1,022,697	− 14.10	5,116,954	.821
1912	a 4,925,906	2.21	−1,305,258	− 20.95	4,794,784	.932
1913	4,773,138	1.93	− 152,768	− 3.10	6,588,068	1.380
1914	5,062,543	1.90	+ 289,405	+ 6.07	5,983,356	1.182
Total	433,459,475	13.00			317,238,616	.732

a Includes production of Michigan.

Marketed production of petroleum in the Lima-Indiana field in 1913 and 1914, by States, showing increase and percentage of increase by fields, in barrels.

District.	Production.			Percentage of increase (+) or decrease (−).
	1913	1914	Increase (+) or decrease (−).	
North Lima	3,144,968	3,077,007	− 67,961	− 2.16
South Lima	672,075	650,080	− 21,995	− 3.27
Indiana	956,095	1,335,456	+379,361	+39.68
Total	4,773,138	5,062,543	+289,405	+ 6.07

Marketed production, value, and average price per barrel of petroleum in the Lima-Indiana field, 1905–1914, in barrels.

Year.	North Lima, Ohio.		Average price per barrel.	South Lima, Ohio.		Average price per barrel.
	Quantity.	Value.		Quantity.	Value.	
1905	6,931,635	$6,290,459	$0.907	4,398,289	$3,771,533	$0.857
1906	6,859,669	6,479,607	.944	3,021,515	2,678,034	.886
1907	6,399,917	6,016,238	.940	1,593,140	1,409,242	.885
1908	5,430,124	5,574,400	1.027	1,318,552	1,287,485	.977
1909	4,761,065	4,434,277	.931	1,154,292	1,017,220	.881
1910	4,131,060	3,431,618	.831	963,076	750,011	.779
1911	3,676,397	3,221,308	.876	859,478	666,811	.776
1912	[a] 3,237,926	3,237,849	1.000	717,971	670,960	.934
1913	3,144,968	4,403,858	1.400	672,075	904,984	1.346
1914	3,077,007	3,687,742	1.198	650,080	747,572	1.150

Year.	Indiana.		Average price per barrel.	Total.		Average price per barrel.
	Quantity.	Value.		Quantity.	Value.	
1905	10,964,247	$9,404,909	$0.858	22,294,171	$19,466,901	$0.873
1906	7,673,477	6,770,066	.882	17,554,661	15,927,707	.907
1907	5,128,037	4,536,930	.885	13,121,094	11,962,410	.912
1908	3,283,629	3,203,883	.976	10,032,305	10,065,768	1.003
1909	2,296,086	1,997,610	.870	8,211,443	7,449,107	.907
1910	2,159,725	1,568,475	.726	7,253,861	5,750,104	.793
1911	1,695,289	1,228,835	.725	6,231,164	5,116,954	.821
1912	970,009	885,975	.913	4,925,906	4,794,784	.932
1913	956,095	1,279,226	1.337	4,773,138	6,588,068	1.380
1914	1,335,456	1,548,042	1.159	5,062,543	5,983,356	1.182

[a] Includes production of Michigan.

Marketed production of petroleum in the Lima-Indiana field, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	573,742	541,714	318,785	409,902	451,053
February	525,559	499,770	308,755	346,167	326,355
March	651,605	768,873	398,094	336,321	463,922
April	606,702	514,381	459,811	427,768	465,415
May	622,447	545,007	481,496	411,245	457,749
June	729,242	525,481	439,984	390,532	460,915
July	635,859	487,953	455,238	401,394	458,553
August	637,249	505,856	444,752	391,953	429,468
September	586,639	479,695	400,677	400,905	422,501
October	569,978	483,435	437,515	424,560	420,495
November	557,431	419,807	383,094	394,534	363,741
December	557,408	459,192	397,705	437,857	342,376
Total	7,253,861	6,231,164	4,925,906	4,773,138	5,062,543

Average daily output of petroleum in the Lima-Indiana field each month, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	18,508	17,475	10,283	13,223	14,550
February	18,770	17,849	10,647	12,363	11,656
March	21,020	24,802	12,842	10,849	14,965
April	20,223	17,146	15,327	14,259	15,514
May	20,079	17,581	15,532	13,266	14,766
June	24,308	17,516	14,666	13,017	15,364
July	20,512	15,740	14,685	12,948	14,792
August	20,556	16,318	14,347	12,644	13,854
September	19,555	15,990	13,356	13,364	14,083
October	18,386	15,595	14,113	13,695	13,564
November	18,581	13,994	12,770	13,151	12,125
December	17,981	14,813	12,829	14,124	11,044
Average	19,874	17,072	13,459	13,077	13,870

PIPE-LINE RUNS IN LIMA-INDIANA OIL FIELD.

Pipe-line runs in the Lima-Indiana oil field in 1913 and 1914, by months, in barrels.

Month.	Buckeye pipe line.	Other Ohio.	Indiana pipe line.	Other Indiana.	Total.
1913.					
January	234,428	102,237	56,477	16,760	409,902
February	191,841	83,990	55,024	15,312	346,167
March	191,646	87,471	39,137	18,067	336,321
April	244,764	104,440	59,179	19,385	427,768
May	233,760	100,106	59,636	17,743	411,245
June	220,054	97,422	54,643	18,413	390,532
July	229,084	98,472	55,947	17,891	401,394
August	223,957	95,529	51,136	21,331	391,953
September	225,303	94,140	49,574	31,888	400,905
October	239,187	93,805	49,423	42,145	424,560
November	207,835	88,255	44,873	53,571	394,534
December	232,531	96,786	50,055	58,485	437,857
Total	2,674,390	1,142,653	625,104	330,991	4,773,138
1914.					
January	240,830	100,332	49,141	60,750	451,053
February	161,001	68,309	34,748	62,297	326,355
March	236,771	106,643	41,493	79,015	463,922
April	232,468	106,277	49,558	77,112	465,415
May	231,764	97,492	45,612	82,881	457,749
June	228,892	102,168	44,667	85,188	460,915
July	230,815	106,616	45,176	75,946	458,553
August	215,483	104,046	40,109	69,830	429,468
September	214,212	97,990	40,010	70,289	422,501
October	213,851	100,675	41,345	64,624	420,495
November	185,997	89,472	31,271	57,001	363,741
December	175,184	79,799	30,510	56,883	342,376
Total	2,567,268	1,159,819	493,640	841,816	5,062,543

Pipe-line runs and deliveries of Lima-Indiana oil, by months, in barrels, in 1913 and 1914, and stocks at end of each month.

Month.	1913			1914		
	Runs.	Deliveries.	Stocks.	Runs.	Deliveries.	Stocks.
Dec. 31, 1912	....	....	2,419,541	....	....	....
January	409,902	374,280	2,455,163	451,053	365,581	1,831,827
February	346,167	442,569	2,358,761	326,355	276,382	1,881,800
March	336,321	439,064	2,256,018	463,922	626,835	1,718,887
April	427,768	330,353	2,353,433	465,415	424,473	1,759,829
May	411,245	694,753	2,169,925	457,749	502,862	1,714,716
June	390,532	480,573	2,079,884	460,915	357,174	1,818,457
July	401,394	325,058	2,156,220	458,553	443,323	1,833,687
August	391,953	481,723	2,067,450	429,468	378,259	1,884,896
September	400,905	317,730	2,150,625	422,501	387,762	1,919,635
October	424,560	673,064	1,902,121	420,495	450,280	1,889,850
November	394,534	428,586	1,768,069	363,741	490,933	1,762,658
December	437,857	458,571	1,746,355	342,376	456,419	1,648,615
Total	4,773,138	5,446,324	....	5,062,543	5,160,283	....

PRICES OF PETROLEUM IN LIMA-INDIANA FIELD.

In the following table are shown the fluctuations in prices for the various grades of Lima and Indiana oil in 1912–1914. The dates are those on which changes in prices became effective:

Fluctuations in prices of Lima (Ohio) and Indiana petroleum in 1912–1914, per barrel.

Date.	1912			Date.	1913			Date.	1914		
	North Lima.	South Lima and Indiana.	Princeton, Ind.		North Lima.	South Lima and Indiana.	Princeton, Ind.		North Lima.	South Lima and Indiana.	Princeton, Ind.
Jan. 1	$0.84	$0.79	$0.67	Jan. 1	$1.25	$1.20	$1.05	Jan. 1	$1.49	$1.44	$1.45
Jan. 2	.87	.82	.70	Jan. 3	......	......	1.08	Apr. 18	1.44	1.39	1.40
Jan. 6	.89	.84	.72	Jan. 6	1.28	1.23	......	Apr. 25	1.39	1.34	1.35
Jan. 24	.92	.87	......	Jan. 27	1.31	1.26	1.11	Apr. 28	1.34	1.29	1.30
Feb. 1	.95	.90	.75	Feb. 1	1.34	1.29	1.14	May 1	1.29	1.24	1.25
Mar. 4	.98	.93	.81	Feb. 5	......	......	1.17	May 5	1.24	1.19	1.20
Apr. 24	1.00	.95	.83	Feb. 6	1.37	1.32	1.20	May 12	1.19	1.14	1.15
May 20	1.02	.97	......	Feb. 20	......	......	1.25	June 17	1.16	1.11	1.12
May 24	......	......	.85	Apr. 16	1.39	1.34	1.30	Aug. 1	1.11	1.06	1.07
July 25	1.04	.99	.87	Nov. 5	1.44	1.39	1.35	Aug. 7	1.06	1.01	1.02
Oct. 28	1.07	1.02	......	Nov. 22	1.49	1.44	......	Sept. 15	1.01	.96	.97
Nov. 9	1.09	1.04	.89	Dec. 9	......	......	1.45	Sept. 23	.96	.91	.92
Nov. 15	1.11	1.06	.91					Oct. 26	.93	.88	.89
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								

Average monthly prices of Ohio and Indiana petroleum in 1912, 1913, and 1914, per barrel.

Month.	1912			1913			1914		
	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	$0.89	$0.84	$0.72	$1.28	$1.23	$1.08	$1.49	$1.44	$1.45
February	.95	.90	.75	1.36	1.31	1.21	1.49	1.44	1.45
March	.98	.93	.80	1.37	1.32	1.25	1.49	1.44	1.45
April	.98	,93	.81	1.38	1.33	1.28	1.45	1.40	1.41
May	1.01	.96	.83	1.39	1.34	1.30	1.21	1.16	1.17
June	1.02	.97	.85	1.39	1.34	1.30	1.18	1.13	1.14
July	1.02	.97	.85	1.39	1.34	1,30	1.16	1.11	1.12
August	1.04	.99	.87	1.39	1.34	1.30	1.07	1.02	1.03
September	1.04	.99	.87	1.39	1.34	1.30	1.02	.97	.98
October	1.04	.99	.87	1.39	1.34	1.30	.95	.90	.91
November	1.10	1.05	.90	1.45	1.41	1.34	.93	.88	.89
December	1.21	1.16	1.01	1.49	1.44	1.42	.93	.88	.89
Average	1.023	.973	.844	1.390	1.340	1.282	1.19	1.15	1.16
Average of North Lima, South Lima, and Indiana	.998			1.365			1.17		

Highest, lowest, and average prices of Lima (Ohio) petroleum, 1905–1914, per barrel.

Year.	Highest.	Lowest.	Average.	Year.	Highest.	Lowest.	Average.
1905	[a] $1.01	[b] $0.81	$0.888	1910	[a] $0.84	[b] $0.77	$0.804
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
1908	[a] 1.04	[b] .89	1.001	1913	[a] 1.49	[b] 1.20	1.375
1909	[a] 1.04	[b] .79	.906	1914	[a] 1.49	[b] .88	1.17

[a] North Lima. [b] South Lima.

SUMMARY OF WELLS DRILLED.

Number of wells completed in the Lima-Indiana field, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Lima, Ohio	501	480	482	873	765	57	32	55	90	69	572	527	551	972	850
Indiana	284	74	65	213	470	66	35	20	86	259	366	117	89	311	742
Total	785	554	547	1,086	1,235	123	67	75	176	328	938	644	640	1,283	1,592

Number of oil wells and dry holes drilled in the Lima-Indiana field in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1915.	
	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.	Oil.	Dry.
Lima, Ohio	84	5	74	6	65	3	63	11	94	10	75	14	75	4	71	4	66	5	39	6	25	..	34	1	765	69	873	90
Indiana	36	17	45	25	42	30	44	27	74	27	79	34	54	26	40	22	23	20	10	7	8	11	15	13	470	259	213	86
Total	120	22	119	31	107	33	107	38	168	37	154	48	129	30	111	26	89	25	49	13	33	11	49	14	1,235	328	1,086	176

Number of oil wells drilled in the Lima-Indiana field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	33	51	52	61	66	84	86	83	76	59	82	52	785
1911	50	48	47	43	45	48	45	49	53	45	45	36	554
1912	17	20	24	34	47	48	50	54	62	52	70	69	547
1913	51	48	70	45	87	89	112	130	101	115	120	118	1,086
1914	120	119	107	107	168	154	129	111	89	49	33	49	1,235

Number of dry holes drilled in the Lima-Indiana field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	8	6	7	9	10	8	11	11	12	9	21	11	123
1911	7	7	2	3	6	7	9	7	2	4	11	2	67
1912	3	2	5	8	5	5	8	9	13	7	7	3	75
1913	6	3	11	10	10	11	13	22	28	23	15	24	176
1914	22	31	33	38	37	48	30	26	25	13	11	14	328

Total number of wells completed in the Lima-Indiana field, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	47	60	60	73	80	95	97	97	89	70	105	65	938
1911	59	58	50	48	52	58	53	57	58	50	62	39	644
1912	23	25	31	42	54	54	58	63	77	60	79	74	640
1913	58	52	82	57	97	102	129	156	129	140	137	144	1,283
1914	145	153	144	145	208	202	162	139	115	67	47	65	1,592

[a] Including gas wells.

Initial daily production of new wells completed in the Lima-Indiana field in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Lima, Ohio	959	916	1,057	759	967	1,088	1,117	657	697	277	221	614	9,329	11,181
Indiana	677	1,213	1,130	1,100	977	1,257	811	410	272	154	151	284	8,436	7,393
Total	1,636	2,129	2,187	1,859	1,944	2,345	1,928	1,067	969	431	372	898	17,765	18,574

Total and average initial daily production of new wells in the Lima-Indiana field, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Lima, Ohio	6,745	6,381	7,229	11,181	9,329	13.5	13.3	15.0	12.8	12.2
Indiana	8,664	1,096	1,083	7,393	8,436	30.5	14.8	16.7	34.7	18.0
Total	15,409	7,477	8,312	18,574	17,765	19.6	13.5	15.2	17.1	14.4

Total initial daily production of new wells in the Lima-Indiana field, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	865	1,310	1,320	1,244	1,311	2,192	1,360	1,894	1,194	921	1,013	785	15,409	1,284
1911	650	652	452	556	526	636	605	785	545	878	517	675	7,477	623
1912	267	281	1,013	490	704	824	690	863	891	635	1,026	628	8,312	693
1913	774	710	926	855	1,426	1,673	1,627	1,851	1,654	2,389	2,652	2,037	18,574	1,548
1914	1,636	2,129	2,187	1,859	1,944	2,245	1,928	1,067	969	431	372	898	17,765	1,480

In the following tables are shown the number of oil wells abandoned in the Lima-Indiana oil field from June, 1906, to December 31, 1914, inclusive.

Number of oil wells abandoned in Indiana and in the Lima (Ohio) oil field from June, 1906, to December, 1914, by months.

Month.	1906	1907	1908	1909	1910	1911	1912	1913	1914	Total.
January	54	45	75	149	61	62	59	17	7	529
February	74	83	59	108	66	21	34	21	4	470
March	27	49	129	237	221	114	28	13	30	848
April	47	129	198	98	140	31	86	47	23	799
May	100	194	358	204	157	233	83	37	74	1,440
June	82	143	207	347	146	118	122	101	52	1,346
July	50	111	191	157	176	141	75	17	82	1,053
August	147	170	228	322	126	122	102	71	100	1,442
September	87	157	195	267	294	79	117	127	64	1,406
October	139	181	144	201	80	137	66	142	59	1,307
November	139	177	155	172	100	160	158	38	176	1,328
December	117	62	220	156	128	41	80	40	29	939
Total, Indiana	1,063	1,501	2,159	2,418	1,695	1,259	1,010	671	700	12,907
Total, Lima, Ohio	1,059	1,357	1,135	1,127	1,500	1,142	856	601	486	9,937
Total, Lima-Indiana	2,122	2,858	3,294	3,545	3,195	2,401	1,866	1,272	1,186	22,844

Number of oil wells abandoned in the Lima-Indiana oil field, June, 1905, to December 31, 1914, by counties.

Lima, Ohio.		Indiana.	
County.	Number of wells.	County.	Number of wells.
Allen	2,101	Adams	786
Auglaize	831	Blackford	1,332
Darke	4	Delaware	1,278
Hancock	1,299	Gibson	1
Lucas	431	Grant	3,994
Mercer	334	Hamilton	9
Ottawa	139	Huntington	838
Putnam	20	Jay	539
Sandusky	767	Knox	12
Seneca	118	Madison	87
Shelby	10	Marion	15
Van Wert	601	Miami	49
Wood	3,027	Randolph	206
Wyandot	255	Sullivan	1
		Wabash	16
Total	9,937	Wells	3,744
		Total	12,907

INDIANA.

GENERAL STATEMENT.

The output of petroleum in Indiana in 1914 disclosed an increase for the first time since 1904, final returns crediting the State with 1,335,456 barrels, representing an increase of nearly 40 per cent over the output in 1913. This increase may be attributed chiefly to the pools in Sullivan County, in the southwestern part of the State, which supported an active development throughout the year.

Field activity in Indiana in 1914 resulted in the completion of 742 wells, of which 470, or 63 per cent, yielded oil in commercial quantities, and 259, or 35 per cent, were barren; the remaining 13, representing 2 per cent, were classed as gas wells.

Oil in Indiana is derived from strata of Paleozoic age, commercial production being limited to three principal limestone and sandstone zones. The "Trenton" limestone, of the Ordovician system, has furnished the bulk of the State's output of oil, and is the oil and gas yielding formation sought in the productive fields of the northern and eastern portions of the State. The "Corniferous" limestone, of the Devonian system, yields oil near Terre Haute, in Vigo County, on the Illinois border, and oil and gas in Pike County and certain portions of Gibson County, in the southwestern part of the State. The "Huron" sandstone, of the Mississippian series (lower Carboniferous), is the source of the petroleum obtained in the Princeton field, Gibson County, and in the fields adjacent to Sullivan and Shelburn in Sullivan County.

DEVELOPMENT.

Northeastern Indiana.—There was little activity in the Indiana poriton of the Lima-Indiana field in 1914, and the production credited to this division of the State showed a notable decline from that of previous years. There were 90 wells drilled during the year, of which 58, or 64 per cent, produced oil, yielding a total initial production of 947 barrels, or an average of 16.3 barrels per well for the first day of productive life.

Southwestern Indiana.—Although only nominal activity prevailed in the Vigo, Pike, and Gibson County pools, exceptional activity was apparent in Sullivan County, where more or less prospecting has been done at various times in the last 25 years, but where discoveries that seemed to warrant extensive development had not been made prior to the summer of 1913. During the latter part of that year and continuing through the greater part of 1914 a considerable area adjacent to Sullivan and Shelburn in Sullivan County was thoroughly drilled, and five distinct productive areas or "pools" of relatively small areal extent were outlined. The shallow depths, 600 to 900 feet, at which the productive strata were reached, and the corresponding low cost of drilling, rendered the Sullivan County field particularly attractive to operators, who were facing a declining petroleum market during much of the year. By the end of the year the productive territory had been fairly well drilled and activity had subsided to nominal proportions.

In the southwestern Indiana division 652 wells were completed in 1914, of which number 412, or about 63 per cent, produced oil, yielding a total initial production of 7,489 barrels, or an average production of 18 barrels per well.

MARKETED PRODUCTION.

Marketed production of petroleum in Indiana, 1910–1914, by months, in barrels.

Month.	1910	1911	1912	1913	1914
January	143,481	146,582	64,403	73,237	109,891
February	136,388	135,064	62,991	70,336	97,045
March	163,588	355,552	81,148	57,204	120,508
April	161,865	133,947	92,965	78,764	126,670
May	178,582	139,302	101,102	77,379	128,493
June	292,521	132,096	85,819	73,056	129,855
July	219,210	120,737	90,011	73,838	121,122
August	200,681	122,416	86,492	72,467	109,939
September	179,536	114,109	78,432	81,462	110,299
October	169,338	107,317	83,634	91,368	105,969
November	159,878	89,007	69,733	98,444	88,272
December	154,657	99,160	73,279	108,540	87,393
Total	2,159,725	1,695,289	970,009	956,095	1,335,456

SUMMARY OF WELLS DRILLED.

In the following tables are shown the wells completed in Indiana from 1910 to 1914, inclusive:

Number of wells completed in Indiana, 1910–1914, by counties.

County.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Adams	12	1	6	8	4	1	1	....	....	....	13	2	6	8	4
Blackford	5	2	2	9	1	2	....	2	2	....	7	2	4	11	3
Daviess	1	....	1	1	....	....	2	....	....	....	1	7	2	1	....
Delaware	9	10	15	47	24	....	5	7	8	8	10	15	22	55	32
Dubois	1	....	....	....	....	4	....	....	....	1	5	....	....	....	1
Gibson	2	....	....	18	3	7	1	....	1	....	9	1	....	19	3
Grant	1	....	1	1	3	1	....	1	1	....	2	....	2	4	4
Harrison	....	....	....	....	2	....	....	....	....	....	....	....	....	....	2
Huntington	3	....	....	....	....	....	....	....	....	....	3	....	....	....	....
Jay	21	9	14	27	14	10	3	4	6	4	34	13	20	33	21
Knox	1	1	1	....	....	3	6	4	1	6	4	7	5	2	6
Madison	....	....	....	....	....	....	3	....	....	....	....	3	....	....	....
Martin	1	....	....	....	....	1	....	....	....	1	2	....	....	....	1
Miami	....	....	....	....	....	....	....	....	1	2	....	....	....	1	2
Pike	179	27	5	11	6	25	11	1	5	8	215	40	6	20	14
Randolph	13	4	4	8	4	7	....	....	3	1	20	4	4	11	7
Shelby	....	....	....	....	4	....	....	....	....	....	....	....	....	....	4
Sullivan	3	....	2	75	400	....	....	....	52	219	3	....	2	132	624
Vigo	....	....	1	....	3	1	....	....	....	2	1	....	1	....	5
Wabash	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
Warrick	....	....	....	....	....	3	1	....	....	....	3	1	....	....	....
Wells	32	17	6	5	1	....	....	....	1	1	33	17	6	6	1
Miscellaneous	....	3	7	3	....	1	2	1	5	7	1	5	9	8	7
Total	284	74	65	213	470	66	35	20	86	259	366	117	89	311	742

[a] Including gas wells.

Number of oil wells and dry holes drilled in Indiana in 1914, by counties and months.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	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.	Oil.	Dry.
Adams			1				1				1		1												4		8	
Blackford	1																								1		9	2
Daviess																											1	
Delaware	2	1			2	4	2	1	1	1	3	1	4		5		2						3		24	8	47	8
Dubois																1										1		
Gibson			1		1				1																3		18	1
Grant	1						1		1																3		1	1
Harrison									1		1														2			
Jay	3				2		1	1	2		2	1	2		1			1	1	1					14	4	27	6
Knox						2								1				1						2		6		1
Martin																1										1		
Miami																		1						1		2		1
Pike					1	1	1	1	1	1	1			2			2	1		1				1	6	8	11	5
Randolph			1		1			1			1				1										4	1	8	3
Shelby																	4								4			
Sullivan	29	16	42	25	35	23	38	21	67	25	70	32	46	23	32	19	15	14	8	4	6	11	12	6	400	219	75	52
Vigo								1								1			1		2				3	2		
Wabash															1										1			
Wells													1												1		5	1
Miscellaneous								1										2		1				3		7	3	5
Total	36	17	45	25	42	30	44	27	74	27	79	34	54	26	40	22	23	20	10	7	8	11	15	13	470	259	213	86

Number of oil wells drilled in Indiana, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	3	9	13	4	17	16	14	28	18	27	34	30	213
1914	36	45	42	44	74	79	54	40	23	10	8	15	470

Number of dry holes drilled in Indiana, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	3	4	3	5	4	2	4	6	7	5	16	7	66
1911	4	3	1	3	2	2	5	4	2	2	7		35
1912	2	1	1	5			3	2	3	2		1	20
1913	2		3		2	5	7	6	15	15	11	20	86
1914	17	25	30	27	27	34	26	22	20	7	11	13	259

Total number of wells completed in Indiana, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	5	9	17	5	19	22	22	37	33	44	47	51	311
1914	54	71	74	71	104	113	82	63	43	18	21	28	742

[a] Including gas wells.

Initial daily production of new wells completed in Indiana in 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Adams	.....	5	.....	30	.....	4	4	.....	.....	.....	.....	.....	43	73
Blackford	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	46
Daviess	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
Delaware	30	.....	55	145	5	90	100	65	30	.....	.....	25	545	1,765
Gibson	.....	2	5	.....	2	.....	.....	.....	.....	.....	.....	.....	9	332
Grant	20	.....	.....	2	5	.....	.....	.....	.....	.....	.....	.....	27	5
Harrison	.....	.....	.....	.....	5	5	.....	.....	.....	.....	.....	.....	10	.....
Jay	50	.....	25	3	12	17	15	15	.....	30	.....	.....	167	423
Pike	.....	.....	37	25	25	32	.....	.....	17	.....	.....	.....	136	202
Randolph	.....	10	50	.....	.....	10	.....	10	.....	.....	.....	.....	80	395
Shelby	.....	.....	.....	.....	.....	.....	.....	.....	50	.....	.....	.....	50	.....
Sullivan	574	1,196	958	895	923	1,099	690	300	175	109	116	259	7,294	4,032
Vigo	.....	.....	.....	.....	.....	.....	.....	.....	.....	15	35	.....	50	.....
Wabash	.....	.....	.....	.....	.....	.....	.....	20	.....	.....	.....	.....	20	.....
Wells	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	2	50
Miscellaneous	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60
Total	677	1,213	1,130	1,100	977	1,257	811	410	272	154	151	284	8,436	7,393

Total and average initial daily production of new wells in Indiana, 1910–1914, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Adams	73	10	103	73	43	6.1	10.0	17.2	9.1	10.8
Blackford	75	5	7	46	3	15.0	2.5	3.5	5.1	3.0
Daviess	5	.....	10	10	.....	5.0	.....	10.0	10.0	.....
Delaware	232	325	425	1,765	545	25.8	32.5	28.3	37.6	22.7
Dubois	15	.....	.....	.....	.....	15.0	.....	.....	.....	.....
Gibson	20	.....	.....	332	9	10.0	.....	.....	18.4	3.0
Grant	1	.....	5	5	27	1.0	.....	5.0	5.0	9.0
Harrison	.....	.....	.....	.....	10	.....	.....	.....	.....	5.0
Huntington	40	.....	.....	.....	.....	13.3	.....	.....	.....	.....
Jay	203	90	204	423	167	9.7	10.0	14.6	15.7	11.9
Knox	10	5	3	.....	.....	10.0	5.0	3.0	.....	.....
Martin	5	.....	.....	.....	.....	5.0	.....	.....	.....	.....
Pike	7,453	439	150	202	136	41.6	16.3	30.0	18.4	22.7
Randolph	207	26	35	395	80	15.9	6.5	8.8	49.4	20.0
Shelby	.....	.....	.....	.....	50	.....	.....	.....	.....	12.5
Sullivan	25	.....	15	4,032	7,294	8.3	.....	7.5	53.8	18.2
Vigo	.....	.....	30	.....	50	.....	.....	30.0	.....	16.7
Wabash	.....	.....	.....	.....	20	.....	.....	.....	.....	20.0
Wells	300	181	31	50	2	9.4	10.6	5.2	10.0	20.0
Miscellaneous	.....	15	65	60	.....	.....	5.0	9.3	20.0	.....
Total	8,664	1,096	1,083	7,393	8,436	30.5	14.8	16.7	34.8	18.0

Total initial daily production of new wells in Indiana, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	488	885	820	714	746	1,745	676	1,159	400	480	290	261	8,664	722
1911	142	53	129	73	66	77	107	155	75	85	52	82	1,096	91
1912	75	60	30	50	85	57	47	82	148	172	187	90	1,083	90
1913	65	271	327	223	555	467	384	437	756	1,466	1,430	1,012	7,393	616
1914	677	1,213	1,130	1,100	977	1,257	811	410	272	154	151	284	8,436	703

ILLINOIS OIL FIELD.

GENERAL STATEMENT.

Notwithstanding a decrease of 1,974,150 barrels from the output of petroleum in Illinois in 1913, a total marketed production of 21,919,749 barrels in 1914 was sufficient to insure for the State its rank of third in quantity of production among the oil-producing States, a position it has held undisputed since 1907.

The decline of 8.26 per cent shown by the Illinois returns for 1914 indicates a notable improvement when compared with the decline of 16.45 per cent that characterized 1913 and tends to confirm the opinion that for the productive fields of this State the stage of rapid decline, has been passed and that a period of settled production with gradual decline, subject, however, to fluctuations resulting from the possible discovery of new pools has been entered.

DEVELOPMENT.

Field activity in Illinois in 1914 resulted in the completion of 1,579 wells in 21 counties, of which number 1,163, or nearly 74 per cent, yielded an average initial oil production of 33.75 barrels per well per day; 28, or about 1 per cent, were gas wells, and the remaining 388, or 25 per cent, including wildcat wells in many parts of the State, were barren. The declining petroleum market, which characterized the midsummer months, resulted in a lessening of field activities and in a notable decrease in wells completed in the latter part of the year.

SOUTHEASTERN ILLINOIS.

Cumberland, Coles, Clark, and Edgar counties.—The shallow-sand fields of Cumberland, Coles, Clark, and Edgar counties proved attractive during the year on account of the relatively low cost of completions at depths of 400 to 600 feet. The yield of individual wells, though low, less than 5 barrels a day, is fairly steady, and where a number of wells can be pumped from one central power operation is profitable. In Cumberland County slight additions to the productive areas were made in 1914, and throughout the extent of the previously proved fields the redrilling of oil wells and the drilling of inside locations long neglected because of low prospective yield was generally attended with success.

Crawford and Lawrence counties.—The deep-sand fields of Crawford and Lawrence counties continued to yield the bulk of the State's production from sands lying at depths of 800 to 2,200 feet below the surface. In Crawford County operations were routine in character and confined for the most part to the drilling of inside locations. At Robinson the town-lot field, opened at the close of 1913, was rapidly developed and almost completely exhausted early in 1914, owing to the small extent of the pool and the close placing of the wells.

In Lawrence County, the richest oil-producing area of the State, considerable impetus was given to otherwise routine developments by the completion, on April 6, of a 3,100-barrel well located in sec. 5, Dennison Township, where previous tests had been either light producers or barren. This gusher, which was from the McClasky sand, penetrated at a depth of 1,835 feet, was the forerunner of much active work, resulting in a substantial eastern and southeastern addition to the productive area in Lawrence County. As a result of this development, the production of the county in 1914 showed no appreciable decline from that of 1913.

Wabash County.—To the 36 productive wells in the Allendale pool at the close of 1913, there were 7 added in 1914, with no material extensions of productive area. For 1915 a thorough test is proposed of the area lying between the Allendale pool on the south and the newly proved extension of the Lawrence County field on the north.

SOUTH-CENTRAL ILLINOIS.

Clinton County.—Developments in the Carlyle pool, 3 miles northwest of Carlyle, opened April, 1911, resulted in the addition of two productive wells, whose output was insufficient to check the gradual decline in the pool's production. At the end of the year there were 156 active wells in the field.

Marion County.—The Sandoval pool was opened in the summer of 1909, and 6 productive wells and 1 dry hole were drilled therein in 1914. A slight decline from the production of 1913 was noted. There were 118 wells productive in this pool on December 31, 1914.

Macoupin County.—Three productive wells, with a total initial output of 15 barrels and 1 dry hole constituted the year's developments in the Carlinville field, the daily production of which is now less than 100 barrels. In Bulletin 28, of the Illinois State Geological Survey, issued in 1914, is described a structural dome presenting conditions favorable for prospecting for petroleum in southern Macoupin County, northwest of Staunton.

WESTERN ILLINOIS.

McDonough County.—As the result of a showing of 5 gallons of oil at a depth of 425 feet in a well completed March 5, 1914, in sec. 20, Lamoine Township, prospecting for oil in western McDonough County received an impetus which resulted in the discovery of a new oil pool remote from the other productive localities of the State. The initial well of the Colmar or "Plymouth" pool, lying about 3 miles northeast of Plymouth, was completed April 30, on the J. Hoeing farm, in the SW. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 16, Lamoine Township (T. 4 N., R. 4 W.). This well yielded an initial production of 75 barrels of light gravity oil from a sand encountered at a depth of 417 feet. The attractive combination of fair yield, shallow depth, and low cost of drilling resulted in a rapid development of the pool, which proved to be of small areal extent and comparable in many ways with the Carlyle and the Sandoval pools. Of 174 wells drilled in the Colmar field before the end of the year, 138 yielded a total initial production of 3,919 barrels and 36 were barren.

Geologically the Colmar oil field lies near the apex of a low, well defined anticline or arch affecting Paleozoic strata, the uppermost of which, exposed on the crest of the fold, comprise limestone beds assigned to the Meramec and Osage groups of the Mississippian series. The productive formation of the pool is described by the Illinois State Geological Survey (Bulletin 23) as a sandy limestone that is doubtfully identified with the lower part of the Devonian or the upper part of the Silurian system, and the oil, which is unaccompanied by gas, is reported to be green in color, of about 37° Baumé, and to contain only a small percentage of sulphur.

The finding of oil in this locality is of especial interest because of previous recommendations in a report[1] prepared in 1913 by a geologist of the United States Geological Survey, in cooperation with the Illinois State Geological Survey, on the geology of the Colchester and Macomb quadrangles, Illinois.

Hancock County.—A few miles west of the Colmar pool, in St. Marys Township, Hancock County, an oil well with an initial production of 45 barrels was completed in September. Other wells were immediately drilled in the same locality, but up to the end of the year no additional production had been found, and the one producing well had been completely surrounded by barren holes.

MISCELLANEOUS DRILLING.

In 1914 unsuccessful tests were drilled for oil near Sorento, Bond County; Mahomet, Champaign County; Ava, Jackson County; Staunton, Macoupin County; Collinsville, Madison County; Ohlman and Nokomis, Montgomery County; Cottagegrove, Saline County; Birmingham, Brooklyn, and Camden, Schuyler County; Mode, Shelby County; and Allerton, Vermilion County.

MARKETED PRODUCTION.

The marketed production of petroleum in the Illinois field from 1889 to 1914, inclusive, is shown in the following table:

Marketed production of petroleum in Illinois, 1889–1914, in barrels.

Year.	Marketed production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).	Value.	Yearly average price per barrel.
1889	1,460				$4,906	$3.360
1890	900		− 560	− 38.36	3,000	3.333
1891	675		− 225	− 25.00	2,363	3.500
1892	521		− 154	− 22.81	1,823	3.500
1893	400		− 121	− 23.22	1,400	3.500
1894	300		− 100	− 25.00	1,800	6.000
1895	200		− 100	− 33.33	1,200	6.000
1896	250		+ 50	+ 25.00	1,250	5.000
1897	500		+ 250	+ 100.00	2,000	4.000
1898	360		− 140	− 28.00	1,800	5.000
1899	360				1,800	5.000
1900	200		− 160	− 44.44	1,000	5.000
1901	250		+ 50	+ 25.00	1,250	5.000
1902	200		− 50	− 20.00	1,000	5.000
1903			− 200	− 100.00		
1904						
1905	181,084	0.13	+ 181,084		116,561	.644
1906	4,397,050	3.47	+ 4,215,966	+2,328.18	3,274,818	.745
1907	24,281,973	14.62	+19,884,923	+ 452.23	16,432,947	.677
1908	33,686,238	18.87	+ 9,404,265	+ 38.73	22,649,561	.672
1909	30,898,339	16.87	− 2,787,899	− 8.28	19,788,864	.640
1910	33,143,362	15.82	+ 2,244,923	+ 7.27	19,669,383	.593
1911	31,317,038	14.21	− 1,826,224	− 5.51	19,734,339	.630
1912	28,601,308	12.83	− 2,715,730	− 8.67	24,332,605	.851
1913	23,893,899	9.62	− 4,707,409	− 16.45	30,971,910	1.296
1914	21,919,749	8.25	− 1,974,150	− 8.26	25,426,179	1.160
Total	232,326,616	6.97			182,423,759	.785

[1] Hinds, Henry, Oil and gas in the Colchester and Macomb quadrangles: Illinois Geol. Survey Extract Bull. 23, pp. 11–13, 1914.

Marketed production of petroleum in Illinois, 1910–1914, by months, in barrels.

Month.	1910	1911	1912	1913	1914
January	2,640,303	2,578,579	2,241,867	2,149,264	1,935,492
February	2,353,684	2,373,229	2,262,440	1,859,412	1,570,790
March	2,865,055	2,790,515	2,369,428	2,008,245	1,969,915
April	2,776,800	2,560,963	2,351,693	2,015,058	1,833,099
May	2,860,760	2,731,965	2,535,039	2,117,425	1,970,688
June	2,746,620	2,634,521	2,503,038	2,003,278	1,932,303
July	3,029,787	2,740,654	2,698,582	2,075,444	1,907,521
August	3,007,151	2,770,946	2,519,651	2,001,228	1,844,983
September	2,850,119	2,615,120	2,366,712	1,942,052	1,817,437
October	2,768,750	2,638,927	2,424,472	1,982,002	1,813,364
November	2,629,132	2,400,670	2,174,856	1,819,116	1,678,783
December	2,615,201	2,480,949	2,153,530	1,921,375	1,645,374
Total	33,143,362	31,317,038	28,601,308	23,893,899	21,919,749

Average daily output of petroleum in Illinois each month, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	85,171	83,180	72,318	69,331	62,435
February	84,060	84,758	78,015	66,407	56,100
March	92,421	90,017	76,433	64,782	63,546
April	92,560	85,365	78,390	67,169	61,103
May	92,283	88,128	81,775	68,304	63,570
June	91,554	87,817	83,435	66,776	64,410
July	97,735	88,408	87,051	66,950	61,533
August	97,005	89,385	81,279	64,556	59,516
September	95,004	87,171	78,890	64,735	60,581
October	89,315	85,127	78,209	63,936	58,496
November	87,638	80,022	72,495	60,637	55,959
December	84,361	80,031	69,469	61,980	53,076
Average	90,804	85,800	78,146	65,463	60,054

PIPE-LINE RUNS, DELIVERIES, AND STOCKS.

Pipe-line runs and deliveries to trade of petroleum from Illinois, by months, in 1913 and 1914, and stocks at end of each month, in barrels.

Month.	1913			1914		
	Runs.	Deliveries.	Stocks.[a]	Runs.	Deliveries.	Stocks.[a]
Dec. 31, 1912			15,709,738			
January	2,149,264	3,075,502	14,783,500	1,935,492	1,999,562	8,179,351
February	1,859,412	2,722,247	13,920,665	1,570,790	1,630,031	8,120,110
March	2,008,245	2,533,839	13,395,071	1,969,915	1,751,213	8,338,812
April	2,015,058	2,659,425	12,750,704	1,833,099	1,287,533	8,884,378
May	2,117,425	2,622,819	12,245,310	1,970,688	1,106,610	9,748,456
June	2,003,278	2,533,606	11,714,982	1,932,303	1,336,937	10,343,822
July	2,075,444	2,706,745	11,083,681	1,907,521	1,336,571	10,914,772
August	2,001,228	2,413,448	10,671,461	1,844,983	844,178	11,915,577
September	1,942,052	2,814,292	9,799,221	1,817,437	1,157,088	12,575,926
October	1,982,002	2,623,700	9,157,523	1,813,364	1,330,773	13,058,517
November	1,819,116	2,329,011	8,647,628	1,678,783	1,549,704	13,187,590
December	1,921,375	2,325,582	8,243,421	1,645,374	1,269,227	13,563,743
Total	23,893,899	31,360,216		21,919,749	16,599,427	

[a] Includes a small quantity of Indiana oil of Illinois grade.

The following tables show the runs, deliveries, and stocks of the Ohio Oil Co. during the years 1910–1914, by months:

Pipe-line runs, deliveries, and stocks of the Ohio Oil Co. in Illinois, 1910–1914, by months, in barrels.

PIPE-LINE RUNS.

Month.	1910	1911	1912	1913	1914
January	2,220,842	2,137,674	1,853,266	1,591,944	1,425,574
February	1,976,637	1,968,429	1,853,379	1,348,292	1,148,926
March	2,377,012	2,349,208	1,949,945	1,457,711	1,469,331
April	2,306,336	2,138,500	1,916,071	1,456,551	1,328,430
May	2,374,134	2,264,925	2,084,743	1,551,323	1,434,303
June	2,274,501	2,177,280	2,083,087	1,471,437	1,407,706
July	2,569,830	2,265,374	2,230,164	1,531,800	1,398,849
August	2,528,532	2,312,973	1,996,824	1,483,801	1,371,731
September	2,409,232	2,154,693	1,871,325	1,437,974	1,345,016
October	2,334,659	2,172,457	1,901,119	1,473,679	1,350,167
November	2,211,286	1,977,073	1,668,306	1,360,159	1,246,292
December	2,168,089	2,068,894	1,594,700	1,420,484	1,222,575
Total	27,751,090	25,987,480	23,002,929	17,585,155	16,148,900

DELIVERIES.[a]

Month.	1910	1911	1912	1913	1914
January	1,226,379	933,861	1,350,621	1,201,633	936,867
February	842,135	838,566	1,387,078	1,042,834	1,027,023
March	882,209	1,218,111	1,532,428	1,172,522	749,703
April	936,706	1,022,936	1,420,013	1,139,433	525,769
May	946,346	1,132,231	1,301,727	1,226,625	819,105
June	1,156,895	1,174,211	1,302,537	1,161,667	752,134
July	1,332,242	1,231,534	1,327,329	1,171,492	803,558
August	1,229,479	1,206,244	1,306,563	794,844	474,569
September	1,135,323	1,252,988	1,359,968	1,039,267	594,960
October	1,245,778	1,352,605	1,401,807	1,065,320	630,028
November	997,805	1,304,663	1,230,357	810,907	256,567
December	1,036,260	1,454,394	1,206,516	1,204,375	15,090
Total	12,967,557	14,122,344	16,126,944	13,030,919	7,585,373

STOCKS.[b]

Month.	1910	1911	1912	1913	1914
January	28,355,182	26,252,274	18,393,303	11,118,521	5,508,791
February	28,356,243	25,643,012	17,706,835	10,344,393	5,188,339
March	28,373,855	24,005,215	17,279,112	9,935,612	5,627,743
April	28,593,365	24,013,861	17,001,576	9,446,550	6,500,409
May	29,025,647	24,138,187	16,636,329	8,941,584	7,284,952
June	29,106,098	23,195,749	16,235,353	8,054,011	8,035,036
July	29,198,965	22,714,129	15,689,994	7,548,743	8,682,851
August	29,177,382	22,265,928	14,682,823	6,876,978	9,683,090
September	28,879,676	21,904,719	13,949,064	6,416,698	10,473,407
October	28,492,136	21,359,482	13,039,507	5,748,180	11,033,448
November	28,086,619	20,211,934	12,307,725	5,829,018	11,183,664
December	27,348,358	19,131,678	11,591,427	5,551,556	11,390,608

[a] These deliveries are to trade only. Deliveries to other pipe lines are also made.
[b] Stocks include some Indiana petroleum of Illinois grade.

RAILROAD SHIPMENTS.

The following table shows the quantity of petroleum shipped by railroad from the Illinois oil field, 1910–1914, by months. The shipments were made by the Vandalia Railroad Co., the Baltimore & Ohio Southwestern Railroad Co., the Illinois Southern Railway Co., the Illinois Central Railroad Co., and the Cleveland, Cincinnati, Chicago & St. Louis Railway from Lawrenceville, Flat Rock, Sparta, Stoy, Bridgeport, Robinson, Sandoval, and Casey stations.

Shipments of petroleum by railroad in tank cars from Illinois oil field, in barrels, 1910–1914, by months.

Month.	1910 [a]	1911 [a]	1912 [a]	1913 [a]	1914 [a]
January	220,856	228,404	232,522	192,735	189,689
February	217,917	224,856	172,106	167,632	129,220
March	263,056	254,927	216,156	176,028	185,210
April	257,292	347,530	211,809	135,341	195,535
May	283,285	333,324	232,043	226,364	215,962
June	285,095	329,621	214,860	224,614	236,792
July	276,533	311,681	211,025	272,536	204,147
August	277,317	297,784	281,991	264,424	158,930
September	253,788	238,917	210,974	271,709	152,805
October	213,217	292,004	249,263	299,451	152,237
November	287,750	263,627	222,866	291,287	143,853
December	234,819	285,082	219,034	298,227	141,291
Total	3,070,925	3,407,757	2,674,649	2,820,348	2,105,671

[a] Calculations made according to the specific gravity of the oil, ranging from 296.476 to 321.17 pounds to the barrel.

PRICES.

In the following table are shown the dates of change and the changes in prices at wells of the different grades of petroleum produced in Illinois during the years 1912–1914:

Fluctuation in prices, per barrel, of Illinois petroleum in 1912–1914.

Date.	Above 30° B.	Below 30° B.	Date.	Above 30° B.	Below 30° B.	Date.	All grades.
1912.			1913.			1914.	
Jan. 1	$0.67	$0.57	Jan. 1	$1.08	$1.05	Jan. 1	$1.45
Jan. 2	.70	.60	Jan. 3	1.08		Apr. 18	1.40
Jan. 6	.72	.62	Jan. 27	1.11		Apr. 25	1.35
Jan. 24	.75	.65	Feb. 2	1.14		Apr. 28	1.30
Feb. 1	.78	.68	Feb. 5	1.17		May 1	1.25
Mar. 4	.81	.71	Feb. 6	1.20		May 5	1.20
Apr. 24	.83	.73	Feb. 20	1.25		May 12	1.15
May 24	.85	.75	Apr. 16	1.30		June 17	1.12
June 13		.77	Nov. 5	1.35		Aug. 1	1.07
June 27		.79	Nov. 19	1.40		Aug. 7	1.02
July 25	.87	.82	Nov. 22	1.45		Sept. 14	.97
Sept. 12		.84				Sept. 23	.92
Oct. 28	.90	.87				Oct. 26	.89
Nov. 9	.92	.89					
Nov. 15	.94	.91					
Nov. 25	.96	.93					
Dec. 2	.99	.96					
Dec. 9	1.02	.99					
Dec. 16	1.05	1.02					
Dec. 20		1.05					
Dec. 23	1.08	1.05					

The following table shows the average monthly prices paid for Illinois petroleum at wells in Illinois from 1910 to 1914, inclusive:

Average monthly prices of Illinois petroleum, 1910–1914, per barrel.

Month.	1910		1911		1912		1913	1914
	Above 30° B.	Below 30° B.	Above 30° B.	Below 30° B.	Above 30° B.	Below 30° B.		
January	$0.60	$0.52	$0.60	$0.52	$0.72	$0.62	$1.09	$1.45
February	.60	.52	.60	.52	.78	.68	1.21	1.45
March	.60	.52	.60	.52	.81	.71	1.25	1.45
April	.60	.52	.60	.52	.81	.71	1.28	1.41
May	.60	.52	.63	.55	.84	.74	1.30	1.17
June	.60	.52	.64	.55	.85	.76	1.30	1.14
July	.60	.52	.65	.55	.85	.80	1.30	1.12
August	.60	.52	.65	.55	87	.82	1.30	1.03
September	.60	.52	.66	.56	.87	.83	1.30	.98
October	.60	.52	.67	.57	.87	.84	1.30	.91
November	.60	.52	.67	.57	.93	.90	1.38	.89
December	.60	.52	.67	.57	1.04	1.02	1.45	.89
Average	.60	.52	.637	.546	.853	.786	1.288	1.16

SUMMARY OF WELLS DRILLED.

The following tables show the wells completed in Illinois from 1910 to 1914, inclusive:

Number of wells completed in Illinois, 1910–1914, by counties.

County.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Bond	1					5	9			2	7	10			2
Clark	80	45	50	169	157	28	25	12	35	62	112	72	62	208	221
Clinton		123	35	14	2	3	49	13	5	2	3	172	48	19	4
Coles	4	2	1	3	16	1		5	3	5	5	2	6	6	21
Crawford	950	369	310	540	542	214	93	96	110	136	1,210	481	414	669	706
Cumberland	13	6	42	49	22	2	7	8	11	2	17	13	50	61	24
Edgar						1	1				2	1			
Hancock	1				1					19	1				20
Jackson			1			2		4	2		2		6	2	
Jasper	4	3		2	3	4	2	1		2	8	5	1	2	5
Lawrence	594	466	495	538	294	79	38	77	69	69	689	523	586	663	365
McDonough					138					36					174
Macoupin		2	1	3	3	2			6	2	2	2	1	9	5
Madison						1	1	4		1	1	1	4		1
Marion	34	44	22	21	6	26	11	4	1	1	60	55	26	22	7
Randolph								1					1		
Saline						1			2	1	1			2	1
Wabash			22	24	7			20	24	5			42	48	12
Miscellaneous		1	1			24	27	12	10	11	29	28	13	10	11
Total	1,681	1,061	980	1,363	1,191	393	263	257	278	356	2,149	1,365	1,260	1,721	1,579

[a] Including gas wells.

Number of oil wells and dry holes drilled in Illinois in 1914, by counties and months.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	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.	Oil.	Dry.
Bond	...	..	...	..	...	..	...	..	...	..	...	..	...	1	...	..	...	..	...	..	...	..	...	1	.....	2	.....	...
Clark	25	3	14	5	10	3	20	3	20	9	20	15	7	6	11	3	7	3	10	3	4	5	9	4	157	62	169	35
Clinton	...	..	...	1	...	..	...	..	...	..	...	1	1	..	...	..	...	..	1	..	...	..	...	..	2	2	14	5
Coles	...	..	1	..	2	..	2	..	1	1	1	1	3	1	2	..	...	2	1	..	2	..	1	..	16	5	3	3
Crawford	59	9	45	10	80	12	87	27	68	17	64	15	36	13	23	13	26	5	26	4	20	4	8	7	542	136	540	110
Cumberland	2	..	...	..	1	..	2	..	5	..	1	..	...	..	3	..	5	..	1	2	1	..	1	..	22	2	49	11
Hancock	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	3	1	3	...	8	...	2	...	3	1	19	.....	...
Jackson	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	.....	...	.....	2
Jasper	...	..	...	..	...	..	1	..	2	..	...	..	...	1	...	..	...	1	...	..	...	..	...	..	3	2	2	...
Lawrence	35	2	40	11	23	3	33	8	18	5	33	12	32	6	19	5	26	10	14	3	12	2	9	2	294	69	538	69
McDonough	...	..	...	..	...	..	...	..	2	3	3	5	18	8	40	11	44	2	15	5	9	1	7	1	138	36	.....	...
Macoupin	3	1	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	1	3	2	3	6
Madison	...	..	...	1	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	.....	1	.....	...
Marion	1	..	1	..	...	..	3	1	...	..	1	..	...	..	...	..	...	..	...	..	...	..	...	..	6	1	21	1
Saline	...	..	...	..	...	..	...	..	...	..	...	..	...	1	...	..	...	..	...	..	...	..	...	..	.....	1	.....	2
Wabash	1	..	2	..	...	..	...	1	...	..	...	3	1	..	...	..	2	..	1	..	...	..	...	1	7	5	24	24
Miscellaneous	...	..	...	..	...	..	...	1	...	..	...	..	...	..	...	4	...	2	...	2	...	..	...	2	.....	11	.....	10
Total	126	15	103	28	116	18	148	41	116	35	123	52	98	37	98	39	111	28	69	27	48	14	35	22	1,191	356	1,363	278

Number of oil wells drilled in Illinois, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	106	83	71	92	137	112	139	116	145	151	115	96	1,363
1914	126	103	116	148	116	123	98	98	111	69	48	35	1,191

Number of dry holes drilled in Illinois, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	9	36	24	31	35	44	37	40	42	29	36	30	393
1911	16	16	10	13	31	37	24	25	34	16	23	18	263
1912	7	15	8	17	21	24	44	30	13	21	31	26	257
1913	23	22	12	13	21	35	28	38	16	31	24	15	278
1914	15	28	18	41	35	52	37	39	28	27	14	22	356

Total number of wells completed in Illinois, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	131	107	89	105	159	153	170	156	163	181	143	164	1,721
1914	148	135	136	191	154	180	138	140	139	98	63	57	1,579

[a] Including gas wells.

Initial daily production of new wells completed in Illinois in 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Clark	282	178	71	180	234	190	85	85	87	85	32	81	1,590	2,610
Clinton	......	......	......	......	......	......	15	......	......	5	......	......	20	134
Coles	......	20	15	20	10	35	32	15	......	5	15	5	172	75
Crawford	685	900	1,577	1,797	1,034	764	487	222	343	299	305	200	8,613	9,990
Cumberland	45	......	5	3	31	1	......	15	5	10	10	2	127	595
Hancock	......	......	......	......	......	......	......	......	45	......	......	......	45	......
Jasper	......	......	......	25	3	......	......	......	......	......	......	......	28	30
Lawrence	1,858	2,152	775	2,798	4,170	5,432	2,212	1,175	1,400	755	595	1,002	24,324	32,316
McDonough	......	......	......	......	70	95	940	1,280	980	283	199	72	3,919	......
Macoupin	15	......	......	......	......	......	......	......	......	......	......	......	15	165
Marion	15	15	......	15	......	25	......	......	......	......	......	......	70	492
Wabash	25	150	......	......	......	......	30	......	65	75	......	......	345	998
Total	2,925	3,415	2,443	4,838	5,552	6,542	3,801	2,792	2,925	1,517	1,156	1,362	39,268	47,405

Total and average initial daily production of new wells in Illinois, 1910–1914, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Bond	25	......	......	......	......	25.0	......	......	......	......
Clark	1,802	771	1,178	2,610	1,590	22.5	17.1	23.6	15.4	10.1
Clinton	......	11,681	1,127	134	20	......	95.0	32.2	9.6	10.0
Coles	65	10	5	75	172	16.3	5.0	5.0	25.0	10.7
Crawford	26,382	9,802	7,175	9,990	8,613	27.8	26.6	23.1	18.5	15.9
Cumberland	162	100	800	595	127	12.5	16.7	19.0	12.1	5.8
Hancock	5	......	......	......	45	5.0	......	......	......	45.0
Jackson	......	......	3	......	......	......	......	3.0	......	......
Jasper	40	20	......	30	28	10.0	6.7	......	15.0	9.3
Lawrence	61,015	40,432	51,975	32,316	24,324	102.7	86.8	105.0	60.1	82.7
McDonough	......	......	......	......	3,919	......	......	......	......	28.4
Macoupin	......	7	3	165	15	......	3.5	3.0	55.0	5.0
Marion	3,760	4,025	610	492	70	110.6	91.5	27.7	23.4	11.6
Wabash	......	......	2,235	998	345	......	101.6	41.6	......	49.3
Miscellaneous	......	3	575	......	......	......	3.0	575.0	......	......
Total	93,256	66,851	65,686	47,405	39,268	55.5	63.0	67.0	34.8	33.0

Total initial daily production of new wells in Illinois, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
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	7,771
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	5,571
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	5,474
1913	4,000	3,886	2,337	3,702	4,170	3,718	4,637	3,581	4,662	4,643	3,641	4,428	47,405	3,950
1914	2,925	3,415	2,443	4,838	5,552	6,542	3,801	2,792	2,925	1,517	1,156	1,362	39,268	3,272

MID-CONTINENT OIL FIELD.

GENERAL STATEMENT.

For commercial purposes it is customary to group under the title "Mid-Continent field" the oil pools in Kansas, Oklahoma, northern Texas (often called the Panhandle fields), and northern Louisiana. The numerous fields included in this designation are described under the appropriate State reviews.

This field began to contribute to the crude-petroleum industry in 1889 by furnishing a small quantity of lubricating oil from Kansas, but it was not until 1898 that the output became sufficient to constitute 1 per cent of the total output of petroleum in the United States. Since that time, however, the output of the Mid-Continent field has shown a consistent increase year by year until in 1914 the quantity marketed from its almost innumerable pools constituted slightly less than 37 per cent of the entire marketed production of the country.

MARKETED PRODUCTION.

Marketed production of petroleum in the Mid-Continent field in 1913 and 1914, by months, in barrels.

1913.

Month.	Kansas.	Oklahoma.	Northern Texas.	Northern Louisiana.	Total.
January	160,899	5,003,741	563,629	542,905	6,271,174
February	161,306	4,689,487	537,780	562,863	5,951,436
March	176,134	5,200,619	626,642	717,963	6,721,358
April	184,231	5,267,004	646,958	860,274	6,958,467
May	184,093	5,613,275	707,308	968,538	7,473,214
June	183,156	5,321,915	774,509	1,010,049	7,289,629
July	194,637	5,320,234	848,714	953,530	7,317,115
August	200,304	5,050,977	863,157	802,200	6,916,638
September	209,082	5,188,563	887,324	812,062	7,097,031
October	217,392	5,558,189	936,438	905,558	7,617,577
November	234,381	5,580,288	905,928	814,545	7,535,142
December	269,414	5,785,092	885,865	831,073	7,771,444
Total	2,375,029	63,579,384	9,184,252	9,781,560	84,920,225

1914.

Month.	Kansas.	Oklahoma.	Northern Texas.	Northern Louisiana.	Total.
January	260,343	5,895,182	887,537	997,931	8,040,993
February	250,421	5,317,883	811,785	866,232	7,246,321
March	291,631	6,845,126	894,852	1,195,105	9,226,714
April	262,733	6,541,862	850,359	938,306	8,593,260
May	280,922	7,109,701	836,565	934,734	9,161,922
June	284,835	6,843,686	792,658	1,160,559	9,081,738
July	292,972	6,585,127	775,123	1,219,786	8,873,008
August	234,845	4,794,055	775,112	1,034,014	6,838,026
September	238,908	4,352,149	733,115	950,552	6,274,724
October	238,510	6,037,018	729,568	896,355	7,901,451
November	230,848	6,455,123	692,601	815,077	8,193,649
December	236,617	6,854,812	672,347	799,818	8,563,594
Total	3,103,585	[a]73,631,724	9,451,622	11,808,469	97,995,400

[a] Does not include 19,550,000 barrels produced in 1914 in the Cushing and Healdton fields and placed in field storage.

Marketed production of petroleum in the Mid-Continent field, 1889–1914, in barrels.

Year.	Production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).	Value.	Yearly average price per barrel.
1889	500				$2,500	$5.000
1890	1,200		+ 700	+140.00	8,400	7.000
1891	1,430		+ 230	+ 19.17	9,950	6.958
1892	5,080		+ 3,650	+255.24	5,480	1.079
1893	18,010	0.04	+ 12,930	+254.53	18,060	1.003
1894	40,130	.08	+ 22,120	+122.82	40,810	1.017
1895	44,467	.08	+ 4,337	+ 10.81	26,910	.605
1896	115,141	.19	+ 70,674	+158.93	52,587	.457
1897	147,648	.24	+ 32,507	+ 28.23	71,914	.487
1898	616,600	1.11	+ 468,952	+317.62	305,875	.496
1899	738,183	1.29	+ 121,583	+ 19.72	523,068	.709
1900	917,225	1.44	+ 179,042	+ 24.25	945,992	1.031
1901	989,696	1.43	+ 72,471	+ 7.90	778,096	.787
1902	986,720	1.12	− 2,976	− .30	745,803	.756
1903	1,573,085	1.57	+ 586,365	+ 59.42	1,645,936	1.046
1904	6,186,629	5.28	+ 4,613,544	+293.28	5,859,982	.947
1905	12,533,777	9.30	+ 6,347,148	+102.60	6,908,002	.551
1906	22,839,911	18.05	+10,306,134	+ 82.23	10,357,923	.454
1907	46,896,267	28.23	+24,056,356	+105.33	19,239,085	.410
1908	48,823,747	27.35	+ 1,927,480	+ 4.11	19,134,658	.392
1909	50,833,740	27.75	+ 2,009,993	+ 4.12	18,863,436	.371
1910	59,217,582	28.26	+ 8,383,842	+ 16.49	23,163,676	.391
1911	66,595,477	30.21	+ 7,377,895	+ 12.46	31,928,208	.479
1912	65,473,345	29.48	− 1,122,132	− 1.68	45,300,669	.692
1913	84,920,225	34.18	+19,446,880	+ 29.70	80,767,758	.951
1914	[a] 97,995,400	36.87	+13,075,175	+ 15.40	78,671,902	.803
Total	568,511,215	17.04			345,376,680	.608

[a] Does not include 19,550,000 barrels produced in 1914 in the Cushing and Healdton fields in Oklahoma and placed in field storage.

Marketed production of petroleum in the Mid-Continent field in 1913 and 1914, by States, showing increase and percentage of increase, in barrels.

State.	Production.		Increase.	Percentage of increase.
	1913	1914		
Kansas	2,375,029	3,103,585	728,556	30.68
Oklahoma	63,579,384	[a] 73,631,724	10,052,340	15.81
Northern Texas	9,184,252	9,451,622	267,370	2.91
Northern Louisiana	9,781,560	11,808,469	2,026,909	20.72
Total	84,920,225	97,995,400	13,075,175	15.40

[a] Does not include 19,550,000 barrels produced in 1914 in the Cushing and Healdton fields and placed in field storage.

Marketed production, value, and average price per barrel of petroleum in the Mid-Continent field, 1905–1914, by States, in barrels.

Year.	Kansas and Oklahoma.			Northern Texas.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905	12,013,495	$6,546,398	$0.545	520,282	$361,604	$0.695
1906	21,718,648	9,615,198	.443	1,117,905	740,542	.662
1907	45,933,649	18,478,658	.402	912,618	721,577	.791
1908	47,600,546	18,441,538	.387	723,264	479,072	.662
1909	49,122,982	17,920,623	.364	681,940	393,732	.577
1910	53,157,386	20,367,423	.383	969,403	505,396	.521
1911	57,348,456	27,060,523	.472	2,251,193	1,213,960	.539
1912	53,019,867	35,768,302	.674	5,275,529	4,112,826	.779
1913	65,954,413	61,830,231	.937	9,184,252	9,125,185	.992
1914	[a]76,735,309	59,686,261	.778	9,451,622	7,778,955	.823

Year.	Northern Louisiana.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905	....	....	....	12,533,777	$6,908,002	$0.551
1906	3,358	$2,183	$0.650	22,839,911	10,357,923	.454
1907	50,000	38,850	.277	46,896,267	19,239,085	.410
1908	499,937	214,048	.428	48,823,747	19,134,658	.392
1909	1,028,818	549,081	.533	50,833,740	18,863,436	.371
1910	5,090,793	2,290,857	.450	59,217,582	23,163,676	.391
1911	6,995,828	3,653,725	.522	66,595,477	31,928,208	.479
1912	7,177,949	5,419,541	.755	65,473,345	45,300,669	.692
1913	9,781,560	9,812,342	1.003	84,920,225	80,767,758	.951
1914	11,808,469	11,206,686	.949	97,995,400	78,671,902	.803

[a] Does not include 19,550,000 barrels produced in the Cushing and Healdton fields in Oklahoma and placed in field storage.

Marketed production of petroleum in the Mid-Continent oil field, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	4,556,738	4,919,620	4,955,463	6,271,174	8,040,993
February	4,028,540	4,683,538	4,895,427	5,951,436	7,246,321
March	5,161,294	7,080,646	5,158,823	6,721,358	9,226,714
April	5,563,228	5,952,082	5,145,162	6,958,467	8,593,260
May	5,117,565	5,742,241	5,539,186	7,473,214	9,161,922
June	5,248,177	5,584,423	5,187,674	7,289,629	9,081,738
July	5,048,983	5,488,403	5,557,030	7,317,115	8,873,008
August	4,836,711	5,386,153	5,806,372	6,916,638	6,838,026
September	5,115,361	5,466,628	5,545,693	7,097,031	6,274,724
October	5,121,995	5,680,980	6,113,379	7,617,577	7,901,451
November	4,677,634	5,352,694	5,641,809	7,535,142	8,193,649
December	4,741,356	5,258,069	5,927,327	7,771,444	8,563,594
Total	59,217,582	66,595,477	65,473,345	84,920,225	97,995,400

Average daily production of petroleum in the Mid-Continent oil field each month, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	146,992	158,697	159,208	202,296	259,387
February	143,876	167,269	168,808	212,551	258,797
March	166,493	228,408	166,414	216,818	297,636
April	185,441	198,403	171,505	231,949	286,442
May	165,083	185,234	178,683	241,071	295,546
June	174,939	186,147	172,932	242,988	302,725
July	162,870	177,045	179,259	236,036	286,226
August	156,023	173,747	187,302	223,117	220,582
September	170,512	182,221	184,856	236,568	209,157
October	165,226	183,257	197,206	245,728	254,886
November	155,931	178,423	188,060	251,171	273,122
December	152,947	169,615	191,204	250,692	276,245
Average	162,240	182,453	178,889	232,658	268,481

PIPE-LINE RUNS, DELIVERIES, AND STOCKS.

Pipe-line runs and deliveries to trade of petroleum from the Mid-Continent field, by months, in barrels, in 1913 and 1914 and stocks at end of each month.

Month.	1913			1914		
	Runs.	Deliveries.	Stocks.	Runs.	Deliveries.	Stocks.
Dec. 31, 1912			51,537,779			
January	6,271,174	5,280,230	52,528,723	8,040,993	6,919,479	58,513,360
February	5,951,436	5,823,690	52,656,469	7,246,321	6,843,355	58,926,326
March	6,721,358	6,202,572	53,175,255	9,226,714	8,833,892	59,309,148
April	6,958,467	6,456,718	53,677,004	8,593,260	7,478,268	60,424,140
May	7,473,214	7,189,648	53,960,570	9,161,922	7,605,413	61,980,649
June	7,289,629	6,501,766	54,748,433	9,081,738	7,164,284	63,898,103
July	7,317,115	6,666,738	55,398,810	8,873,008	7,318,108	65,453,003
August	6,916,638	6,666,782	55,648,666	6,838,026	6,747,414	65,543,615
September	7,097,031	6,906,896	55,838,801	6,274,724	7,803,882	64,014,457
October	7,617,577	7,324,808	56,131,570	7,901,451	9,728,614	62,187,294
November	7,535,142	6,662,930	57,003,782	8,193,649	9,202,788	61,178,155
December	7,771,444	7,383,380	57,391,846	8,563,594	8,924,055	60,817,694
Total	84,920,225	79,066,158		97,995,400	94,569,552	

PRICES.

The following table shows the changes in prices of Mid-Continent oil per barrel in 1912, 1913, and 1914, with the dates on which the changes were made:

Prices paid for Mid-Continent oil per barrel in 1912–1914, with the dates on which the changes were made.

Date.	Kansas and Oklahoma.	Northern Texas.				Caddo, La.
		Corsicana (light).	Henrietta.	Powell (heavy).	Electra.	
1912.						
Jan. 1	$0.50	$0.50	$0.50	$0.50	$0.50	$0.40–$0.62
Jan. 2	.53					
Jan. 4						.40– .65
Jan. 15	.55					
Jan. 18						.40– .67
Jan. 26	.57					
Jan. 27						.40– .69
Feb. 1		.55	.55		.55	
Feb. 2						.40– .72
Feb. 5	.60					
Mar. 1				.55		
Apr. 10	.62					
Apr. 16	.64	.60	.60		.60	
Apr. 17						.40– .75
May 7	.66					
May 17	.68					
May 20		.65	.65		.65	.40– .77
June 20						.55– .77
July 15						.55– .80
July 16	.70					
July 18		.70	.70		.70	
Sept. 10				.60		.60– .80
Oct. 25				.65		
Nov. 7	.73					
Nov. 9						.60– .83
Nov. 14		.75	.75		.75	
Nov. 27	.76					
Dec. 11	.78					
Dec. 12						.60– .88
Dec. 14		.80	.80	.70	.80	.60– .91
Dec. 16	.80					
Dec. 24	.83					
Dec. 26		.83	.88		.88	
1913.						
Jan. 1	.83	.83	.88	.70	.88	.60– .91
Jan. 7						.70– .93
Jan. 9		.90	.90		.90	
Jan. 10		.88	.88		.88	
Jan. 13		.90	.90		.90	
Jan. 29	.88	.95	.95		.95	
Feb. 1						.70– .98
Apr. 7				.80		
July 7	.93					.75– 1.00
July 21	.98					
July 24		1.00	1.00		1.00	
Aug. 19	1.03					
Aug. 22						.75– 1.05
Aug. 25		1.05	1.05		1.05	

Prices paid for Mid-Continent oil per barrel in 1912–1914, with the dates on which the changes were made—Continued.

Date.	Kansas and Oklahoma.	Healdton, Okla.	Northern Texas.				Caddo, La.
			Corsicana (light).	Henrietta.	Powell (heavy).	Electra.	
1914.							
Jan. 1	$1.03		$1.05	$1.05	$0.80	$1.05	$0.75–$1.05
Jan. 26		$1.03					
Feb. 2	1.05						
Mar. 2		.70–1.03			.70		
Mar. 9		.70–1.05					
Mar. 26		.70					
Apr. 3							.60– 1.05
Apr. 8	1.00						
Apr. 10	.95						
Apr. 13	.90	.60	.95	.95	.60	.95	
Apr. 15	.85						
Apr. 17							.50– 1.05
Apr. 20		.50	.85	.85	.50	.85	
Apr. 27	.80						
Apr. 30	.75						
May 5			.75	.75		.75	
July 9							.50– 1.00
Aug. 8							.45– .95
Aug. 13							.45– .85
Sept. 1							.45– .80
Sept. 12	.65						
Sept. 22	.55		.70	.70		.70	
Oct. 6			.65	.65		.65	
Nov. 13			.60	.60		.60	

In the following table is shown the average price per month of the different oils of the Mid-Continent field during the years 1913 and 1914:

Average monthly prices of Mid-Continent petroleum in 1913 and 1914, per barrel.

1913.

Month.	Kansas and Oklahoma.	Northern Texas.				Caddo, La.
		Corsicana (light).	Henrietta.	Powell (heavy).	Electra.	
January	$0.83	$0.88	$0.88	$0.70	$0.88	$0.68–$0.93
February	.88	.95	.95	.70	.95	.70– .98
March	.88	.95	.95	.70	.95	.70– .98
April	.88	.95	.95	.78	.95	.70– .98
May	.88	.95	.95	.80	.95	.70– .98
June	.88	.95	.95	.80	.95	.70– .98
July	.92	.96	.96	.80	.96	.74– .94
August	1.00	1.01	1.01	.80	1.01	.75– 1.02
September	1.03	1.05	1.05	.80	1.05	.75– 1.05
October	1.03	1.05	1.05	.80	1.05	.75– 1.05
November	1.03	1.05	1.05	.80	1.05	.75– 1.05
December	1.03	1.05	1.05	.80	1.05	.75– 1.05
Average	.939	.983	.983	.773	.983	.723–.991

1914.

January	$1.03	$1.05	$1.05	$1.80	$1.05	$0.75–$1.05	$1.03
February	1.01	1.05	1.05	1.80	1.05	.75– 1.05	1.03
March	1.05	1.05	1.05	.74	1.05	.75– 1.05	.72–0.98
April	.91	.95	.95	.60	.95	.56– 1.05	.56
May	.75	.76	.76	.50	.76	.50– 1.05	.50
June	.75	.75	.75	.50	.75	.50– 1.05	.50
July	.75	.75	.75	.50	.75	.50– 1.01	.50
August	.75	.75	.75	.50	.75	.46– .90	.50
September	.66	.74	.74	.50	.74	.45– .80	.50
October	.55	.66	.66	.50	.66	.45– .80	.50
November	.55	.62	.62	.50	.62	.45– .80	.50
December	.55	.60	.60	.50	.60	.45– .80	.50
Average	.76	.81	.81	.75	.81	.55– .95	.61

SUMMARY OF WELLS DRILLED.

Number of wells completed in the Mid-Continent field, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1811	1912	1913	1914
Kansas	85	172	536	1,422	1,753	82	96	160	260	270	428	418	949	2,016	2,340
Oklahoma	3,188	3,294	4,712	6,965	6,410	408	489	843	1,308	1,343	3,777	4,087	5,993	8,851	8,292
North Texas	108	84	299	581	497	[a] 82	38	124	208	221	190	126	434	799	744
Northern Louisiana	124	246	239	356	302	54	63	62	92	91	[b] 226	341	353	518	445
Total	3,505	3,796	5,786	9,324	8,962	626	686	1,189	1,868	1,925	4,621	4,972	7,729	12,184	11,821

[a] Including gas wells. [b] Includes Marion County, Tex.

Number of oil wells and dry holes drilled in the Mid-Continent field in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Kansas	207	31	194	18	199	32	191	42	230	30	203	10	153	21
Oklahoma	684	153	653	138	733	149	725	190	796	178	660	116	531	101
North Texas	64	24	49	23	95	39	79	22	46	26	44	14	23	18
North Louisiana	21	3	25	6	40	6	31	9	41	12	42	15	27	4
Total	976	211	921	185	1,067	226	1,026	263	1,113	246	949	155	734	144

District	Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Kansas	115	9	95	17	61	15	50	20	55	25	1,753	270	1,422	260
Oklahoma	469	78	438	75	282	44	186	52	253	69	6,410	1,343	6,965	1,308
North Texas	29	11	16	6	20	18	22	12	10	8	497	221	581	208
North Louisiana	26	6	13	6	10	10	11	6	15	8	302	91	356	92
Total	639	104	562	104	373	87	269	90	333	110	8,962	1,925	9,324	1,868

Number of oil wells drilled in the Mid-Continent field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	208	265	287	317	336	325	253	261	265	308	326	230	[a] 3,505
1911	254	290	349	413	378	279	254	243	262	249	317	262	[a] 3,796
1912	152	317	335	456	486	576	558	567	532	588	637	582	5,786
1913	488	553	514	624	811	867	880	927	839	881	953	987	9,324
1914	976	921	1,067	1,026	1,113	949	734	639	562	373	269	333	8,962

[a] Caddo, La., not given by months.

Number of dry holes drilled in the Mid-Continent field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	34	62	59	60	48	52	50	25	67	43	40	32	[a] 626
1911	45	29	39	71	68	74	57	47	34	39	61	59	[a] 686
1912	32	78	64	98	103	120	95	93	107	146	158	95	1,189
1913	111	98	100	76	162	191	237	176	139	177	184	217	1,868
1914	211	185	226	263	246	155	144	104	104	87	90	110	1,925

[a] Caddo, La., not given by months.

Total number of wells completed in the Mid-Continent field, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	307	387	386	417	426	427	332	306	357	384	383	283	[b]4,621
1911	328	344	421	528	482	417	364	304	351	322	407	363	4,972
1912	207	444	437	615	653	776	706	729	711	822	890	739	7,729
1913	669	715	660	758	1,083	1,180	1,207	1,186	1,062	1,144	1,223	1,297	12,184
1914	1,260	1,186	1,368	1,377	1,461	1,176	945	812	712	556	448	520	11,821

[a] Including gas wells. [b] Caddo, La., not given by months.

Initial daily production of new wells completed in the Mid-Continent field in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
Kansas	2,077	2,196	1,950	2,083	2,411	2,178	1,820
Oklahoma	27,785	40,344	60,201	61,233	102,674	128,886	84,652
Northern Texas	5,401	4,217	3,785	2,731	2,306	2,229	965
Northern Louisiana	3,045	6,750	24,405	7,118	13,802	19,467	7,580
Total	38,308	53,507	90,341	73,165	121,193	152,760	95,017

District.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Kansas	1,395	1,006	700	501	615	18,932	22,467
Oklahoma	91,886	92,453	81,357	71,488	133,285	976,244	334,050
Northern Texas	1,138	1,184	261	622	164	25,003	57,435
Northern Louisiana	10,565	1,455	1,605	2,790	3,611	102,193	151,955
Total	104,984	96,098	83,923	75,401	137,675	1,122,372	565,907

Total and average initial daily production of new wells in the Mid-Continent field, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Kansas	1,897	3,271	7,245	22,467	18,932	22.3	19.0	13.5	15.8	10.8
Oklahoma	226,638	262,333	228,886	334,050	976,244	71.1	79.6	48.6	48.0	152.3
Northern Texas	1,683	19,180	28,213	57,435	25,003	15.6	228.3	94.3	98.9	50.3
Northern Louisiana	[a]139,945	169,123	84,098	151,955	102,193	1,128.6	687.5	351.9	426.8	338.4
Total	370,163	453,907	348,442	565,907	1,122,372	105.6	119.6	60.2	60.7	125.2

[a] Includes Marion County, Tex.

Total initial daily production of new wells in the Mid-Continent field, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	15,840	18,090	21,057	19,110	19,758	27,462	15,204	16,906	19,305	18,899	18,187	20,400	[a]370,163	30,847
1911	23,525	26,970	40,855	31,168	28,828	24,225	16,968	12,934	17,274	20,754	22,738	18,545	[a]453,907	37,826
1912	19,283	22,437	24,429	37,573	24,592	22,099	23,971	30,153	36,468	38,877	37,573	30,987	348,442	29,037
1913	29,305	35,551	36,189	54,518	59,191	55,466	48,142	53,929	41,405	48,436	40,756	63,019	565,907	47,159
1914	38,308	53,507	90,341	73,165	121,193	152,760	95,017	104,984	96,098	83,923	75,401	137,675	1,122,372	93,531

[a] Caddo, La., not given by months.

KANSAS.

GENERAL STATEMENT.

Following the example of Oklahoma, Kansas increased its record output of petroleum in 1913 by more than 30 per cent in 1914. Final statistics credit the State with an output of 3,103,585 barrels in 1914, compared with 2,375,029 barrels in 1913. This gain was attended by no spectacular features, however, but was due rather to the orderly development of a number of productive pools opened in 1913, together with the prudent handling of many wells of moderate production, which tended to retard, for the time being, their steady decline. In common with other oil-producing States, Kansas enjoyed great activity in the oil industry during the early part of the year; later a period of uncertainty and hesitation was caused by the declining market of the midsummer months, and this period merged into a third stage of slight activity lasting until the end of the year.

Because of the depressed market for petroleum during much of the year, the gain in value of the Kansas production of petroleum in 1914 was not proportionate to the gain in quantity. The average price per barrel at the wells in Kansas in 1914 was 78 cents, compared with nearly 95 cents in 1913, and the total value of the State's output in 1914 was $2,433,074, an increase of 8 per cent over the $2,248,283 received in 1913.

DEVELOPMENT.

The total number of wells completed in the Kansas end of the Mid-Continent field in 1914 was 2,304, of which 1,753, or 76 per cent, were oil wells; 317, or 14 per cent, were classed as gassers; and 270, or 10 per cent, were barren. The total wells completed disclose an increase of 324 wells over the 1913 record of 2,016 wells, and the ratio of dry holes to total wells completed, which was about 1 to 8 in 1913, was approximately 1 to 9 in 1914.

The total initial production contributed by the 1,753 oil wells completed in 1914 was 18,932 barrels, an average output of nearly 11 barrels a well for the first day of productive life.

Montgomery County, as usual, led in activity and in new production. Chautauqua County was a close second in production, obtained principally from the new wells contributed by the Elgin pool. Butler County, which has yielded considerable gas for a number of years, completed its first oil well in June, 1914, and added four other oil producers before the end of July. South of Butler, in Cowley County, wildcat activity resulted in the completion in May of the first oil well in that portion of the State, the discovery being made in sec. 25, T. 32 S., R. 4 E., about 2 miles east of Winfield. These discoveries are of considerable importance, being situated some distance west of the developed oil pools of the State, and will undoubtedly incite further activity in the search for oil in this direction.

At the north end of the field activity was nominal in the Paola (Miami County) and Rantoul (Franklin County) pools. The completion in June of a small oil well near Piper, 40 miles northeast of these pools, in Wyandotte County, excited considerable interest, but to the end of the year no further discoveries of value had been made in the locality. A wildcat test near Zeandale, Riley County, was barren of oil or gas and is reported to have entered granite at a depth of about 1,000 feet.

At the end of the year Kansas had a total of 3,412 active oil wells, compared with 3,054 at the end of 1913.

MARKETED PRODUCTION.

Marketed production of petroleum in Kansas, 1913 and 1914, by months, in barrels.

1913.

Month.	Runs to local refineries.	Other runs and field fuel.	Rail shipments not included in pipe-line runs.	Total.
January	38,053	386	122,460	160,899
February	38,053	934	122,319	161,306
March	38,053	391	137,690	176,134
April	38,053	1,133	145,045	184,231
May	38,053	3,322	142,718	184,093
June	38,053	2,598	142,505	183,156
July	38,053	1,501	155,083	194,637
August	38,053	4,552	157,699	200,304
September	38,053	5,909	165,120	209,082
October	38,053	2,167	177,172	217,392
November	38,053	3,246	193,082	234,381
December	38,050	1,605	229,759	269,414
Total	a 456,633	27,744	1,890,652	2,375,029

1914.

Month.	Runs to local refineries.	Other runs and field fuel.	Rail shipments not included in pipe-line runs.	Total.
January	44,906	2,890	212,547	260,343
February	38,473	2,158	209,790	250,421
March	47,137	789	243,705	291,631
April	47,426	155	215,152	262,733
May	44,522	192	236,208	280,922
June	45,768	575	238,492	284,835
July	47,219	384	245,369	292,972
August	36,794	384	197,667	234,845
September	31,624	346	206,938	238,908
October	34,571	309	203,630	238,510
November	34,928	327	195,593	230,848
December	35,652	519	200,446	236,617
Total	489,020	9,028	2,605,537	3,103,585

a Averaged.

SUMMARY OF WELLS DRILLED.

The following tables show the wells completed in Kansas from 1910 to 1914, inclusive:

Number of wells completed in Kansas, 1910–1914, by counties.

County.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Allen	13	30	50	154	175	14	10	6	11	10	78	59	58	171	193
Anderson					1										1
Bourbon					1										1
Butler					5										29
Chautauqua	42	64	182	311	308	14	11	28	77	38	60	82	222	442	376
Coffey					5					1					7
Cowley					3					8					17
Elk							4			3	1	4			3
Franklin	1		18	54	163				3	30	3		18	58	225
Labette	1		2		8					18	3	1	2	3	54
Linn					2										2
Miami					131					42					186
Montgomery	16	60	202	602	691	7	22	47	92	75	79	118	365	867	903
Neosho	9	16	62	257	221	17	22	23	27	19	87	59	115	316	263
Wilson	1	2	18	40	27	27	27	52	45	20	108	94	156	139	59
Woodson			1	2	12			3	3	2			7	5	14
Miscellaneous	2		1	2		3		1	2	4	9	1	6	15	7
Total	85	172	536	1,422	1,753	82	96	160	260	270	428	418	949	2,016	2,340

[a] Including gas wells.

Number of oil wells and dry holes drilled in Kansas in 1914, by counties and months.

County.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	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.	Oil.	Dry.
Allen	21	1	17	..	17	1	15	3	24	3	20	..	19	..	11	..	13	2	4	..	8	..	6	..	175	10	154	11
Anderson											1														1			
Bourbon	1																								1			
Butler											2		3												5			
Chautauqua	16	1	14	3	26	1	39	5	34	4	41	1	38	11	36	4	26	2	19	..	10	1	9	5	·308	38	311	77
Coffey											3				1								1	1	5	1		
Cowley								1	1	1					1		1	1				1		4	3	8		
Elk																1								2		3		
Franklin	1	3	4	..	19	2	14	7	32	5	30	1	21	..	10	1	11	4	11	2	8	2	5	3	163	30	54	3
Labette						1	1										3			7	1	9		1	8	18		
Linn									2																2			
Miami	27	9	19	7	22	5	14	13	18	2	12	1	6	3	9	..	3	2					1	..	131	42		
Montgomery	98	11	100	6	81	9	81	10	86	10	68	6	45	5	38	2	26	5	18	4	19	3	31	4	691	75	602	92
Neosho	38	3	37	2	33	9	23	..	26	1	23	1	18	..	8	..	7	..	7	..	1	3			221	19	257	27
Wilson	1	3	2	..	1	4	3	3	3	2	3	..	3	2	1	1	5	1	2	2	1	1	2	1	27	20	40	45
Woodson	4	..	1				1	..	4	2											2				12	2	2	3
Miscellaneous																								4		4	2	2
Total	207	31	194	18	199	32	191	42	230	30	203	10	153	21	115	9	95	17	61	15	50	20	55	25	1,753	270	1,422	260

Number of oil wells drilled in Kansas, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	44	69	61	63	97	128	147	155	133	147	184	194	1,422
1914	207	194	199	191	230	203	153	115	95	61	50	55	1,753

Number of dry holes drilled in Kansas, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	6	9	12	13	29	30	31	20	23	32	24	31	260
1914	31	18	32	42	30	10	21	9	17	15	20	25	270

Total number of wells completed in Kansas, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	75	107	88	96	172	190	202	207	185	209	236	249	2,016
1914	266	228	251	254	284	228	201	144	133	119	114	118	2,340

[a] Including gas wells.

Initial daily production of new wells completed in Kansas in 1914, by counties and months, in barrels.

County.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Allen	230	202	186	245	268	228	249	94	65	25	59	45	1,896	2,960
Anderson						10							10	
Bourbon	5												5	
Butler						7	40						47	
Chautauqua	465	326	362	505	542	677	537	613	501	393	228	230	5,379	7,358
Coffey						30		5				10	45	
Cowley					25			25	100				150	
Franklin	5	75	112	96	233	190	259	120	67	103	60	40	1,360	748
Labette				10					12		10		32	
Linn					30								30	
Miami	165	203	99	162	63	70	40	82	11			25	920	
Montgomery	836	914	810	709	857	683	438	349	178	124	124	240	6,262	5,871
Neosho	344	448	373	324	251	255	234	102	38	40	5		2,414	5,168
Wilson	4	23	8	26	72	28	23	5	34	15	5	25	268	342
Woodson	23	5		6	70						10		114	13
Miscellaneous														7
Total	2,077	2,196	1,950	2,083	2,411	2,178	1,820	1,395	1,006	700	501	615	18,932	22,467

Total and average initial daily production of new wells in Kansas, 1910–1914, by counties, in barrels.

County.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Allen	210	353	632	2,960	1,896	16.2	11.8	12.6	19.2	10.83
Anderson					10					10.00
Bourbon					5					5.00
Butler					47					9.40
Chautauqua	1,100	1,355	2,963	7,358	5,379	26.2	21.2	16.3	23.7	17.46
Coffey					45					9.00
Cowley					150					50.00
Franklin	5		155	748	1,360	5.0		8.6	13.9	8.34
Labette	20		15		32	20.0		7.5		4.00
Linn					30					15.00
Miami					920					7.02
Montgomery	382	1,300	2,522	5,871	6,262	23.9	21.7	12.5	9.8	9.06
Neosho	130	208	693	5,168	2,414	14.4	13.0	11.2	20.1	10.9
Wilson	10	55	255	342	268	10.0	27.5	14.2	8.6	9.9
Woodson			5	13	114			5.0	6.5	9.5
Miscellaneous	40		5	7		20.0		5.0	3.5	
Total	1,897	3,271	7,245	22,467	18,932	22.3	19.0	13.5	15.8	10.8

Total initial daily production of new wells in Kansas, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	......	95	65	95	170	40	235	200	257	305	210	225	1,897	158
1911	155	90	304	161	438	255	285	363	265	380	265	310	3,271	273
1912	65	173	213	390	352	714	834	940	507	842	1,185	1,030	7,245	604
1913	860	1,065	1,003	1,897	1,548	1,918	1,945	2,250	2,283	2,501	2,857	2,340	22,467	1,872
1914	2,077	2,196	1,950	2,083	2,411	2,178	1,820	1,395	1,006	700	501	615	18,932	1,578

OKLAHOMA.

GENERAL STATEMENT.

The total aboveground production of petroleum in Oklahoma in 1914 is placed at 93,181,724 barrels, of which 73,631,724 barrels represents the quantity marketed plus that consumed in field development, and the remaining 19,550,000 barrels represents the quantity placed in producers' storage in the Cushing and Healdton fields. Outside the fields specified the quantity of unsold oil in producers' storage did not attain such proportions as to warrant the compilation of data on the subject. In Cushing and Healdton, however, the accumulation of unmarketed oil in quantities greater than the combined output of Pennsylvania and West Virginia for the whole year had so far-reaching an effect on the petroleum industry of the entire United States that a record of it has been found necessary.

If the marketed production alone is considered, the statistics for 1914 disclose an increase of nearly 16 per cent over the record output in 1913 of 63,579,384 barrels. The total aboveground production, however, exceeds the marketed output of 1913 by more than 46 per cent.

The yearly average price received for the State's production declined from 94 cents a barrel in 1913 to 78 cents a barrel in 1914, and the total value of the quantity marketed was $2,000,000 less than in 1913—amounting in 1914 to $57,253,187.

Throughout the year the petroleum industry in Oklahoma and to a scarcely less extent the petroleum industry of the entire United States was dominated by the Cushing field, in the northwest corner of Creek County, with its phenomenal output of the highest grade of crude petroleum yet discovered in large quantities west of the Appalachian fields. From a total production of about 25,000 barrels of oil a day at the close of 1913 this field increased its output to more than 150,000 barrels a day at the end of June, 1914, and at the end of December was averaging more than 225,000 barrels a day with little prospect of immediate permanent decline. Available refining capacity and pipe-line facilities were wholly inadequate to care for this unprecedented production and the surplus was forced into field storage with deplorable losses in both quantity and quality.

The mounting surplus of crude oil quickly brought conviction of the tremendous potentialities of the field, and early in April the already overstrained market began a decline which eventually affected every type of high-grade oil produced in the United States, and in the remarkably short space of 22 days reduced the quotations on Kansas and Oklahoma grades from the record price of $1.05 a barrel attained in February to 75 cents a barrel. At the latter price the market for the better grades of Mid-Continent oil officially remained until September, when a demoralized export market resulting from the outbreak of the European war in August, reacting through the refiners thus temporarily deprived of an outlet for their product, effected further declines and brought the market price to 55 cents a barrel, a point maintained to the close of the year.

Of more than passing interest were the efforts of the Oklahoma Corporation Commission, invoked by many of the producers concerned, to regulate the production of the Cushing field by fixing a minimum price at which the oil might be sold and by prohibiting drilling except where necessary for offsetting or complying with lease requirements. For a time it appeared that the means adopted might prove successful. The output of the excepted wells, however, maintained and in fact increased the production of the field. Hampered by the lack of suitable storage, certain of the producers were forced to dispose of their oil at any price obtainable. As soon as it became apparent that price cutting was in order the large purchasers, who prior to this time had complied with the commission's orders, declined to handle any more oil at the price fixed, thus forcing the commission to recede from its position and to permit the law of supply and demand to take its course. The temporary retarding of the field's production was, on the whole, advantageous, as it gave opportunity for the construction of much-needed storage for the flood of oil subsequently brought to the surface.

DEVELOPMENT.

Field activity in Oklahoma in 1914 was more apparent in the early part of the year than in the later part, because of the overproduction at Cushing and Healdton and of the further depression of the petroleum market occasioned by the European war. A total of 8,292 wells were completed in the State during the 12 months in review, of which number 6,410, or 77 per cent, produced oil; 539, or 7 per cent, were classed as gassers and 1,343, or 16 per cent, were barren.

The oil wells furnished a total initial production of 976,244 barrels, representing an average for the State of 152 barrels per well for the first day of productive life.

Interest was of course centered in the Cushing field, where the discovery of a prolific yield of oil in the deep-lying Bartlesville sand late in 1913 induced a frenzied campaign of drilling, which resulted in the development of one of the greatest oil fields in the history of the petroleum industry. This field was opened in March, 1912, by a well on the Wheeler lease, sec. 31, T. 18 N., R. 7 E. Indian meridian, and, until December, 1913, was developed for production found in the Layton and Wheeler sands, encountered at average depth of 1,400 feet, and 2,100 feet, respectively. In December, 1913, however, a test well drilled by the Prairie Oil & Gas Co. in sec. 3, T. 17 N., R. 7 E., furnished proof of the extraordinary richness of the Bartlesville sand, which was penetrated at a depth below 2,500 feet, and since that time attention has been confined almost exclusively to the development of this prolific source, the upper sands being cased off and reserved for future consideration. More than 750 wells were drilled in the Cushing field in 1914, and at the end of the year the development in the Bartlesville sand occupied a belt 3 to 5 miles in width and extending from the southern tier of sections in the west half of T. 19 N., R. 7 E., southeastward a distance of more than 9 miles, into secs. 21 and 22, T. 17 N., R. 7 E. At the close of the year the field was still being extended, particularly toward the north, and gave abundant promise of dominating the petroleum industry in 1915.

Another field which contributed notably to the Oklahoma output in 1914 was that at Healdton, in Carter County, which is of especial interest as being the first oil pool of real consequence to be developed in the southern part of the State. This field was opened in August, 1913, by a well drilled by the Red River Oil Co. (now Dundee Petroleum Co.), on the Wirt Franklin farm, in the NE. $\frac{1}{4}$ sec. 8, T. 4 S., R. 3 W. Indian meridian, which furnished an initial yield of 25 to 30 barrels of oil from a depth of about 900 feet. Drilling was exceedingly active in this locality in the early part of 1914, and the field was developed mainly to the north and east of the discovery well over a roughly elliptical area having an east-west extent of about 5 miles and a north-south extent of about $2\frac{1}{2}$ miles. To the end of the year about 275 productive wells had been drilled in the district with initial daily production ranging up to a maximum in excess of 5,000 barrels. Operations were severely hampered by lack of adequate storage, and large quantities of oil were lost as the result of leakage and evaporation from open sumps, as well as by disastrous fires kindled by lightning. Early in the year the Magnolia Petroleum Co. constructed a 6-inch pipe line from Bowie, Tex., to the field, a distance of 32 miles, but was unable to handle more than a fraction of the oil produced. Field activities were practically suspended in November, but at the end of the year the field storage amounted to approximately 1,535,000 barrels.

The occurrence of the oil at Healdton, which is in the "Red Beds" of the Permian system, is fully described in a report on the Healdton field by geologists of the Survey who examined the area late in 1914.[1]

Though overshadowed by the results at Cushing and Healdton, developments of interest were recorded in other portions of Oklahoma in 1914.

The so-called Booch Sand field opened near Morris, Okmulgee County, in August, 1913, supported much activity in 1914 and was extended to include a number of detached pools occupying an area approximately 12 miles long by 4 miles broad. Eastward from this locality considerable success attended operations at Boynton in western Muskogee County. Southwest of Sapulpa, in Creek County, an extension of the Glenn pool yielded a number of gushers and attracted some attention. Tulsa County showed renewed activity, resulting in the completion of a number of good wells in the deep pay at Red Fork and Jenks and of a few small wells in the shallow Bartlesville sand north of Tulsa.

The Inola, Wann, and Owasso pools opened in 1913 proved disappointing as to area and yield in 1914.

In Kay County the Newkirk field responded admirably to active development, which was, however, greatly hampered by the lack of market facilities. In the northwestern part of the county near Blackwell a small pumper producing from a sand encountered below

[1] Wegemann, C. H., and Heald, K. C., The Healdton oil field, Carter County, Okla.: U. S. Geol. Survey Bull. 621, pp. 13-30, 1915 (Bull. 621-B).

3,000 feet furnished incentive for seven or eight other deep tests in the area adjacent to the Kansas boundary, all of which proved barren of oil or gas.

In Okfuskee County interest was centered in a wildcat well in sec. 8, T. 12 N., R. 7 E. Indian meridian, near Paden, which was reported in November, 1914, to show promise of a new field in that locality, though the well was not completed and tested before the end of the year.

Farther south in Pontotoc County a small shallow-sand pool near Allen was one of the developments of the year. Near Ada, in the same county, a number of gas wells were completed, and in the southwestern part of the State, in Comanche County, a few small oil producers were found near Lawton.

As a result of the increased production of oil in Oklahoma and of the correspondingly low prices prevailing for high-grade oil, there was a notable increase in the number of plants and in the capacity of the independent refineries of Oklahoma and Kansas. Four new refineries were completed at Cushing, 1 at Bristow, 1 at Ponca City, 1 at Tulsa, 1 at Ardmore, and 1 at Arkansas City, Kans., and others were being built at Cushing and Yale at the close of the year. Pipeline construction was also a feature of the year and centered, of course, in Cushing, from which radiated some 23 short lines to adjacent refineries, tank farms, and loading racks. In addition a 6-inch line was completed by the Milliken Pipe Line Co. from this field to Vinita, a distance of 80 miles, and a 40-mile, 6-inch line was constructed by the Cosden Pipe Line Co. from this field to Tulsa. Outside of Cushing a 3-inch line was completed between Okmulgee and Bristow, a distance of 30 miles, by the Indiahoma Refining Co. At Healdton, in addition to the previously mentioned line of the Magnolia Pipe Line Co., there were completed late in the year two smaller lines—one a private line to Ringling and the other a common-carrier line to Ardmore.

MARKETED PRODUCTION.

Marketed production of petroleum in Oklahoma, in 1914, by districts and months, in barrels.

Month.	Glenn.	Cushing.	Healdton.	Other.	Total.
January	839,483	652,076	107,586	4,296,037	5,895,182
February	769,809	751,637	71,213	3,725,224	5,317,883
March	871,334	1,577,168	70,680	4,325,944	6,845,126
April	849,316	1,668,866	109,922	3,913,758	6,541,862
May	897,397	2,040,454	48,961	4,122,889	7,109,701
June	852,901	1,904,627	72,056	4,014,102	6,843,686
July	828,350	1,691,460	88,287	3,977,030	6,585,127
August	535,027	1,442,817	61,860	2,754,351	4,794,055
September	431,051	1,644,857	64,163	2,212,078	4,352,149
October	584,178	2,398,686	59,733	2,994,421	6,037,018
November	604,397	2,946,265	53,177	2,851,284	6,455,123
December	614,346	3,226,072	50,568	2,963,826	6,854,812
Total	8,677,589	21,944,985	858,206	42,150,944	73,631,724

Marketed production of petroleum in Oklahoma in 1913 and 1914, by months, in barrels.

1913.

Month.	Runs from wells.		Field fuel and rail shipments not included in pipe-lines runs.	Total.
	Gulf, Magnolia, Prairie, and Texas companies' trunk lines.	Private and other lines supplying refineries in Oklahoma and Kansas.		
January	4,030,733	915,437	57,571	5,003,741
February	3,826,109	793,618	69,660	4,689,487
March	4,288,256	827,145	85,218	5,200,619
April	4,244,596	840,327	182,081	5,267,004
May	4,471,192	862,264	279,819	5,613,275
June	4,210,510	874,078	237,327	5,321,915
July	4,239,810	902,681	177,743	5,320,234
August	4,026,405	880,415	144,157	5,050,977
September	4,141,791	844,851	201,921	5,188,563
October	4,535,799	853,933	168,457	5,558,189
November	4,525,751	815,385	239,152	5,580,288
December	4,718,619	869,443	197,030	5,785,092
Total	51,259,571	[a]10,279,577	2,040,236	63,579,384

1914.

Month.	Gulf, Magnolia, Prairie, and Texas companies' trunk lines.	Private and other lines supplying refineries in Oklahoma and Kansas.	Field fuel and rail shipments not included in pipe-lines runs.	Total.
January	4,598,535	991,915	304,732	5,895,182
February	4,193,255	915,729	208,899	5,317,883
March	5,480,133	1,173,397	191,596	6,845,126
April	5,252,138	1,090,695	199,029	6,541,862
May	5,822,786	978,818	308,097	7,109,701
June	5,500,908	994,942	347,836	6,843,686
July	5,196,925	1,100,406	287,796	6,585,127
August	3,635,911	878,805	279,339	4,794,055
September	2,854,628	981,394	516,127	4,352,149
October	4,217,248	1,179,743	640,027	6,037,018
November	4,344,929	1,298,479	811,715	6,455,123
December	4,796,614	1,350,576	707,622	6,854,812
Total	55,894,010	12,934,899	4,802,815	73,631,724

[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 1914, inclusive:

Marketed production of petroleum by the Indian Territory Illuminating Oil Co. and its sublessees from Jan. 1, 1903, to Dec. 31, 1914.

Year	Barrels.	Year	Barrels.
1903	56,905	1909	4,516,524
1904	652,479	1910	5,892,970
1905	3,421,478	1911	11,707,676
1906	5,219,106	1912	8,169,158
1907	5,143,971	1913	9,009,996
1908	4,961,147	1914	9,935,692

Total marketed production and value of royalty oil and gas from wells in Osage County during the years 1913 and 1914.

1913.

Received by—	Total quantity produced.	Amount received by Osage Nation for royalty of one-eighth of production.
	Barrels.	
Prairie Oil & Gas Co	7,611,686	$875,453
Gulf Pipe Line Co	464,772	53,050
Uncle Sam Oil Co	132,620	14,918
Southwestern Refining Co	244,853	26,649
Texas Co	546,709	62,403
Sold by lessees for fuel	9,356	1,057
Total	9,009,996	1,033,530
Royalty received by Osage Nation for gas		5,943
Total amount received by Osage Nation for oil and gas		1,039,473

1914.

Received by—	Total quantity produced.	Amount received by Osage Nation for royalty of one-eighth of production.
Prairie Oil & Gas Co	8,259,824	$844,809
Gulf Pipe Line Co	520,858	53,282
Gypsy Oil Co	13,469	1,378
Texas Co	6,233	638
Cosden & Co	233,236	23,859
Uncle Sam Oil Co	118,795	12,253
Sold by lessees for fuel	436	45
	9,152,851	936,244
Prairie Oil & Gas Co., royalty of ⅛	382,841	57,526
Total	9,535,692	993,770
Received by Osage Nation for gas		10,252
Total amount received by Osage Nation for oil and gas		1,004,022

The following table shows the number of wells owned in Osage County by the Indian Territory Illuminating Oil Co. and its sublessees from 1903 to 1914, inclusive:

Oil and gas wells in Osage County, 1903–1914.

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
Dec. 31, 1913	3,307	2,323	145	839
Dec. 31, 1914	3,785	2,654	172	959

[a] Wells which have been exhausted and abandoned in addition to wells that were dry when drilled in.

GLENN POOL.

The following table shows the marketed production of petroleum in the Glenn pool (Creek County) for the last five years:

Estimated production and sales of petroleum from Glenn pool, 1910–1914, by months, in barrels.

Month.	1910	1911	1912	1913	1914
January	1,745,206	1,099,192	882,385	792,336	839,483
February	1,543,660	967,924	867,566	718,580	769,809
March	1,974,514	2,584,464	924,144	807,022	871,334
April	1,674,709	1,570,947	898,527	823,645	849,316
May	1,676,366	1,069,863	927,182	850,607	897,397
June	1,573,578	958,519	816,028	816,789	852,901
July	1,557,869	965,122	880,906	787,274	828,350
August	1,609,702	981,946	927,675	734,476	535,027
September	1,593,986	937,886	794,958	773,847	431,051
October	1,521,794	969,247	921,736	817,628	584,178
November	1,400,118	864,519	768,254	753,115	604,397
December	1,365,412	910,489	886,157	794,551	614,346
Total	19,236,914	13,880,118	10,495,518	9,469,870	8,677,589

SUMMARY OF WELLS DRILLED.

The following table shows the wells completed in Oklahoma in 1913 and 1914, by districts and pools:

Well record in Oklahoma in 1913 and 1914, by districts and pools.

District and pool.	1913					1914				
	Wells completed.			Initial daily production		Wells completed			Initial daily production.	
	Oil.	Dry.	Total.[a]	Total.	Average per well.	Oil.	Dry.	Total.[a]	Total.	Average per well.
				Barrels.	*Barrels.*				*Barrels.*	*Barrels.*
Cherokee, deep sand:										
Bartlesville—Hogshooter	829	75	948	19,412	28.4	389	44	454	3,925	10.1
Bird Creek—Turley	610	70	755	17,813	29.2	236	80	428	3,946	16.8
Collinsville	122	49	205	8,129	66.6					
Copan—Ramsey-Wann	393	50	469	6,309	16.1	266	79	421	7,022	26.4
Dewey	770	55	872	15,842	20.6	440	33	486	5,093	11.6
Total	2,724	299	3,249	67,505	24.8	1,331	236	1,789	19,986	15.0
Cherokee, shallow sand: Delaware—Alluwe-Chelsea	1,071	139	1,231	17,672	16.5	1,472	77	1,558	16,172	11.0
Pawnee: Cleveland	187	68	262	15,787	84.4	77	27	111	3,905	50.7
Creek:										
Bald Hill	155	65	238	10,000	64.5	472	104	579	40,135	85.0
Cushing	717	41	821	101,245	141.2	670	52	758	668,365	997.6
Glenn—Taneha-Sapulpa-Tulsa-Inola, Wicey	740	186	989	31,595	426.9	872	252	1,195	56,920	65.3
Beggs—Preston	75	51	145	14,163	188.8					
Morris—Okmulgee-Eram	336	130	491	19,335	57.5	256	85	358	16,197	63.3
Muskogee	60	31	100	1,569	26.1	200	139	380	7,532	32.7
Coweta—Haskell-Broken Arrow-Wagoner										
Schulter	203	105	337	7,912	39.9	139	70	235	5,427	39.0
Mound—Hamilton Switch	118	45	192	7,977	67.6	42	17	68	2,484	59.1
Total	2,404	654	3,313	193,796	80.6	2,651	719	3,573	797,060	300.7
Osage	506	69	620	34,856	68.8	423	99	572	26,787	63.3
Carter County	15	5	23	844	56.2	340	43	392	106,171	312.3
Comanche County						5	2	14	59	11.8
Kay County	29	23	55	2,964	102.2	58	49	113	5,417	93.4
Kiowa County						33	1	36	185	5.6
Pontotoc County						10	10	26	172	17.2
Miscellaneous	29	51	98	626	21.5	10	80	108	330	33.0
Grand total	6,965	1,308	8,851	334,050	47.9	6,410	1,343	8,292	976,244	152.3

[a] Including gas wells.

Number of wells completed in Oklahoma, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Cherokee, deep	627	806	2,444	2,724	1,331	61	114	256	299	236	802	1,074	2,906	3,249	1,789
Cherokee, shallow	1,665	1,381	761	1,071	1,472	152	109	87	139	77	1,830	1,576	881	1,231	1,558
Cleveland	10	129	196	187	77	2	31	46	68	27	13	165	253	262	111
Creek	657	536	852	2,404	2,651	142	175	344	654	719	837	746	1,346	3,313	3,573
Osage	206	438	417	506	423	25	40	54	69	99	239	494	489	620	572
Ponca City	.....	.....	31	29	58	.....	.....	20	23	49	.....	.....	58	55	113
Comanche County	.....	.....	.....	.....	5	.....	.....	.....	.....	2	.....	.....	.....	.....	14
Carter County	.....	.....	.....	15	340	.....	.....	.....	5	43	.....	.....	.....	23	392
Kiowa County	.....	.....	.....	.....	33	.....	.....	.....	.....	1	.....	.....	.....	.....	36
Pontotoc County	.....	.....	.....	.....	10	.....	.....	.....	.....	10	.....	.....	.....	.....	26
Miscellaneous	23	4	11	29	10	26	20	36	51	80	56	32	60	98	108
Total	3,188	3,294	4,712	6,965	6,410	408	489	843	1,308	1,343	3,777	4,087	5,993	8,851	8,292

[a] Including gas wells.

Number of oil wells and dry holes drilled in Oklahoma in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Cherokee, deep	203	30	173	37	177	29	159	37	159	30	122	22	108	14
Cherokee, shallow	124	13	144	5	185	17	154	15	216	8	128	7	104	4
Cleveland	15	4	12	1	6	3	19	6	6	3	6	4	6	2
Creek	260	79	254	65	262	79	282	102	295	104	274	63	231	55
Osage	57	10	48	14	56	13	56	11	41	14	51	11	39	9
Ponca City	16	7	7	8	10	.....	2	4	3	5	6	2	1	.....
Comanche County	2	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....
Carter County	7	5	11	2	31	1	46	3	66	8	63	3	33	8
Kiowa County	.....	.....	3	.....	4	.....	3	.....	6	1	7	.....	5	.....
Pontotoc County	.....	.....	.....	.....	2	2	3	1	2	2	1	.....	1	.....
Miscellaneous	.....	5	.....	6	.....	5	1	10	2	3	2	4	2	9
Total	684	153	653	138	733	149	725	190	796	178	660	116	531	101

District.	Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Cherokee, deep	99	11	70	10	44	4	5	5	12	7	1,331	236	2,724	299
Cherokee, shallow	94	2	109	2	72	1	74	1	68	2	1,472	77	1,071	139
Cleveland	2	1	4	2	.....	1	1	.....	.....	.....	77	27	187	68
Creek	215	48	209	47	129	25	87	21	153	31	2,651	719	2,404	654
Osage	20	4	17	2	16	4	14	.....	8	7	423	99	506	69
Ponca City	3	6	5	3	4	1	.....	4	1	9	58	49	29	23
Comanche County	.....	.....	1	.....	.....	.....	.....	1	.....	.....	5	2	.....	.....
Carter County	34	3	17	1	16	7	5	2	11	.....	340	43	15	5
Kiowa County	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	33	1	.....	.....
Pontotoc County	.....	.....	.....	.....	1	.....	.....	.....	.....	5	10	10	.....	.....
Miscellaneous	2	3	1	8	.....	1	.....	18	.....	8	10	80	29	51
Total	469	78	438	75	282	44	186	52	253	69	6,410	1,343	6,965	1,308

Number of oil wells drilled in Oklahoma in 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	375	433	401	470	624	664	647	691	626	656	669	709	6,965
1914	684	653	733	725	796	660	531	469	438	282	186	253	6,410

Number of dry holes drilled in Oklahoma, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	69	61	67	46	111	135	180	130	97	125	122	165	1,308
1914	153	138	149	190	178	116	101	81	72	44	52	69	1,343

Total number of wells completed in Oklahoma, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	483	520	492	548	793	885	884	864	775	830	846	931	8,851
1914	976	849	929	974	1,044	829	668	588	527	372	278	358	8,292

[a] Including gas wells.

Initial daily production of new wells completed in Oklahoma in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
Cherokee, deep	3,737	3,677	2,972	2,027	2,101	1,510	1,316
Cherokee, shallow	951	1,205	1,553	1,641	2,467	1,719	1,801
Cleveland	501	466	636	1,055	658	244	183
Creek	15,706	26,902	40,178	37,543	71,674	102,304	72,805
Osage	4,687	4,108	6,997	3,251	1,869	2,196	1,323
Ponca City	1,440	1,190	890	108	300	535	300
Carter County	744	2,775	6,902	15,535	23,530	20,270	6,850
Comanche County	19	10					20
Kiowa County		11	33	16	40	43	24
Pontotoc County			40	52	25	30	10
Miscellaneous				5	10	35	20
Total	27,785	40,344	60,201	61,233	102,674	128,886	84,652

District.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Cherokee, deep	981	679	456	140	390	19,986	67,505
Cherokee, shallow	1,388	1,598	721	503	625	16,172	17,672
Cleveland	100	37		25		3,905	15,787
Creek	78,337	82,782	76,209	67,955	124,665	797,060	193,796
Osage	870	789	322	240	135	26,787	34,856
Ponca City	225	285	124		20	5,417	2,964
Carter County	9,925	6,055	3,510	2,625	7,450	106,171	844
Comanche County		10				59	
Kiowa County		18				185	
Pontotoc County			15			172	
Miscellaneous	60	200				330	626
Total	91,886	92,453	81,357	71,488	133,285	976,244	334,050

Total and average initial daily production of new wells in Oklahoma, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Cherokee, deep	28,903	30,135	76,025	67,505	19,986	46.1	37.4	31.1	24.8	15.0
Cherokee, shallow	85,147	70,221	10,930	17,672	16,172	51.1	50.8	14.3	16.5	11.0
Cleveland	713	22,100	33,903	15,787	3,905	71.3	171.3	173.0	84.4	50.7
Creek	76,485	49,879	77,588	193,796	797,060	116.4	93.1	91.1	80.6	300.7
Osage	35,060	89,660	25,400	34,856	26,787	170.2	204.7	60.9	68.9	63.3
Ponca City			4,790	2,964	5,417			154.5	102.2	93.4
Carter County				844	106,171				56.3	312.3
Comanche County					59					11.8
Kiowa County					185					5.6
Pontotoc County					172					17.2
Miscellaneous	330	338	250	626	330	14.3	84.5	22.7	21.6	33.0
Total	226,638	262,333	228,886	334,050	976,244	71.1	79.6	48.6	48.0	152.3

Total initial daily production of new wells in Oklahoma, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
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	18,887
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	21,861
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	19,074
1913	19,220	19,505	21,615	29,847	27,139	32,192	26,071	27,897	27,267	30,953	29,211	43,133	334,050	27,838
1914	27,785	40,344	60,201	61,233	102,674	128,886	84,652	91,886	92,453	81,357	71,488	133,285	976,244	81,354

GULF OIL FIELD.

GENERAL STATEMENT.

The Gulf field includes the many oil pools of southern Texas and Louisiana, the oils of which are similar in character and geologic occurrence. From 1889 to 1901 the production of petroleum in the Gulf field was derived from a few shallow wells near San Antonio, in Bexar County, Tex., and was negligible compared with the total output of the country. In 1901 the opening of Spindletop, in Jefferson County, made the Gulf field a factor in the petroleum industry of the United States to the extent of 5 per cent of the total output credited to that year. In 1905 an output of more than 36,500,000 barrels increased the Gulf field's contribution to more than 27 per cent of the total yield. Since 1905 the output of the field has greatly decreased, fluctuating during the last five years approximately 10,000,000 barrels a year, and representing 5 per cent or less of the total output of petroleum in the entire country. In 1914 the output took an upward course, increasing to more than 13,000,000 barrels, which, however, because of notable increases in the output of other of the major fields, was not quite sufficient to constitute a 5 per cent contribution to the marketed production of the entire United States.

MARKETED PRODUCTION

Marketed production of petroleum in the Gulf field in 1913 and 1914, by months, in barrels.

Month.	1913			1914		
	Coastal Texas.	Coastal Louisiana.	Total.	Coastal Texas.	Coastal Louisiana.	Total.
January	443,707	261,193	704,900	616,115	186,094	802,209
February	423,212	187,491	610,703	580,324	168,039	748,363
March	538,087	338,246	876,333	831,623	236,346	1,067,969
April	476,895	279,447	756,342	1,010,514	216,827	1,227,341
May	509,716	248,051	757,767	1,042,417	214,345	1,256,762
June	464,718	231,816	696,534	1,072,371	187,418	1,259,789
July	457,051	219,189	676,240	945,745	179,269	1,125,014
August	472,821	214,699	687,520	920,260	219,088	1,139,348
September	485,500	198,438	683,939	888,436	212,768	1,101,204
October	487,849	190,211	678,060	991,078	231,086	1,222,164
November	492,718	179,071	671,789	873,616	230,875	1,104,491
December	572,952	169,416	742,368	844,063	218,811	1,062,874
Total	5,825,226	2,717,268	8,542,494	10,616,562	2,500,966	13,117,528

Marketed production of petroleum in the Gulf field, 1889–1914, in barrels.

Year.	Production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease. (−).	Value.	Yearly average price per barrel.
1889	48				$340	$7.084
1890	54		+ 6	+ 12.50	227	4.204
1891	54				227	4.204
1892	45		− 9	− 16.67	225	5.000
1893	50		+ 5	+ 11.11	210	4.200
1894	60		+ 10	+ 20.00	300	5.000
1895	50		− 10	− 16.67	250	5.000
1896	50				250	5.000
1897	50				250	5.000
1898	1,450		+ 1,400	+2,800.00	7,250	5.000
1899	530		− 920	− 63.45	2,650	5.000
1900	0		− 530	− 100.00		
1901	3,593,113	5.18	+ 3,593,113		630,752	.175
1902	18,014,404	20.29	+14,421,291	+ 401.36	3,766,683	.209
1903	18,371,383	18.29	+ 356,979	+ 1.98	7,418,393	.411
1904	24,631,269	21.03	+ 6,259,886	+ 34.07	8,817,454	.357
1905	36,526,323	27.11	+11,895,054	+ 48.29	8,791,983	.240
1906	20,524,162	16.23	−16,002,161	− 43.81	9,380,691	.457
1907	16,360,299	9.85	− 4,163,863	− 20.29	13,704,469	.837
1908	15,772,137	8.83	− 588,162	− 3.60	9,511,007	.603
1909	10,883,240	5.94	− 4,888,897	− 30.00	7,872,686	.723
1910	9,680,465	4.62	− 1,202,775	− 11.05	7,383,571	.763
1911	10,999,873	4.99	+ 1,319,408	+ 13.63	7,355,681	.669
1912	8,545,018	3.83	− 2,454,855	− 22.32	6,344,173	.742
1913	8,542,494	3.44	− 2,524	− .03	7,993,997	.936
1914	13,117,528	4.94	+ 4,575,034	+ 53.56	8,844,104	.674
Total	215,564,149	6.46			107,827,823	.497

Marketed production, value, and average price per barrel of petroleum produced in the Gulf field, 1905–1914, by years and States, in barrels.

Year.	Coastal Texas.			Coastal Louisiana.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905..	27,615,907	$7,190,658	$0.2603	8,910,416	$1,601,325	$0.178	36,526,323	$8,791,983	$0.240
1906..	11,449,992	5,825,036	.5087	9,074,170	3,555,655	.392	20,524,162	9,380,691	.457
1907..	11,410,078	9,680,286	.848	4,950,221	4,024,183	.813	16,360,299	13,704,469	.837
1908..	10,483,200	6,221,636	.593	5,288,937	3,289,371	.622	15,772,137	9,511,007	.603
1909..	8,852,527	6,399,318	.723	2,030,713	1,473,368	.725	10,883,240	7,872,686	.723
1910..	7,929,863	6,100,359	.769	1,750,602	1,283,212	.733	9,680,465	7,383,571	.763
1911..	7,275,281	5,340,592	.734	3,724,592	2,015,089	.541	10,999,873	7,355,681	.669
1912..	6,459,528	4,739,887	.734	2,085,490	1,604,286	.769	8,545,018	6,344,173	.742
1913..	5,825,226	5,550,408	.953	2,717,268	2,443,589	.899	8,542,494	7,993,997	.936
1914..	10,616,562	7,163,893	.675	2,500,966	1,680,211	.672	13,117,528	8,844,104	.674

Marketed production of petroleum in the Gulf field in 1913 and 1914, by States, showing increase or decrease and percentage of increase or decrease, in barrels.

State.	Production.		Increase.	Decrease.	Percentage.	
	1913	1914			Increase.	Decrease.
Coastal Texas	5,825,226	10,616,562	4,791,336	....	82.25	....
Coastal Louisiana	2,717,268	2,500,966	....	216,302	....	7.96
Total	8,542,494	13,117,528	4,575,034	....	53.56	....

Marketed production of petroleum in the Gulf oil field, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	776,908	1,080,926	717,938	704,900	802,209
February	711,583	1,280,144	741,842	610,703	748,363
March	790,178	1,283,975	784,730	876,333	1,067,969
April	746,059	1,004,704	752,583	756,342	1,227,341
May	771,995	985,075	707,766	757,767	1,256,762
June	757,875	848,610	684,210	696,534	1,259,789
July	814,933	822,501	713,912	676,240	1,125,014
August	844,980	777,506	700,644	687,520	1,139,348
September	803,947	750,862	675,053	683,938	1,101,204
October	864,183	758,321	670,532	678,060	1,222,164
November	847,080	671,778	684,341	671,789	1,014,491
December	950,744	735,471	711,467	742,368	1,062,874
Total	9,680,465	10,999,873	8,545,018	8,542,494	13,117,528

Average daily production of petroleum in the Gulf oil field each month, 1910–1914, by months and years, in barrels.

Month.	1910	1911	1912	1913	1914
January	25,062	34,869	23,159	22,739	25,878
February	25,414	45,719	25,581	21,811	26,727
March	25,490	41,419	25,314	28,269	34,451
April	24,869	33,490	25,086	25,211	40,911
May	24,903	31,777	22,831	24,445	40,541
June	25,263	28,287	22,807	23,218	41,993
July	26,288	26,532	23,029	21,814	36,291
August	27,257	25,081	22,601	22,178	36,753
September	26,798	25,029	22,502	22,798	36,707
October	27,877	24,462	21,630	21,873	39,425
November	28,236	22,393	22,811	22,393	36,816
December	30,669	23,725	22,951	23,947	34,286
Average	26,522	30,137	23,347	23,404	35,938

PIPE-LINE RUNS, DELIVERIES, AND STOCKS.

Pipe-line runs and deliveries of petroleum from the Gulf field, by months, in 1913 and 1914, and stocks at end of each month, in barrels.

Month.	1913			1914		
	Runs.	Deliveries.	Stocks.	Runs.	Deliveries.	Stocks.
Dec. 31, 1912	....	....	1,472,247	....	....	....
January	704,900	710,810	1,466,337	802,209	946,533	1,914,452
February	610,703	588,059	1,488,981	748,363	598,039	2,064,776
March	876,333	854,248	1,511,066	1,067,969	695,174	2,437,571
April	756,342	768,032	1,499,376	1,227,341	816,813	2,848,099
May	757,767	723,866	1,533,277	1,256,762	963,029	3,141,832
June	696,534	688,463	1,541,348	1,259,789	666,686	3,734,935
July	676,240	638,673	1,578,915	1,125,014	1,063,036	3,796,913
August	687,520	719,832	1,546,603	1,139,348	1,104,615	3,831,646
September	683,938	569,705	1,660,836	1,101,204	1,184,335	3,748,515
October	678,060	617,587	1,721,309	1,222,164	950,706	4,019,973
November	671,789	556,733	1,836,365	1,104,491	1,023,848	4,100,616
December	742,368	519,957	2,058,776	1,062,874	1,199,746	3,963,744
Total	8,542,494	7,955,965	....	13,117,528	11,212,560	....

PRICES.

The average monthly prices per barrel of petroleum at wells in the Gulf field in the years 1913 and 1914 were as follows:

Average monthly prices per barrel of petroleum in the Gulf field, 1913 and 1914.

1913.

Month.	Coastal Texas.				
	Batson.	Dayton.	Goose Creek.	Humble.	Markham.
January	$0.75-$0.78	$0.75	$0.70-$0.85	$0.87½-$1.00	$0.90
February	.84	....	.71	1.00	.90
March	.80- .87	.80	.62- .85	.95 - 1.00	.90
April	.80- .90	.80	.76- .85	.90 - 1.00	.90
May	.80- .91	.80	.82- .85	.90 - 1.00	.90
June	.80- .90	.80	.81- .85	.90 - 1.00	.90
July	.80- .94	.80	.81- .85	.90 - 1.00	.90
August	.80- .99	.80	.40- .82	.90 - 1.00	.90
September	.80- .99	.80	.40- .83	.90 - 1.00	.90
October	.80- .99	.80	.83	.90 - 1.00	.90
November	.80- 1.00	.80	.40- .83	.90 - 1.00	.90
December	.80- 1.00	.80	.40- .85	.90 - 1.00	.90
Average	.904	.797	.826	.965	.90

Month.	Coastal Texas.			Coastal Louisiana.	
	Saratoga.	Sourlake.	Spindletop.	Jennings.	Vinton.
January	$0.87½-$1.00	$0.87½-$1.08	$0.84-$0.92½	$0.78-$0.90	$0.73 -$0.90
February	.96 - 1.00	1.00 - 1.08	.98- 1.05	.90- .95	.86 - .90
March	.93 - 1.00	.95 - 1.08	1.00- 1.02	.90- 1.00	.86 - .90
April	.90 - 1.00	.90 - 1.08	.95- 1.06	.90- 1.00	.87 - .90
May	.90 - 1.00	.90 - 1.08	.95- 1.06	.90- 1.00	.87 - .90
June	.90 - 1.00	.90 - 1.08	.95- 1.04	.90- 1.00	.87 - .90
July	.90 - 1.00	.90 - 1.08	.95- 1.04	.90- 1.02	.87½- .90
August	.90 - 1.00	.90 - 1.08	.95- 1.03	.90- 1.00	.87 - .90
September	.90 - 1.00	.90 - 1.08	.95- 1.03	.90- 1.00	.88 - .90
October	.90 - 1.00	.90 - 1.08	.95- 1.04	.90- 1.00	.87 - .90
November	.90 - 1.00	.90 - 1.08	.95- 1.04	.90- 1.00	.87 - .90
December	.90 - 1.00	.90 - 1.06	.95- 1.04	.90- 1.00	.88 - .90
Average	.913	1.000	1.000	.974	.869

Average monthly prices per barrel of petroleum in the Gulf field, 1913 and 1914—Contd.

1914.

Month.	Coastal Texas.					
	Batson.	Dayton.	Goose Creek.	Humble.	Markham.	Orange County.
January	$0.85–$1.00	$0.75	$0.85	$0.85–$1.00	$0.90	$1.27
February	.85– 1.00	.75	.85	.85– 1.00	.90	1.27
March	.85– 1.00	.65	$0.70–.85	.75– .80	.75	1.27
April	.57– .97	.48	.65–.85	.50– .52	.50	1.17
May	.50– .95	.40	.50–.85	.45– .50	.50	1.17
June	.45– .92	.30	.50–.85	.40– .50	.50	1.17
July	.40– .92	.30	.45–.85	.40	.50	.74
August	.40– .92	.30	.40–.45	.40	.50	.77
September	.40– .92	.30	.40–.45	.40	.50	.77
October	.40– .91	.30	.45	.40	.50	.70
November	.40– .83	.30	.40–.45	.40	.50	.70
December	.40– .89	.30	.40–.45	.40	.50	.70
Average	.804	.469	.586	.548	.598	1.023

Month.	Coastal Texas.			Coastal Louisiana.		
	Saratoga.	Sourlake.	Spindletop.	Edgerly.	Jennings.	Vinton.
January	$0.85–$0.99	$0.85–$1.06	$0.90–$1.03	$0.90	$0.90–$1.00	$0.90–$1.00
February	.85– .98	.85– 1.02	.90– 1.03	.90	.90– 1.00	.90– 1.00
March	.80– .99	.75– .99	.85– 1.02	.89	.75– .99	.75– .99
April	.57– .99	.50– .84	.60– 1.03	.68	.50– 1.00	.50– .98
May	.50– 1.00	.47½– .79	.50– 1.02	.51	.50– 1.00	.50– .99
June	.45– 1.00	.45– .84	.45– 1.02	.50	.50– 1.00	.50– .99
July	.40– .77	.40– .79	.40– 1.04	.50	.45– 1.00	.40– .91
August	.40– .74	.40– .81	.40– 1.03	.40	.45– 1.00	.40– .99
September	.40– .70	.40– .86	.40– 1.02	.40	.45– 1.00	.40– .99
October	.40– .72	.40– .87	.40– .99	.40	.45– 1.00	.40– .99
November	.40– .69	.40– .85	.40– .99	.40	.45– 1.00	.40– .99
December	.40– .70	.40– .92	.40– .99	.40	.45– 1.00	.40– .91
Average	.727	.679	1.004	.490	.909	.671

SUMMARY OF WELLS DRILLED.

Number of wells completed in the Gulf field, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Coastal Texas	365	352	353	325	323	116	117	109	255	130	481	502	462	592	464
Coastal Louisiana	32	63	59	81	72	10	32	25	57	48	42	112	84	139	121
Total	397	415	412	406	395	[a]126	149	134	312	178	523	614	546	731	585

[a] Including gas wells.

Number of oil wells and dry holes drilled in the Gulf field in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	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.	Oil.	Dry.
Coastal Texas	38	3	18	4	22	7	20	18	37	8	27	10	37	18	32	20	21	8	23	16	26	13	22	5	323	130	325	255
Coastal Louisiana	7	2	8	4	4	6	4	3	8	6	8	2	6	6	3	6	7	2	2	2	8	5	7	4	72	48	81	57
Total	45	5	26	8	26	13	24	21	45	14	35	12	43	24	35	26	28	10	25	18	34	18	29	9	395	178	406	312

Number of oil wells drilled in the Gulf field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	41	22	43	29	30	26	35	28	25	29	31	26	[a] 397
1911	26	35	29	30	31	58	40	24	19	16	20	24	[a] 415
1912	16	44	39	47	29	30	28	35	34	40	43	27	412
1913	31	30	43	42	26	40	48	43	29	27	21	26	406
1914	45	26	26	24	45	35	43	35	28	25	34	29	395

[a] Coastal Louisiana not given by months.

Number of dry holes drilled in the Gulf field, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	14	16	9	11	20	11	11	10	7	1	3	3	[a] 126
1911	15	10	17	14	10	17	11	......	......	9	9	5	[b] 149
1912	8	9	8	15	14	14	9	12	14	13	8	10	[c] 134
1913	9	25	16	45	16	41	33	34	22	22	17	32	[c] 312
1914	5	8	13	21	14	12	24	26	10	18	18	9	[c] 178

[a] Coastal Louisiana not given by months; including gas wells.
[b] Coastal Louisiana not given by months.
[c] Not including gas wells.

Total number of wells completed in the Gulf field, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	55	38	52	40	50	37	46	38	32	30	34	29	[b] 523
1911	41	46	46	44	41	76	51	41	33	25	29	29	[b] 614
1912	24	53	47	62	43	44	37	47	48	53	51	37	546
1913	42	56	60	90	46	84	81	77	51	49	37	58	731
1914	51	37	39	46	61	47	68	63	39	43	53	38	585

[a] Including gas wells. [b] Coastal Louisiana not given by months.

Initial daily production of new wells completed in the Gulf field in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.	Total, 1914.	Total, 1913.
Coastal Texas	5,026	3,696	20,075	25,249	12,816	16,907	15,923	12,823	12,773	12,320	14,172	8,915	160,695	38,978
Coastal Louisiana	5,525	3,405	11,900	15,375	3,255	6,745	10,162	220	15,912	3,200	3,600	3,615	82,914	55,740
Total	10,551	7,101	31,975	40,624	16,071	23,652	26,085	13,043	28,685	15,520	17,772	12,530	243,609	94,718

Total and average initial daily production of new wells in the Gulf field, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Coastal Texas	63,283	32,740	33,082	38,978	160,695	173.5	93.0	93.7	119.9	497.5
Coastal Louisiana	15,230	74,145	25,520	55,740	82,914	475.9	1,176.9	432.5	688.2	1,151.6
Total	78,513	106,885	58,602	94,718	243,609	197.8	257.6	142.2	233.3	616.7

Total initial daily production of new wells in the Gulf field, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
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	[a]78,513	6,543
1911	5,970	5,890	2,115	6,380	1,561	3,455	2,708	935	1,355	772	619	980	[a]106,885	8,907
1912	2,670	5,690	4,679	3,885	2,030	2,575	7,475	3,313	12,045	1,170	7,779	5,291	58,602	4,884
1913	15,712	4,447	27,571	10,300	8,335	5,525	4,275	4,584	2,087	3,459	1,066	7,357	94,718	7,893
1914	10,551	7,101	31,975	40,624	16,071	23,652	26,085	13,043	28,685	15,520	17,772	12,530	243,609	20,301

[a] Coastal Louisiana not given by months.

TEXAS.

GENERAL STATEMENT.

The marketed production of oil in Texas in 1914 broke all previous State records, exceeding the output in 1913 by nearly 34 per cent. This increase was due chiefly to the development of highly productive oil sands lying at greater depth than the sands that had hitherto yielded the State's increasing output. The quantity entering the markets from the Texas fields during the year was 20,068,184 barrels, including the oil used directly in field development. The value of this production amounted to $14,942,848, an increase of less than 2 per cent over the value of the output of 1913. This condition may be attributed in part to the fact of a depressed market during much of the year, but in a greater degree it was due to the fact that there was a far greater relative output of the lower-priced grades of fuel oil from the coastal pools than of the higher-priced grades of refining oils from other parts of the State. Thus, in 1914, the output from the fields of northern Texas increased only 3 per cent over the production in 1913, whereas an 82 per cent increase was recorded in the output of the coastal pools.

Although the overproduction in Oklahoma was responsible for the decline of 17 cents in the yearly average price per barrel received for north Texas oils, there remains to be accounted for the corresponding decline of 28 cents in the price of the coastal product. The explanation lies chiefly in the fact that the coastal oils are utilized principally for fuel and that keen competition with fuel oils imported in increasing quantities from Mexico has forced the readjustment.

DEVELOPMENT.

Although 1914 was a year of exceptional activity in Texas the record of completed wells did not equal that of 1913, owing to the curtailment of activity in the latter part of 1914. There were 1,208 wells completed in the State in 1914, of which 820, or 78 per cent, produced oil, and the remainder were either gassers or barren. In the northern districts completed wells numbered 744, of which 497, or 67 per cent, produced oil, whereas in the coastal pools, of 464 wells completed, 323, or 70 per cent, yielded oil.

From the 820 oil wells completed in 1914 in the State, 185,698 barrels of initial production were obtained, the average output for the first day of productive life being about 226 barrels a well. There were 497 new wells in the northern districts, with an average initial yield of 50 barrels each, which produced 25,003 barrels of this output and 323 new wells in the coastal fields, with an average initial yield of 497 barrels each, which furnished the remainder.

NORTHERN TEXAS.

Wichita County.—The productive fields of Wichita County, including Electra, Burkburnett, Fowlkes, and Iowa Park, showed a nominal activity. At Electra, the mainstay of the north Texas fields, development was chiefly confined to inside locations, a great number of which still remain undrilled. Burkburnett acquired substantial additions on the north and west but was fairly well outlined on the south. The shallow-sand fields at Iowa Park and Fowlkes station received considerable attention in the early part of the year, though activity waned when the "spotted" character of the fields was recognized. The successful use of nitroglycerine at Burkburnett and at Fowlkes materially increased production from the shallow sands.

Clay County.—Little of interest developed in the Petrolia oil and gas field during the year. Slight extensions of the field were made to the west and a number of gas wells of large volume were reported.

Shackelford County.—The Moran field, which, in addition to its output of gas, yielded a little oil in 1913, took its place among the regular north Texas oil fields as the result of developments in 1914. The field is practically controlled by one company and development work is going forward at a very conservative rate. The results obtained during the year were insufficient to prove the full extent or value of the field.

Navarro County.—No developments of consequence were reported from the Corsicana light-oil and gas field or the Powell heavy-oil field.

Marion County.—The Marion County field which constitutes the western extension of the Caddo, La., district made a small production but was devoid of interesting developments.

Other counties.—In Archer County a small quantity of oil was found in a test well drilled on the Sanders & McCall ranch near Holliday, and other tests were begun in the locality. In Cooke County a barren well was drilled near Coesfield. In Haskell County well No. 1 on the Colbert ranch was completed dry at about 1,900 feet. In the northeast corner of Eastland County a number of good gas wells were completed on properties of the Texas & Pacific Coal Co., near Strawn. Late in the year an encouraging showing of oil was reported from a well near Mineola, Wood County.

COASTAL TEXAS.

Sourlake.—As the result of deeper drilling in the southern extension of the Sourlake field the production of this pool increased more than 286 per cent, compared with 1913. There were 140 oil wells, having an average production of 931 barrels each for the first day of productive life, completed during the year. Some of the wells tapping this prolific source are credited with an initial output as high as 8,000 barrels. Prior to December, 1913, the field's production was from sands penetrated at depths less than 1,200 feet. The first well to penetrate the lower sands, which lie between 1,800 and 2,400 feet below the surface, was No. 2 Jackson, of the Sour Lake Petroleum Co., completed December 2, 1913, at 1,940 feet. Eastern and southern extensions to the pool were made during the year.

Humble.—The rejuvenation of the Humble pool in Harris County was likewise a feature of interest in the Gulf coast region. Compared with the preceding year, its output in 1914 disclosed an increase of 86 per cent. As at Sourlake, the increase was due to the development of deeper sands, penetrated at depths below 2,500 feet. Although the lower sands had been tested in certain parts of the field with indifferent success in previous years, consistent efforts to develop them were not undertaken until 1914; these efforts were made after the successful completion in November, 1913, of well No. 11 Carroll, of the Producers Oil Co., on the east side of the pool, which was rated at 10,000 barrels on initial appearance, the production being obtained from a depth of about 2,700 feet. Forty-six oil wells were completed in the field during the year, with an average initial production of 497 barrels a well.

Saratoga.—A policy of conservation governed activities at Saratoga, the output declining 5 per cent from 1913. The activity displayed was principally limited to the southern extension of the field proved in 1913.

Batson.—The few small wells completed at Batson in 1914 were more than sufficient to balance the decline in the older wells, and the output of the pool showed an increase of nearly 5 per cent.

Spindletop.—Little activity was apparent at Spindletop and the output of this pioneer field decreased 19 per cent. A deep test was started by the J. M. Guffey Petroleum Co., a short distance southwest of proved territory.

Dayton.—Two fair oil wells were completed in the Dayton pool, Liberty County, and increased the output of the field 41 per cent.

Goose Creek.—A revival of activity at Goose Creek, Harris County, resulted in the completion of 34 wells, having an average initial output of 70 barrels each. In spite of this activity the output of the pool declined 46 per cent from its production in 1913.

Orange County.—The Cow Bayou district, which appeared to offer considerable promise early in 1914, ended the year as it began, with one well (the discovery well) producing oil in commercial quantities. Two wells which yielded small quantities of oil for brief periods, and five additional salt water producers summarizes the history of the field.

San Patricio County.—An important discovery of natural gas was made November 12, 1914, in well No. 2 of the White Point Oil & Gas Co., at White Point on Nueces Bay, about 7 miles north of Corpus Christi. At a reported depth of 2,255 feet an enormous volume of gas, estimated at not less than 30,000,000 cubic feet a day, was unexpectedly encountered. The pressure and volume of the escaping gas frustrated all efforts to cap the well, which "ran wild" for several days, gradually excavating a crater in the poorly consolidated strata, which engulfed the derrick and the drilling rig. At the end of the year the crater formed by the blowout, from which gas was still escaping through water with a slightly diminished flow, had enlarged until its diameter was about 175 feet. This spectacular discovery resulted in the quick leasing of adjacent property, and a number of wells were located in the vicinity before the end of the year.

Zapata County.—About 30 miles south of the Reiser gas field a well drilled for water on the ranch of J. D. Jennings, in Zapata County, adjacent to the Mexico boundary, encountered a flow of gas estimated at 15 million cubic feet at a reported depth of 1,314 feet. The well was brought in under control and capped to await a market. Other tests for both oil and gas have been started in this locality.

Wildcat tests.—Small quantities of oil were reported in tests drilled at Pierce Junction, Harris County; Big Hill, Matagorda County; and Devil's Lake, Valverde County. Unsuccessful tests were completed at High Island, Chambers County; Field, Potter County; Pine Island, Hardin County; Bellair, Harris County; Bessie Heights, Orange County; and Cactus, Webb County.

Active oil wells in Texas at the end of 1914 numbered 3,851.

MARKETED PRODUCTION.

Marketed production of petroleum in Texas, 1905–1914, by districts, in barrels.

Year.	Northern Texas.							Coastal Texas.		
	Corsicana.	Petrolia (Henrietta).	Powell.	Marion County.	Electra.	Moran.	Total.[a]	Batson.	Dayton.	Goose Creek.
1905	311,554	75,592	132,866	....	....	....	520,282	3,774,841	60,294	....
1906	332,622	111,072	673,221	....	....	....	1,117,905	2,289,507	92,850	....
1907	226,311	83,260	596,897	....	....	....	912,618	2,164,453	108,038	....
1908	211,117	85,963	421,659	....	....	....	723,264	1,593,570	39,901	....
1909	180,764	113,485	383,137	....	....	....	681,940	1,206,214	17,647	....
1910	137,331	126,531	450,188	251,717	....	....	969,403	1,113,767	9,582	....
1911	128,526	168,965	373,055	677,689	899,579	....	2,251,193	1,023,493	4,344	....
1912	233,282	197,421	251,240	362,870	4,227,104	....	5,275,529	844,563	12,151	43.898
1913	158,830	344,868	282,476	262,392	8,131,624	....	9,184,252	741,350	13,329	249,641
1914	133,811	550,585	282,279	180,584	8,227,968	68,191	9,451,622	775,804	18,791	134,748

Year.	Coastal Texas—Continued.								Total.
	Humble.	Matagorda County.	Orange County.	Saratoga.	Sourlake.	Spindletop.	Other.	Total.	
1905	15,594,310	46,471	....	3,125,028	3,362,153	1,652,780	[b] 30	27,615,907	28,136,189
1906	3,571,445	3,600	....	2,182,057	2,156,010	1,077,492	77,031	11,449,992	12,567,897
1907	2,929,640	1,573	....	2,130,928	2,353,940	1,699,943	21,563	11,410,078	12,322,696
1908	3,778,521	62,640	....	1,634,786	1,595,060	1,747,537	31,185	10,483,200	11,206,464
1909	3,237,060	29,103	....	1,183,559	1,703,798	1,388,107	87,039	8,852,527	9,534,467
1910	2.495,511	455,999	....	1,024,348	1,518,723	1,182,436	129,497	7,929,863	8,899,266
1911	2,426,220	561,828	....	925,777	1,364,880	965,939	2,800	7,275,281	9,526,474
1912	1,829,923	613,292	....	1,116,655	1,175,108	822,916	1,022	6,459,528	11,735,057
1913	1,504,880	294,553	17,706	937,720	1,348,053	716,374	1,620	5,825,226	15,009,478
1914	2,799,458	164,192	43,208	889,743	5,209,208	580,130	1,280	10,616,562	20,068,184

[a] Includes other districts of northern Texas. [b] Bexar County.

Marketed production and value of petroleum in northern and coastal Texas, 1905–1914, in barrels.

Year.	Northern Texas.		Coastal Texas.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1913	9,184,252	9,125,185	5,825,226	5,550,408	15,009,478	14,675,593
1914	9,451,622	7,778.955	10,616,562	7,163,893	20,068,184	14,942,848

Marketed production and value of petroleum in Texas in 1913 and 1914, by districts, in barrels, with increase or decrease, in barrels, and percentage of increase or decrease.

District.	1913			1914			Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.		
Northern Texas:								
Corsicana	158,830	$156,844	$0.987	133,811	$123,556	$0.923	− 25,019	− 15.75
Petrolia	344,868	342,783	.994	550,585	465,628	.846	+ 205,717	+ 59.65
Powell	282,476	216,402	.766	282,279	169,490	.600	− 197	− .07
Electra	8,131,624	8,142,797	1.001	8,227,968	6,789,359	.825	+ 96,344	+ 1.18
Marion County	262,392	261,965	.998	180,584	175,922	.974	− 81,808	− 31.18
Moran				68,191	47,081	.690	+ 68,191	+100.00
Other	4,062	4,394	1.081	8,204	7,919	.965	+ 4,142	+101.97
Total	9,184,252	9,125,185	.994	9,451,622	7,778,955	.823	+ 267,370	+ 2.91
Coastal Texas:								
Batson	741,350	670,323	.904	775,804	632,926	.804	+ 34,454	+ 4.65
Dayton	13,329	10,633	.797	18,791	8,813	.469	+ 5,462	+ 40.98
Goose Creek	249,641	206,311	.826	134,748	79,012	.586	+ 114,893	− 46.02
Humble	1,504,880	1,453,158	.965	2,799,458	1,535,468	.548	+1,294,578	+ 86.03
Matagorda County	294,553	266,338	.904	164,192	98,203	.598	− 130,361	− 44.26
Orange County	17,706	19,123	1.080	43,208	44,223	1.023	+ 25,502	+144.03
Saratoga	937,720	855,935	.913	889,743	647,075	.727	− 47,977	− 5.12
Sourlake	1,348,053	1,350,379	1.000	5,209,208	3,534,720	.679	+3,861,155	+286.42
Spindletop	716,374	716,993	1.000	580,130	582,388	1.004	− 136,244	− 19.02
Other	1,620	1,215	.75	1,280	1,065	.832	− 340	− 20.98
Total	5,825,226	5,550,408	.953	10,616,562	7,163,893	.675	+4,791,336	+ 82.25
Total Texas	15,009,478	14,675,593	.978	20,068,184	14,942,848	.745	+5,058,706	+ 33.70

Marketed production of petroleum in Texas, 1913–1914, by districts and months, in barrels.

1913.

Month.	Northern Texas.							Coastal Texas.	
	Corsicana.	Petrolia (Henrietta).	Powell.	Electra.	Marion County.	Other.[a]	Total.	Batson.	Goose Creek.
January	13,889	21,479	22,649	482,240	23,035	337	563,629	58,910	17,655
February	13,288	20,305	21,763	460,133	21,954	337	537,780	56,856	14,184
March	14,662	30,059	23,409	535,524	22,651	337	626,642	62,157	15,857
April	14,243	27,693	23,797	557,094	23,794	337	646,958	61,136	16,341
May	13,779	32,626	24,156	613,602	22,808	337	707,308	64,101	27,341
June	16,788	28,187	23,791	682,831	22,570	342	774,509	59,889	23,275
July	12,873	30,027	24,415	759,961	21,095	343	848,714	60,370	20,120
August	12,942	30,660	23,868	771,300	24,050	337	863,157	67,842	22,832
September	11,707	34,428	24,336	796,213	20,302	338	887,324	64,575	21,987
October	15,185	32,424	23,692	844,934	19,864	339	936,438	59,565	23,592
November	9,119	29,108	25,019	820,887	21,456	339	905,928	64,343	24,084
December	10,355	27,872	21,581	806,905	18,813	339	885,865	61,606	22,373
Total	158,830	344,868	282,476	8,131,624	262,392	4,062	9,184,252	741,350	249,641

[a] Includes Archer, Coleman, Brown, McCulloch, and McLennan counties.

Marketed production of petroleum in Texas, 1913–1914, by districts and months, in barrels—Continued.

1913—Continued.

Month.	Coastal Texas.								Total.
	Humble.	Matagorda County.[a]	Orange County.	Saratoga.	Sourlake.	Spindletop.	Other.[b]	Total.	
January	109,033	32,489	....	83,260	69,207	72,623	530	443,707	1,007,336
February	100,245	27,004	....	72,611	86,503	65,674	135	423,212	960,992
March	112,188	30,142	....	80,724	165,667	70,669	683	538,087	1,164,729
April	114,376	30,334	....	79,582	107,113	66,847	1,166	476,895	1,123,853
May	110,053	30,085	....	83,124	130,661	63,123	1,228	509,716	1,217,024
June	119,628	24,594	....	78,324	100,079	58,483	446	464,718	1,239,227
July	115,553	23,526	....	79,914	97,125	59,976	467	457,051	1,305,765
August	120,080	21,478	1,848	79,633	101,322	56,685	1,101	472,821	1,335,978
September	133,172	20,984	3,013	76,768	115,488	46,297	3,216	485,500	1,372,824
October	135,214	18,766	2,578	78,547	116,143	51,196	2,248	487,849	1,424,281
November	136,405	17,572	6,694	73,851	116,350	51,773	1,646	492,718	1,398,646
December	198,933	17,579	3,573	71,382	142,395	53,028	2,083	572,925	1,458,817
Total	1,504,880	294,553	17,706	937,720	1,348,053	716,374	14,949	5,825,226	15,009,478

[a] Markham and Big Hill. [b] Includes Duval County and Dayton.

1914.

Month.	Northern Texas.								Coastal Texas.	
	Corsicana.	Petrolia (Henrietta).	Powell.	Electra.[a]	Marion County.	Moran.	Other.[b]	Total.	Batson.	Goose Creek.
January	10,621	50,125	26,719	775,144	19,317	4,928	683	887,537	66,682	8,095
February	9,764	55,372	21,408	705,069	16,604	2,885	683	811,785	55,299	10,457
March	11,255	59,044	24,744	782,101	17,025	....	683	894,852	63,627	15,585
April	10,059	44,527	23,369	752,047	15,618	4,056	683	850,359	62,089	15,324
May	9,945	47,335	22,634	737,281	14,640	4,046	684	836,565	67,928	14,196
June	10,905	42,257	23,988	696,772	13,648	4,404	684	792,658	69,483	15,827
July	10,587	40,331	23,420	683,536	13,018	3,547	684	775,123	64,981	13,452
August	11,379	40,121	23,390	680,734	15,136	3,668	684	775,112	64,881	9,366
September	10,656	37,631	23,351	636,373	15,846	8,574	684	733,115	64,211	9,611
October	16,791	38,942	23,639	625,407	14,855	9,250	684	729,568	65,152	7,530
November	11,540	47,380	22,895	585,350	12,475	12,277	684	692,601	66,430	7,650
December	10,309	47,520	22,722	568,154	12,402	10,556	684	672,347	65,041	7,655
Total	133,811	550,585	282,279	8,227,968	180,584	68,191	8,204	9,451,622	775,804	134,748

Month.	Coastal Texas.								Total.
	Humble.	Matagorda County.[c]	Orange County.	Saratoga.	Sourlake.	Spindletop.	Other.[d]	Total.	
January	208,330	16,342	3,770	78,282	182,762	49,292	2,560	616,115	1,503,652
February	186,181	14,254	3,716	63,155	199,787	45,712	1,763	580,324	1,392,109
March	309,244	15,342	5,377	74,823	297,764	47,873	1,988	831,623	1,726,475
April	310,368	15,991	4,422	75,193	477,150	47,138	2,839	1,010,514	1,860,873
May	291,057	13,083	3,921	69,012	532,184	49,075	1,961	1,042,417	1,878,982
June	273,153	15,042	3,607	69,680	573,409	49,950	2,220	1,072,371	1,865,029
July	245,233	13,708	3,745	74,066	479,428	49,852	1,280	945,745	1,720,868
August	232,694	13,213	3,301	82,160	464,357	48,731	1,557	920,260	1,695,372
September	206,317	12,550	3,011	80,787	463,050	47,856	1,043	888,436	1,621,551
October	189,754	12,205	2,876	75,091	587,617	50,281	572	991,078	1,720,646
November	172,540	11,388	2,441	74,916	489,488	47,579	1,184	873,616	1,566,217
December	174,587	11,074	3,021	72,578	462,212	46,791	1,104	844,063	1,516,410
Total	2,799,458	164,192	43,208	889,743	5,209,208	580,130	20,071	10,616,562	20,068,184

[a] Includes Burkburnett.
[b] Includes Archer, Coleman, McLennan, and McMullen counties.
[c] Markham and Big Hill.
[d] Includes Duval and Naoogdoches counties and Dayton.

Quantity of petroleum shipped by railroad in tank cars from the oil fields of Texas, at the stations named, by months, during the years 1913 and 1914, in barrels.

1913.

Month.	Electra, Iowa Park, Petrolia.	Beaumont, Guffey.	Corsicana.	Markham, Noledo.	Houston (Trice).	Humble.	Saratoga.	Sourlake.	Total.
January	18,706	46,527	87,826	4,420	44,263	16,735	1,834	10,587	230,898
February	32,748	70,830	42,520	5,571	10,143	45,155	450	19,540	226,957
March	24,436	14,748	60,074	3,095	10,100	24,585	225	12,638	149,901
April	42,708	22,348	53,757	4,670	10,479	22,722	679	23,398	180,761
May	57,919	19,557	22,871	8,048	19,545	24,821	1,350	77,144	231,255
June	40,602	43,141	12,711	11,122	22,420	17,608	....	29,720	177,324
July	31,601	10,476	28,271	6,810	44,327	19,221	....	32,740	173,446
August	27,352	7,349	37,561	5,571	71,358	11,307	....	15,240	175,738
September	36,181	5,594	44,691	4,454	58,094	7,135	....	31,327	187,476
October	57,302	27,729	25,739	6,345	44,256	7,461	....	22,771	191,603
November	99,071	20,916	22,380	4,952	50,464	8,779	1,125	29,863	237,550
December	84,299	36,576	29,794	3,250	56,982	8,323	....	5,977	225,201
Total	552,925	325,791	468,195	68,308	442,431	213,852	5,663	310,945	2,388,110

1914.

Month.	Electra.	Iowa Park.	Petrolia.	Beaumont, Guffey.	Corsicana.	Markham, Noledo, Somerset.	Houston (Trice).	Humble.	Sourlake.	Total.
January	106,122	11,175	10,198	10,281	28,568	2,750	64,791	10,559	14,210	258,654
February	73,759	8,545	10,021	9,513	17,357	2,159	93,892	18,468	....	233,714
March	58,978	7,923	11,563	11,894	9,946	3,250	122,614	32,583	....	258,751
April	56,449	7,964	12,912	18,923	16,641	3,681	105,970	65,446	....	287,986
May	39,971	6,807	8,287	86,368	60,773	6,421	89,324	28,279	1,525	327,755
June	5,992	5,781	7,324	35,981	93,857	6,976	61,311	18,016	463	235,701
July	9,294	5,011	8,454	26,933	45,717	10,933	74,233	25,359	18,915	224,849
August	2,497	4,624	6,924	70,038	58,655	7,157	74,794	25,562	32,169	282,420
September	25,476	4,385	7,901	68,411	83,374	6,576	71,544	30,772	67,443	365,882
October	29,668	3,740	3,661	36,164	93,467	3,798	59,988	33,200	72,875	336,561
November	17,462	3,662	....	15,281	75,211	3,752	41,578	38,685	39,272	234,903
December	578	3,276	....	14,783	50,963	3,636	49,596	37,136	19,058	179,026
Total	426,246	72,893	87,245	404,570	634,529	61,089	909,635	364,065	265,930	3,226,202

SUMMARY OF WELLS DRILLED.

Number of wells completed in northern Texas, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Corsicana	17	20	17	3	10	10	19	7	1	5	27	39	24	4	15
Electra	.....	51	259	[b]435	[b]394	.....	1	66	[b]125	169	.....	53	326	[b]561	[b]567
Marion County	.....	6	3	16	8	.....	9	7	6	2	.....	15	10	22	10
Petrolia[c]	35	7	6	122	80	37	9	10	45	32	72	19	20	171	126
Powell	56	.....	.....	.....	.....	35	.....	.....	.....	.....	91	.....	.....	.....	.....
Moran	.....	.....	.....	1	3	.....	.....	.....	4	3	.....	.....	.....	6	12
Other	.....	.....	14	4	2	.....	.....	34	27	10	.....	.....	54	35	14
Total	108	84	299	581	497	[a]82	38	124	208	221	190	126	434	799	744
Coastal Texas	365	352	353	325	323	116	117	109	255	130	481	502	462	592	464
Total Texas	473	436	652	906	820	198	155	233	463	351	671	628	896	1,391	1,208

[a] Including gas wells. [b] Including other districts in Wichita County. [c] Including Henrietta.

Number of oil wells and dry holes drilled in northern Texas in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total 1914.		Total 1913.	
	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.	Oil.	Dry.
Corsicana	2	2	...	..	2	2	3	1	...	..	1	..	...	..	...	..	...	..	...	..	2	..	...	...	10	5	3	1
Electra[a]	51	22	46	22	63	32	57	15	41	19	40	11	22	17	22	6	15	5	13	9	16	8	8	3	394	169	435	125
Petrolia[b]	10	..	2	1	27	4	18	5	3	4	2	..	...	..	6	5	...	..	6	5	4	4	2	4	80	32	122	45
Marion County	1	..	...	..	3	1	...	..	1	1	1	..	1	..	1	..	...	..	...	..	...	..	...	...	8	2	16	6
Moran	...	..	...	..	...	..	1	1	1	..	...	1	...	1	...	..	1	..	...	..	...	..	...	...	3	3	1	4
Other	...	..	1	..	...	..	...	..	...	2	...	2	...	..	...	..	...	1	1	4	...	..	...	1	2	10	4	27
Total	64	24	49	23	95	39	79	22	46	26	44	14	23	18	29	11	16	6	20	18	22	12	10	8	497	221	581	208
Coastal Texas	38	3	18	4	22	7	20	18	37	8	27	10	37	18	32	20	21	8	23	16	26	13	22	5	323	130	325	255
Total Texas	102	27	67	27	117	46	99	40	83	34	71	24	60	36	61	31	37	14	43	34	48	25	32	13	820	351	906	463

[a] Including other districts in Wichita County. [b] Including Henrietta.

Number of oil wells drilled in northern Texas, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	(a)	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
1913	38	31	35	55	57	61	47	56	41	48	68	44	581
1914	64	49	95	79	46	44	23	29	16	20	22	10	497

[a] No record.

Number of dry holes drilled in northern Texas, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	27	25	12	16	18	19	17	20	9	10	25	10	208
1914	24	23	39	22	26	14	18	11	6	18	12	8	221

[a] No record. [b] Including gas wells.

Total number of wells completed in northern Texas, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	66	57	47	73	76	80	66	77	50	59	93	55	799
1914	89	74	138	106	73	60	42	42	25	40	36	19	744

[a] Including gas wells. [b] No record.

Initial daily production of new wells completed in northern Texas in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Corsicana	6	.....	5	7	.....	1	.....	.....	.....	.....	4	.....	23	12
Electra [a]	5,042	3,402	3,231	2,493	1,945	2,118	950	1,038	684	242	610	162	21,917	49,286
Petrolia [b]	333	800	364	156	171	100	.....	15	.....	9	8	2	1,958	2,676
Marion County	20	.....	185	.....	75	10	15	85	.....	.....	.....	.....	390	5,250
Moran	.....	.....	.....	75	115	.....	.....	.....	500	.....	.....	.....	690	200
Other	.....	15	.....	.....	.....	.....	.....	.....	.....	10	.....	.....	25	11
Total	5,401	4,217	3,785	2,731	2,306	2,229	965	1,138	1,184	261	622	164	25,003	57,435
Coastal Texas	5,026	3,696	20,075	25,249	12,816	16,907	15,923	12,823	12,773	12,320	14,172	8,915	160,695	38,978
Total Texas	10,427	7,913	23,860	27,980	15,122	19,136	16,888	13,961	13,957	12,581	14,794	9,079	185,698	96,413

[a] Includes other districts in Wichita County. [b] Includes Henrietta.

Total and average initial daily production of new wells in northern Texas, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Corsicana	54	107	108	12	23	3.2	5.4	6.4	4.0	2.3
Electra	....	15,550	26,932	[a]49,286	[a]21,917	....	304.9	104.0	113.3	55.6
Petrolia [b]	1,331	69	315	2,676	1,958	38.0	9.9	52.5	21.9	24.5
Marion County	....	3,454	198	5,250	390	....	575.7	66.0	328.1	48.8
Powell	298	....	....	....	....	5.3	....	....	....	....
Moran	....	....	....	200	690	....	....	....	40.0	210.0
Other	....	....	660	11	25	....	....	47.1	2.2	12.5
Total	1,683	19,180	28,213	57,435	25,003	15.6	228.3	94.3	98.9	50.3
Coastal Texas	63,283	32,740	33,082	38,978	160,695	173.5	93.0	93.7	119.9	497.5
Total Texas	64,966	51,920	61,295	96,413	185,698	137.3	119.1	94.0	106.4	226.4

[a] Including other districts in Wichita County. [b] Including Henrietta.

Total initial daily production of new wells in northern Texas, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
1910	([a])	210	77	83	43	1,044	54	26	50	9	62	25	1,683	140
1911	4	3,265	12	567	200	......	428	450	2,300	2,209	5,250	4,495	19,180	1,598
1912	650	3,395	3,185	2,004	2,955	955	1,909	2,462	2,250	5,006	1,678	1,764	28,213	2,351
1913	2,726	3,366	2,986	1,909	6,258	9,720	7,391	4,593	5,605	5,092	5,291	2,498	57,435	4,786
1914	5,401	4,217	3,785	2,731	2,306	2,229	965	1,138	1,184	261	622	164	25,003	2,084

[a] No record.

Number of wells completed in coastal Texas, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Batson	51	23	23	51	51	14	10	7	16	9	65	36	30	69	60
Dayton	....	....	....	....	2	....	....	....	....	....	....	....	....	....	2
Goose Creek	1	1	17	27	34	2	4	9	24	10	3	5	26	51	44
Hoskins Mound[b]	2	....	....	....	....	2	....	....	....	....	4	....	....	....	....
Humble	115	122	90	89	46	45	40	27	54	33	160	170	117	144	80
Markham	9	27	31	8	1	7	9	17	13	....	16	41	48	21	4
Orange County	....	....	....	....	3	....	....	....	....	5	....	....	....	....	8
Piedras Pintas	1	....	....	....	....	....	....	....	....	....	1	....	....	....	....
Saratoga	30	45	91	49	17	7	10	11	28	4	37	56	102	78	21
Sourlake	83	76	54	64	140	12	21	8	18	44	95	101	62	85	184
Spindletop	73	58	47	29	24	27	23	30	40	7	100	93	77	69	32
Miscellaneous	....	....	....	8	5	....	....	....	62	18	....	....	....	75	29
Total	365	352	353	325	323	116	117	109	255	130	481	502	462	592	464
Northern Texas	108	84	299	581	497	[a]82	38	124	208	221	190	126	434	799	744
Total Texas	473	436	652	906	820	198	155	233	463	351	671	628	896	1,391	1,208

[a] Including gas wells. [b] Includes West Columbia.

Number of oil wells and dry holes drilled in coastal Texas in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Total, 1914.		Total, 1913.	
	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.	Oil.	Dry.
Batson	5	1	2	..	2	2	3	1	8	..	3	..	2	..	8	2	4	..	6	..	3	1	5	2	51	9	51	16
Dayton	...	..	...	..	1	..	1	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	2	....	....	....
Goose Creek	16	..	...	3	3	2	3	1	2	2	...	..	...	..	2	1	1	1	4	..	2	..	1	..	34	10	27	24
Humble	5	2	5	1	2	1	2	5	7	3	5	3	3	4	4	1	3	..	2	5	6	6	2	2	46	33	89	54
Markham	...	..	...	..	...	..	...	..	...	..	...	..	...	..	...	..	1	..	...	..	...	..	...	..	1	....	8	13
Orange County	1	..	1	..	...	..	1	3	...	..	...	..	...	..	...	2	...	..	...	..	...	..	...	..	3	5	....	....
Saratoga	...	..	...	..	...	..	2	..	...	..	...	..	3	..	4	..	2	2	2	1	2	..	2	1	17	4	49	28
Sourlake	8	..	8	..	13	1	8	6	18	3	17	6	26	5	12	8	7	3	5	7	9	5	9	..	140	44	64	18
Spindletop	1	..	2	..	1	..	...	..	2	..	2	..	2	1	2	2	3	2	3	1	3	1	3	..	24	7	29	40
Miscellaneous	2	..	...	..	...	1	...	2	...	..	...	1	1	8	...	4	...	..	1	2	1	..	...	..	5	18	8	62
Total	38	3	18	4	22	7	20	18	37	8	27	10	37	18	32	20	21	8	23	16	26	13	22	5	323	130	325	255
Northern Texas	64	24	49	23	95	39	79	22	46	26	44	14	23	18	29	11	16	6	20	18	22	12	10	8	497	221	581	208
Total Texas	102	27	67	27	117	46	99	40	83	34	71	24	60	36	61	31	37	14	43	34	48	25	32	13	820	351	906	463

Number of oil wells drilled in coastal Texas, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	26	25	32	33	20	31	36	31	25	23	19	24	325
1914	38	18	22	20	37	27	37	32	21	23	26	22	323

Number of dry holes drilled in coastal Texas, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910	14	16	9	11	20	11	11	10	7	1	3	3	[a]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
1913	6	18	16	30	15	31	27	30	20	21	16	25	255
1914	3	4	7	18	8	10	18	20	8	16	13	5	130

[a] Including gas wells.

Total number of wells completed in coastal Texas, 1910–1914, by months. [a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	34	43	49	66	38	65	63	61	45	44	35	49	592
1914	42	24	29	39	47	37	56	54	30	39	40	27	464

[a] Including gas wells.

Initial daily production of new wells completed in coastal Texas in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Batson	120	18	50	114	163	70	28	73	53	360	37	1,105	2,191	5,980
Dayton	......	.....	250	150	......	......	......	......	......	......	......	.....	400	......
Goose Creek	530	.....	360	475	160	......	......	250	40	245	250	65	2,375	3,130
Humble	80	132	9,500	20	775	2,085	600	255	3,710	120	3,415	2,150	22,842	8,119
Markham	......	.....	......	......	......	......	......	......	25	......	......	.....	25	380
Orange County	300	30	......	20	......	......	......	......	......	......	......	.....	350	......
Saratoga	......	.....	......	20	......	......	190	450	25	100	25	90	900	7,883
Sourlake	3,836	3,470	9,900	24,450	11,685	14,640	14,950	11,645	8,650	11,350	10,350	5,415	130,341	11,443
Spindletop	150	46	15	......	33	112	115	150	270	135	75	90	1,191	1,778
Miscellaneous	10	.....	......	......	......	......	40	......	......	10	20	.....	80	265
Total	5,026	3,696	20,075	25,249	12,816	16,907	15,923	12,823	12,773	12,320	14,172	8,915	160,695	38,978
Northern Texas	5,401	4,217	3,785	2,731	2,306	2,229	965	1,138	1,184	261	622	164	25,003	57,435
Total Texas	10,427	7,913	23,860	27,980	15,122	19,136	16,888	13,961	13,957	12,581	14,794	9,079	185,698	96,413

Total and average initial daily production of new wells in coastal Texas, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Batson	2,328	606	829	5,980	2,191	45.6	26.3	36.0	117.3	43.0
Dayton	....	....	....	....	400	....	....	....	....	200.0
Goose Creek	100	250	3,005	3,130	2,375	100.0	250.0	176.8	115.9	69.9
Hoskins Mound	4,500	....	....	....	....	2,250.0	....	....	....	....
Humble	7,502	4,597	5,615	8,119	22,842	65.2	37.6	62.3	91.2	496.6
Markham	22,100	13,275	10,040	380	25	2,455.5	491.7	323.8	47.5	25.0
Orange County	....	....	....	....	350	....	....	....	....	116.7
Piedras Pintas	150	....	....	....	....	150.0	....	....	....	....
Saratoga	2,137	2,309	9,350	7,883	900	71.2	51.3	102.7	160.9	52.9
Sourlake	16,388	4,463	1,530	11,443	130,341	197.4	58.7	28.3	178.8	931.0
Spindletop	8,078	7,240	2,713	1,778	1,191	110.7	124.8	57.7	61.3	49.6
Miscellaneous	....	....	....	265	80	....	....	....	33.1	16.0
Total	63,283	32,740	33,082	38,978	160,695	173.5	93.0	93.7	119.9	497.5
Northern Texas	1,683	19,180	28,213	57,435	25,003	15.6	228.3	94.3	98.9	50.3
Total Texas	64,966	51,920	61,295	96,413	185,698	137.3	119.1	94.0	106.4	226.4

Total initial daily production of new wells in coastal Texas, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
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	5,274
1911	5,970	5,890	2,115	6,380	1,561	3,455	2,708	935	1,355	772	619	980	32,740	2,728
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	2,757
1913	1,147	3,652	10,936	2,305	5,595	3,195	1,335	1,147	1,757	2,186	1,016	4,707	38,978	3,248
1914	5,026	3,696	20,075	25,249	12,816	16,907	15,923	12,823	12,773	12,320	14,172	8,915	160,695	13,391

LOUISIANA.

GENERAL STATEMENT.

The output of petroleum in Louisiana in 1914 amounted to 14,309,435 barrels, exceeded the 1913 output by 1,810,607 barrels, or nearly 14.5 per cent, and established a new record for production of oil in the State. The increase came entirely from the productive districts in the northwestern portion of the State, which furnished 11,808,469 barrels, as against 2,500,966 barrels from the coastal pools, the former quantity representing an increase of more than 20.5 per cent over the output of the northern fields in 1913 and the latter quantity representing an 8 per cent decline from the output of the southern pools in 1913.

Market reverses in the late spring and summer months reflecting the general depression of crude-oil values throughout the country brought the average price per barrel for the entire Louisiana production from $0.98 in 1913 to $0.90 in 1914, the average for the northwestern Louisiana product declining from $1 to $0.95 a barrel and the heavier coastal product from $0.90 to $0.67 a barrel. This moderate decline in the yearly average price is due to the steady demand for the lighter grades of oil from the northwestern Louisiana fields for refining purposes and to the fact that much of the heavier coastal product was marketed on long period contracts entered into before the market declines set in.

Oil and gas in northwestern Louisiana are derived from fairly well defined though variable zones of poorly consolidated sand and porous chalk rock occurring in 1,500 feet or more of strata belonging to the Cretaceous system. In the southern Louisiana pools the production is obtained from layers of sand and porous limestone of Cretaceous, Tertiary, and even Quaternary age occurring in association with crystalline limestone, gypsum, sulphur, and rock salt in low structural domes or arches in the strata generally of very small areal extent.

DEVELOPMENT.

During the year 1914 a total of 566 wells were drilled in Louisiana, of which 374, or 66 per cent, yielded oil; 53, or about 1 per cent, yielded gas only; and 139, or 33 per cent, were barren.

Northwestern Louisiana.—In the oil fields of Caddo, De Soto, Red River, and Sabine parishes a total of 445 wells were completed during the year. Of these wells 302, or 68 per cent, produced oil; 91, or 20 per cent, were barren; and the remainder were classed as gas wells.

Field work in this division was particularly active during the spring and early summer, when effort was made to extend the limits of the proved fields. Though accompanied with indifferent success in the Caddo district this activity resulted in the development of an important pool near Naborton, in De Soto Parish, following discoveries made in 1913, and in the opening of a new pool 6 miles to the northeast near Abington. The Naborton pool, which lies mainly in secs. 2 and 11, T. 12 N., R. 12 W., and secs. 35 and 36, T. 13 N., R. 12 W., Louisiana meridian, attracted considerable activity throughout the year, which resulted in substantial additions to the productive area, through the appearance of salt water in a number of wells in certain portions of the pool, the high cost of drilling in this deed sand district, and the depressed condition of the market served to retard activity during the later part of the year.

The discovery well of the Abington pool was completed late in April in the NW. ¼ SE. ¼ sec. 14, T. 13 N., R. 11 W., by the Gulf Refining Co. on lands leased from B. W. Marston, jr. Considerable activity followed in the locality characterized by unsuccessful efforts to establish a connection between the new pool and the Naborton pool, 6 miles to the southwest, and by successful efforts, attaining their fullest fruition in 1915, to extend the pool eastward across Red River.

Prior to the market depression in early summer, interest was manifest in discoveries of both oil and gas in what is termed the Pelican district, in Sabine Parish, about 16 miles south of the Naborton pool. In April a well was completed in sec. 28, T. 10 N., R. 12 W. Louisiana meridian, which yielded an initial production of 30 barrels of oil from a sand reported to lie at a depth of 3,200 feet. The conditions of depth and low yield disclosed by this well, however, served to postpone active development of the district pending a more favorable market.

Coastal Louisiana.—Activity in the productive pools of coastal Louisiana resulted in the completion of 121 wells, of which number 72, or about 60 per cent, yielded oil, and 48, or nearly 40 per cent, were barren.

The total initial production credited to the coastal fields during the year amounted to 82,914 barrels, representing an average output of about 1,152 barrels a well for the first day of productive life.

A notable development in the coastal fields of Louisiana in 1914 was the rise of Edgerly, in Calcasieu Parish, which developed from a wildcat discovery made in June, 1913, by the Bright Oil Co. (subsequently purchased by the Gulf Refining Co.) into a consistent and reliable factor in Gulf coast production in 1914. From an output of less than 5,000 barrels in January, the pool increased to more than 80,000 barrels in October and was credited with more than 60,000 barrels in December.

In the other coastal pools of Louisiana operations were nominal, Jennings and Welsh recording a notable decline in production, Vinton a slight decline, and Anse la Butte a considerable increase compared with the output of the preceding year.

MARKETED PRODUCTION.

Marketed production of petroleum in Louisiana, 1905–1914, by districts, in barrels.

Year.	Northern Louisiana.				Coastal Louisiana.						Total.
	Caddo.	De Soto.	Red River.	Total.	Jennings.	Welsh.	Anse la Butte.	Vinton.	Edgerly.	Total.	
1905					8,891,416	10,000	9,000			8,910,416	8,910,416
1906	3,358			3,358	9,025,174	23,996	25,000			9,074,170	9,077,528
1907	50,000			50,000	4,842,520	47,316	60,385			4,950,221	5,000,221
1908	499,937			499,937	5,111,577	31,555	145,805			5,288,937	5,788,874
1909	1,028,818			1,028,818	1,966,614	26,169	37,930			2,030,713	3,059,531
1910	5,090,793			5,090,793	1,625,159	54,724	44,018	26,701		1,750,602	6,841,395
1911	6,995,828			6,995,828	1,180,177	27,901	62,411	2,454,103		3,724,592	10,720,420
1912	7,177,949			7,177,949	1,105,711	22,140	25,000	932,639		2,085,490	9,263,439
1913	9,781,560			9,781,560	790,648	31,144	6,612	1,888,864		2,717,268	12,498,828
1914	7,572,254	[a] 3,834,593	401,622	11,808,469	412,036	18,629	18,623	1,465,302	586,376	2,500,966	14,309,435

[a] Includes Sabine.

Marketed production of petroleum in Louisiana in 1913–1914, by districts and months, in barrels.

1913.

Month.	Northern Louisiana (Caddo).	Coastal Louisiana.					Total.
		Jennings.	Welsh.	Anse la Butte.	Vinton.	Total.	
January	542,905	78,215	3,257	155	179,566	261,193	804,098
February	562,863	76,100	2,430	....	108,961	187,491	750,354
March	717,963	79,670	2,360	310	255,906	338,246	1,056,209
April	860,274	84,923	2,428	306	191,790	279,447	1,139,721
May	968,538	74,877	2,840	1,621	168,713	248,051	1,216,589
June	1,010,049	66,839	2,459	3,446	159,072	231,816	1,241,865
July	953,530	64,190	3,265	774	150,960	219,189	1,172,719
August	802,200	53,899	2,798	....	158,002	214,699	1,016,899
September	812,062	54,960	2,488	....	140,990	198,438	1,010,500
October	905,558	57,891	2,157	....	130,163	190,211	1,095,769
November	814,545	51,852	2,124	....	125,095	179,071	993,616
December	831,073	47,232	2,538	....	119,646	169,416	1,000,489
Total	9,781,560	790,648	31,144	6,612	1,888,864	2,717,268	12,498,828

1914.

Month.	Northern Louisiana.			
	Caddo.	De Soto.[a]	Red River.	Total.
January	704,739	293,192	....	997,931
February	603,935	262,297	....	866,232
March	671,476	523,629	....	1,195,105
April	659,048	279,258	....	938,306
May	677,675	223,728	33,331	934,734
June	654,020	444,238	62,301	1,160,559
July	637,295	521,995	60,496	1,219,786
August	636,937	316,622	80,455	1,034,014
September	604,470	287,645	58,437	950,552
October	601,474	244,934	49,947	896,355
November	556,634	201,788	56,655	815,077
December	564,551	235,267	....	799,818
Total	7,572,254	3,834,593	401,622	11,808,469

Month.	Coastal Louisana.						Total.
	Jennings.	Welsh.	Anse la Butte.	Vinton.	Edgerly.	Total.	
January	45,502	1,966	2,087	131,647	4,892	186,094	1,184,025
February	34,544	1,166	2,246	113,312	16,771	168,039	1,034,271
March	37,435	1,166	1,637	175,626	20,482	236,346	1,431,451
April	32,321	1,166	1,333	131,562	50,445	216,827	1,155,133
May	28,842	1,167	1,229	118,924	64,183	214,345	1,149,079
June	29,504	1,167	1,339	91,117	64,291	187,418	1,347,977
July	29,702	1,167	1,226	104,548	42,626	179,269	1,399,055
August	32,930	1,167	1,303	139,592	44,096	219,088	1,253,102
September	33,308	3,451	1,068	117,303	57,638	212,768	1,163,320
October	35,288	1,167	918	112,503	81,210	231,086	1,127,441
November	36,099	1,167	2,853	113,126	77,630	230,875	1,045,952
December	36,561	2,712	1,384	116,042	62,112	218,811	1,018,629
Total	412,036	18,629	18,623	1,465,302	586,376	2,500,966	14,309,435

[a] Includes Sabine.

Marketed production and value of petroleum in Louisiana in 1913 and 1914, by districts, in barrels, with increase or decrease in barrels and percentage of increase and decrease.

District.	1913			1914			Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.		
Northern Louisiana:								
Caddo	9,781,560	$9,812,342	$1.003	7,572,254	$7,177,535	$0.948	−2,209,306	−22.59
De Soto [a]				3,834,593	3,649,922	.952	+3,834,593	+100.00
Red River				401,622	379,229	.944	+401,622	+100.00
Total	9,781,560	9,812,342	1.003	11,808,469	11,206,686	.949	+2,026,909	+20.72
Coastal Louisiana:								
Jennings	790,648	769,917	.974	412,036	374,611	.909	−378,612	−47.89
Welsh	31,144	26,745	.859	18,629	17,614	.946	−12,515	−40.18
Anse la Butte	6,612	5,290	.800	18,623	17,036	.915	+12,011	+181.66
Vinton	1,888,864	1,641,637	.869	1,465,302	983,588	.671	−423,562	−22.42
Edgerly				586,376	287,362	.490	+586,376	+100.00
Total	2,717,268	2,443,589	.899	2,500,966	1,680,211	.672	−216,302	−7.96
Total Louisiana	12,498,828	12,255,931	.981	14,309,435	12,886,897	.901	+1,810,607	+14.49

[a] Includes Sabine.

Marketed production, value, and average price per barrel of petroleum in the Caddo field, 1906-1914, in barrels.

Year.	Caddo, La.			Marion County, Tex.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1906	3,358	$2,183	$0.650				3,358	$2,183	$0.650
1907	50,000	38,863	.777				50,000	38,863	.777
1908	499,937	214,048	.428				499,937	214,048	.428
1909	1,028,818	549,081	.533				1,028,818	549,081	.533
1910	5,090,793	2,292,349	.451	251,717	$102,842	$0.409	5,342,510	2,395,191	.448
1911	6,995,828	3,653,725	.522	677,689	365,067	.539	7,673,517	4,018,792	.524
1912	7,177,949	5,419,541	.755	362,870	290,974	.802	7,540,819	5,710,515	.757
1913	9,781,560	9,812,342	1.003	262,392	261,965	.998	10,043,952	10,074,307	1.003
1914	7,572,254	7,177,535	.948	180,584	175,922	.974	7,752,838	7,353,457	.948
Total	38,200,497	29,159,667	.763	1,735,252	1,196,770	.690	39,935,749	30,356,437	.761

RAILROAD SHIPMENTS.

Shipments by rail of petroleum from stations on the lines of the Louisiana Western Railroad and the Kansas City Southern Railway in Louisiana in 1913 and 1914, by months, in barrels.

1913.

Month.	Anse la Butte.	Caddo oil.					Jennings oil.			Vinton.	Total.
		Lewis.	Mooringsport.	Oil City.	Vivian.	Mansfield.	Egan.	Jennings.	Mermentau.		
January	155	10,384	567	39,303	7,161	694	3,163	13,858	10,177	27,938	113,400
February	....	11,431	8,448	40,709	1,403	967	2,719	19,203	4,798	19,645	109,323
March	310	17,564	23,205	40,436	1,513	194	7,779	24,101	848	17,100	133,050
April	306	17,869	55,372	29,765	5,407	....	5,401	55,422	5,888	8,161	183,591
May	1,621	23,282	41,415	43,096	2,628	....	8,251	69,024	15,773	974	206,064
June	3,446	22,229	....	49,684	1,210	1,921	9,045	27,722	15,282	....	130,539
July	774	24,306	....	49,706	1,537	19,970	5,926	22,144	13,722	....	138,085
August	....	43,173	....	60,203	2,471	13,847	2,895	17,114	15,334	....	155,037
September	....	15,941	....	53,845	3,203	16,788	8,126	31,038	27,856	....	156,797
October	....	4,905	....	43,073	2,664	19,810	2,179	26,480	8,158	....	107,269
November	....	14,942	....	50,802	3,446	16,383	1,393	21,062	15,600	....	123,628
December	....	5,117	....	49,129	2,233	62,809	2,106	25,956	6,285	....	153,635
Total	6,612	211,143	129,007	549,751	34,876	153,383	58,983	353,124	139,721	73,818	1,710,418

1914.

Month.	Anse la Butte.	Caddo oil.			De Soto oil.	Jennings oil.			Vinton.	Total.
		Lewis.	Oil City.	Vivian.	Mansfield and South Mansfield.	Egan.	Jennings.	Mermentau.		
January	1,629	8,636	48,849	2,043	137,886	155	27,672	2,299	....	229,169
February	1,788	4,405	39,515	1,785	90,627	310	6,429	1,749	154	146,762
March	1,179	7,384	41,721	4,535	131,277	....	13,279	2,298	....	201,673
April	875	6,623	30,295	1,336	31,884	....	1,528	2,682	945	76,168
May	771	12,408	36,452	3,282	45,091	465	3,033	4,563	3,029	109,094
June	881	6,549	24,405	1,577	78,554	773	1,495	12,361	4,860	131,455
July	768	4,888	28,709	4,137	22,560	1,934	2,642	10,312	16,479	92,429
August	845	54,228	24,228	2,732	....	1,768	2,561	17,244	1,963	105,569
September	609	46,281	23,653	571	....	10,105	956	574	1,363	84,112
October	459	2,967	31,925	190	....	11,415	3,643	1,725	4,216	56,540
November	2,394	1,860	31,335	190	....	7,006	2,820	5,188	1,915	55,708
December	925	4,849	45,242	....	....	1,230	13,536	3,956	554	70,292
Total	13,123	161,078	409,329	22,378	537,879	35,161	79,594	64,951	35,478	1,358,971

SUMMARY OF WELLS DRILLED.

Number of wells completed in Louisiana, 1910–1914, by districts.

District.	Oil.					Dry.					Total completed.[a]				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Northern Louisiana:															
Caddo	124	246	239	356	208	54	63	62	92	57	[b]226	341	353	[c]518	[d]294
De Soto	.....	.....	.....	.....	77	.....	.....	.....	.....	24	.....	.....	.....	([e])	123
Red River	.....	.....	.....	.....	14	.....	.....	.....	.....	7	.....	.....	.....	.....	21
Sabine	.....	.....	.....	.....	3	.....	.....	.....	.....	3	.....	.....	.....	([e])	7
Total	124	246	239	356	302	54	63	62	92	91	226	341	353	518	445
Coastal Louisiana:															
Anse la Butte	3	.....	3	5	3	1	1	4	1	.....	4	1	7	6	8
Calcasieu	.....	.....	.....	4	.....	.....	.....	.....	1	2	.....	.....	.....	5	2
Cameron	.....	.....	.....	.....	.....	.....	.....	.....	2	1	.....	.....	.....	2	1
Edgerly	.....	.....	.....	.....	30	.....	.....	.....	.....	16	.....	.....	.....	.....	46
Evangeline	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....
Jennings	16	4	24	19	12	6	1	9	9	9	22	5	33	28	21
Pine Prairie	.....	.....	1	2	.....	.....	.....	5	4	.....	.....	.....	6	6	.....
Rapides	.....	.....	.....	.....	.....	.....	.....	.....	1	3	.....	.....	.....	1	3
Terrebonne	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
Vinton	8	54	31	45	22	3	27	7	34	12	11	96	38	79	35
Welsh	5	5	.....	6	5	.....	3	.....	4	5	5	10	.....	10	10
Total	32	63	59	81	72	10	32	25	57	48	42	112	84	139	121
Total Louisiana	156	309	298	437	374	64	95	87	149	139	268	453	437	657	566

[a] Including gas wells.
[b] Including Marion County, Tex.
[c] Including Bossier, DeSoto, and Sabine parishes.
[d] Including Bossier Parish.
[e] Included in Caddo.

Number of oil wells and dry holes drilled in Louisiana in 1914, by districts and months.

District.	Jan.		Feb.		Mar.		Apr.		May.		June.		July.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Northern Louisiana:														
Caddo	20	3	22	5	30	5	25	5	28	6	22	10	17	3
De Soto	1	.....	3	1	10	.....	6	3	11	6	20	5	8	1
Red River	.....	.....	.....	.....	.....	1	.....	1	1	.....	.....	.....	1	.....
Sabine	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....
Total	21	3	25	6	40	6	31	9	41	12	42	15	27	4
Coastal Louisiana:														
Anse la Butte	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....
Calcasieu	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Cameron	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....
Edgerly	4	.....	1	2	2	2	2	.....	4	4	6	1	2	1
Evangeline	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Jennings	2	1	.....	1	.....	1	.....	3	1	1	1	.....	2	1
Pine Prairie	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rapides	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
Vinton	1	1	3	1	2	3	2	.....	2	.....	.....	.....	2	1
Welsh	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	7	2	8	4	4	6	4	3	8	6	8	2	6	6
Total Louisiana	28	5	33	10	44	12	35	12	49	18	50	17	33	10

Number of oil wells and dry holes drilled in Louisiana in 1914, by districts and months—Continued.

District.	Aug.		Sept.		Oct.		Nov.		Dec.		Total 1914.		Total 1913.	
	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.	Oil.	Dry.
Northern Louisiana:														
Caddo	16	5	7	4	5	2	8	4	8	5	[a]208	[a] 57	[b]356	[b] 92
De Soto	7	1	5	2	3	3	.....	1	3	1	77	24	.....	.....
Red River	3	.....	1	.....	1	2	3	1	4	2	14	7	.....	.....
Sabine	.....	.....	.....	.....	1	3	.....	.....	.....	.....	3	3	.....	.....
Total	26	6	13	6	10	10	11	6	15	8	302	91	[b]356	[b] 92
Coastal Louisiana:														
Anse la Butte	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	3	.....	5	1
Calcasieu	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	2	4	1
Cameron	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	2
Edgerly	.....	2	2	1	2	1	3	2	2	.....	30	16	.....	.....
Evangeline	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Jennings	2	1	2	.....	.....	.....	1	.....	1	.....	12	9	19	9
Pine Prairie	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	4
Rapides	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	1
Vinton	1	3	1	.....	.....	1	4	1	4	1	22	12	45	34
Welsh	.....	.....	1	1	.....	.....	.....	2	.....	2	5	5	6	4
Total	3	6	7	2	2	2	8	5	7	4	72	48	81	57
Total Louisiana	29	12	20	8	12	12	19	11	22	12	374	139	437	149

[a] Includes Bossier Parish. [b] Includes Bossier, De Soto, and Sabine parishes.

Number of oil wells drilled in Louisiana, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	36	25	28	45	39	23	51	37	43	34	34	42	437
1914	28	33	44	35	49	50	33	29	20	12	19	22	374

Number of dry holes drilled in Louisiana, 1910–1914, by months.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	12	10	9	16	5	17	15	10	12	11	14	18	149
1914	5	10	12	12	18	17	10	12	8	12	11	12	139

Total number of wells completed in Louisiana, 1910–1914, by months.[a]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
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
1913	53	44	44	65	49	44	73	54	58	51	51	71	657
1914	38	48	60	50	74	69	46	47	36	29	33	36	566

[a] Including gas wells.

Initial daily production of new wells completed in Louisiana in 1914, by districts and months, in barrels.

District.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1914.	Total, 1913.
Northern Louisiana:														
Caddo	1,245	1,450	1,765	3,701	2,482	3,532	1,355	1,790	250	525	650	496	[a]19,241	[a]151,955
De Soto	1,800	5,300	22,640	3,417	8,290	15,935	6,155	5,475	1,180	30	......	390	70,612	......
Red River	......	......	......	......	3,000	......	35	3,300	25	960	2,140	2,725	12,185	......
Sabine	......	......	......	......	30	......	35	......	......	90	......	......	155	......
Total	3,045	6,750	24,405	7,118	13,802	19,467	7,580	10,565	1,455	1,605	2,790	3,611	102,193	151,955
Coastal Louisiana:														
Anse la Butte	......	......	......	......	40	150	......	......	150	......	......	......	340	2,362
Calcasieu	......	......	......	......	......	......	......	......	......	......	......	......	......	1,780
Edgerly	450	3,000	5,500	5,200	2,615	6,570	4,000	......	4,700	3,200	850	2,700	38,785	......
Jennings	75	......	......	......	200	25	132	20	50	......	50	40	592	4,813
Pine Prairie	......	......	......	......	......	......	......	......	......	......	......	......	......	80
Vinton	5,000	290	6,400	10,175	400	......	6,030	200	11,000	......	2,700	875	43,070	46,605
Welsh	......	115	......	......	......	......	......	......	12	......	......	......	127	100
Total	5,525	3,405	11,900	15,375	3,255	6,745	10,162	220	15,912	3,200	3,600	3,615	82,914	55,740
Total Louisiana	8,570	10,155	36,305	22,493	17,057	26,212	17,742	10,785	17,367	4,805	6,390	7,226	185,107	207,695

[a] Includes Bossier, De Soto, and Sabine parishes.

Total and average initial daily production of new wells in Louisiana, 1910–1914, by districts, in barrels.

District.	Total initial production.					Average initial production per well.				
	1910	1911	1912	1913	1914	1910	1911	1912	1913	1914
Northern Louisiana:										
Caddo	[a]139,945	169,123	84,098	[b]151,955	19,241	1,128.6	687.5	351.9	426.8	92.5
De Soto	......	......	......	......	70,612	......	......	......	......	917.0
Red River	......	......	......	......	12,185	......	......	......	......	870.4
Sabine	......	......	......	......	155	......	......	......	......	51.7
Total	[a]139,945	169,123	84,098	[b]151,955	102,193	1.128.6	687.5	351.9	426.8	338.4
Coastal Louisiana:										
Anse la Butte	735	......	590	2,362	340	245.0	......	196.7	472.4	113.3
Calcasieu	......	......	......	1,780	......	......	......	......	445.0	......
Edgerly	......	......	......	......	38,785	......	......	......	......	1,292.8
Jennings	3,230	480	5,905	4,813	592	201.9	120.0	246.0	253.3	49.3
Pine Prairie	......	......	1,050	80	......	......	......	1,050.0	40.0	......
Vinton	11,100	73,550	17,975	46,605	43,070	1,387.5	1,362.0	579.8	1,035.7	1,957.7
Welsh	165	115	......	100	127	33.0	23.0	......	16.7	25.4
Total	15,230	74,145	25,520	55,740	82,914	475.9	1,176.9	432.5	688.1	1,151.6
Total Louisiana	155,175	243,268	109,618	207,695	185,107	994.7	787.3	367.8	475.3	494.9

[a] Includes Marion County, Tex. [b] Includes Bossier, De Soto, and Sabine parishes.

Total initial daily production of new wells in Louisiana, 1910–1914, by months, in barrels.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Monthly average.
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	12,931
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	20,272
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	9,135
1913	21,064	12,410	27,220	28,860	26,986	13,966	15,675	22,626	6,580	11,163	3,447	17,698	207,695	17,308
1914	8,570	10,155	36,305	22,493	17,057	26,212	17,742	10,785	17,367	4,805	6,390	7,226	185,107	15,426

CALIFORNIA OIL FIELD.

GENERAL STATEMENT.

Despite the fact that California's claim to first rank among the oil-producing States was seriously contested in 1914 for the first time since 1903, when it wrested that position from Ohio, a marketed production of 99,775,327 barrels in 1914 gave the State a clear margin of 26,000,000 barrels over the similar production of its nearest competitor, Oklahoma. In addition to the marketed production in 1914, more than 5,000,000 barrels of petroleum were placed in field storage in California in the Sunset district alone, half of this quantity being the contribution of a single well, No. 1 of the Lakeview No. 2 Oil Co. The statistics of marketed production and the available figures of additions to storage show, when combined, that the total yield of California's oil wells in 1914 was in excess of 104,000,000 barrels.

The marketed production considered, which alone is comparable with available statistics for previous years, the output of petroleum in California in 1914 established a new record slightly more than 2 per cent above the record set in 1913.

The increase in output which made the new record possible is credited in the main to the Midway-Sunset division of the San Joaquin Valley fields but in part to the Whittier-Coyote division of the southern California fields.

The value of the marketed production amounted to $48,066,096, or an average of 48.1 cents a barrel, this being an increase of 1.4 cents over the average price per barrel received in 1913. In general, oils of refinable grade averaged lower in price per barrel in 1914 than in 1913, whereas fuel grades averaged slightly higher.

The Shell Co. of California (Inc.), a subsidiary of the Royal Dutch Syndicate, which entered California late in 1913, strengthened its position to some extent in 1914. This company increased its field holdings, erected 10 tanks of 55,000-barrel capacity each in the North Midway field and 25 tanks of similar capacity in the Coalinga field, and constructed 52 miles of its pipe line from Coalinga to Martinez, on San Francisco Bay, a distance of 173 miles. At Martinez land was purchased for the erection of a refinery and 20 additional 55,000-barrel storage tanks.

DEVELOPMENT.

A total of 512 wells were completed in the California field in 1914, of which 465, or 91 per cent, produced oil and 47, or 9 per cent, were barren. Drilling was fairly active during the first half of the year throughout the oil fields of the State but was greatly curtailed in the last part of the year. owing to a depressed market resulting from the European war.

SAN JOAQUIN VALLEY FIELDS.

Coalinga.—Activity at Coalinga was mostly centered in the East Side field, where the Shell Co. made preparations to develop its properties acquired from the California Oilfields (Ltd.) and the Turner

Oil Co. Developments were wholly within defined limits. In the West Side area water troubles retarded the successful operation of a number of properties.

In the Jacalitos Hills, south of Coalinga, the test well of the Bohemian Oil Co., in sec. 22, T. 21 S., R. 15 E. of the Mount Diablo meridian, was abandoned at a reported depth of 4,000 feet. The well had been drilling for nearly five years, and although several showings of oil were found, some of which are alleged to have tested as high as 37° Baumé in gravity, the quantity present was too small to be of value.

McKittrick.—The demand for fuel grades of oil early in 1914 inspired considerable activity at McKittrick, Belridge, and Lost Hills in the spring and early summer, but the market restrictions in the later months brought about a cessation of new development work in the fall and winter months.

Midway-Sunset.—The most successful developments in the Valley fields in 1914 were centered in the Midway-Sunset district, interest being localized in the North-Midway and Maricopa Flat subdivisions.

The North Midway development took place north and west of Shale and consisted of active drilling for heavy gravity oil found in unusually thick oil sands at depths of less than 1,000 feet below the surface. Market conditions caused a cessation of activity late in the year.

On Maricopa Flats the succession of gusher wells of large capacity was the feature of interest. Following the number of good wells of the gusher type completed in this locality late in 1913, well No. 1 of the Spreckles Oil Co. in sec. 32, T. 12 N., R. 23 W. San Bernardino meridian, completed in the lower sand in February, 1914, was the first phenomenal producer of the new year. The well came in with an estimated flow of 1,000 barrels an hour but was gradually pinched in to an average flow of 3,000 barrels a day, which was maintained for several months. As a spectacular producer, however, well No. 1 of the Lakeview No. 2 Oil Co. in sec. 4, T. 11 N., R. 23 W. San Bernardino meridian was the feature not only of the Sunset district but of the entire California field for the year. From May 10 to October 25 this well ran wild, the estimated daily flow reaching at times as much as 50,000 barrels, the greater part of which was stored in the old sumps of its world-famous predecessor, Lakeview No. 1. At first the new well produced practically pure oil, but water eventually broke in, and during the last few weeks the production was more than 60 per cent emulsion. Well No. 2 of the Miocene Oil Co. in sec. 32, T. 12 N., R. 23 W. San Bernardino meridian, after yielding more or less oil and considerable emulsion from upper sands penetrated in February and April was drilled to a reported depth slightly below 3,100 feet in June, where it responded with a 4,000-barrel output the first 24 hours after completion. Although the rate of flow increased somewhat afterwards, the well was brought under control and continued to yield several thousand barrels of oil a day in excess of transportation until March, 1915, when natural flow ceased.

In addition to the wells which have been mentioned, there were many others of the gusher type, and with an initial yield of more than 1,000 barrels the first day, completed on Maricopa flat and in the Buena Vista Hills during the year.

Kern River.—In the old Kern River field marketed production recorded a decrease of 32 per cent below 1913, due in part to the normal decline of the field but in a much greater degree to the closing of a great number of wells for whose product no market was available. Interest was centered in the successful efforts of the Standard Oil Co. of California to extend the field to the northwest along the low foothills bordering San Joaquin Valley on the east. In September a wildcat well in sec. 27, T. 28 S., R. 27 E. Mount Diablo meridian, 2½ miles northwest of the developed portion of the field, was completed with a reported average output of 125 barrels of oil a day. Other tests were begun or were under way in 1914 in secs. 5, 15, and 35 of the same township. The discovery is of interest in that it tends to substantiate the theory held by many geologists familiar with the conditions involved, that the productive sands of the Kern River field extend northward and westward from the developed part of the field, but that they lie at a considerably greater depth than in the old field. The cost of drilling in the new extension is further increased by the copious flows of water encountered in sands above the zone of oil-bearing strata.

COASTAL AND SOUTHERN CALIFORNIA.

Santa Maria.—Developments in the various subdivisions of the Santa Maria field were without especial interest. Owing to the high cost of drilling, activities in this area were less than usual. The St. Helens Petroleum Co., after more than two years of effort, finally abandoned early in 1915 its deep test at Fuglers Point, at a reported depth of 5,677 feet, without obtaining oil or gas in commercial quantities.

Ventura County.—In Ventura County little activity was apparent outside the operations of the Montebello Oil Co., along Oakridge, on the south side of Santa Clara Valley, and the operations of three or four companies in a small field termed the Santa Susana field, in Simi Valley, near the mouth of Tapo Canyon.

Los Angeles County.—No field developments of interest were recorded in 1914 in the Los Angeles City field or in the old Salt Lake field west of the city.

Whittier-Fullerton.—Operations in the Whittier-Fullerton (Puente-Coyote) district were fairly active throughout the year, with interest centered in the Coyote Hills locality, where a number of gusher wells, yielding more than 1,000 barrels of oil the first day of productive life, were completed. At the east end of La Habra Valley, in the vicinity of Placentia and Carlton, developments were equally successful and important additions to the productive area of the field were made.

The famous well No. 7 of the Standard Oil Co. on the Emery Ranch in the Coyote Hills, which was completed in December, 1913, with an initial flow of 12,000 barrels a day, flowed steadily throughout 1914, but with decreasing volume, owing to the completion of other wells near by.

As a result of the prolific additions to the southern California fields in 1914, an abundance of oil is assured the big refinery of the Standard Oil Co. at El Segundo for some time.

MARKETED PRODUCTION.

Marketed production of petroleum in California, 1876–1914, in barrels.

Year.	Production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).	Value.	Yearly average price per barrel.
1876	12,000	0.13			$30,000	$2.500
1877	13,000	.10	+ 1,000	+ 8.33	32,500	2.500
1878	15,227	.10	+ 2,227	+ 17.13	35,174	2.309
1879	19,858	.10	+ 4,631	+ 30.41	45,872	2.310
1880	40,552	.15	+ 20,694	+104.21	93,675	2.309
1881	99,862	.36	+ 59,310	+146.26	230,727	2.310
1882	128,636	.42	+ 28,774	+ 28.81	297,149	2.309
1883	142,857	.61	+ 14,221	+ 11.06	330,000	2.310
1884	262,000	1.08	+ 119,143	+ 83.40	605,220	2.310
1885	325,000	1.49	+ 63,000	+ 24.46	750,750	2.310
1886	377,145	1.34	+ 52,145	+ 16.05	870,205	2.307
1887	678,572	2.39	+ 301,427	+ 79.92	1,567,501	2.310
1888	690,333	2.50	+ 11,761	+ 1.73	1,390,666	2.014
1889	303,220	.86	− 387,113	− 56.08	356,048	1.174
1890	307,360	.67	+ 4,140	+ 1.37	384,200	1.251
1891	323,600	.59	+ 16,240	+ 5.28	401,264	1.240
1892	385,049	.76	+ 61,449	+ 18.99	561,333	1.458
1893	470,179	.97	+ 85,130	+ 22.11	608,092	1.293
1894	705,969	1.43	+ 235,790	+ 50.15	823,423	1.166
1895	1,208,482	2.28	+ 502,513	+ 71.18	849,082	.703
1896	1,252,777	2.05	+ 44,295	+ 3.67	1,240,990	.991
1897	1,903,411	3.15	+ 650,634	+ 51.93	1,713,102	.900
1898	2,257,207	4.08	+ 353,796	+ 18.59	1,917,596	.850
1899	2,642,095	4.63	+ 384,888	+ 15.67	2,508,751	.950
1900	4,324,484	6.80	+ 1,682,389	+ 63.67	4,076,975	.943
1901	8,786,330	12.66	+ 4,461,846	+103.17	4,974,540	.566
1902	13,984,268	15.75	+ 5,197,938	+ 59.16	4,873,617	.348
1903	24,382,472	24.27	+10,398,204	+ 74.36	7,399,349	.303
1904	29,649,434	25.33	+ 5,266,962	+ 21.60	8,265,434	.279
1905	33,427,473	24.81	+ 3,778,939	+ 12.74	8,201,846	.245
1906	33,098,598	26.17	− 328,875	− .98	9,553,430	.289
1907	39,748,375	23.93	+ 6,649,777	+ 20.09	14,699,956	.370
1908	44,854,737	25.13	+ 5,106,362	+ 12.87	23,433,502	.523
1909	55,471,601	30.29	+10,616,864	+ 23.67	30,756,713	.554
1910	73,010,560	34.84	+17,538,959	+ 31.62	35,749,473	.490
1911	81,134,391	36.80	+ 8,123,831	+ 11.13	38,719,080	.477
1912	[a] 87,272,593	39.15	+ 6,138,202	+ 7.57	39,624,501	.454
1913	97,788,525	39.356	+10,515,932	+ 12.05	45,709,400	.467
1914	99,775,327	37.54	+ 1,986,802	+ 2.03	48,066,096	.482
Total	741,273,559	22.22			341,747,232	.461

[a] Includes small quantity from Alaska.

The following table shows the marketed production and value of petroleum in California in 1913 and 1914, by districts and counties:

Marketed production and value of petroleum in California in 1913 and 1914, by districts and counties, in barrels.

District and county.	1913			1914		
	Quantity.	Value.	Price per barrel.	Quantity.	Value.	Price per barrel.
Coastal and southern:						
Los Angeles County—						
Los Angeles city	320,804	$176,398	$0.550	296,862	$153,879	$0.518
Newhall				127,706	97,999	.767
Salt Lake-Sherman				2,058,820	1,054,189	.512
Puente				667,504	383,611	.575
Whittier						
Orange County—						
Fullerton [a]	19,777,885	11,027,878	.557	13,260,226	8,202,968	.618
Ventura County—						
Santa Paula				857,685	947,681	1.104
Santa Barbara County—						
Lompoc				4,310,236	2,163,912	.502
Santa Maria						
Summerland	66,000	44,150	.669	53,561	32,692	.610
Monterey County				20,751	10,637	.512
San Mateo County						
San Luis Obispo County	42,216	25,368	.601			
Santa Clara County						
San Joaquin Valley:						
Fresno County—						
Coalinga	19,302,654	8,507,714	.442	15,692,733	7,173,559	.457
Kern County—						
Lost Hills	3,440,595	2,209,909	.642	3,325,516	1,961,995	.589
Kern River	9,885,380	3,917,273	.396	6,683,592	2,589,238	.387
McKittrick [b]	6,391,716	2,485,492	.389	5,315,638	2,054,342	.386
Midway	32,348,970	14,885,269	.460	37,862,683	17,363,080	.458
Sunset	6,212,305	2,429,949	.391	9,241,814	3,876,314	.419
Total	58,278,966	25,927,892	.445	62,429,243	27,844,969	.446
Grand total	97,788,525	45,709,400	.467	99,775,327	48,066,096	.481

[a] Includes Coyote Hills. [b] Includes Belridge.

The following table shows the marketed production of petroleum in California, by counties, from 1905 to 1914, inclusive:

Marketed production of petroleum in California, 1905–1914, by counties, in barrels.

Year.	Fresno.	Kern.	Los Angeles.	Orange.	Santa Barbara.	Ventura.	San Mateo.	Santa Clara.	Total.
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	[c] 17,095,395				[b] 20,123		87,272,593
1913	19,302,654	58,278,966					[b] 42,216		97,788,525
1914	15,692,733	62,429,243	3,150,892	13,260,226	4,363,797	857,685	[d] 20,751		99,775,327

[a] Includes oil produced in San Luis Obispo County.
[b] Production of Santa Clara and San Luis Obispo counties.
[c] Includes small quantity from Alaska.
[d] Includes Monterey County.

Marketed production of petroleum in California in 1913 and 1914, by districts and counties with increase or decrease and percentage thereof, in barrels.

District and county.	1913	1914	Increase.	Decrease.	Percentage.	
					Increase.	Decrease.
Coastal and southern:						
Los Angeles County—						
Los Angeles city	320,804	296,862		23,942		7.46
Newhall						
Puente						
Salt Lake-Sherman						
Whittier						
Orange County—						
Fullerton	19,777,885	21,282,177	1,504,292		7.61	
Ventura County—						
Santa Paula						
Santa Barbara County—						
Lompoc						
Santa Maria						
Summerland	66,000	53,561		12,439		18.85
San Luis Obispo County Santa Clara County	42,216	20,751		21,465		50.85
San Joaquin Valley:						
Fresno County—						
Coalinga	19,302,654	15,692,733		3,609,921		18.70
Kern County—						
Kern River	9,885,380	6,683,592		3,201,788		32.39
Lost Hills	3,440,595	3,325,516		115,079		3.36
McKittrick	6,391,716	5,315,638		1,076,078		16.84
Midway	32,348,970	37,862,683	5,513,713		17.04	
Sunset	6,212,305	9,241,814	3,029,509		48.77	
Total	58,278,966	62,429,243	4,150,277		7.12	
Grand total	97,788,525	99,775,327	1,986,802		2.03	

Marketed production, value, and average price per barrel of petroleum in California, 1905–1914, by districts, in barrels.

Year.	Coastal and southern.			San Joaquin Valley.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905	25,454,982	$5,351,572	$0.2102	7,972,491	$2,850,274	$0.357	33,427,473	$8,201,846	$0.245
1906	22,511,893	5,191,060	.231	10,586,705	4,362,370	.412	33,098,598	9,553,430	.289
1907	24,523,879	7,393,036	.301	15,224,496	7,306,920	.4799	39,748,375	14,699,956	.370
1908	16,335,676	9,296,743	.569	28,519,061	14,136,759	.4956	44,854,737	23,433,502	.523
1909	16,844,374	9,737,616	.578	38,627,227	21,019,097	.544	55,471,601	30,756,713	.554
1910	16,726,083	10,532,080	.629	56,284,477	25,217,393	.448	73,010,560	35,749,473	.490
1911	16,728,928	10,607,280	.904	64,405,463	28,111,800	.436	81,134,391	38,719,080	.477
1912	[a]17,115,518	[a]10,454,186	.615	70,157,075	29,170,315	.416	87,272,593	39,624,501	.454
1913	20,206,905	11,293,794	.557	77,581,620	34,435,606	.444	97,788,525	45,709,400	.467
1914	31,653,351	13,047,568	.603	78,121,976	35,018,528	.448	99,775,327	48,066,096	.481

[a] Includes small quantity from Alaska.

FIELD REPORT.

Field report for California in 1913 and 1914, by counties and districts.

1913.

County and district.	Wells.					Acreage.		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
		Oil.	Dry.					
Fresno County	1,042	91	16	47	1,086	47,201	12,644	59,845
Kern County:								
Kern River	1,813	70	1	105	1,778	12,088	2,790	14,878
Lost Hills	56	83	2	3	136	12,664	5,570	18,234
McKittrick	297	64	12	18	343	37,717	1,188	38,905
Midway	843	264	15	33	1,074	24,818	23,618	48,436
Sunset	339	41	6	11	369	10,397	13,949	24,346
Los Angeles County:								
Los Angeles city	395			9	386	406	341	747
Newhall-Puente	102	19		6	115	6,975	298	7,273
Salt Lake-Sherman	304	12	2	9	307	11,677	3,476	15,153
Whittier	118	6		2	122	2,999	1,368	4,367
Orange County	298	39	4	2	335	9,989	13,526	23,515
San Luis Obispo County	4			3	1	160	718	878
San Mateo County	4				4		600	600
Santa Clara County	4			1	3		6,115	6,115
Santa Barbara County:								
Lompoc-Santa Maria	249	40	4		289	94,489	31,050	125,539
Summerland	152	2		20	134	54		54
Ventura County	299	58	3	23	334	20,898	90,720	111,618
Miscellaneous	2		2	1	1	800	1,640	2,440
Total	6,321	789	67	293	6,817	293,332	209,611	502,943

1914.

County and district.	Productive Jan. 1.	Completed Oil.	Completed Dry.	Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.
Fresno County	1,086	35	5	50	1,071	35,549	12,273	47,822
Kern County:								
Kern River	1,778	17		38	1,757	13,407	4,864	18,271
Lost Hills	136	32	4	8	160	11,050	2,800	13,850
McKittrick	343	36	7	8	371	40,925	669	41,594
Midway	1,074	172	6	41	1,205	22,990	24,965	47,955
Sunset	369	42	7	4	407	8,058	11,377	19,435
Los Angeles County:								
Los Angeles city	386			8	378	152	25	177
Newhall-Puente	115	9	1		124	10,146	1,169	11,315
Salt Lake-Sherman	307	8	1	3	312	2,516	779	3,295
Whittier	122	8			130	12,438	2,126	14,564
Monterey County	1	4	1	1	4	1,142	2,820	3,962
Orange County	335	70	5	10	395	9,737	14,536	24,273
San Luis Obispo County	1				1	298	60	358
San Mateo County	4				4		600	600
Santa Clara County	3	2	1		5	300	6,000	6,300
Santa Barbara County:								
Lompoc-Santa Maria	289	9	2	6	292	83,514	22,393	105,907
Summerland	134	8		8	134	73	5	78
Ventura County	334	60	6	12	382	96,217	17,924	114,141
Miscellaneous			1			80	1,864	1,944
Total	6,817	512	47	197	7,132	348,592	127,249	475,841

COLORADO OIL FIELD.

GENERAL STATEMENT.

As in former years, the marketed production of petroleum in Colorado came almost entirely from the old Boulder and Florence fields, the former showing a decline of nearly 45 per cent below the output in 1913 and the latter registering an increase of 22 per cent, which, together with a small production contributed by the De Beque and Rangely fields, was sufficient to increase the total output of oil of the State 18 per cent over that of 1913.

Supplying as the Colorado production does a local and fairly constant market, prices of crude oil were little affected by the depressing influences which caused relatively large reductions in price in the major oil-yielding States. Nevertheless, the average price for the Colorado output in 1914 showed a decrease of about 2 cents a barrel below the average for 1913.

The fact that no wells were drilled during the year in the Boulder field, together with the fact that 11 new producers were completed in the Florence field, readily explains the fluctuations in production noted above.

In the De Beque district, Mesa County, the year's activity resulted in the completion of 1 small producer of oil and 1 barren hole. In the Rangely district, Rio Blancó County, there were no completions, the 23 productive wells in the field being capped and shut in, awaiting transportation facilities.

Wildcat tests during the year resulted in barren wells near Fowler, Crowley County, and near Falcon, El Paso County. Incompleted tests of this type were under way at the end of the year near Aurora, Denver County; Montrose, Montrose County; Craig, Routt County; Akron, Washington County; and on upper Piceance Creek, in Rio Blanco County.

MARKETED PRODUCTION.

In the following table is given the marketed production of petroleum in Colorado, by fields and months, in 1913 and 1914:

Marketed production of petroleum in Colorado in 1913 and 1914, by fields and months, in barrels.

Month.	1913				1914			
	Boulder.	Florence.	Other.[a]	Total.	Boulder.	Florence.	Other.[a]	Total.
January	1,269	17,464	25	18,758	880	15,757	59	16,696
February	1,273	14,795	25	16,093	594	14,910	59	15,563
March	1,570	15,708	26	17,304	472	15,905	59	16,436
April	1,318	14,099	26	15,443	518	17,409	59	17,986
May	1,315	14,811	26	16,152	575	17,271	59	17,905
June	1,141	14,752	26	15,919	433	17,312	59	17,804
July	914	14,993	26	15,933	520	19,355	59	19,934
August	314	14,203	26	14,543	370	20,124	59	20,553
September	575	14,307	26	14,908	588	19,182	59	19,829
October	1,007	14,153	26	15,186	488	20,098	59	20,645
November	704	13,687	26	14,417	695	19,134	59	19,888
December	396	13,721	26	14,143	382	19,091	61	19,534
Total	11,796	176,693	310	188,799	6,515	215,548	710	222,773

[a] Averaged.

The following table shows the marketed production of petroleum in Colorado from 1887 to 1914, inclusive:

Marketed production, value, average price per barrel of petroleum in Colorado, 1887–1914, with the increase or decrease for each year, in barrels.

Year.	Production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).	Value.	Average yearly price per barrel.
1887	76,295	0.27			$76,295	$1.000
1888	297,612	1.07	+ 221,317	+ 29.01	267,851	.900
1889	316,476	.90	+ 18,864	+ 6.34	280,240	.885
1890	368,842	.80	+ 52,366	+ 16.54	309,827	.840
1891	665,482	1.22	+ 296,640	+ 80.42	559,005	.840
1892	824,000	1.63	+ 158,518	+ 23.82	692,160	.840
1893	594,390	1.22	− 229,610	− 27.86	497,581	.838
1894	515,746	1.05	− 78,644	− 13.23	303,652	.589
1895	438,232	.83	− 77,514	− 15.02	336,010	.767
1896	361,450	.59	− 76,782	− 17.52	318,977	.883
1897	384,934	.64	+ 23,484	+ 6.50	332,122	.863
1898	444,383	.80	+ 59,449	+ 15.44	367,447	.827
1899	390,278	.69	− 54,105	− 12.18	404,110	1.035
1900	317,385	.50	− 72,893	− 18.67	323,434	1.019
1901	460,520	.66	+ 143,135	+ 45.09	461,031	1.000
1902	396,901	.45	− 63,619	− 13.81	484,683	1.220
1903	483,925	.48	+ 87,024	+ 21.93	431,723	.892
1904	501,763	.43	+ 17,838	+ 3.67	578,035	1.152
1905	376,238	.28	− 125,525	− 25.02	337,606	.897
1906	327,582	.26	− 48,656	− 12.93	262,675	.802
1907	331,851	.20	+ 4,269	+ 1.30	272,813	.822
1908	379,653	.21	+ 47,802	+ 14.40	346,403	.913
1909	310,861	.17	− 68,792	− 18.12	318,162	1.023
1910	239,794	.12	− 71,067	− 22.86	243,402	1.015
1911	226,926	.10	− 12,868	− 5.37	228,104	1.005
1912	206,052	.09	− 20,874	− 9.20	199,661	.973
1913	188,799	.07	− 17,253	− 8.37	174,779	.926
1914	222,773	.09	+ 33,974	+ 17.99	200,894	.902
Total	10,649,143	.32			9,608,682	.903

Marketed production of petroleum in Colorado in 1913 and 1914, by districts, showing increase or decrease and percentage of increase or decrease, in barrels.

District.	Production.		Increase.	Decrease.	Percentage.	
	1913	1914			Increase.	Decrease.
Boulder	11,796	6,515		5,281		44.77
Florence	176,693	215,548	38,835		21.99	
Other	310	710	400		129.03	
Total	188,799	222,773	33,974		17.99	

Marketed production, value, and average price per barrel of petroleum in Colorado, 1905–1914, by districts, in barrels.

Year.	Boulder.			Florence.			Total.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
1905	10,502	$11,502	$1.095	365,736	$326,104	$0.892	376,238	$337,606	$0.897
1906	48,952	53,847	1.0999	278,630	208,828	.7495	327,582	262,675	.802
1907	68,353	75,188	1.0999	263,498	197,625	.750	331,851	272,813	.822
1908	84,174	124,794	1.482	295,479	221,609	.750	379,653	346,403	.913
1909	85,709	129,812	1.514	225,062	187,900	.834	[a] 310,861	318,162	1.023
1910	42,186	63,420	1.503	193,482	174,332	.901	[b] 239,794	243,402	1.015
1911	37,973	50,393	1.327	187,341	175,763	.938	[b] 226,926	228,104	1.005
1912	15,304	19,130	1.250	190,498	180,281	.946	[c] 206,052	199,661	.973
1913	11,796	15,366	1.303	176,693	159,103	.900	[c] 188,799	174,779	.926
1914	6,515	9,117	1.399	215,548	191,067	.886	[d] 222,773	200,894	.902

[a] Includes a small production in Garfield County.
[b] Includes production of Garfield and Rio Blanco Counties.
[c] Includes production of Rio Blanco County.
[d] Includes production of Mesa and Rio Blanco counties.

FIELD REPORT.

Field report for Colorado in 1913 and 1914, by counties.

County.	Wells.									Acreage.					
	1913					1914				1913			1914		
	Productive Jan. 1.	Completed.		Abandoned.	Productive Dec. 31.	Completed.		Abandoned.	Productive Dec. 31.	Fee.	Lease.	Total.	Fee.	Lease.	Total.
		Oil.	Dry.			Oil.	Dry.								
Boulder	19	2		3	18			4	14	2,567	445	3,012	2,599	95	2,694
Cowley			1				1				2,500	2,500		2,600	2,600
El Paso							1							8,000	8,000
Fremont	50	4	12	3	51	11	8	10	52	2,366	1,820	4,186	8,806	17,470	26,276
Mesa						1			1				300		300
Rio Blanco	42	2		21	23				23	4,800	800	5,600	5,360		5,360
Other	1			1							40	40			
Total	112	8	13	28	92	12	10	14	90	9,733	5,605	15,338	17,065	28,165	45,230

UTAH OIL FIELD.

DEVELOPMENT.

One dry hole in the San Juan field constitutes the record of wells completed in Utah in 1914. There was no commercial production of oil in the State. Considerable interest was aroused late in the year by the discovery of a small quantity of oil in a well near Fillmore, located in sec. 36, T. 20 S., R. 5 W. of the Salt Lake meridian, in Millard County. The locality is one in which encouraging oil "showings" have been previously encountered in water wells, and one which is now being given a thorough test.

FIELD REPORT.

The field report for Utah in 1913 and 1914 is shown in the following table:

Field report for Utah in 1913 and 1914, by counties.

County.	Wells.									Average.					
	1913					1914				1913			1914		
	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.
Emery	......	....	2	....	......	....	....	....	......	2,560	....	2,560	....	......	......
Grand	......	....	1	....	......	....	....	....	......	5,000	....	5,000	....	......	......
San Juan	9	....	4	4	5	....	1	....	5	13,737	....	13,737	13,417	1,680	15,097
Uinta	1	....	1	....	1	....	....	1	......	1,300	....	1,300	1,300	......	1,300
Washington	3	....	....	....	3	....	....	3	......	600	....	600	....	......	......
Wayne	......	....	1	....	......	....	....	....	......	....	....	....	....	......	......
Total	13	....	9	4	9	....	1	4	5	23,197	....	23,197	14,717	1,680	16,397

WYOMING OIL FIELD.

GENERAL STATEMENT.

Situated as Wyoming is, remote from the great oil markets of the Atlantic and Pacific seaboards, the development of its oil industry has been the result chiefly of a slowly increasing demand by tributary railroads for liquid fuel.

The policy of the Federal Government in reserving from immediate development certain areas of prospective oil land, in Wyoming particularly, has been the cause of much adverse criticism, not all of which has been wholly disinterested. In consideration of the fact that production from unreserved lands in the State has more than kept pace with the slowly developing market and in the light of the demonstration in 1914 in the Cushing field, Oklahoma, of the disastrous effects attending unrestrained development of the Nation's petroleum resources, the criticisms aimed at the policy of conservation appear to be very poorly founded.

The petroleum output of Wyoming in 1914 aggregated 3,560,375 barrels, a substantial increase of nearly 48 per cent over the record output in 1913 and an increase of more than 100 per cent over the output in 1912, which of itself constituted an increase of nearly 750 per cent over the output in 1911. As usual, the greater part of this output came from the Natrona County fields, Salt Creek and Shannon, 96 per cent of the State total being credited to these fields in 1914.

The addition to Wyoming's wealth represented by this resource amounted to $1,679,192 in 1914, this contribution being $491,960, or 41 per cent, greater than the contribution from the same source in 1913, the increase alone amounting to more than the value of the entire output of the State from the beginning of the industry to and including the year 1911. The average price per barrel received at the wells for the production in 1914 was 47 cents, a decline of 2 cents from the average price received in 1913.

DEVELOPMENT.

Field work was especially active in Wyoming in 1914, a total of 114 wells being drilled for oil during the year. Of this number, 86, or 75 per cent, produced oil, and 28, or 25 per cent, were barren. At the close of the year the State contained 263 active oil wells, as compared with 198 at the end of 1913 and 189 at the end of 1912.

Natrona County.—In the Salt Creek and Shannon districts 52 wells were completed during the year, of which only 7 proved failures, the ratio of dry holes to total completions being about 1 to 7½. The increased activity in this district is largely accounted for by the increased refinery capacity at Casper, where the Standard Oil Co. of Indiana completed and placed in operation a modern by-product plant early in the year. Outside the proved districts Natrona County furnished an incentive for further drilling in a new locality nearly 30 miles west of Casper, where a strong flow of gas and a slight showing of oil were found in a wildcat well drilled by the Pine Dome Oil Co. in sec. 36, T. 35 N., R. 84 W. sixth principal meridian. Although drilling was continued the discovery of water in underlying sands, together with the fact that no market was available for the gas, tended to postpone further developments.

Bighorn County.—Revived activity was apparent in the Basin, Greybull, and Byron fields in 1914, due in part to the increased refining facilities made available by the enlargement of the Northwestern Refining Co.'s plant at Cowley and by the completion of the Chicago, Burlington & Quincy Railroad Co.'s line between Thermopolis and Casper, which furnishes a direct route from the fields to the refineries at the latter place. Extensions of productive area were made northward in the Byron field, and considerable gas and oil were found in a small structural dome, known locally as the "Lamb anticline," 3 miles northeast of Basin. In the old Bonanza field, at the south end of the county, where a few tests were made several years ago, one or two new tests were begun during the latter part of the year.

Fremont County.—In the old Dallas field on Little Popo Agie River southeast of Lander, the year was uneventful. About 2 miles northeast of Lander a new field was opened in fractional sec. 30, T. 2 S., R. 2 E. Wind River meridian, on the north side of Popo Agie River and along the crest of a deeply eroded anticline. Six wells were completed in this field during the first half of the year, the yield aggregating about 200 barrels of oil a day. The product, which is a typical asphalt-base oil suitable for locomotive fuel, is obtained at a relatively shallow depth and is believed to come from the Embar formation of Pennsylvanian and Permian (?) age.

Uinta and Lincoln counties.—The Spring Valley and Labarge fields, which have furnished a small production for a number of years, completed 3 producers and abandoned 10 exhausted wells in 1914.

Hot Springs County.—The feature of chief interest in the Wyoming petroleum industry in 1914 was the opening of a new field of high-grade refining oil in Hot Springs County on the southwest side of the

Bighorn Basin. The discovery well, located in sec. 18, T. 46 N., R. 98 W. sixth principal meridian, was brought in early in June and before the end of the year 18 wells had been completed, all of which showed oil, though in 6 the quantity was not sufficient to warrant a commercial rating. The new field, which is known as the Grass Creek field, occupies a part of the crest of an eroded dome or arch capped with Cretaceous strata. Production is obtained at a relatively shallow depth from sandstone beds assigned to the Frontier formation. The domelike structure, which the Grass Creek tests have proved productive of oil and gas, highly favors the ultimate development of an oil field of importance in the locality. Development is now retarded by the lack of transportation facilities for the oil, but arrangements are already under way for the construction of a gravity pipe line from the field to connect with the Chicago, Burlington & Quincy Railroad at Kirby, 25 miles to the southeast.

Other counties.—In southern Park County a few miles north of the Grass Creek field 2 wells completed during the year proved the presence of enormous quantities of natural gas along the crest of an eroded anticline in Buffalo Basin. In north-central Park County 3 oil wells of small production were completed near Cody. New work was undertaken in Converse County in the Brenning Basin district near Douglas without notable success. On the west flank of the Black Hills in Crook County a small quantity of lubricating oil was marketed from wells on the Wyoming side of the State line a few miles west of Rochford, S. Dak.

MARKETED PRODUCTION.

Marketed production of petroleum in Wyoming in 1914, by months and counties, in barrels.

Month.	Bighorn.	Fremont.	Natrona.	Uinta.	Other.[a]	Total.
January	8,014	2,282	188,278	1,115	173	199,862
February	8,014	2,283	151,863	1,115	173	163,448
March	8,015	2,283	218,802	1,115	174	230,389
April	8,015	2,283	288,662	1,115	174	300,249
May	8,015	2,283	364,620	1,115	174	376,207
June	8,015	2,283	209,903	1,116	174	221,491
July	8,015	2,283	275,722	1,116	174	287,310
August	8,015	2,283	366,663	1,116	174	378,251
September	8,015	2,283	375,054	1,116	175	386,643
October	8,015	2,283	362,040	1,116	175	373,629
November	8,015	2,283	331,296	1,116	175	342,885
December	8,015	2,283	288,422	1,116	175	300,011
Total	[b] 96,178	[b] 27,395	3,421,325	[b] 13,387	[b] 2,090	3,560,375

[a] Converse and Crook counties. [b] Averaged.

Marketed production, value, and average price per barrel of petroleum in Wyoming, 1894–1914, with the increase or decrease for each year, in barrels.

Year.	Production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).	Value.	Average yearly price per barrel.
1894	2,369	....	....	....	$15,920	$6.720
1895	3,455	....	+ 1,086	+ 45.84	27,640	8.000
1896	2,878	....	− 577	− 16.70	23,024	8.000
1897	3,650	....	+ 772	+ 26.82	29,200	8.000
1898	5,475	....	+ 1,825	+ 50.00	38,325	7.000
1899	5,560	....	+ 85	+ 1.55	38,920	7.000
1900	5,450	....	− 110	− 1.98	38,150	7.000
1901	5,400	....	− 50	− .92	37,800	7.000
1902	6,253	....	+ 853	+ 15.74	43,771	7.000
1903	8,960	....	+ 2,707	+ 40.29	62,720	7.000
1904	11,542	....	+ 2,582	+ 28.82	80,794	7.000
1905	8,454	....	− 3,088	− 26.75	51,545	6.100
1906	[a] 7,000	....	− 1,454	− 17.20	49,000	7.000
1907	[b] 9,339	0.005	+ 2,339	+ 33.41	21,883	2.343
1908	[b] 17,775	.01	+ 8,436	+ 90.33	27,920	1.570
1909	[b] 20,056	.01	+ 2,281	+ 12.83	34,456	1.718
1910	[b] 115,430	.05	+ 95,374	+475.54	93,536	.810
1911	[b] 186,695	.085	+ 71,265	+ 61.74	124,037	.664
1912	1,572,306	.71	+1,385,611	+742.18	798,470	.507
1913	2,406,522	.97	+ 834,216	+ 53.06	1,187,232	.493
1914	3,560,375	1.34	+1,153,853	+ 47.95	1,679,192	.472
Total	7,964,944	.24	....	....	4,503,535	.565

[a] Estimated. [b] Includes Utah.

FIELD REPORT.

The field report for Wyoming in 1913 and 1914 is shown in the following table:

Field report for Wyoming in 1913 and 1914, by counties.

County.	Wells.									Acreage.					
	1913					1914				1913			1914		
	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.
Albany	....	....	....	....	....	....	1	....	....	......	......	......	......	9,035	9,035
Big Horn	16	....	....	....	16	21	5	....	37	532	2,190	2,722	1,129	4,357	5,486
Converse	7	6	....	4	9	3	1	3	9	468	2,240	2,708	7,927	9,920	17,847
Crook	10	2	2	....	12	....	....	....	12	1,880	......	1,880	2,840	......	2,840
Douglas	....	....	....	....	....	....	1	....	....	......	......	......	160	2,240	2,400
Fremont	31	....	1	10	21	6	3	2	25	1,260	5,320	6,580	......	4,380	4,380
Hot Springs	....	....	....	....	....	8	5	....	8	......	......	......	......	2,860	2,860
Johnson	1	....	....	1	....	....	....	....	....	160	......	160	160	......	160
Lincoln	....	....	1	....	....	....	....	....	....	......	......	......	......	......	......
Natrona	100	7	7	10	97	45	7	6	136	4,840	14,480	19,320	1,320	15,600	16,920
Park	....	....	....	....	....	....	2	....	....	......	......	......	......	......	......
Uinta	24	19	5	....	43	3	3	10	36	9,080	11,000	20,080	7,960	26,360	34,320
Total	189	34	16	25	198	86	28	21	263	18,220	35,230	53,450	21,496	74,752	96,248

MICHIGAN, MISSOURI, AND ALASKA.

The small production of petroleum credited to Michigan in 1914 consisted, as in previous years, of natural lubricating oil from a few wells near Port Huron, St. Clair County. Two oil wells were completed in this field during the year and 2 were abandoned, leaving 26 productive wells in the State at the end of December.

In Missouri commercial production of oil was limited to Jackson County in 1914. The excitement at Swartz, Vernon County, chronicled in the report for 1913, failed to result in the discovery of more than a small quantity of thick asphaltic oil, which tended to discourage further efforts in the locality. Barren wells were completed in Lewis and Franklin counties, and at the end of the year additional tests were under way north of Tarkio, Atchison County, and near Excelsior Springs, Clay County.

In Alaska the Katalla field yielded a small output of petroleum, which, as in previous years, was absorbed by the local refinery. One productive well was completed during the year, additional activity consisting only in the performance of the annual assessment work required on a few unpatented oil claims entered prior to the withdrawal from entry of Alaskan oil lands in 1906.

MARKETED PRODUCTION.

The marketed production of petroleum in Missouri from 1889 to 1914, inclusive, is given in the following table:

Marketed production of petroleum in Missouri, 1889–1914, in barrels.

Year.	Production.	Percentage of total production.	Increase (+) or decrease (−).	Percentage of increase (+) or decrease (−).	Value.	Average yearly price per barrel.
1899	20				$40	$2.000
1890	278		+ 258	+1,290.00	556	2.000
1891	25		− 253	− 91.01	84	3.360
1892	10		− 15	− 60.00	40	4.000
1893	50		+ 40	+ 400.00	154	3.080
1894	8		− 42	− 84.00	40	5.000
1895	10		+ 2	+ 25.00	50	5.000
1896	43		+ 33	+ 330.00	185	4.300
1897	19		− 24	− 55.81	174	9.158
1898	10		− 9	− 47.37	105	10.500
1899	132		+ 122	+1,220.00	205	1.553
1900	[a]1,602		+ 1,470	+1,113.64	1,177	.735
1901	[a]2,335		+ 733	+ 45.76	2,600	1.114
1902	[a]757		− 1,578	− 67.58	1,066	1.408
1903	[a]3,000		+ 2,243	+ 296.30	4,650	1.550
1904	[a]2,572		− 428	− 14.27	4,769	1.854
1905	[a]3,100		+ 528	+ 20.53	3,320	1.071
1906	[a]3,500		+ 400	+ 12.90	4,890	1.397
1907	[a]4,000		+ 500	+ 14.28	6,500	1.625
1908	[a]15,246		+11,246	+ 281.15	22,345	1.466
1909	[a]5,750		− 9,496	− 62.28	7,830	1.362
1910	[a]3,615		− 2,135	− 37.13	4,794	1.326
1911	[a]7,995		+ 4,380	+ 121.16	7,995	1.000
1912	([b])					
1913	[c]10,843	0.004	+10,843		19,263	1.777
1914	[d]7,792		− 3,051	− 28.14	14,291	1.834
Total	72,712				107,123	1.473

[a] Includes Michigan.
[b] No production for Missouri; Michigan included in Lima, Ohio.
[c] Includes Alaska, Michigan, and New Mexico.
[d] Includes Alaska and Michigan.

OTHER STATES.

Arizona.—A test well was begun in 1914, in Tonto Basin, near Lake Roosevelt, in Gila County.

Alabama.—Efforts to discover oil at Clanton, Chilton County, and near Stevenson, Jackson County, were not successful to the end of 1914.

Arkansas.—One barren well was completed during the year near Ozark, Franklin County, and tests were begun in the State at or near Meg, Franklin County; Paris, Logan County; Hope, Hempstead County; and De Queen, Sevier County.

Florida.—Pockets of gas of no commercial value were penetrated in a test well begun during the year near Kissimmee, Osceola County.

Georgia.—A test well was begun in 1914 near Waycross, Ware County.

Maryland.—Near Parsonsburg, Wicomico County, on the "Eastern Shore," a well was drilled to a reported depth of 500 feet and abandoned in quicksand, after having penetrated one or more inconsequential pockets of gas.

Mississippi.—No commercial production of oil was obtained in Mississippi, though tests were drilled near Seminary, Covington County, and others were begun near Fayette, Jefferson County, and Meridian, Lauderdale County.

Montana.—Showings of oil were reported at a depth of 1,244 feet in a well put down for water on the ranch of E. C. Tanberg, T. 17 N., R. 10 E. of the Montana meridian, in eastern Cascade County. Considerable land was leased in the locality and further tests were proposed. Near Havre, Chouteau County, a fair volume of gas was developed in wells in or near the town.

New Mexico.—One exhausted well abandoned and 1 barren well drilled, both in Eddy County, in the Artesia basin district, constitute the results of activity in New Mexico in 1914. In San Juan County 1 well was drilling at the end of the year.

North Dakota.—Near Gettysburg, Potter County, a deep test proved barren of oil or gas.

Oregon.—One well was drilling in the discredited Vale district at the end of the year.

Tennessee.—No completed wells were reported from Tennessee in 1914, though one test was started in the northern part of the State, in Macon County.

Washington.—Two barren wells were completed at the mouth of Hoh River in Jefferson County, and one near Willapa Harbor, Pacific County. Late in the year considerable excitement resulted from the report of a discovery of oil in a well near Tenino, Thurston County, but interest waned rapidly when the well failed to yield oil in commercial quantities. Other wells were begun in the locaility but failed of completion to the end of the year. Other incompleted tests were located near Tahola, on the Queniult Reservation, Chehalis County; near Forks and Sequim, Clallam County; at Enterprise, Whatcom County; at Bay View, Skagit County; and at Chico, Kitsap County.

IMPORTS.

Crude petroleum, petroleum products, and ozokerite to the total value of $12,326,387 were imported for consumption in the United States during the calendar year 1914. Imports of crude petroleum alone amounted to 17,247,483 barrels, valued at $11,465,466, and comprised 93 per cent of the total value of the products imported. Compared with 1913, imports of these materials decreased slightly in both quantity and value. Practically all of the crude petroleum imported by the United States comes from Mexico, and is brought in for use directly as fuel, or for refinery treatment in the manufacture of oil, asphalt, paving cements, roofing material, rubber substitutes and solvents.

The slight decrease in the quantity of crude petroleum imported in 1914 may be accounted for by the increased output of asphaltic oils of domestic origin in the Gulf coast fields.

Small quantities of crude petroleum for experimentation or for special limited uses were entered for consumption in 1914 from Canada, Peru, Trinidad, England, Belgium, and Germany.

The following table presents a summary of the imports for consumption in the United States of crude petroleum and its principal imported products for the last five years:

Quantity and value of petroleum, paraffin oil, and ozokerite and paraffin wax imported for consumption into the United States, 1910–1914.

Year.	Petroleum.		Paraffin oil.		Ozokerite and paraffin wax.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Barrels.		*Barrels.*		*Pounds.*		
1910	557,181	$1,398,861	2,952	$39,748	15,971,672	$986,081	$2,424,690
1911	1,709,932	2,410,884	4,019	43,343	12,699,459	749,475	3,203,702
1912	7,383,229	6,082,881	2,571	32,565	17,617,068	985,959	7,101,405
1913	17,809,058	12,947,280	3,676	49,458	16,051,322	932,894	13,929,632
1914	17,247,483	11,465,466	2,481	36,687	15,516,242	824,234	12,326,387

EXPORTS.

TERRITORIAL SHIPMENTS.

Alaska.—The market for petroleum and its products in Alaska has greatly expanded in the last decade, as is shown by the following statistical summary compiled from the records of the Bureau of Foreign and Domestic Commerce:

Shipments of petroleum products to Alaska from other parts of the United States, 1905–1914.

Year.	Oil used for fuel, including crude, gas oil, residuum.		Gasoline, including all lighter products of distillation.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*		*Gallons.*	
1905	2,715,974	$91,151	713,496	$109,921	627,391	$113,921	83,319	$31,660
1906	2,688,940	38,499	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	14,119,102	340,225	746,930	118,810	531,727	98,786	85,687	35,882
1910	19,143,091	506,200	788,154	136,569	626,972	95,483	104,512	38,625
1911	20,878,843	485,279	1,238,865	167,915	423,750	57,896	100,141	34,048
1912	15,523,555	309,804	2,736,739	344,739	672,176	100,722	154,565	60,949
1913	15,682,412	453,756	1,735,658	272,661	661,656	106,603	150,918	61,966
1914	18,601,384	404,349	2,878,723	373,607	731,146	103,779	191,878	74,535

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 1905 to 1914, inclusive:

Shipments of petroleum products to Hawaii, the Philippines, and Porto Rico, 1905–1914.

Year.	Oil used for fuel, including crude, gas oil, residuum.		Gasoline, including all lighter products of distillation.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
HAWAII.								
	Gallons.		*Gallons.*		*Gallons.*		*Gallons.*	
1905	31,904,340	$1,112,939	320,703	$39,069	892,094	$142,313	195,850	$61,605
1906	38,883,100	871,830	550,975	71,954	1,225,864	199,443	241,567	76,134
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	43,764,041	871,485	804,169	127,076	1,401,381	232,340	367,831	121,282
1910	54,539,511	1,095,549	974,268	160,700	1,359,671	226,481	359,528	133,968
1911	47,250,018	949,409	1,329,589	203,052	1,587,873	220,505	466,826	138,927
1912	58,790,343	1,182,230	2,501,938	343,062	1,817,718	190,939	477,012	165,993
1913	60,066,083	1,154,188	2,058,091	315,333	1,807,288	210,997	456,477	145,455
1914	67,893,460	1,207,036	3,162,667	364,260	2,157,021	250,158	408,606	147,243
PHILIPPINES.								
1905	....	....	60,000	9,096	3,847,810	380,322	236,123	44,573
1906	7,360	442	40,450	6,482	4,412,398	398,706	195,006	39,887
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	21,789	1,581	184,390	23,428	5,995,090	558,642	362,068	81,278
1910	13,703	1,122	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	106,872	5,358	1,326,040	216,810	12,634,519	1,094,596	487,607	121,999
1913	10,370	1,013	1,414,225	280,690	12,091,810	1,142,403	517,494	105,001
1914	11,408	564	1,197,774	206,754	12,906,403	1,219,404	971,977	189,279
PORTO RICO.								
1905	....	....	49,493	7,697	1,365,446	140,569	93,513	20,253
1906	16,585	1,224	79,841	17,786	1,315,589	151,013	196,732	41,777
1907	....	....	219,691	38,003	1,700,838	176,808	223,389	53,599
1908	25,437	2,118	285,188	45,479	1,623,477	189,021	264,012	65,776
1909	7,566	475	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	238,935	91,356
1911	51,656	2,899	1,106,327	133,470	2,323,401	207,804	479,579	117,034
1912	29,204	1,857	1,470,105	223,325	2,168,105	212,043	471,596	134,882
1913	21,108	1,439	1,580,772	303,012	2,381,187	246,137	507,412	120,007
1914	53,586	4,939	1,836,896	320,163	2,227,195	227,500	361,117	80,247

FOREIGN SHIPMENTS.

The export trade of the United States in petroleum and its liquid products in the calendar year 1914 showed a gain of 5.6 per cent in quantity over 1913, though the declared value of these exports declined about 5.9 per cent below the total value of the shipments in 1913. During the first seven months of 1914 the total shipments of mineral oils from United States' ports exceeded in quantity the total shipments during the corresponding period in 1913 by nearly 20 per cent, representing an increase in declared value of about 7 per cent in favor of 1914.

The outbreak of the European war, however, temporarily demoralized the export situation by cutting off certain of the foreign consumers as well as diminishing the supply of available tankers, and although the situation remedied itself to a great extent before the end of the year because of increasing demands for petroleum products from other consumers and of the transfer to American registry of a great number of oil tankers, the remaining five months of 1914 recorded a decline of about 13.5 per cent in quantity and about 13 per cent in declared value of petroleum exports compared with the corresponding period in 1913.

Total exports of petroleum and its liquid products from the United States in 1914 amounted in value to $139,900,587. Total imports for consumption of petroleum and petroleum products during the same period were valued at $12,326,387, leaving a trade balance of $127,574,200 in favor of the American petroleum industry, exclusive of the trade in the solid products of petroleum (paraffin wax and greases).

EXPORTS BY CALENDAR YEARS.

The following tables compiled from the records of the Bureau of Foreign and Domestic Commerce show the quantity and declared value of petroleum and its liquid products (mineral oils) exported from the United States in 1913 and 1914:

Exports of mineral oils from the United States in 1913 and 1914, by months, in gallons.

Month.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
January	168,170,286	$11,176,786	163,830,375	$10,608,233
February	129,026,557	9,650,639	151,251,958	10,011,456
March	148,935,705	10,854,484	173,095,529	11,544,113
April	171,498,655	13,152,384	221,052,913	14,641,651
May	174,851,170	12,786,745	196,196,201	12,860,072
June	185,643,586	12,574,364	217,744,327	13,387,524
July	176,685,335	12,520,886	231,745,397	14,155,736
August	182,584,132	12,482,146	147,667,507	7,990,191
September	191,555,641	13,277,685	203,460,460	13,047,539
October	219,474,668	15,147,538	195,883,472	12,391,489
November	171,537,378	11,887,420	169,995,910	9,713,612
December	216,502,608	13,805,332	168,109,603	9,548,971
Total	2,136,465,721	149,316,409	2,240,033,652	139,900,587

CLASSIFICATION OF KINDS AND PORTS.

Exports of mineral oils from the United States in the calendar years 1913 and 1914, by kind and port.

Kind and port.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
CRUDE.	*Barrels.*		*Barrels.*	
New York	1,174,017	$3,957,755	507,799	$1,667,949
Philadelphia	6	38		
Galveston	495	1,503		
Other districts	3,455,712	4,488,998	2,462,095	3,290,889
Total	4,630,230	8,448,294	2,969,894	4,958,838
NAPHTHA.	*Gallons.*		*Gallons.*	
Baltimore	62,965	11,617	52,218	6,478
Boston and Charlestown	44,381	8,585	30,182	4,634
New York	102,869,333	16,872,213	104,489,412	14,053,210
Philadelphia	23,053,365	3,348,437	24,284,157	2,786,555
Galveston	35,911	5,346	42,225	5,555
Other districts	61,977,424	7,845,410	80,794,461	8,431,982
Total	188,043,379	28,091,608	209,692,655	25,288,414

Exports of mineral oils from the United States in the calendar years 1913 and 1914, by kind and port—Continued.

Kind and port.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
ILLUMINATING.	*Gallons.*		*Gallons.*	
Baltimore	139,282	$14,199	900,124	$57,000
Boston and Charlestown	108,963	11,668	88,246	9,742
New York	538,619,277	40,100,916	467,633,204	34,736,938
Philadelphia	229,282,278	13,890,288	142,498,871	9,029,794
Galveston	165	20	20,000	2,125
Other districts	351,291,278	18,025,016	399,308,808	20,277,173
Total	1,119,441,243	72,042,107	1,010,449,253	64,112,772
LUBRICATING AND PARAFFIN.				
Baltimore	12,115,947	1,648,470	8,135,368	1,164,547
Boston and Charlestown	94,506	18,972	102,923	21,068
New York	138,778,365	20,227,289	139,412,476	18,822,914
Philadelphia	43,095,432	5,243,542	29,468,223	3,587,246
Galveston	552,276	114,154	268,076	51,859
Other districts	13,002,566	2,356,122	14,260,504	2,668,679
Total	207,639,092	29,608,549	191,647,570	26,316,313
RESIDUUM.				
Baltimore	....	....	1,424,281	42,894
Boston and Charlestown	2,505	263	105,550	4,780
New York	37,109,808	1,428,062	103,433,079	3,817,903
Philadelphia	20,220,194	742,123	18,622,616	846,572
Galveston	252	72	....	....
Other districts	369,539,614	8,955,331	579,923,095	14,512,101
Total	426,872,373	11,125,851	703,508,621	19,224,250
Grand total	2,136,465,721	149,316,409	2,240,033,652	139,900,587

RECAPITULATION BY KINDS.

Crude.....gallons	194,469,634	$8,448,294	124,735,553	$4,958,838
Naphtha.....do	188,043,379	28,091,608	209,692,655	25,288,414
Illuminating.....do	1,119,441,243	72,042,107	1,010,449,253	64,112,772
Lubricating and paraffin.....do	207,639,092	29,608,549	191,647,570	26,316,313
Residuum.....do	426,872,373	11,125,851	703,508,621	19,224,250
Total	2,136,465,721	149,316,409	2,240,033,652	139,900,587

RECAPITULATION BY PORTS, IN GALLONS.

Port.	1913		1914	
	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*	
Baltimore	12,318,194	$1,674,286	10,511,991	$1,270,919
Boston and Charlestown	250,355	39,488	326,901	40,224
New York	866,685,489	82,586,235	836,295,729	73,098,914
Philadelphia	315,651,519	23,224,428	214,873,867	16,250,167
Galveston	609,374	121,095	330,301	59,539
Other districts	940,950,790	41,670,877	1,177,694,863	49,180,824
Total	2,136,465,721	149,316,409	2,240,033,652	139,900,587

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 during 1913 and 1914:

Exports to foreign countries of crude and refined petroleum from all ports of Texas in calendar year 1913, by months.

Month.	Crude.			Naphtha.		Illuminating.	
	Quantity.		Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.	*Gallons.*		*Gallons.*		*Gallons.*	
January	17	730	$30	2,791	$437	4,692,255	$220,543
February	21,872	918,656	32,057	2,112,992	178,202	4,597,760	290,373
March				2,077	279	4,011,913	185,700
April				2,273,505	232,742	11,048,049	719,760
May	4,512	189,510	16,264	2,067,508	195,044	9,586,779	568,817
June				475,075	116,180	15,680,497	935,074
July	19	806	29	302,445	42,273	11,838,645	874,044
August	3,877	162,878	15,478	2,092,477	240,398	14,930,530	788,680
September	18,787	789,061	18,908	57,514	9,458	7,163,617	422,400
October	27	1,145	42	728,631	55,422	13,702,416	732,398
November	79,121	3,323,120	117,478	238,956	17,184	11,869,053	667,231
December	444	18,479	427	623,222	99,320	12,529,774	666,938
Total	128,676	5,404,385	200,713	10,977,193	1,186,939	121,651,288	7,071,958

Month.	Lubricating and paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
January	54,916	$10,506	8,107,199	$276,571	12,857,891	$508,087
February	132,820	27,328	4,353,404	154,865	12,115,632	682,825
March	40,234	7,435	7,285,601	246,283	11,339,825	439,697
April	111,551	23,090	3,570,363	124,962	17,003,468	1,100,554
May	54,009	11,089	7,958,931	266,266	19,856,737	1,057,480
June	396,467	79,789	10,963,638	391,176	27,515,677	1,522,219
July	2,749	795	9,178,753	312,925	21,323,398	1,230,066
August	168,617	33,809	11,350,660	369,235	28,705,162	1,447,600
September	47,663	9,720	8,247,131	286,940	16,304,986	747,426
October	142,510	28,295	10,953,119	357,261	25,527,821	1,173,418
November	17,771	4,279	7,918,435	261,329	23,367,335	1,067,501
December	212,193	45,584	12,570,033	424,959	25,953,701	1,237,228
Total	1,381,500	281,719	102,457,267	3,472,772	241,871,633	12,214,161

Exports to foreign countries of crude and refined petroleum from all ports of Texas in calendar year 1914, by months.

Month.	Crude.			Naphtha.		Illuminating.	
	Quantity.		Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.	*Gallons.*		*Gallons.*		*Gallons.*	
January	2,975	124,946	$2,498	281,266	$44,709	11,306,239	$628,121
February	20,297	852,460	20,515	2,389,942	246,791	9,276,028	544,841
March	2,905	122,034	9,411	111,435	17,859	9,054,878	514,687
April	52,436	2,202,299	66,068	342,906	56,226	17,161,547	865,621
May	18,402	772,883	25,182	2,378,472	242,480	16,857,239	845,170
June	34	1,428	73	2,480,388	250,073	11,473,866	692,155
July	32	1,333	60	3,352,098	357,887	18,904,691	999,182
August	3,012	126,526	9,811	2,231,057	251,553	8,817,860	590,988
September				3,014,517	329,572	15,697,843	866,674
October	3,111	130,673	9,920	5,984,086	514,747	8,282,410	508,099
November				1,880,282	189,119	8,813,710	406,322
December	5,588	234,685	8,214	1,797,207	180,768	4,607,927	249,989
Total	108,792	4,569,267	151,752	26,243,656	2,681,784	140,254,238	7,711,849

Exports to foreign countries of crude and refined petroleum from all ports of Texas in calendar year 1914, by months—Continued.

Month.	Lubricating and paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
January	23,088	$3,007	11,535,876	$374,668	23,271,415	$1,053,003
February	269,251	55,296	4,007,086	130,736	16,794,767	998,179
March	43,279	9,179	17,549,977	586,659	26,881,603	1,137,795
April	84,198	16,268	13,542,047	430,477	33,332,997	1,434,660
May	33,064	6,292	16,756,172	554,512	36,797,830	1,673,636
June	135,106	27,867	16,220,962	537,848	30,311,750	1,508,016
July	896,267	59,211	13,562,549	453,525	36,716,938	1,869,865
August	168,175	33,906	28,686,672	892,466	40,030,290	1,778,724
September	71,695	14,921	29,089,519	945,335	47,873,574	2,156,502
October	67,629	12,996	28,378,250	946,566	42,843,048	1,992,328
November	76,721	18,513	24,536,921	781,917	35,307,634	1,395,871
December	31,009	6,383	34,548,390	1,112,403	41,219,218	1,557,757
Total	1,899,482	263,839	238,414,421	7,747,112	411,381,064	18,556,336

Exports of crude and refined petroleum from Texas, by customs districts, in calendar year 1913.

Customs district.	Crude, including all natural oils.			Naphtha.		Illuminating.	
	Quantity.		Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.	*Gallons.*		*Gallons.*		*Gallons.*	
Laredo	203	8,513	$324	6,041	$994	17,927	$1,659
Galveston	494	20,770	1,503	35,911	5,346	165	20
Sabine	127,464	5,353,482	198,269	10,893,581	1,171,952	121,555,683	7,056,324
El Paso	....	....	....	19,825	3,959	23,249	2,604
Eagle Pass	515	21,620	617	21,835	4,688	54,264	11,351
Total	128,676	5,404,385	200,713	10,977,193	1,186,939	121,651,288	7,071,958

Customs district.	Lubricating and heavy paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
Laredo	22,480	$3,233	247	$50	55,208	$6,260
Galveston	552,276	114,154	252	72	609,374	121,095
Sabine	773,481	156,528	102,456,668	3,472,633	241,032,895	12,055,706
El Paso	11,228	2,807	....	....	54,302	9,370
Eagle Pass	22,035	4,997	100	17	119,854	21,670
Total	1,381,500	281,719	102,457,267	3,472,772	241,871,633	12,214,101

Exports of crude and refined petroleum from Texas, by customs districts, in calendar year 1914.

Customs district.	Crude, including all natural oils.			Naphtha.		Illuminating.	
	Quantity.		Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.	*Gallons.*		*Gallons.*		*Gallons.*	
Laredo				23,868	$2,767	247,648	$21,056
Galveston				42,225	5,555	20,000	2,125
Sabine	101,405	4,259,021	$141,408	25,995,937	2,649,973	139,442,092	7,617,942
El Paso	7,159	300,685	10,014	166,632	20,802	460,206	56,428
Eagle Pass	228	9,561	330	14,994	2,687	84,292	14,298
Total	108,792	4,569,267	151,752	26,243,656	2,681,784	140,254,238	7,711,849

Customs district.	Lubricating and heavy paraffin.		Residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
Laredo	2,819	$900			274,335	$24,723
Galveston	268,076	51,859			330,301	59,539
Sabine	1,496,736	178,586	238,414,421	$7,747,112	409,608,207	18,335,021
El Paso	105,937	26,241			1,033,460	113,485
Eagle Pass	25,914	6,253			134,761	23,568
Total	1,899,482	263,839	238,414,421	7,747,112	411,381,064	18,556,336

Exports of crude petroleum, including shipments to noncontiguous territories, from Pacific ports, 1912–1914, in barrels.

Customs district.	1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
From—						
Southern California	209,374	$181,024	294,327	$230,713	297,327	$236,622
Washington	985,244	1,043,653	1,475,823	1,281,185	103,775	88,741
Oregon			2	3	4	21
San Francisco	1,213,988	996,789	580,164	445,494	1,963,849	1,470,045
Total	2,408,606	2,221,466	2,350,316	1,957,395	2,364,955	1,795,429
To—						
Alaska	79,144	64,866	4,727	4,723	415,559	319,512
Brazil					36,524	49,500
Canada	973,170	1,030,508	1,471,098	1,276,465	83,434	72,646
Chile	144,003	86,405	98,000	73,500	173,119	131,250
China					41,667	21,000
Guatemala	45,000	27,000				
Hawaii	917,238	861,080	772,493	598,980	1,614,633	1,201,445
Mexico	10,874	8,424	3,827	3,213	18	72
Panama	239,000	142,800				
Salvador	42	49	12	12		
Other	135	334	159	502	1	4
Total	2,408,606	2,221,466	2,350,316	1,957,395	2,364,955	1,795,429

The following table exhibits the total marketed production of petroleum from 1905 to 1914, in barrels and in gallons, also the separate derivatives exported and their value, together with their sum and value:

Marketed quantity of petroleum produced in, and quantities and values of petroleum products exported from, the United States during each of the calendar years from 1905 to 1914, inclusive, in gallons.

Year.	Marketed production.		Exports.			
	Barrels of 42 gallons.	Gallons.	Mineral, crude (including all natural oils, without regard to gravity).		Mineral, refined or manufactured. Naphtha, benzine, gasoline, etc.	
			Quantity.	Value.	Quantity.	Value.
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	209,557,248	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	222,935,044	9,363,271,848	188,711,420	6,770,484	186,000,094	20,459,378
1913	248,446,230	10,434,741,660	194,469,634	8,448,294	188,043,379	28,091,608
1914	265,762,535	11,162,026,470	124,735,553	4,958,838	209,692,655	25,288,414

Year.	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.
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
1913	1,119,441,243	72,042,107	207,639,092	29,608,549	426,872,373	11,125,851	2,136,465,721	149,316,409
1914	1,010,449,253	64,112,772	191,647,570	26,316,313	703,508,621	19,224,250	2,240,033,652	139,900,587

EXPORTS BY FISCAL YEARS.

In the following table is given a statement showing the foreign markets for oil in the five fiscal years ending June 30, 1914:

Exports of petroleum in its various forms from the United States for the fiscal years 1910 to 1914, by countries and kinds.

Country and kind.	Year ending June 30—				
	1910	1911	1912	1913	1914
CRUDE.					
Europe:	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Belgium	3		54	131	65
France	311,607	520,092	880,808	584,092	719,166
Germany		417	275	238	45
Spain	230,744	276,588	224,561	307,202	288,716
United Kingdom		5	96,864	26,589	67
Other Europe			23,810	476	129,625
	542,354	797,102	1,226,372	918,728	1,137,684
North America:					
Mexico	981,019	580,913	541,728	384,260	354,771
Cuba	112,228	124,485	109,364	127,656	164,577
Dominion of Canada	933,858	1,244,306	1,817,256	2,969,525	1,269,623
Panama	633,283	927,572	668,688	107	25
Other North America	95,344	72,681	46,336	419	202
	2,755,732	2,949,957	3,183,372	3,481,967	1,789,198
South America	722,706	661,764	543,794	255,177	518,320
All other countries	731	481	1,471	2,293	42,354
Total crude	4,021,523	4,409,304	4,955,009	4,658,165	3,487,556
REFINED.					
Gasoline.[a]					
Europe:	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
France				3,494,604	19,608,286
Germany				1,942,746	6,033,675
Netherlands				4,007,592	7,150,000
United Kingdom				6,049,646	25,802,912
Other Europe				2,048,357	13,411,131
				17,542,945	72,006,004
North America				51,932,234	35,599,207
South America				8,652,143	29,274,936
Africa				1,614,794	4,832,810
Asia and Oceania				1,956,801	9,898,580
Total gasoline				81,698,917	151,611,537
Naphtha.					
Europe:					
France	6,583,437	8,570,396	25,626,916	16,491,593	5,737,733
Germany	11,394,253	7,668,059	15,317,517	12,926,229	318
Sweden	522,680	702,010	1,283,881	1,471,525	422,092
United Kingdom	16,924,159	28,332,440	26,820,738	13,426,820	7,022,218
Other Europe	12,419,372	20,487,537	30,877,612	22,046,570	11,531,420
	47,843,901	65,760,442	99,926,664	66,362,737	24,713,781
North America	17,320,657	24,173,133	35,213,601	4,118,900	6,385,876
West Indies	320,160	539,065	856,510	265,424	10,700
South America	5,785,161	11,047,387	18,933,132	15,360,440	1,921,796
Asia and Oceania	5,210,862	8,339,291	13,707,125	11,766,558	5,862,405
Africa	1,170,182	2,138,942	2,403,118	3,947,513	1,946,172
	29,807,022	46,237,818	71,113,486	35,458,835	16,126,949
Total naphtha	77,650,923	111,998,260	171,040,150	101,821,572	40,840,730

[a] Included with naphtha prior to 1913.

Exports of petroleum in its various forms from the United States for the fiscal years 1910 to 1914, by countries and kinds—Continued.

Country and kind.	Year ending June 30—				
	1910	1911	1912	1913	1914
Illuminating.					
Europe:	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
Belgium	41,287,412	51,194,876	47,032,277	58,881,411	56,404,169
Denmark	20,238,497	23,494,756	29,966,403	30,104,209	36,356,857
France	46,924,343	45,322,937	37,702,251	52,953,474	58,433,470
Germany	151,890,625	106,405,766	92,289,677	103,983,882	79,471,322
Italy	26,057,918	23,915,541	30,469,655	21,182,834	36,627,276
Netherlands	121,808,987	102,904,032	112,747,606	134,204,916	176,810,812
Sweden and Norway	37,187,417	43,055,097	39,681,488	43,376,319	55,875,802
United Kingdom	194,226,610	164,599,861	166,215,650	169,288,659	197,107,760
Portugal	5,751,226	3,958,728	6,710,191	6,640,313	7,806,059
Other Europe	4,191,054	3,952,915	7,180,070	5,633,149	5,924,137
	649,564,089	568,804,509	569,995,268	626,249,166	710,817,664
North America:					
British North America	10,201,902	11,257,460	15,605,516	18,226,258	16,706,848
Central America	2,590,238	3,413,245	2,494,184	4,086,746	3,480,445
Mexico	740,615	200,252	165,396	1,225,289	971,355
West Indies—					
British	3,002,377	3,164,058	3,538,767	3,184,152	3,834,965
Other	3,447,741	4,031,921	2,960,860	5,318,112	3,996,493
Other North America	669,073	836,597	911,203	1,004,131	945,457
	20,651,946	22,903,533	25,675,926	33,044,688	29,935,563
South America:					
Argentina	18,490,512	15,723,182	28,449,374	21,367,616	16,225,791
Brazil	29,874,870	30,846,695	37,491,101	32,828,176	32,275,552
Chile	8,059,982	7,123,137	7,361,898	7,961,224	9,125,953
Uruguay	7,009,158	6,140,675	6,675,489	8,561,419	7,223,710
Venezuela	1,444,847	1,449,897	1,511,255	1,552,294	1,705,572
Other South America	3,546,848	3,270,171	2,961,441	2,790,195	3,661,199
	68,426,217	64,553,757	84,450,558	75,060,924	70,217,777
Asia:					
Chinese Empire	65,817,980	107,167,449	68,164,997	79,015,610	86,006,918
Hongkong	12,692,037	12,074,776	14,794,710	7,767,090	20,093,317
East Indies—					
British	37,545,823	51,735,360	57,390,564	36,171,967	37,592,984
Dutch	12,572,121	19,235,260	14,370,190	13,417,693	20,275,280
Other East Indies	4,707,640	6,185,050	7,246,805	4,700,340	1,552,700
Japan	58,067,925	57,750,354	109,215,587	85,399,913	90,671,843
Other Asia	11,596,113	19,887,195	15,101,190	22,891,700	16,239,680
	202,999,639	274,035,444	286,284,043	249,364,313	272,432,722
Oceania:					
British	26,452,025	29,478,944	32,077,747	25,635,287	29,109,477
Philippine Islands	6,265,167	9,887,437	14,054,707	13,073,752	10,451,468
Other Oceania	10,880	17,084	18,417	44,904	118,483
	32,728,072	39,383,465	46,150,871	38,753,943	39,679,428
British Africa	18,135,570	16,604,729	14,961,057	14,449,160	16,674,949
Other Africa	12,522,003	36,025,605	16,532,125	11,972,103	17,525,207
	30,657,573	52,630,334	31,493,182	26,421,263	34,200,156
Total illuminating	1,005,027,536	1,022,311,042	1,044,049,848	1,048,894,297	1,157,283,310
Lubricating.					
Europe:					
Belgium	10,671,107	10,229,815	11,806,155	13,782,639	10,919,766
France	20,653,620	19,449,734	25,575,537	26,136,545	23,413,014
Germany	20,533,022	20,450,031	24,308,176	26,418,269	22,596,497
Italy	7,606,839	8,323,598	9,283,969	7,637,394	8,072,548
Netherlands	9,571,203	10,488,285	11,396,618	12,174,926	13,987,320
United Kingdom	54,748,608	53,573,129	62,886,561	61,412,394	57,611,048
Other Europe	7,986,759	9,026,568	11,189,030	13,243,346	11,605,547
	131,771,158	131,541,160	156,446,046	160,805,513	148,205,740
North America	6,095,575	7,064,255	7,587,478	9,846,385	9,109,497
West Indies	1,380,979	1,505,270	1,717,456	1,881,707	1,992,112
South America	7,494,903	7,843,115	10,162,069	11,504,006	10,098.789
Asia and Oceania	17,047,643	18,752,639	20,859,871	23,248,022	21,320,931
Africa	6,640,019	6,936,056	5,352,277	6,385,866	6,157,627
	38,659,119	42,101,335	45,679,151	52,865,986	48,678,956
Total lubricating	170,430,277	173,642,495	202,125,197	213,671,499	196,884,696

Exports of petroleum in its various forms from the United States for the fiscal years 1910 to 1914, by countries and kinds—Continued.

Country and kind.	Year ending June 30—				
	1910	1911	1912	1913	1914
Gas and fuel oil.[a]	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*
Europe				152,327,387	248,198,540
North America				100,101,349	141,575,840
South America				66,883,260	81,203,535
Asia					238,809
Oceania				38,213	58,575
Africa				1,179,716	3,867,906
Total gas and fuel				320,529,925	475,143,205
Residuum.					
Europe	112,792,362	102,430,883	111,321,764	146,037	510
North America	10,742,492	15,708,381	30,443,892	2,169,607	24,462,560
All other countries	520,409	5,258,924	26,573,822	25,197,924	88,907,175
Total residuum	124,055,263	123,398,188	168,339,478	27,513,568	113,370,245

[a] Included with residuum prior to 1913.

PRICES.

The exports of kerosene given in the preceding tables are the dominant factor in the fluctuation of New York and Philadelphia prices for that product. The following quotations obtained from New York trade journals are therefore for oil with a flash of 70° C., by Abel closed cup; that is, for the principal brand for export. The decline in price was continuous in 1914.

Weekly prices of refined petroleum in the United States in 1914 at New York, in cents per gallon.

Week ending—	Refined oil.			Week ending—	Refined oil.		
	Bulk.	Cases.	Barrels.		Bulk.	Cases.	Barrels.
Jan. 3	5.25	11.25	8.75	July 4	5.00	11.00	8.50
10	5.25	11.25	8.75	11	4.90	10.90	8.40
17	5.25	11.25	8.75	18	4.75	10.75	8.25
24	5.25	11.25	8.75	25	4.75	10.75	8.25
31	5.25	11.25	8.75	Aug. 1	4.75	10.75	8.25
Feb. 7	5.25	11.25	8.75	8	4.75	10.75	8.25
14	5.25	11.25	8.75	15	4.75	10.75	8.25
21	5.25	11.25	8.75	22	4.75	10.75	8.25
28	5.25	11.25	8.75	29	4.75	10.75	8.25
Mar. 7	5.25	11.25	8.75	Sept. 5	4.75	10.75	8.25
14	5.25	11.25	8.75	12	4.75	10.75	8.25
21	5.25	11.25	8.75	19	4.75	10.75	8.25
28	5.25	11.25	8.75	26	4.75	10.75	8.25
Apr. 4	5.25	11.25	8.75	Oct. 3	4.75	10.75	8.25
11	5.25	11.25	8.75	10	4.60	10.60	8.10
18	5.25	11.25	8.75	17	4.50	10.50	8.00
25	5.25	11.25	8.75	24	4.50	10.50	8.00
May 2	5.25	11.25	8.75	31	4.50	10.50	8.00
9	5.25	11.25	8.75	Nov. 7	4.50	10.50	8.00
16	5.10	11.10	8.60	14	4.50	10.50	8.00
23	5.10	11.10	8.60	21	4.50	10.50	8.00
30	5.00	11.00	8.50	28	4.50	10.50	8.00
June 6	5.00	11.00	8.50	Dec. 5	4.50	10.50	8.00
13	5.00	11.00	8.50	12	4.50	10.50	8.00
20	5.00	11.00	8.50	19	4.50	10.50	8.00
27	5.00	11.00	8.50	26	4.50	10.50	8.00

Wholesale prices of refined petroleum at New York at the first of each month, 1910–1914.

Month.	1910			1911			1912			1913			1914		
	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	1	8.05	10.45	7	7.40	8.90	6	7.50	9.00	4	8.50	10.80	3	8.75	11.25
February	5	7.90	10.30	4	7.40	8.90	3	8.10	9.90	1	8.50	10.80	7	8.75	11.25
March	5	7.90	10.30	4	7.40	8.90	2	8.10	9.90	1	8.50	10.80	7	8.75	11.25
April	2	7.90	10.30	1	7.40	8.90	6	8.20	10.10	5	8.50	10.80	4	8.75	11.25
May	7	7.75	10.15	6	7.25	8.75	4	8.60	10.50	3	8.50	10.80	2	8.75	11.25
June	4	7.75	10.15	3	7.25	8.75	1	8.60	10.50	7	8.70	11.00	6	8.50	11.00
July	2	7.65	10.05	1	7.25	8.75	6	8.60	10.50	5	8.70	11.00	4	8.50	11.00
August	6	7.65	10.05	5	7.25	8.75	3	8.35	10.25	2	8.70	11.00	1	8.25	10.75
September	3	7.50	9.90	2	7.25	8.75	7	8.35	10.25	6	8.70	11.00	5	8.25	10.75
October	1	7.50	9.90	7	7.35	8.85	5	8.35	10.25	4	8.70	11.00	3	8.25	10.75
November	5	7.40	8.90	4	7.35	8.85	2	8.35	10.25	1	8.75	11.75	7	8.00	10.50
December	3	7.40	8.90	2	7.35	8.85	7	8.50	10.40	6	8.75	11.75	5	8.00	10.50

Monthly average prices, in cents per gallon, of petroleum exported from the United States in bulk, 1910–1914.

Month.	1910		1911		1912		1913		1914	
	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.	Crude.	Refined, illuminating.
January	2.9	6.5	3.1	5.3	3.3	5.6	4.3	6.3	6.1	6.7
February	2.7	6.0	3.5	5.3	2.5	5.6	3.0	6.4	4.1	6.7
March	2.7	5.9	2.4	5.6	3.2	5.9	3.9	6.2	6.1	6.9
April	3.4	6.1	2.8	5.5	3.7	5.9	3.6	7.0	4.1	6.6
May	3.0	6.1	2.8	5.6	4.0	6.4	4.2	6.7	4.2	6.4
June	3.6	6.0	3.1	5.4	3.6	6.4	4.4	6.8	3.9	6.3
July	2.5	6.3	2.8	5.4	3.3	6.2	4.7	6.6	3.9	6.1
August	2.3	6.1	3.2	5.6	3.4	6.2	4.7	6.2	3.2	6.3
September	3.4	5.9	2.4	5.4	3.9	6.3	4.8	6.1	3.8	6.5
October	3.0	5.7	3.6	5.5	3.7	5.9	4.4	6.3	3.5	6.4
November	3.2	5.0	3.9	5.7	4.1	5.8	4.8	6.6	3.4	5.6
December	2.9	5.5	3.2	5.4	4.0	6.0	5.1	6.3	3.2	5.7

FOREIGN OIL FIELDS.

The world-wide activity in the search for petroleum deposits of commercial importance which characterized the year 1913 continued unabated during the early part of 1914. During the latter part of the year development in proved areas was greatly curtailed and exploration work postponed on account of the European war and the enormous overproduction of oil in the United States and Mexico.

NORTH AMERICA.

CANADA.

PRODUCTION.

The steady decline that has characterized the production of petroleum in Canada since the record output of 1907 was maintained in 1914, statistics compiled by J. C. Waddell, of Petrolia, supervisor of bounties for the Province of Ontario, showing a decrease of 14,057 barrels from the production in 1913.

As usual, Ontario furnished the bulk of the production. With the exception of Belle River, Essex County, which registered an increase, all the contributing fields in both Ontario and New Brunswick recorded slight declines. The increase in output from the Belle River field was due to the fact that, although this shallow sand field was opened in 1913 it did not receive its greatest development until 1914.

The following table records the total production of petroleum in Canada from 1905 to 1914, inclusive, as reported by the geological survey of Canada:

Production of petroleum in Canada, 1905–1914.

Year.	Quantity.	Value.	Average price per barrel.
	Barrels.[a]		
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	243,336	345,050	1.418
1913	228,080	406,439	1.782
1914	[b] 214,805	343,124	1.590

[a] Barrels of 35 imperial gallons. The Canadian barrel of 35 imperial gallons is the practical equivalent of the United States barrel of 42 gallons, the difference being less than 0.03 per cent.
[b] Includes 387 barrels from Alberta.

Production of petroleum in Ontario and New Brunswick, 1910–1914, by districts, in barrels.[a]

District.	1910	1911	1912	1913	1914
Bothwell	36,998	35,244	34,486	34,349	33,961
Dutton	7,752	6,732	4,335	4,610	2,190
Lambton	205,456	184,450	150,272	155,747	154,186
Leamington	141	13,501	7,115	4,172	2,437
Onondaga (Brant County)	1,005				
Tilbury and Romney	63,058	48,708	44,727	26,824	18,530
Belle River	....	....	....	464	1,191
Total Ontario	314,410	288,635	240,935	226,166	212,495
New Brunswick	1,485	2,461	2,679	2,111	1,725
Total Canada	315,895	291,096	243,614	228,277	214,220

[a] Reported by supervisor of bounties at Petrolia.

PRICES.

Although record prices were received for the Canadian product during the early months, a gradual decline reflecting the conditions of overproduction in the United States characterized the market throughout the remainder of the year 1914.

The average monthly prices per barrel from 1910 to 1914, inclusive, are given in the following table:

Average monthly prices per barrel for crude oil at Petrolia, 1910–1914.

Month.	1910	1911	1912	1913	1914	Month.	1910	1911	1912	1913	1914
January	$1.24	$1.22	$1.26	$1.681	$1.89	August	$1.22	$1.22	$1.44	$1.790	$1.47
February	1.24	1.22	1.35	1.738	1.89	September	1.22	1.24	1.44	1.790	1.45
March	1.24	1.22	1.38	1.761	1.89	October	1.22	1.24	1.44	1.790	1.41
April	1.24	1.22	1.38	1.780	1.80	November	1.22	1.24	1.48	1.831	1.36
May	1.24	1.22	1.40	1.790	1.60	December	1.22	1.24	1.59	1.856	1.36
June	1.23	1.22	1.42	1.790	1.58						
July	1.22	1.22	1.42	1.790	1.56	The year	1.23	1.22$\frac{2}{3}$	1.42	1.782	1.59

DEVELOPMENT.

Though considerable effort was made to extend the boundaries of the productive areas in Ontario and New Brunswick, new production sufficient to offset the decline in the older wells was obtained, as previously stated, only in the Belle River field. A number of good gas wells were found in the Tilbury, Ontario, field and considerable gas production was obtained in the Albert field, New Brunswick; but attempts to prevent the declining output of oil were unsuccessful.

In the western provinces wildcat activity, with apparently undue interest centered in the vicinity of Calgary, Alberta, was the feature of the year. The discovery of small quantities of high-grade petroleum at depths of 1,562 and 2,700 feet in the Dingman well, southwest of Calgary, created a hysterical rush for mining locations in the area. Drilling was commenced at a number of points southwest and northwest of Calgary and, though proving the presence of small quantities of heavy oil in certain areas of favorable structure, it failed to demonstrate the true extent or value of the field before the end of the year. In northern Alberta the lack of transportation facilities retarded the development of the promising strikes near Fort McKay of heavy oil, suitable for fuel.

In British Columbia encouraging oil indications in the valley of Flathead River, in the vicinity of Revelstoke, Kootenai County, and at Pitt Meadows, New Westminster County, near Vancouver, resulted in more or less prospect drilling.

In Saskatchewan interest was centered at Moose Jaw, where good oil showings were found, but included projects at Regina, Battleford, and Saskatoon, and in Souris Valley, where oil seepages occur near Roche Percee.

MEXICO.

Early in 1914 field operations in the oil districts of Mexico were very active—more so in the northern fields at Panuco and Topila than in the southern fields, where work was interrupted by the belligerent political factions. The bringing in of an enormous gusher by the Corona Oil Co. (Dutch-Shell) at Panuco on January 11, became the signal for a pronounced increase of work in that field, where, as in the southern fields, the lack of adequate storage facilities tended to hamper developments to a considerable degree. The initial flow of the Corona well (No. 5 Panuco) was estimated at 100,000 barrels a day, but lack of storage facilities compelled the owners to pinch it down to 600 barrels a day as rapidly as the pressure would permit. A number of other gushers of 1,000 to 30,000 barrels capacity completed in the early months of the year further justified the activity centered at Panuco.

Work in all districts was abruptly curtailed and in many places terminated by the exodus of operators and workmen beginning in April. Although the subsequent activities of the warring factions resulted in no great damage to the petroleum interests, the resulting conditions of unstable government prevented the resumption of more than nominal activity in the oil fields up to the end of the year. Late in the year the resumption of local oil consumption by the Mexican railroads and mining industries served to revive activity to some extent at Panuco and Topila.

Of more than passing interest was the fire which raged about the famous Potrero del Llano No. 4 well of the Mexican Eagle Oil Co. during the later part of the year. Seepages of oil escaping to the surface after the well had been capped were ignited by lightning on August 14, and up to the close of the year the fire, though confined to a small area, had defied all efforts to extinguish it.

During the year the Panuco field was extended to the southwest and the Topila field to the west. Wildcatting at Rancho el Chapopote revealed promising indications of an oil field near Campeche, State of Campeche. An outlet for the production of the Mexican Eagle Oil Co. in Los Naranjos field was provided by an 8-inch pipe line from the field to San Diego, where connection was made with the line from Tanhuijo to Tampico. An 8-inch line was also completed by the Penn Mexican Fuel Co. from its producing wells at El Alamo to Tuxpam. The topping plant of the Mexican Eagle Oil Co., at Tampico, was completed and put in operation in August. A 4-still topping plant was also installed at this port by the Standard Oil Co. Construction work was started by the Tampico & Panuco Valley Tramways Co. on a 25-mile railroad connecting Tampico with the Topila oil field.

PRODUCTION.

From the best information available the production of petroleum in Mexico from 1907 to 1914 is as follows:

Production of petroleum in Mexico, 1907–1914.

1907	barrels..	1,717,690
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
1913	do....	25,902,439
1914	do....	21,188,427

IMPORTS.

The following table shows the quantity of crude petroleum, naphtha, and illuminating oil imported from the United States into Mexico in 1912, 1913, and 1914:

Imports of petroleum and specified products into Mexico from the United States, years ending June 30, 1912, 1913, and 1914.

Kind of oil.	1912		1913		1914	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
Crude	22,752,588	$884,320	16,138,930	$590,098	14,900,388	$532,780
Naphtha	314,667	37,373	168,809	27,187	168,809	27,187
Illuminating	165,396	20,607	1,225,289	95,668	971,355	153,108
Lubricating	1,060,745	194,270	889,577	211,729	791,556	186,134
Residuum	118,758	6,984	15,572	706	1,475,242	42,210
Total	24,412,154	1,143,554	18,438,177	925,388	18,307,350	941,419

Quantity and value of mineral oils imported into Mexico from the United States, 1905–1914.

Year ending June 30—	Mineral.					
	Crude.		Refined, including residuum.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
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
1913	16,138,930	590,098	2,299,247	335,290	18,438,177	925,388
1914	14,900,388	532,780	3,406,962	408,629	18,307,350	941,419

CENTRAL AMERICA AND THE WEST INDIES.

HONDURAS.

Examination of the indications of petroleum in Honduras resulted in the formation in 1914 of the Honduras Oil Co., financed by local capital, which is reported to have obtained concessions in the departments of Atlantido, Yoro, and Comayagua.

SALVADOR.

By legislative decree the Government of Salvador granted in 1914 to Alfredo Leon Schlesinger, a native of Austria-Hungary, the exclusive privilege of conducting geologic studies of the mineral resources of San Salvador for one year and of exploiting them for a period of 30 years, subject to a 25 per cent royalty and to the reversion of all property to the Government at the end of the concession period.

CUBA.

Drilling for oil in Cuba continued without encouraging results in the vicinity of Cardenas, Matanzas Province.

BARBADOS.

Proposed tests of promising structure and of indications of oil in Barbados were postponed by the failure of the legislature to enact laws permitting such exploration.

TRINIDAD.

The impetus given to developments of petroleum in Trinidad by the action of the British Admiralty in purchasing a portion of its oil supply from that source resulted in a record output of petroleum in 1914, compared with previous years. The first shipment of Trinidad oil for the British Admiralty was made on June 20, 1914, when the tanker Aragoz was loaded at Point Fortin with 6,400 tons of oil consigned to the admiralty depot at Thameshaven.

Development work during the year 1914 was attended with such success that available tankage was found wholly inadequate, and many wells were shut in pending the construction of additional storage.

The following excerpts from a paper read before the Institution of Petroleum Technologists by Professor John Cadman, of Birmingham University, who examined the Trinidad fields in 1914 at the instance of the British Government, indicate the conditions of occurrence of oil on the island:

The island of Trinidad is topographically divided by three ranges of hills, running from east to west. The northern range, following the north coast line of the island, is composed of metamorphosed rock of so far undetermined age. The central range, stretching from Manzanilla Point to San Fernando, consists chiefly of rocks of Lower Tertiary age, with isolated exposures of Cretaceous. The southern range, traversing the southern coast, is of Lower Tertiary origin, although probably a little higher in the horizon than the rocks composing the central range, with here and there pre-Tertiary inliers projecting through the newer rocks. It is estimated that the thickness of the Tertiary rocks is 6,000 to 6,500 feet, consisting chiefly of clays, sands, and marls, with oil rocks recognized at three main horizons.

The upper oil horizon is known as the La Brea sands, which is exposed in the neighborhood of La Brea, and here gives rise to the pitch lake deposit for which Trinidad has so long been famous. Some 1,400 to 1,500 feet below this sand or group of sands appears the second oil-bearing belt, termed by Mr. Cunningham Craig the Rio Blanco oil sand, and at a further depth of 3,600 to 4,000 feet approaching the base of the Tertiary, is to be found the Galeota petroliferous group. A lower horizon is said to have been isolated in the neighborhood of Tabaquita, but it is questionable whether the bed will not be found to be a member of the Galeota group when more detailed mapping has been resorted to.

Part of the area lying to the south of the central range has been geologically mapped, and its structure more or less worked out. There is, however, much detailed work still to be undertaken before areas can be selected for test drilling. Within this southern area lie the zones which have so far been examined and in which the development is progressing.

To the north of the central range is a tract of flat-lying country covered with an alluvium, and it is not improbable that light oils similar to the Tabaquita oil may be discovered in this region. No work has, however, been done in this locality.

The oils so far recovered vary widely in composition, with asphaltic base of specific gravity 0.975, containing 4 per cent of petroleum spirit, to an oil of 0.810 specific gravity containing 40 per cent of petroleum spirit, the heavier oil being confined to the upper horizons, while the lighter oil appears to be confined to the lower sands.

Although refineries have been constructed on several of the fields, it is only within a comparatively recent period that any attempt has been made to refine Trinidad oil in the colony, and no refinery has yet been constructed to deal with the product on a large scale. This delay has naturally arisen through lack of production. As the production is now assured, the refining of oil in the colony will shortly be accomplished with more ambitious dimensions.

Similarly, with the delay in refining the construction of pipe lines for the conveyance of the oil has not, to any extent, been established. Facilities are available in the nature of legislation to enable pipe lines to be constructed for the transport of a company's production, and one company has undertaken common-carrier obligations.

Conclusions.—Whilst the rate of development has not been as rapid as one might have expected, much good work has been accomplished, many difficulties have been overcome, many new problems have been solved, and sufficient work has been accomplished to demonstrate unquestionably the potential value of Trinidad as a source of petroleum.

With the activity now being pursued by such companies as the Trinidad Lake Petroleum Co., the United British Oilfields (Ltd.), the United British West India Petroleum Syndicate, the Trinidad Central, the Cruse Syndicate, the Venezuelan Oil Exploration Co., and Messrs. Stollmeyer, who are all producing oil at the moment, the future of the oil fields of Trinidad is assured.

The output of petroleum in Trinidad for the last seven years is shown in the following table:

Production of petroleum in Trinidad, 1908–1914, in barrels of 42 gallons.

1908 (estimated)	169
1909 (estimated)	57,143
1910 (estimated)	142,857
1911	285,307
1912	436,805
1913	503,616
1914	643,533

SOUTH AMERICA.

COLOMBIA.

The discovery of petroleum and natural gas at Tubara, tributary to the important Caribbean seaport of Barranquilla, indicates the possible development of an oil field in close proximity to the Panama Canal. The field is still in the prospecting stage, but the import of considerable drilling machinery and equipment during 1914 implies that prospecting has resulted favorably. In the Loico district near Sinn River an American company is reported to be making thorough tests.

ECUADOR.

Investigations of the indications of petroleum along the coast and in the mountains near Quito by a Dutch syndicate suggest the possible development of Ecuador's resources of petroleum in the near future.

PERU.

The output of petroleum from the developed fields of Peru in 1914 registered a slight decline from the record production of 1913. This decline is ascribed chiefly to the curtailment of activity following the outbreak of the European war and the consequent inability of the producing companies to procure adequate tankers for transporting the oil. In the Zorritos field storage was taxed to the limit and additional tankage was constructed. The productive area of the Negritos field received substantial additions both on the north and on the south, the southern extension being southwest of Lagunitos, where a number of good gas wells were obtained. With an abundant supply of gas available, the use of oil fuel in the fields is decreasing.

The location of the Peruvian fields at no great distance from the Panama Canal is an important one, and the demand for their product will doubtless increase rapidly.

At Callao and Payta large storage tanks have been erected and equipped with all the modern facilities for transferring oil to steamers in a rapid and economical manner. Similar installations have been provided by the Peruvian oil companies in the ports of Chile.

By acquiring a controlling interest in the Lagunitos Oil Co. (Ltd.), the Imperial Oil Co., of Canada, notably increased its holdings during the year.

PRODUCTION.

The production of petroleum in Peru in the last 10 years is shown in the following tables:

Production of petroleum in Peru, 1905–1914, in tons and barrels.

Year.	Production.	
	Metric tons.[a]	Barrels.
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
1913	284,434	2,133,261
1914	255,707	1,917,802

[a] One metric ton=7.5 barrels.

Production of petroleum in Peru, 1905–1914, by districts, in barrels.

Year.	Lobitos.	Negritos.	Zorritos.	Lake Titicaca (Huancane).	Lagunitos.	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
1913	557,355	1,136,490	83,343	[a]10,000	346,073	2,133,261
1914	504,743	1,032,210	88,136	[a]10,000	282,713	1,917,802

[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 1914, inclusive:

Production, shipments, and stocks of petroleum and number of producing wells in Lobitos oil field, 1905–1914.

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			105
1913	74,314	557,355			110
1914	67,299	504,743			

[a] Estimated.

The following table gives the production of petroleum in the Negritos oil field of Peru from 1905 to 1914, in tons and barrels:

Production of petroleum in Negritos oil field, Peru, 1905–1914.

Year.	Production.	
	Metric tons.	Barrels.
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
1913	151,532	1,136,490
1914	137,628	1,032,210

Production of petroleum in Zorritos oil field of Peru, 1905–1914, in gallons.

Year.	Crude petroleum.	Refined.[a]	Gasoline.	Benzine.
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	2,700,000	650,000		200,000
1912	3,280,000	476,620	226,440	
1913	3,500,424	565,320	324,000	
1914	3,701,718	482,850	277,440	

[a] Kerosene.

BOLIVIA.

Geologic investigations in the area between the Incahuasi and the Aguaraygua ranges have shown the presence of a considerable area of prospective oil land south of Sucre, and the reported acquisition of petroleum concessions in that region indicates that the area will be thoroughly tested.

CHILE.

Several companies were organized in Santiago to test certain districts of Chile, in which surface indications of petroleum have been known for many years.

ARGENTINA.

In the Comodoro Rivadavia oil district, in southern Argentina, 5,000 hectares (12,355 acres) of land has been reserved by the Government, of which 350 hectares (865 acres) is being exploited by the State. Legislation providing for the exploitation of the petroleum deposits in Comodoro Rivadavia is now under consideration by the Argentine Congress.

In April, 1915, it was reported that the reserved area contained 8 active wells, 3 undergoing repairs, and 9 drilling. Adjacent to this development on the northeast, west, and southwest, a number of privately owned wells have been put down. In April, 1915, the total number of private wells was stated to be 11, of which number only 3 had been completed. Drilling in the Comodoro Rivadavia district is difficult on account of the copious flows of water encountered.

VENEZUELA.

Early in 1914 impetus was given to petroleum development in Venezuela by the discovery of oil at a shallow depth in a well drilled by the Caribbean Oil Co., an American corporation, on the eastern coast of Lake Maracaibo near San Timoteo, Sucre district. The discovery well is said to have produced at the rate of 10 barrels of oil a day, the product being reported as high-grade oil suitable for lubrication. The Venezuela Oil Concessions (Ltd.), an English company, holding properties in Bolivar and Maracaibo districts, also took steps looking to the active development of its concessions, as did the Colon Development Co. (Ltd.), and the Bermudez Co. holding concessions in adjacent districts. As in other prospective oil fields in South America activity was greatly restricted after the outbreak of the European war.

EURASIA.

RUSSIA.

The net result of petroleum operations in Russia in 1914 was an increase in output of a little more than 4,000,000 barrels, representing an increase of nearly 7 per cent compared with 1913. On the Apsheron Peninsula the principal oil fields in the vicinity of Baku recorded a steady decline, with the exception of Balakhani, which increased its output to a moderate degree. Development in these fields was retarded by a labor strike which lasted from June 11 to July 31, and was followed immediately by the mobilization of the Russian Army, which involved a great number of the oil-field workers as well as hampered transportation facilities. Nevertheless, production in the fields made substantial headway during the latter part of the year. A total of 127 dessiatines (343 acres) in the Balakhani, Sabunchi, Romani, and Bibi-Eibat fields was leased for exploitation by the Russian Government.

At Grosny, on the north flank of the Caucasus, active drilling and extensions of the productive area resulted in a record output, 34 per cent greater than that of the previous year. Farther to the west, at Maikop, a slight decrease in the usual small production was noted in spite of significant oil strikes in the Khadijenskaia district, northwest of the developed portion of the field.

In the relatively new Ural-Emba or Ural-Caspian area lying north and east of the Caspian Sea the Dos Sor field attracted the greatest attention, though minor activity, chiefly prospecting, was reported at some 40 other localities throughout an area of 300 square miles east of Ural River. As a result the output of this new district was more than doubled during the year and amounted in 1914 to slightly more than 2,000,000 barrels. A refinery at Bolshaia Rakusha, near Guriev, commenced operations in January.

The production of the island of Tcheleken in the Caspian Sea recorded a moderate decline in 1914.

To the east of the Caspian Sea in the Ferghana Valley, Turkestan, developments were nominal. The combined output of the old Tchimion field and the new Sel-Rokh field aggregated about 215,000 barrels in 1914, as compared with approximately 169,000 barrels in 1913, the production being about evenly divided between the two fields in 1914.

The following tables give statistics relating to the petroleum industry in Russia:

Production of petroleum in Russia, 1905–1914, by fields.

Year.	Baku.		Grosny.		Maikop.	
	Poods.[a]	Barrels of 42 gallons.	Poods.	Barrels of 42 gallons.	Poods.	Barrels of 42 gallons.
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
1913	404,538,000	48,563,985	73,659,265	8,842,649	4,802,926	576,582
1914	360,372,031	43,261,948	98,445,187	11,818,150	3,956,906	475,019

Year.	Other.		Total.	
	Poods.	Barrels of 42 gallons.	Poods.	Barrels of 42 gallons.
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
1913	[g] 40,410,000	4,851,140	523,410,191	62,834,356
1914	[h] 95,506,820	11,465,405	558,280,944	67,020,522

[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 Berekei and Tchimion oil fields.

[c] Produced in Surakhany.

[d] Includes as follows: Surakhany, 10,613,909 poods; Sviatoi, 1,392,306 poods; Ferghana, 610,500 poods; and Taman, 91,575 poods.

[e] Includes as follows: Surakhany, 19,896,524 poods; Sviatoi, 2,515,363 poods; Tcheleken, 10,205,740 poods; and Ferghana, 610,500 poods; other districts, 648,158 poods.

[f] Includes as follows: Surakhany, 43,900,000 poods; Sviatoi, 3,300,000 poods; Tcheleken, 13,300,000 poods; and Ferghana, 2,200,000 poods.

Includes as follows: Sviatoi, 4,733,000 poods; Balakhani, 13,860,000 poods; Berekei, 6,000,000 poods; Emba, 7,182,000 poods; Ferghana, 1,406,000 poods; and Tcheleken, 7,229,000 poods.

[h] Includes as follows: Surakhany, 5,874,820 poods; Sviatoi, 5,883,000 poods; Schucany, 6,988,000 poods; Balakhani, 7,253,000 poods; Berekei, 35,000 poods; Emba, 16,675,000 poods; Tcheleken, 5,009,000 poods; Ferghana, 1,789,000 poods.

Total production of crude petroleum on the Apsheron Peninsula and shipments of petroleum products from Baku, 1905–1914, in barrels.

Year.	Production.	Shipments from Baku.					
		Illuminating.	Lubricating.	Other products.	Residuum.	Crude oil.	Total.
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
1913	48,563,985	10,380,813	2,326,931	1,196,169	22,227,408	6,974,106	43,105,427
1914	43,261,949	8,511,556	1,331,818	656,094	19,438,241	6,883,805	36,821,514

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, 1905–1914, in barrels.

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
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
1913	7,878,872	19,273,469	8,467,107	11,186,074	1,758,463	48,563,985
1914	8,049,290	17,225,876	6,642,357	8,662,073	2,682,353	43,261,949

a Other. b Includes 1,283,599 barrels in other districts. c 1910.

Production of petroleum from pumping and flowing wells in the Baku field, 1905–1914, by districts, in barrels.

Year.	Balakhani.	Sabunchi.	Romani.	Bibi-Eibat.	Binagadi.	Total.
PUMPING.						
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
1913	7,878,872	19,273,469	8,282,713	10,587,635	1,638,415	47,661,104
1914	8,049,290	17,225,876	6,148,214	7,872,254	2,142,137	41,437,771
FLOWING.						
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
1913	....	....	184,394	598,439	120,048	902,881
1914	....	....	494,143	789,819	540,216	1,824,178

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, 1913 and 1914.

Condition of wells.	Balakhani.		Sabunchi.		Romani.		Bibi-Eibat.		Total.	
	1913	1914	1913	1914	1913	1914	1913	1914	1913	1914
Completed	68	74	112	128	23	26	22	11	225	239
Producing, Dec. 31	934	1,053	1,288	1,361	290	287	331	289	2,843	2,990
Trial pumping, Dec. 31	12	6	25	20	3	1	1	10	41	37
Drilling, Dec. 31	73	61	107	61	40	60	66	58	286	240
Drilling deeper, Dec. 31	20	19	22	29	13	7	17	22	72	77
Cleaning out and repairing	32	42	107	86	61	51	57	58	257	237
Standing idle	394	360	616	738	231	275	157	207	1,398	1,580
Rigs up, ready for drilling	45	38	75	60	8	12	12	17	140	127
New wells sunk	100	64	143	104	30	34	46	13	319	215
Length of wells drilled, in feet	115,269	89,873	198,184	154,364	56,593	60,011	83,902	59,843	453,950	364,091

The stock of petroleum and petroleum products in the Baku field at the close of the year from 1910 to 1914 were as follows:

Stocks of petroleum in Baku, Dec. 31, 1910–1914, in barrels.

	1910	1911	1912	1913	1914
At oil wells: Crude	938,391	906,625	952,676	1,068,427	1,099,851
At refineries:					
Crude	3,073,853	1,887,270	2,551,577	2,081,428	3,587,960
Illuminating	947,024	1,028,885	1,268,626	1,144,663	1,401,197
Lubricating	272,017	272,170	260,397	260,599	253,127
Residuals	5,647,526	3,195,771	3,396,775	2,817,656	4,625,735
Other products	224,240	306,825	443,643	374,909	446,274
Total	11,103,051	7,597,546	8,873,694	7,747,682	11.414,144

Grosny field.—The following tables show the production in the Grosny field from 1910 to 1914:

Production of petroleum in the Grosny oil field, 1910–1914, in poods and barrels.

Year.	Pumping.		Flowing.		Total.	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*
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
1913	68,643,505	8,240,517	5,015,760	602,132	73,659,265	8,842,649
1914	85,773,447	10,296,932	12,671,740	1,521,217	98,445,187	11,818,150

Well record in the Grosny field in 1910–1914.

Year.	Number of plots.		Total wells.	Producing, Dec. 31.	Boring and deepening, Dec. 31.	Average depth of wells.	Total length of wells drilled in the year.
	Producing.	Being exploited.					
						Feet.	*Feet.*
1910	44	71	343	234	67	1,557	87,836
1911	80	195	358	195	61	1,670	72,933
1912	....	223	402	264	71	1,752	119,165
1913	83	280	554	352	116	1,798	201,867
1914	86	315	665	435	123	1,885	275,807

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; Dec. 31, 1913, 533,133 barrels.

Novorossisk.—The following tables show the shipments of petroleum and its products from Novorossisk from 1910 to 1913 and stocks on December 31, 1912 and 1913:

Shipments of petroleum from Novorossisk, 1910–1913, in metric tons.[a]

Year.	Crude oil.	Illuminating.[b]	Benzine.	Residuals.	Total.
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
1913	....	69,216	120,000	20,973	210,189

[a] Figures for 1914 not available.

[b] Refined.

Stocks of petroleum at Novorossisk, Dec. 31, 1912 and 1913.[a]

	1912		1913	
	Poods.	Barrels.	Poods.	Barrels.
Crude	72,000	8,643	100,600	12,077
Illuminating oils	443,400	55,425	738,100	92,263
Astatki	230,000	25,555	839,000	93,222
Other products	1,073,900	127,845	1,736,500	207,281
Total	1,819,300	217,468	3,414,200	404,843

[a] Figures for 1914 not available.

Batum.—The following table shows the shipments of petroleum products from Batum from 1910 to 1914:

Shipments of petroleum from Batum, 1910–1914.

Year.	Refined. petroleum.	Lubricating.	Residuals.	Total.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*
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
1913	454,165	183,180	62,594	699,939
1914	240,162	83,638	31,809	355,609

The following were the stocks of petroleum products held at Batum at the close of the year from 1910 to 1913, in poods and barrels:

Stocks of petroleum at Batum, Dec. 31, 1910–1913.[a]

	1910		1911		1912		1913	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*	*Poods.*	*Barrels.*
Illuminating	2,590,778	323,847	2,216,007	278,251	3,384,654	423,082	1,777,723	222,215
Lubricating	1,092,431	133,670	888,605	108,631	2,009,475	245,657	1,458,001	178,240
Solar oil, Vaseline, Residuals	522,032	60,000	300,585	35,880	963,794	107,088	1,063,459	118,162
Total	4,205,241	517,517	3,405,197	422,762	6,357,923	775,827	4,299,183	518,617

[a] Figures for 1914 not available.

ROUMANIA.

In consideration of the handicap of a greatly restricted market during the latter half of the year, following the closing of the Dardanelles and the declaration by the Government of an embargo on many petroleum products, the decline of less than a million barrels in the output of petroleum in Roumania in 1914 is remarkable. That the output recorded no greater falling off is due to the success that attended active drilling operations during the first half of the year, which proved the presence of vast stores of petroleum in previously untested areas. Substantial additions were made both on the east and on the west of the productive area at Bana-Moreni, on the south at Tzuicani, and on the northwest (Ferbatori) at Baicoi. A new field was opened by the Astra-Romana Co. at Ochiuri, in the Department of Dambovitza, and test wells at Ceptura, Valea Telegei, and Cricov furnished results which warranted the projection of additional work in those localities for 1915.

The increasing use of the rotary system of drilling in the Roumanian fields during the last three years has contributed in no small degree to the success of operations in that country.

The following statistical tables summarize developments in the Roumanian petroleum industry for a number of years:

Production of petroleum in Roumania in 1913 and 1914, by districts and months, in metric tons. [a]

1913.

Month.	District Prahova.					Dambovitza.	Buzeu.	Bacau.	Total.
	Bustenari-Calinet-Bordeni.	Campina Poiana.	Moreni.	Other.	Total.				
January	30,869	22,285	85,485	12,465	151,104	3,356	9,602	2,103	166,165
February	25,265	21,595	76,685	10,396	133,941	2,838	8,512	2,462	147,753
March	25,149	23,151	78,637	15,991	142,828	2,710	10,217	2,767	158,522
April	23,988	21,298	88,087	12,952	146,325	2,734	10,107	4,517	163,683
May	24,786	22,160	84,617	12,178	143,741	3,499	10,162	4,014	161,416
June	26,115	21,327	88,862	10,996	147,300	3,874	10,075	3,798	165,047
July	25,094	20,881	84,481	10,786	141,242	3,739	8,880	2,365	156,226
August	21,333	19,219	88,167	9,506	138,225	3,540	9,167	2,733	153,665
September	20,809	17,536	82,979	13,575	134,999	3,455	11,306	3,637	153,397
October	28,946	18,948	86,717	14,287	148,898	3,532	12,054	3,776	168,260
November	26,904	17,962	61,766	12,617	119,249	3,782	12,002	4,021	139,054
December	24,356	17,353	75,470	12,728	129,907	4,524	13,638	3,968	152,037
Total	303,614	243,715	981,953	148,477	1,677,759	41,583	125,722	40,161	1,885,225

1914.

Month.	Bustenari-Calinet-Bordeni.	Campina Poiana.	Moreni.	Other.	Total.	Dambovitza.	Buzeu.	Bacau.	Total.
January	21,951	15,446	70,450	10,489	118,336	4,552	13,535	3,551	139,974
February	22,980	13,804	67,100	9,318	113,202	3,503	12,280	3,488	132,473
March	24,771	16,617	88,082	10,624	140,094	3,533	14,065	4,141	161,833
April	22,707	16,449	79,404	8,624	127,184	2,962	13,834	3,995	147,975
May	24,347	15,833	76,491	9,367	126,038	2,976	14,243	4,229	147,486
June	26,542	16,520	74,153	9,943	127,158	3,028	13,926	4,663	148,775
July	27,529	14,494	73,184	12,699	127,906	3,285	13,646	4,068	148,905
August	23,044	14,253	68,039	13,727	119,063	2,956	10,659	4,542	137,220
September	21,758	13,813	60,593	15,121	111,285	4,070	9,774	4,388	129,517
October	24,740	13,543	81,678	18,464	138,425	6,584	11,909	4,329	161,247
November	27,042	12,207	74,300	15,544	129,093	5,757	8,871	4,163	147,884
December	26,576	11,534	82,622	38,011	158,743	5,962	11,673	4,280	180,658
Total	293,987	174,513	896,096	171,931	1,536,527	49,168	148,415	49,837	1,783,947

[a] 1 metric ton=7.19 barrels of 42 gallons.

The following table gives the statistics of the production of petroleum in Roumania in 1910–1914:

Roumanian petroleum industry, 1910–1914, in metric tons.

	1910	1911	1912	1913	1914
Crude-oil production	1,352,407	1,544,847	1,804,761	1,885,225	1,783,947
Crude oil treated at refineries	1,215,299	1,404,403	1,668,389	1,787,245	1,680,894
Output of refineries:					
Benzine	230,703	260,653	352,492	422,019	396,865
Illuminating oil	272,222	312,711	345,802	380,074	352,682
Lubricating oil	25,064	24,703	43,438	48,416	100,047
Residuals	667,260	783,136	898,011	906,735	807,276
Home consumption:					
Benzine	20,314	24,450	30,656	30,131	31,672
Illuminating oil	41,849	43,941	49,941	51,396	51,710
Lubricating oil	17,544	22,401	28,997	33,725	40,816
Residuals	360,551	434,094	540,383	560,492	584,254
Fuel at the refineries	108,314	123,029	140,590	135,728	134,324
Exports:					
Benzine	125,751	124,384	173,817	237,168	(a)
Illuminating oil and distillate	339,282	318,441	353,563	418,622	
Crude, residuals, etc	116,223	233,895	318,443	380,077	
Paraffin	285	476	600	579	
Stocks on Dec. 31:					
Benzine	29,006	51,862	60,647	66,746	
Illuminating oil	56,557	73,908	126,009	145,466	
Lubricating oil and residuals	270,493	248,375	227,140	79,766	

[a] Not available.

The percentage 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, 1910–1914, by departments.

Department.	1910	1911	1912	1913	1914
Prahova	92.10	89.67	89.51	89.00	86.03
Dambovitza	3.20	4.47	4.11	2.21	2.78
Buzeu	2.94	4.08	4.83	6.66	8.38
Bacau	1.76	1.78	1.55	2.13	2.81
Total	100.00	100.00	100.00	100.00	100.00

Percentage of refined products from Roumanian crude petroleum, 1910–1914.

Product.	1910	1911	1912	1913	1914
Crude benzine	19.0	18.6	21.2	23.6	23.6
Illuminating oil	22.4	22.3	20.7	21.3	21.0
Lubricating oil	2.0	1.8	2.6	2.7	5.9
Residue	54.9	55.8	53.8	50.7	48.0
Loss	1.7	1.5	1.7	1.7	1.5

The production of petroleum in Roumania in the last 10 years has been as follows:

Production of petroleum in Roumania, 1905–1914, in barrels.

Year.	Quantity.	Year.	Quantity.
1905	4,420,987	1910	9,723,806
1906	6,378,184	1911	11,107,450
1907	8,118,207	1912	12,976,232
1908	8,252,157	1913	13,554,768
1909	9,327,278	1914	12,826,579

The well record in Roumania in 1914 is shown in the following table:

Record of wells completed in Roumania in 1914, by districts.

District.	Jan. 1, 1914.						Dec. 31, 1914.					
	Bore holes.			Hand wells.			Bore holes.			Hand wells.		
	Producing.	Drilling.	Abandoned.	Producing.	Drilling.	Abandoned.	Producing.	Drilling.	Abandoned.	Producing.	Drilling.	Abandoned.
Prahova	765	354	488	96	80	247	802	312	607	99	203	325
Dambovitza	24	8	21	58	6	148	26	15	20	59	17	145
Buzeu	72	33	24	52	2	50	75	41	36	44	2	48
Bacau	87	11	15	328	22	462	84	12	15	360	22	462
Total	948	406	548	534	110	907	987	380	678	562	244	980

In the following table are given the exports in the years 1910–1913, in tons. Statistics are not available to show the exports of petroleum products from Roumania in 1914.

Exports of petroleum products from Roumania in 1910–1913, in metric tons.

Kind.	1910	1911	1912	1913
Crude oil, gas oil, lubricating oil, and residuals	116,223	124,384	173,817	237,168
Illuminating oil	339,282	318,441	353,563	418,622
Benzine	125,751	233,895	318,443	380,077
Paraffin scale	285	476	600	579
Total	581,541	677,196	846,423	1,036,446

AUSTRIA-HUNGARY.

GALICIA.

In the oil fields of east Galicia active drilling early in 1914 resulted in a southern extension of the Boryslaw field, which is interpreted to indicate the ultimate connection of that field with the development at Mraznica. In west Galicia no important developments were reported. Operations in all fields were greatly curtailed and in places brought to a complete standstill during the latter part of the year when the adjacent territory became the theater of conflict between the Russian and the Austrian armies. Owing to the unsettled conditions in the country, the Survey has been unable to procure complete statistics of petroleum output in Galicia in 1914. Statistics for the principal west Galician fields, Boryslaw and Tustanowice, covering the first half of the year only, are presented.

The following tables contain statistics relating to the Galician petroleum industry:

Production of petroleum in Galicia, 1910–1914, by fields, in metric tons.[a]

Field.	1910	1911	1912	1913	1914
East Galicia:					
Tustanowice	1,404,320	1,105,420	856,440	691,382	[b] 356,447
Boryslaw	209,300	197,320	170,500	205,904	[b] 116,613
Schodnica	32,860				
Urycz					
Mraznica	38,170				
Other fields					
West Galicia:					
Potok	13,010	160,200	160,067	190,000	....
Rogi	8,200				
Rowne					
Krosno	25,200				
Tarnawa-Wielopole-Zagorz	2,700				
Kobylanka, Kryg, Zalawie, Lipinki, Libusza, etc	28,800				
Total	1,762,560	1,462,940	1,187,007	1,087,286	....

[a] 1 metric ton=7.1905 barrels of crude petroleum of 42 gallons=2,204.62 pounds.
[b] Figures for first six months only.

Production of petroleum in Galicia, 1905–1914.

Year.	Metric centners.[a]	Barrels of 42 gallons.	Year.	Metric centners.[a]	Barrels of 42 gallons.
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
1908	17,540,220	12,612,295	1913	10,872,860	7,818,130
1909	20,767,400	14,932,799	1914	[b] 7,000,000	5,033,350

[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.
[b] Estimated.

In the following table are given the imports and exports of petroleum products into and from Austria-Hungary in 1910–1913.

Imports and exports of petroleum into and from Austria-Hungary in 1910–1913,[a] *in metric tons.*

Kind.	1910		1911		1912		1913	
	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.	Imports.	Exports.
Illuminating oils	1,460	266,739	1,517	265,378	1,377	383,183	1,868	285,445
Lubricating and other oils	15,358	139,071	18,213	91,065	19,687	155,583	27,037	155,907
Benzine	40	39,320	10	41,904	89	68,698	2,683	49,773
Paraffin	455	44,432	631	37,940	546	51,594	300	43,101
Crude petroleum	18,967	5,472	19,020	610	17,873	1,660	19,134	1,112
Ozokerite	....	....	....	....	150	2,525	146	2,275
Ceresin	....	....	....	....	39	1,712	16	1,550
Total	36,280	495,034	39,391	436,467	39,761	664,955	51,184	539,163

[a] Figures for 1914 not available.

GERMANY.

Complete statistics of the production of petroleum in Germany in 1914 are not available. Six producing properties in Alsace-Lorraine report an output of 49,055 metric tons of petroleum as compared with 49,584 tons in 1913.

In the following table are shown the quantity and value of petroleum produced in the German Empire, by States, from 1905 to 1914, inclusive:

Production of petroleum in the German Empire, 1905–1914, by States.

Year.	Alsace-Lorraine.	Prussia.	Total.		Total value.	
	Quantity.	Quantity.	Quantity.			
	Metric tons.	*Metric tons.*	*Metric tons.*	*Barrels (42 gallons).*	*Marks.*	*Dollars.*
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			144,961	1,031,050	10,190,000	2,425,220
1913			b 140,000	995,764	9,790,285	2,330,088
1914			b 140,000	995,764	9,790,285	2,330,088

a Includes Bavaria. b Estimated.

1 metric ton, crude=7.1126 barrels.

BRITISH ISLES.

Oil shale.—The entire output of petroleum in the British Isles is obtained by the distillation of oil shales in southern Scotland. Though the yield rarely exceeds 30 gallons of oil to a ton of shale treated the industry has been an important one for more than 40 years, the profit derived therefrom lying in the by-products, paraffin wax and sulphate of ammonia, rather than in the petroleum obtained.

Although the Scottish companies suffered some embarrassment as the result of the moratorium declared at the outbreak of the European war, the advancing market for their products arising from the consequent removal of competition with paraffin wax imported from Galicia and ammonium sulphate imported from Germany, together with an increasing demand for the latter product in America, served to avert a serious depression and gave the industry a promising outlook at the end of the year.

In the following table is shown the production of oil shale in Great Britain in 1905 to 1914, taken from the Mineral Statistics of the United Kingdom:

Quantity and value of oil shale produced in Great Britain, 1905–1914, in long tons.

Year.	England.		Scotland.		Wales.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1912			3,184,826	3,726,425			3,184,826	3,726,425
1913			3,279,903	4,001,839	240	341	3,280,143	4,002,180
1914 a			3,000,000	3,700,000			3,000,000	3,700,000

a Estimated.

ITALY.

The output of petroleum in Italy, which has never been of importance, decreased slightly in 1914.

Developments begun during 1914 near San Giovanni d'Incarico, in the Province of Caserta, resulted in one well in February, 1915, with an initial production reported at about 15 barrels a day, with prospect of an increased flow. Other tests are under way at San Giovanni and also at Pilso, near Gaeta.

The following table shows the production of petroleum in Italy from 1905 to 1914. Statistics are taken from the volumes of the Rivista del Servizio Minerario:

Production of petroleum in Italy, 1905–1914.

Year.	Number of wells in operation.	Quantity.		Value.	
		Metric tons.	United States barrels.	Lire.[a]	Dollars.
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	9	7,479	53,778	1,196,640	230,952
1913	9	6,572	47,256	1,643,000	317,099
1914[b]	9	5,500	39,548	1,000,000	193,000

[a] Lira=$0.193. 1 metric ton, crude=7.1905 barrels. [b] Estimated.

SPAIN.

Promising surface indications of petroleum in the area about Cadiz, in southern Spain, were examined in 1914, at the expense of the Spanish Government. In northern Spain, near Santander, petroleum in small quantities was discovered in a boring made for salt.

TURKEY.

Plans for the active development of the imperfectly operated oil fields in the Tigris and Euphrates valleys, in the vicinity of Mosul and Bagdad, were postponed by the European war.

In Palestine prospecting was active at Makarim, in the area between the River Jordan and Deraa adjacent to the Hedjaz Railway, by the Turkish Petroleum Co., a successor in interest to the Syrian Exploration Co.

PERSIA.

Interest in Persian developments was greatly stimulated by the decision of the British Government, announced May 22, to acquire a majority interest in the Anglo-Persian Oil Co., and thereby secure for the Admiralty undisputed access to valuable oil lands adjacent to the Persian Gulf. The effect of the European war on this agreement was not apparent at the end of the year.

The Anglo-Persian Oil Co. was organized in 1909 to operate a concession granted by the Persian Government for a term of 60 years, dated from May 28, 1901, which granted the exclusive right to work and transport oil throughout the Persian Empire, with the exception of certain specified Provinces bordering the Caspian Sea—Azerbajan, Ghilan, Mazenderan, Asdrabad, and Khorassan.

Development work has thus far been limited to the Maidan-i-Naphtun field in northern Arabistan, where about 10 wells were being operated and 20 more were shut down at the top of the sand prior to the European war. In the neighboring Maidan-i-Naphtek field one well had been drilled and capped and a second well begun prior to March, 1914, and development work to the extent of one test well had been begun in what is called the "White Oil Springs" district.

A pipe line, 145 miles in length, with a reported capacity of 240,000 tons of oil per annum, connects the Maidan-i-Naphtun field with a refinery at tidewater, located at Abadan, near the head of the Persian Gulf.

This refinery, which has 34 stills producing gasoline, kerosene, and fuel oil, is reported to have a potential capacity of 400,000 tons of crude oil per annum, though limited at present to the capacity of the tributary pipe line.

BRITISH INDIA.

Operations in the Yengenyoung, Singu, and Yengenyat districts, in Burma, were nominal, the search for deeper sands in the first two districts furnishing variable results not altogether satisfactory. Wildcatting in Burma resulted in the opening of a promising new field at Indaw, Kindat Township, in the upper Chindwin district.

The following table shows the production of petroleum in India from 1905 to 1914 in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1905–1914.

Year.	Quantity.		Value.	
	Imperial gallons.	Barrels (42 United States gallons).	Rupees.[a]	Dollars.
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
1913	277,555,225	7,930,149	15,518,790	5,035,803
1914 [b]	280,000,000	8,000,000	16,000,000	5,190,933

[a] The value of the rupee is taken as 32.44⅓ cents; 15 rupees=£1.
[b] Estimated.

Production of petroleum in India, 1910–1913,[a] by Provinces, in imperial gallons.

Province.	1910	1911	1912	1913
Burma	211,507,903	222,225,531	245,335,209	272,865,397
Eastern Bengal and Assam	3,320,680	3,565,163	3,747,359	4,688,628
Punjab	1,064	1,400	950	1,200
Total	214,829,647	225,792,094	249,083,518	277,555,225

[a] Figures for 1914 not available.

CHINA.

Under the terms of an agreement entered into by the Chinese Government and the Standard Oil Co. of New York, a joint investigation of the petroleum resources in the Provinces of Shensi and Chihli was made in 1914. It is reported that petroleum indications are present at 23 localities in Chihli, 17 in Hunnan, 13 in Kueichou, 8 in Shensi, 5 in Kiangsu, 5 in Kwangsi, 4 in Shansi, 4 in Hunau, 4 in Fengtieu, 3 in Szechuan, 2 in Kirin, 2 in Hupele, and 1 in Kwangtung, a total of 91. Active drilling operations were commenced during the year in the Yenchang field, Shensi, in a locality where a number of wells drilled six or seven years ago resulted in two small producers, supplying oil to a small refinery with a purely local trade.

JAPAN.

Interest in Japan in 1914 was centered in Akita Prefecture, where the Nippon Oil Co., drilling with a rotary outfit, brought in a large well on its Kurokawa property on May 25. The initial production of the well was estimated at 12,000 barrels a day, and a year later its output was reported to be holding up to 600 barrels a day. In this field the same company completed a second gusher with an initial daily output of 5,500 barrels on September 1. As a direct result of this successful activity, the petroleum output of the country showed a very substantial increase compared with previous years.

Another event of importance to the Japanese petroleum industry during 1914 was the establishment of a plant for the manufacture of gasoline from natural gas. The initiative was taken by the Nippon Oil Co., which installed a plant with a capacity of 1,000 gallons of gasoline a day in the Nishiyama field, Niigata Prefecture.

According to the Petroleum World (London, July, 1914) the oil fields of Japan are widely distributed in a belt lying along the west side of north Japan and extending from the west coast of the island of Sakhalin on the north along the coast of the Sea of Japan through the west side of the central mountain range of Hokkaido, thence stretching across the Provinces of Mutsu, Ugo, Uzeu, Echigo, and Shinano to the Pacific coast of Totomi on the south. In Formosa an oil belt has been defined near the west coast.

The fields in the empire which are to-day commercially developed are stated to be 14 in number, distributed as follows: Higashyama, Nishiyama, Kubiki, Niitsu, Ojiya, Yoneyama, Gotsu, Hiyama, and Kurokawa in the Province of Echigo; Ishikari and Yufutsu in the Province of Ugo; Nagano, in Shinano; Sagara, in Totomi; and Byoritsu, in Formosa.

Until 1914, when a large production was credited for the first time to Akita, the Japanese oil production had been derived chiefly from the fields of Echigo Province among which Niitsu ranked first in point of age and production.

Oil in the Niitsu field is obtained in coarse sandstone layers, interstratified with sandy shale of Tertiary age and penetrated by wells ranging from 600 to 2,000 feet in depth, most of the production coming, however, from less than 700 feet below the surface.

The oil from the Japanese fields ranges around 25° Baumé in gravity and resembles the California oil, though containing traces of paraffin.

Five small refineries, or rather topping plants, are reported to be in operation in Japan, 2 located on the Pacific coast and the remaining 3 on the coast of Japan Sea.

The petroleum industry in Japan is practically controlled by a few companies, the more important of which are the Nippon and the Hoden companies, which together control about nine-tenths of the output, and the Chuo and Nakano companies.

In the following table is given the production of petroleum in Japan from 1905 to 1914, inclusive:

Production of petroleum in Japan, 1905–1914.[a]

[Barrels of 42 gallons.]

Year.	Crude.	
	Koku.	*Barrels.*
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	1,520,458	1,727,240
1911	1,529,593	1,737,618
1912	1,458,290	1,656,617
1913	1,693,582	1,923,909
1914	2,395,836	2,721,670

[a] Exclusive of the island of Formosa.

1 koku=39.7 English gallons=47.46 United States gallons=1.136 United States barrels.

In the following table is given a statement of the production of petroleum in Japan, 1910–1914, by fields, as reported by the Imperial Mining Bureau of the Department of Agriculture and Commerce, Tokyo:

Production of petroleum in Japan, 1910–1914, inclusive.

Field.	1910	1911	1912	1913	1914
	Koku.	*Koku.*	*Koku.*	*Koku.*	*Koku.*
Akita	12,924	25,090	31,365	76,830	625,719
Hokkaido	1,892	1,358	5,038	4,218	6,270
Nagano	61	55			
Niigata	1,502,807	1,500,482	1,419,539	1,610,117	1,761,792
Shizuoka	2,637	2,229	2,030	1,983	2,055
Yamagata	135	356	205	336	
Kagoshima		23			
Others			113	98	
Total	1,520,458	1,529,593	1,458,290	1,693,582	2,395,836
Formosa	3,208	1,442	3,040	15,933	14,708
Total	1,523,664	1,531,035	1,461,330	1,709,515	2,410,544

Production of petroleum in Japan and Formosa, 1906–1914.

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	1,520,458	1,727,240	3,208	4,062	1,523,664	1,730,882
1911	1,529,593	1,737,618	1,442	1,638	1,531,035	1,739,256
1912	1,458,290	1,656,617	3,040	3,454	1,461,330	1,660,071
1913	1,693,582	1,923,909	15,933	18,100	1,709,515	1,942,009
1914	2,395,836	2,721,670	14,708	16,708	2,410,544	2,738,378

[a] Estimated.

OCEANIA.

EAST INDIES.

In Borneo, Sumatra, and Java no notable additions to productive area were made in 1914. Borneo and Java recorded moderate increases in output, whereas Sumatra recorded a notable decline. The output from Ceram increased nearly sixfold as compared with 1913. In the northeastern portion of Papua (New Guinea) indications of petroleum were reported near Eitape, and in the southeastern portion of the island an investigation by Australian geologists indicated the presence of valuable deposits of petroleum on the west flank of the Albert Mountains between the river Purari on the north and Yule Island on the south.

Exploratory work with indifferent results was continued in British North Borneo and the adjoining Province of Brunei on the island of Borneo.

The following table shows the production of petroleum in the Dutch East Indies from 1905 to 1914, inclusive:

Production of petroleum in Dutch East Indies, 1905–1914.

Year.	Borneo.		Java.		Sumatra.		Total.		
	Metric tons.	Liters.	Metric tons.	Liters.	Metric tons.	Liters.	Metric tons.	Liters.	Barrels.
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
1913	797,059	883,061,666	207,135	366,608,237	529,947	652,735,720	[a] 1,534,223	1,902,550,755	11,966,857
1914	[c] 931,903	1,032,455,334	226,590	401,041,641	475,423	585,578,509	[b] 1,634,403	2,019,937,425	12,705,208

[a] Includes 82 metric tons produced in Ceram.
[b] Includes 487 metric tons produced in Ceram.
[c] Includes 65,185 metric tons produced in British Borneo.

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.

PHILIPPINE ISLANDS.

Petroleum occurs as a very light, paraffin-base oil in shales in various parts of the Philippine Islands, notably in Bondoc Peninsula, Tayabas, Luzon, and in Cebu. Two wells, one shallow and one deep, have yielded a small output of oil.

AUSTRALIA.

SOUTH AUSTRALIA.

A governmental examination of the supposed oil-bearing areas of South Australia was made in the latter part of 1914 by Dr. Arthur Wade, whose report is published as Bulletin 4 of the Geological Survey of South Australia. The examination covered some 10,000 square miles of territory lying in four main areas—Eyre's Peninsula and the west coast, Kangaroo Island, Yorke Peninsula, and the southeastern district. The conclusions reached by Dr. Wade as the result of this investigation are as follows:

One is bound to conclude that the chances of obtaining a supply of petroleum from the districts now under consideration is very slight indeed. The far southeast carries a faint possibility, which is based on surmise and no evidence.

In the interior of the continent the Coonanna Bore gave some signs which have resulted in nothing tangible when tested by further boring. Shales which may produce oil on distillation are also known to occur in these far removed areas. But difficulties connected with climate, water, and communication will probably cause a long period to elapse before the actual value of these interior deposits can be adequately tested and made known, and will largely discount their economic value for many years.

The Government offers "a bonus of £5,000 to the person or body corporate which first obtains from a bore or well situated in the State of South Australia 100,000 gallons of crude petroleum containing not less than 90 per cent of products obtainable by distillation."

At present this substantial offer only applies to oil obtained from bores or wells. I suggest that it be extended so as to include oil obtained by distillation from shales or lignites in similar quantities and under similar conditions.

NEW SOUTH WALES.

The following data relating to the output in 1914 of oil shale in New South Wales are obtained from the annual report of the Department of Mines, New South Wales:

Kerosene shale to the amount of 50,049 tons, valued at £27, 372, was raised, showing an increase of 33,064 tons and £20,033 in value on that raised in 1913. The increased output is due to the greater activity of the British Australian Oil Co. in the northern district, while the reduced production from the western district is accounted for by the fact that comparatively little has been done by the Commonwealth Oil Corporation on their Wolgan, Newnes, or Glen Alice properties.

Quantity and value of oil shale produced in New South Wales, 1905–1914, in long tons.

Year.	Quantity.	Value.	Year.	Quantity	Value.
1905	38,226	$103,399	1910	68,293	$164,955
1906	32,446	138,549	1911	75,104	179,963
1907	47,331	154,996	1912	[a] 86,018	169,208
1908	46,303	126,855	1913	[a] 16,985	35,715
1909	48,718	114,932	1914	50,049	133,205

[a] Estimated.

NEW ZEALAND.

Interest in 1914 was centered in the Taranaki district, New Plymouth, North Island, where six companies were reported to be engaged in development work. The wells in this district range in depth from 2,280 to 3,330 feet and yield less than 25 barrels a day of high-grade paraffin-base oil, free from sulphur and containing only small quantities of unsaturated hydrocarbons. The Taranaki Petroleum Co. has erected a modern refinery of a capacity of 10,000 gallons a day to supply the local market for oil products.

On South Island the Shell interests abandoned a test well at 900 feet after penetrating metamorphic rock.

AFRICA.

ALGERIA.

Work on the test well of the Algerian Oil Fields (Ltd.) at Abd-er-Rahim was suspended in April, 1914, at a reported depth of 902 meters, on account of parted casing. A second test, begun in March, was located at Messila.

EGYPT.

The activity of the Anglo-Egyptian Oil Fields (Ltd.) resulted in the completion of a number of creditable wells in the Hurghada district. In well No. 1 oil was struck in large quantities at 1,670 feet in October, but the well sanded up and remained closed to the end of the year. Several wells at shallow depth produced the principal output of the field. At Gemsah salt-water flooding ruined two good producers. All efforts to obtain oil in paying quantities in the Zeitieh field failed and the territory was abandoned.

The following table shows the growth and extent of the Egyptian petroleum industry in the last four years:

Production of petroleum in Egypt, 1911–1914, in metric tons and barrels.

Year.	Metric tons.	Barrels.
1911	1,220	9,150
1912	27,454	205,905
1913	12,618	94,635
1914	103,605	777,038

UNITED STATES GEOLOGICAL SURVEY PUBLICATIONS, 1901-1914, ON THE OIL FIELDS OF THE UNITED STATES.

The following publications of the United States Geological Survey refer to the oil and gas fields of the United States:

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. $1.50.
The Trenton limestone as a source of petroleum and inflammable gas in Ohio and Indiana, by Edward Orton, pp. 475–662, pls. liv–lx.

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] Nineteenth Annual Report of the United States Geological Survey, 1897–98, Charles D. Walcott, Director.
Pt. II. Papers chiefly of a theoretic nature, v, 958 pp., 172 pls., 1899. $2.65.
(*e*) The Cretaceous formation of the Black Hills as indicated by the fossil plants, by L. F. Ward with the collaboration of W. P. Jenney, W. M. Fontaine, and F. H. Knowlton, pp. 521–946, pls. liii–clxii.

[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. $2.
The Gaines oil field of northern Pennsylvania, by M. L. Fuller, pp. 573–627, pls. xxxvi–xliii.

PROFESSIONAL PAPERS.

[a] 53. Geology and water resources of the Bighorn Basin, Wyoming, by C. A. Fisher. 72 pp., 16 pls., 1907. 60c.

[a] 56. Geography and geology of a portion of southwestern Wyoming, with special reference to coal and oil, by A. C. Veatch. 178 pp., 26 pls., 1907. 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. 105 pp., 24 pls., 1909.

BULLETINS.

[a] 128. The Bear River formation and its characteristic fauna, by C. A. White. 108 pp., 11 pls., 1895. 15c.

[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. 64 pp., 10 pls., 1901. 30c.

[a] 198. The Berea grit oil sand in the Cadiz quadrangle, Ohio, by W. T. Griswold. 43 pp., 1 pl., 1902. 10c.

[a] 212. Oil fields of the Texas-Louisiana Gulf Coastal Plain, by C. W. Hayes and William Kennedy. 174 pp., 11 pls., 1903. 20c.

[a] 213. Contributions to economic geology, 1902; S. F. Emmons and C. W. Hayes, geologists in charge. 449 pp., 1903. 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.

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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] 225. Contributions to economic geology, 1903; S. F. Emmons and C. W. Hayes, geologists in charge. 527 pp., 1 pl., 1904. 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.

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Oil and gas fields of eastern Greene County, Pa., by Ralph W. Stone, p. 396.

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259. Report on progress of investigations of mineral resources of Alaska in 1904, by A. H. Brooks and others. 196 pp., 3 pls., 1905.

[a] 260. Contributions to economic geology, 1904; by S. F. Emmons and C. W. Hayes, geologists in charge. 620 pp., 4 pls., 1905. 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.

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[a] 282. Oil fields of the Texas-Louisiana Gulf Coastal Plain, by N. M. Fenneman. 146 pp., 11 pls., 1906. 20c.

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The Nineveh and Gordon oil sands in western Greene County, Pa., by F. G. Clapp.

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[a] 296. Economic geology of the Independence quadrangle, Kansas, by F. C. Schrader and Erasmus Haworth. 74 pp., 6 pls., 1906. 50c.

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346. Structure of the Berea oil sand in the Flushing quadrangle, Ohio, by W. T. Griswold. 30 pp., 2 pls., 1908.

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The Campton oil pool, Kentucky, by M. J. Munn. Oil and gas development in Knox County, Ky., by M. J. Munn. The Fayette gas field, Alabama, by M. J. Munn. The Powder River oil field, Wyoming, by C. H. Wegemann. Geology of the San Juan oil field, Utah, by E. G. Woodruff. Marsh gas along Grand River near Moab, Utah, by E. G. Woodruff. Preliminary report on the geology and possible oil resources of the south end of the San Joaquin Valley, Cal., by Robert Anderson. Stock exhausted but reprinted in five separate pamphlets, numbered 471a-1 to 471a-5, each containing the papers relating to a single State. (1, Kentucky; 2, Alabama; [a]3, Wyoming; 4, Utah; [a]5, California.

475. Diffusion of petroleum through fuller's earth, by J. Elliott Gilpin and O. E. Bransky. 50 pp., 1911.

[a]491. The data of geochemistry (second edition), by F. W. Clarke. 782 pp., 1911. 70c.

531. Contributions to economic geology (short papers and preliminary reports), 1911. Part II: Mineral fuels. M. R. Campbell, geologist in charge. 361 pp., 24 pls., 1913.

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(*a*) The Menifee gas field and Ragland oil field, Kentucky, by M. J. Munn, 18 pp., 4 pls.

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(*a*) Oil and gas in the northern part of the Cadiz quadrangle, Ohio, by D. D. Condit, 9 pp., 1 pl; Gas from mud lumps at the mouth of the Mississippi, by E. W. Shaw, 4 pp.

(*b*) Structure of the Fort Smith-Poteau gas field, Arkansas-Oklahoma, by C. D. Smith, 14 pp., 1 pl.; The Glenn oil and gas pool and vicinity, Oklahoma, by C. D. Smith, 15 pp., 1 pl.

(*c*) The Douglas oil and gas field, Converse County, Wyo., by V. H. Barnett, 40 pp., 1 pl.; The Shoshone River section, Wyoming, by D. F. Hewett, 25 pp., 1 pl.

(*d*) Oil and gas near Green River, Grand County, Utah, by C. T. Lupton, 19 pp., 1 pl.; Petroleum near Dayton, N. Mex., by G. B. Richardson, 6 pp.

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[a]543. Geology and geography of a portion of Lincoln County, Wyo., by A. R. Schultz. 141 pp., 11 pls., 1914. 50c.

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579. Reconnoissance of oil and gas fields in Wayne and McCreary counties, Ky., by M. J. Munn. 105 pp., 6 pls., 1914.

581. Contributions to economic geology (short papers and preliminary reports), 1913. Part II: Mineral fuels. M. R. Campbell and David White, geologists in charge. 187 pp., 11 pls., 1915.

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(*a*) Oil shale of northwestern Colorado and northeastern Utah, by E. G. Woodruff and D. T. Day, pp. 1–21, pl. i.

(*b*) Oil and gas in the western part of the Olympic Peninsula, Washington, by by C. T. Lupton, pp, 23–81, pl. ii.

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581. Contributions to economic geology—Continued.
(*c*) The Moorcroft oil field, Crook County, Wyo., by V. H. Barnett, pp. 83–104, pl. iii; Possibilities of oil in the Big Muddy Dome, Converse and Natrona counties, Wyo., by V. H. Barnett, pp. 105–117, pl. iv.
(*d*) Geology and oil prospects of Waltham, Priest, Bitterwater, and Peachtree valleys, central California, with notes on coal, by R. W. Pack and W. A. English, pp. 119–160, pl. v.
585. Useful minerals of the United States, compiled by Samuel Sanford and R. W. Stone. 250 pp., 1914.
590. Reconnoissance of the geology and oil prospects of northwestern Oregon, by C. W. Washburne. 111 pp., 1 pl., 1914.
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(*e*) Reconnaissance in Palo Pinto County, Tex., with special reference to oil and gas, by C. H. Wegemann.
(*f*) Possibilities of oil in the Porcupine dome, Rosebud County, Mont., with a log of the deep well at Vananda, by C. F. Bowen.
(*g*) The Lawton oil and gas field, Okla., by C. H. Wegemann and R. W. Howell.
(*h*) Anticlines in the Clinton sand near Wooster, Wayne County, Ohio, by C. A. Bonine.
(*j*) A reconnaissance for oil near Quanah, Hardeman County, Tex., by C. H. Wegemann, pp. 109–115, 1 pl.

In preparation.

619. The Caddo oil and gas field, Louisiana-Texas, by G. C. Matson.
623. Petroleum withdrawals and restorations affecting the public domain, with a chapter on oil-land law, by M. W. Ball.

WATER-SUPPLY PAPERS.

113. The disposal of strawboard and oil-well wastes, by R. L. Sackett and Isaiah Bowman. 52 pp., 4 pls., 1905.
149. Preliminary list of deep borings in the United States, second edition with additions, by N. H. Darton. 175 pp., 1905.

FOLIOS OF THE GEOLOGIC ATLAS OF THE UNITED STATES CONCERNING PETROLEUM AND NATURAL-GAS FIELDS, 1897–1913.[a]

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[a]53. Standingstone, Tenn., by M. R. Campbell. 1899.
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furnace flux	879
glass sand	279
granite	839
gypsum	265
lime	366
limestone	870
marble	861
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fuller's earth	35
furnace flux	879
granite	839
grindstones	554
gypsum	265
lime	366
limestone	870
marble	861
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DEPARTMENT OF THE INTERIOR

FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, Director

Production of Coal in the United States from 1807, the date of the earliest record, to the close of 1914.

(SHORT TONS.)

Year	Pennsylvania	Virginia	Kentucky	Illinois.	Ohio	Pennsylvania	Missouri.	Indiana.	Alabama.	Tennessee.	Iowa.	Arkansas.	North Carolina.	Maryland.	Washington.	Michigan.	Georgia	California.	West Virginia.	Colorado.	Wyoming.	Kansas.	Utah.	Oklahoma (Indian Territory)	Oregon.	Montana.	New Mexico	Texas.	North Dakota	Miscellaneous a	Total	Year
	Anthracite					*Bituminous.*																										
1807-1820	12,000													3,000																	15,000	1807-1820
1821	1,322																														1,322	1821
1822	4,583	54,000																													58,583	1822
1823	8,563	60,000																													68,563	1823
1824	13,685	67,040																													80,725	1824
1825	42,988	75,000																													117,988	1825
1826	59,194	88,720																													147,914	1826
1827	78,151	94,000																													172,151	1827
1828	95,500	100,080	328																												195,908	1828
1829	138,086	100,000	2,000																												240,086	1829
1830	215,272	102,800	2,000																												320,072	1830
1831	217,842	118,000	2,100																												337,942	1831
1832	447,550	132,000	2,500											12,000																	594,050	1832
1833	600,907	125,000	2,750	6,000																											734,657	1833
1834	464,015	124,000	5,000	7,500																											600,515	1834
1835	690,854	120,000	6,000	8,000																											824,854	1835
1836	842,832	124,000	8,000	10,000																											984,832	1836
1837	1,071,151	160,000	10,000	12,500																											1,253,651	1837
1838	910,075	300,000	11,500	14,000	119,952																										1,855,527	1838
1839	1,008,322	396,000	16,000	15,038	125,000																										1,560,360	1839
1840	967,108	424,894	23,527	16,967	140,536	464,826	9,972	9,682	946	558	400	320	3	8,880																1,520	2,070,039	1840
1841	1,182,441	379,000	35,000	35,000	160,000	475,000	12,000	10,000	1,000	600	500																				2,291,141	1841
1842	1,365,563	373,640	50,000	58,000	225,000	500,000	15,000	18,000	1,000	1,000	750			2,104																	2,610,057	1842
1843	1,556,753	370,000	60,000	75,000	280,000	650,000	25,000	25,000	1,200	4,500	1,000			12,421																	3,060,874	1843
1844	2,009,207	365,000	75,000	120,000	340,000	675,000	35,000	30,000	1,200	10,000	2,500			18,346																	3,661,252	1844
1845	2,480,032	360,000	100,000	150,000	890,000	700,000	50,000	35,000	1,500	18,000	5,000			30,372																	4,309,904	1845
1846	2,887,815	340,000	115,000	165,000	420,000	760,000	68,000	40,000	1,500	25,000	6,500			36,707																	4,865,522	1846
1847	3,551,005	325,000	120,000	180,000	480,000	389,840	80,000	45,000	2,000	30,000	8,000			65,222																	5,286,067	1847
1848	3,805,942	318,000	125,000	200,000	540,000	500,000	85,000	50,000	2,000	40,000	10,000			98,032																	5,773,974	1848
1849	3,995,334	315,000	140,000	260,000	600,000	750,000	90,000	56,000	2,500	52,000	12,500			175,497																	6,448,831	1849
1850	4,138,164	310,000	150,000	300,000	640,000	1,000,000	100,000	60,000	2,500	60,000	15,000			242,517																	7,018,181	1850
1851	5,481,065	310,000	160,000	320,000	670,000	1,200,000	125,000	60,000	3,000	70,000	18,000			317,460																	8,734,525	1851
1852	6,151,957	325,000	175,000	340,000	700,000	1,400,000	140,000	75,000	3,000	75,000	20,000			411,707																	9,816,664	1852
1853	6,400,426	350,000	180,000	375,000	760,000	1,500,000	160,000	75,000	4,000	85,000	23,000			667,862																	10,570,288	1853
1854	7,394,875	370,000	190,000	385,000	800,000	1,650,000	175,000	80,000	4,500	90,000	25,000			812,727																	11,977,102	1854
1855	8,141,754	380,782	200,000	400,000	890,000	1,780,000	185,000	60,000	6,000	100,000	28,000			735,137																	12,926,673	1855
1856	8,534,779	352,687	215,000	410,000	930,000	1,850,000	200,000	85,000	6,500	115,000	30,000			817,659																	13,546,925	1856
1857	8,186,567	363,605	240,000	450,000	975,000	2,000,000	220,000	85,000	8,000	125,000	33,000			654,017																	13,340,180	1857
1858	8,426,102	377,690	250,000	490,000	1,000,000	2,200,000	240,000	87,000	3,500	135,000	37,500			722,686																	13,974,178	1858
1859	9,619,771	359,055	275,000	530,000	1,060,000	2,400,000	260,000	95,000	9,000	150,000	42,000			833,349																	15,633,175	1859
1860	8,115,842	473,360	285,760	728,400	1,265,600	2,690,786	280,000	101,280	10,200	165,300	41,920	200		438,000	5,374	2,320	1,900													3,500	14,610,042	1860
1861	9,799,654	445,165	250,000	670,000	1,150,000	3,200,000	300,000	128,000	10,000	160,000	50,000			287,073	6,000	3,000	2,500	6,620													16,488,012	1861
1862	9,695,110	445,124	275,000	780,000	1,200,000	4,000,000	320,000	150,000	12,500	140,000	53,000		30,000	346,201	7,000	5,000	3,500	23,400													17,485,835	1862
1863	11,785,320	40,000	250,000	890,000	1,204,681	5,000,000	300,000	200,000	15,000	100,000	57,000		30,000	877,313	8,000	8,000	6,000	43,200	444,648												21,319,062	1863
1864	12,538,649	40,000	350,000	1,000,000	1,815,022	5,839,000	375,000	250,000	15,000	100,000	63,000		25,000	755,764	10,000	12,000	10,000	50,700	454,888	500											23,005,123	1864
1865	11,891,746	40,000	200,000	1,260,000	1,536,218	6,350,000	420,000	280,000	12,000	100,000	69,574		20,000	1,025,208	12,000	15,000	10,000	60,530	487,897	1,200	800										23,792,173	1865
1866	15,651,183	40,000	180,000	1,580,000	1,887,424	6,800,000	450,000	320,000	12,000	100,000	89,320		20,000	1,217,868	13,000	20,000	8,000	84,020	512,068	6,400	2,600										29,003,583	1866
1867	16,002,100	50,000	175,000	1,800,000	2,092,334	7,300,000	500,000	350,000	10,000	110,000	150,000		20,000	1,381,429	14,500	25,000	8,000	124,690	589,360	17,000	5,000										30,724,422	1867
1868	17,003,405	69,051	100,000	2,000,000	2,475,844	7,500,000	541,000	375,000	10,000	125,000	241,453		18,000	1,529,870	15,000	28,000	10,000	143,670	609,227	10,500	6,925										32,861,960	1868
1869	17,083,134	65,000	160,000	1,854,000	2,461,986	6,750,000	550,000	400,000	10,000	130,000	295,105		16,000	2,216,300	16,200	29,980	12,000	157,234	603,148	8,000	49,382	36,891									32,004,300	1869
1870	15,664,275	61,803	150,582	2,624,163	2,527,285	7,798,518	621,930	437,870	11,000	133,418	263,487		15,000	1,819,824	17,844	28,150	15,000	141,890	608,878	4,500	50,000	32,938	5,800							1,425	33,035,580	1870
1871	19,342,057	70,000	250,000	3,000,000	4,000,000	9,040,565	725,000	600,000	15,000	180,000	300,000		15,000	2,670,338	20,000	32,000	20,000	152,493	618,830	15,000	147,328	41,000								5,029,809	46,885,080	1871
1872	24,233,166	69,440	380,800	3,360,000	5,315,294	11,695,040	784,000	896,000	10,800	224,000	336,000		12,000	2,647,156	23,000	33,000	25,000	190,859	700,000	68,540	221,745	44,800								170,159	51,453,399	1872
1873	26,152,837	67,200	400,000	3,920,000	4,550,028	13,096,829	784,000	1,000,000	44,500	350,000	392,000		10,000	3,108,011	26,000	50,000	40,000	186,611	1,000,000	69,997	259,700	56,000								1,939,567	57,602,480	1873
1874	24,818,790	70,000	300,000	4,203,000	3,267,585	12,320,000	789,680	812,000	50,400	350,000	789,936			2,599,392	30,352	58,000	60,000	216,352	1,120,000	77,372	219,061	85,000									52,605,920	1874
1875	22,485,766	60,000	500,000	4,453,178	4,864,260	11,760,000	840,000	800,000	67,200	360,000	1,231,547			2,808,018	99,568	62,500	80,000	166,638	1,120,000	98,838	300,808	150,000								40,000	52,348,320	1875
1876	22,793,245	55,000	650,000	5,000,000	3,500,000	12,880,000	1,008,000	950,000	112,000	550,000	1,250,000			2,126,873	110,342	66,000	110,000	128,049	896,000	117,666	334,550	225,000	50,400							366,875	53,280,000	1876
1877	25,660,310	50,000	850,000	5,350,000	5,250,000	14,000,000	1,008,000	1,000,000	196,000	450,000	1,300,000			1,939,575	120,836	69,197	120,000	107,789	1,120,000	160,000	342,853	300,000	50,400							1,056,734	60,501,760	1877
1878	21,689,682	50,000	900,000	5,700,000	5,500,000	15,120,000	1,008,000	1,000,000	224,000	375,000	1,350,000			2,068,925	131,600	85,322	128,000	134,237	1,120,000	200,630	333,200	375,000	67,200							374,744	57,035,600	1878
1879	30,207,793	45,000	1,000,000	5,000,000	6,000,000	16,240,000	1,008,000	1,196,490	280,000	450,000	1,400,000			2,133,233	142,666	82,015	140,000	147,379	1,400,000	322,732	400,991	460,000	50,000								68,105,700	1879
1880	28,649,812	43,079	946,288	6,115,377	6,008,595	18,425,163	844,304	1,454,327	323,972	495,131	1,461,116	14,778	350	2,228,917	145,015	100,800	154,644	236,950	1,829,844	462,747	559,595	771,442	14,748	120,947	43,205	224				200	71,481,570	1880
1881	31,020,018	50,000	1,232,000	6,720,000	9,240,000	22,400,000	1,960,000	1,984,120	420,000	840,000	1,960,000	20,000	300	2,533,348	196,000	112,000	168,000	140,000	1,680,000	706,744	420,000	840,000	52,000	150,000	33,600	5,000				97,900	85,881,030	1881
1882	35,121,256	112,000	1,300,000	9,115,653	9,450,000	24,640,000	2,240,000	1,976,470	896,000	850,000	3,920,000	25,000	400	1,555,445	177,340	135,339	160,000	112,592	2,240,000	1,061,479	707,764	750,000	100,000	200,000	35,000	10,000	157,092			6,502,359	103,551,189	1882
1883	38,456,845	252,000	1,650,000	12,123,456	8,229,429	26,880,000	2,520,000	2,560,000	1,568,000	1,000,000	4,457,540	50,000	400	2,476,075	244,990	71,296	155,000	76,162	2,335,833	1,229,593	779,689	900,000	200,000	350,000	40,000	19,795	211,347			6,870,075	115,707,525	1883
1884	37,156,847	336,000	1,550,000	12,208,075	7,640,062	28,000,000	2,800,000	2,260,000	2,240,000	1,200,000	4,370,566	75,000	500	2,765,617	166,038	38,712	150,000	77,485	3,360,000	1,130,024	902,620	1,100,000	200,000	435,000	45,000	80,376	220,557	125,000	35,000	9,498,174	120,155,551	1884
1885	38,335,974	567,000	1,600,000	11,834,459	7,816,179	26,000,000	3,080,000	2,375,000	2,492,000	1,440,957	4,012,575	100,000	500	2,833,337	380,250	45,178	150,000	71,615	3,369,062	1,356,062	807,328	1,212,057	213,120	500,000	50,000	86,440	305,202	100,000	25,000		111,160,295	1885
1886	39,035,446	684,951	1,550,000	11,175,241	8,435,211	27,094,501	1,800,000	3,000,000	1,800,000	1,714,290	4,315,779	125,000	400	2,517,577	423,525	60,434	223,000	100,000	4,005,796	1,368,338	829,355	1,400,000	200,000	534,580	45,000	49,846	271,285	100,000	25,955	[illegible]	113,680,427	1886
1887	42,088,197	825,263	1,933,185	12,423,066	10,300,708	31,516,856	3,209,916	3,217,711	1,950,000	1,000,000	4,473,828	129,600	300	3,278,023	772,601	71,461	313,715	50,000	4,881,620	1,791,735	1,170,318	1,596,879	180,021	685,011	37,696	10,202	508,034	75,000	21,470	1,237,195	130,650,511	1887
1888	46,619,564	1,073,000	2,570,000	14,328,181	10,910,951	33,796,727	3,909,967	3,140,979	2,900,000	1,967,207	4,052,440	276,871	250	3,479,470	1,215,750	81,407	180,000	95,000	5,498,800	2,185,477	1,481,540	1,550,000	256,961	761,986	75,000	41,467	626,665	90,000	34,000	4,257,007	148,659,657	1888

1860	8,115,842	473,360	285,760	728,400	1,265,600	2,690,786	280,000	101,280	10,200	165,300	41,920	260		638,000	5,374	2,320	1,900													3,300	14,610,042	1860
1861	9,799,654	445,165	290,000	670,000	1,160,000	3,200,000	300,000	128,000	10,000	150,000	50,000			287,073	6,000	3,000	2,500	6,620													16,488,012	1861
1862	9,695,110	445,124	275,000	780,000	1,200,000	4,000,000	320,000	150,000	12,500	140,000	53,000		30,000	346,201	7,000	5,000	3,500	23,400													17,485,535	1862
1863	11,765,320	40,000	250,000	890,000	1,201,591	5,000,000	360,000	200,000	15,000	100,000	57,000		30,000	877,313	8,000	8,000	6,000	43,200	444,648												21,319,062	1863
1864	12,538,640	40,000	250,000	1,000,000	1,815,622	5,539,000	375,000	250,000	15,000	100,000	63,000		25,000	765,764	10,000	12,000	10,000	50,700	454,888	500											23,005,123	1864
1865	11,891,746	40,000	200,000	1,260,000	1,536,218	6,350,000	420,000	280,000	12,000	100,000	69,574		20,000	1,025,209	12,000	15,000	10,000	60,530	487,897	1,200	800										23,792,173	1865
1866	15,651,183	40,000	180,000	1,560,000	1,887,424	6,800,000	450,000	320,000	12,000	100,000	99,320		20,000	1,217,668	13,000	20,000	8,000	84,020	512,068	6,400	2,500										29,003,583	1866
1867	16,002,109	50,000	175,000	1,900,000	2,092,234	7,300,000	500,000	350,000	10,000	110,000	150,000		20,000	1,381,420	14,500	25,000	8,000	124,590	589,360	17,000	5,000										30,724,422	1867
1868	17,003,405	69,051	160,000	2,000,000	2,476,844	7,500,000	541,000	375,000	10,000	125,000	241,453		18,000	1,529,879	15,000	29,000	10,000	143,676	600,227	10,600	6,925										32,861,960	1868
1869	17,083,134	65,000	160,000	1,854,000	2,461,986	6,750,000	550,000	400,000	10,000	130,000	295,105		16,000	2,216,300	16,200	29,980	12,000	157,234	603,148	8,000	49,382	36,891									32,904,360	1869
1870	15,664,275	61,803	150,582	2,624,163	2,527,285	7,798,518	621,930	437,870	11,000	133,418	263,487		15,000	1,819,824	17,844	28,150	15,000	141,890	608,878	4,500	50,000	32,938	5,800							1,425	33,035,580	1870
1871	19,342,057	70,000	250,000	3,000,000	4,000,000	9,040,595	725,000	600,000	15,000	190,000	300,000		15,000	2,670,338	20,000	32,000	20,000	162,493	618,830	15,600	147,328	41,000								5,629,809	46,885,050	1871
1872	24,233,166	60,440	380,800	3,360,000	5,315,294	11,695,040	784,000	896,000	16,800	224,000	330,000		12,000	2,617,156	23,000	33,500	25,000	190,859	700,000	68,540	221,745	44,800								176,159	51,453,399	1872
1873	26,152,837	67,200	400,000	3,020,000	4,550,028	13,098,829	784,000	1,000,000	44,800	350,000	392,000		10,000	3,198,911	26,000	50,000	40,000	180,611	1,000,000	69,897	259,700	50,000								1,939,547	57,[illegible],480	1873
1874	24,818,790	70,000	360,000	4,203,000	3,207,555	12,320,000	780,050	812,000	50,400	350,000	789,936			2,590,392	30,352	58,000	60,000	215,352	1,120,000	77,372	219,061	85,000									52,605,920	1874
1875	22,485,766	60,000	500,000	4,453,178	4,864,260	11,700,000	840,000	800,000	67,200	360,000	1,231,547			2,808,013	99,568	62,500	80,000	166,638	1,120,000	95,538	300,808	150,000								40,000	52,348,320	1875
1876	22,793,245	55,000	650,000	5,000,000	3,500,000	12,880,000	1,008,000	950,000	112,000	550,000	1,250,000			2,126,873	110,342	60,000	110,000	128,049	896,000	117,666	334,550	225,000	50,400							300,875	53,280,000	1876
1877	25,660,316	50,000	850,000	5,350,000	5,250,000	14,000,000	1,008,000	1,000,000	196,000	450,000	1,300,000			1,939,575	120,696	69,197	120,000	107,789	1,120,000	150,000	342,653	300,000	50,400							1,056,734	60,501,760	1877
1878	21,689,682	50,000	900,000	5,700,000	5,500,000	15,120,000	1,008,000	1,000,000	224,000	375,000	1,350,000			2,068,925	131,060	85,322	128,000	134,237	1,120,000	200,630	333,200	375,000	67,200							374,744	57,135,000	1878
1879	30,207,793	45,000	1,000,000	5,000,000	6,000,000	16,240,000	1,008,000	1,196,490	280,000	450,000	1,400,000			2,132,233	142,666	52,015	140,000	147,379	1,400,000	322,732	400,991	460,000	50,000								68,105,799	1879
1880	28,649,812	43,079	946,288	6,115,377	6,008,595	19,426,163	844,304	1,454,327	323,972	495,131	1,461,116	14,778	350	2,228,917	145,015	100,900	154,644	236,950	1,829,844	402,747	589,595	771,442	14,748	120,947	43,205	224				200	71,481,570	1880
1881	31,920,018	50,000	1,232,000	6,720,000	9,240,000	22,400,000	1,960,000	1,984,120	420,000	840,000	1,960,000	20,000	300	2,533,348	199,000	112,000	168,000	140,000	1,680,000	706,744	420,000	810,000	52,000	160,000	33,000	5,000				97,900	85,881,030	1881
1882	35,121,250	112,000	1,300,000	9,115,653	9,450,000	24,640,000	2,240,000	1,976,470	896,000	850,000	3,920,000	25,000	400	1,555,445	177,340	135,339	160,000	112,592	2,240,000	1,061,479	707,704	750,000	100,000	200,000	35,000	10,000	157,092			6,502,368	103,551,189	1882
1883	38,456,845	252,000	1,650,000	12,123,456	8,229,429	26,880,000	2,520,000	2,560,000	1,568,000	1,000,000	4,457,540	50,000	400	2,470,075	244,800	71,298	155,000	76,162	2,335,833	1,229,593	779,689	900,000	200,000	350,600	40,000	19,795	211,347			6,870,075	115,707,525	1883
1884	37,156,847	336,000	1,550,000	12,208,075	7,640,062	28,000,000	2,800,000	2,260,000	2,240,000	1,200,000	4,370,566	75,000	500	2,765,617	166,036	36,712	150,000	77,485	3,360,000	1,130,024	902,620	1,100,000	200,000	425,000	45,000	80,376	220,557	125,000	35,000	9,498,174	120,155,551	1884
1885	38,335,974	567,000	1,600,000	11,834,459	7,816,179	26,000,000	3,080,000	2,375,000	2,402,000	1,140,957	4,012,575	100,000	500	2,833,337	380,250	45,178	150,000	71,615	3,369,062	1,356,062	807,329	1,212,057	213,120	500,000	50,000	50,440	306,202	100,000	25,000		111,160,295	1885
1886	39,035,446	684,951	1,550,000	11,175,241	8,435,211	27,094,501	1,800,000	3,000,000	1,800,000	1,714,290	4,315,779	125,000	400	2,517,577	423,525	60,434	223,000	100,000	4,005,796	1,368,338	829,355	1,400,000	200,000	534,580	45,000	42,840	271,285	100,000	25,955	794,917	113,680,427	1886
1887	42,088,107	825,263	1,933,185	12,423,066	10,300,708	31,516,856	3,209,916	3,217,711	1,050,000	1,000,000	4,473,828	129,600	300	3,278,023	772,601	71,461	313,715	50,000	4,881,620	1,791,735	1,170,318	1,596,879	180,021	685,911	37,696	10,202	508,034	75,000	21,470	1,237,105	130,650,511	1887
1888	46,619,564	1,073,000	2,570,000	14,328,181	10,910,951	33,796,727	3,909,967	3,140,979	2,900,000	1,067,297	4,952,440	276,871	250	3,479,470	1,215,750	81,407	180,000	65,000	5,498,800	2,185,477	1,481,540	1,850,000	258,961	761,986	75,000	41,467	626,665	60,000	34,000	4,257,907	148,659,657	1888
1889	45,546,970	865,786	2,399,755	12,104,272	9,976,787	36,174,089	2,557,823	2,943,057	3,572,983	1,925,689	4,095,358	279,584	222	2,939,715	1,030,578	67,431	225,934	119,820	6,231,880	2,597,181	1,388,947	2,221,043	236,651	752,832	64,359	303,301	486,943	128,216	28,907	1,400	141,229,513	1889
1890	46,468,641	784,011	2,701,496	15,292,420	11,494,506	42,302,173	2,735,221	3,305,737	4,090,409	2,169,585	4,021,739	399,888	10,262	3,357,813	1,363,689	74,977	228,337	110,711	7,394,654	3,077,003	1,870,366	2,259,922	318,159	869,229	61,514	517,477	375,777	184,440	30,000	807	157,770,963	1890
1891	50,665,431	736,399	2,916,069	15,660,698	12,808,683	42,788,490	2,674,606	2,973,474	4,760,781	2,413,678	3,826,495	542,379	20,355	3,920,239	1,056,249	80,307	171,000	93,301	9,220,665	3,512,632	2,327,841	2,716,705	371,045	1,091,032	61,826	541,861	462,328	172,100	30,000	2,000	168,566,669	1891
1892	52,472,504	675,205	3,025,313	17,862,276	13,562,927	46,694,576	2,733,949	3,345,174	5,529,312	2,092,064	3,918,491	535,558	9,679	3,410,962	1,213,427	77,990	215,493	65,178	9,738,755	3,510,830	2,503,839	3,007,276	361,013	1,102,721	34,661	564,648	661,330	245,690	40,726	1,500	179,329,071	1892
1893	53,967,543	820,339	3,007,179	19,949,564	13,253,646	44,070,724	2,807,442	3,791,851	5,136,935	1,002,259	3,972,229	574,763	17,000	3,716,041	1,264,877	45,979	372,740	72,603	10,708,578	4,102,389	2,439,311	2,652,546	413,205	1,252,110	41,683	892,309	665,094	302,200	49,630		182,352,774	1893
1894	51,921,121	1,229,053	3,111,192	17,113,576	11,909,856	39,912,463	2,245,033	3,423,921	4,307,176	2,180,879	3,967,253	512,626	16,900	3,501,428	1,106,470	70,022	354,111	67,247	11,627,757	2,331,409	2,417,463	3,388,251	431,550	949,606	47,521	937,396	597,196	420,848	42,015	150	170,741,526	1894
1895	57,999,337	1,368,324	3,357,770	17,735,864	10,355,806	50,217,228	2,372,393	3,995,892	5,603,775	2,535,644	4,156,074	598,322	24,900	3,915,585	1,191,410	112,322	260,998	75,453	11,387,961	3,052,982	2,246,911	2,926,870	471,836	1,211,185	73,685	1,504,193	720,054	484,959	38,297	200	193,117,530	1895
1896	54,346,081	1,254,723	3,333,478	19,786,626	12,876,202	49,557,453	2,331,542	3,905,779	5,748,697	2,663,106	3,054,028	675,374	7,813	4,143,936	1,195,504	92,882	236,546	76,544	12,876,296	3,112,400	2,229,624	2,884,901	418,627	1,366,646	101,721	1,543,445	622,626	544,015	78,050	18,792	191,986,357	1896
1897	52,611,680	1,528,302	3,602,097	20,072,758	12,196,912	54,417,974	2,065,626	4,151,169	5,893,770	2,888,849	4,611,865	856,190	21,280	4,442,128	1,434,112	223,592	195,869	87,992	14,248,159	3,361,703	2,597,896	3,054,012	521,560	1,336,380	107,289	1,647,882	716,981	639,341	77,246	18,565	200,229,199	1897
1898	53,382,644	1,815,274	3,687,908	18,599,299	14,516,867	65,165,133	2,688,321	4,920,743	6,535,263	3,022,896	4,619,842	1,205,479	11,495	4,674,884	1,884,571	315,722	244,187	145,888	16,700,999	4,076,347	2,853,812	3,400,555	503,709	1,381,466	58,184	1,479,803	992,288	680,734	83,806	17,039	219,976,267	1898
1899	60,418,005	2,105,791	4,607,255	24,439,019	16,500,270	74,160,175	3,025,814	6,006,523	7,593,416	3,330,659	5,177,479	843,554	26,896	4,807,396	2,029,881	624,708	233,111	160,015	19,252,995	4,776,224	3,837,392	3,852,267	766,049	1,637,427	80,888	1,490,451	1,050,714	863,832	98,809	1,277	253,741,192	1899
1900	57,367,915	2,393,754	5,328,964	25,767,981	18,988,150	79,842,326	3,540,103	6,484,086	8,394,275	3,509,563	5,202,939	1,447,045	17,734	4,024,688	2,474,093	849,475	315,557	171,708	22,647,207	5,244,364	4,014,602	4,467,870	1,147,027	1,922,298	58,864	1,601,775	1,290,299	969,373	129,883	1,210	269,684,027	1900
1901	67,471,667	2,725,873	5,469,086	27,331,552	20,943,807	82,305,946	3,802,088	6,918,225	9,099,052	3,633,290	5,617,499	1,518,136	12,000	5,113,127	2,578,217	1,241,241	342,825	151,079	24,068,402	5,700,015	4,485,374	4,900,528	1,322,614	2,421,781	69,011	1,396,081	1,080,546	1,107,053	100,001	1,300	293,299,816	1901
1902	41,373,595	3,182,093	6,766,984	32,939,373	23,519,894	98,574,367	3,890,154	9,446,424	10,354,570	4,382,968	5,904,766	1,913,932	23,000	5,271,609	2,681,214	964,718	414,083	84,984	24,570,826	7,401,343	4,429,491	5,266,065	1,574,521	2,820,666	65,848	1,560,823	1,048,763	601,912	226,511	4,242	301,590,439	1902
1903	74,607,068	3,451,307	7,538,032	36,957,104	24,838,103	103,117,178	4,238,586	10,794,692	11,654,324	4,798,004	6,419,811	2,229,172	17,309	4,846,165	3,193,273	1,367,619	416,951	104,673	26,337,241	7,423,602	4,035,293	5,839,976	1,681,409	3,517,388	91,144	1,488,810	1,541,781	926,759	278,645	4,997	357,356,416	1903
1904	73,156,709	3,410,914	7,576,482	36,475,060	24,400,220	97,938,287	4,108,303	10,842,189	11,262,046	4,782,211	6,519,933	2,009,451	7,000	4,813,622	3,137,681	1,342,840	383,191	78,888	32,406,752	6,658,355	5,178,556	6,333,307	1,493,027	3,046,539	111,540	1,358,919	1,452,325	1,195,944	271,928	4,174	351,816,398	1904
1905	77,659,850	4,275,271	8,432,523	38,434,363	25,552,950	118,413,637	3,983,378	11,895,252	11,866,069	5,766,690	6,798,609	1,934,673	1,557	5,108,539	2,864,926	1,473,211	351,991	77,050	37,791,580	8,826,429	5,602,021	6,423,979	1,332,372	2,924,427	109,041	1,643,832	1,649,933	1,200,684	317,542	9,656	392,722,635	1905
1906	71,282,411	4,254,879	9,653,647	41,480,104	27,731,640	129,293,206	3,758,008	12,092,560	13,107,963	6,259,275	7,266,224	1,864,268		5,435,453	3,276,184	1,346,338	332,107	25,290	43,290,350	10,111,218	6,133,994	6,024,775	1,772,551	2,860,200	70,731	1,620,921	1,964,713	1,312,873	305,689	11,706	414,157,278	1906
1907	85,604,312	4,710,895	10,753,124	51,317,146	32,142,419	150,143,177	3,997,936	13,985,713	14,250,454	6,810,243	7,574,322	2,670,438		5,532,628	3,680,532	2,035,858	362,401	13,950	48,091,583	10,790,236	6,252,990	7,322,449	1,047,607	3,642,658	70,981	2,016,857	2,128,959	1,618,069	347,760	17,727	480,363,424	1907
1908	83,268,754	4,259,042	10,246,553	47,659,690	26,270,639	117,179,527	3,317,315	12,314,890	11,604,593	6,199,171	7,161,310	2,078,357		4,377,093	3,024,943	1,835,019	264,822	15,755	41,897,843	9,634,973	5,489,902	6,216,508	1,846,792	2,948,116	80,259	1,820,190	2,167,037	1,895,377	320,742	8,586	415,842,698	1908
1909	81,070,359	4,752,217	10,697,361	50,904,990	27,939,641	137,966,791	3,756,530	14,834,259	13,703,450	6,358,646	7,757,762	2,377,157		4,023,241	3,602,203	1,784,082	211,196	15,838	51,849,220	10,716,936	6,393,109	6,986,478	2,266,899	3,119,377	87,276	2,553,940	[illegible]	1,824,440	422,047	7,363	460,814,616	1909
1910	84,485,236	6,507,997	14,623,319	45,900,246	34,209,668	150,521,526	2,982,433	18,389,815	16,111,462	7,121,380	7,928,120	1,905,958		5,217,125	3,911,899	1,534,967	177,245	11,164	61,671,010	11,973,736	7,533,088	4,921,451	2,517,809	2,646,226	67,533	2,920,970	3,508,321	1,592,176	399,041	5,448	501,596,378	1910
1911	90,401,067	8,504,667	14,019,703	53,679,118	30,759,986	144,561,257	3,836,107	14,201,355	15,021,421	6,433,156	7,331,648	2,106,789	120	4,685,795	3,572,815	1,476,074	165,210	10,747	59,831,580	10,157,363	6,744,864	6,178,728	2,513,175	3,074,242	46,661	2,076,358	3,148,158	1,974,593	502,628	2,721	496,371,126	1911
1912	84,361,598	7,846,038	16,490,521	59,885,226	31,628,727	161,865,488	4,339,850	15,286,718	16,100,600	6,473,228	7,289,529	2,100,819	200	4,961,038	3,350,032	1,206,230	227,503	10,978	66,786,687	10,977,824	7,308,124	6,986,182	3,016,149	3,675,418	41,037	3,048,495	3,536,521	2,186,612	490,480	3,319	534,466,580	1912
1913	91,524,922	8,824,048	19,016,600	61,618,744	36,200,527	173,781,217	4,318,125	17,165,671	17,678,522	6,860,184	7,525,936	2,234,107		4,779,839	3,877,891	1,231,786	255,626	24,839	71,254,136	9,232,510	7,393,066	7,202,210	3,254,828	4,165,770	46,063	3,240,973	3,708,806	2,429,144	496,320	14,789	569,960,219	1913
1914	90,821,507	7,959,535	20,382,763	57,589,107	18,843,115	147,983,294	3,935,980	16,641,132	15,593,422	5,943,258	7,461,022	1,536,540		4,133,547	3,064,820	1,283,030	166,493	(a)	71,707,626	8,170,559	6,475,293	6,860,988	3,103,036	3,058,613	51,558	2,805,173	3,877,659	2,323,773	506,655	25,821	513,525,477	1914
Total	2,537,517,517	104,247,316	228,511,417	1,023,105,520	701,521,601	2,879,928,353	124,104,452	268,273,230	270,547,780	129,693,623	194,054,110	38,396,128	477,125	179,787,226	67,524,260	24,194,741	9,591,796	5,153,264	859,196,650	183,532,257	125,216,211	136,567,749	37,355,870	63,462,777	2,217,379	44,205,232	45,374,295	28,973,063	5,930,201	39,034,202	10,367,655,414	

a From 1871 to 1888, inclusive, production reported in this column is due principally to colliery consumption, which in some years was estimated and not included in the distribution by States. Since 1888 small, irregular production from several unimportant sources has been included in this column.

Division of Mineral Resources. *C. E. LESHER, Geologist.*

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