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MINERAL RESOURCES
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PART II—NONMETALS

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CONTENTS.

[The dates of publication of the separate chapters are given in parentheses.]

NOTE.—Owing to the long delay in obtaining some of the figures for the chapters on petroleum, natural gas, and coal, it has been decided to omit these chapters from this volume and to include complete statistics in the volume for 1921. Certain figures on these subjects are given in the summary at the beginning of Part I of Mineral Resources for 1920.

ILLUSTRATIONS.

INSERT.

MINERAL RESOURCES OF THE UNITED STATES, 1920—PART II.

MAGNESITE.

By Charles G. Yale and Ralph W. Stone.

PRODUCTION.

A preliminary estimate published by the United States Geological Survey January 17, 1921, reported that between 275,000 and 300,000 short tons of crude magnesite had been mined and sold or treated in the United States in 1920. This estimate included 60,000 tons for California and 220,000 tons for Washington. Reports received from all producers show, however, that 303,767 short tons of crude domestic magnesite, valued at $2,748,150, was produced and sold or treated in 1920, an increase of 94 per cent in quantity and 120 per cent in value over 1919. Production and sales are not identical, because each year some magnesite is mined but for one reason or another remains at the mine unmarketed. This quantity, however, is small.

Crude magnesite produced and sold or treated in the United States in 1919–20.

State and county.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
California:				
Fresno, Riverside, San Benito	2,876	$28,986		
Fresno			708	$6,850
Napa, San Benito, Sonoma			16,608	218,750
Napa	10,112	86,752		
Santa Clara	10,912	128,924	26,400	389,950
Stanislaus	4,057	40,730	4,063	39,435
Tulare	22,063	219,581	34,003	428,277
	50,020	504,973	81,782	1,083,262
Washington: Stevens	106,206	743,442	221,985	1,664,888
	156,226	1,248,415	303,767	2,748,150

Crude magnesite produced and sold or treated in the United States, 1913–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1913	9,632	$77,056	1917	316,838	$2,899,818
1914	11,293	124,223	1918	231,605	1,812,601
1915	30,499	274,491	1919	156,226	1,248,415
1916	154,974	1,393,693	1920	303,767	2,748,150

The figures are not absolutely accurate, because reports made by producers to the Bureau of the Census for 1919 do not agree in all particulars with reports made by the same producers to the California State Mining Bureau or to the United States Geological Survey. It is for this reason that the Geological Survey figures for sales in California, based on reports made to the Bureau of the Census, show about 6,000 tons more than the figures published by the State Mining Bureau for 1919. There is a possible small inaccuracy in the figures for California for 1920, because not all the reports were consistent.

The value of the country's output of crude magnesite is uncertain, as it is calculated in part from sales of calcined magnesite. Magnesite mined in Washington was not sold crude on the open market, most of it being converted by the producing company into calcined or dead-burned magnesite and marketed as such. A value of $7 a ton was assumed for the crude magnesite produced in Washington in 1919. The figure is lower than the average price in California, because the Washington material can be mined cheaper. For 1920, on account of reported higher cost of labor and supplies, a value of $7.50 a ton has been assumed for crude Washington magnesite. This is purely an assumption for the purpose of continuing the statistical table in its original form.

IMPORTS.

The following statistics of imports were obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce, and converted for some tables from long to short tons. The first table shows that imports more than trebled, increasing from 15,852 tons in 1919 to 48,332 tons in 1920. This, however, is a small quantity compared with that usually imported before the World War:

Magnesite, not purified, imported into the United States in 1919 and 1920.

[General imports.]

Country.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Australia			38	$417
Austria-Hungary	2,650	$64,933		4
Canada	8,066	216,605	6,751	184,060
Czecho-Slovakia			4,288	126,827
England	29	4,849	31	3,511
Germany	34	2,023	799	28,566
Greece			4,480	38,418
Italy	2,416	62,753	23,727	241,220
Mexico	2,563	13,500	560	6,300
Netherlands			917	54,991
Scotland	94	9,369	213	13,720
Straits Settlements				4
Turkey in Europe			3,952	70,540
Venezuela			2,576	11,500
	15,852	374,032	48,332	780,078

Magnesite, not purified, imported into the United States in 1920, by months.

[General imports.]

Month.	Czecho-Slovakia.		Germany.		Italy.		Canada.		Other countries.[a]		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
January					3,133	$41,787	501	$11,626	413	$7,228	4,047	$60,641
February							963	25,547	139	9,725	1,102	35,272
March					5,428	78,169	849	20,620	263	5,983	6,540	104,772
April			31	$1,314			273	6,781	27	2,255	331	10,350
May					1,754	10,693	529	13,588	16	1,395	2,299	25,676
June							400	11,281	4,110	80,370	4,510	91,651
July			8	719	4	76	874	25,098	59	3,899	945	29,792
August					7,858	65,538	826	26,138			8,684	91,676
September	972	$30,471	15	1,409	2,242	15,417	585	18,037	2,639	12,720	6,453	78,054
October	1,305	40,317	73	1,963			465	12,375	120	6,623	1,963	61,278
November	834	25,976	133	1,461	3,308	29,540	334	8,099	4,745	55,395	9,354	120,471
December	1,177	30,063	539	21,700			152	4,870	236	13,812	2,104	70,445
	4,288	126,827	799	28,566	23,727	241,220	6,751	184,060	12,767	199,405	48,332	780,078

[a] Australia, Austria, Hungary, England, Greece, Mexico, Netherlands, Scotland, Straits Settlements, Turkey, Venezuela.

Imports from Austria, Hungary, Germany, and Italy increased from 5,100 to 28,814 short tons. Material received in 1920 from Czechoslovakia came from the former Hungarian mines near Jolsva and Nyustya, and most of Italy's large production came from the Province of Pisa. A shipment from Greece received in November was the first recorded from that country since 1916. Imports from Turkey in Europe may be Grecian magnesite taken to Turkey for calcining. The arrival of 2,300 tons of magnesite from Venezuela in September, 1920, was a notable event, as the records of imports of magnesite from that country are meager.

Magnesium compounds imported for consumption in the United States in 1919 and 1920.

Material.	1919		1920	
	Quantity. (pounds).	Value.	Quantity (pounds).	Value.
Magnesia:				
Calcined, medicinal	22,637	$11,358	26,859	$9,093
Carbonate of, medicinal	5,094	1,101	14,930	1,512
Sulphate of (epsom salts)	17,647	1,473	1,803,769	66,944
Magnesite:				
Calcined, not purified	18,941,440	270,721	29,559,040	373,165
Crude	12,761,280	103,311	67,099,200	406,204

Magnesite imported for consumption in the United States, 1914–1920.

Year.	Crude.		Calcined, not purified.	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.
1914	26,708,381	$54,677	243,633,205	$1,323,194
1915	99,527,772	255,140	53,148,739	232,071
1916	150,689,445	634,447	18,539,704	204,183
1917	60,554,420	232,105	7,931,159	232,601
1918	10,864,000	103,233	38,098,815	824,022
1919	12,761,280	103,311	18,941,440	270,721
1920	67,099,200	406,204	29,559,040	373,165

From the last table it appears that the declared value of crude magnesite at the port of shipment increased from $4 to $20 a ton during the war and fell to about $12 in 1920 and that calcined magnesite increased in declared value from $10 to $58 a ton and then fell to about $25 in 1920.

DOMESTIC CONSUMPTION OF MAGNESITE.

Prior to the World War the annual consumption of crude magnesite in the United States was approximately 300,000 short tons. About 10,000 tons was produced in this country, and the rest, or 96 per cent, was imported. Magnesite is imported in two forms, crude and calcined. It takes 2 tons of crude to make 1 ton of calcined. In order to have all figures on the same basis the quantity of calcined magnesite has been converted to the equivalent in the crude form and from long to short tons for use in the following table.

Magnesite (expressed as crude) consumed in the United States, 1910–1920, in short tons.

Year.	Domestic production.	Imports.	Total.	Percentage of imports to total.
1910	12,443	322,652	335,095	96
1911	9,375	270,098	279,473	97
1912	10,512	268,309	278,821	96
1913	9,632	347,428	357,060	97
1914	11,293	256,988	268,281	96
1915	30,499	102,913	133,412	77
1916	154,974	93,885	248,859	38
1917	316,838	38,208	355,046	11
1918	231,605	43,530	275,135	16
1919	156,226	25,321	181,547	14
1920	303,767	63,110	366,877	17

This table shows a reversal of conditions, imports falling to only 11 per cent of the large consumption in 1917 and to 14 per cent of the small consumption in 1919. The imports for the last four years have averaged only 15 per cent of the consumption. There was a small increase in the proportion of imports in 1920. The accompanying figure illustrates the large and fluctuating increase in production and the great decrease in imports.

CONDITION OF THE MAGNESITE INDUSTRY.

CALIFORNIA.

GENERAL FEATURES.

There was no decrease in the number of productive magnesite mines in California in 1920, the output of crude ore increased materially in quantity and more than 100 per cent in value, and the average price per ton was much higher, yet the producers of magnesite in California report that the work of the year was not profitable to them, and their individual reports generally express complaint and discouragement. The causes of complaint are the excessive cost of labor, of supplies, and of freight to the Eastern States, and the competition of foreign magnesite. Miners in the California foothills who were getting first $5 and then $6 a day left the mines to pick oranges at $10 to $12 a day, and the large increase in domestic freight rates operated to cut off orders from the Eastern States, where imported magnesite was obtainable. The imports have decreased the demand for California magnesite, most of which is now used as plastic material. All the larger mines of the State that made an output in 1919 continued to do so in 1920, the principal producers being the Tulare Mining Co., the Sierra Magnesite Co. (including the Porterville Magnesite Co.), the White Rock (or Sweasy) Co., the Western Magnesite Development Co., the Sampson mine, and the Plastic Magnesite Co. Few, if any, small new deposits were opened in 1920, the conditions not being favorable for obtaining capital in the magnesite industry

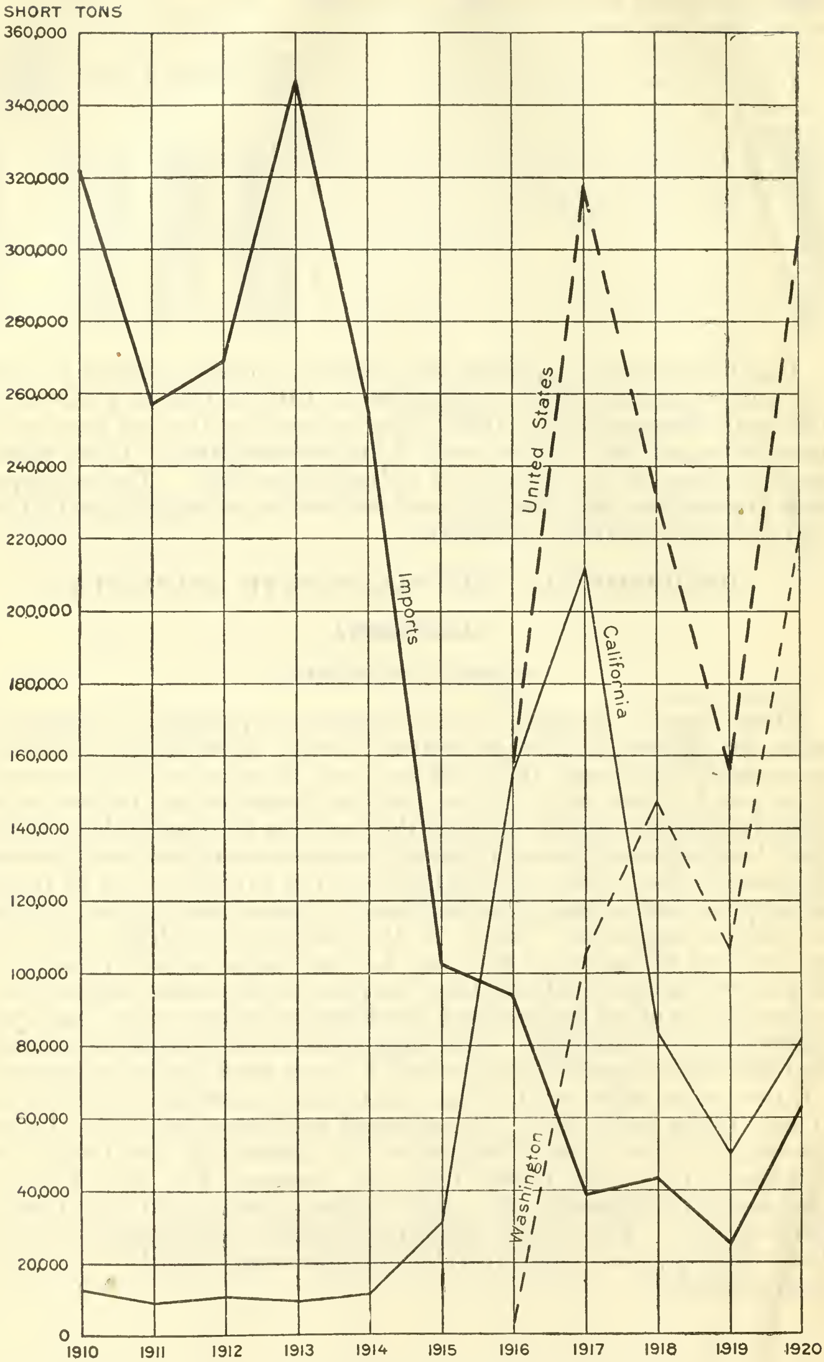

FIGURE 1.—Diagram showing production and imports of magnesite in the United States, 1910–1920, in short tons of crude magnesite.

Crude magnesite produced in California, 1913–1920.

Year.	Producing mines.	Quantity (short tons).	Value.
1913	1	9,632	$77,056
1914	6	11,293	124,223
1915	16	30,499	274,491
1916	45	154,259	1,388,331
1917	65	211,663	2,116,630
1918	30	84,077	761,811
1919	18	50,020	504,973
1920	18	81,782	1,083,262

The average spot price of all the California crude ore in 1920 was $13.25 a ton, as compared with $10.10 in 1919. Some of the larger companies obtained as high as $14 and even $15 a ton for the crude ore; other smaller mines sold for $8 a ton and even less. The average price of all the crude ore mined and shipped in 1920 in Fresno County was $9.68 a ton; in Napa, San Benito, and Sonoma counties, $13.17; in Santa Clara County, $14.77; in Stanislaus County, $9.71; and in Tulare County, $12.60. The quantity of ore resulting from the calcination of crude at the reduction plants of the mines was 30,758 tons, and the remainder of the crude was shipped to other points for calcination or for use as crude. The average price of the calcined ore in 1920 was $30 a ton, although some companies reported as high as $35 a ton. In general, the larger operators obtained more for both crude and calcined magnesite than the smaller operators, most of which have truck hauls to main-line railroads.

REVIEW BY COUNTIES.

Alameda County.—The Cedar Mountain mine made no output of magnesite in 1920. One lessee on the claim mined a nominal quantity of ore, but it was not enough to hold the lease and it was not shipped.

Fresno County.—The Frederick-Coughlin mine, Piedra, shipped a small quantity of ore in 1920, and then work was stopped, the deposit having been worked out. Sinclair Bros. & Ferguson calcined ore in their shaft kiln at Piedra, this coming in about equal quantities from the Ward and the Ferguson mines. Ore from the Ferguson mine has heretofore been sold to the refractories trade, but it is intended now to provide material for the plastic market. The costs were too high and prices too low to warrant much work in 1920. A small quantity of ore was shipped from Cramner's mine, in the vicinity of Watts Valley. No ore was produced by William Terrill, of Piedra, or the Vance mine, at Pine Flats.

Inyo and Kern counties.—The J. E. Gould mine, at Owenyo, Inyo County, was not operated in 1920, and there was no production from the county, although a little development work was done. Nothing was done at the Bissell deposit, in Kern County.

Napa County.—The only productive magnesite mine in Napa County in 1920 was the White Rock (Sweasy) mine, in Pope Valley, and it made a large output. All the ore was dead-burned in vertical kilns, with coke as fuel. Almost all this calcined ore was used for bottom lining in open-hearth steel furnaces, but a small quantity was made into magnesite brick. The Giant mine, Soda Valley, and the Soda Creek mine, Tulare Co.'s property, and White Cape mine, at Chiles Valley, were all idle during 1920.

Placer County.—No output was made in 1920 by either the Little Bear Magnesite Co or the Sullivan mine in Placer County.

Riverside County.—The only formerly productive mine in Riverside County, that of the Magnesco Refractory Products Co., near Winchester, was idle in 1920. Production ceased in 1919, the underground workings have caved, and the plant has been removed.

San Benito County.—At the Sampson mine, on Sampson Peak, near New Idria, all the ore produced was calcined in three kilns and shipped East in that form, being hauled to the main-line railroad on autotrucks from the mine. No other mine in the county made any output.

San Bernardino County.—The Cliffside Mining Co., at Yermo, was idle in 1920, and there are no other developed magnesite properties in San Bernardino County.

Santa Clara County.—The extensive mines of the Western Magnesite Development Co., at Red Mountain, in Santa Clara County, were worked in 1920 under lease by C. S. Maltby, of San Francisco. The calcined ore was used mainly as plastic material and was shipped in motor trucks 42 miles to the railroad station at Livermore. The ore was calcined in four vertical furnaces and in a new type of "fines" furnace, which is an old Scott quicksilver furnace that was formerly in use at the adjacent Phoenix quicksilver mine and has been rebuilt to handle the fine material from the Western mine, the coarser ore being put through the vertical kilns. Large quantities of fines are produced at the Sampson mine, San Benito County, and at the Western mine, in Santa Clara County, both under the same management in 1920. The Sampson has to consider its fines as waste, but handling them at the Western in the rebuilt quicksilver furnace has proved very successful, according to Mr. Maltby. A small output of ore was made from the Delaney lease on the Madrone Magnesite Co.'s mine, at Madrone; and some production was also made at the Jackson mine, Morgan Hill. Most of the small mines of the Bay Cities Water Co. in this county, usually worked under lease, were idle in 1920. The mine on the Catherine Dunn ranch was also idle.

Sonoma County.—The only productive property in Sonoma County in 1920 was that of the Cloverdale Magnesite Co., at Preston, formerly known as the Turton mine. The ore is especially adapted for refractory use. During the war this property yielded more than $200,000 worth of magnesite in the form of fire brick and furnace lining. The calcining plant has a capacity of 50 tons of crude ore daily, and there is also grinding machinery to put the calcined product in shape for the market. Oil is used as fuel. The mine on the Albert ranch was not worked in 1920 but will be started up again when the owners can be assured of contracts at $12 a ton for crude ore. The Guerneville Farms Co.'s property, the Lucky Elsie, and the Sonoma Magnesite Co.'s mine, at Guerneville, and the Standard mine, at Cazadero, were all idle in 1920.

Stanislaus County.—The most productive mine in Stanislaus County was that of the Plastic Magnesite Co., 16 miles west of Ingomar. The crude ore was shipped to the Adams Balcom Co., at Patterson, Calif. A small quantity of ore was shipped crude from the Bald Eagle mine, near Gustine. The Olympia mine, of the Red Mountain Magnesite Co., shipped crude ore only to the railroad at Patterson; the mine was under lease to Frame & Garrison in 1920.

Tulare County.—The Tulare Mining Co., always one of the largest magnesite producers of California, maintained its usual position in 1920. A small quantity of the ore was sold crude, but most of it was calcined at the furnaces of the company before shipment. The Sierra Magnesite Co., Porterville, was also a very large producer, but a new one in the industry, its corporate activities beginning October 1, 1920. It is understood that the Sierra Co. is controlled by the same interests as the National Kellastone Co., 155 East Superior Street, Chicago. The Sierra Co. has acquired the mining properties formerly worked by the Porterville Magnesite Co. and has also purchased the calcining plant previously owned by the American Magnesite Co. and later by the C. W. Hill Magnesite Co., of Porterville. The properties and plant of the Oakland Magnesite Co. were under lease during 1920 to the Porterville Magnesite Co., which has been declared bankrupt and whose records are in the custody of the bankruptcy court. The production of the Porterville Magnesite Co. for part of the year and that of the Oakland Co. are included in the figures of output of the Sierra Magnesite Co. in 1920, which makes this company appear among the largest in the State. It also has the calcining plant of the Oakland Magnesite Co. under lease, although little was done on that mine itself in 1920 while it was under lease to the Porterville Co. The Blue Crystal group of magnesite mines, at Lindsay, made some shipments of crude ore to Wilmington in 1920. The Rocky Hill and Merryman mines, at Exeter; the Dinuba mine, at Dinuba; the Schrei, at Lindsay; and the Burlington, at Lindsay, were all small producers in 1920. The Magnesite Refractories Co.'s property at Porterville, and the old Duncan mine, at Success, were not operated.

Tuolumne County.—Neither the Sims Creek (White Rock) nor the Stratton mines, at Chinese, in Tuolumne County, made any production in 1920.

WASHINGTON.

Three companies operating in Washington in 1920 mined 221,985 short tons of magnesite, or more than twice as much as in 1919. The growth of the industry since its beginning in December, 1916, is shown in the following table:

Crude magnesite produced and sold or treated in Washington, 1916–1920.

Year.	Operators.	Quantity (short tons).	Value.
1916	1	715	$5,362
1917	3	105,175	783,188
1918	2	147,528	1,050,790
1919	3	106,206	743,442
1920	3	221,985	1,664,888
		581,609	4,247,670

Of this production in 1920 a small quantity was shipped crude for experimental purposes; less than 50 tons was calcined for use in a paper mill; a few thousand tons was shipped in the calcined form for dead-burning elsewhere; and the remainder was dead-burned before shipment. Practically the entire shipment from Washington was sold or used for refractory purposes, less than 100 tons being employed otherwise.

The value of crude magnesite was not reported by the producers because the ore is not marketed in that form. For 1920 a value of \$7.50 a ton has been assumed, based on reported costs of mining plus profit. The total value of the calcined and dead-burned magnesite as shipped f. o. b. Chewelah and Valley in 1920 was approximately \$3,000,000, in comparison with a total value of about \$1,438,000 in 1919.

American Mineral Production Co.—The American Mineral Production Co., at Valley, operated the Allen and Moss quarries and shipped 62,877 tons over a half-mile track to the Finch quarry of the Northwest Magnesite Co. Here it was crushed and delivered over a 5-mile aerial tram to the plant at Chewelah. According to H. F. Wierum, general manager, this company has practically completed a specially designed kiln for calcining magnesite under closely controlled temperature conditions for the plastic trade. Calcining is conducted at a temperature far below the point at which calcium carbonate ($CaCO_3$) is broken up, hence the calcines contain no calcium oxide (CaO) whatever. The plant is expected to have a capacity of 1,000 tons a month and to produce a product ground to 98 per cent through a 150-mesh in a Raymond roller mill.

The American Mineral Production Co. ceased active mining on December 31, 1920. The company is continuing experiments with the preparation of calcined magnesite for use as a plastic material, and in 1921 is operating a small replica of the big kiln, producing plastic cancines for flooring, stucco, and other plastic magnesite products.

American Refractories Co.—The American Refractories Co. operated the Double Eagle magnesite deposit 12 miles from Valley, under an agreement with the Western Materials Co., which holds a lease on the property. A few thousand tons of crude magnesite was calcined in three small vertical stack kilns fired with wood, and the material was shipped to plants at Harper, Ohio, and Baltimore, Md., where it was dead-burned for making refractory products. About 60 men were employed at the quarry, and the ore was hauled to Valley by a fleet of 11 autotrucks. According to P. B. Mossman, vice president of the American Refractories Co., that company began to operate the property in 1920 because shipments could not be obtained from its own operations in Austria, nor could it purchase ferromagnesite on any terms from the one producer in the State of Washington. Mr. Mossman says in a letter dated February 16, 1921: "On account of the impassability of the wagon roads during the fall and early winter, we were unable to get our calcined material shipped, and our storage facilities were filled to the limit shortly before the end of the year, at which time the operation was shut down."

The Western Materials Co. was organized by F. M. Handy and B. E. Kehler, of Spokane, after the Valley Magnesite Co. became defunct. It leases the same deposit that was developed by the Valley Magnesite Co. under lease from the owner, the Double Eagle Mining Co.

Northwest Magnesite Co.—The Northwest Magnesite Co., Chewelah, continued to operate its Finch mine and was the largest producer in the United States, a position which it has held for four years. Its entire output, together with many thousands of tons of magnesite mined by the American Mineral Production Co. on its adjacent property, was made into synthetic ferromagnesite at the plant at

Chewelah. The Northwest Magnesite Co. uses six rotary kilns, 125 feet long and $7\frac{1}{2}$ feet in diameter, fired with pulverized coal for dead burning its product. Roy N. Bishop, manager of the company, writes under date of February 24, 1921:

The general slackness in the steel industry and the increased importations of Austrian magnesite material caused the refractory companies to discontinue ordering from us, and on December 31, 1920, we were compelled to completely shut down our plant.

It is reported that during much of the year the Northwest Magnesite Co. employed 350 men. The Finch quarry was operated in two shifts, and the calcining plant, with an average daily output of 350 tons of dead-burned magnesite, was operated on a three-shift basis. This company has been troubled by shortage of electric power during the period of low water, but has solved the difficulty by the erection of a 40-mile transmission line which brings electric current from the Long Lake plant of the Washington Water Power Co.

The company has planned the erection of a 6-mile aerial tram between the Keystone and Finch deposits. The Keystone deposit has been tested with the diamond drill and proved to contain a large body of ore. The proposed tram would connect with the line at the Finch quarry and make a continuous tram 11 miles long, ending at the kilns at Chewelah.

The magnetite (magnetic iron oxide) used by the Northwest Magnesite Co. in making ferromagnesite has been supplied by the Neutral mine, near Chewaw, Okanogan County, Wash. It is understood that the company has arranged to obtain a by-product iron from the Dupont Powder Works, at Tacoma, Wash., and the Neutral mine was recently closed.

New development.—Extensive exploratory development work was done on some of the Washington deposits in 1920. In the winter of 1919–20 the American Refractories Co. spent many thousand dollars in diamond drilling and developing the Double Eagle magnesite deposit to determine the quantity and grade of the material; the quantity was considered entirely too small to justify the building of a transportation line and kilns suitable for dead burning the ore. In the summer of 1920 the Northwest Magnesite Co. employed a geologist to make a detailed examination of the magnesite deposits in Stevens County and made a thorough examination of one of them, the Keystone deposit, by means of the diamond drill.

NEVADA.

In view of the increasing use of magnesite for plastic purposes, the following description of a massive deposit of magnesite examined by H. S. Gale, of the United States Geological Survey, in 1914, may be of interest. It was issued as a press bulletin at that time.

The deposit lies in Clark County, Nev., in the valley of Muddy River, one of the tributaries of Virgin River, a few miles above the town of St. Thomas. The material has been known for some time as kaolin.

The recognized outcrops have been located as mining claims, and some preliminary exploration and development work has been done. A side track on the St. Thomas branch of the Los Angeles & Salt Lake Railroad, about 3 miles northeast of the northernmost group of claims, offers a readily available railroad connection, and the station has been named Kaolin, from this deposit.

The so-called kaolin is in fact a magnesite and was deposited in a highly magnesian sedimentary bed, a part of a regularly stratified series of sedimentary strata exposed by stream channels that cut across a low ridge at the upper edge of Muddy Valley. The deposit forms a chalky-looking bluff, dazzlingly white in the bright sunlight. The material is porcelain-white, fine grained, and massive, is remarkably free from foreign material, and has the structureless appearance and conchoidal fracture that are generally characteristic of magnesite. It is not so hard as the more typical magnesite, and it crumbles more rapidly on exposure to the weather.

The deposit is included between tilted beds of conglomerate and sandstone below and shale above. The lower contact is sharply defined, but the magnesite grades off into the overlying beds. The purer part of the deposit consists of beds aggregating at least 200 feet in thickness. Within the section of purer material there are a few bands of sandy matter, but these are minor in amount and apparently almost negligible, as they could undoubtedly be avoided in mining. The whole section lies in the form of a "hogback"—that is, the softer beds lap up against a uniform slope of the sandstone and conglomerate that has a northeasterly dip of 30°-50°.

The region in which the deposit lies is in large part covered with alluvial wash, which conceals most of the bedrock formations, so that the section including the magnesite is exposed at only a few places where streams have cut down through the overlying deposits. The regularity of the exposed section and the continuity of the harder beds, which project through the surface wash, justify the assumption that the magnesite is practically continuous between exposures and for considerable distances beyond. Its length at the surface seems to be a mile, at least.

Unlike most of the magnesite deposits of California, this is not a vein deposit such as occurs with serpentine, but resembles closely the deposits discovered in 1911 at Bissell siding, near Mohave, Calif., both being interbedded with sandstone and shale and of sedimentary origin. The deposit at Bissell, however, does not appear to be so large or regular as the deposit on Muddy River. The similarity in the composition of the magnesite from the two places is shown by the analyses given below:

Analyses of samples of magnesite from Muddy River, Nev., and from Bissell, Calif.

	Muddy River, Nev.		Bissell, Calif.
	1	2	
SiO_2	11.12	11.82	9.64
$Al_2O_3+Fe_2O_3$	.98	.94	2.46
CaO	5.36	5.90	4.25
MgO	36.72	36.40	37.19
CO_2	[a] 44.15	[a] 43.45	40.70
	98.33	98.51	94.24

[a] Determined by loss on ignition, and therefore includes moisture.

The samples from Muddy River were analyzed by W. B. Hicks, of the United States Geological Survey; that from Bissell was analyzed by J. G. Fairchild, of the United States Geological Survey, and represents the average material from a bed 3 feet 7 inches thick, the most promising part of the deposit.

The two samples of the Muddy River magnesite deposit were taken from exposures in gulches about a mile apart. Sample 1 consisted of cuttings across a clean face and represented 10 feet of material in a section 200 feet thick; the remainder of this section is nearly all of apparently similar material, though a part of it may contain more silica in the form of sand. Sample 2 consisted of similar cuttings from another large exposure, where an even greater thickness of white beds is revealed, the sample representing, however, only about 4 feet in a section of 40 to 50 feet of notably pure white material. The high content of silica in the material from both places is evidently due to grains of sand that formed an original constituent of the deposits. The 5 to 6 per cent of lime shown by the analyses may prove a detriment to some uses of the magnesite, but in this respect the material closely resembles that from the Bissell deposit, at which magnesite was mined and shipped regularly in 1915.

IDAHO.

The following statement was written by E. V. Shannon, of the United States National Museum:

Hydromagnesite occurs as several deposits within 4 miles of Soda Springs, in Bannock County, Idaho. The mineral forms small discontinuous and disconnected surface deposits. One of these has a surface area of 13 acres, another of 8 acres, and another of 2 acres. The hydromagnesite is from 2 to 4 feet thick, although below 2 feet the material is somewhat discolored.[1]

An average and typical specimen of this material in the National Museum (catalog No. 94140) is white and earthy in texture and is somewhat friable. It is very similar in appearance to other white earthy materials and might be mistaken for chalk, clay, diatomaceous earth, or tripoli. It is not plastic. Under the microscope the material is apparently amorphous, and no definite optical properties can be determined. The mineral could not be identified without chemical tests. An analysis of this material, made by the writer in the laboratory of the National Museum, gave the following results:

Analysis of hydromagnesite from Soda Springs, Idaho.

Insoluble and silica (SiO_2)	7.52
Alumina and ferric oxide (Al_2O_3, Fe_2O_3)	1.77
Magnesia (MgO)	38.28
Lime (CaO)	1.18
Carbon dioxide (CO_2)	34.97
Water (H_2O) above 105° C	15.41
Water (H_2O) below 105° C	1.06
	100.19

From the nature and occurrence of this earthy hydromagnesite it would be expected to be impure. Deducting as impurities the silica, insoluble matter, lime, iron, alumina, and water below 105° C. the remaining constituents, recalculated to 100 per cent, compare as follows with the theoretical composition of hydromagnesite:

	Original percentage.	Recalculated percentage.	Theoretical percentage.
MgO	38.28	43.18	43.90
H_2O	15.41	17.38	19.80
CO_2	34.97	39.44	36.30
	88.66	100.00	100.00

These figures show that the sample analyzed consisted of approximately 90 per cent of hydromagnesite and 10 per cent of various impurities. These deposits are quite probably of economic value as a source of magnesite for refractory materials and for the other uses for which magnesite is suited, as the material is of a fair degree of purity and can be cheaply mined.

DISTRIBUTION AND USES.

As may be inferred from the preceding text the principal deposits of magnesite in the United States are in California and Washington. In California the deposits are scattered along the Coast Range from Mendocino County on the north to Riverside County on the south and along the western slope of the Sierra Nevada from Placer County to Kern County. The largest deposits are in Red Mountain, south of Livermore, Santa Clara County; in Sampson Peak, San Benito County; and in the vicinity of Porterville, Tulare County.

In Washington the deposits are in Stevens County, about 60 miles north of Spokane, and a few miles west of Valley and Chewelah. Magnesite occurs also in Nevada, New Mexico, and other States, but is not mined.

According to a rough estimate, probably 57,000 of the 81,000 tons of magnesite produced in California in 1920, was used for plastic material and 24,000 tons for refractory material. Of the total pro-

[1] Information furnished by J. Spotts McDowell, personal letter, Nov. 13, 1920.

duction of the country, approximately 246,000 tons was used for refractory material and 57,000 tons for plastic material. A division of imports in 1920 by sources and probable utilization gives 33,000 tons for refractory and 15,000 tons for plastic and other uses. These items taken together show that approximately three-quarters of the magnesite consumed in the United States is for refractory use and one-quarter for plastic and other uses.

Practically all the magnesite produced in Washington in 1920 was made into synthetic ferromagnesite at Chewelah and went to steel plants and to manufacturers of refractory products. The remainder of the output was calcined near Valley and shipped East for use in refractory products. In the dead-burned form, either granular or made into brick, it is used as a refractory lining for open-hearth furnaces and converters in the steel industry, and in copper converters, reverberatories, settlers, and electric and other melting and welding furnaces. Magnesite brick are used also for lining rotary kilns used in the manufacture of Portland cement.

The magnesite produced in California in 1920 was used largely in the caustic calcined form for the manufacture of oxychloride or Sorel cement. The use of magnesite cement in floors and as interior and exterior wall plaster is growing in this country. Magnesite from California mines is used also for making carbon dioxide, pipe and furnace coverings, and other products which consume only a small part of the output. The output of the White Rock mine, Napa County, and of a mine at Preston, Sonoma County, is used by Pacific coast steel plants as a refractory lining in their basic, open-hearth, and electric furnaces.

Magnesite or Sorel cement consists of finely ground calcined magnesite mixed with a solution of magnesium chloride. This mixture is generally modified by the addition of filler materials, such as wood fiber, cork, talc, asbestos, clay, marble dust, and sand, besides coloring matter.

The use of magnesite cement as flooring in Army camps and transports during the World War must have called this material to the attention of many people and besides giving a temporary boost to the magnesite flooring industry seems to have helped the California magnesite industry as a whole, for it is several times larger than it was before the war. Magnesite floors were used in mess halls, kitchens, pantries, hospitals, and toilets, and in the living quarters of Army transports.

The following specifications for magnesite cement are furnished by P. H. Bates, Bureau of Standards, Department of Commerce:

Magnesite flooring composition.

	Per cent by weight.	
	Top coat.	Under coat.
Magnesium oxide	45	40
Wood flour	15	25
Asbestos	5	0
Color	10	10
Kaolin, talc, or kieselguhr	10	10
Silica	15	15

Of this mixture 90 per cent should pass a 100-mesh sieve, and 85 per cent of magnesium oxide and 90 per cent of silica should pass a 200-mesh sieve. After thoroughly mixing this dry material it should be wet with a 22° Baumé solution of magnesium chloride.

Magnesite stucco composition.

	Per cent by weight.
Magnesium oxide	10–15
Silica, fine ground	20–25
Sand	70–60

This material is mixed dry and then wet with magnesium chloride of about 22° Baumé.

The following specifications for magnesite stucco were proposed at a conference of the War Industries Board, October 17, 1918:

Magnesite stucco composition.

Base coat.	Pounds.	Finish coat.	Pounds.
Magnesium oxide	335	Magnesium oxide	335
Asbestos fiber	40	Asbestos fiber	40
Granite-marble flour	150	Ground silica	100
Sand	1,475	Sand—Ottawa	1,525
	2,000		2,000
Magnesium chloride	320	Magnesium chloride	320

Average specification:	Pounds.
Magnesium oxide	335
Asbestos fiber	40
Granite-marble flour	150
Ground silica	50
Sand—Ottawa	1,425
	2,000
Magnesium chloride	320

Magnesium oxide to be not less than 85 per cent of magnesium, calcined to show loss by weight at ignition of not less than 2 per cent and not more than 6 per cent; ground so that not more than 3 per cent is held on a 100-mesh screen. Magnesium chloride to be 97 per cent pure, not more than 1 per cent CaCl.

DOMESTIC SUPPLY.

In October, 1917, when the development of the Washington magnesite deposits had been in progress less than a year the United States Geological Survey published the following statement:

> Computations of the quantity of magnesite in these deposits are astoundingly large when compared with the quantity of magnesite found in other localities in the United States. On more than one of the properties an estimate of 1,000,000 tons of ore within 100 feet of the surface is reasonable. It is safe to say that there are 7,000,000 tons of magnesite in the Stevens County district, and exploratory drilling may multiply this estimate many fold.

Since 1917 considerable diamond drilling has been done, and many samples of magnesite have been analyzed to determine its quality. Detailed work by the companies operating the deposits shows that although there are several million tons of magnesite in the Stevens County district, it is not all of commercial grade. In fact, the magnesite containing the low percentage of silica and lime specified by the refractory trade may not exceed 3,500,000 tons. It is understood that a recent detailed examination of the entire magnesite field in Stevens County indicates that it contains approximately 3,000,000 tons of commercial magnesite. With this reserve, and under the present specifications of the refractory trade, the deposits in Washington will support a production of 200,000 tons annually for only about 15 years.

The quantity of commercial magnesite in California is difficult to estimate, but it is believed that 1,000,000 tons would be rather liberal. As the production in the last six years has averaged slightly more than 100,000 tons annually, only a 10-year supply is available from the known deposits of California.

The exhaustion of the domestic deposits may be retarded by (1) discovery and utilization of deposits at present unknown or undeveloped, (2) development of new methods permitting the use of lower-grade ore, (3) substitution of dolomite or other material in place of magnesite for some uses, (4) importation of magnesite. It is always possible that new deposits may be discovered, but the chances are that they will be far from transportation facilities. New methods may be devised by which magnesite not now considered usable may find a market. On the other hand, new uses may be developed which will increase the demand for high-grade ores. The use of dead-burned dolomite as a substitute for magnesite has reached considerable proportions. The extent of reserves in other countries which have supplied much of our need in the past is not known to the writers. It is certain, however, that if the United States continues to consume 50 per cent or more of the world's output of magnesite it must place considerable dependence on foreign deposits.

WORLD'S PRODUCTION.

Magnesite produced in 1913–1920, by countries, in metric tons.

Country.	1913	1914	1915	1916	1917	1918	1919	1920
Australia	7,217	2,055	1,815	4,032	9,606	4,157	9,767	....
Austria-Hungary [a]	422,439	279,651	78,314	81,771	106,783	(b)	(b)	....
Canada	....	....	26,815	52,387	57,397	52,276	18,968	29,447
Greece	98,517	136,701	159,981	199,484	162,938	39,340	29,885	....
India	14,457	1,707	7,569	17,922	18,493	5,947	17,401	....
Italy	600	1,140	9,200	18,252	31,070	28,882	35,930	....
Spain	958	583	1,400	2,500	800	1,700	120	....
Union of South Africa	403	519	569	553	709	756	929	....
United States	8,738	10,245	27,668	140,589	287,429	210,107	141,725	275,571
Venezuela [c]	....	....	....	6,360	1,700	....	....	2,300
	553,329	432,601	313,331	523,850	676,925	343,165	254,725	....

[a] Exports computed on basis of 2.1 tons crude to 1 ton sintered.
[b] Figures not available.
[c] Figures not verified.

PRODUCERS OF MAGNESITE IN 1920.

CALIFORNIA.

Bay Cities Water Co., Humboldt Bank Building, San Francisco.
Cloverdale Magnesite Co., Preston.
A. D. Davenport, Gustine.
Edward Duryee, Exeter.
Frederick-Coughlin, Piedra via Reedley.
J. D. Hoff Asbestos Co., Monadnock Building, San Francisco.
Jackson Magnesite Co., Morgan Hill.
Alvah Joyner, Exeter.
Lawton & Cone, Lindsay.
Madrone Magnesite Co., Madrone.
Oakland Magnesite Co., Realty Syndicate Building, Oakland.
Plastic Magnesite Co., Ingomar.
Red Mountain Magnesite Co., Russ Building, San Francisco.
E. F. Schrei, Lindsay.
Sierra Magnesite Co., Porterville.
Sinclair Bros. & Ferguson, Fresno.
Frank R. Sweasy, Humboldt Bank Building, San Francisco.
Tulare Mining Co., 310 Sansome Street, San Francisco.
Western Magnesite Development Co., Humboldt Bank Building, San Francisco.

WASHINGTON.

American Mineral Production Co., Valley.
American Refractories Co., Valley.
Northwest Magnesite Co., Chewelah.

SALT, BROMINE, AND CALCIUM CHLORIDE.

By R. W. Stone.[1]

SALT.

PRODUCTION AND TRADE CONDITIONS.

The quantity of salt produced and sold in the United States in 1920 was 6,840,029 short tons, valued at $29,894,075, a decrease of 42,873 tons but an increase of nearly $3,000,000 over 1919.

Salt produced and marketed in the United States, 1916–1920.

Year.	Quantity (short tons).				Total value.[a]	Average price per ton.
	Manufactured (evaporated).	In brine.	Rock salt.	Total.		
1916	2,454,836	2,539,717	1,368,353	6,362,906	$13,645,947	$2.14
1917	2,482,564	2,890,588	1,605,025	6,978,177	19,940,442	2.86
1918	2,724,203	2,830,600	1,683,941	7,238,744	26,940,361	3.72
1919	[b] 2,392,290	2,850,639	[b] 1,639,973	6,882,902	27,074,694	3.93
1920	2,409,924	2,819,916	1,610,189	6,840,029	29,894,075	4.37

[a] The values do not include cost of cooperage or containers. [b] Revised figures.

The figures in this table show a small increase in the quantity of manufactured salt and a small decrease in the quantity of salt in brine and rock salt. The average price per ton of all salt marketed by the original producers in 1920 was $4.37, or more than double the average price in 1916.

Statements made by many producers suggest that although there was a small decrease in production the increase in cost, especially of coal, cooperage, and labor, was much greater than the increase in price. One firm reports that the cost of operation in 1920 was three times as much as it was before the war. In some parts of the country the demand fell off during the later part of the year.

PRODUCTION BY STATES.

In 1920 the leading States in total quantity of salt produced were Michigan, New York, Ohio, Kansas, and Louisiana. There were two new producers in Louisiana, making four in all, so that the production of that State can be shown for the first time without dis-

[1] The statistical part of this report is the work of Miss E. A. Menaugh for domestic material and of J. A. Dorsey for imports and exports.

closing confidential information. The new producers in Louisiana were the Benners Salt Co. (Inc.), operating a mine at Anse La Butte, St. Martin Parish, and the Jefferson Island Salt Co., operating a mine at Jefferson Island, Iberia Parish.

The number of operating plants in California was 24, Michigan 21, New York 15, Kansas 13, Ohio 8, and other States from 1 to 6 each, a total of 104 plants, as compared with 102 plants in 1919.

Salt produced and marketed in the United States, 1917–1920, by States.

State.	1917		1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Michigan	2,250,939	$6,877,202	2,403,125	$9,048,650	2,492,378	$9,456,138	2,262,915	$10,698,674
New York	2,164,069	5,371,713	2,130,530	7,336,867	1,947,829	7,159,547	1,903,101	7,584,921
Ohio	1,026,803	2,839,575	1,089,887	3,273,390	991,730	2,362,941	1,057,802	3,324,492
Kansas	746,976	2,027,466	819,504	3,598,289	773,576	4,497,247	783,655	3,839,409
Louisiana	(a)	(a)	(a)	(a)	(a)	(a)	265,085	1,517,414
California	215,154	933,429	204,957	1,167,777	200,115	1,555,596	212,008	1,301,426
Texas	85,181	564,029	79,657	762,006	(a)	(a)	91,103	667,835
Utah	79,195	352,145	94,204	580,375	77,336	432,130	75,259	546,186
West Virginia	24,844	191,044	26,077	251,668	18,599	167,529	29,802	348,556
Idaho	16	216	(a)	(a)	39	530	(a)	(a)
Nevada	(a)	(a)	970	4,175	(a)	(a)	(a)	(a)
Undistributed [b]	385,000	783,623	389,833	917,164	381,300	1,443,036	159,299	65,162
	6,978,177	19,940,442	7,238,744	26,940,361	6,882,902	27,074,694	6,840,029	29,894,075

[a] Included under "Undistributed."
[b] 1917: Hawaii, Louisiana, Nevada, New Mexico, Oklahoma, Pennsylvania, Porto Rico, and Virginia; 1918: Hawaii, Idaho, Louisiana, New Mexico, Oklahoma, Porto Rico, and Virginia; 1919: Hawaii, Louisiana, Nevada, New Mexico, Porto Rico, Texas, and Virginia; 1920: Hawaii, Idaho, Nevada, New Mexico, and Virginia.

ROCK SALT.

New York is by far the largest producer of rock salt and is followed by Kansas, Louisiana, and Michigan. State totals may not be published without disclosing individual output, because in most States there are only one or two producers.

The following table gives the total output by 18 producers in 8 States:

Rock salt produced and marketed in the United States, 1916–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.
1916	1,368,353	$2,665,270	$1.95
1917	1,605,025	3,897,595	2.43
1918	1,683,941	5,684,661	3.38
1919	[a] 1,639,973	[a] 6,224,920	3.80
1920	[b] 1,610,189	[b] 7,048,315	4.38

[a] Revised figures.
[b] Includes 15,182 tons of pressed blocks, valued at $172,211, made from rock salt.

BRINE SALT.

The following table shows the quantity and value of the various grades of salt produced by evaporating natural and artificial brine:

Brine salt produced and marketed in the United States, 1916–1920.

Year.	Table and dairy.		Packer's salt.			
			Common fine.		Common coarse.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	654,601	$4,326,531	1,048,032	$3,314,795	567,985	$1,958,094
1917	688,022	5,908,788	1,048,572	5,311,668	493,515	2,659,013
1918	804,482	7,336,667	1,072,331	7,024,631	541,329	3,689,807
1919 [a]	717,062	7,570,220	860,474	5,823,246	[b] 480,125	[b] 3,703,586
1920	732,195	8,369,065	880,329	6,371,988	511,030	3,985,796

Year.	Coarse solar.		Pressed blocks.		Other grades.		In brine.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	116,913	$339,079	[c] 67,305	[c] $210,337	(c)	(c)	2,539,717	$831,841	4,994,553	$10,980,677
1917	159,361	524,987	64,380	457,273	28,714	$97,532	2,890,588	1,083,586	5,373,152	16,042,847
1918	191,260	903,669	94,150	939,900	20,651	115,761	2,830,600	1,245,265	5,554,803	21,255,700
1919 [a]	143,413	776,433	119,510	1,358,757	71,706	194,108	2,850,639	1,423,424	[b] 5,242,929	[b] 20,849,774
1920	154,348	833,108	114,042	1,342,830	17,980	108,576	2,819,916	1,834,397	5,229,840	22,845,760

[a] Figures for subdivisions of evaporated salt in 1919 have been derived by dividing the correct total proportionately among the kinds.
[b] Revised figures.
[c] "Pressed blocks" includes "Other grades."

No very marked change in the quantity of salt of any of these classes sold during the last three years is noted, but the general increase in price is shown by increases in total values. The evaporated salt, except that in brine sold as such or used by chemical works, was produced in the States and in the quantities shown in the following table:

Evaporated salt produced and marketed in the United States in 1919 and 1920, by States.

State.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
California	158,651	$1,310,062	211,978	$1,301,126
Kansas	338,183	3,215,343	282,533	2,461,287
Louisiana	(a)	(a)	1,495	12,512
Michigan	[b] 995,279	[b] 8,036,287	951,189	9,156,170
Nevada	(a)	(a)	(a)	(a)
New York	436,209	3,785,279	471,727	3,996,265
Ohio	301,730	1,923,656	297,802	2,534,490
Texas	(a)	(a)	91,103	667,835
Utah	73,313	416,347	71,473	522,620
West Virginia	18,599	167,529	29,802	348,556
Undistributed [c]	70,326	571,847	822	10,502
	[b] 2,392,290	[b] 19,426,350	2,409,924	21,011,363
Percentage of increase in 1920			0.74	8.16

[a] Included under "Undistributed."
[b] Revised figures.
[c] 1919: Hawaii, Idaho, Nevada, New Mexico, Porto Rico, and Texas; 1920: Hawaii, Idaho, New Mexico, and Virginia.

AVERAGE PRICE.

The following table shows the average prices received by the producers for rock salt and brine salt in certain States during the last five years. The rise in prices is very apparent.

Average price per ton of domestic salt, 1916–1920, by States.

State.	Rock salt.					Brine salt.[a]				
	1916	1917	1918	1919	1920	1916	1917	1918	1919	1920
California	$2.99	$4.21	$5.50	$5.92	$10.00	$4.20	$4.34	$5.69	$8.26	$6.14
Hawaii	......	......	......	......	......	7.00	15.00	18.00	9.99	......
Idaho	10.00	10.00	10.00	......	......	15.00	15.60	18.00	13.59	......
Kansas	1.35	1.66	2.53	2.94	3.40	2.61	3.63	5.91	9.51	6.43
Louisiana	2.28	3.37	3.67	5.05	5.71	......	......	......	......	8.37
Michigan	2.60	2.92	3.63	[b]3.82	4.32	2.18	3.06	3.78	[b]4.22	4.76
Nevada	......	3.00	3.00	......	......	4.35	3.18	5.32	6.00	......
New Mexico	......	......	......	1.50	......	2.00	2.41	10.00	2.34	......
New York	1.98	2.41	3.59	3.88	4.42	1.81	2.52	3.33	3.37	3.68
Ohio	......	......	......	......	......	2.17	2.77	3.00	2.38	3.14
Oklahoma	......	......	......	......	......	6.22	6.61	4.74	......	......
Pennsylvania	......	......	......	......	......	......	3.00	......	......	......
Porto Rico	......	......	......	......	......	2.62	4.24	4.00	4.90	......
Texas	......	......	......	......	......	5.46	6.62	9.56	8.74	7.33
Utah	2.24	2.54	3.50	3.92	6.27	4.99	4.60	6.35	5.68	7.31
West Virginia	......	......	......	......	......	3.67	7.69	9.65	9.00	11.70
Average for the United States	1.95	2.43	3.38	3.80	4.38	2.62	2.99	3.83	3.98	4.37

[a] Includes evaporated salt and salt in brine. [b] Revised figures.

PRESSED BLOCKS.

It has been common practice for many years to salt cattle by placing large lumps of rock salt in the field or stable. Recently pressed blocks of salt have been put on the market as a substitute. It is believed that the pressed block was originated as a means of disposing of refined salt spilled around the machines in the evaporating and packing departments. The blocks are made by a hydraulic press and may be composed of salt alone or may contain a small quantity of sulphur or other medicament of benefit to cattle. The production of pressed blocks in the last four years as reported by the original producers of the salt is shown in the following table. This does not represent the entire pressed-block industry, because some firms that do not produce salt are making pressed blocks of salt bought in the open market.

Pressed blocks produced and sold in the United States, 1917–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.
1917	64,380	$457,273	$7.10
1918	94,150	939,900	9.98
1919	119,510	1,358,757	11.37
1920	129,224	1,515,041	11.72

The price per ton received by the producers in 1920 ranged from $8 to about $50. The high-priced product was a compound prepared as a tonic for stock, compressed into bricks, and packed in individual cartons.

DOMESTIC CONSUMPTION.

The population of the continental United States in 1920 was nearly 106,000,000. As the salt produced and sold in the United States amounted to 6,840,000 short tons, this quantity was equivalent to about 130 pounds of salt per capita. This large quantity for each individual in the country included, of course, salt used in packing meat, curing fish, tanning hides, dairying, refrigerating, and chemical industries. Only a few pounds are actually used by each person for seasoning food. The following table shows that nearly all the salt used in the United States was of domestic origin and that in 1920 the imports practically balanced the exports.

Supply of salt for domestic consumption, 1916–1920, in short tons.

Source.	1916	1917	1918	1919	1920
Domestic production	6,362,906	6,978,177	7,238,744	6,882,902	6,840,029
Imports	122,079	64,922	40,290	59,514	137,654
	6,484,985	7,043,099	7,279,034	6,942,416	6,977,683
Exports	84,065	113,993	136,783	119,416	139,272
Domestic consumption	6,400,920	6,929,106	7,142,251	6,823,000	6,838,411
Comparison with preceding year	+1,006,659	+528,186	+213,145	−319,251	+15,411
Percentage of imports to total consumption	1.9	0.9	0.6	0.9	2.0

IMPORTS.

According to figures obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce, and converted from pounds, as reported by that bureau, to short tons, the salt imported and entered for consumption in the United States in the last five years was as follows:

Salt imported and entered for consumption in the United States, 1916–1920.

Year.	In bags, barrels, and other packages.		In bulk.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	24,402	$200,290	97,677	$142,298	122,079	$342,588
1917	13,472	139,339	51,450	140,796	64,922	280,135
1918	10,259	148,128	30,031	133,340	40,290	281,468
1919	9,676	137,627	49,838	105,077	59,514	242,704
1920	29,567	240,923	108,087	435,576	137,654	676,499

The source of the imported salt is shown in the following table:

Salt imported into the United States, 1918–1920, by countries.

[General imports.]

Country.	1918		1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
France			56,000	$601		
Germany			6,613,800	81,698	47,669,300	$143,158
Netherlands					314,700	294
Portugal	112,000	$216	22,100	242	17,008,000	34,624
Spain	10,180,000	6,750	55,722,100	37,952	65,732,100	71,158
England	34,102,700	219,007	18,401,200	139,408	44,281,500	236,374
Scotland					200	1
Canada	589,200	6,663	299,700	3,050	3,156,200	22,188
Panama				1		
Mexico	76,500	614	79,700	637		
British West Indies	25,779,400	35,815	41,930,900	55,423	74,961,600	124,654
Cuba	103,800	134				
Dutch West Indies	4,731,400	8,779	2,139,300	4,633	20,415,600	39,571
French West Indies	200,000	425			1,106,200	2,868
Virgin Islands of the United States			374,600	725		
Argentina					228,400	1,142
Dominican Republic	3,858,000	4,824				
Venezuela					75,600	137
Japan	200	5	1,500	12	300	4
Hongkong			200	5	100	17
Portuguese Africa	896,000	800				
Australia			1,100	15		
Canary Islands					358,400	309
	80,629,200	284,032	125,642,200	324,402	275,308,200	676,499

The larger part of the imported salt is coarse solar salt, made by evaporating sea water, and comes from the West Indies and Spain. In 1920 there was a very notable increase in the quantity of salt imported from Germany, Portugal, England, Canada, and the Dutch West Indies.

EXPORTS.

Although there was a very considerable increase in imports in 1920, the quantity of salt exported was only a little greater than in 1919. The total, however, was the largest in the history of the industry, amounting to 139,272 short tons, valued at $1,901,593. The accompanying tables were compiled from the records of the Bureau of Foreign and Domestic Commerce.

Salt exported from the United States, 1916–1920.

Year.	Quantity.		Value.
	Pounds.	Equivalent in short tons.	
1916	168,129,201	84,065	$567,441
1917	227,985,222	113,993	1,000,773
1918	273,565,496	136,783	1,677,577
1919	238,831,706	119,416	1,396,625
1920	278,544,338	139,272	1,901,593

Salt exported from the United States, 1918–1920, by countries.

Country.	1918		1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Europe:						
Azores and Madeira Islands	....	....	1,471	$25	....	....
Belgium	....	....	....	....	600	$16
Denmark	....	....	....	....	4,800	150
France	10,000	$150	....	....	38,140	3,654
Germany	....	....	820	17	2,051	30
Greece	....	....	....	....	112	2
Iceland and Faroe Islands	51,284	2,031	12,570	439	2,000	77
Italy	4,400	67	2,520	48	....	....
Netherlands	....	....	1,000	20	....	....
Norway	2,160	84	7,500	222	....	....
Poland and Danzig	....	....	....	....	395	19
Rumania	....	....	....	....	274	17
Russia in Europe	27,714	241	5,308	174	6,000	96
Serbia and Montenegro, etc	....	....	200	3	....	....
Spain	....	....	....	....	92	8
Sweden	....	....	....	....	778,748	14,366
Switzerland	26,000	390	....	....	....	....
Turkey in Europe	....	....	8,536	526	4,720	118
United Kingdom—England	56,694	406	....	....	227,600	1,226
North America:						
Bermuda	295,650	2,909	34,840	622	138,221	1,697
British Honduras	611,722	4,598	320,166	3,228	300,285	3,404
Canada	160,360,923	617,907	157,596,910	654,657	182,799,386	959,451
Central American States:						
Costa Rica	240,819	4,200	649,177	6,233	438,134	4,995
Guatemala	173,521	1,876	132,199	1,883	132,098	2,219
Honduras	2,159,241	16,892	1,842,919	17,730	2,641,512	23,022
Nicaragua	557,894	6,883	700,306	8,932	566,838	8,908
Panama	5,881,821	49,707	3,945,329	37,980	3,137,777	36,457
Salvador	5,735	194	5,632	336	2,000	60
Mexico	6,958,031	78,554	7,931,184	89,534	10,647,691	130,022
Miquelon, Langley, etc	1,346	23	1,656	63	1,520	42
Newfoundland and Labrador	5,827,019	48,115	4,891,549	31,211	879,888	7,660
West Indies:						
Barbados	1,952	48	15,557	219	1,450	26
Jamaica	43,749	295	28,511	334	78,503	1,405
Trinidad and Tobago	3,105	88	4,890	66	15,908	445
Other British	15,262	428	19,327	646	10,551	330
Cuba	58,498,163	530,669	47,291,884	388,956	62,569,363	519,224
Dominican Republic	572,821	5,320	361,246	4,630	348,192	7,151
Dutch West Indies	487	10	190	12	....	....
French West Indies	20,158	572	24,281	705	8,539	367
Haiti	12,989	430	7,530	304	12,804	529
Virgin Islands of the United States	3,957	100	16,714	466	10,080	228
South America:						
Argentina	26,140	1,015	521,600	4,110	143,035	4,504
Bolivia	320	9	1,400	8	1,575	13
Brazil	7,946	127	3,799	118	3,831	217
Chile	27,044	452	5,160	132	20,386	647
Colombia	189,362	2,698	445,096	4,283	75,933	1,244
Ecuador	....	....	244	12	1,700	22
Guiana:						
British	18,453	334	710	19	9,739	373
Dutch	6,010	132	21,910	370	13,500	215
French	17,000	198	5,000	75	11,112	344
Paraguay	14,000	175	....	....	....	....
Peru	....	....	148	4	1,920	60
Uruguay	....	....	....	....	54	2
Venezuela	....	....	1,320	40	1,049	20
Asia:						
China	28,175	1,710	36,651	1,882	46,488	3,097
Kwangtung, leased territory	....	....	36	3	4,400	425
Japanese China	74	6	....	....	....	....
Chosen	5,819	225	11,297	386	6,802	192
East Indies:						
British:						
British India	42,269	2,975	18,619	1,201	6,169	634
Straits Settlements	7,345	439	18,728	742	1,458	148
Other British	11,882	755	5,506	299	2,776	207
Dutch	498,712	17,783	95,222	3,626	16,134	1,407
French	6,979	283	4,192	230	120	14
Hongkong	7,077	467	29,360	2,257	15,569	1,049
Japan	2,418,230	13,369	7,138,600	38,974	8,571,850	66,622
Russia in Asia	70	2	249,600	2,287	96,529	3,279
Siam	7,586	233	595	57	3,044	196
Turkey in Asia	....	....	12	1	176	12

Salt exported from the United States, 1918–1920, by countries—Continued.

Country.	1918		1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Oceania:						
British:						
Australia	3,992,560	$50,988	2,209,634	$44,457	1,155,704	$29,652
New Zealand	22,931,065	192,988	1,553,914	26,484	1,932,538	43,065
Other British	34,748	494	21,069	552	24,949	679
French Oceania	537,074	7,109	174,384	2,865	295,672	4,111
German Oceania	53,914	869	44,836	866		
Other Oceania					13,430	280
Philippines	222,679	7,760	192,976	7,760	252,593	11,256
Africa:						
Belgian Kongo	7,876	143	6,605	343	3,143	95
British Africa:						
West	17,522	567	61,110	1,034	2,274	28
South	124	2			100	2
East	1,200	40	595	19	700	21
French Africa	100	3	89,648	901		
German Africa			74	3		
Canary Islands					96	4
Liberia	520	19	56	1	302	14
Portuguese Africa	1,004	21	78	3	1,216	22
	273,565,496	1,677,577	238,831,706	1,396,625	278,544,338	1,901,593

According to the preceding table more than half the salt exported from the United States is sent to Canada. Cuba is the next largest consumer of United States salt and is followed by Mexico and Japan. The table shows shipments to practically all parts of the world, although the quantity sent to some countries is only a small fraction of a ton.

BROMINE.

PRODUCTION.

The bromine marketed in 1920 was 37 per cent less in quantity and 40 per cent less in value than in 1919. The quantity marketed during the last 10 years is shown in the following table:

Bromine marketed in the United States, 1911–1920.

Year.	Quantity (pounds).	Value.	Average price per pound.
1911	651,541	$110,902	$0.17
1912	647,200	145,805	.22
1913	572,400	115,436	.20
1914	576,991	203,094	.35
1915	855,857	856,307	1.00
1916	728,520	951,932	1.31
1917	895,499	492,703	.55
1918	1,727,156	970,099	.56
1919	1,854,971	1,234,969	.67
1920	1,160,584	745,381	.64

The output in 1920, which was the smallest since 1917, was made, as usual, from bittern left after extracting salt from the brine pumped from deep wells in Michigan, Ohio, and West Virginia.

A large part of the output is not marketed as bromine but in the form of potassium and sodium bromide and other salts. The figures given in the table include the bromine content of these salts.

Bromine has not been imported into the United States for several years, and the exports of bromine are not separately reported by the Bureau of Foreign and Domestic Commerce.

PRICE.

The prices given in the preceding table are derived from the total quantity and value reported to the Geological Survey by the producers and represent average prices for the year f. o. b. at the plants.

The wholesale price per pound of bulk bromine as quoted in 1920, according to Chemical and Metallurgical Engineering, ranged from 78 to 83 cents in January, 90 to 95 cents in February and March, 85 to 90 cents in April and May, and 70 to 90 cents from June to October; it fell off slightly in November and was 50 to 52 cents in December.

CALCIUM CHLORIDE.

The calcium chloride reported in the following table is an original constituent of the natural brine produced in connection with the manufacture of salt and bromine in Michigan, Ohio, and West Virginia. This material is interchangeable for most uses with calcium chloride obtained as a waste product of the ammonia-soda process, but it contains a considerable percentage of magnesium.

Calcium-magnesium chloride produced and marketed in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.
1911	14,606	$91,215	$6.25
1912	18,550	117,272	6.32
1913	19,611	130,030	6.63
1914	19,403	121,766	6.28
1915	20,535	130,830	6.37
1916	27,709	224,997	8.12
1917	30,503	451,480	14.80
1918	26,624	503,452	18.91
1919	26,123	321,596	12.31
1920	27,849	539,471	19.37

PHOSPHATE ROCK.[1]

By R. W. Stone.

PRODUCTION.

PHOSPHATE ROCK SOLD.

The phosphate rock sold in the United States in 1920 amounted to 4,103,982 long tons, valued at $25,079,572, an increase in quantity of 80 per cent and in value of 116 per cent over 1919.

Phosphate rock sold in the United States, 1911–1920.

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1911	3,053,279	$11,900,693	1916	1,982,385	$5,896,993
1912	2,973,332	11,675,774	1917	2,584,287	7,771,084
1913	3,111,221	11,796,231	1918	2,490,760	8,214,463
1914	2,734,043	9,608,041	1919	2,271,983	11,591,268
1915	1,835,667	5,413,449	1920	4,103,982	25,079,572

PHOSPHATE ROCK MINED.

The quantity of phosphate rock mined in any year is not the same as that sold, and the quantity in stock at the mines or drying plants at the end of each year is variable. The total quantity of phosphate rock mined in 1920 was 3,975,001 long tons, an increase of 115 per cent over the output in 1919. South Carolina and Wyoming were the only States in which production decreased.

Phosphate rock mined in 1919 and 1920, by States, in long tons.

State.	1919	1920	Percentage of increase or decrease.
Florida	1,254,609	3,255,720	+160
South Carolina	49,032	42,709	− 13
Tennessee and Kentucky	530,973	627,677	+ 18
Western States	16,935	48,895	+189
	1,851,549	3,975,001	+115

[1] The domestic statistical data in this report were prepared by Miss K. W. Cottrell, of the United States Geological Survey. The tables relating to imports and exports were compiled by J. A. Dorsey, of the Survey, from records of the Bureau of Foreign and Domestic Commerce.

STOCKS.

Stocks reported on hand at the end of 1920 were about 537,000 long tons, as compared with 555,000 tons at the end of 1919. The stocks in Florida decreased from 521,000 to 470,600 tons, but stocks in Tennessee increased from 31,000 to 59,700 tons. Only about 5,500 tons of rock was on hand in South Carolina at the end of the year, and in Kentucky and the Western States stocks were negligible.

PRODUCTION BY STATES.

Phosphate rock mined and sold in the United States, 1919–20.

State.	1919			1920		
	Quantity (long tons).	Value.	Average price per ton.	Quantity (long tons).	Value.	Average price per ton.
Florida:						
Hard rock	285,467	$2,452,563	$8.59	400,249	$4,525,191	$11.31
Soft rock	14,498	196,318	13.54	13,953	190,551	13.66
Land pebble	1,360,235	5,149,048	3.79	2,955,182	14,748,620	4.99
	1,660,200	7,797,929	4.70	3,369,384	19,464,362	5.78
South Carolina:						
Land rock	60,823	308,968	5.08	44,141	367,209	8.32
Tennessee:						
Brown rock	[a] 475,475	3,123,565	6.57	[a] 556,177	4,425,761	7.96
Blue rock	58,550	290,951	4.97	78,671	518,234	6.59
	[a] 534,025	3,414,516	6.39	[a] 634,848	4,943,995	7.79
Western States [b]	16,935	69,855	4.12	55,609	304,006	5.47
	2,271,983	11,591,268	5.10	4,103,982	25,079,572	6.11

[a] Includes brown rock from Kentucky.
[b] 1919: Idaho, Utah, and Wyoming; 1920: Idaho and Utah.

Florida phosphate rock sold in 1916–1920.

Year.	Hard rock.			Soft rock.		
	Quantity (long tons).	Value.	Average price per ton.	Quantity (long tons).	Value.	Average price per ton.
1916	[a] 47,087	[a] $295,755	$5.26	(a)	(a)	$9.76
1917	[a] 18,608	[a] 159,366	5.93	(a)	(a)	12.40
1918	62,052	377,075	6.08	8,331	$147,103	17.66
1919	285,467	2,452,563	8.59	14,498	196,318	13.54
1920	400,249	4,525,191	11.31	13,953	190,551	13.66

Year.	Land pebble.			Total.		
	Quantity (long tons).	Value.	Average price per ton.	Quantity (long tons).	Value.	Average price per ton.
1916	1,468,758	$3,874,410	$2.64	1,515,845	$4,170,165	$2.75
1917	2,003,991	5,305,127	2.65	2,022,599	5,464,493	2.70
1918	1,996,847	5,565,928	2.79	2,067,230	6,090,106	2.95
1919	1,360,235	5,149,048	3.79	1,660,200	7,797,929	4.70
1920	2,955,182	14,748,620	4.99	3,369,384	19,464,362	5.78

[a] Soft rock included with hard rock.

South Carolina phosphate rock sold in 1916–1920.

Year.	Quantity (long tons).	Value.	Average price per ton.
1916	53,047	$211,125	$3.98
1917	33,485	138,482	4.14
1918	37,040	164,650	4.45
1919	60,823	308,968	5.08
1920	44,141	367,209	8.32

Tennessee phosphate rock sold in 1916–1920.

Year.	Brown rock.		Blue rock.		Total.	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
1916	[a] 364,108	[a] $1,357,888	47,682	$152,465	[a] 411,790	[a] $1,510,353
1917	[a] 447,203	[a] 1,920,533	65,904	205,820	[a] 513,107	[a] 2,126,353
1918	[a] [b] 374,535	[a] [b] 1,917,546	([b])	([b])	[a] 374,535	[a] 1,917,546
1919	[a] 475,475	[a] 3,123,565	58,550	290,951	[a] 534,025	[a] 3,414,516
1920	[a] 556,177	[a] 4,425,761	78,671	518,234	[a] 634,848	[a] 4,943,995

[a] Includes a small quantity of brown rock from Kentucky.
[b] Blue rock is included with brown rock.

Western States phosphate rock sold in 1916–1920.

Year.	Quantity (long tons).	Value.	Average price per ton.
1916	1,703	$5,350	$3.14
1917	15,096	41,756	2.77
1918	11,955	42,161	3.53
1919	16,935	69,855	4.12
1920	55,609	304,006	5.47

EXPORTS.

The quantity of phosphate rock exported from the United States steadily declined from 1913 to 1918, falling from 1,300,000 long tons to 143,455 tons, or to about one-tenth of its former volume. In 1919, however, European demand for phosphate rock was renewed, and in 1920, for the first time since 1913, exports were more than 1,000,000 tons, as is shown in the following table:

Phosphate rock exported from the United States, 1918–1920.

Kind.	1918		1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Phosphate rock, ground or unground, not acidulated:						
High-grade rock	57,771	$445,419	215,039	$2,261,852	344,896	$4,496,457
Land pebble	64,559	303,758	128,860	904,308	693,355	5,593,814
All other	21,125	163,308	34,832	401,822	31,461	479,904
	143,455	912,485	378,731	3,567,982	1,069,712	10,570,175

Most of the phosphate rock exported in 1920 went to northern Europe. Spain and Portugal were the only countries in southern Europe to receive it direct, and Spain was the largest buyer.

The shipments made to the leading purchasers were as follows: Spain, 166,546 tons; England, 163,281 tons; Germany, 116,862 tons; Netherlands, 89,999 tons; Belgium, 82,433 tons; Scotland, 77,487 tons; Denmark, 76,617 tons; Sweden, 73,075 tons; Ireland, 68,197 tons; Japan, 48,190 tons; Cuba, 42,342 tons; Norway, 33,478 tons; Canada, 19,035 tons.

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1918–1920.

High-grade rock.

Country.	1918		1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Belgium	....	....	16,161	$161,610	55,645	$690,705
Canada	379	$5,823	752	14,195	2,226	39,442
Cuba	53	860	1,884	21,216	....	....
Denmark	....	....	80,753	828,519	58,211	755,655
England	1,850	9,250	....	....	8,306	124,587
Germany	....	....	28,062	300,782	104,433	1,407,445
Ireland	....	....	....	....	4,600	69,000
Japan	....	....	....	....	4,292	35,076
Netherlands	....	....	10,702	134,147	19,522	266,217
Norway	21,133	145,827	18,517	201,036	30,978	428,865
Spain	....	....	18,527	200,255	24,480	312,845
Sweden	34,356	283,659	37,106	375,048	32,203	366,620
Switzerland	....	....	2,575	25,044	....	....
	57,771	445,419	215,039	2,261,852	344,896	4,496,457

Land pebble.

Country.	1918 Quantity (long tons).	1918 Value.	1919 Quantity (long tons).	1919 Value.	1920 Quantity (long tons).	1920 Value.
Belgium	....	....	....	....	26,788	$216,934
Canada	5,445	$20,991	1,202	$4,807	3,854	30,494
Cuba	12,063	32,134	8,449	32,857	34,208	262,204
Denmark	....	....	17,943	161,776	18,406	192,648
England	19,804	100,936	27,324	177,993	154,975	1,277,278
France	9,602	48,010	....	....	....	....
Germany	....	....	....	....	9,129	96,855
Ireland	....	....	11,517	75,889	61,097	395,797
Italy	1,440	4,320	....	....	....	....
Japan	....	....	....	....	42,516	322,428
Netherlands	....	....	26,953	185,256	70,477	505,612
Norway	....	....	....	....	2,500	22,500
Other British West Indies	....	....	....	....	3,675	25,100
Portugal	....	....	....	....	8,305	55,381
Scotland	....	....	7,150	82,225	77,487	574,305
Spain	11,848	73,312	16,072	108,540	139,066	1,226,670
Sweden	4,357	24,055	12,250	74,965	40,872	389,608
	64,559	303,758	128,860	904,308	693,355	5,593,814

All other phosphate rock.

Country.	1918 Quantity (long tons).	1918 Value.	1919 Quantity (long tons).	1919 Value.	1920 Quantity (long tons).	1920 Value.
Australia	....	....	....	....	3	$30
Barbados	....	....	50	$1,375	....	....
Belgium	....	....	5,554	55,540	....	....
British Honduras	....	....	1	7	....	....
Canada	8,419	$78,888	5,303	70,958	12,955	187,780
China	....	....	1	6	....	....
Costa Rica	....	....	250	1,450	....	....
Cuba	4,388	32,337	4,156	74,181	8,134	160,824
Denmark	....	....	2,000	36,960	....	....
England	2,525	13,080	1	2	....	....
Germany	....	....	....	....	3,300	51,150
Honduras	....	....	1	28	....	....
Ireland	....	....	....	....	2,500	14,250

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1918–1920—Continued.

All other phosphate rock—Continued.

Country.	1918		1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.	Quantity (long tons).	Value.
Jamaica			75	$1,601		
Japan					1,382	$12,737
Mexico			2	70		
Netherlands			3,500	59,500		
Newfoundland and Labrador					37	316
New Zealand					1	10
Norway	3,975	$23,853	2,200	17,607		
Other British West Indies			1	10	149	3,307
Spain					3,000	49,500
Sweden	1,818	15,150	11,737	82,527		
	21,125	163,308	34,832	401,822	31,461	479,904

The following table and figure show the proportion of exports to total sales of domestic rock in the United States during the last eight years. The exports decreased from 44 per cent of the production in 1913 to 6 per cent in 1917 and 1918, but rose to 26 per cent in 1920.

Phosphate rock marketed in and exported from the United States, 1913–1920.

Year.	Quantity marketed (long tons).	Exports (long tons).	Proportion of exports to total sales (per cent).
1913	3,111,221	1,366,508	44
1914	2,734,043	964,114	35
1915	1,835,667	253,421	14
1916	1,982,385	243,678	12
1917	2,584,287	166,358	6
1918	2,490,760	143,455	6
1919	2,271,983	378,731	17
1920	4,103,982	1,069,712	26

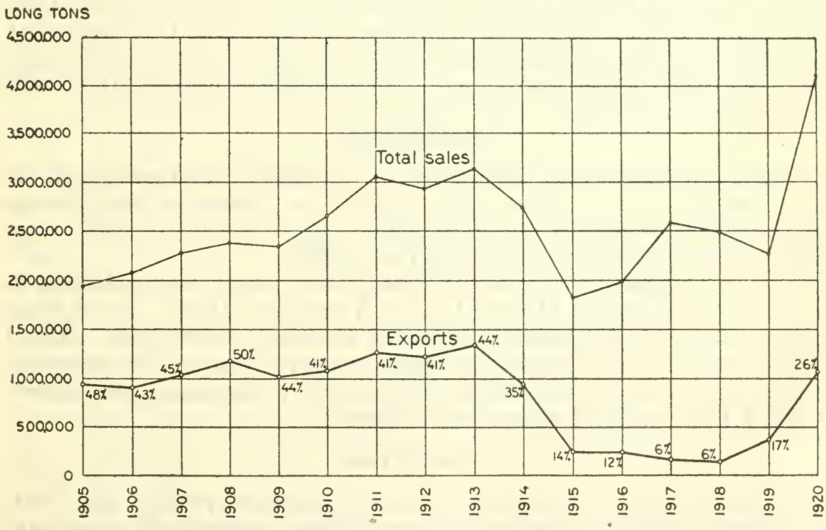

FIGURE 2.—Curve showing total sales and exports of domestic phosphate rock, 1905–1920. Figures on export curve indicate percentage of total sales leaving the country.

NOTES ON WESTERN STATES.

In view of the very largely increased production and rapid development in the Western States in 1920, it seems justifiable to publish the following notes concerning the industry in those States, although the Eastern States have not been so treated.

LEGISLATION.

The mineral lands leasing bill was passed and was signed by the President February 25, 1920.

Regulations concerning phosphate leases and prospect permits, approved by the Secretary of the Interior May 22, were issued by the General Land Office. The phosphate regulations provide that applicants for phosphate leases must file application in the land office of the district in which the land is situated, and that the district office shall advertise the same for 30 days and forward the application to the General Land Office. The minimum royalty is 2 per cent of the gross value of the output, and a rental of 25 cents an acre will be charged the first year, 50 cents an acre from the second through the fifth years, and $1 an acre thereafter. Leases will be given for not more than 2,560 acres.

Nearly 2,500,000 acres of phosphate lands in Utah, Idaho, and Wyoming that have been withdrawn from entry for several years were thus opened for exploitation of the phosphate deposits.

PRODUCTION.

As shown by the table on a preceding page, the total output of phosphate rock in the Western States in 1920 was 55,609 long tons, valued at $304,006. This was an increase of 228 per cent in quantity and of 335 per cent in value over 1919. There were four operators, three in Bear Lake County, Idaho, and one in Rich County, Utah. The Utah production was less than 5 per cent of the total.

The average price per ton of rock sold seems to have varied from $5 to $6.50, depending on the condition and quality of the material. Rock that had been crushed and dried brought a higher price than that sold in the crude lump form. The average price for the whole district was $5.47 a ton.

SHIPMENTS.

Of the phosphate rock shipped from this field, fertilizer plants on San Francisco Bay received about 25,000 tons, those in the Chicago district 2,700 tons, and one in western New York 1,400 tons. Approximately 4,000 tons went to St. Louis, Mo.

In June shipments were begun from Bear Lake County, Idaho, to the Anaconda Copper Mining Co., at Anaconda, Mont. By the end of the year these shipments amounted to nearly 9,000 tons. About 5,000 tons of Idaho phosphate rock went to Japan, this material being shipped from the field in March, May, June, and September. In the fall about 2,700 tons went to Hawaii.

COMPANIES.

Although only four companies mined phosphate rock in the Western States in 1920, there are several others which hold phosphate lands and may eventually become producers. The companies now known to be interested in this field are mentioned briefly below in alphabetic order.

American Phosphate Corporation.—In February, 1920, a mine was opened about 5 miles up the canyon east of Montpelier, Idaho, by the American Phosphate Corporation. On February 23 a franchise was granted by the city council to construct a railway through a street of Montpelier. In December, 1920, a 500-ton milling plant for crushing and drying the phosphate rock was being built near the mouth of the canyon. This company is operating under a 10-year lease from the San Francisco Chemical Co.

Peter B. & Robert S. Bradley.—A mine near Randolph, Rich County, Utah, was operated part of the year by Peter B. & Robert S. Bradley, 92 State Street, Boston, Mass. This mine has been in operation for several years, but with small production.

Anaconda Copper Mining Co.—At the plant of the Anaconda Copper Mining Co. large quantities of sulphuric acid are derived from smelter fumes. High freight rates and the distance from the market have made it practically impossible for the company to market this sulphuric acid, and the metallurgical department therefore conducted experiments for a considerable time at the old Bradley plant at Anaconda in the utilization of this acid in the manufacture of fertilizer. The Anaconda Co. owns phosphate deposits at Melrose and Garrison, Mont., and did some development work at both places. The manufacture of "Anaconda triple superphosphate" was begun in the summer of 1920 in a plant having a capacity of 50 tons of raw material a day. The process of making superphosphate is, briefly, as follows: Raw phosphate rock is crushed and ground in Hardinge mills to about 80-mesh; it is then treated in agitators (tanks) with 60 per cent sulphuric acid, ton for ton. The solution goes to Dorr thickeners, thence to an evaporator; and the concentrated solution is mixed with finely pulverized raw phosphate rock in the proportion of 2:3. The finished product is said to contain about 48 per cent available plant food.

After experimenting with Montana phosphate rock, the company for a number of months bought its supply from Paris, Idaho. Instead of moving its phosphate rock to the plant at Anaconda, however, the company now proposes to ship sulphuric acid made at its Anaconda smelter to the phosphate mine which it is opening at Soda Springs, Idaho. When the installation, which is now in progress, has been completed the manufacture of superphosphate will be begun at the mine.

A railroad was started in July, 1920, from the main line of the Oregon Short Line at Soda Springs, 7 miles north to the phosphate locality, and a large mining and milling equipment is being assembled.

According to R. N. Bell, in the annual report of the mining industry of Idaho for the year 1920, page 11:

> The principal feature of the mine development now in progress consists of a projected crosscut tunnel, to be 2 miles long when completed, that is already under cover several hundred feet, is 9 by 9 feet in the clear, to be laid with 60-pound steel and equipped with 15-ton storage-battery motors and 10-ton steel dump cars.
>
> The big mining avenue when completed will cut two main legs of the steeply folded phosphate vein series and give a four-way drifting advantage at a maximum depth of 1,000 feet, and is designed for the ultimate daily

production of 3,000 tons of phosphate ore, with the principal vein of the series outcropping through the company's holdings for several miles. A power line from one of the main plants of the Utah Power & Light hydro-electrical development on Bear River near by has been completed to the mine and a copper-circuit private telephone line. A compressor plant of 1,000 feet cubic capacity has already been installed with which to push the tunnel development. Material is now on the ground for the installation of a storage bin of 3,000 tons capacity, and also the necessary machinery for the first 500-ton unit of a milling plant with which to crush, dry, or pulverize the ore.

Bear Lake Phosphate Co.—A new enterprise, the Bear Lake Phosphate Co., has opened a mine near Paris, Idaho, adjacent to the mine of the Western Phosphate Co. A double-track tunnel has been driven about 1,000 feet on a 5-foot bed of high-grade rock. Development work only was done in 1920. Several hundred tons of phosphate rock was mined in the later part of the year, but none was shipped. Shipments began, however, in January, 1921, and were consigned to a fertilizer plant on San Francisco Bay. The mine is equipped with an air compressor and other modern mining machinery.

Merriman Potash Products Co.—A mine at Cavanaugh, between Montpelier and Soda Springs, Idaho, was operated by the Merriman Potash Products Co., and shipments were made during the first four months in 1920. The company ceased operations before early summer and seems to have gone out of business.

Montana Phosphate Co.—During 1920 development work was done on high-grade phosphate deposits near Maxville, Mont., by the Montana Phosphate Co., F. J. Russell, manager. This work was preliminary to putting in a small plant to grind phosphate rock for application to the soil in the raw state.

San Francisco Chemical Co.—The Waterloo mine, 3 miles east of Montpelier, Idaho, has been developed by the San Francisco Chemical Co. to a depth of 800 feet on the dip by short adits 50 to 150 feet long. Drifts have been driven on the strike for 2,000 feet, and ore has been mined by back-stoping. The bed is 6 feet thick, and the mine has shipped 100 tons of phosphate rock daily for several months. The plant consists principally of a 50-ton loading bin, a blacksmith shop, and an air compressor. On account of lack of demand for its product the mine was closed temporarily at the end of 1920.

United States Phosphate Co.—The United States Phosphate Co., of Detroit, Mich., did no mining on its phosphate deposits in Bear Lake County, Idaho, Morgan and Rich counties, Utah, and Lincoln County, Wyo.

Western Phosphate Co.—A mine developed on property acquired in May, 1917, 3 miles from Paris, Idaho, has been operated for several years by the Western Phosphate Co. A spur track from Paris, begun in October, 1919, has been completed. The mine is developed by an adit tunnel 1,800 feet long, with overhead stopes. This adit, driven from the canyon on a steeply dipping bed, has 36 stope chutes, with a maximum of 300 feet of ore above the adit. By crosscutting a second bed of phosphate rock 12 feet thick was disclosed, part of which is said to be of very high grade. The mine has modern equipment, including ventilating system, compressor, and small rotating jackhammers. A mill for drying the rock has been completed with four 250-ton rotary driers and a 5-ton Raymond pulverizer with a daily capacity of 80 tons. Early in 1921 the company was in the hands of a receiver pending reorganization.

PHOSPHATE ROCK FOR DIRECT APPLICATION TO THE SOIL.

The use of raw phosphate rock for direct application to the soil has grown considerably during the last few years and seems to indicate that excellent results have been obtained in increased crops. Several companies, especially in the Florida and Tennessee phosphate fields, are handling this product. Beginning with 1914 the Geological Survey in its annual statistical inquiry has asked the producers to state the quantity of raw rock phosphate sold for direct application to the soil. The total of such direct returns from the miners, however, does not represent the total quantity of raw rock phosphate now sold for direct application, because some lump rock is sold to grinders who do not report directly to the Geological Survey. The following figures may be of interest and suggestive of the trend of this phase of the fertilizer business. In this table both soft phosphate and finely ground hard rock phosphate are included.

Raw phosphate rock sold for direct application to the soil, 1914–1920.

	Long tons.		Long tons.
1914	48,317	1918	45,294
1915	50,468	1919	79,189
1916	70,233	1920	72,801
1917	75,861		

SAND-LIME BRICK.[1]

By Jefferson Middleton.

The production of sand-lime brick in 1920 continued to increase from the low output of 1918. Though the quantity was smaller than in any other year since 1911 (except 1918 and 1919) the value was the highest recorded. The lag in the resumption of building operations, on account of high costs, is undoubtedly responsible for the slow recovery of the sand-lime brick industry. With the renewal of building activity the output of this product should increase rapidly, as it seems to be firmly established in public favor in many localities. The trade was generally reported good during the first nine months of 1920, after which the demand fell off very considerably. The industry was also handicapped by the shortage and inefficiency of labor and by difficulties of transportation, which not only delayed the shipment of brick but so delayed the receipt of materials in some localities as to affect production.

The quantity of brick produced in 1920 was 16 per cent greater than in 1919, and 73 per cent greater than in 1918, but 9 per cent less than in 1917 and 25 per cent less than in 1916. The value exceeded that of 1919 by 46 per cent, that of 1918 by 182 per cent, that of 1917 by 75 per cent, and that of 1916 by 69 per cent. Compared with 1913, the quantity in 1920 decreased 10 per cent and the value increased 101 per cent.

The number of operators (37) reporting sales in 1920 was the smallest since 1903, except in 1919. The average value of the sales per active operator in 1920 was $67,305, compared with $48,719 in 1919, $21,046 in 1918, and $30,220 in 1917. The average output per active operator was 4,588,000 brick in 1920, 4,198,000 in 1919, 2,343,000 in 1918, and 3,990,000 in 1917.

Seventeen States reported the production of sand-lime brick in 1920, an increase of one—Idaho dropped out and California and Washington reappeared in the list of producers. Ten of the States that reported in both 1919 and 1920 increased in output and value; these were Florida, Massachusetts, Minnesota, New York, Ohio, Pennsylvania, South Dakota, Texas, and Wisconsin, and the District of Columbia. The quantity decreased in Georgia, Indiana, and Michigan, but the value increased, and both quantity and value decreased in Louisiana and North Dakota. In 1920, as for many years, Michigan was the leading State in marketing sand-lime brick and reported 23 per cent of the total quantity and 26 per cent of the total value, a decrease of 7 per cent in quantity, but an increase of 26 per cent in value,

[1] The statistical data in this report were prepared by Miss Katrine W. Cottrell.

compared with 1919. Minnesota ranked second in output, reporting 15 per cent of the quantity and 12 per cent of the value, an increase of 6 per cent in quantity and 21 per cent in value. Wisconsin was third in quantity and fourth in value; Florida was fourth in quantity and third in value; New York was fifth in both quantity and value. These first five States, rated by production, reported 64 per cent of the quantity and 63 per cent of the value.

About 99 per cent of the output was marketed as common brick, in which there was an increase of 15 per cent in quantity and 45 per cent in value, compared with 1919. The average price per thousand for common brick in 1920 was $14.61, compared with $11.58 in 1919, $8.94 in 1918, and $7.54 in 1917. For face brick the average price was $19.48 in 1920, compared with $13.29 in 1919, $11.35 in 1918, and $9.36 in 1917.

Sand-lime brick marketed in the United States, 1915–1920.

Year.	Number of operators reporting sales.	Quantity (thousands).	Value.	Year.	Number of operators reporting sales.	Quantity (thousands).	Value.
1915	56	179,643	$1,135,104	1918	42	98,399	$883,929
1916	53	227,344	1,474,073	1919	35	146,947	1,705,163
1917	47	187,546	1,420,330	1920	37	169,761	2,490,283

Sand-lime brick marketed in the United States in 1919 and 1920.[a]

State.	1919		1920	
	Quantity (thousands).	Value.	Quantity (thousands).	Value.
Georgia	(b)	(b)	3,523	$55,528
Indiana	11,738	$108,089	10,034	128,013
Michigan	42,063	507,010	39,280	640,744
Minnesota	23,391	239,676	24,891	290,394
New York	10,958	159,399	11,294	176,114
North Dakota	(b)	(b)	30	500
Ohio	(b)	(b)	8,350	120,075
Pennsylvania	(b)	(b)	10,840	154,983
Texas	(b)	(b)	7,125	113,533
Wisconsin	(b)	(b)	17,157	215,988
Other States [c]	58,797	690,989	37,237	594,411
	146,947	1,705,163	169,761	2,490,283

[a] Common brick, except 1,670,000 face brick, valued at $22,197, in 1919, and 2,172,000, valued at $42,313, in 1920, made in each year in Florida, Indiana, Michigan, and Wisconsin.
[b] Included under "Other States."
[c] 1919: District of Columbia, Florida, Georgia, Idaho, Louisiana, Massachusetts, North Dakota, Ohio, Pennsylvania, South Dakota, Texas, and Wisconsin; 1920, California, District of Columbia, Florida, Louisiana, Massachusetts, South Dakota, and Washington.

FULLER'S EARTH.[1]

By Jefferson Middleton.

GENERAL CONDITIONS.

The great activity in the fuller's earth industry that began in 1915 continued during 1920 and is reflected in the large output for the year. The search for deposits of this material was active, not only in the Pacific Coast States, where some very valuable deposits have been reported, but in old producing States, such as Alabama, Florida, Georgia, and also in States that have not been producers, such as Pennsylvania and Virginia, where promising deposits have been found. The output in 1920 was the largest recorded; it was greater than that of 1919 by 21 per cent, more than three times as great as the output of 1913, and nearly 19 times as great as that of the first year of production. The value of this output and the average price per ton were also the largest ever recorded, the value being 25 per cent greater than that of 1919, nearly seven times greater than that of 1913, and more than 60 times as great as that of 1895. The average price per ton of fuller's earth in 1920 was only 4 per cent greater than that of 1919. The quantity of imports in 1920 increased in even greater proportion than the domestic output, but the value of imports increased only 17 per cent, owing to the lower average price per ton, which decreased 16 per cent, as compared with 1919.

PRODUCTION.

The growth of the industry in the last five years, the five-year average of production and value from 1896 to 1915, and the production by groups of States are shown in the following tables:

Fuller's earth produced and marketed in the United States, 1896–1920.

Year.	Number of operators reporting sales.	Quantity (short tons).	Value.	Average price per ton.
1896–1900 (average)		12,785	$85,062	$6.65
1901–1905 (average)		20,191	153,651	7.61
1906–1910 (average)		32,183	286,171	8.89
1911–1915 (average)		40,178	390,252	9.71
1916	10	67,822	706,951	10.42
1917	11	72,567	772,087	10.64
1918	14	84,468	1,146,354	13.57
1919	10	106,145	1,998,829	18.83
1920	12	128,487	2,506,189	19.51

[1] The statistical data of this report have been prepared by Miss Katrine W. Cottrell.

Fuller's earth produced and marketed in the United States in 1919 and 1920.

State.	1919			1920		
	Number of operators reporting sales.	Quantity (short tons).	Value.	Number of operators reporting sales.	Quantity (short tons).	Value.
Alabama, Florida, and Texas..	6	102,972	$1,944,792	6	116,676	$2,274,896
Georgia and Massachusetts....	4	3,173	54,037	3	10,350	189,483
Arkansas, California, and Nevada				3	1,461	41,810
	10	106,145	1,998,829	12	128,487	2,506,189

The small number of producers makes it impossible to publish totals for some States without disclosing individual operations, consequently the distribution of output is grouped as above. About 99 per cent of the output and value in 1920 was reported from the Southern States. Florida was the leading producing State, as it has been since the beginning of the industry, and reported about 85 per cent of the output and 86 per cent of the value for 1920. Named in the order of rank in output, the producing States were Florida, Georgia, Texas, Alabama, Nevada, Arkansas, California, and Massachusetts.

IMPORTS.

The trend of imports of fuller's earth before the World War was upward, the maximum being reached in 1914. During the war imports naturally decreased because of interrupted transportation and reached their minimum since 1908 in 1918. With the cessation of hostilities the imports have increased from 50 per cent of of the maximum in 1918 to 77 per cent in 1920. The inability to obtain a sufficient supply of earth during the war compelled some refiners of edible oils and fats—for which the imported earth is probably used exclusively—to adapt domestic earth to their needs, and it may be that imported earth will never again be so essential to the American industry. In 1919 and 1920, however, imports increased considerably, the increase in quantity being 10 per cent in 1919 and 39 per cent in 1920. The value of the imported fuller's earth in 1920 was the largest recorded, notwithstanding the decrease in average price, and was 17 per cent greater than that of 1919 and 14 per cent greater than the previous maximum. In 1920 91 per cent of the imported earth was wrought or manufactured; the remainder was unwrought or unmanufactured.

Fuller's earth imported and entered for consumption in the United States, 1911–1920.

Year.	Unwrought or unmanufactured.			Wrought or manufactured.			Total.		
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
1911–1915 (average)......	1,617	$9,860	$6.10	18,459	$146,642	$7.94	20,076	$156,502	$7.80
1916....................	1,132	7,742	6.84	15,669	131,922	8.42	16,801	139,664	8.31
1917....................	1,441	11,718	8.13	15,553	164,699	10.58	16,994	176,417	10.38
1918....................	900	10,502	11.67	11,707	155,033	13.24	12,607	165,535	13.13
1919....................	373	4,301	11.53	13,500	185,410	13.73	13,873	189,711	13.67
1920....................	1,738	19,793	11.38	17,497	202,100	11.55	19,235	221,893	11.54

PEAT.

By K. W. Cottrell.

As there was no great change or development in the peat industry in 1920 and the comprehensive reports published in Mineral Resources for 1914 and 1918 are still available for distribution, this report contains only the statistics.

PRODUCTION.

As shown in the following tables, the quantity of peat produced for fertilizer and fertilizer ingredient increased more than 8,000 tons and for stock food more than 2,000 tons, but the quantity reported as dug for fuel fell off more than 7,000 tons, so the net gain in production was only 4,007 tons. On account of higher prices the total value of the peat sold increased more than $200,000 and was greater than in any preceding year except 1918.

Peat produced in the United States, 1916–1920.

Year.	Number of plants reporting.	Quantity (short tons).	Value.	Average price per ton.
1916	13	52,506	$369,104	$7.03
1917	18	97,363	709,900	7.29
1918	25	107,261	1,047,243	9.76
1919	15	69,197	705,532	10.20
1920	18	73,204	921,732	12.59

Peat used in manufacturing fertilizer in the United States, 1916–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.
1916	48,106	$336,004	$6.98
1917	92,263	658,500	7.14
1918	79,573	775,313	9.74
1919	54,690	557,240	10.19
1920	63,272	773,635	12.23

Peat used in manufacturing stock food in the United States, 1916–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.
1916	4,300	$32,250	$7.50
1917	5,100	51,400	10.08
1918	7,096	106,935	15.07
1919	6,402	98,940	15.45
1920	[a] 9,182	[a] 143,047	15.58

[a] Includes small quantity of moss and stable litter.

IMPORTS AND EXPORTS.

The imports of peat in 1920 consisted of peat moss or litter, which is used largely for packing material. The quantity was 2,762 tons, or six times as much as in 1919. The price per ton, however, fell from $35 to $13. No exports of crude peat or peat products were reported in 1920.

SUMMARY.

Peat and peat moss used in the manufacture of peat products in the United States in 1919 and 1920.

Kind of product.	Production.		Imports.		Consumption.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1919.						
Fertilizer and fertilizer ingredient	54,690	$557,240			54,690	$557,240
Stock food	6,402	98,940			6,402	98,940
Fuel and miscellaneous products	8,105	49,352			8,105	49,352
Moss			464	$16,345	464	16,345
	69,197	705,532	464	16,345	69,661	721,877
1920.						
Fertilizer and fertilizer ingredient	63,272	773,635			63,272	773,635
Stock food	[a] 9,182	[a] 143,047			9,182	143,047
Fuel	750	5,050			750	5,050
Moss	([b])	([b])	2,762	36,201	2,762	36,201
	73,204	921,732	2,762	36,201	75,966	957,933

[a] Includes small quantity of moss and stable litter.
[b] Included with stock food.

CONSUMPTION.

The consumption of peat and peat moss (production plus imports) was 69,661 tons, valued at $721,877, in 1919, and 75,966 tons, valued at $957,933, in 1920.

DISTRIBUTION OF PEAT PLANTS.

The 18 plants reporting production in 1920 were distributed as follows: California 3, New Jersey 3, Illinois 2, and Florida, Georgia, Indiana, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, and Wisconsin 1 each. Illinois was the largest producer, but the State total can not be published without revealing confidential information, as there were only two producers. New Jersey was second in rank, with an output of 26,623 short tons, valued at $281,527, and California third, with 9,927 tons, valued at $77,614.

PRODUCERS OF PEAT IN THE UNITED STATES.

The following individuals and companies reported to the Geological Survey that they produced crude peat or peat products in the United States in 1920:

Alphano Humus Co., Whitehall Building, New York, N. Y.
American Peat Products Co., Morrison, Ill.
Appleton Peat Products Co., Appleton, Wis.
Bacterized Humus Co., Lakeville, Ind.
Chapman, I. S., & Co. (Inc.), 937 Third Street, San Bernardino, Calif.
Day, James H., 35 South Street, Milford, N. H.
Hennepin Atomized Fuel Co., 520 Security Building, Minneapolis, Minn.
Hyper-Humus Co., Newton, N. J.
McElhone, Asa, Fishkill, N. Y.
Marcrum, J. G., Netcong, N. J.
Michigan Humus & Chemical Co., Chassell, Mich.
Pacific Humus Co., 205 Central Building, Pasadena, Calif.
Phos-Pho Germ Manufacturing Corporation, New Bern, N. C.
Riverside Orange Co. (Ltd.), Arlington Heights, Riverside, Calif.
Saugus River Peat Products Co., Lynn, Mass.
Southern Humus Co., Smyrna, Ga.
Wiedmer Chemical Co., Pierce Building, St. Louis, Mo.

ASPHALT AND RELATED BITUMENS.

By K. W. Cottrell.[1]

INTRODUCTION.

The figures in this report showing the quantity and value of the domestic output of asphalt and related bitumens are based on data obtained directly from the producers. A table showing manufactured asphalt by uses in 1920 is included, but a similar table for 1919 could not be made because the reports received through the Bureau of the Census for 1919 did not contain the information.

SALES.

The sales of native asphalt and related bitumens in the United States in 1920 showed an increase of 125 per cent in quantity and of about 78 per cent in value over 1919. The sales of manufactured asphalt obtained from domestic petroleum increased 14 per cent in quantity and 37 per cent in value. The sales of asphalt manufactured in the United States from Mexican petroleum increased 55 per cent in quantity and 85 per cent in value.

The number of companies reporting the production of asphalt and related bitumens in 1920 was 44, of which 18 manufactured asphalt exclusively from petroleum of domestic origin, 7 used petroleum of Mexican origin, 5 used petroleum from both sources, and 14 produced native asphaltic material.

The output of bituminous rock in 1920, reported by six operators (two each in California and Oklahoma, one each in Kentucky and Texas) was more than double the output in 1919. Gilsonite was reported from Uinta County, Utah; wurtzilite (elaterite) from Duchesne County, Utah; and grahamite from Pushmataha County, Okla.

NATIVE ASPHALT.

Native asphalt and related bitumens sold in the United States, 1915–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1915	75,751	$526,490	1918	60,034	$780,808
1916	98,477	923,281	1919	88,281	682,989
1917	81,604	773,424	1920	198,497	1,213,908

[1] Statistics of imports and exports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Native asphalt and related bitumens sold in the United States, 1915–1920, by States.

State.	1915		1916		1917	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
California	17,794	$61,485	18,135	$45,102	6,009	$19,447
Oklahoma	16,907	118,351	(a)	(a)	(a)	(a)
Utah	b 21,739	b 281,302	26,874	633,440	35,192	569,325
Other States c	19,311	65,352	53,468	244,739	40,403	184,652
	75,751	526,490	98,477	923,281	81,604	773,424

	1918		1919		1920	
California	3,260	$12,516	d 3,614	$15,037	(a d)	(a d)
Oklahoma	(a)	(a)	e 4,323	18,187	e 7,522	$45,898
Utah	31,072	663,258	f 33,992	406,610	g 63,522	659,176
Other States c	25,702	105,034	h 46,352	243,155	d 127,453	508,834
	60,034	780,808	88,281	682,989	198,497	1,213,908

a Included under "Other States."
b Includes Colorado.
c 1915: Kentucky and Texas; 1916 and 1917: Colorado, Kentucky, Oklahoma, and Texas; 1918: Kentucky, Oklahoma, and Texas; 1919: Illinois, Kentucky, and Texas; 1920: California, Kentucky, and Texas.
d Bituminous rock.
e Bituminous rock and grahamite.
f Elaterite and gilsonite.
g Gilsonite and wurtzilite.
h Bituminous rock, grahamite, and impsonite.

MANUFACTURED ASPHALT.

FROM DOMESTIC PETROLEUM.

In the production of asphalt manufactured from domestic petroleum in 1920, California, with nine operators reporting, ranked first; Texas, with four operators reporting, ranked second; and Oklahoma, with six operators, ranked third. The asphalt manufactured from oil produced in these three States represented 84 per cent of the total quantity and 82 per cent of the total value.

Asphalt manufactured from domestic petroleum and sold at refineries, 1915–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.	Year.	Quantity (short tons).	Value.	Average price per ton.
1915	664,503	$4,715,583	$7.10	1918	604,723	$8,796,541	$14.55
1916	688,334	6,178,851	8.98	1919	614,692	8,727,372	14.20
1917	701,809	7,734,691	11.02	1920	700,496	11,985,457	17.11

Asphalt and asphaltic material manufactured in the United States from domestic petroleum and sold at refineries, 1920, by varieties.

Product.	Solid and semisolid products of less than 200 penetration. Asphalt. Quantity (short tons).	Value.	Average price per ton.	Semisolid and liquid products of more than 200 penetration. Flux.[a] Quantity (short tons).	Value.	Average price per ton.	Grand total. Quantity (short tons).	Value.
Paving [b]	245,987	$4,159,530	$16.91	9,520	$180,966	$19.01	255,507	$4,340,496
Roofing and waterproof [c]	254,587	4,454,762	17.50	54,436	1,002,446	18.42	309,023	5,457,208
Mineral rubber [d]	4,951	290,379	58.65				4,951	290,379
Other [e]	29,640	654,131	22.07	14,817	52,235	35.25	44,457	706,366
Road oil [f]				86,558	1,191,008	13.76	86,558	1,191,008
	535,165	9,558,802	17.86	165,331	2,426,655	14.68	700,496	11,985,457

[a] Flux: Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.
[b] Paving asphalt: Refined native asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler in brick, block, and monolithic pavements.
[c] Roofing and waterproofing asphalt: Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.
[d] Mineral rubber: Asphalt and asphaltic cement used by the rubber industry.
[e] Other solid and semisolid products: Asphalt and asphaltic cement used as dips and in the manufacture of insulating material, acid-resisting compounds, putty, mastic, and briquets and not included in the preceding definitions. Other liquid products: Petroleum asphalt used in the manufacture of saturant, paint, varnish, or other coating, exclusive of fuel oil and not included in the preceding definitions.
[f] Road oil: Residual asphaltic oil used for surface treatment.

FROM MEXICAN PETROLEUM.

The increase in the quantity of asphalt manufactured in the United States from Mexican petroleum in 1920 over 1919 was almost five times as great as that of 1919 over 1918.

Asphalt manufactured in the United States from Mexican petroleum and sold at refineries 1915–1920.

Year.	Quantity (short tons).	Value.	Average price per ton.
1915	388,318	$3,730,436	$9.61
1916	572,387	6,018,851	10.52
1917	645,613	7,441,813	11.53
1918	597,697	9,417,818	15.76
1919	674,876	7,711,510	11.43
1920	1,045,779	14,272,862	13.65

Asphalt and asphaltic material manufactured in the United States from Mexican petroleum and sold at refineries, 1920, by varieties.

Product.	Solid and semisolid products of less than 200 penetration.			Semisolid and liquid products of more than 200 penetration.			Total.	
	Asphalt.			Flux.[a]				
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.
Paving[b]	300,335	$4,429,456	$14.75	122,734	$1,228,005	$10.01	423,069	$5,657,461
Roofing and waterproof[c]	283,250	3,634,526	12.83	118,892	963,372	8.10	402,142	4,597,898
Mineral rubber[d]	7,173	187,780	26.18				7,173	187,780
Other[e]	7,921	116,461	14.70	162,400	3,023,907	18.62	170,321	3,140,368
Road oil[f]				43,074	689,355	16.00	43,074	689,355
	598,679	8,368,223	13.98	447,100	5,904,639	13.21	1,045,779	14,272,862

[a] Flux: Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.
[b] Paving asphalt: Refined native asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler in brick, block, and monolithic pavements.
[c] Roofing and waterproofing asphalt: Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.
[d] Mineral rubber: Asphalt and asphaltic cement used by the rubber industry.
[e] Other solid and semisolid products: Asphalt and asphaltic cement used as dips and in the manufacture of insulating material, acid-resisting compounds, putty, mastic, and briquets and not included in the preceding definitions. Other liquid products: Petroleum asphalt used in the manufacture of saturant, paint, varnish, or other coating, exclusive of fuel and not included in the preceding definitions.
[f] Road oil: Residual asphaltic oil used for surface treatment.

TOTAL SALES.

Asphalt sold at mines and refineries in the United States, 1915–1920, by varieties.

Variety.	1915		1916		1917	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Petroleum asphalt[a]	664,503	$4,715,583	688,334	$6,178,851	701,809	$7,734,691
Bituminous rock	44,329	157,083	63,172	197,286	41,919	136,255
Gilsonite	} 20,559	275,252	26,870	629,640	} 35,049	532,989
Wurtzilite			4	3,800		
Ozokerite					18	1,000
Grahamite	10,863	94,155	8,431	92,555	[b]4,618	[b]103,180
	740,254	5,242,073	786,811	7,102,132	783,413	8,508,115

Variety.	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Petroleum asphalt[a]	604,723	$8,796,541	614,692	$8,727,372	700,496	$11,985,457
Bituminous rock	25,346	92,238	53,589	262,309	132,353	531,134
Gilsonite	30,848	606,639	([c])	([c])	56,204	548,776
Ozokerite	37	45,399				
Other bituminous substances[d]	3,803	36,532	34,692	420,680	9,940	133,998
	664,757	9,577,349	702,973	9,410,361	898,993	13,199,365

[a] Includes asphalt produced from domestic petroleum only.
[b] Includes maltha.
[c] Included under "Other bituminous substances."
[d] 1918: Grahamite and wurtzilite; 1919: Elaterite, gilsonite, grahamite, and impsonite; 1920: Grahamite and wurtzilite (including kapak or refined elaterite).

IMPORTS.

NATIVE ASPHALT AND BITUMINOUS ROCK.

Native asphalt and bituminous rock imported for consumption in the United States, 1915–1920.

Year.	Crude.		Bituminous limestone.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1915	135,276	$661,356	2,976	$19,001	138,252	$680,357
1916	147,383	732,917	330	1,795	147,713	734,712
1917	187,473	978,087	413	15,028	187,886	993,115
1918	114,686	624,967	39	2,528	114,725	627,495
1919	104,913	609,923	735	5,576	105,648	615,499
1920	127,027	1,055,951	1,387	11,665	128,414	1,067,616

Native asphalt and bituminous rock imported into the United States, 1918–1920, by countries.

[General imports.]

Source.	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
North America:						
Canada	221	$4,112	38	$1,088	88	$2,832
Mexico	12,968	96,125	6,566	31,587	15	66
West Indies:						
British:						
Barbados	55	5,047	31	3,069	68	8,128
Trinidad and Tobago	58,791	327,091	51,062	350,431	100,783	892,545
Cuba	56	1,783	636	17,270	274	7,447
Dutch			(a)	10		
South America:						
Colombia			6	169	6	207
Venezuela	42,587	192,855	47,309	211,875	27,179	156,282
Europe:						
England	47	482				
Ireland					1	109
	114,725	627,495	105,648	615,499	128,414	1,067,616

[a] Figures for quantity not available.

OZOKERITE.

The imports of ozokerite and other mineral waxes in 1920 increased 14 per cent in quantity and 10 per cent in value over those of 1919; they also exceeded the imports of 1916 by 42 per cent in quantity and 155 per cent in value.

Ozokerite and other mineral waxes imported for consumption in the United States, 1915–1920.

Year.	Quantity (pounds).	Value.	Average price per pound.
1915	2,795,256	$210,019	$0.075
1916	3,007,676	196,185	.065
1917	899,405	90,510	.101
1918	1,809,459	147,805	.082
1919	3,748,080	454,840	.121
1920	4,272,341	499,758	.117

ICHTHYOL.

The following table was compiled from the records of the Bureau of Foreign and Domestic Commerce:

Ichthyol and ichthyol substitutes imported for consumption in the United States, 1915–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1915	24,921	$28,560	1918	65,752	$39,452
1916	116,738	93,762	1919	30,976	38,975
1917	58,397	36,232	1920	98,135	79,133

It is understood that the Meadows Chemical Corporation, 52 Vanderbilt Avenue, New York City (formerly the Meadows Oil & Chemical Corporation), began producing an ichthyol-like substance in 1920 from marine fossiliferous limestone quarried near Burnet, Tex. In April, 1920, the company began operations at Burnet, and in July it opened a plant at Durant, Rockland County, N. Y., where a product was prepared and marketed under the name "Meadows ammonium ichthyolate." The following statement regarding oil at Burnet was made in a report published by the United States Geological Survey in 1911:[2]

A small oil seepage in a spring near the town of Burnet has deposited at the surface asphaltic material in the cracks and interstices of the neighboring limestones. In Post Mountain also a little oily residue is found about 20 feet above the base of the Cretaceous.

A light oil is distilled from the limestone at Burnet and shipped to the laboratory at Durant, N. Y., where the drug is prepared.

EXPORTS.

According to the records of the Bureau of Foreign and Domestic Commerce, the export trade of the United States in unmanufactured asphalt in 1920 increased more than 28 per cent in quantity and more than 22 per cent in value, compared with that of 1919. The value of the manufactured asphalt exported increased about 39 per cent and the increase in the total value of the asphalt exported was about 28 per cent.

Asphalt exported from the United States, 1915–1920.

Year.	Unmanufactured.		Manufactures of (value).	Total value.
	Quantity (short tons).	Value.		
1915	42,787	$735,952	$438,685	$1,174,637
1916	40,816	759,769	494,895	1,254,664
1917	30,107	587,256	585,472	1,172,728
1918	22,108	577,654	577,936	1,155,590
1919	40,208	1,103,930	606,918	1,710,848
1920	51,706	1,356,116	842,074	2,198,190

[2] Paige, Sidney, Mineral resources of the Llano-Burnet region, Tex.: U. S. Geol. Survey Bull. 450, p. 93, 1911.

Asphalt exported from the United States in 1920, by countries.

Country.	Unmanufactured.		Manufactures of.
	Quantity (short tons).	Value.	
North America:			
Canada	21,598	$442,285	$227,334
Central America:			
Costa Rica			645
Guatemala			86
Honduras			142
Nicaragua			496
Panama	501	18,340	42,570
Salvador			211
Mexico	86	3,353	20,388
Newfoundland	46	3,656	1,683
West Indies:			
British:			
Barbados			20
Jamaica			1,098
Trinidad and Tobago	2	129	37
Other British			1,475
Cuba	1,277	33,754	19,357
Dominican Republic			1,022
Virgin Islands of the United States			25
South America:			
Argentina	1,096	33,847	37,289
Brazil	640	23,902	48,568
Chile	1,482	41,182	13,089
Colombia			5,491
Ecuador	532	20,000	179
Guiana (Dutch)			45
Paraguay			171
Peru			4,476
Uruguay			88
Venezuela	6	200	648
Europe:			
Austria	6	275	
Belgium	579	26,343	8,454
Denmark	24	1,541	
France	1,093	51,005	11,016
Germany	1,234	48,541	27,035
Greece			21
Italy	157	6,514	2,260
Netherlands	577	24,120	425
Norway	20	1,080	2,568
Spain	52	2,031	12,770
Sweden	124	4,285	522
Switzerland			1,500
United Kingdom:			
England	8,754	271,243	95,621
Scotland	491	16,257	9,718
Asia:			
China	3,546	91,753	77,363
Kwantung, leased territory			180
Chosen			225
East Indies:			
British:			
India	1,851	45,552	19,178
Straits Settlements	54	1,942	1,149
Other British	20	780	2,361
Dutch	81	3,022	4,634
French	27	1,405	1,662
Hongkong	187	6,195	3,149
Japan	1,047	29,988	49,257
Persia	10	391	
Russia in Asia			125
Siam	9	300	
Africa:			
British:			
West			103
South	481	13,048	4,111
Egypt			319
Portuguese	31	1,120	
Oceania:			
British:			
Australia	1,314	33,239	24,927
New Zealand	1,494	30,297	39,171
Other British			3,717
Philippine Islands	1,177	23,201	11,900
	51,706	1,356,116	842,074

CONSUMPTION.

It is impossible to arrive at an exact statement of the asphaltic material consumed, but if from the sum of the quantity produced from domestic deposits and manufactured from domestic and Mexican petroleum plus the quantity imported is taken the quantity exported in a given year, the result reached is approximately correct. The following table gives the figures so obtained for the years 1915 to 1920, inclusive:

Asphaltic material consumed in the United States, 1915–1920.

	Short tons.		Short tons.
1915	1,225,447	1918	1,356,009
1916	1,467,657	1919	1,445,178
1917	1,587,284	1920	2,023,665

ASPHALT INDUSTRY IN PRINCIPAL COUNTRIES.

A table showing the output of all forms of natural asphalt in the principal producing countries, by calendar years (except as otherwise stated), from 1906 to 1919, inclusive, as far as reliable statistics are available, was given in the report for 1919, copies of which may be obtained from the United States Geological Survey. Little additional information is available at the time of writing (June, 1921).

ASPHALT ASSOCIATION.

The Asphalt Association, which was organized in 1919, maintains a main office at 25 West Forty-third Street, New York City, and a branch office at 29 South La Salle Street, Chicago. The officers are: President, J. R. Draney, of the United States Asphalt Refining Co.; vice president, W. W. McFarland, of the Warner Quinlan Co.; treasurer, N. G. M. Lukyx, of the Freeport Mexican Fuel Oil Co.; secretary, J. E. Pennybacker.

PRODUCERS.

The following operators reported to the United States Geological Survey that they produced asphaltic material from crude petroleum in the United States in 1920:

Asphaltum & Oil Refining Co., 2475 East Ninth Street, Los Angeles, Calif.
Atlantic Refining Co., 3144 Passyunk Avenue, Philadelphia, Pa.
Byerley & Sons, Cleveland, Ohio.
Central Refining Co., Lawrenceville, Ill.
Craig Oil Co., Toledo, Ohio.
Gulf Refining Co., Frick Building Annex, Pittsburgh, Pa.
Indian Refining Co., 244 Madison Avenue, New York, N. Y.
King Refining Co., 255 Holbrook Building, San Francisco, Calif.
Magnolia Petroleum Co., Box 1667, Dallas, Tex.
Mexican Petroleum Corporation, Los Angeles, Calif.
Parafline Co. (Inc.), 34 First Street, San Francisco, Calif.
Pioneer Asphalt Co., Lawrenceville, Ill.
Pioneer Paper Co., 251 South Los Angeles Street, Los Angeles, Calif.
Producers Refining Co., Bakersfield, Calif.
Prudential Oil Corporation, 110 William Street, New York, N. Y.
Seaside Oil Co., Summerland, Calif.
Shell Co. of California, Security Building, San Francisco, Calif.
Sinclair Refining Co. of Louisiana, Houston, Tex.

Standard Asphalt & Refining Co., 208 South La Salle Street, Chicago, Ill.
Standard Oil Co. of California, 200 Bush Street, San Francisco, Calif.
Standard Oil Co. of Indiana, 910 South Michigan Avenue, Chicago, Ill.
Standard Oil Co. of Louisiana, Baton Rouge, La.
Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y.
Sun Co., Philadelphia, Pa.
Texas Co., Houston, Tex.
Union Oil Co. of California, Union Oil Building, Los Angeles, Calif.
United States Asphalt Refining Co., 90 West Street, New York, N. Y.
Warner Quinlan Asphalt Co., 79 Wall Street, New York, N. Y.

Native asphalt and related bitumens were produced commercially in this country in 1920 by the following companies:

American Asphalt Association, 918 Wainwright Building, St. Louis, Mo.
Central Commercial Co., 111 North Market Street, Chicago, Ill.
City Street Improvement Co., 3001 Seventeenth Street, San Francisco, Calif.
Continental Asphalt & Petroleum Co., Continental Building, Oklahoma, Okla.
Elaterite Varnish & Rubber Co., Los Angeles, Calif.
Fort Smith Asphalt Co., Fort Smith, Ark.
Gilson Asphaltum Co., 1900 Land Title Building, Philadelphia, Pa.
Kentucky Rock Asphalt Co., 712 Paul Jones Building, Louisville, Ky.
Meadows Oil & Chemical Corporation, 52 Vanderbilt Avenue, New York, N. Y.
Raven Mining Co., Marquette Building, Chicago, Ill.
Sattler & Stevens, Carpinteria, Calif.
J. O. Tipton, Ada, Okla.
United States Elaterite Products Co., Salt Lake City, Utah.
Utah Gilsonite Co., Watson, Utah.
Uvalde Rock Asphalt Co., San Antonio, Tex.

GYPSUM.

By R. W. Stone.[1]

PRODUCTION.

In 1920, for the first time, the total quantity of gypsum produced in the United States in a single year exceeded 3,000,000 tons. Since 1909, when the annual output first passed the 2,000,000-ton mark, it has fluctuated, not falling below 2,000,000 tons nor going above 2,760,000 tons. The value of the product marketed also was much greater than in any previous year.

Gypsum produced in the United States, 1916–1920.

Year.	Crude mined (short tons).	Value of crude and calcined sold.
1916	2,757,730	$7,959,032
1917	2,696,226	11,116,452
1918	2,057,015	11,470,854
1919	2,420,163	15,727,907
1920	3,129,142	24,533,065

There has been an increase of 35 per cent in quantity of gypsum mined in the last 10 years, and an increase of 280 per cent in the value of the product in the same period. This great increase in value is due to increased cost of production, including higher wages and higher cost of supplies, and to a very great increase in the quantity of gypsum board manufactured in recent years. In comparison with 1919 the gypsum industry increased in quantity mined 29 per cent and in value of product sold 56 per cent.

[1] The domestic statistical data in this report were prepared by Miss Katrine W. Cottrell, of the United States Geological Survey. The tables relating to imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Gypsum produced and sold in the United States, 1919 and 1920, by States.

State.	Number of plants reporting.	Total quantity mined (short tons).	Sold without calcining.				Sold calcined.		Total value.
			Agricultural gypsum.		For Portland cement, paint, and other purposes.				
			Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	
1919.									
Iowa	6	421,279	2,405	$8,760	66,619	$222,672	264,656	$2,403,012	$2,634,444
Kansas	3	78,479	(a)	(a)	(a)	(a)	52,994	481,561	520,673
Michigan	6	339,125	1,597	10,422	57,157	163,688	250,687	2,216,257	2,390,367
Nevada	3	91,756	(a)	(a)	(a)	(a)	63,973	474,334	497,561
New York	8	591,153	5,458	23,984	210,959	596,355	316,767	2,910,404	3,530,743
Ohio	3	251,259	1,435	6,363	6,390	20,373	219,900	2,022,987	2,049,723
Oklahoma	5	114,313	(a)	(a)	24,761	63,920	71,986	644,537	708,660
Texas	5	176,607	(a)	(a)	10,637	16,442	130,642	1,064,264	1,080,754
Wyoming	3	51,079					37,314	282,587	282,587
Other States b	15	305,113	c 29,083	c 136,037	c 93,744	c 249,187	187,101	1,709,761	2,032,395
	57	2,420,163	39,978	185,566	470,267	1,332,637	1,596,020	14,209,704	15,727,907
1920.									
Iowa	6	571,895	41,404	161,838	69,435	252,593	321,400	4,008,534	4,422,965
Kansas	3	130,044	(a)	(a)	(a)	(a)	78,347	864,334	968,298
Michigan	6	382,212	12,092	54,050	61,750	214,918	261,499	3,252,060	3,521,028
Nevada	4	143,929	(a)	(a)	13,043	32,123	105,280	1,036,158	1,100,261
New York	8	780,295	15,510	67,862	255,567	919,641	387,856	5,451,426	6,438,929
Ohio	3	277,899	(a)	(a)	8,474	35,707	220,903	2,122,223	2,161,038
Oklahoma	4	135,279	(a)	(a)	(a)	(a)	69,924	772,749	816,768
Texas	5	220,157	(a)	(a)	16,900	47,961	164,956	1,391,382	1,439,491
Wyoming	4	57,732	(a)	(a)	(a)	(a)	43,384	410,599	410,724
Other States b	18	429,700	c 38,437	c 274,175	c 136,648	c 504,327	250,935	2,658,405	3,253,563
	61	3,129,142	107,443	557,925	561,817	2,007,270	1,904,484	21,967,870	24,533,065

a Included under "Other States."
b Alaska, Arizona, California, Colorado, Montana, New Mexico, Oregon, South Dakota, Utah, and Virginia. Includes also a small quantity sold by warehouses and not elsewhere accounted for.
c This figure includes also output of States entered as "(a)" above.

Gypsum produced and sold in the United States, 1916–1920, by uses.

Year.	Sold without calcining.											
	For Portland cement.			As agricultural gypsum.			For other purposes.			Total.		
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
1916	a 454,112	a $607,995	$1.34	81,879	$167,136	$2.04	a 11,128	a $15,299	$1.37	547,119	$790,430	$1.44
1917	a 526,881	a 867,123	1.65	84,366	230,808	2.74	a 12,748	a 26,439	2.07	623,995	1,124,370	1.80
1918	a 403,635	a 974,283	2.41	64,571	255,716	3.96	a 1,986	a 6,553	3.30	470,192	1,236,552	2.63
1919	a 470,267	a 1,332,637	2.83	39,978	185,566	4.64	(a)	(a)	....	510,245	1,518,203	2.98
1920	541,901	1,941,057	3.58	107,443	557,925	5.19	19,916	66,213	3.32	669,260	2,565,195	3.83

Year.	Sold calcined.														
	As plaster of Paris, wall plaster, Keenes cement, etc.			For dental plaster.			To glass factories.			As boards, tile, and blocks, and for other purposes.			Total.		
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
1916	1,677,081	$6,884,960	$4.11	661	$8,766	$13.26	11,537	$28,839	$2.50	116,535	$246,037	$2.11	1,805,814	$7,168,602	$3.97
1917	1,531,535	8,873,176	5.79	991	7,672	7.74	13,808	72,558	5.25	131,056	1,038,676	7.93	1,677,390	9,992,082	5.96
1918	1,174,359	8,483,633	7.22	(b)	(b)	....	13,567	84,928	6.26	b 140,343	b 1,665,741	11.88	1,328,269	10,234,302	7.70
1919	1,393,141	11,809,624	8.48	(b)	(b)	....	14,677	96,561	6.58	b 188,202	b 2,303,519	12.24	1,596,020	14,209,704	8.90
1920	1,578,360	15,723,372	9.96	1,731	27,440	15.85	15,637	125,441	8.02	308,756	6,091,617	19.73	1,904,484	21,967,870	11.53

a A small quantity of paint material and of gypsum sold for other purposes included with gypsum sold for Portland cement.
b Some dental plaster included with boards, tile, etc.

The increase was general in each of the principal producing States and also by uses. The largest proportionate increase was that of agricultural gypsum, which rose from about 40,000 to 107,000 tons. A comparison of the quantity of gypsum produced and sold crude for agricultural gypsum and for Portland cement in 1919 and 1920 is shown in the following tables.

Gypsum sold crude for agriculture in 1919 and 1920.

State.	1919		1920	
	Number of plants.	Quantity (short tons).	Number of plants.	Quantity (short tons).
Iowa	3	2,405	4	41,404
Michigan	4	1,597	5	12,092
New York	5	5,458	6	15,510
Ohio	3	1,435	2	(a)
Other States (11)	14	29,083	15	38,437
	29	39,978	32	107,443

a Included under "Other States."

Gypsum sold crude for Portland cement in 1919 and 1920.

State.	1919		1920	
	Number of plants.	Quantity (short tons).	Number of plants.	Quantity (short tons).
Iowa	5	66,619	5	69,435
Michigan	4	48,798	5	52,705
Nevada	2	(a)	3	13,043
New York	5	210,959	5	255,567
Ohio	3	6,290	3	8,474
Oklahoma	3	24,761	2	(a)
Texas	3	10,637	3	16,900
Other States (9)	14	93,744	12	125,777
	39	461,808	38	541,901

a Included under "Other States."

The production of Keenes cement may not be shown by States without revealing the output of individual plants. The quantity of this gypsum product made in the United States is here shown separately for the first time:

Keenes cement produced in the United States, 1918–1920.

Year.	Number of manufacturers.	Quantity (short tons).	Value.	Average price per ton.
1918	5	12,823	$151,802	$11.84
1919	6	15,395	200,360	13.01
1920	6	16,542	246,433	14.90

Plaster board, tile, and blocks were made in 15 States at plants operated by the original producers of the gypsum used in their manufacture. Plants of firms that make these products but do not mine gypsum are not included here; the gypsum they use is already accounted for in these tables as plaster sold by original manufacturers. Therefore the figures given below for boards and blocks do not include the entire production of these articles in the United States.

The production of gypsum plaster board, wall board, tile, and blocks, at plants of the class indicated, grew in five years from 80,000 to 180,000 tons and in 1920 was 308,756 tons, valued at $6,091,617. An effort was made to get statistics of gypsum boards separate from blocks with the following result: Boards, 154,980 tons, valued at $4,073,569; blocks and tile, 153,776 tons, valued at $2,018,048. The quantity of gypsum used for the two purposes is nearly equal but the price of boards per ton seems to be double that of blocks.

BUSINESS NOTES.

The most important business change in the gypsum industry in 1920 was the purchase by the Beaver Boards Co., of Buffalo, N. Y., of the capital stock of the American Cement Plaster Co. and the Bestwall Manufacturing Co. The corporate entity of the companies remains unchanged, and they will continue to operate and manufacture the same products as in the past. The plants of the American Cement Plaster Co. are at Akron, N. Y., Gypsum, Ohio, Grand Rapids, Mich., Fort Dodge, Iowa, Blue Rapids, Kans., and Acme, Tex. A large addition to the plant at Akron, N. Y., is planned.

According to the Salt Lake Mining Review, March 30, 1920, the Union Gypsum Co. has been organized to operate the Giant group of gypsum claims, 6 miles north of Jean, Clark County, Nev.

The American Hard Wall Plaster Co., Utica, N. Y., and the Paragon Plaster Co., Syracuse, N. Y., began early in 1920 to sink a shaft between Wheatville and Oakfield, N Y. The companies combined in a venture to provide their own needs in plaster. The production of gypsum is to begin in 1921.

The United States Gypsum Co. is building an $800,000 plant at Sweetwater, Tex., which is to utilize both rock gypsum and gypsite and to specialize in the manufacture of "sheetrock" wall board and gypsum blocks. It may also build a paper mill at Sweetwater to make chip paper from old newspaper. According to H. E. Brookby, the gypsum deposit consists, in ascending order, of a bottom ledge 12 feet thick, 4 or 5 inches of sandstone, a 4-foot gypsum bed, a sand and dirt parting, and a deposit of gypsite 2 inches to 18 feet thick, derived from the weathering of a bed of gypsum originally about 20 feet thick. The location of the deposit and plant at the crossing of the Santa Fe and the Texas & Pacific railways is particularly advantageous. The United States Gypsum Co. abandoned development work at Heath, Mont.

The Acme Cement Plaster Co. began work on a mill 2 miles west of Dilworth, Okla., on the edge of a 50-acre gypsite deposit.

The Connecticut Adamant Plaster Co., New Haven, Conn., whose plant was destroyed by fire in July, 1920, rebuilt it with fireproof construction of steel and concrete. The plant is equipped with kettles and Raymond mills. All bunkers and bins are of steel, and the machinery is driven by individual motors.

The Gypsum Industries Association maintains offices at 111 West Washington Street, Chicago, Ill. H. H. Macdonald is secretary, V. G. Marani chief engineer, and Dr. William Crocker agronomist.

IMPORTS.

Most of the gypsum imported into the United States is in the crude lump or unground form. As shown in the following table, the imports in 1920 included 282,000 tons of unground and 15,000 tons of ground or calcined gypsum, increases of 64 and 43 per cent, respectively, over the imports in 1919.

Gypsum imported and entered for consumption in the United States, 1916–1920.[a]

Year.	Unground.		Ground or calcined.		Value of manufactured plaster of Paris.	Keenes cement.		Total value.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.		Quantity (short tons).	Value.	
1916	254,131	$275,043	11,706	$72,345	$9,085	600	$9,890	$366,363
1917	240,269	265,504	16,533	109,732	6,016	484	8,003	389,255
1918	50,653	55,004	6,117	70,028	1,765	111	2,259	129,056
1919	171,733	211,946	10,415	126,405	7,719	187	5,984	352,054
1920	282,486	397,942	14,921	179,191	10,282	202	5,338	592,753

[a] Figures compiled from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

The crude gypsum imported into the United States comes almost exclusively by boat from Nova Scotia and New Brunswick and is calcined at New Haven, Conn., and New Brighton and New York City, N. Y. The following table shows the source of imports by countries.

Gypsum, crude, ground, or calcined imported into the United States in 1920.

[General imports.]

Country.	Quantity (short tons).	Value.
Canada	292,600	$562,362
England	4,705	13,611
France	86	830
Hongkong	6	190
Italy	10	140
	297,407	577,133

Only three companies reported to the Geological Survey that they imported gypsum in 1920. These were J. B. King & Co. and the Rock Plaster Corporation, New York City, N. Y., and the Connecticut Adamant Plaster Co., New Haven, Conn. These companies sold only a few hundred tons of gypsum in the crude or uncalcined form. Very little of this was sold for agricultural gypsum, most of it being used in paint and as terra alba. About 165,000 tons was sold calcined. About 73,000 tons was sold as mixed wall plaster and 78,000 tons as plaster of Paris and molding and finishing plaster; the remainder was used in the manufacture of gypsum plaster board, tile, and blocks, for dental plaster, and for other purposes.

Values for the imported gypsum manufactured and sold by these companies can not be given because they were not reported in detail, it being found impracticable to arrive at correct figures. It is estimated, however, that the total value of gypsum and gypsum products sold by these three firms in 1920 was more than $2,770,000, in comparison with a business of more than $24,500,000 done by the entire domestic industry.

EXPORTS.

The data in the following table were obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce. The value of the exports of plaster or wall board in 1920 was 37 per cent greater than that of the exports in 1919. England took by far the largest quantity of our exports of plaster or wall board in 1920, as indicated by the value, $382,338, in comparison with Canada and New Zealand, the next largest buyers, at $244,168 and $165,433, respectively.

Destination and value of gypsum plaster or wall board exported from the United States, 1918–1920.

Country.	1918	1919	1920
North America:			
Bermuda	$21		
British Honduras	61	$4	$632
Canada	39,785	107,462	244,168
Central America:			
Costa Rica		18	
Guatemala	4,067	8,288	698
Honduras		1,856	2,664
Nicaragua			16
Panama	53	7,290	1,935
Salvador	1,181	495	360
Mexico	3,518	14,663	72,273
Newfoundland and Labrador	51	2,789	598
British West Indies:			
Barbados		28	
Jamaica	47	90	734
Trinidad and Tobago		175	416
Other British	52	1,131	1,101
Cuba	81,910	8,455	86,919
Dominican Republic	1,808	398	6,779
Dutch West Indies		57	110
French West Indies			355
Haiti	308		1,604
Virgin Islands of the United States	225	182	258
South America:			
Argentina	12,031	62,715	58,811
Bolivia		116	413
Brazil	4,907	19,419	20,217
Chile	3,156	15,546	7,564
Colombia		1,320	3,951
Ecuador			65
Guiana: British	80		31
Peru	4,574	663	24,555
Uruguay		5,171	6,187
Venezuela	6	330	4,236
Europe:			
Belgium		4,398	18,868
Denmark		3,546	
France			1,435
Greece		2,177	30,466
Iceland and Faroe Islands	1,975		
Italy	454		88
Malta, Gozo, etc			164
Netherlands		18,573	47,328
Norway		4,456	4,664
Poland and Danzig			4,000
Russia		27	
Spain		487	32,150
Sweden		5,553	222
Switzerland			33,228
United Kingdom:			
England	15,394	303,573	382,338
Scotland		12,564	30,112
Ireland		9,058	13,460
Asia:			
China	407	22,623	19,890
British East Indies:			
India	4,585	8,293	42,779
Straits Settlements		38	
Other British	24		199
Dutch East Indies	5,440	5,535	3,440
Hongkong	170	4,723	893

Destination and value of gypsum plaster or wall board exported from the United States, 1918-1920—Continued.

Country.	1918	1919	1920
Asia—Continued.			
Japan	$113,931	$229,010	$20,146
Russia in Asia		78	114
Turkey in Asia		8,886	5,242
Australia	70,796	90,091	102,133
New Zealand	20,285	53,054	165,433
Oceania:			
French	65	3	2,668
Former German		142	
Other			270
Philippine Islands	10,608	5,608	15,575
Africa:			
Belgian Kongo			60
British Africa:			
South	13,786	79,556	35,056
West	3,838	7,099	1,227
East	2,386	8	2,491
Egypt		808	359
French Africa			443
Portuguese Africa		3,187	1,329
	421,985	1,141,815	1,565,920

PRODUCTION OF GYPSUM IN CANADA.[2]

The production of gypsum in Canada showed a substantial gain in 1920, the value of the crude, crushed, or calcined product shipped being greater than in any previous year and the quantity the largest since 1915.

The total quantity of gypsum rock quarried in Canada in 1920 was 460,354 tons, of which 148,964 tons was calcined. According to the Canadian report the shipments of all grades amounted to 429,144 tons, valued at $1,876,595, and included lump gypsum, 262,442 tons, valued at $439,762; crushed, 48,379 tons, valued at $146,947; fine ground, 6,615 tons, valued at $46,584; and calcined, 111,708 tons, valued at $1,243,302. The Provinces shipping were Nova Scotia, 260,661 tons, valued at $556,356; New Brunswick, 49,405 tons, valued at $428,183; Ontario, 74,707 tons, valued at $404,162; Manitoba, 45,371 tons, valued at $487,894.

Gypsum produced and marketed in Canada, 1917-1920.

Year.	Quantity (short tons).	Value.
1917	336,332	$881,984
1918	152,287	823,006
1919	299,063	1,215,287
1920	429,144	1,876,595

MANUFACTURERS.

MANUFACTURERS OF GYPSUM PLASTER.

HEAD OFFICES.

Acme Cement Plaster Co., 703 Frisco Building, St. Louis, Mo.
Alabastine Co., Grand Rapids, Mich.
American Cement Plaster Co., Buffalo, N. Y.
American Gypsum Co., Port Clinton, Ohio.

[2] Preliminary report on the mineral production of Canada during the calendar year 1920, Canada Dept. Mines, Mines Branch, Feb. 24, 1921.

Arizona Gypsum Plaster Co., Douglas, Ariz.
Best Bros. Keenes Cement Co., Medicine Lodge, Kans.
Cardiff Gypsum Plaster Co., Fort Dodge, Iowa.
Centerville Gypsum Co., Centerville, Iowa.
Colorado Portland Cement Co., Ideal Building, Denver, Colo.
Connecticut Adamant Plaster Co. (importer), New Haven, Conn.
Dakota Plaster Co., Rapid City, S. Dak.
Ebsary Gypsum Co. (Inc.), 171 Court Street, Rochester, N. Y.
Empire Gypsum Co., Rochester, N. Y.
Garbutt & Orcutt, Athletic Club Building, Los Angeles, Calif.
Globe Plaster & Mining Co., 222 Commerce Building, Kansas City, Mo.
Grand Rapids Plaster Co., Grand Rapids, Mich.
Jumbo Plaster & Cement Co., Sigurd, Utah.
J. B. King & Co. (importer), 17 State Street, New York, N. Y.
Lycoming Calcining Co., Williamsport, Pa.
Nephi Plaster & Manufacturing Co., 322 Ness Building, Salt Lake City, Utah.
Niagara Gypsum Co., Buffalo, N. Y.
Oklahoma Portland Cement Co., Denver, Colo.
Overland Cement Plaster Co., Laramie, Wyo.
Pacific Coast Gypsum Co., Tacoma, Wash.
Pacific Portland Cement Co., Pacific Building, San Francisco, Calif.
Plymouth Gypsum Co., Fort Dodge, Iowa.
Rock Plaster Corp. (importer), 381 Fourth Avenue, New York, N. Y.
Southern Gypsum Co., North Holston, Va.
Texas Cement Plaster Co., Oklahoma City, Okla.
Three Forks Portland Cement Co., Denver, Colo.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.
Wasem Plaster Co., Fort Dodge, Iowa.
White Star Plaster Co., 1324 Washington Building, Los Angeles, Calif.
Wyoming Cement Plaster Co., Greybull, Wyo.

MANUFACTURERS OF GYPSUM PLASTER OPERATING MORE THAN ONE PLANT.

Acme Cement Plaster Co	Grand Rapids, Mich.
	Acme, Okla.
	Acme, Tex.
	Acme, N. Mex.
	Laramie, Wyo.
	Gypsum, Oreg.
American Cement Plaster Co	Akron, N. Y.
	Gypsum, Ohio.
	Grand Rapids, Mich.
	Fort Dodge, Iowa.
	Blue Rapids, Kans.
	Acme, Tex.
Colorado Portland Cement Co	Portland, Colo.
	Red Butte, Wyo.
Grand Rapids Plaster Co	Grand Rapids, Mich.
	Grandville, Mich.
United States Gypsum Co	Oakfield, N. Y.
	Plasterco, Va.
	Gypsum, Ohio.
	Alabaster, Mich.
	Grand Rapids, Mich.
	Fort Dodge, Iowa.
	Blue Rapids, Kans.
	Southard, Okla.
	Eldorado, Okla.
	Piedmont, S. Dak.
	Loveland, Colo.
	Arden, Nev.
	Amboy, Calif.

MANUFACTURERS OF KEENES CEMENT.

Acme Cement Plaster Co., 703 Frisco Building, St. Louis, Mo.
Best Bros. Keenes Cement Co., Medicine Lodge, Kans.
Nephi Plaster & Manufacturing Co., 322 Ness Building, Salt Lake City, Utah.
Pacific Portland Cement Co., 827 Pacific Building, San Francisco, Calif.
Texas Cement Plaster Co., Oklahoma City, Okla.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.

MANUFACTURERS OF GYPSUM PLASTER BOARD AND WALL BOARD.

American Cement Plaster Co., Buffalo, N. Y.
Bell, H. W., & Co., 2592 Park Avenue, New York City.
Bestwall Manufacturing Co., Military Road, Buffalo, N. Y.
Buttonlath Manufacturing Co., Vernon and Boyle avenues, Los Angeles, Calif.
Duffy, J. P., & Co., 51st Street and Second Avenue, Brooklyn, N. Y.
Empire Gypsum Co., Rochester, N. Y.
Gypsite Fireproofing Co., 2034 Dime Bank Building, Detroit, Mich.
Hercules Plaster Board Co., Hampton, Va.
Kelley Plaster & Plaster Board Co., 261 Central Avenue, Passaic, N. J.
Keyhole Plaster Lath Co., 148 Hooper Street, San Francisco, Calif.
King, J. B., & Co., 17 State Street, New York City.
New Jersey Adamant Manufacturing Co., 79 Passaic Avenue, East Newark, N. J.
Pacific Coast Gypsum Co., 403 Perkins Building, Tacoma, Wash.
Plymouth Gypsum Co., Fort Dodge, Iowa.
Rader, Gustav, 1105 Metropolitan Avenue, Brooklyn, N. Y.
Reeb, M. A., Corporation, 597 Michigan Avenue, Buffalo, N. Y.
Rock Plaster Corporation, 381 Fourth Avenue, New York City.
Schumacher Wall Board Co., 58th Street and San Pedro and Slauson avenues, Los Angeles, Calif.
Southern Gypsum Co., North Holston, Va.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.

MANUFACTURERS OF GYPSUM BLOCK AND TILE.

Acme Cement Plaster Co., 703 Frisco Building, St. Louis, Mo.
Alabastine Co., Grand Rapids, Mich.
American Cement Plaster Co., Buffalo, N. Y.
American Gypsum Co., Port Clinton, Ohio.
Arizona Gypsum Plaster Co., Douglas, Ariz.
Ebsary Gypsum Co. (Inc.), Rochester, N. Y.
Empire Gypsum Co., Rochester, N. Y.
King, J. B., & Co., 17 State Street, New York, N. Y.
Nephi Plaster & Manufacturing Co., 322 Ness Building, Salt Lake City, Utah.
Plymouth Gypsum Co., Fort Dodge, Iowa.
Reeb, M. A., Corporation, 597 Michigan Avenue, Buffalo, N. Y.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.
Wyoming Cement Plaster Co., Greybull, Wyo.

MINERS.

[Gypsum sold crude only.]

American Gypsum Co., 301 Livingston Building, Rochester, N. Y.
Briggs, H. H., 4621 Bliss Street, El Paso, Tex.
Simmons, Arthur, Norwich, N. Y.

FLUORSPAR AND CRYOLITE.

By Hubert W. Davis.

FLUORSPAR.

INTRODUCTION.

Although prices of fluorspar were somewhat lower in 1920 than in 1919 and 1918, the industry apparently enjoyed a very satisfactory year. The demand was good throughout the year except in January and December, and at times little material was available for delivery even at attractive prices. During the later part of February a number of contracts expired, and this condition of the industry, together with the depletion of the stocks accumulated during the war period, forced many consumers into the market for fresh supplies. In June it was believed that there would be a shortage of fluorspar during the last half of the year and that the price of fluxing material would be advanced. Despite the fact that shipments were being made under difficulties, owing to the insufficient car supply, consumers began to press producers for delivery, the effort of steel manufacturers being to get large supplies of fluorspar in their bins. That they succeeded is shown by reports furnished to the Geological Survey by a group of the largest steel producers, which indicate that stocks of fluorspar amounting to about 66,600 short tons had been accumulated on December 31, 1920. These stocks are probably the largest ever accumulated by steel manufacturers, and the effect on the output of fluorspar in the dull year of 1921 is clearly apparent.

CHARACTER.[1]

Fluorspar, or fluorite, chemically calcium fluoride (CaF_2), consists of calcium and fluorine in the proportions of 51.1 to 48.9. The mineral is often spoken of as "spar," but the term is misleading, as the same term is also applied to feldspar, barite (heavy spar), calcite (calc spar, Iceland spar), and several other minerals. Fluorspar is only slightly harder than calcite and consequently crushes easily, but it may be distinguished from calcite by its failure to effervesce with dilute hydrochloric acid. It crystallizes in the isometric system and is often found in cubical crystals. In color fluorspar ranges, according to purity, from a clear, colorless, or slightly bluish glasslike substance through various brilliant shades,

[1] The mineralogic character and geologic relations of fluorspar have been treated in greater detail in former volumes of Mineral Resources by Ernest F. Burchard, who was the author of the chapters on fluorspar from 1906 to 1918, inclusive, and of the notes on fluorspar in Survey Bull. 470, pp. 533-545, 1911, and Bull. 666, pp. 175-182, 1919.

of which purple and green are most common, and much of it is white and opaque. The mineral is usually very pure, some of the material marketed running 98 to 99 per cent of calcium fluoride. It commonly occurs in veins cutting both sedimentary and igneous rocks.

HISTORY OF DEVELOPMENT.

Although fluorspar is widely distributed throughout the United States, there are but few States in which it has been found in sufficient quantity and so conveniently located as to be of commercial value.

The first fluorspar produced for commercial use in the United States, so far as it is possible to determine, appears to have been mined about 1837 from a topaz vein near Trumbull, Conn.[2] This fluorspar, which sold for $60 a ton, was said to have been used with magnetic iron pyrite in the smelting of copper ores. Jackson [3] mentions the occurrence of green fluorspar in Maine, at Long Island, in Bluehill Bay, and states that it was sold in the apothecaries' shops for 50 cents a pound, but that the demand was very small.

Numerous references to the occurrence of fluorspar, or "fluate of lime," as it was then called, in southern Illinois were published in 1818 and the following years, but the mineral seems to have been first discovered in place in 1839, being encountered with galena in sinking a well on the Anderson farm, now the property of the Fairview Fluor Spar & Lead Co.[4] Fluorspar was first mined in Illinois at Rosiclare in 1842, and since then operations have been carried on more or less continuously to the present time. Shipments apparently began in the early seventies.

The presence of fluorspar in Kentucky was first recognized by David Dale Owen and Sidney S. Lyon during the progress of the first geological survey of the State in 1854–1857.[5] Shipments apparently began about 1871 and were continued for several years, but the long wagon hauls over bad roads finally caused the two mines operating to close. The first mill for grinding fluorspar was built at the Royal mines in the early seventies. Work was begun on deposits near Marion during 1896, and from that time on Kentucky has contributed annually an output which from 1898 to 1904 exceeded that of Illinois.

The mining of fluorspar in Colorado appears to date back to the early seventies, when fluorspar was mined from the deposit on Cub Creek, southwest of Evergreen, Jefferson County, and carted 28 miles to the Central City district, where it was used as a flux in smelting gold and silver ores.[6] Shipments were first reported from the Jamestown district in 1905 and from Wagon Wheel Gap in 1913.

In Tennessee development work was begun in 1901 on deposits of fluorspar near Bellwood, Smith County, and shipments were made in the following year.

The first shipments from Arizona were reported in 1902, from New Mexico in 1909, from New Hampshire in 1911, from Utah in 1918, and from Nevada in 1919.

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[2] Shepard, C. U., Report on the geological survey of Connecticut, p. 80, 1837.
[3] Jackson, C. T., Geology of Maine, p. 125, 1838.
[4] Bain, H. F., Fluorspar deposits of southern Illinois: U. S. Geol. Survey Bull. 255, 1905.
[5] Ulrich, E. O., and Smith, W. S. T., The lead, zinc, and fluorspar deposits of western Kentucky: U. S. Geol. Survey Prof. Paper, 36, 1905.
[6] Burchard, E. F., Min. and Sci. Press, Aug. 21, 1909, p. 258.

Prior to 1898 fluorspar was used chiefly in the preparation of hydrofluoric acid and the manufacture of opalescent glass, but since 1899, when it became generally recognized that fluorspar possessed many advantages over limestone as a flux in the manufacture of open-hearth steel, by far the greater part of the output has been used in the steel industry.

OCCURRENCE.

The most valuable fluorspar deposits in the United States, size, purity, and nearness to markets considered, are in Illinois and Kentucky, from which 89 per cent of the domestic output in 1920 was obtained.

There are veins of high-grade fluorspar in many Western States, but development is handicapped on account of the distance to the market in the Eastern States, where competition with Illinois–Kentucky producers is mainly a matter of costs of transportation.

At many of the domestic deposits the fluorspar is associated with ores of greater economic importance than itself; at some the occurrence is only of mineralogic interest; and at others the fluorspar, although probably occurring in sufficient quantity, can not be profitably mined at present on account of the location with regard to transportation and markets.

ESSENTIAL FEATURES OF A COMMERCIAL FLUORSPAR DEPOSIT.

The increased demand for fluorspar and the corresponding advance in price during recent years have stimulated exploration and resulted in the development of new deposits, some of which, although profitable under the abnormal conditions prevailing during 1918, can not be successfully operated at present on account of their location and the consequent expensive haul by wagon or autotruck to a railroad.

The freight charges on fluorspar are an important factor in the profitable operation of a deposit, and as the fluorspar industry is mainly dependent on the manufacture of open-hearth steel, 84 per cent of which is produced in the four contiguous States of Pennsylvania, Ohio, Indiana, and Illinois, the deposits that are near these markets and that are accessible to transportation facilities have an advantage over those not so favorably situated.

The quantity of fluorspar available in a deposit is of importance. A commercial deposit should be capable of producing at least a carload of merchantable fluorspar a day and have a life of not less than 15 years.

Many impurities are found in fluorspar, and in order both to satisfy purchasers and to command a price satisfactory to producers the objectionable impurities have to be eliminated. About 83 per cent of the fluorspar shipped in 1920 was in the form of gravel (usually less than five-eighths of an inch in diameter), and where it is mixed with clay, sand, and other light impurities the log washer is generally employed to prepare it for the market. A convenient supply of water is therefore essential. Fluorspar associated with such minerals as galena, sphalerite, pyrite, calcite, barite, and quartz requires more elaborate mechanical treatment for cleaning. In arid portions of the West it is cleaned by hand cobbing, but this method entails much waste.

The cost of properly developing a fluorspar deposit and of installing satisfactory equipment for mining and cleaning the material is considerable, ranging from $25,000 for small deposits to $1,000,000 or more for large ones. Before construction is undertaken accurate information should be obtained as to the size of the deposit and the quality of the ore. Upon the advice of unscrupulous promoters large sums of money have been spent by prospective fluorspar producers for the purchase of leases on properties which did not contain fluorspar in sufficient quantity to warrant development. Much time and money can generally be saved by consulting a competent geologist or mining engineer and studying the information furnished by the Federal and State geological surveys.

Fluorspar prepared for making iron and steel should carry at least 80 per cent of calcium fluoride, preferably more, and it should be free from sulphides, sulphates, and phosphates. "Acid" fluorspar, used in the manufacture of hydrofluoric acid, is sold either in lumps or pulverized and is usually guaranteed to contain not less than 98 per cent of calcium fluoride and not more than 1 per cent of silica. Ground fluorspar analyzing 92 to 98 per cent of calcium fluoride and 1 to 4 per cent of silica is used by the manufacturers of opalescent glass and sanitary and enamel ware.

FLUORSPAR MINED AND SHIPPED.

The fluorspar reported to the Geological Survey as sold (shipped from domestic mines) in 1920 showed an increase of 35 per cent in quantity and 34 per cent in value as compared with 1919. The general average price per ton f. o. b. mines or shipping points for all grades in 1920 was $25.26, a decrease of 23 cents a ton from 1919. The highest average price reported in 1920 was in Kentucky and the lowest was in New Mexico.

The exact quantity of crude fluorspar mined can not be ascertained, because at most of the smaller mines only the cleaned material is weighed. From such figures as are available, showing the relation between crude ore treated and beneficiated fluorspar recovered, it is apparent that in Illinois the crude ore hoisted contains approximately 25 per cent of waste, in Kentucky approximately 30 per cent, and in Colorado about 69 per cent. The total quantity of crude fluorspar mined in 1920 amounted to approximately 271,700 short tons, an increase of 41 per cent over 1919. The total quantity of merchantable fluorspar recovered in 1920 was 201,372 short tons, an increase of 31 per cent over 1919.

Such details of the shipments of fluorspar from 1916 to 1920 by States as may be published without revealing statistics of individual producers, except by permission, are given in the following table:

Domestic fluorspar sold, 1916–1920.

State.	Gravel. Quantity (short tons).	Gravel. Value.	Gravel. Average price per ton.	Lump. Quantity (short tons).	Lump. Value.	Lump. Average price per ton.	Ground. Quantity (short tons).	Ground. Value.	Ground. Average price per ton.	Total. Quantity (short tons).	Total. Value.	Total. Average price per ton.
1916.												
Illinois	123,983	$660,714	$5.33	14,489	$114,993	$7.94	7,595	$94,039	$12.38	146,067	$869,746	$5.95
Kentucky												
Other States[a]	[b] 9,668	[b] 52,908	5.47	([b])	([b])	....	....	....	....	9,668	52,908	5.47
	[b] 133,651	[b] 713,622	5.34	[b] 14,489	[b] 114,993	7.94	7,595	94,039	12.38	155,735	922,654	5.92
1917.												
Colorado	11,140	94,365	8.47	5,964	102,268	17.15	....	....	....	17,104	196,633	11.50
Illinois	136,954	1,111,348	8.11	19,584	247,192	12.62	10,136	178,342	17.59	156,676	1,373,333	8.77
Kentucky	33,641	534,017	15.87							43,639	697,566	15.98
Other States[a]	[b] 1,409	[b] 20,190	14.33	([b])	([b])	....	....	....	....	1,409	20,190	14.33
	[b] 183,144	[b] 1,759,920	9.61	[b] 25,548	[b] 349,460	13.68	10,136	178,342	17.59	218,828	2,287,722	10.45
1918.												
Arizona	....	....	....	364	5,537	15.21	....	....	....	364	5,537	15.21
Colorado	32,680	287,620	8.80	5,795	129,160	22.29	....	....	....	38,475	416,780	10.83
Illinois	122,721	2,565,394	20.90	9,518	260,948	27.42	8,752	273,203	31.22	132,798	2,887,099	21.74
Kentucky	79,411	1,856,739	23.38							87,604	2,069,185	23.62
New Mexico	[b] 1,309	[b] 25,507	19.49	[b] 3,267	[b] 61,373	18.79	....	....	....	3,437	64,348	18.72
Other States[a]										1,139	22,532	19.78
	[b] 236,121	[b] 4,735,260	20.05	[b] 18,944	[b] 457,018	24.12	8,752	273,203	31.22	263,817	5,465,481	20.72
1919.												
Illinois	81,026	1,962,934	24.23	4,246	133,993	31.56	10,373	446,224	43.02	92,729	2,430,361	26.21
Kentucky	29,470	770,381	26.14							32,386	883,171	27.27
Colorado	[b] 12,088	[b] 184,044	15.23	[b] 1,087	[b] 27,998	25.76	....	....	....	9,687	150,739	15.56
New Mexico										2,346	37,643	16.05
Other States[a]										1,142	23,660	20.72
	[b] 122,584	[b] 2,917,359	23.80	[b] 5,333	[b] 161,991	30.38	10,373	446,224	43.02	138,290	3,525,574	25.49
1920.												
Illinois	103,486	2,396,322	23.16	8,332	381,171	36.27	8,481	537,151	43.32	120,299	3,096,767	25.74
Kentucky	39,997	1,029,195	25.73	2,178			3,916			46,091	1,246,942	27.05
Nevada	530	[b] 13,332	17.61	....	[b] 8,608	20.30	2			532	22,070	18.66
New Hampshire	[b] 202			([b])			....	....	....	202		
Utah	....			268			....	....	....	268		
Arizona	25			156			....	....	....	181		
Colorado	10,076	157,768	14.96	2,776	195,000	22.52	....	....	....	12,852	251,308	19.55
New Mexico	470			5,883			....	....	....	6,353	101,460	15.97
	[b] 154,786	[b] 3,596,617	23.24	[b] 19,593	[b] 584,779	29.85	12,399	537,151	43.32	186,778	4,718,547	25.26

[a] 1916: Arizona, Colorado, and New Hampshire: 1917: Arizona and New Hampshire; 1918: New Hampshire, Utah, and Washington; 1919: Arizona, Nevada, New Hampshire, and Utah. [b] Some lump spar is included with gravel.

Merchantable fluorspar recovered in 1919 and 1920, by States.

State.	1919		1920	
	Quantity (short tons).	Percentage of total.	Quantity (short tons).	Percentage of total.
Illinois	103,113	67.31	124,953	62.05
Kentucky	32,548	21.25	53,756	26.70
Colorado	12,484	8.15	12,702	6.31
New Mexico	3,645	2.38	8,679	4.31
New Hampshire	531	.35	202	.10
Arizona	45	.10	180	.09
Utah	116		268	.13
Nevada	700	.46	632	.31
	153,182	100.00	201,372	100.00

FLUORSPAR INDUSTRY BY STATES.

Arizona.—In Arizona three operators reported the shipment of fluorspar in 1920. One shipment was used as a flux in smelting copper; the remainder went to steel plants. The Safford Fluorspar Mining Co., which has acquired a property near Duncan, Greenlee County, reports that it intends to install a mill in the near future.

Colorado.—The output from Colorado in 1920 was obtained from Wagon Wheel Gap and the vicinity of Jamestown. The Wagon Wheel Gap mine, which produces both gravel and high-grade lump fluorspar, is the largest producer. The operators reported a good demand up to the latter part of the year, but labor and other local conditions were said to be bad.

In the Jamestown district the only mill operating during 1920 was that of E. W. Lehman. Most of the fluorspar in this district has to be concentrated to make it marketable, although it is reported that since the beginning of 1921 shipments of crude spar carrying 80 per cent of calcium fluoride have been made.

Illinois.[7]—An important feature of the year in the southern Illinois district was the work on the new mill of the Hillside Fluor Spar & Lead Mining Co., near Rosiclare. This company owns the eastern extension of the Rosiclare vein adjoining the property of the Rosiclare Lead & Fluor Spar Mining Co. A 6 by 20 foot shaft was sunk to a depth of 250 feet, and the upper 170 feet was concreted. The shaft has three compartments, two for hoisting and one for pipe and ladderway equipped with steel stairs. Two 3-ton skips will be used in balance. A well-equipped mill of concrete and steel, designed for a capacity of 25 tons of crude ore an hour, is being built. Power house, pump house, and hoist houses of brick and a steel headframe are under construction. Important features of the mill will be close sizing by trommels with separate jigging of each size, special dewatering and drying conveyors, and automatic conveying of finished spar to loading bins over the railroad tracks. This will be one of the largest and most modern fluorspar mills in existence.

The Blue Diggings deposit of the Fairview Fluor Spar & Lead Co. was exhausted during the year and the headworks were removed. The increase in zinc sulphide (sphalerite) in the Fairview ores neces-

[7] The writer is indebted to R. B. Ladoo, of the Bureau of Mines, for most of the notes on developments in Illinois.

sitated some changes in the mill. A new jig was installed, slightly finer grinding was used, and the feed was sized closer to eliminate more zinc sulphide, the specific gravity of which is close to that of fluorspar. Four new concentrating tables were added to treat the fines. During the year this company also built a plant to crush its limestone waste rock to pass through a one-fourth-inch mesh screen for use as agricultural limestone. The company is planning to build a new mill to treat its fluorspar ores high in zinc.

The Rosiclare Lead & Fluor Spar Mining Co. made considerable progress in development work. The main shaft was sunk to 680 feet, and an ore pocket cut on the 600-foot level in preparation for mining on that level. The 400-foot level of the Daisy mine, on the Daisy vein 600 feet north of the Rosiclare vein, was opened in 15 feet of good ore. Mining here, however, is somewhat more difficult than on the main vein, as the walls are bad and square-set timbering must be used. This company is probably the only fluorspar company which has done diamond drilling from underground, but the results obtained have proved the value of such work. About 3,000 feet of horizontal holes were drilled from the mine levels during the year, and two veins were discovered. On the surface a large coal-storage basin with concrete walls was constructed, making possible the storage of large supplies of coal as insurance against a fuel shortage. No changes in milling were made, but it is planned to remodel the concentrating department during 1921. An extensive schedule of development in the form of sinking new shafts, and crosscutting to other veins is also planned.

The Indiana Fluorspar Co. operated a diamond drill in its main shaft. The Superior Fluorspar Co. sank a new shaft and added a new hoist to its equipment. The Southern Illinois Fluorspar Co., near Karbers Ridge, in the course of development work during the last two years has sunk a shaft 200 feet deep with drifts at the 104 foot, 140-foot, and 190-foot levels. The Chicago Fluorspar Co., has about completed a mill for washing and concentrating the fluorspar from the Stewart mine. The Eichorn Fluorspar Co., which has acquired a property adjacent to the Empire mine, has a shaft sunk to a depth of about 85 feet.

Several of the fluorspar mines in this district were somewhat hampered by a strike early in the fall, some closing down entirely and others running short-handed. Gradually the men began to return to work, and the mines were running at about the normal rate when the strike ended in November.

Most of the mines in this district formerly shipped all their ores by river barges down Ohio River to railroad loading points, but as a railroad was completed from Golconda to and a little beyond Rosiclare in 1919, many of the mines are now able to ship directly by rail.

Kentucky.—Fluorspar is mined in two districts in Kentucky—the western district, including Crittenden, Livingston, and Caldwell counties, and the central district, including Woodford and Mercer counties. The western district is the more productive. The central Kentucky district, however, promises to become a much larger producer in the future, as the Heyward Minerals Co. has taken over the Moore mine, near Mundys Landing, and the Twin Chimney and Dean mines, near Harrodsburg. At the Twin Chimney mine, which produces both fluxing and acid fluorspar, the company has erected a modern concentrating mill having a capacity of 100 tons a day. The fluorspar is transported down Kentucky River on barges to Frankfort, where it is loaded with clamshell buckets into cars.

In the western Kentucky district the operation of the Haffaw mine, near Mexico, by the Aluminum Ore Co. is of interest. This mine has been yielding mostly gravel fluorspar, but experiments are being made in the mill to raise the grade of the ore mechanically to acid fluorspar. The general practice now is to make acid grade by hand sorting, but if this can be done mechanically costs will be greatly reduced and much material previously unsuitable will be available for acid grade.

During the winter of 1919–20 a new working shaft 110 feet in depth was sunk at the Big Four mine, and it is reported that a very large body of ore was opened by crosscutting to the La Rue vein.

At the Watson mine of the Eagle Fluorspar Co. a mill is under construction.

The Standard Spar Mining Co. reports the exhaustion of the Eaton mine. This company is developing its Keystone mine and has sunk a 2-compartment shaft 200 feet. The compartments are 4 by 5 feet in the clear. It is planned to sink the shaft 400 or 440 feet before cutting over to the vein.

A new shaft was sunk at the Lucille mine, at Marion.

Considerable development work was done during the year at the Holly mine, near Sheridan, and at the Matthews mine, near Frances.

Several ore lenses in the vicinity of Mexico were reported to have been exhausted in 1920.

Nevada.—The Continental Fluorspar Co., which commenced operations in the fall of 1919, reported a small production in 1920 from its Daisy mine, near Beatty, Nev. Most of the fluorspar is shipped to steel plants in California. This company reports a shipment of ground fluorspar which was used in the refining of silver.

The deposits, which lie in the Bare Mountains, 5 miles southeast of Beatty, are fissure veins. On one claim, the Daisy, there is an outcrop 200 feet long.[8] On this claim a 6 by 8 foot inclined shaft has been sunk 160 feet in solid fluorspar. On the 85-foot level two drifts, each more than 100 feet long, have been driven in fluorspar. At this depth the vein is 17 feet wide. Half a mile west of this claim is another, the Fluoride, in which the company has sunk a 70-foot shaft in material containing 92 per cent of calcium fluoride with a low silica content. It is thought that further work may prove this vein to be a continuation of that in the Daisy. Four miles to the south is another group of claims on a vein 150 feet wide, which crops out for half a mile. Little work has been done on these claims, although they are believed to contain ore of commercial grade. The company has erected at Beatty a plant for grinding the product to 150 mesh with a Sturtevant mill. Power is furnished by a 40-horsepower Venn-Severin semi-Diesel engine. A 15-horsepower Fairbanks-Morse hoist is used at the Daisy shaft, and the ore is dumped directly into bins, from which trucks take it to the mill. No stoping has been done in any of the claims. The deposits are said to be free from sulphides.

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[8] Min. and Sci. Press, Mar. 20, 1920, p. 426.

New Hampshire.—Operations were curtailed at the Stoddard mine, at Westmoreland, Cheshire County, N. H., which is operated by the American Steel & Wire Co. to supply the demand of its steel plant at Worcester, Mass. This company has opened a new mine near Chesterfield, Cheshire County.

New Mexico.—Practically all the fluorspar shipped from New Mexico in 1920 was obtained from mines in Sierra, Dona Ana, and Grant counties. The Nakaye mine, in Sierra County, opened in 1920, is at the foot of the Caballo Mountains, 2½ miles east of Derry and 18 miles from Hatch, the shipping point, to which the spar is hauled by teams and trucks.

The output in Dona Ana County was obtained from the Heathden mine, near Rincon, and the Tortuga mine, near Mesilla Park. To improve the fluorspar from the Heathden mine a mill consisting of jigs, rolls, screens, classifier, and concentrating tables and having a capacity of 30 tons of concentrates per 10-hour shift was completed and put in operation about April 1, 1921. The product of both the Nakaye and the Heathden mines was sold for flux in 1920. At the Tortuga mine during 1920 were installed a gasoline hoist, an aerial tramway 1,000 feet long, an air compressor and drills, a power plant, workmen's barracks, a truck road, and bins. The larger part of the material shipped in 1920 from the Tortuga mine was high-grade lump fluorspar.

In Grant County the Great Eagle mine contributed to the output in 1920. This mine produces both fluxing and acid fluorspar. A new mill consisting of jigs, tables, crushers, and tables for concentration has recently been completed and put in operation. A trial run of the mill indicates, it is reported, a daily capacity of 80 tons of 100-mesh product. The output is hauled 30 miles by autotruck to the railroad at Lordsburg.

Utah.—The operator of the Silver Queen mine, near Delle, Utah, reported a small though increased production in 1920. The market for the output is limited to the demand of the open-hearth steel furnaces at Salt Lake City, principally on account of high freight rates to large markets.

TOTAL OUTPUT.

The historical table that follows gives the production and value of fluorspar so far as recorded by the Geological Survey.

Fluorspar produced [a] in the United States, 1880–1920.

Year.	Quantity (short tons).	Value.
1880–1915 [b]	1,162,961	$7,081,067
1916	155,735	922,654
1917	218,828	2,287,722
1918	263,817	5,465,481
1919	138,290	3,525,574
1920	186,778	4,718,547
	2,126,409	24,001,045

[a] Beginning with 1906 figures represent shipments from mines.
[b] Statistics by years between 1883 and 1915 have been published in the chapters on fluorspar in Mineral Resources for 1917, 1918, and 1919.

Figure 3 shows graphically the course of the production of fluorspar in the United States from 1883 to 1920. The quantities beginning in 1906 represent shipments from mines. For convenience in

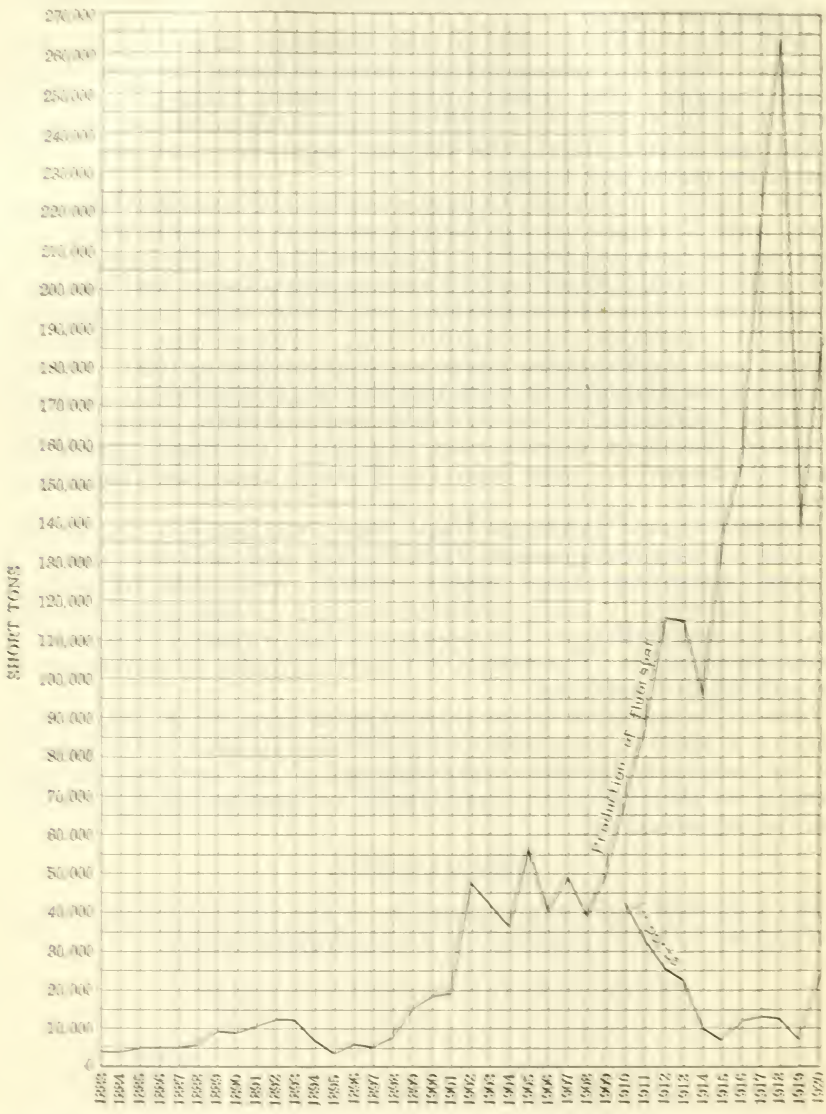

FIGURE 3.—Diagram showing production of fluorspar in the United States, 1883–1920, and imports, 1910–1920.

comparison the imports, beginning with the first full year for which records are available, 1910, are shown on the same diagram.

Figure 4 shows the course of the average prices of domestic fluorspar from 1883 to 1920.

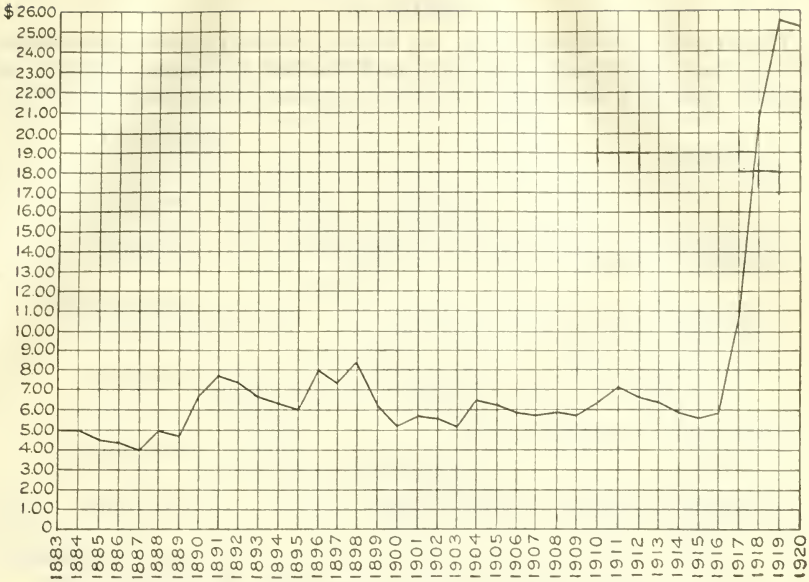

FIGURE 4.—Curve showing average prices per ton of fluorspar at the mines in the United States, 1883-1920.

STOCKS OF FLUORSPAR.

According to the reports of producers the total quantity of fluorspar in stock at the mines or at shipping points at the end of 1920 amounted to 41,784 short tons, an increase of 31 per cent over 1919. As the quantity of fluorspar in stock piles is necessarily partly estimated, there are variations in the mine reports from year to year which prevent an absolute balance between the quantity mined and the quantity shipped and stocks on hand. These stocks amounted in 1919 and 1920 to about 23 and 22 per cent, respectively, of the total quantity shipped from the mines and represented a rather high ratio to the total output of fluorspar. Data on consumers' stocks, noted under consumption (p. 78), which show still greater totals, indicate so large a surplus that a considerable curtailment in output may be expected in the near future.

Stocks of fluorspar at mines or shipping points in 1919 and 1920, by States, in short tons.

State.	1919	1920
Arizona	255	174
Colorado	5,870	1,400
Illinois	16,044	18,615
Kentucky	7,404	16,355
Nevada	300	250
New Mexico	1,880	4,790
Washington	200	200
	31,953	41,784

IMPORTS.[9]

The imports of fluorspar into the United States in 1920 were greater than in any other year since 1913 and showed an increase of 254 per cent in quantity and 147 per cent in value, compared with 1919.

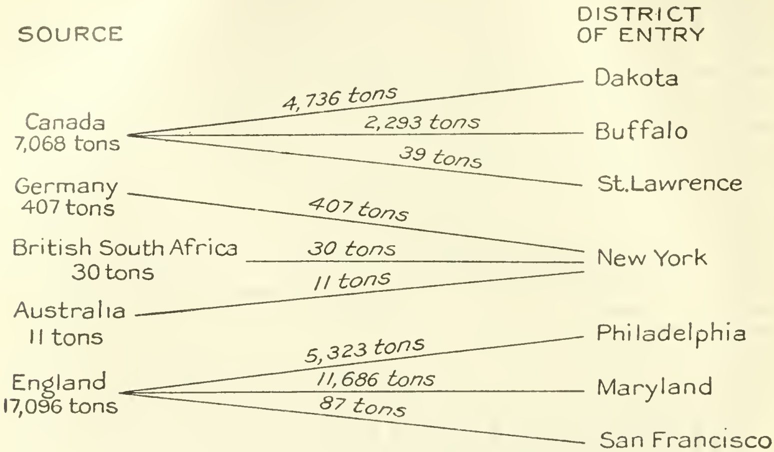

FIGURE 5.—Source and district of entry of fluorspar imported into the United States in 1920.

The value at the foreign ports of the shipments made to the United States in 1920 averaged $10.79 a ton.

The imports of fluorspar in 1920 were equivalent to about 15.9 per cent of the domestic shipments of gravel fluorspar, as compared with about 5.7 per cent in 1919.

According to the values reported, including the duty of $1.34 a short ton ($1.50 a long ton) and the ocean freight, estimated to be about $4.50 a ton, the average cost of imported English fluorspar at the docks in the United States was $14.27 a ton in 1920, compared with $23.24 for domestic merchantable gravel at the mine or mill.

The distances that domestic fluorspar must be transported from mines to steel plants in the Lehigh and Susquehanna valleys of Pennsylvania are generally much greater than the distances that English fluorspar must be carried from the ports of entry to these points, so that an advantage in price on account of a saving in railway freight charges may be enjoyed by users of the imported material. Unless ocean freight rates are moderate, however, foreign fluorspar is not in a position to enjoy much advantage in American markets for the reason that the foreign material is not generally of so high grade as the mechanically treated domestic product, and, as fluorspar is of value chiefly according to its purity, purchasers should find that the purer American fluorspar is more efficient and consequently cheaper in the end.

[9] The statistics of imports were compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

As shown by the accompanying diagram and table, the greater part of the fluorspar imported in 1920 was brought from England and most of it was probably taken by steel plants at Sparrows Point, Md., and Coatesville and Steelton, Pa. The greater part of the Canadian fluorspar was shipped to steel plants at Indiana Harbor, Ind. The fluorspar from British South Africa and Australia was taken by a chemical manufacturer at Cleveland, Ohio, who states that it is the equal of the best domestic acid fluorspar, the analysis showing 99.5 per cent of calcium fluoride, less than 0.05 per cent of silica, and traces of calcium carbonate. The fluorspar imported from Australia was obtained from a mine in the Orange River Colony, Africa.

Fluorspar imported into the United States, by countries, in 1919 and 1920.

Country.	1919			1920		
	Quantity (short tons).	Value.	Average value per ton.	Quantity (short tons).	Value.	Average value per ton.
England	6,041	$94,099	$15.58	17,096	$144,142	$8.43
Canada	902	13,532	15.00	7,068	110,532	15.64
Germany				407	9,450	23.22
British South Africa				30	1,080	36.00
Australia				11	426	38.73
	6,943	107,631	15.50	24,612	265,630	10.79

Fluorspar imported and entered for consumption, 1913–1920.

Year.	Quantity (short tons).	Value.	Average value per ton.
1913	22,682	$71,463	$3.15
1914	10,205	38,943	3.82
1915	7,167	22,878	3.19
1916	12,323	54,000	4.38
1917	13,616	114,598	8.42
1918	12,572	169,364	13.47
1919	6,943	107,631	15.50
1920	24,612	265,630	10.79

EXPORTS.

The exports of fluorspar from the United States, as reported to the United States Geological Survey by the producers of fluorspar, amounted to 2,764 short tons, valued at $65,475, or $23.69 a ton. The exported fluorspar, most of which was gravel, went to Canada.

CONSUMPTION.

The market for the bulk of the fluorspar sold in the United States depends on the condition of the steel industry, and the demand fluctuates with the rise and fall in the production of basic open-hearth steel. Most of the domestic gravel and some of the lump fluorspar, together with probably most of the imported fluorspar, are consumed as flux in basic open-hearth steel furnaces and to a smaller extent in other metallurgic operations. From 1916 to 1920 the sales of gravel have constituted between 83 and 89 per cent of the total shipments of domestic fluorspar. Fluorspar is used also as a flux in iron blast furnaces, iron foundries, and gold, silver, copper, and lead smelters; it is used also in the manufacture of glass, of enameled and sanitary ware, of sodium fluoride used as a wood preservative, and of hydrofluoric acid; in the electrolytic refining of antimony and lead; and in the production of aluminum. Other miscellaneous uses are as a bond for constituents of emery wheels, for carbon electrodes, in the extraction of potash from feldspar, and in the recovery of potash in the manufacture of Portland cement.

Data furnished by steel manufacturers who produce about 75 per cent of the output of basic open-hearth steel show that the consumption of fluorspar per ton of steel produced in 1920 ranged from 4.8 to 16.1 pounds, with 8 pounds as an average. These steel companies reported a consumption of 87,870 short tons of fluorspar in 1920, which, on the assumption that the remaining 25 per cent of the companies consumed a like proportion, would indicate a total consumption of about 117,000 tons for all open-hearth plants. This group of steel manufacturers also reported stocks of fluorspar on January 1, 1921, amounting to 49,981 short tons, which would indicate total stocks of about 66,600 tons at all steel plants.

The manufacturers of ferroalloys reported the consumption of 253 short tons of fluorspar in 1920 and had stocks of 164 tons on hand January 1, 1921.

The shipments of domestic fluorspar plus the imports minus the exports should give from year to year an index to the quantity available for consumption and indicate its relative increase or decrease. The total quantity of all grades of fluorspar available for consumption in 1920 was 208,626 short tons, an increase of 44 per cent compared with 1919.

The general relation between the total supply of fluorspar and the output of open-hearth steel may be noted by comparison of the two following tables:

Fluorspar available for consumption, 1913–1920, in short tons.

Year.	Sales of domestic spar.	Imports for consumption.	Exports.	Available for consumption.
1913	115,580	22,682	(a)	138,262
1914	95,116	10,205	(a)	105,321
1915	136,941	7,167	(a)	144,108
1916	155,735	12,323	(a)	168,058
1917	218,828	13,616	(a)	232,444
1918	263,817	12,572	(a)	276,389
1919	138,290	6,943	(a)	145,233
1920	186,778	24,612	2,764	208,626

[a] Not available.

Open-hearth steel produced in 1913–1920, in long tons.[a]

Year.	Basic.	Acid.	Total.
1913	20,344,626	1,255,305	21,599,931
1914	16,271,129	903,555	17,174,684
1915	22,308,725	1,370,377	23,679,102
1916	29,616,658	1,798,769	31,415,427
1917	32,087,507	2,061,386	34,148,893
1918	32,476,571	1,982,820	34,459,391
1919	25,719,312	1,229,382	26,948,694
1920	31,375,723	1,296,172	32,671,895

[a] Statistics from reports of the American Iron and Steel Institute.

SHIPMENTS, BY USES.

In the following table are presented data on the shipments and value of fluorspar sold for use in the industries. The large dependence of the fluorspar industry on the steel industry is clearly shown by the fact that 81 per cent of the fluorspar shipped in 1920 was taken by steel manufacturers. There is considerable variation in the average price per ton of the fluorspar shipped to the several industries. The high price of fluorspar for hydrofluoric acid and glass and enamel ware is due to the high quality demanded.

Fluorspar shipped in 1920, by uses.

Use.	Quantity.		Value.	Average price per ton.
	Percentage of total.	Short tons.		
Steel	81.01	151,311	$3,393,246	$22.43
Aluminum	6.55	12,230	417,992	34.18
Glass and enamel ware	5.76	10,756	474,483	44.11
Hydrofluoric acid	3.89	7,268	300,752	41.38
Miscellaneous	1.31	2,449	66,599	27.19
	98.52	184,014	4,653,072	25.29
Exported to Canada	1.48	2,764	65,475	23.69
	100.00	186,778	4,718,547	25.26

FLUORSPAR IN FOREIGN COUNTRIES.

CANADA.[10]

Although occasional shipments had previously been made, the regular production of fluorspar in Canada began in 1916, and during this and the three following years the Madoc district in Ontario was the principal source of production. In 1920 the maximum output of 11,229 short tons, valued at $260,446, consisted of 3,752 tons, valued at $68,475, from Ontario and 7,477 tons, valued at $191,971, from British Columbia, so that British Columbia contributed more than 66 per cent of the total.

The Rock Candy group, near Grand Forks, in British Columbia, was opened up in 1918 and contributed 32 per cent of the total shipments in 1919, which were 5,063 tons, valued at $97,837.

The exports of fluorspar during 1920 were 6,900 tons, valued at $109,683.

Canadian steel companies use from 10,000 to 15,000 tons of fluorspar per annum. This consumption is, however, at present all in eastern Canada, and the fluorspar produced in British Columbia in excess of the requirements at the Trail electrolytic lead refinery is finding an export market.

[10] Preliminary report of the mineral production of Canada during the calendar year 1920, Canada Dept. Mines, Mines Branch, 1921.

GREAT BRITAIN.

According to the official report[b] issued by the Home Office, at London, Great Britain produced in 1919, the latest year for which statistics concerning value are available, 36,890 long tons (41,283 short tons) of fluorspar, valued at £36,252, as compared with 53,498 long tons (59,918 short tons), valued at £41,310, in 1918. The output in 1920 was 54,683 long tons (61,245 short tons).

PRODUCTION IN PRINCIPAL COUNTRIES.

Fluorspar produced in some principal countries, 1913, 1916, and 1917–1920, in metric tons.[c]

Country	1913	1916	1917	1918	1919	1920
United States	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Canada			[illegible]	[illegible]	[illegible]	[illegible]
Great Britain	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Spain	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	(1)
France	[illegible]	(1)	(1)	(1)	[illegible]	(1)
Italy		....	[illegible]	[illegible]	[illegible]	(1)
Norway		[illegible]	....	[illegible]	(1)	(1)
Australia:						
New South Wales		[illegible]	[illegible]	[illegible]	[illegible]	(1)
Queensland		....	[illegible]	....	....	[illegible]

c No statistics are available for Germany and Austria-Hungary, but the annual pre-war output of these countries was about 5,000 tons and 25,000 tons, respectively.
1 Figures not yet available.

CRYOLITE.

Cryolite occurs in commercial quantities only in Greenland, at Ivigtut. It is mined and shipped in two grades, white and black. The white cryolite, which is nearly pure, except for a mixture of pyrite, galena, and siderite, is shipped to Copenhagen, and the black cryolite, which contains a large quantity of fluorite, is shipped to the Pennsylvania Salt Manufacturing Co., at Philadelphia, Pa.

Cryolite is essential for the production of aluminum, the fused mineral being used as the bath for the electrolysis of alumina to the metal. It is used also in the manufacture of opaque white glass, in the enameling of ironware, and as a flux in the manufacture of white Portland cement.

Cryolite shipped from Greenland and imported into the United States, 1913, 1917–1920.

Year	Total shipped (long tons).[a]	Imports into United States.[1]		
		Quantity (long tons).	Value.	Average value per ton.
1913	[illegible]	[illegible]	[illegible]	[illegible]
1917	[illegible]	[illegible]	[illegible]	[illegible]
1918	[illegible]	[illegible]	[illegible]	[illegible]
1919	[illegible]	[illegible]	[illegible]	[illegible]
1920	(2)	[illegible]	[illegible]	[illegible]

a The mineral industry of the British Empire and foreign countries: Aluminum and bauxite: Imperial Mineral Resources Bureau (London), 1921.
1 Bureau of Foreign and Domestic Commerce.
2 Not available.

b Mines and Quarries: Great Britain, general report for 1919, pt. 3, 1920.

GRAPHITE.

By L. M. Beach.

PRODUCTION.

NATURAL GRAPHITE.

In 1920 natural graphite was produced by 17 firms, operating in nine different States. The total sales of domestic graphite amounted to 9,510 short tons, valued at $626,202, an increase in quantity of 28 per cent and a decrease in value of 20 per cent as compared with 1919.

Domestic natural graphite sold, 1916–1920.

Year.	Amorphous.		Crystalline.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	2,622	$20,723	5,466	$914,748	8,088	$935,471
1917	8,301	73,481	5,292	1,094,398	13,593	1,167,879
1918	6,560	69,455	6,431	1,454,799	12,991	1,524,254
1919	3,379	47,716	4,043	731,141	7,422	778,857
1920	4,694	49,758	4,816	576,444	9,510	626,202

During the last five years 26,048 short tons of crystalline graphite and 25,556 short tons of amorphous graphite was sold. In 1917 and 1918 more amorphous graphite than crystalline was sold; prior to 1917 and in 1919 and 1920 the sales of crystalline exceeded those of amorphous.

Number of operators reporting production of graphite, 1918–1920.

State.	1918	1919	1920
Alabama	25	10	7
California	1	1	1
Colorado	1	1	1
Montana	1		1
Nevada	1	1	1
New York	3	2	2
Pennsylvania	6	3	1
Rhode Island	2	1	2
Texas	2	1	1
	42	20	17

CRYSTALLINE GRAPHITE.

The crystalline graphite sold in 1920 amounted to 9,632,360 pounds, valued at $576,444, an increase of 19 per cent in quantity and a decrease of 21 per cent in value as compared with 1919. Sales of crystalline graphite were reported from Alabama, California, Montana, New York, Pennsylvania, and Texas.

Reports received from producers in Alabama late in 1920 indicated that the graphite industry there was at a standstill. Many companies that were in operation early in 1920 closed their mines late in the year, and probably not more than two companies were in operation at the beginning of 1921. Furthermore, according to Commerce Reports of January 12 and February 5, 1921, the graphite industry in Ceylon and Madagascar is in the same condition as in Alabama and other States that produce crystalline graphite. No new mines are being opened, no new properties are being developed, and many of the old mills have been closed to await more favorable conditions.

Alabama led in production in 1920, the sales amounting to 4,894,648 pounds, or 51 per cent of the total quantity sold in United States.

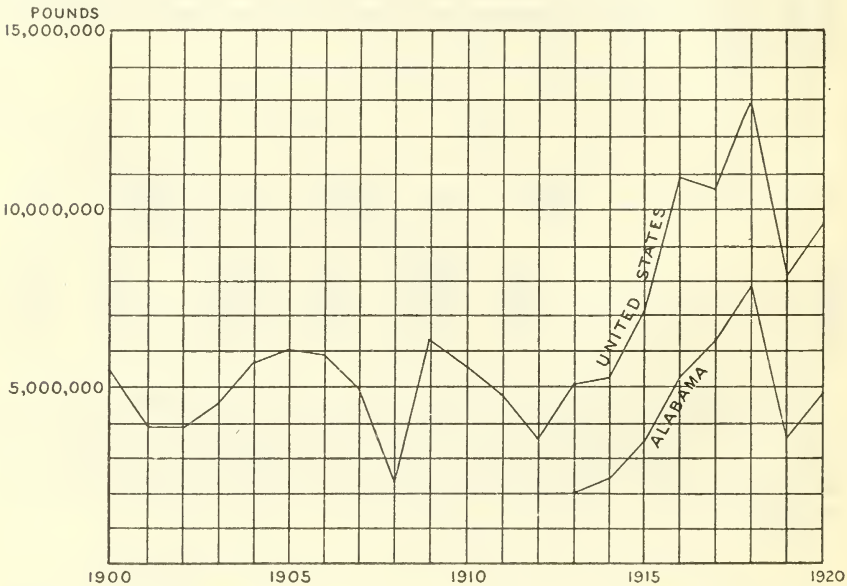

FIGURE 6.—Diagram showing production of crystalline graphite in the United States, 1900–1920, and in Alabama, 1913–1920.

Three of the firms that produced graphite in 1919 reported that their mines were closed. The active firms were as follows:

C. B. Allen Graphite Co., Ashland, Ala.
Ceylon Co., Birmingham, Ala.
Diamond Graphite Co., Alexander City, Ala.
Griesemer Graphite Co., Ashland, Ala.
May Brothers, Ashland, Ala.
Quenelda Graphite Corporation, Louisville, Ky.
Superior Flake Graphite Co., Chicago, Ill.

New York ranked second in the production of crystalline graphite in 1920, but the figures may not be published because there were only two producers—the Hooper Graphite Co., Whitehall, N. Y., and the Joseph Dixon Crucible Co., Jersey City, N. J.

Texas ranked third in production with only one mine in operation, owned by the Southwestern Graphite Co., Boston, Mass.

One mine in California, in Los Angeles County, owned by the California Graphite Co., of Los Angeles, was in operation in 1920.

The Graphite Products Co., Byers, Pa., reported a production from its mine at Uwchlan. Harry Schmehl, of Chester Springs, Pa., reported the recovery of high-grade graphite from old crucibles in 1920. Certain manufacturers send him their old crucibles and he returns the graphite recovered from them for a few cents per pound. The recovered graphite is reported to be free from slag or metal, although there is a considerable percentage of metal in the tailings from some of the pots.

Domestic crystalline graphite sold in the United States, 1918–1920.

State.	1918		1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Alabama	7,795,475	$999,152	3,569,030	$272,413	4,894,648	$306,977
New York	3,266,518	273,188	(a)	(a)	(a)	(a)
Pennsylvania	1,016,900	112,059	484,060	26,003	(a)	(a)
Other States [b]	782,946	70,400	4,033,101	432,725	4,737,712	269,467
	12,861,839	1,454,799	8,086,191	731,141	9,632,360	576,444

[a] Included under "Other States."
[b] 1918: California, Montana, Texas; 1919: California, New York, Texas; 1920: California, Montana, New York, Pennsylvania, Texas.

The following table shows the crystalline graphite imported into and produced in the United States since 1916. In 1920 imports decreased 23 per cent while domestic production increased 19 per cent, in comparison with 1919.

Crystalline graphite imported and produced in the United States, 1916–1920.

	Quantity (short tons).				
	1916	1917	1918	1919	1920
Imports: [a]					
Ceylon	26,232	24,575	9,029	9,451	9,204
Madagascar	1,631	4,393	970	10,016	4,710
Other countries	4,297	3,494	3,314	1,505	2,200
	32,160	32,462	13,313	20,972	16,114
Domestic production	5,466	5,292	6,431	4,043	4,816
Total available supply	37,626	37,754	19,744	25,015	20,930
Per cent represented by domestic production	14.5	14.0	32.6	16.2	23.0

	Value.				
Imports: [a]					
Ceylon	$6,356,532	$7,179,208	$2,397,735	$1,530,281	$1,077,290
Madagascar	241,863	1,057,081	265,338	1,205,350	286,383
Other countries	335,736	353,481	270,136	102,390	159,517
	6,934,131	8,589,770	2,933,209	2,838,021	1,523,190
Domestic production	914,748	1,094,398	1,454,799	731,141	576,444
Total available supply	7,848,879	9,684,168	4,388,008	3,569,162	2,099,634
Per cent represented by domestic production	11.7	11.3	33.2	20.5	27.5

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

AMORPHOUS GRAPHITE.

Sales of amorphous graphite in 1920 amounted to 4,694 short tons, valued at $49,758, which represents an increase of 39 per cent in quantity and only 4 per cent in value, in comparison with 1919. Rhode Island, Nevada, and Colorado furnished the supply in 1920. The State totals may not be published without revealing individual outputs. Frank D. Fenner, Arlington, R. I., and the Graphite Mines Corporation, of New York, reported the production from Rhode Island. The Carson Black Lead Co., of Oakland, Calif., reported the Nevada output from its mine at Carson. The Graphite Corporation, Chicago, Ill., reported production from the mine at Pitkin, Colo., formerly owned by Woodruff & Woodruff.

MANUFACTURED GRAPHITE.

Graphite is manufactured by the Acheson Graphite Co. at Niagara Falls, N. Y. The figures given below, published by permission of this company, represent only the manufactured graphite that comes into competition with natural graphite.

Graphite manufactured by the Acheson Graphite Co., 1916–1920.

	Pounds.		Pounds.
1916	8,397,281	1919	8,163,177
1917	10,474,649	1920	7,399,749
1918	9,182,272		

IMPORTS AND EXPORTS.[1]

The reports of the Bureau of Foreign and Domestic Commerce show only the country shipping the goods, which is not always the country of origin. For example, graphite entered in the bureau's statements as imported from France probably originated in Madagascar, and imports from Great Britain should probably be credited to Ceylon and possibly Madagascar. Shipments from Japan probably consisted of graphite from Chosen. Imports from Canada in 1915 and 1919 slightly exceeded the Canadian production in these years; and it is assumed that this excess represents reshipments of Canadian imports or of stocks. Imports of more doubtful origin are included under "Other countries."

Graphite imported into the United States, 1916–1920.

[General imports.]

Country of origin.	Quantity (short tons).				
	1916	1917	1918	1919	1920
Ceylon	26,232	24,575	9,029	9,451	9,204
Madagascar	1,631	4,393	970	10,016	4,710
Canada	4,127	3,476	3,084	1,504	2,170
Brazil	1	18	45		
Mexico	5,331	7,570	5,600	5,506	3,659
Chosen (Korea)	5,375	2,462	568	126	810
Italy	151	115	17	22	137
Austria					58
Germany					30
Other countries	169		185	1	317
	43,017	42,609	19,498	26,626	21,095

[1] Figures of imports and exports are compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Graphite imported into the United States, 1916–1920—Continued.

Country of origin.	Value.				
	1916	1917	1918	1919	1920
Ceylon	$6,356,532	$7,179,208	$2,397,735	$1,530,281	$1,077,290
Madagascar	241,863	1,057,081	265,338	1,205,350	286,383
Canada	314,177	349,034	236,226	102,163	157,015
Brazil	75	4,380	7,351	....	....
Mexico	238,000	285,568	134,183	135,464	131,832
Chosen (Korea)	103,619	83,558	24,455	3,948	29,936
Italy	4,133	3,092	628	663	5,072
Austria					1,195
Germany	....	....	....	....	2,502
Other countries	21,484	67	26,559	227	20,087
	7,279,883	8,961,988	3,092,475	2,978,096	1,711,312

Graphite imported for consumption in the United States, 1911–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1911	20,702	$1,495,729	1916	42,930	$7,279,883
1912	25,643	1,709,337	1917	42,577	8,961,988
1913	28,879	2,109,791	1918	19,498	3,092,475
1914	21,990	1,398,209	1919	26,626	2,978,096
1915	23,075	2,241,163	1920	21,095	1,711,312

Exports of graphite from the United States are comparatively small.

In 1920 there was a decrease in value of exports of manufactured graphite of 23 per cent, while the value of exports of raw graphite increased about 25 per cent as compared with 1919.

The exports of lead pencils are not included in the classification of articles of manufactured graphite. These statistics are given in a separate table.

Graphite exported from the United States, 1916–1920.

Year.	Unmanufactured graphite.		Manufactures of graphite.
	Quantity (pounds).	Value.	
1916	1,595,608	$98,118	$1,339,259
1917	5,146,816	349,563	891,687
1918	1,907,719	121,555	731,518
1919	1,258,040	90,185	788,755
1920	1,213,616	112,771	610,261

Value of pencils and pencil leads exported from the United States, 1919–1920.

Country.	1919	1920	Country.	1919	1920
France	$75,375	$61,734	China	$50,062	$101,591
Italy	45,498	6,462	British India	143,452	161,140
Spain	104,411	44,122	Straits Settlements	16,224	20,262
England	1,062,888	1,074,783	Dutch East Indies	41,429	15,021
Canada	415,926	611,608	Japan	70,552	129,655
Mexico	207,573	160,204	Australia	180,500	88,974
Cuba	192,600	271,949	New Zealand	26,311	14,457
Argentina	182,049	291,062	Philippine Islands	140,947	138,637
Brazil	202,637	153,353	British South Africa	71,789	14,686
Chile	49,251	55,167	Other countries	195,722	289,894
Colombia	19,002	58,582			
Peru	27,479	43,326		3,565,347	3,849,221
Uruguay	43,670	42,552			

PRICES.

In 1920 prices for domestic flake ranged between 1.75 and 13 cents a pound. In 1919 the corresponding figures were 4.9 and 14 cents.

The average price of domestic flake at the mines in 1920 was 5.9 cents, or 3.1 cents less than in 1919. In New York the average price a pound in 1920 was 6 cents, against 11½ cents in 1919; in Texas the price averaged 4 cents in 1920 and 10 cents in 1919; in Alabama the average price dropped from 7.6 cents in 1919 to 6.2 cents in 1920; in Pennsylvania, however, the average price rose from 5.4 cents in 1919 to 9.5 cents in 1920.

The following table is based on information furnished by importers prior to 1920. The figures for 1920 were furnished by Mr. Charles E. Pettinos, of New York. Part of the letter written by Mr. Pettinos to the United States Geological Survey is quoted below:

> Prices were high in the first half and low in the second half of the year, the wide variation in prices for 1920 being due in large measure to the great variation in the value of the pound sterling, which did a lot of jumping around during the year. You will note, however, that the "high" for 1920 was about on a par with the "low" for 1919. Each year, including 1917, the market went steadily down.
>
> Graphite is of course dependent upon the steel, brass, and other nonferrous metal industries. They all went dead in November-December, 1920. So did graphite, although graphite was about half dead the whole of the year. From January 1, 1921, to the present time [June, 1921] there has been virtually no market at all for graphite; there have been no buyers, and stocks in Ceylon or anywhere else have been going begging, being offered from time to time at lower and lower prices, as holders needed money and were willing to takes losses. To-day you can buy No. 1 grades of lump, chip and dust, c. i. f. New York, about as follows: Lump, 6½ cents; chip, 5 cents; dust, 3½ cents. These prices do not begin to represent actual cost of production. The situation with graphite is identical with that on rubber and copper. Even in the face of a proposed tariff on graphite buyers are absolutely indifferent and show no inclination to stock up. As a matter of fact, however, most large users are well stocked on material purchased at higher prices than those prevailing to-day, and they all seem to want to keep their money and take a chance. There is virtually no mining going on in Ceylon or anywhere else, and under conditions such as these at present stocks would last an indefinite period. My own opinion is that even if business picks up late this fall and continues fairly active there will not be much reason for mining graphite anywhere in the world until well on into 1922, or possibly the latter part of that year.

Average prices of Ceylon graphite c. i. f. New York, 1914–1920.

[Cents per pound.]

Year.	Lump.		Chip.		Dust.		Remarks.
	First grade.	Second grade.	First grade.	Second grade.	First grade.	Second grade.	
1914	6½– 9½	7½– 8½	7¼– 7¾	6½– 7	4¾– 5¼	3½– 4	Low, first half; high, second half.
1915	9⅝–20	8 –14	7 –14	6½–12	7½– 9½	6½– 9½	Do.
1916	20 –28	14 –21	13½–20	11½–17	9½–12	9½–10	Do.
1917	28 –32	21 –23	20 –23	17 –19	11 –13	10 –12	High level maintained throughout the year.
1918	28½–15¼	22 –14	21½–12½	18½–11	12 –10½	10 – 9	High, first half; low, second half.
1919	14 –15¼	12 –13	10 –11	8 – 9	6¾– 7½	5 – 6	Low throughout the year.
1920	14 – 9	11 – 7	10 – 7	7½– 5½	7 – 5	5 – 3½	High, first half; low, second half.

FUEL BRIQUETS.[1]

By W. F. McKenney.

PRODUCTION.

The fuel-briquetting industry made rapid strides during the year 1920 and produced a record output. The total production of briquets was 567,192 net tons, which, as compared with 1919, a year of marked depression, was an increase of 92 per cent and which exceeded the previous high record, set in 1918, by 89,957 tons. This increase was made possible by the shortage and consequent high prices of raw coal, both anthracite and bituminous, which became increasingly apparent as the year progressed. In search of a substitute for their regular fuel, domestic consumers naturally turned to fuel briquets.

Fuel briquets produced in the United States in 1919 and 1920.

	1919			1920		
	Operating plants.	Quantity (net tons).	Value.	Operating plants.	Quantity (net tons).	Value.
Eastern States:						
New Jersey	1			2		
New York [a]				1		
Pennsylvania	3			4		
Virginia	1			1		
	5	68,203	$339,051	8	258,621	$1,691,504
Central States:						
Missouri	1			1		
North Dakota	1			1		
Wisconsin	2			2		
	4	146,587	1,242,210	4	212,176	1,959,196
Pacific Coast States:						
California	1			1		
Oregon	1			1		
Washington	1			1		
	3	80,944	719,793	3	96,395	973,131
	12	295,734	2,301,054	15	567,192	4,623,831

[a] No production in 1919.

The increase in output was most striking in the Eastern States, where also the decrease in the preceding year had been most pronounced. Two new plants began production, and another, which had been idle for two years, resumed active operation. In consequence, the output in the East was nearly four times as great as in 1919. The region of next greatest increase was the Central States,

[1] The tables in this report were prepared by Miss J. M. Corse, of the United States Geological Survey, who has compiled the statistics of fuel briquets since 1911.

where the output exceeded that of 1919 by 45 per cent. The output in the Pacific Coast States, where competition with coal is not so keen and the shortage of domestic fuel did not become so acute, was 19 per cent greater than in 1919.

That the high prices of domestic fuel, particularly of anthracite, played an important part in the increased output of briquets is suggested by the fact that the greatest gains in quantity produced were made in Wisconsin and Pennsylvania, States which depend largely on

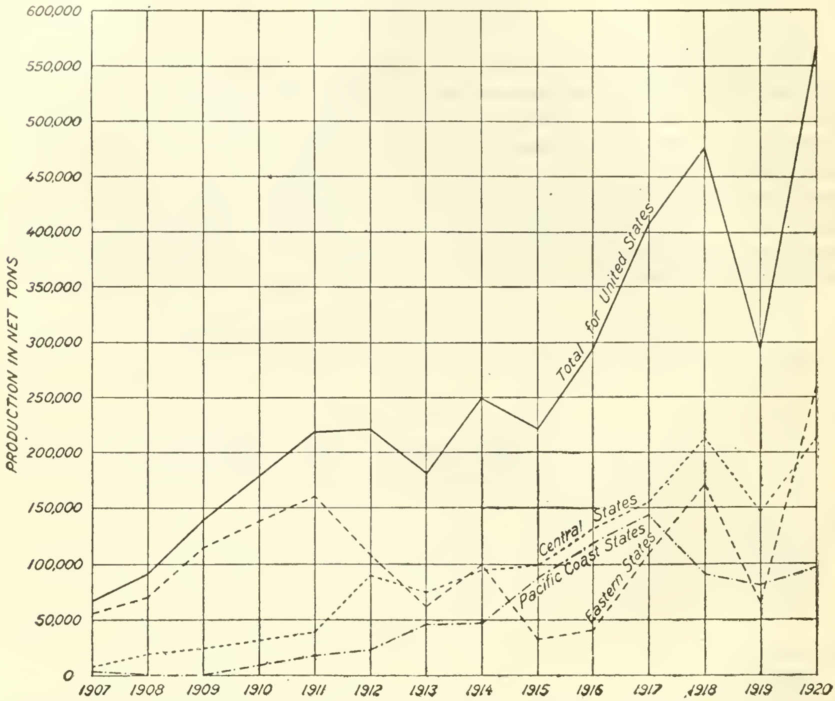

FIGURE 7.—Fuel briquets produced in the Eastern, Central, and Pacific Coast States and in the United States, 1907-1920.

anthracite for domestic fuel. The output in these two States was 64.5 per cent of the total. Both States have available supplies of material suitable for the manufacture of briquets—culm from the banks in the anthracite region in Pennsylvania, and slack and fines from the Lake docks in Wisconsin.

Fuel briquets produced in the United States in 1907–1909 and 1911–1920.

Year.	Quantity (net tons).	Value.	Year.	Quantity (net tons).	Value.
1907	66,524	$258,426	1915	221,537	$1,035,716
1908	90,358	323,057	1916	295,155	1,445,662
1909	139,661	452,697	1917	406,856	2,233,888
1911	218,443	808,721	1918	477,235	3,212,793
1912	220,064	952,261	1919	295,734	2,301,054
1913	181,859	1,007,327	1920	567,192	4,623,831
1914	250,635	1,154,678			

VALUE.

The value of the briquets produced in 1920 was $4,623,831, an increase when compared with 1918 and 1919 of $1,411,038, or 43.9 per cent, and $2,322,777, or 101 per cent, respectively. The average value per ton f. o. b. plant, which had risen without interruption from $4.90 in 1916 to $7.78 in 1919, continued to rise in 1920, reaching $8.15, an increase over 1919 of 4.8 per cent and over 1916 of 66 per cent.

The average value is a composite of sales at relatively high prices at plants distant from the mines and of sales at much lower prices at plants in the mining region. The average value is therefore not always an accurate index of the trend of prices. Thus, the fact that the low-cost product of Pennsylvania formed a much larger proportion of the total in 1920 tended to depress the average value per ton and to offset in part the effect of the increased prices reported from most other localities. A better idea of the trend in prices of briquets may be gained from the following table, which shows the average value per ton at the plants in Pennsylvania from 1907 to 1920.

Average value per ton f. o. b. plant of briquets produced in Pennsylvania, 1907–1920.

1907	$3.05	1914	$2.48
1908	2.61	1915	2.90
1909	2.49	1916	3.83
1910	No data available.	1917	3.15
1911	2.37	1918	4.11
1912	2.68	1919	4.17
1913	2.65	1920	5.60

Two factors enter into the higher prices realized at plants distant from the mines—the higher cost of the raw fuel from which the briquets are made and the higher prices of coals with which the briquets compete. Thus, the plants in New Jersey, New York, Oregon, and Wisconsin realized average values as high as $13.02 a ton, whereas in Pennsylvania and Virginia the average values f. o. b. plant were $5.60 and $5.63, respectively.

RAW MATERIAL AND BINDERS.

All plants that reported in 1919 continued to use the same raw fuel in 1920; the three additional plants operating during 1920 used anthracite culm or fines. Of the 15 plants in operation in 1920, seven used anthracite as the fuel base, two semianthracite, one a mixture of anthracite fines and bituminous slack, one semibituminous slack, one a mixture of bituminous slack and subbituminous coal, one brown lignite, and two carbon residue from the manufacture of oil gas. In 1920 the total quantity of raw fuel used was 572,039 net tons. The quantity of anthracite and semianthracite, which in 1919 had been 40 per cent of the total, increased in 1920 to 62 per cent. Of the remaining raw fuel 22 per cent was semibituminous and bituminous slack, and 16 per cent lignite, subbituminous coal, and oil-gas residue.

From the 572,039 tons of raw fuel used, only 567,192 tons of briquets were made. The discrepancy is due to the practice of screening the raw fuel and removing the larger sizes at certain plants that use anthracite culm and to the fact that where the raw fuel is wet considerable moisture is expelled with consequent loss of weight in the process of manufacture.

Raw fuels used in making briquets in the United States, 1918–1920, in net tons.

Fuel.	1918	1919	1920
Anthracite culm and fine sizes Semianthracite	232,080	118,595	356,877
Semibituminous slack Bituminous slack	158,324	97,387	125,506
Lignite and subbituminous coal Oil-gas residue	76,602	80,383	89,656
	467,006	296,365	572,039

Of the plants in operation in 1920, three used no binder, five asphaltic pitch, two coal-tar pitch, one a mixture of asphaltic and coal-tar pitch, one sulphite liquor, one asphaltic oil and corn starch, one cellulose pitch, and one a patent binder.

Asphaltic pitch and coal-tar pitch remained the standard binders and were used either singly or as a mixture in 76 per cent of the total output. About 60 per cent of the entire output of briquets was made either with asphaltic pitch alone or with a compound binder in which asphaltic pitch was the principal constituent.

Briquets produced in the United States in 1920, by type of binder used, in net tons.

No binder	66,051
Asphaltic pitch	242,342
Asphaltic pitch and coal-tar pitch Coal-tar pitch Asphaltic oil and corn starch	187,896
Sulphite liquor Cellulose pitch Patent binder	70,903
	567,192

BRIQUETTING PLANTS IN THE UNITED STATES.

In 1920, in addition to the plants that had reported in 1919, three other plants came into active operation. Of these, the General Briquetting Co. and the Burnrite Coal Briquette Co. were new and the American Briquet Co., which had been idle since 1917, resumed operations.

Briquetting plants operated in the United States in 1920.

Group.	Name and address of operator.	Location of plant.	Date put in operation.	Raw fuel used.
Eastern States:				
New Jersey	Burnrite Coal Briquette Co., 543 New Jersey Avenue, Newark, N. J	Newark	1920	Anthracite.
Do	Fuel Briquet Co., 520 Brunswick Avenue, Trenton, N. J.	Trenton	1918	Do.
New York	General Briquetting Co., 25 Broad Street, New York, N. Y.	New York	1920	Do.
Pennsylvania	American Briquet Co., Drexel Building, Philadelphia, Pa.	Lykens	1920	Do.
Do	Anthracite Briquette Co., Sunbury, Pa.	Sunbury	1919	Do.
Do	Lehigh Coal & Navigation Co., 437 Chestnut Street, Philadelphia, Pa.	Lansford	1909	Do.
Do	Scranton Anthracite Briquette Co., Dickson City, Pa.	Dickson City	1907	Do.
Virginia	Delparen Anthracite Briquette Co., Parrott, Va.	Parrott	1915	Virginia semianthracite.
Central States:				
Missouri	Standard Briquet Fuel Co., 319 North Fourth Street, St. Louis, Mo.	Kansas City	1909	Arkansas semianthracite.
North Dakota	Johnson Fuel Co., Scranton, N. Dak.	Scranton	1917	Lignite.
Wisconsin	Berwind Fuel Co., 122 South Michigan Avenue, Chicago, Ill.	Superior	1912	Semibituminous slack.
Do	Stott Briquet Co., Merchants' National Bank Building, St. Paul, Minn.	do	1909	Anthracite fines and bituminous slack.
Pacific Coast States:				
California	Los Angeles Gas & Electric Corp., 645 South Hill Street, Los Angeles, Calif.	Los Angeles	1905	Carbon (petroleum residue).
Oregon	Portland Gas & Coke Co., Gasco Building, Portland, Oreg.	Portland	1913	Do.
Washington	Pacific Coast Coal Co., 612 L. C. Smith Building, Seattle, Wash.	Renton	1914	Bituminous slack and subbituminous coal.

STRONTIUM.[1]

By George W. Stose.

PRODUCTION OF STRONTIUM ORE.

No strontium ore was mined in the United States in 1920. Most of the strontium ore that has been produced in the United States has been mined in California, Arizona, Texas, and Washington. From 1916 to 1918, inclusive, 4,685 short tons was marketed, a large part of which was mined in 1917. Only a small quantity was produced in 1918, and none in either 1919 or 1920. Most of the ore was celestite (strontium sulphate), but part of that mined in California and Washington was strontianite (strontium carbonate).

PRODUCTION OF STRONTIUM SALTS.

Strontium salts were made from strontium ore at only two plants in the United States in 1920, one in New Jersey and one in Missouri. Some of the ore used in these factories was ground to a fine powder in other mills before it was used in the chemical plants, but it is here regarded as strontium ore. Strontium compounds made in some other factories were manufactured not from ore but from chemically prepared strontium salts bought in the market, so they are not included in the statistics here given. Plants in New York and Pennsylvania that formerly manufactured strontium compounds from ore did not produce any in 1920.

The ore used in the two chemical factories was celestite imported from England. Strontium nitrate, used mainly in pyrotechnics and signal lights, was the chief product made. Strontium bromide, salicylate, carbonate, chloride, and hydroxide were also made in these factories. About twice as much celestite was used in the manufacturing plants in 1920 as the average used in recent years, and the total quantity of chemicals produced exceeded that produced in any other year except 1918. The details of production can not be given without divulging confidential information.

IMPORTS.[2]

The quantity of strontium ore imported is not separately recorded by the customs officers, and therefore the quantity of foreign ore used in manufacturing plants in the United States can not be exactly determined. It is estimated, however, that between 1,500 and 2,500 short tons has been imported annually in recent years, but the imports in 1920 were considerably greater than in any previous year.

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[1] The statistical data in this report were prepared by Mrs. E. R. Phillips, of the United States Geological Survey.

[2] Compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Strontium compounds that are imported free of duty are separately recorded by the customs officers, but those that are dutiable are not separately recorded, so that it is impossible to obtain an accurate record of the total quantity of strontium compounds imported. The following table, which gives the quantity and value of strontium carbonate and oxide imported, therefore does not include strontium nitrate and some other chemicals that are extensively used in the United States and that may have been imported in considerable quantity:

Strontium carbonate and strontium oxide [a] imported for consumption in the United States, 1895–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1895–1913 (yearly average)	(b)	$447	1917	(b)	$23,216
1914	(b)	1,016	1918	(c)	2,459
1915	(b)	6,411	1919	1,225,952	3,380
1916	(b)	11,049	1920	1,659,083	15,479

[a] "Oxide of strontium, protoxide of strontium, and strontianite or mineral carbonate of strontium" imported for consumption in the United States, compiled from the records of the Bureau of Foreign and Domestic Commerce.
[b] Figures for quantity not available prior to July, 1918.
[c] In the last half of the year 185,920 pounds, valued at $356, was imported.

PRICES.

The following table gives the prices of strontium salts commonly made from celestite:

Prices of strontium nitrate and strontium carbonate in New York, 1914–1920, in cents per pound. [a]

Salt.	1914	1915	1916	1917	1918	1919	1920		
							January–May.	June–November.	December.
Strontium nitrate	7¼–8	15–17	22–23	40–45	25–30	25–30	30–31	47–48	17–23
Strontium carbonate:									
Technical	(b)	(b)	(b)	(b)	40–45	40–45	(b)	(b)	(b)
Chemically pure	(b)	(b)	(b)	(b)	55–60	55–60	36–38	40–41	40–41

[a] Oil, Paint, and Drug Reporter Yearbook, 1919, and weekly reports, 1920. [b] No quotations.

The price at the end of 1920 of strontium compounds, including salts not made directly from crude ore or its immediate derivatives in the same factory, many of which are used largely for pharmaceutical purposes, was as follows:

Price per pound of strontium salts.[3]

Acetate, granular	$1.36
Arsenite, powder	2.91
Bromide, crystals and granular	.82
Bromide, dried, powder	1.33
Carbonate, precipitated pure powder	.55
Chloride, granular	.47
Chloride, dried, powder	.68
Chloride, crystals, chemically pure	.93
Iodide, fused	$4.62
Lactate, powder	2.30
Nitrate, granular	.47
Oxalate, powder	1.20
Peroxide (dioxide) powder	3.12
Phosphate, powder	1.41
Salicylate, powder	1.04
Sulphate, powder	.98

[3] Powers, Weightman & Rosengarten Co., Philadelphia, price list, Jan. 1, 1921.

USES AND MARKET.

Strontium salts are used chiefly in the manufacture of signal lights, fireworks, and medicines. Strontium nitrate and strontium carbonate are used in the production of red fire or light in pyrotechnics, flares, fusees, signal shells, and signal lights. Bromide, nitrate, carbonate, chloride, hydroxide, sulphate, iodide, salicylate, and other salts of strontium are used in chemicals, drugs, and medicines. Strontium is alloyed with copper in making certain castings. In Europe large quantities of oxide and hydroxide of strontium are used in the sugar industry. It is claimed that these strontium salts are more efficient and economical than lime in extracting the sugar from molasses, especially that derived from beet sirup. The strontium process is not at present employed in the beet-sugar industry in the United States.

Fireworks and signal lights are manufactured in the United States almost exclusively near the Atlantic seaboard, and few if any pharmaceutical chemicals are manufactured west of the Mississippi, so the present demand for strontium ore is largely confined to the Eastern States. As the only known deposits of strontium ore of possible commercial value occur in the far West, chiefly in California and Washington, there is no incentive to work them in normal times, as their product can not compete in price in the eastern market with celestite imported from England. The importation of ore, stopped during the war, was resumed early in 1919.

DEPOSITS OF STRONTIUM ORE IN THE UNITED STATES.

The known workable deposits of strontium ore in this country are in Arizona, California, Texas, Utah, and Washington. Other deposits of doubtful value occur in several other of the Western States and in a few States east of Mississippi River. These have been briefly described in Mineral Resources of the United States for 1916, 1918, and 1919.

POTASH.

By M. R. Nourse.[1]

INTRODUCTION.

More domestic potash was produced in 1918 than in any other year. During that year 128 plants produced 207,686 tons of crude material containing 54,803 short tons of potash (K_2O), an increase of nearly 70 per cent over the production for 1917, and in addition many projects and processes were being devised for increasing this output. When the armistice was signed in November, it was believed that low-priced potash would be immediately available from abroad, and sales of the domestic material were severely checked, the price falling from $5 to $2.50 a unit. At the end of 1918 large stocks of domestic potash salts were still in the hands of the producers. As few of the plants had repaid their original investment this condition was disastrous to many of them. Most of the plants were closed, some of them permanently.

As foreign potash was not imported in the quantities expected a number of the plants that had been closed in 1918 were reopened in 1919, but some of them had to be closed again later because of labor and fuel difficulties. However, a number of plants were in operation at the end of 1919, and 102 reported production during the year. The average operating period of the domestic potash plants in 1919 was about six months, and the production was 116,634 short tons of crude salts, containing 32,474[2] short tons of potash (K_2O), which about equaled the production of 1917.

At the beginning of 1920 the fear of large imports of foreign potash salts still harassed the domestic potash industry, but as imports did not meet the demand and as prices on imported material early in the year were not materially lower than the prices on domestic salts a large proportion of the 66 plants reporting production remained in operation throughout most of the year. A few plants reported operation for only the first three months of the year.

About 225,000 short tons of potash (K_2O) was imported in 1920. This with the 48,077 short tons of domestic output made the available quantity about equal to that normally used in each of the five years immediately preceding the World War. Because of the low prices received for their produce many of the farmers of the country were unable to take up the promissory notes given by them for fertilizer in the spring of 1920 and were also unable to buy the fertilizer they required in the fall. This condition, coupled with the abundance of potash on the market, resulted in a cancellation by the fertilizer-

[1] The assistance rendered by Miss Ethel Menaugh, of the United States Geological Survey, in the compilation of the statistics in this report is gratefully acknowledged.

[2] The figures of production and sales for 1919 given in this chapter differ from those printed in the advance chapter for 1919 because additional information has been received from the Bureau of the Census and with the schedules for 1920.

manufacturing companies of orders for domestic potash and greatly reduced the prices of all potash fertilizer materials. As a consequence all the Nebraska plants were closed by the end of December.

The price of potassium chloride (muriate) in the New York market ranged from $1.75 to $2.60 a unit during 1920. The net price for the same grade of material from 1911 to 1913 was 76 cents.

As a natural result of the general business depression and of the precarious footing of the domestic potash industry, very few new enterprises for the production of potash were undertaken in 1920. However, at the end of the year the Bonneville Co., to operate on the Salduro Salt Marsh, Utah, the Eastern Potash Corporation, to operate on the greensands of New Jersey, the United States Potash Co., to produce potash from feldspar in California, and several companies that proposed to operate on the alunite of Utah were continuing arrangements to produce potash in 1921.

Since the signing of the armistice the domestic producers have been urging a tariff on potash.

In November the United States Potash Producers Association began the issuance of a bimonthly leaflet in the interest of the potash industry.

Potash produced in the United States, 1915–1920, classified according to sources.

Source.	1915-16		1917		1918	
	Crude material (short tons).	Available content of potash (K_2O) (short tons).	Crude material (short tons).	Available content of potash (K_2O) (short tons).	Crude material (short tons).	Available content of potash (K_2O) (short tons).
Mineral:						
Natural brines:						
Nebraska lakes	[a] 13,910	4,068	61,053	14,558	116,662	28,854
Other brines	2,981	790	18,823	6,094	32,390	10,862
	16,891	4,858	79,876	20,652	149,052	39,716
Alunite	[a] 3,036	1,518	7,153	2,402	6,180	2,621
Dust from cement mills	[a] 5,435	504	13,582	1,621	12,652	1,549
Dust from blast furnaces	185	11	2,133	185	2,954	205
Silicate rocks	46	25			201	105
Organic:						
Kelp	[a] 5,416	1,574	11,306	3,572	14,029	4,804
Molasses distillery waste	7,775	1,799	8,589	2,846	11,792	3,467
Steffens waste water from beet-sugar refineries	380	46	2,642	369	8,795	1,374
Wood ashes	[b] 825	412	1,035	621	1,100	673
Miscellaneous industrial wastes	124	63	645	305	931	289
	40,113	10,810	126,961	32,573	207,686	[c] 54,803

[a] Production was made from this source in 1915.
[b] Figures for 1915 not available.
[c] Some of the material produced in 1918 was sold in 1919.

Potash produced in the United States, 1915–1920, classified according to sources—Contd.

Source.	1919 [a]		1920		Total.	
	Crude material (short tons).	Available content of potash (K_2O) (short tons).	Crude material (short tons).	Available content of potash (K_2O) (short tons).	Crude material (short tons).	Available content of potash (K_2O) (short tons).
Mineral:						
Natural brines:						
Nebraska lakes	36, 176	9, 072	85, 245	20, 934	313, 046	77, 486
Other brines	37, 395	12, 518	45, 438	16, 581	137, 027	46, 845
	73, 571	21, 590	130, 683	37, 515	450, 073	124, 331
Alunite	6, 599	2, 294	4, 151	2, 076	27, 119	10, 911
Dust from cement mills	11, 665	1, 258	10, 168	1, 147	53, 502	6, 079
Dust from blast furnaces	1, 101	94	2, 203	173	8, 576	668
Silicate rocks	1, 307	127	160	51	1, 714	308
Organic:						
Kelp	368	132	410	205	31, 529	10, 287
Molasses distillery waste	8, 791	2, 892	9, 420	3, 253	46, 367	14, 257
Steffens water from beet-sugar refineries	12, 423	3, 601	9, 201	3, 394	33, 441	8, 784
Wood ashes	807	484	438	263	4, 205	2, 453
Miscellaneous industrial wastes	2	2			1, 702	659
	116, 634	32, 474	166, 834	48, 077	658, 228	178, 737

[a] The figures of production and sales for 1919 given in this chapter differ from those published in the advance chapter for 1919 because of additional information received from the Bureau of the Census and in connection with the 1920 schedules.

The approximate average prices per unit of potash (K_2O) of the domestic output f. o. b. plant for the same years are estimated, as follows:

Approximate average prices per unit of domestic potash (K_2O) f. o. b. plant, 1915–1920.

1915	$3. 14	1918	$4. 11
1916	4. 37	1919	2. 46
1917	4. 29	1920	1. 80

The value of the output for the last six years at point of shipment, as given by the producers, amounted to $54,616,582; this value is based on the price received for material actually sold, the average price per unit of potash (K_2O) having been about $3.

PRODUCTION AND SALES.

STATISTICS.

According to statements made to the United States Geological Survey 57 companies, operating 66 plants, produced 166,834 short tons of crude potash material in this country in 1920. This material contained an average of 28.8 per cent or 48,077 short tons of potash (K_2O), which was equivalent to about 19 per cent of the average annual consumption of the country for the five years immediately preceding the World War, this average consumption being estimated at about 250,000 short tons. Nine kinds of raw material were utilized. The production in 1920 does not equal that of 1918 by about 6,700 tons of potash, but it exceeds that of any other year and it is almost 50 per cent larger than that of 1919.

The sales for the year amounted to 139,963 tons of crude material, containing 41,444 short tons of potash (K_2O), valued at $7,463,026, an average price of $1.80 a unit. The stocks reported on hand at the end of the year were 32,378 short tons of crude material, containing 8,999 short tons of potash.

Potash produced and sold in the United States in 1919, classified according to sources.[a]

Source.	Production.				Sales.		
	Number of plants.	Crude potash (short tons).	Available content of potash (K_2O).		Crude potash (short tons).	Available content of potash (K_2O) (short tons).	Value f. o. b. plant.
			Quantity (short tons).	Percentage of total.			
Mineral:							
Natural brines:							
Nebraska lakes	10	36,176	9,072	27.9	95,276	23,908	$5,240,352
Other brines	7	37,395	[b]12,518	38.6	25,677	10,584	2,744,963
	17	73,571	21,590	66.5	120,953	34,492	7,985,315
Alunite	7	6,599	2,294	7.1	6,599	2,294	718,506
Dust from cement mills	14	11,665	1,258	3.8	13,115	1,439	311,365
Dust from blast furnaces and silicate rocks	8	2,408	221	.7	2,328	214	48,021
Organic:							
Kelp and miscellaneous industrial wastes	4	370	134	.4	370	134	37,274
Molasses distillery waste	6	8,791	2,892	8.9	8,541	2,802	801,533
Steffens water from beet-sugar refineries	11	[c]12,423	3,601	11.1	13,313	3,847	1,081,053
Wood ashes	35	807	484	1.5	844	506	288,202
	102	116,634	32,474	100.0	166,063	45,728	11,271,269

[a] Some of the material sold in 1919 was produced in 1918.
[b] A considerablequantity lost through accident to plant.
[c] A large part of this material used privately.

Potash produced and sold in the United States in 1920, classified according to sources.

Source.	Production.				Sales.			Stocks on hand Dec. 31, 1920.	
	Number of plants.	Crude potash (short tons).	Available content of potash (K_2O).		Crude potash (short tons).	Available content of potash (K_2O) (short tons).	Value f. o. b. plant.	Crude potash (short tons).	Available content of potash (K_2O) (short tons).
			Quantity. (short tons).	Percentage of total.					
Mineral:									
Natural brines:									
Nebraska lakes	11	85,245	20,934	43.5	79,872	19,628	$3,755,084	5,436	1,318
Other brines	6	45,438	16,581	34.5	30,186	13,058	1,770,374	21,081	5,869
	17	130,683	37,515	78.0	110,058	32,686	5,525,458	26,517	7,187
Dust from cement mills	8	10,168	1,147	2.4	9,334	840	175,279	864	300
Dust from blast furnaces	9	2,203	173	.4	1,126	106	16,240	1,207	75
Alunite and silicate rocks	3	4,311	2,127	4.4	4,018	2,006	457,576	315	132
Organic:									
Molasses, distillery waste, and kelp	5	9,830	3,458	7.2	9,140	3,233	654,139	940	315
Steffens waste water from beet-sugar refineries	7	9,201	3,394	7.1	5,904	2,343	496,480	2,475	953
Wood ashes	17	438	263	.5	383	230	137,854	60	37
	66	166,834	48,077	100.0	139,963	41,444	7,463,026	32,378	8,999

The plants operating for the primary purpose of producing potash—most of those utilizing brines, alunite, silicate rocks, and wood ashes—produced 39,877 tons of potash (K_2O), or about 83 per cent of the total. The output of those producing potash as a by-product was 8,200 short tons of K_2O.

The potash is marketed in various forms, mostly as crude mixed salts, high-grade chloride, low-grade chloride, and sulphate. The largest percentage is in the form of crude mixed salts, comprising the output from the Nebraska lakes, sugar refineries, and molasses distilleries. The high-grade chloride is obtained from brines and kelp; the low-grade chloride from brine and silicate rocks. Some sulphate of potash is refined from cement dusts, but the larger part was produced from alunite. Most of the dust from cement mills and blast furnaces was sold as recovered without refining. The product from wood ashes is mostly crude carbonate.

Domestic potash produced and sold in the United States in 1919 and 1920, classified according to material marketed.[a]

Material marketed.	Crude potash (short tons).	Available content of potash (K_2O).		
		Percentage.	Quantity (short tons).	Percentage of total.
1919.				
Crude mixed salts	55,821	8–44	15,470	52.4
Chloride (muriate)	22,750	35–60	10,056	34.1
Sulphate	4,883	37.5–52	2,375	8.0
Dust from cement mills and blast furnaces	11,074	2.5–12.8	683	2.3
Low-grade chloride	3,383	3–33	435	1.5
Caustic	319	70–80	252	.9
Crude carbonate	490	40–70	234	.8
	98,720	....	29,505	100.0
1920.				
Crude mixed salts	94,601	10–48	25,033	60.4
High-grade chloride	22,126	45.5–58	11,926	28.8
Sulphate	4,988	33–45	2,352	5.7
Low-grade chloride	8,630	15–32	1,388	3.4
Dust from cement mills and blast furnaces	9,249	2.27–12	521	1.2
First sorts	276	60	150	.5
Caustic	93	80	74	
	139,963	....	41,444	100.0

[a] Does not include material produced in 1918 but sold in 1919.

Potash produced in the United States in 1919 and 1920, by States.

State.	Number of plants.	Crude potash (short tons).	Available content of potash (K_2O).	
			Quantity (short tons).	Percentage of total.
1919.				
California	15	39,673	13,756	42.4
Nebraska	11	37,637	9,721	29.9
Utah	13	22,426	5,411	16.7
Colorado	3	3,777	1,678	5.2
Wisconsin	18	616	370	1.1
Pennsylvania	10	3,080	310	1.0
Michigan	18	666	166	.5
Other States [a]	14	8,759	1,062	3.2
	102	116,634	32,474	100.0
1920.				
Nebraska	12	87,100	21,804	45.4
California [b]	11	30,868	12,234	25.4
Utah [c]	6	34,905	10,069	20.9
Colorado	3	4,095	1,683	3.5
Wisconsin	10	345	207	
Pennsylvania	10	2,256	176	0.9
Michigan	7	93	56	
Other States [d]	7	7,172	1,848	3.9
	66	166,834	48,077	100.0

[a] Includes two plants in Maryland, and one each in Georgia, Illinois, Indiana, Iowa, Massachusetts, Missouri, New York, Ohio, Porto Rico, Tennessee, Washington, and Wyoming.
[b] Some of the material utilized in a California plant was produced in Hawaii.
[c] Some of the material produced in Utah was utilized in a Virginia manufacturing plant.
[d] Includes two plants in Maryland, and one each in Missouri, New York, Ohio, Porto Rico, and Wyoming.

An unsuccessful effort has been made to learn what proportion of the domestic potash produced in 1920 was utilized in the chemical industry and what portion in the fertilizer industry. Reports have been received stating that "some" material was sold to chemical manufacturing firms, but undoubtedly the bulk of the material was used for fertilizer.

SOURCES OF RAW MATERIAL.

SALINES.

Seventeen plants were in operation in 1920 for the extraction of potash from natural brines. Eleven of these were in the alkali-lake region of western Nebraska (two plants were operated by one company), three were in California, and three in Utah. As in several former years, the alkali-lake region of western Nebraska produced more potash than any other locality; the individual plant producing the largest quantity of potash (K_2O) was that of the Utah-Salduro Co. at Salduro, Utah. Some of the plants producing potash from natural brines were operated throughout the year, but by the end of the year all the Nebraska plants and that of the Salt Lake Potash Co., which utilized brines from Great Salt Lake, were closed.

OPERATING PLANTS.

California.—The American Trona Corporation and the Solvay Process Co. reported production of potash from the brines of Searles Lake, San Bernardino County, Calif. The American Trona Corporation has installed two additional sets of evaporators, which have caused a decided decrease in cost of production, and also a refrigerator plant. The recent changes in the operations of this corporation have resulted in a higher grade of potash salts and a decreased percentage of borax. The marketed product is a high-grade chloride with less than 0.5 per cent of borax. The refinery at San Pedro has been closed. No essential change in method of treatment at the plant of the Solvay Process Co. has been reported, though a higher-grade product has been obtained by recrystallization of the salts that contained too much borax. The plant was closed shortly after the end of the year.

One plant reported the production of a small quantity of potassium chloride in connection with the manufacture of salt and magnesium chloride from sea waters.

Nebraska.—Ten of the eleven plants which reported a production of potash from the alkali-lake region of western Nebraska were in operation throughout 1920. One plant went out of business about the end of March. All the others were closed by the end of December. At several of the plants experiments were conducted throughout the year for the separation of the potassium and sodium salts. The brines from the alkali lakes of western Nebraska vary in concentration and in their content of potash, but the dissolved salts in most of the brines are remarkably similar in composition. Of the two analyses given in the following table No. 1 represents the advertised product from one of the plants and No. 2 is a typical analysis submitted by one of the companies:

Composition of commercial potash from Nebraska lakes.

Reported analyses.			Calculated salts.[a]		
	1	2		1	2
K_2O	28.49	22.37	K_2SO_4	31.60	35.64
Na_2O	32.11	33.87	K_2CO_3	16.72	4.60
CO_2	21.91	22.88	Na_2CO_3	46.87	51.62
SO_3	14.53	16.39	NaCl	4.70	6.92
Cl	2.85	4.20	Loss on ignition	....	1.02
Loss on ignition	....	1.02	Insoluble	.11	.20
Insoluble	.11	.20		100.00	100.00
	100.00	100.93			

[a] The figures representing calculated salts were obtained by calculating all the SO_3 to K_2SO_4, the excess of K_2O to K_2CO_3, all the Cl to NaCl, and assuming the remainder of the 100 per cent to be Na_2CO_3.

It will be easily seen from these analyses that the proposed separation of the sodium and potassium salts would be a great advantage in lowering freight rates as well as in making available the sodium salts in the form of caustic soda and soda ash. The future of the potash industry in Nebraska may depend on the successful outcome of these experiments for the separation of the salts.

The capacity of the American Potash Co., which operates two plants, was increased during the year by the addition of one quadruple set of evaporators, extra boilers, and other machinery. No essential changes were made by the other companies, though various economies in methods were successfully adopted.

The pioneer company of the Nebraska district, the Potash Reduction Co.—also one of the pioneers of the American potash industry—made the largest production of potash salts in this district.

It is stated that the cost of producing a unit of potash (K_2O) at the Nebraska plants in 1920, including an item for depreciation, was a little more than \$2. Doubtless the cost was considerably increased because of the dilution of the brines by the heavy rainfall in the spring and summer, which made concentration both difficult and expensive.

A recent report on the potash resources of Nebraska[3] contains the conclusions reached after a field examination made in 1918. The estimates of potash resources given in this report are considered as a minimum because there are probably a good many unexplored lakes, other parts of the subsurface area than those now productive probably contain at least low-grade brines, and small quantities of potash leached from the surrounding hills are being continually carried into the lakes. The estimated potash content (K_2O) of the known productive lakes is given as 215,110 short tons, that of the lakes reported to be productive but concerning which little data are at hand as 50,000 short tons, and that available in dilute brines as 25,000 tons—a total of 290,110 short tons.

Utah.—Of the three companies in Utah reporting a production of potash salts from brines in 1920 two utilized the waters of Great Salt Lake, and the third utilized the brines of Salduro Salt Marsh, in the extreme western part of the State.

The Salt Lake Potash Co., having a plant on the north shore of Great Salt Lake near Kosmos and producing potash from the waters of the lake by a solar evaporation process, has a yearly capacity of about 40,000 tons. Its product is a low-grade mixture of potassium sulphate and potassium chloride. At the end of the year the plant was closed because of the unsettled condition of the potash market, the high cost of labor, and the difficulties of transportation. The Salt Lake Chemical Co., which has for a number of years been producing potassium salts at its plant at Burmester, on the south shore of Great Salt Lake, is a subsidiary of the Diamond Match Co.

The Utah-Salduro Co. at Salduro, 60 miles west of Great Salt Lake, produced more potash salts in 1920 than any other company in the United States. The deposit from which the potash is extracted has been described in former reports of the United States Geological Survey. The composition of the brine is similar to that of the artificial brines of the German potash works. Solar evaporation produces crude salts containing potassium, sodium, and magnesium chlorides. These crude salts are boiled with hot brine and on cooling yield high-grade potassium chloride. Both high and low grade salts are marketed. Solar evaporation permits great saving of fuel. During 1920 the Utah-Salduro Co. was granted patent to 30,607 acres of land in the Great Salt Lake Desert.

PROSPECTIVE OPERATIONS.

California.—The West End Chemical Co., which has already reported a production of borax from Searles Lake, Calif., contemplates the production in the near future of potash also. A fourth

[3] Hicks, W. B., Potash resources of Nebraska: U. S. Geol. Survey Bull. 715, pp. 125–139, 1921.

plant at Searles Lake is reported as under construction. Newspaper reports state that another effort is to be made to utilize the water of Owens Lake as a source of potash salts. The water is to be evaporated by solar heat, the sodium salts are to be separated out by treatment with carbon dioxide, and further evaporation and crystallization will result in the recovery of both borax and potassium chloride. The Inyo Chemical Co. reports the successful operation of an experimental plant in Deep Springs Valley, where it is proposed to produce high-grade potassium chloride by a very simple method from the brines of the alkali lake.

Utah.—The Bonneville Potash Co. has applied for patent to land in the Salduro Salt Marsh, west of Salduro, Utah. The plant is to be located at Wendover, near the Utah-Nevada line. The brines are to be run into vats through a large drainage ditch and concentrated by solar evaporation which will throw down common salt, and then further evaporation will release the crude potassium chloride and magnesium chloride. The crude potash salts will be refined, the marketed product being a high-grade potassium chloride. Both processes and product will be similar to those of the Utah-Salduro Co. It is expected that this plant will be in operation by the summer of 1921.

Texas.—Exploratory work continues on the alkali lakes of the Texas Panhandle, and one firm is reported to be operating a small plant which is experimenting in the economical separation of the salts.

ALUNITE.

Practically all the potash made from alunite in 1920 was produced by the Mineral Products Corporation, with plant at Marysvale, Utah, now owned by the Armour Fertilizer Works. An accident during the summer of 1920 retarded production somewhat, but new machinery designed to reduce materially the cost of producing potash was partly installed before the plant was shut down early in 1921. The demoralized condition of the fertilizer industry and the consequent lowered price of German sulphate, together with high freight rates, are given as the reasons for closing this plant, which produced a high-grade potassium sulphate and was one of the pioneers in the domestic potash industry.

Projects for the utilization of other alunite deposits in the Marysvale region are reported, among them that of the Aluminum Potash Co. of America, which owns the Copper Butte claims and plans to build a mill near Winkleman, where it is proposed to produce aluminum sulphate as well as potash. Continued experimental work was done by this company in the laboratories of the Salt Lake station of the Bureau of Mines on the extraction of potash from low-grade alunite. The Industrial Potash Co., utilizing the White Hills and Closein properties, is said to have purchased $100,000 worth of machinery and to have already on the mill site 1 mile northeast of Marysvale the equipment for a gas-producer plant. Producer gas is to be used in calcining the alunite. The first unit of the plant is to treat 250 tons of rock a day.

The Utah Potash Co. of Utah, operating a deposit of alunitized rock (formerly known as the Krotki iron mine) west of Twin Peaks in the Marysvale region, states that the mill on its property has been completed with a capacity of 150 tons a day and claims that it has evolved a more economical method of working and recovery than other firms that have endeavored to utilize alunite as a source of potash salts.

Experiments in the extraction of potash from low-grade alunite from Marysvale were conducted by the University of Utah State School of Mines in cooperation with the United States Bureau of Mines.[4] The tests showed that extraction of 80 per cent of the potash was possible with alunite ores running between 5 and 8 per cent, crushed to one-half inch, and roasted for one hour at 800° C. or for half an hour at 1,000° C.; that the loss by volatilization of potash during roasting is negligible in roasts up to a temperature of 1,000° C.; that a maximum extraction of potash is obtainable with water heated to 95° C. in a leaching period of five minutes with agitation and with the use of a pulp ratio of calcine to water of 1:3, provided the calcine will pass a 10-mesh sieve; that the calcine may be dropped hot into the leaching solution without detriment to the extraction of potash; and that the quantity of alumina leached from a calcine of a properly conducted roast is small.

No developments have been reported for 1920 on the alunite property near Sulphur, Nev., but it is said that assessment work continued to disclose large bodies of alunite.

SILICATE ROCKS.

The possible utilization as a source of potash of the enormous quantity of available silicate rocks continues to attract attention and is believed by many to be the only basis on which a permanent domestic potash industry can be established.

Wyoming.—The only commercial potash produced from silicate rocks reported to the United States Geological Survey for 1920 was a small quantity made by the Liberty Potash Co. from the wyomingite of Green River, Wyo. The plant of this company was run intermittently from November, 1919, to February, 1920. The product was a low-grade chloride. Since the plant was closed much additional experimental work has been done, and hopes are entertained of refinancing the project and putting it on a sound operating basis.

New Jersey.—The Eastern Potash Corporation (formerly the Kaolin Products Corporation and the American Potash Corporation) operated its experimental plant at Jones Point, N. Y., intermittently during 1920. It has erected a large plant at New Brunswick, N. J., in the glauconite belt of that State, where it intends to produce brick, agricultural lime, and potash products, using glauconite as the source of the potash salts. The potash products are to be various high-grade potash salts. The process is said to be a simple one, involving the heating for one hour at a temperature corresponding to a 500-pound steam pressure of a slurry of about equal parts of greensand and lime with five parts of water.

Georgia.—The American Metals Co. has continued its experiments on the utilization of the slates of the Cartersville district, Ga., as a source of potash.

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[4] Varley, Thomas, and Reid, W. S., Extraction of potash from low-grade alunite from Marysvale district, Utah: Utah Univ. Bull., vol. 2, No. 15, 28 pp., December, 1920.

Illinois.—The potash content of the shales of Illinois has been investigated by M. M. Austin and S. W. Parr, but no report on their work was available in May, 1921.

California.—The United States Potash Co., operating a plant at Monolith, Calif., owned by the city of Los Angeles and formerly utilized in the manufacture of cement, expects to make potash from feldspar and to utilize the residue in the manufacture of cement or brick. The process and patents are those of A. C. Spencer.

Virginia.—It is reported that the process utilized by the Eastern Potash Corporation, or a very similar one, will be used for the production of potash and brick by a company at Roanoke, Va., using feldspar as a raw material. A proposition to mix equal quantities of low-grade phosphate, sodium carbonate, and crushed feldspar and heat the mixture to about 800° C., producing a "complete" mixed fertilizer, has been widely advertised by the Emporia Potassium Phosphate Co., of Emporia, Va., but no production has yet been reported by this company to the Geological Survey.

Patents.—The following United States patents covering the extraction of potash from silicate rocks were issued during 1920:

1324737. Dec. 9, 1919, Gilbert, L. D., Taylor, P. S., Dean, J. G., Elder, L. E. Apparatus for collecting soluble salts from flue gases.

1327164. Jan. 6, 1920, Meadows, T. C., Hauber, Mathias, and Charlton, H. W. Greensand and lime are digested at high pressure and temperature with water containing in solution sufficient calcium chloride to react with the potassium in the greensand until a solution containing about 3 per cent of potassium chloride is obtained, the potassium being then separated by filtration.

1327781. Jan. 13, 1920, Scholes, S. R., and Brenner, R. F. An insoluble potassium silicate is mixed with a reagent and fused to form a glasslike mass which is mixed with water, boiled, and treated with carbon dioxide.

1327782. Jan. 13, 1920, Scholes, S. R., and Brenner, R. F. Similar to the preceding, with the additional step of removing a portion of the sodium carbonates and returning the remaining carbonates to the process and repeating the cycle until all the sodium carbonate originally added has been removed.

1329369. Feb. 3, 1920, Charlton, H. W. A potassium-bearing silicate is mixed with lime and water of five times the weight of the lime and digested at superatmospheric pressure.

1332114. Feb. 24, 1920, Dutt, E. E. Feldspar is treated with arsenic trichloride, the mass lixiviated, and the potassium chloride dissolved and evaporated.

1334940. Mar. 23, 1920, Auden, A. C. A mineral containing silicates of iron and potassium is roasted with lime and salt, finely ground, and treated with steam and hot water in a closed vessel.

1334989. Mar. 30, 1920, Charlton, H. W. Potassium hydroxide, free from sodium and aluminum; a product resulting from process disclosed in patent 1329369.

1341110. May 25, 1920, Charlton, H. W. Greensand is heated with ferrous chloride, potassium chloride being formed.

1344705. June 29, 1920, Messerschmitt, Anton. Finely ground potassium silicate and sodium nitrate are heated in the presence of water at a high temperature under pressure until the sodium and potassium have replaced each other.

1344830. June 29, 1920, Spencer, A. C. Silicates are treated with chloride solution in excess of the potash equivalent in the material heated, pressure being used to hasten the reaction.

1345034. June 29, 1920, Stringfield, R. F. A potassium compound is recovered from solid material containing potassium, calcium, and the sulphate radicle by treating such material with water in such manner as to produce a solution containing potassium sulphate and calcium sulphate in such concentration that the relatively insoluble double sulphate of potassium and calcium is also produced.

1346002. July 6, 1920, Charlton, H. W. Finely ground potassium silicate is heated and digested with a mixture of calcium and alkali metal hydrates at high temperature and pressure, potassium-hydrate being recovered.

1346365. July 13, 1920, Bergve, Einar. Potassium silicates are subjected to the action of sulphur vapors at temperatures of from 800° to 1,400° C., the resulting sulphosilicates being decomposed with water under pressure at high temperature and the potassium obtained in solution.

1349113. Aug. 10, 1920, Westling, E. H. Feldspar is heated with a heavy metal sulphate at a temperature sufficiently high to decompose the sulphate and form an alkali metal sulphate which is separated out.

1350091. Aug. 17, 1920, Ashcroft, E. A. Fused salt is permitted to percolate through a mass of potassium-bearing silicate material at a temperature of about 1,000° C. in the absence of air and moisture to form potassium chloride.

1351693. Aug. 31, 1920, Sadtler, S. S. The reaction of calcium hydroxide on disodium phosphate produces an alkali metal hydroxide.

1354642. Oct. 5, 1920, Anderson, Evald, and Moon, F. S. Furnace dust containing potassium sulphate and potassium chloride is leached with a solution containing sufficient calcium chloride to convert the alkali metal sulphates present to the form of chloride, removing the solution from the solids and recovering the potassium chloride from the solution.

1354727. Oct. 5, 1920, Catlett, C. Recovery of potassium compounds facilitated by addition of 1 to 5 per cent calcium-oxychloride compounds of the sorel cement type sufficient to supply chloride to the potassium to be recovered. The volatilized potassium values leaving the kiln with the dust may be recovered by simple subsidence, use of wet or dry filtrates, or by electric precipitation.

1354747. October 5, 1920, Catlett, Charles. A mineral containing potassium is mixed with a set cement composition of the Sorel type, comprising an oxysalt of calcium, and subjected to reacting conditions.

1355381. October 12, 1920, Blackmore, H. S. Feldspar is exposed to the action of an alkaline silicofluorid, separating the resultant soluble product and exposing it to the action of a chemical reagent capable of regenerating a compound similar to that originally employed as the transforming agent and producing a still more soluble alkali metal compound.

1355588. October 12, 1920, Blackmore, H. S. An insoluble alkali metal silicate is exposed to the action of a silicofluorid of a metal of the iron group, the resultant soluble product being separated therefrom and exposed to the action of a chemical reagent capable of producing a still more soluble alkali metal compound.

1355794. October 12, 1920, Blackmore, H. S. Finely ground orthoclase or similar material is mixed with thin paste of sodium silicofluorid and heated, which converts the potassium in the silicate into potassium silicofluorid. The latter is dissolved in hot water and crystallizes out on cooling.

1357025. October 26, 1920, Blackmore, H. S. An alkali metal compound is exposed to the action of nonacid metal silicofluorid, the resultant soluble product being separated therefrom and exposed to the action of a chemical reagent capable of producing a still more soluble alkali metal compound.

1357873. November 2, 1920, Jungner, E. W. Carbonaceous material is incorporated with a siliceous and calcareous material, the mixture is furnaced and alkali compounds collected with the resulting fume.

KELP.

Only the Government experimental potash-kelp plant at Summerland, Calif., was in operation during 1920 on kelp as a source of potash salts. The capacity of the plant was not increased, but the energies of the force were directed to the development of by-products, principally bleaching powder and iodine, both of which are now commercialized and placed on the market. The plant capacity for these materials, however, is not yet sufficient to put the experiment on a profitable basis. The output of potash from this plant has increased and the cost of production has steadily decreased. The output in June, 1920, was officially stated as 2 tons a day of 80 per cent muriate.

As the bleaching powder and iodine are to carry the operating expenses of the plant, the potash is a by-product.

OTHER SOURCES.

No developments of interest have been noted in connection with the production of potash salts from the dusts of cement mills and blast furnaces, Steffens waste water from sugar refineries, molasses distillery waste, or wood ashes. Figures of production and sales will be found in the foregoing tables. No production of potash was reported from miscellaneous industrial wastes.

EXPORTS.

A comparatively small quantity of potash materials, including refined potassium salts, is exported from the United States, but data concerning these exports are meager. The available data on exports for 1919 and 1920 are shown in the following table:

Potassium salts exported from the United States in 1919 and 1920.

Salt.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Chlorate	991	$524,193	1,410	$445,243
All other		2,231,351		3,116,772
		2,755,544		3,562,015

GOVERNMENT ACTIVITIES.

UNITED STATES GEOLOGICAL SURVEY.

Active efforts to discover new sources of raw potash materials have for various reasons been discontinued by the United States Geological Survey, except in the "Red Beds" region of Texas and neighboring States. The laboratory maintained at Cliffside, Tex., by cooperative agreement between the University of Texas Bureau of Economic Geology and Technology and the United States Geological Survey was in charge of O. C. Wheeler until September, 1920. Since that time it has been in charge of D. D. Christner. The potash deposits of Germany and France were discovered by accident during the boring of deep wells in search of other minerals. It seems probable that in the "Red Beds" region of Texas, New Mexico, Kansas, and Oklahoma, which is similar geologically to those regions in Europe where potash has been found, potash salts may be discovered in wells bored for oil or water. The drillers of such wells are therefore urged to keep samples of all salts and brines encountered. Whenever possible such borings are visited by the Government representative from the Cliffside laboratory, the log of the well is studied, samples are taken, and simple qualitative tests are made. Detailed chemical analyses are made of samples which seem to indicate an unusual content of potash.

In 1919 Mr. Wheeler examined lakes in Lynn, Terry, and Gaines counties, Tex., with a view to determining their possibilities as a source of potash. A brief press notice[5] was issued concerning the results of tests. A more detailed report on the nature of the samples and the apparent quantity of brine available is in preparation. In the spring of 1920 the region was visited by P. S. Smith, and later a lake region farther north in Lamb, Bailey, Cochran, and Hockley counties, Tex., was visited and examined by Mr. Wheeler.

BUREAU OF MINES.

At the Salt Lake station laboratory experiments on the recovery of potash from the low-grade alunite ores of southern Utah showed that concentration and recovery by calcination, leaching, and electrical precipitation was feasible. A report (already noted) on these experiments was issued in December, 1920, by the University of Utah, State School of Mines.

BUREAU OF SOILS.

An appropriation for the completion, operation, and maintenance of the experimental kelp potash plant of the Bureau of Soils at Summerland, Calif., was made by Congress in 1920, this plant having shown, according to specialists of the Department of Agriculture, that the successful outcome of the experiments is assured and that the by-products developed will more than carry the cost of producing the potash. The principal by-products of this plant are iodine, salt, ammonia, and bleaching carbon. Ultimately the plant is expected to be on a profitable basis and to prove the possibility of the commercial extraction of potash from kelp.

The question of the occurrence and determination of borax in fertilizers was studied by the Bureau of Soils, as was also the presence of borax in potash salts derived from various sources. An accurate method for the determination of borax was developed and later tentatively adopted by the Association of Official Agricultural Chemists.

A survey of the blast-furnace industry is in progress by the Bureau of Soils for the purpose of discovering how much potash is available from this source in this country.

FOREIGN POTASH.

IMPORTS.[6]

In 1920 there were imported and entered for consumption in the United States 918,698 short tons of potash salts, containing 197,795 short tons of potash (K_2O), to be used largely as fertilizer, and 63,564 short tons of manufactured potash salts, containing 26,997 short tons of potash, a total of 982,262 short tons of potash material, containing 224,792 short tons of potash (K_2O), valued at $43,389,783. For the five years prior to 1913 the United States imported annually from Germany an average of about 250,000 short tons of potash (K_2O).

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[5] U. S. Geol. Survey Press Bull. 441, 1920.

[6] Figures on imports and exports in this report were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce.

Potash materials imported and entered for consumption in the United States, 1913, 1919, and 1920.[a]

Material.	Approximate potash (K_2O) content (per cent).	1913				1919				1920			
		Quantity (short tons).	Available content of potash (K_2O).		Value.	Quantity (short tons).	Available content of potash (K_2O).		Value.	Quantity (short tons).	Available content of potash (K_2O).		Value.
			Quantity (short tons).	Percentage of total.			Quantity (short tons).	Percentage of total.			Quantity (short tons).	Percentage of total.	
Kainite	12.4	521,176	64,626	23.9	$2,201,730	57,427	7,121	18	$921,481	416,661	51,666	23.0	$8,212,621
Manure salts	20.0	250,529	50,106	18.5	2,245,509	45,372	9,074	22.9	1,269,750	348,837	69,767	31.0	10,625,717
Muriate	50.0	237,630	118,815	43.8	7,075,745	23,202	11,601	29.2	1,783,916	136,194	68,097	30.3	12,703,858
Sulphate	48.6	44,349	21,554	8	1,677,429	1,415	688	1.8	188,592	17,006	8,265	3.7	2,343,431
Total[b]		1,053,684	255,101	94.2	13,200,413	127,416	28,484	71.9	4,163,739	918,698	197,795	88.0	33,885,627
Bicarbonate	46.0	223	103		20,968	24	11		8,921	194	89		93,565
Bitartrate (argol)	20.0	14,499	2,900	1.1	2,779,180	12,904	2,581	6.5	4,311,610	17,779	3,556	1.6	4,452,428
Bitartrate (cream of tartar)	25.0	75	19		28,314	12	3		10,879	109	27		83,903
Carbonate, crude	61.0	4,858	2,963	1.1	272,973	258	157	.4	104,744	8,452	5,156	2.3	510,700
Carbonate, crude or black salts	50.0	344	172	.1	17,852	102	51	.2	10,075	7,356	3,678	1.7	417,797
Carbonate, refined	67.0	6,145	4,117	1.5	393,284	23	15		9,665	882	591	.2	290,354
Caustic	80.0	4,324	3,459	1.3	342,056	242	194	.5	134,166	856	685	.3	451,274
Chlorate	38.0	596	226	.1	64,468	100	38	.1	34,996	742	282	.1	162,417
Chromate and bichromate	40.0	9	4		1,819	8	3		4,271	2	1		2,690
Cyanide	70.0	735	514	.2	216,844	588	412	1.1	68,848	7,224	5,056	2.3	1,088,247
Ferricyanide (red prussiate)	42.0	34	14		12,035	17	7		18,096	51	21		64,686
Ferrocyanide (yellow prussiate)	44.0	1,706	751	.3	388,379	258	108	.3	122,372	381	17		105,962
Iodide	28.0					9	3		54,250	3	1		14,872
Nitrate (saltpeter), crude	40.0	4,826	193	.1	261,078	18,826	7,530	19.0	1,107,313	18,816	7,526	3.4	1,599,346
Nitrate (saltpeter), refined	46.0	203	93		22,602	37	17		8,171	631	290	.1	107,154
Permanganate	29.0	273	79		38,188	2	1		10,163	27	8		29,748
Rochelle salt	22.0	54	12		13,412	20	4		9,537	59	13		29,013
Total[c]		38,904	15,619	5.8	4,873,452	33,430	11,135	28.1	6,028,077	63,564	26,997	12.0	9,504,156
Grand total		1,092,588	270,720	100.0	18,073,865	160,846	39,619	100.0	10,191,816	982,262	224,792	100.0	43,389,783

[a] The figures in this table were compiled from the records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, by recalculation to short tons and to actual potash (K_2O) and by giving the totals for calendar years instead of fiscal years. The tons are calculated to the nearest even unit and the values are those given in the original records, so that the value given for a high-priced commodity received in small quantity may not be strictly applicable to the quantity given. For instance, 2,705 pounds of cyanide received in 1916 is reported as 1 ton, but the value given is that of the actual quantity received. Furthermore the values are those placed on the commodities by the shippers, and represent the values at point of shipment and do not agree with market quotations in this country.

[b] Used principally in fertilizers.

[c] Used principally in chemical industries.

The first four salts listed in the foregoing table are used principally in fertilizers and are produced chiefly in France and Germany, the other materials listed are manufactured potassium salts, more or less refined, and are used in chemical industries.

The following table represents in terms of K_2O approximately the total imports of potash for consumption in the United States during recent years. For the years 1906 to 1912, inclusive, imports have been compiled from a report on the fertilizer industry prepared by the Federal Trade Commission,[7] recalculated from metric to short tons, and for the years 1913 to 1920, inclusive, they have been calculated from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Potash (K_2O) imported for consumption in the United States, 1906–1920, in short tons.

1906	155, 974	1911	274, 446	1916	7, 885
1907	144, 351	1912	253, 678	1917	8, 100
1908	136, 057	1913	270, 720	1918	7, 957
1909	173, 220	1914	207, 089	1919	39, 619
1910	279, 780	1915	48, 867	1920	224, 792

Until 1915 practically all the potash brought into this country came from Germany; from 1916 until 1920 it came from many different countries—during 1920 principally from Germany, France, Belgium, and Holland, though that from Belgium and Holland doubtless originated in Germany and France. Unfortunately there is no authentic information at hand concerning the original source of these shipments.

[7] Report on the fertilizer industry, 1916, p. 115.

Potash imported into the United States in 1920, in short tons.[a]

Country.	Manure salts containing 20 per cent K_2O.	Kainite containing 12.4 per cent K_2O.	Muriate containing 50 per cent K_2O.	Sulphate containing 48.6 per cent K_2O.	Bitartrate argols or wine lees containing 20 per cent K_2O.	Carbonate, including crude or black salts containing 61 per cent K_2O.	Cyanide containing 70 per cent K_2O.	Hydrate containing 80 per cent K_2O.	Nitrate of or saltpeter, crude, containing 40 per cent K_2O.	All other containing 50 per cent K_2O.	Total.	
											Quantity (short tons).	Value.
Austria						6		22			28	$15,492
Belgium	53,204	82,546	16,064	940		114		6		2	152,876	4,523,821
Czechoslovakia			226	47		85		22			380	61,825
Denmark						11		2		40	53	31,659
France	56,622	140,951	15,892		4,034	7,570				31	225,100	6,447,564
Germany	219,895	176,858	88,080	9,951	1	3,946	687	706	57	1,261	501,442	21,908,421
Greece					1,208						1,208	255,245
Italy					3,450						3,450	1,044,670
Malta, Gozo, and Cyprus Islands	11										11	317
Netherlands	23,096	17,657	5,154	1,244		1,184				95	48,430	1,711,481
Norway			171						38	6	215	41,451
Portugal					1,501						1,501	385,047
Russia in Europe						593					593	106,653
Spain					3,112	128					3,240	764,308
Sweden						17		85		381	483	182,057
Switzerland						2,545				20	2,565	221,343
England	1,191	1,688	5,975	1,358	10	173	5	6	273	189	10,868	1,181,574
Scotland	2		1,092	34	6	5					1,139	96,691
Canada	132		3,372	3,200	7	31	6,518			1	13,261	1,751,638
Panama												85
Mexico							14				14	10,422
Jamaica				84							84	8,262
Argentina					1,075					25	1,100	197,196
Brazil										6	6	884
Chile					531				13,614		14,145	1,079,071
Peru					43						43	29,080
Venezuela	1,904										1,904	16,405
China				17		13					30	5,404
British India				55					4,834		4,889	658,047
Other British East Indies			111	76							187	13,044
Dutch East Indies						17					17	9,493
Hongkong						4					4	1,356

a The figures in this table were compiled from the records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, by recalculation to short tons and to the actual potash (K_2O) and by giving the totals by the calendar year instead of the fiscal year. The tons are calculated to the nearest even unit. The data present general imports and include imports both for immediate consumption and those going to warehouses, which may or may not be entered for consumption during the year. They differ slightly from the figures in the preceding table of imports, which represents imports for consumption.

Potash imported into the United States in 1920, in short tons—Continued.

Country.	Manure salts containing 20 per cent K_2O.	Kainite containing 12.4 per cent K_2O.	Muriate containing 50 per cent K_2O.	Sulphate containing 48.6 per cent K_2O.	Bitartrate argols or wine lees containing 20 per cent K_2O.	Carbonate, including crude or black salts containing 61 per cent K_2O.	Cyanide containing 70 per cent K_2O.	Hydrate containing 80 per cent K_2O.	Nitrate of or saltpeter, crude, containing 40 per cent K_2O.	All other containing 50 per cent K_2O.	Total.	
											Quantity (short tons)	Value.
Japan	3		57			248		7		29	344	$168,509
British South Africa					22						22	8,800
French Africa					2,789						2,789	513,971
	356,060	419,700	136,194	17,006	17,789	16,690	7,224	856	18,816	2,086	992,421	43,451,286
Content of potash (K_2O)	71,212	52,043	68,097	8,265	3,558	10,181	5,057	685	7,526	1,043	227,667	

SOURCES.

GERMANY.

In 1920 more than half of the crude potash salts imported into the United States came directly from Germany—501,442 short tons, containing 118,891 short tons of potash (K_2O). Of this quantity 114,785 short tons of potash (K_2O) was material chiefly used in fertilizer. This material was valued at $21,908,421.

The production of potash in Germany in January, 1920, is said to have been the largest in the history of the industry, the increased production being ascribed to the use of returned prisoners in the mines and possibly also to the fact that labor was in a more stable condition. The cost of production has been increased because of increased cost of coal and other materials, rise in wages, and doubling of freight rates. The German domestic market has been unsatisfactory because of the high prices asked. Exports have suffered through strikes at seaports as well as on account of continued high prices.

Rumors of negotiations between Germany and France concerning an adjustment of export prices have been heard from time to time, but apparently no agreement has been arrived at, and French potash has undersold the German at times.

The total output of the German mines in 1920 was 923,700 metric tons [8] of potash (K_2O).

FRANCE.

In 1920 the Alsatian potash mines, with the exception of the Bollwiller and Ensisheim mines, which are worked by the Kali-Ste. Thérèse Co., were under the administration of a sequestration committee known as the Société commerciale des potasses d'Alsace. The Chamber of Deputies has passed a law authorizing the purchase of the Alsatian mines by the French Government, which will, in turn, grant concessions for working them to suitable organizations.

Much of the material from these mines is sold as fertilizer after crushing merely, this crude material carrying from 12 to 16 per cent of potash (K_2O). There were three refining plants in operation in Alsace in 1920, which had a combined output of about 330 metric tons a day of 80 per cent potassium chloride (KCl).

Potash mined in Alsace, 1913–1920.[a]

Year.	Crude material (metric tons).	Content of K_2O (short tons).
1913	355,341	62,540
1914	325,880	57,455
1915	114,358	20,127
1916	204,474	35,987
1917	320,131	56,343
1918	333,499	58,695
1919	592,000	104,192
1920	[b] 1,061,197	186,770

[a] From figures given by E. L. Ives, Commerce Repts., Sept. 4, 1920, p. 1109; Apr. 27, 1921, p. 546.
[b] According to later reports 1,061,191.

[8] Min. Jour. (London), vol. 133, p. 241, 1921.

During 1920 there were imported into the United States directly from France 225,100 short tons of potash salts, containing 42,188 short tons of potash (K_2O). Of this quantity 36,748 short tons of potash (K_2O) was used chiefly in fertilizer. The quantity of French potash imported by way of Belgium and Holland can not be determined. Commerce Reports, April 27, 1921, page 546, states that 327,000 (probably metric) tons was exported to the United States. The difference between this figure and the 225,100 tons reported as imported directly from France may indicate the quantity shipped through Belgium or Holland, or it may indicate a mere difference in bookkeeping, material ordered in a given period sometimes being booked according to the date of order and sometimes according to the date of actual shipment.

Commerce Reports, May 23, 1921, page 1075, contained the following statement by Commercial Attaché Huntington, at Paris:

The total production of the Alsatian mines in 1913 was 350,341 tons, corresponding to 56,000 tons of pure potash; in 1919 the production was 464,607 tons, corresponding to 92,006 tons of pure potash; and in 1920 the total reached 1,061,191 tons, corresponding to 199,230 tons of pure potash.

The following shows the amount of the 1919 production of the grades named compared with the production of 1920:

Grade.	1919	1920
	Tons.	*Tons.*
Sylvinite, 12 to 16 per cent	262,779	664,019
Rich sylvinite, 20 to 22 per cent	163,714	335,820
Chloride of potassium, 50 to 60 per cent	38,114	61,352
	464,607	1,061,191

Shipments during 1919 and 1920, expressed in terms of pure potash, were in amount as follows:

Grade.	To France.		To United States.		To other countries.	
	1919	1920	1919	1920	1919	1920
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Sylvinite, 12 to 16 per cent	20,820	43,994	11,022	27,355	6,303	25,557
Rich sylvinite, 20 to 22 per cent	16,260	31,420	8,276	19,720	9,096	17,679
Chloride of potassium, 50 to 60 per cent	9,973	11,164	3,849	8,892	6,407	13,394
	47,053	86,578	23,147	55,967	21,806	56,630

Since March, 1921, the concentration plants of the Alsatian potash mines have been manufacturing rich sylvinite of 30 per cent K_2O content and sylvinite of 40 per cent K_2O content.

Additional deposits of potash are reported [9] to have been discovered at Ostheim and Ste. Croix-aux-Mines, and exploratory work is to be begun early in 1921.

The Alsatian deposits have been recently described by Hoyt S. Gale.[10]

[9] Econ. Rev., vol. 3, No. 7, p. 134, 1920.
[10] Gale, H. S., The potash deposits of Alsace: U. S. Geol. Survey Bull. 715, pp. 17-55, 1920.

OTHER COUNTRIES.

Although the bulk of the potash salts consumed in the world are produced in Germany and France, a number of other countries produce small quantities, imports into the United States having come from 35 countries in 1920. Some of this most probably consisted of reshipments of French and German material, such as that reported from Belgium, Holland, England, and Canada, which produce practically no potash salts from native raw materials. Potassium bitartrate is imported from a number of grape-growing countries; potassium carbonate, including crude or black salts, is made from wood and plant ashes in many countries; and small quantities of potassium nitrate are also made in many places.

India.—The potassium nitrate industry of India is an old one, and a small importation into the United States of other potash salts than the nitrate was made in 1919 and 1920.

Saltpeter (potassium nitrate) produced in India, 1913–1920.[a]

Year.	Quantity (long tons).	Value.	Year.	Quantity (long tons).	Value.
1913	14,462	£200,803	1917	21,284	£527,666
1914	15,489	272,462	1918	24,741	589,190
1915	18,098	373,891	1919 [b]	17,550	471,247
1916	25,056	607,488	1920	(c)	(c)

[a] The mineral industry of the British Empire and foreign countries—War period, Nitrates, p. 17, Imperial Mineral Resources Bureau, 1920.
[b] Information furnished by Director of India Geol. Survey.
[c] Information not yet available.

Chile.—Several of the nitrate works of Chile are now producing and marketing potassium nitrate.

Japan.—Comparatively little potash was received from Japan during 1920. The potassium chloride, chlorate, permanganate, and nitrate imported into the United States from Japan during the war period were derived from kelp, and the carbonate from the ashes of leaves of the paulownia tree.[11]

Spain.—Potash deposits were discovered a few years ago in the Province of Barcelona, Spain, but thus far no production has been reported from this source. It has been stated that these mines have been placed in German hands for exploitation.[12] The location and extent of the Spanish deposits have been recently described by Gale.[13]

Abyssinia.—The potash deposits in northeastern Abyssinia,[14] about 6 miles from the Eritrean frontier and about 46 miles from the Red Sea port of Mersa Fatimari, are reached by a narrow-gage railway. An Italian company, the Società mineraria coloniale, of Asmara, Eritrea, is working the deposits. Operations have been active since 1915, but the quantity taken out in any one year has not amounted to 4,000 tons. The material as mined is said to be high-grade potassium chloride. The reserves are estimated at 1,000,000 metric tons.

[11] Information furnished by an importer.
[12] Oil, Paint, and Drug Reporter, vol. 97, No. 23, p. 28, 1920.
[13] Gale, H. S., The potash deposits of Spain: U. S. Geol. Survey Bull. 715, pp. 1–16, 1920.
[14] Commerce Repts., June 10, 1920, p. 1438.

Galicia.—A new company has been formed to exploit the potash deposits near Kalusz, Galicia, which were worked in a small way in former years by the Austrian Government.[15]

Russia.—Beds of potash salts are said to have been discovered in the Government of Perm, Russia, but they have not been exploited.[16] Carbonate of potash, made from the ashes of wood and sunflower stalks, has been made in Russia for a number of years.

Tunis.—No information is available concerning the production of potash in 1920 from the lakes near Gaza, Tunis, but even at the time of their exploitation during the war the establishment of a permanent industry was not anticipated.

Italy.—The alunite deposits of the Tolfa Hills, Italy, northeast of Civita Vecchia, have been worked for centuries as a source of potash alum.[17] The quantity of alunite from these deposits utilized from 1913 to 1918, inclusive, averaged about 4,000 metric tons a year.

Canada.—Early in 1920 the discovery of potassium salts was reported at the rock salt mines at Malagash, Cumberland County, Nova Scotia. The Canada Geological Survey[18] states that lenses 6 or 7 inches in diameter in the rock salt were found to contain as high as 50 per cent of potash (K_2O). So far as examined the occurrence is small.

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[15] Commerce Repts., Feb. 24, 1920, p. 1098.
[16] Commerce Repts., Sept. 24, 1920, p. 1399.
[17] The world's supply of potash, p. 37, London Imperial Institute, 1915. Rivista del servizio minerario nel 1918, p. cxxxix.
[18] Personal communication.

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June 9, Manufacture of potash begun in Norway.
June 10, Mining industry of Abyssinia.
June 18, Estimated future production of potash in Alsace.
July 16, Potash production of Alsace.
July 22, Railways in the Aden, Red Sea, district.
Aug. 2, Unfavorable outlook for the German potash industry.
Aug. 16, German-French potash negotiations.
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SODIUM COMPOUNDS.

By Roger C. Wells.[1]

SALES.

The year 1920 was a good one for most sodium compounds, whether the comparison is made by tons or by dollars.

Sodium compounds sold in the United States, 1917–1920.

Year.	Quantity (short tons.)	Value.
1917	10,123,322	$130,694,458
1918	9,997,310	134,594,154
1919	9,166,581	118,836,347
1920	9,774,289	138,607,384

The approximate constancy in these figures from year to year is due in large part to the inclusion of sodium chloride, the fundamental sodium compound from which most of the others are made. Sodium bichromate, sal soda, sodium carbonate monohydrate, sodium ferrocyanide, sodium iodide, and thiosulphate are among those that show decreases in 1920. Most of the other compounds made good advances over 1919, and sodium bicarbonate, bisulphite, phosphate, and borax made new records.

Sodium compounds sold in the United States, 1919 and 1920.

Product.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Sodium acetate	823	$121,167	1,080	$149,287
Sodium benzoate	126	230,224	201	365,841
Sodium bicarbonate	134,962	3,486,635	188,906	4,256,715
Sodium bichromate	26,526	6,233,566	25,973	5,531,954
Sodium bisulphite	[a]11,819	[a]687,750	22,059	1,028,373
Sodium bromide	499	493,319	543	523,724

[1] The statistics of production in this report were prepared with the assistance of Miss E. A. Menaugh, of the United States Geological Survey. The present report differs from those of previous years in two respects. First, in order to avoid needless repetition, matter that is nearly or altogether the same from year to year, such as formulas, uses, methods of manufacture, and lists of producers of the various compounds, has been omitted. For these features the report for 1919 should be consulted. Second, with the one exception of common salt, there have also been omitted from the figures of production all data referring to material consumed by the companies producing it, and the 1919 figures given for comparison with those of 1920 have been made strictly comparable on this basis. Statistical tables on imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

[a] Includes sodium sulphite.

Sodium compounds sold in the United States, 1919 and 1920—Continued.

Product.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Sodium carbonate:				
Soda ash	981,054	$29,895,343	1,238,149	$38,908,726
Monohydrate	31,278	714,930	2,267	115,256
Trona			10,609	343,911
Sal soda	80,090	2,229,994	62,857	2,128,937
Sodium chloride (common salt):				
Salt in brine	2,850,639	1,423,424	2,819,916	1,834,397
Rock salt	1,639,973	6,224,920	1,610,189	7,048,315
Evaporated salt	2,392,290	19,426,350	2,409,924	21,011,363
Sodium citrate, tartrate, and bitartrate	33	58,128	44	67,115
Sodium cyanide, peroxide, and nitrate (refined)	17,188	5,331,123	8,633	3,415,085
Sodium ferrocyanide	3,437	1,346,285	2,930	1,318,049
Sodium fluoride	674	168,960	934	210,782
Sodium fluosilicate	(a)	(a)	719	143,800
Sodium hydroxide	311,388	20,091,978	382,680	25,894,641
Sodium iodide	12	86,985	11	76,441
Sodium nitrite	1,182	265,121	1,197	405,184
Sodium phosphate	14,760	1,733,996	30,515	3,233,896
Sodium silicate	300,138	5,879,628	304,503	5,751,088
Sodium sulphate:				
Salt cake	129,042	2,019,460	178,770	2,049,102
Glauber's salt	47,730	877,060	50,655	990,541
Niter cake	83,402	271,424	308,638	788,544
Sodium sulphide	45,448	2,645,181	42,952	2,962,033
Sodium sulphite	(b)	(b)	3,778	197,782
Sodium tetraborate (borax)	28,518	4,351,891	35,281	5,674,012
Sodium thiosulphate	32,212	1,709,223	24,868	1,290,697
Miscellaneous sodium compounds	1,338	832,282	4,508	891,793
	9,166,581	118,836,347	9,774,289	138,607,384

[a] Included in miscellaneous compounds. [b] Included in sodium bisulphite.

PRICES.

The prices obtained for sodium compounds in 1920 were generally better than those in 1919, although the prices of most of the salts fell toward the end of the year to about the levels they had at the beginning. Jobbers' prices appeared to be an accurate index of the consumers' demands. Sodium sulphate was in especial demand in 1920 on account of foreign bids, and at the end of the year it sold at a slightly higher price than it had reached in recent years. The price of sodium bichromate was, for about a month, higher than it was during the World War, but it fell abruptly later in the year. In fact, the prices of this compound and of sodium chlorate, cyanide, ferrocyanide, nitrate, and nitrite fell lower than they had been for several years. The New York chemical market was not as broad before the war as it is to-day, and quotations were not as generally published then as now, but so far as comparisons are possible most present prices are not yet apparently at pre-war figures; in fact, pre-war prices are not to be expected as long as the cost of coal, labor, and transportation is so much above the level of 1913. The fluctuations of some prices from year to year, however, are greater than the variation of most prices from those of 1913.

IMPORTS.

The following table gives the imports of sodium compounds in 1920 and affords a comparison with those in 1919. Sodium nitrate and nitrite are the only compounds whose imports exceed the domestic production; moreover, the imports of sodium nitrate, which vastly exceed those of any other compound, increased notably in 1920.

Sodium salts imported into the United States for domestic consumption in 1919 and 1920.

Salt.	1919		1920	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.
Sodium arsenate			15,976	$1,481
Sodium benzoate	68,566	$14,435	33	17
Sodium bicarbonate [a]	17,122	3,616	5,828	593
Sodium carbonate:				
Soda ash	829,266	12,998	1,515,278	37,161
Monohydrate and sesquicarbonate			3,342	106
Sal soda	45,060	1,182	4,796	577
Sodium chlorate	39,022	3,814	561,513	50,266
Sodium chloride (common salt)	119,028,200	242,704	275,308,200	676,499
Sodium cyanide	5,174,831	305,426	7,590,495	1,091,443
Sodium ferrocyanide (yellow prussiate of sodium)	1,299,521	218,222	2,201,662	400,873
Sodium hydroxide or caustic soda	42,724	6,888	97,798	11,970
Sodium nitrate	912,932,160	19,558,963	2,961,038,080	63,121,035
Sodium nitrite	2,550,779	246,729	11,690,142	1,378,992
Sodium phosphate	56	22	66	19
Sodium silicate	931,086	25,421	658,658	15,162
Sodium sulphate, crude, or salt cake and niter cake			230,720	2,833
Sodium sulphate crystals, or Glauber's salt			2,240	36
Sodium sulphide	1,668,562	54,251	1,038,181	47,064
Sodium sulphite	58,524	2,376	119,805	5,388
Sodium tetraborate, or refined borax	378	155	30,563	2,451
Sodium thiosulphate, or sodium hyposulphite	27,616	6,312	17,174	11,989
	1,044,713,473	20,703,514	3,262,130,550	66,855,955

[a] Or supercarbonate, or saleratus, and other salts containing 50 per cent or more of sodium bicarbonate.

EXPORTS.

Domestic sodium salts exported from the United States, 1914–1920.

1914 (July 1 to Dec. 31)	$1,320,963	1918	$22,291,735
1915	7,725,034	1919	18,545,420
1916	17,571,439	1920	27,191,439
1917	23,384,969		

Domestic sodium salts exported from the United States, 1919 and 1920, by varieties.

Salt.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Sodium bicarbonate			10,321	$616,261
Sodium carbonate:				
Soda ash	50,481	$2,656,608	83,381	4,689,591
Sal soda	5,563	178,285	6,015	220,487
Sodium chloride (common salt)	119,416	1,396,625	139,272	1,901,593
Sodium hydroxide	82,118	6,748,762	112,069	10,944,017
Sodium silicate	12,150	338,818	17,048	450,770
Sodium tetraborate (borax)			7,163	1,206,936
All other sodium salts		7,226,322		7,161,784
		18,545,420		27,191,439

Sodium compounds exported from the United States in 1920, by countries.

Country.	Soda ash.		Sodium bicarbonate.		Sodium chloride (common salt).		Caustic soda.		Sodium silicate.		Borax.		All other.	Total value.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.		
Europe:														
Belgium	3,109,693	$89,350	25	$3	600	$16	20,338,231	$1,262,995			462,100	$12,296	$387,881	$1,752,541
Denmark	7,353,078	179,300	112,000	8,456	4,800	150	3,687,877	165,263			56,000	4,760	161,425	519,354
Finland	3,997,211	119,773					112,320	3,932					576	124,281
France	5,907,588	205,244	110,300	5,255	38,140	3,654	2,114,688	200,048			247,640	16,436	552,906	983,543
Germany	3,127,412	89,100	30,000	750	2,051	30	5,501,522	307,671			246,400	20,384	247,328	665,263
Greece	56,100	1,460			112	2	51,250	2,850	14,197	$500			13,740	18,552
Iceland			6,000	140	2,000	77	112	7						224
Italy	21,313,978	566,143	280,200	5,604			21,107,104	971,810	134,400	5,800			311,710	1,861,067
Netherlands	21,778,914	574,412	133,409	11,105			20,187,363	1,128,743			745,630	58,911	324,753	2,097,924
Norway	14,176,547	332,719					1,652,268	78,689					619	412,027
Poland and Danzig					395	19							4,789	4,808
Portugal							2,300	90					6,802	6,892
Rumania			330,636	7,570	274	17	390,519	18,247			29,106	2,416	325	28,575
Russia in Europe			175	20	6,000	96	115,370	5,154					50	5,320
Spain			89,062	3,129	92	8	1,143,134	43,300	3,040	1,223	1,796	226	283,266	331,152
Sweden	22,982,565	673,772	4,480	1,097	778,748	14,366	1,354,271	79,510	1,600	64	22,400	2,000	86,721	857,530
Switzerland							4,229,178	158,284			22,400	1,900	112,751	272,935
Turkey in Europe	1,077,726	26,719	4,572	210	4,720	118	1,842,720	92,002			14,099	1,660	1,729	122,438
United Kingdom:														
England	665,721	24,500	87,500	11,683	227,600	1,226	2,281,609	111,414	23,752	1,472	1,181,763	93,971	713,189	957,455
Scotland							12,120	606					35,660	36,266
North America:														
Bermuda	1,050	28	3,896	143	138,221	1,697	240	24			690	107	1,342	3,341
British Honduras	172	8	3,908	234	300,285	3,404					700	124	481	4,251
Canada	21,659,814	628,647	5,064,582	131,650	182,799,386	959,451	9,334,443	373,624	30,013,173	319,895	2,901,446	234,453	1,533,562	4,181,282
Central American States:														
Costa Rica	10,070	306	59,582	1,964	438,134	4,995	150,610	7,319	61,788	1,670	9,049	1,022	13,247	30,523
Guatemala	1,275	33	49,420	1,878	132,098	2,219	28,376	1,852			2,498	264	1,750	7,996
Honduras	24,313	704	8,761	375	2,641,512	23,022	163,711	8,647	45,546	1,443	770	132	34,440	68,763
Nicaragua	24,324	1,359	28,050	1,114	566,838	8,908	154,514	11,487	9,708	287	6,231	693	16,046	39,894
Panama	149,874	5,709	45,865	1,659	3,137,777	36,457	182,483	9,308	94,094	3,432	6,846	845	10,500	67,910
Salvador	17,114	558	66,700	2,700	2,000	60	69,577	3,859	9,200	261	2,293	227	1,381	9,046
Mexico	3,367,804	86,776	2,248,246	73,519	10,647,691	130,022	11,390,153	557,120	938,843	31,874	555,933	69,328	1,024,741	1,973,380
Miquelon, Langley, etc			720	22	1,520	42							83	147
Newfoundland and Labrador	350	10	862	62	879,888	7,660	15,334	1,240	248	8	405	41	5,737	14,758

West Indies:														
British:														
Barbados	1,050	39	54,682	1,534	1,450	26	4,128	252	....	....	50	6	4,133	5,990
Jamaica	2,122	75	112,457	4,873	78,503	1,405	19,250	1,284	525	15	1,749	199	12,519	20,370
Trinidad and Tobago	2,250	44	12,305	375	15,908	445	11,796	939	3,500	122	523	53	1,758	3,736
Other British	1,200	28	22,439	1,261	10,551	330	8,131	350	....	....	1,370	161	9,075	11,205
Cuba	11,575,229	304,290	4,986,801	130,891	62,569,363	519,224	9,160,555	406,064	714,870	18,093	640,530	50,791	98,618	1,527,971
Dominican Republic	94,360	3,506	125,889	4,760	348,192	7,151	298,824	18,961	34,429	859	33,025	3,116	4,862	43,215
Dutch	5,549	231	5,415	320	....	....	3,105	179	90	4	1,963	237	632	1,603
French	....	....	14,831	453	8,539	367	12,678	875	548	52	1,538	164	10,714	12,625
Haiti	2,272	88	74,386	2,394	12,804	529	6,025	220	....	....	4,994	532	1,288	5,051
Virgin Islands of the U. S.	13,350	550	7,860	272	10,080	228	26,120	1,507	175	6	2,392	286	1,943	4,792
South America:														
Argentina	6,674,854	270,117	185,373	5,665	143,035	4,504	15,453,785	810,161	201,498	5,539	10,125	934	79,900	1,176,820
Bolivia	....	....	5,085	206	1,575	13	39,050	3,411	....	....	3,696	474	4,397	8,501
Brazil	1,146,277	39,430	253,694	8,239	3,831	217	15,436,132	883,865	194,318	6,833	76,679	7,972	114,267	1,060,823
Chile	67,420	3,296	73,093	2,709	20,386	647	720,892	35,599	67,533	1,734	108,147	9,708	120,817	174,510
Colombia	1,034,700	29,779	208,188	7,547	75,933	1,244	565,655	33,158	200,393	8,162	25,030	2,902	46,099	128,891
Ecuador	6,520	353	40,357	1,274	1,700	22	105,250	4,521	53,520	1,981	3,856	483	2,140	10,774
Guiana:														
British	1,034	33	31,505	972	9,739	373	3,000	210	....	....	....	....	2,207	3,795
Dutch	1,932	72	4,800	112	13,500	215	13,780	901	10,500	238	225	30	193	1,761
French	....	....	1,036	32	11,112	344	....	....	....	....	....	....	....	376
Paraguay	....	....	880	52	....	....	3,600	126	....	....	....	....	....	178
Peru	113,254	2,993	228,110	6,414	1,920	60	500,892	22,674	2,290	78	24,136	2,279	8,944	43,442
Uruguay	87,679	3,888	3,423	195	54	2	1,667,008	99,223	136,297	4,124	2,271	213	4,847	112,492
Venezuela	424,539	10,002	298,270	11,942	1,049	20	395,757	22,685	460,975	15,004	11,239	1,082	19,439	80,174
Asia:														
China	46,118	1,924	125,095	2,971	46,488	3,097	767,373	28,498	306,128	7,828	268,700	31,908	48,692	124,918
Kwantung, leased territory	....	....	....	....	4,400	425	20,300	979	63,500	1,532	....	....	559	3,495
Chosen	....	....	....	....	6,802	192	140,250	6,732	2,907	86	8,000	800	205	8,015
East Indies:														
British:														
British India	12,400	423	4,272	140	6,169	634	1,112,723	51,025	31,912	930	124	15	68,333	121,500
Straits Settlements	....	....	....	....	1,458	148	41,677	2,009	....	....	....	....	885	3,042
Other British	....	....	....	....	2,776	207	....	....	....	....	....	....	708	915
Dutch	1,073,560	32,870	97,006	3,532	16,134	1,407	4,481,616	216,303	1,400	80	....	....	7,156	261,348
French	....	....	....	....	120	14	....	....	....	....	....	....	10,710	10,724
Portuguese	....	....	....	....	....	....	....	....	....	....	....	....	187	187
Hongkong	59,000	1,494	4,848	163	15,569	1,049	107,316	5,185	87,493	2,974	3,360	403	18,494	29,762
Japan	12,214,683	334,560	4,443,730	133,266	8,571,850	66,622	59,140,600	2,388,155	42,880	1,170	6,550,809	567,213	405,478	3,896,464
Russia in Asia	....	....	11,254	327	96,529	3,279	513,523	17,707	....	....	....	....	110	21,423
Siam	....	....	3,360	300	3,044	196	....	....	....	....	....	....	100	596
Turkey in Asia	....	....	....	....	176	12	....	....	....	....	....	....	8,075	8,087

Sodium compounds exported from the United States in 1920, by countries—Continued.

Country.	Soda ash.		Sodium bicarbonate.		Sodium chloride (common salt).		Caustic soda.		Sodium silicate.		Borax.		All other.	Total value.
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.		
Oceania:														
British:														
Australia	79,690	$2,035	800	$42	1,155,704	$29,652	2,505,832	$144,409	7,795	$627	300	$90	$225,436	$402,291
New Zealand	78,900	1,457	11,541	1,174	1,932,538	43,065	319,245	14,110					84,410	144,216
Other British					24,949	679								679
French			13,711	516	295,672	4,111	21,728	1,318					3,115	9,060
Other					13,430	280								280
Philippine Islands	1,137,938	39,313	400,117	10,806	252,593	11,256	2,047,775	72,672	120,477	4,770	18,806	2,205	32,815	173,837
Africa:														
Belgian Kongo					3,143	95	907	72					23	190
British Africa:														
West					2,274	28							1,948	1,976
South	1,030	71			100	2	569,631	30,772			5,009	457	22,771	54,073
East					700	21							267	288
Canary Islands			6.240	166	96	4	4,000	290					30	490
Egypt			336	17			224,100	8,403					3,136	11,556
Liberia			61	7	302	14					96	16	56	93
Morocco											100	11	250	261
Portuguese Africa					1,216	22	50,000	3,118						3,140
	166,761,603	4,689,591	20,642,201	616,261	278,544,338	1,901,593	224,137,406	10,944,017	34,095,542	450,770	14,325,037	1,206,936	7,382,271	27,191,439

Foreign sodium salts reexported from the United States, 1915-1920.

Year.	Sodium chloride (common salt).		Sodium cyanide.		Sodium nitrate.		All other sodium salts.
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Value.
1915	52	$31,841	949	$347,079	25,472	$1,123,761	$40,358
1916	7,448	61,525	111	58,265	60,079	3,432,273	193,086
1917	1,900	21,830	138	115,067	78,152	5,367,281	25,632
1918	723	13,903	(a)	145	61,271	5,204,413	73,402
1919	457	7,992	....	....	15,314	1,299,563	388,943
1920	418	6,252	78	12,123	21,593	1,448,226	98,386

a 125 pounds.

NOTES ON THE PRODUCTION OF NATURAL SALTS.

Sodium chloride is the principal salt derived directly from natural sources, as is evident from the figures in the table on page 123. The other salts so derived are sodium carbonate, sodium sulphate, trona, and borax. The sales of these four salts in 1920, however, made a record and amounted to 42,683 short tons, valued at $1,513,179, as compared with 29,120 tons, valued at $874,083, in 1919. These salts came chiefly from California and in part from Wyoming. Soda ash, sodium bicarbonate, and trona were obtained from the water of Owens Lake, Calif.; sodium sulphate from Soda Lake, in San Luis Obispo County, Calif., and the Gill Lakes, in Wyoming; and borax and trona from Searles Lake, Calif.

Owing to the continued diversion of the water of Owens River to the Los Angeles aqueduct the level of Owens Lake is falling, with accompanying concentration of the water in consequence. In 1912 the specific gravity of the lake water was 1.085; in March, 1919, it was 1.121; and in October, 1920, it was 1.232. This change will assist the three alkali companies operating at Owens Lake by reducing the preliminary solar evaporation needed, but it has forced the California Alkali Co. repeatedly to extend its intake pipe farther into the lake, as the slope at the south end of the lake is very gradual. It is to be expected that a winter crop of trona and sodium sulphate will form each year from the denser water, and it remains to be seen just what the final result of these changes will be.

According to an article in Chemical and Metallurgical Engineering, April 20, 1921, Wrinkle & Kuhnert, of San Francisco, were planning to start an experimental plant at Owens Lake for obtaining borax and potassium chloride from the mother liquor left after the removal of sodium bicarbonate from the lake water. This same article describes the various plants at Owens and Searles lakes.

Operations at Searles Lake were active in 1920, with four principal companies engaged. The American Trona Corporation made principally potassium chloride and borax. This company also shipped a small quantity of trona and salt. The Solvay Process Co. made only potassium chloride but carried on investigations on the separation of the various salts occurring in the brine. The American Trona Corporation does not employ solar evaporation, and consequently its fuel costs have been very high. The other plants at Searles Lake depend more or less on solar evaporation. In fact the latest operator, G. B. Burnham, is using a process based on solar evaporation entirely. This process is covered by a number of patents involving the separation of the various salts at different temperatures. The distinctive feature of the process, however, is the diurnal shifting of the various solutions undergoing treatment from shallow to deep ponds. Evaporation is brought about in shallow ponds during the day, or cooling at night, and the temperatures so obtained are conserved in deep ponds when desired. The West End Chemical Co. practically completed its plant in 1920, intending to make borax and potassium chloride.

As is well known all our borax with the exception of that made at Searles Lake is made from colemanite. The Pacific Coast Borax Co. is the largest producer. The colemanite ore shipped from the mines in 1920 and the borax made at Searles Lake amounted to 120,320 short tons, valued at $2,173,000, compared with 66,146 tons, valued at $1,380,000, in 1919.

Early in 1921 a new deposit of colemanite was discovered in Callville Wash in the Muddy Mountains, Clark County, Nev. This deposit is said to be a very large bed of good quality, favorably situated for mining. It is about 19 miles from the Salt Lake branch of the Southern Pacific Railroad and about 8 miles from Colorado River. The colemanite-bearing bed is lenticular and lies between limestones, in a succession of Tertiary sandy and shaly beds now considerably tilted. These beds were probably formed from ancient springs. Control of this deposit is said to have been acquired by F. M. Smith, whose activities in the borax industry are well known. It is reported that shipments of colemanite from this deposit are to begin at once.

Some development work was reported in 1920 by the Death Valley Borax Co. on its deposits of colemanite at Furnace Creek, in the Death Valley region, Calif. The president of this company was formerly manager of the Russell Borate Mining Co., which operated at Frazier Mountain, Ventura County, Calif., before its property was sold to the Stauffer Chemical Co. of San Francisco.

Prospecting for sodium sulphate was actively carried on in 1920, and there were reported developments of deposits near the Great Salt Lake, Utah, in Dona Ana County, N. Mex., in the Verde Valley, Ariz., and near the Salton Sea, Calif. In most of these localities the sodium sulphate either occurs or is obtained in the form of Glauber's salt, and considerable experimentation has been made to devise a cheap method of converting it into the anhydrous salt, or salt cake, for shipping, but so far no process appears to have solved the problem with entire satisfaction. The cost of desiccation must be extremely low for the natural salt to compete with chemical salt cake. In Soda Lake, Calif., the Glauber's salt is naturally desiccated in thin layers by solar evaporation, but this form of desiccation is not effective in thick layers as a practicable chemical process.

One reason for the increased demand for sodium sulphate in 1920 was the inability of Swedish paper manufacturers to obtain European supplies sufficient for their needs. Moreover, there are 19 firms in the United States making wood pulp by the so-called sulphate process. This process uses sodium sulphate in making sodium sulphide, which is one of the active chemicals in the process, the other being sodium hydroxide. Salt cake for this process should be ground and should contain at least 95 per cent of anhydrous sodium sulphate. The sodium chloride content should not exceed 2 per cent. The requirements of sodium sulphate for this process are estimated at about 40,000 tons annually in the United States, and roughly the same quantity for Canada, and about 50,000 tons for Sweden and Norway combined. The consumption of pulp wood in the United States in 1920 exceeded all previous records by nearly 12 per cent.

Deposits of sodium sulphate of varying extent have been reported at many places in the Western States. The deposits in the form of Glauber's salt at the Great Salt Lake, Utah, lie under the sand and above an impervious clay along the southern shore of the lake and may represent a winter crop of crystals from the lake which was covered with sand and is protected from redissolving by the impervious clay.

Similar deposits have been reported near the Salton Sea, in southern California.

The deposit about 4 miles north of Squaw Peak, west of Verde River, in Arizona, is anhydrous sodium sulphate. It covers several acres to a depth of possibly 50 feet and therefore represents a large available tonnage.

The deposit in Dona Ana County, N. Mex., lies about 25 miles west of Valmont, between the San Andres Mountains and the white gypsum sands that occupy the central part of the valley west of the railway. The sodium sulphate is concentrated in the lowest part of the flat, mixed with gypsum. The water that rises to the surface in open pits is practically saturated with sodium sulphate, and Glauber's salt may be obtained from it on cooling. This brine is much purer than that from many saline lakes, which carry sodium sulphate as a prominent constituent.

An alkali lake near Juniper Mountain, Lake County, Oreg., is reported to contain about 400,000 tons of sal soda segregated in "pot holes," and a larger quantity of distributed low-grade soda. At present this deposit is about 65 miles from the nearest railroad at Lakeview, and consequently it has not been worked on a large scale.

Low-grade deposits of soda carrying about 20 per cent of carbonate and bicarbonate have long been known in Mexico and Peru, but they are said to be less extensive than those of North America and Africa.

Although deposits of sodium borate and sodium sulphate at the foot of the Andes in Argentina are worked to some extent, both borax and sodium sulphate are imported into Argentina. So far no soda ash or caustic soda has been manufactured from salt in Argentina, as the cost of both salt and electric power has been too high. Sodium carbonate, hydroxide, and silicate head the list of sodium compounds imported, whereas sodium nitrate comes fourth, in striking contrast to the order in the United States.

Some "local natural soda" occurs in Burma as a white efflorescence on the ground carrying from 37 to 50 per cent of sodium carbonate. It has been proposed to use this material in manufacturing caustic soda at Moulmein, in southeastern Burma.

PATENTS.

The patents reviewed briefly in the following notes do not include all those issued in 1920 that refer to sodium compounds, but only those that appear to be important chemically or with reference to the utilization of natural deposits.

United States patent 1334179, dated March 16, 1920, to A. W. Smith and W. R. Veazey, is based on the electrolysis of a mixture of 64.4 per cent of sodium carbonate and 35.6 per cent of sodium chloride for making metallic sodium. This mixture melts at a lower temperature than either of its constituents. Sodium has heretofore been made chiefly by the electrolysis of melted sodium hydroxide.

United States patent 1319128, dated October 21, 1920, to J. R. Watson and W. Hirschkind, claims the preparation of sodium sesquicarbonate by the addition of solid $NaHCO_3$ to a solution containing Na_2CO_3 (such as a natural alkali brine) at a temperature above 45° C., followed by cooling.

Canadian patent 202312, dated July 27, 1920, to Toranoske Nishigawa, relates to the separation of ammonium chloride from Solvay process mother liquor, which is accomplished by adding sodium chloride, cooling, and then adding ammonia. The idea is to convert the ammonia, and incidentally the chlorine, into a salable product instead of recovering the ammonia with lime and discarding calcium chloride. The process presupposes a fresh source of ammonia.

United States patent 1329652, dated February 3, 1920, to J. C. Clancy, covers the preparation of sodium cyanide by extraction from cyanidized briquets with liquid ammonia. The briquets are formed of soda, carbon, and a catalyst such as iron, manganese, or nickel. No ferrocyanide is produced, and the solvent contains practically pure sodium cyanide.

United States patent 1352175, dated September 7, 1920, to J. C. Clancy, covers the manufacture of sodium cyanide from barium cyanide (made by heating barium carbonate, carbon, and catalytic material in nitrogen or producer gas) by means of fusion with sodium carbonate, extraction with water, and recovery of the barium carbonate.

United States patent 1332439, dated March 2, 1920, to H. Foersterling, H. Philipp, and R. N. Sargent, assigned to the Roessler & Hasslacher Chemical Co., describes apparatus for making sodium cyanide from charcoal, sodium, and nitrogen.

United States patent 1354561, dated October 5, 1920, to C. B. Jacobs, specifies the use of a coking coal and sodium carbonate in making sodium cyanide.

A new method of making caustic soda is disclosed in United States patent 1351693, dated August 31, 1920, to S. S. Sadtler, which involves the following reactions:

$$2Na_2HPO_4 + 2Ca(OH)_2 = 4NaOH + Ca_2H_2(PO_4)_2$$
$$2Na_2HPO_4 + 3Ca(OH)_2 = 4NaOH + Ca_3(PO_4)_2 + 2H_2O$$

After separation of the sodium hydroxide solution from the insoluble calcium phosphate, it is proposed to recover the disodium phosphate by treating the dicalcium phosphate with sodium sulphate or the calcium phosphate with niter cake.

United States patent 1354649, dated October 5, 1920, to W. C. Holmes, covers the preparation of acid liquor from niter cake by treating it on the countercurrent principle with water until a liquor of 20 to 30 per cent of acidity is obtained.

The separation of Glauber's salt removes so much water of crystallization from a solution that it has been made the basis of United States patent 1330016, dated February 3, 1920, to G. T. Walker, as a method of concentrating certain brines.

United States patent 1343443, dated June 15, 1920, to F. A. Freeth and H. E. Cocksedge, covers the precipitation of glauberite by the addition of $CaSO_4$ to solutions saturated with sodium sulphate.

United States patent 1321282, dated November 11, 1919, to G. B. Burnham, covers the separation of $KNaSO_4$ from certain natural brines, such as that of Searles Lake, on the addition of Na_2SO_4.

United States patents 1328416, 1328417, and 1328418, dated January 2, 1920, to the same inventor, describe methods of separating the various salts found in the brine of Searles Lake.

United States patent 1338234, dated April 27, 1920, to P. C. McIlhiney, describes the preparation of potassium chlorate from natural brines, after the less soluble salts have been removed, by the addition of other chlorates or chlorine.

United States patent 1343400, dated June 15, 1920, to H. W. Morse, describes a method of separating the salts in Searles Lake brine. The brine is evaporated to a density such that the remaining liquor will dissolve all the KCl and borax when the materials are heated to 90°–100° C. The materials are heated to 90°–100° C. and, after separation of the solution, the dissolved salts are precipitated by cooling.

United States patents 1349445, 1349446, 1349449, dated August 10, 1920, to C. Sundstrom, relate to the treatment of Searles Lake brine. The methods specified include chilling, evaporation by solar heat, evaporation by artificial heat, and acidification with SO_2, trona, or alum; also melting hydrated salts, such as sal soda, to form anhydrous salts and solutions, and appropriate separations of the various salts and solutions.

United States patent 1349134, dated August 10, 1920, to K. J. Jacobi, covers acidification of Searles Lake brine with hydrochloric acid, preliminary to evaporation and the separation of borax.

United States patents 1350089 and 1350090, dated August 17, to N. Wrinkle and W. A. Kuhnert, cover the addition of caustic soda for the purpose of converting the borax into metaborate in order to keep it in solution while the other salts are crystallized and the use of sulphuric acid to form H_3BO_3.

MISCELLANEOUS NOTES.

The Atmospheric Nitrogen Corporation, organized as a subsidiary of the Allied Chemical & Dye Co., has erected a $2,500,000 plant at Syracuse, N. Y., for the production of hydrogen from water gas. The carbon monoxide of the water gas is to be oxidized to carbon dioxide and used in the Solvay process, as noted briefly in the chapter on sodium compounds in Mineral Resources for 1919. The hydrogen and nitrogen remaining are to be combined by a catalytic Haber process to form ammonia, which is required in the process or which will be available for other uses. The unit so far constructed will be studied and improved, and other units will be added if found desirable.

Instead of using calcium cyanamide directly as a fertilizer, the proposal has been made to use its ammonia in the Solvay soda process and recover the ammonium chloride for fertilizer. The lime required for regenerating ammonia in the soda process would be used in making cyanamide. Other methods of combining the cyanamide process with the Solvay process have been proposed, but none have so far been put into operation.

Recent developments in the Bucher process indicate that carbon soaked with ferric chloride or sulphate when heated in superheated steam yields a catalytic mass which is very effective in making cyanide by this process. The best yield has been obtained from 11.7 parts of iron, 105.4 parts of carbon, and 100 parts of soda ash, according to Ryosaburo Hara and Kwanji Murata.[2]

Sodium fluoride has been found to be a good wood preservative, but at present it can not be made as cheaply as zinc chloride, which is the standard wood preservative.[3]

Several papers dealing with the "Fundamentals of the electrolytic diaphragm cell" by H. K. Moore were published in Chemical and Metallurgical Engineering late in 1920 and early in 1921. J. B. Kershaw described the "Rise and development of the electrolytic alkali and chlorine industry in Europe" in the same journal.

Sodium hyposulphite (Na_2SO_2) is often called sodium hydrosulphite in the trade. It is a strong reducing agent made by the action of zinc on sodium bisulphite and is used in reducing certain dyes, such as indigo, to compounds soluble in water. Fabrics dipped in such solutions absorb the dye, which assumes its normal color on mild oxidation, usually by simple exposure to the air.

Foreign advices show that the Belgian chemical industry in 1920 produced 31,000 tons of soda ash, 2,418 tons of caustic soda, and 40,000 tons of sodium sulphate, quantities very nearly equal to or greater than those produced in 1913.

A new German refractory fire brick is reported as consisting of ordinary fire brick coated with a mixture of 75 per cent of carborundum and 25 per cent of sodium silicate, which is slowly dried and burned on.

The Eastman Kodak Co. lists 47 sodium compounds among its organic chemicals which are valued almost entirely for their organic part; the value of the salts ranges from a fraction of a cent to 20 cents a gram. These compounds are intended chiefly for organic chemical research. Mallinckrodt & Co., Parke, Davis & Co., and Squibb & Co. give similar lists of medicinal sodium compounds.

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[2] Jour. Chem. Industry, Tokyo, vol. 23, p. 135, 1920.

[3] Chem. and Met. Eng., Dec. 8, 1920.

SLATE.

By G. F. Loughlin and A. T. Coons.

GENERAL CONDITIONS.

The general industrial conditions in the slate industry in 1920 were seemingly somewhat better than in the three or four preceding years. Labor was very scarce until November. Wages were generally raised from 10 to 35 per cent and for some work at certain quarries even 100 per cent, though at some quarries wages were the same throughout the year and at others they were raised three times during the year, about 10 per cent each time. There were no general strikes. A few sporadic troubles, which closed quarries for a week or 10 days at a time, were settled by increases in wages. The outlook for better labor conditions in 1921 is said to be very promising. Prices advanced for all slate products from 10 to 30 per cent, or enough to cover advances in labor and coal. The prices of roofing slate were in general reduced during the last quarter of the year.

Nearly all the producers reported that the demand for roofing slate was poor or only fair, especially during the last three months of the year, and that the outlook for 1921 is not very promising.

The demand for mill stock was extremely good, and many orders could not be filled on account of labor and railroad conditions. Demand for mill stock for use in the electrical industry, which began to improve late in 1919, was very good until about November, 1920. The demand for blackboards and for school slates, most of which are exported, was good throughout the year. Structural slate was also in good demand, but the poor demand for roofing slate in eastern Pennsylvania is bringing about a scarcity of structural and blackboard slate, as the two kinds of material are so situated in the quarry that the roofing stock must be removed before the structural stock can be worked. The more extensive use of roofing slate will therefore promote more economical quarrying and so tend to reduce the cost of both roofing and structural slate.

The slate quarrymen realize more and more that much of the success of their business, especially in structural slate, lies in the standardization of the sizes of the products. The method of procedure usually followed has been to quarry and prepare structural slate in sizes specified by builders and architects. The lack of uniformity in design or size prevents the production of material in advance. This condition has led to enforced unemployment in mills and quarries and in serious delays to builders, as the slate quarries can not always produce stock at the time orders are received. To improve these conditions the Structural Slate Co., of Pen Argyl, Pa., which represents several producers of structural slate in the Pennsylvania district, has, through the Structural Service Bureau, proposed standard specifications for structural slate products and has issued illustrated pamphlets showing sizes and shapes of standard parts for structural work. It is hoped that the acceptance of these specifications by associations of architects and builders will aid materially in stabilizing the slate industry.

PRODUCTION.

The value of the slate sold by quarrymen in 1920 was the largest yet recorded for this material, but this fact does not indicate any decided revival in the slate industry as a whole, for the quantity of roofing slate sold was only 8 per cent more than in 1879, the year of the lowest recorded sales (367,857 squares), and 72 per cent less than in 1902, the year of the largest recorded sales (1,435,168 squares). The average value per square, however, was $3.35 in 1879, $3.45 in 1902, and $8.90 in 1920.

The total quantity of mill stock sold in 1920 was an increase of 33 per cent over the quantity sold in 1919, but 24 per cent less than that sold in 1913, the record year.

The slate sold in 1920 was produced at well-established quarries in Maine, Maryland, New York, Pennsylvania, Vermont, and Virginia.

Slate sold in the United States, 1916–1920, by uses.

Year.	Roofing slate.			Mill stock.[a]			Other uses (value).	Total value.
	Number of squares (100 sq. ft.).	Value.	Average value per square.	Quantity (square feet).	Value.	Average value per square foot.		
1916	835,873	$3,408,934	$4.08	5,782,842	$1,177,260	$0.20	$752,643	$5,338,837
1917	703,667	3,411,740	4.85	5,478,151	1,277,249	.23	1,060,977	5,749,966
1918	379,817	2,219,131	5.84	4,841,133	1,498,164	.31	1,123,825	4,841,120
1919	454,337	3,085,957	6.79	7,466,000	1,782,793	.24	1,161,898	6,030,648
1920	396,230	3,524,658	8.90	9,910,000	3,147,281	.32	2,054,503	8,726,442
Percentage of increase or decrease	−12.8	+14.2	+31.1	+32.7	+76.5	+33.3	+76.8	+44.7

a For 1919 and 1920 total output of mill stock is given. Prior to 1919 bulletin, blackboard, and school slate material was included under "Other uses."

Slate sold in United States, 1916–1920, by States.

State.	1916	1917	1918	1919	1920
California	(a)	(a)	(a)		
Maine	$342,474	$322,685	$287,891	$279,274	$450,561
Maryland	71,737	67,938	42,113	71,593	80,789
New Jersey	(a)	(a)	(a)		
New York	21,345	55,207	323,558	450,379	911,293
Pennsylvania	3,124,743	3,306,704	2,304,647	2,885,072	3,850,267
Tennessee		(a)	(a)		
Utah	(a)	(a)	175	400	
Vermont	1,607,901	1,858,307	1,769,987	2,143,648	3,182,477
Virginia	165,483	135,380	109,723	200,282	251,055
Undistributed[b]	5,154	3,745	3,026		
	5,338,837	5,749,966	4,841,120	6,030,648	8,726,442

a Included under "Undistributed."
b 1916: California, New Jersey, and Utah; 1917: California, New Jersey, Tennessee, and Utah; 1918: California, New Jersey, and Tennessee.

Slate sold in the United States in 1919 and 1920, by States and uses.

State.	Number of operators.	Roofing slate.			Structural and sanitary.		Electrical.		Other uses.[a]	Total value.
		Number of squares (100 square feet).	Value.	Average value per square.	Quantity (square feet).	Value.	Quantity (square feet).	Value.	Value.	
1919.										
Maine	3	4,476	$42,851	$9.57	2,454	$1,535	387,767	$234,888		$279,274
Maryland	4	6,483	70,336	10.85					$1,257	71,593
New York	6	3,386	35,138	10.38					415,241	450,379
Pennyslvania	43	269,580	1,679,519	6.23	2,206,697	597,727	302,879	114,933	492,893	2,885,072
Utah	1								400	400
Vermont	31	148,522	1,057,831	7.12	49,621	27,747	611,388	257,975	800,095	2,143,648
Virginia	4	21,890	200,282	9.15						200,282
	92	454,337	3,085,957	6.79	2,258,772	627,009	1,302,034	607,796	1,709,886	6,030,648
1920.										
Maine	3	3,716	51,086	13.75	2,740	2,783	510,599	396,692		450,561
Maryland	3	7,199	79,552	11.05	3,792	1,237				80,789
New York	13	6,607	97,244	14.72					814,049	911,293
Pennsylvania	44	220,366	1,746,026	7.92	2,539,396	878,191	638,557	441,726	784,324	3,850,267
Vermont	32	134,477	1,299,695	9.66	47,635	34,005	801,241	653,351	1,195,426	3,182,477
Virginia	4	23,865	251,055	10.52						251,055
	99	396,230	3,524,658	8.90	2,593,563	916,216	1,950,397	1,491,769	2,793,799	8,726,442

[a] For details see following table of sales of slate by uses.

Roofing slate, mill stock,[a] and slate granules, sold in 1919 and 1920, by uses.

Use.	1919			1920			Percentage of increase or decrease.	
	Quantity.	Value.	Average value per unit.	Quantity.	Value.	Average value per unit.	Quantity.	Value.
Roofing ... squares	454,337	$3,085,957	$6.79	396,230	$3,524,658	$8.90	−12.8	+ 14.2
Approximate equivalent in short tons	153,000			134,000				
Electrical ... square feet	1,302,034	607,796	.47	1,950,397	1,491,769	.76	+49.8	+145.4
Approximate equivalent in short tons	9,000			10,700				
Structural and sanitary, square feet	2,258,772	627,009	.28	2,593,563	916,216	.35	+14.8	+46.1
Approximate equivalent in short tons	17,000			19,500				
Grave vaults and covers, square feet	404,475	81,631	.20	477,239	130,795	.27	+18.0	+60.2
Approximate equivalent in short tons	5,800			6,800				
Blackboards and bulletin boards ... square feet	1,845,687	304,251	.16	2,254,876	385,480	.17	+22.2	+26.7
Approximate equivalent in short tons	13,000			16,200				
Billiard table tops, square feet	349,018	107,471	.31	344,258	140,032	.41	− 1.4	+30.3
Approximate equivalent in short tons	2,500			2,500				
School slates ... pieces	2,445,435	54,635	[b] 22.34	4,302,390	82,989	[b] 19.29	+75.9	+51.9
Approximate equivalent in square feet	1,306,000			2,290,000				
Approximate equivalent in short tons	2,200			4,000				
Granules ... short tons	202,611	1,155,140	5.70	268,516	2,044,942	7.62	+32.5	+77.0
Other ... short tons (estimated)	4,500	6,758		6,500	9,561			+41.5
Total (quantities in short tons)	409,600	6,030,648		468,700	8,726,442		+14.4	+44.7

[a] In 1919 the total mill stock sold, including school slates, was approximately 7,466,000 square feet, valued at $1,782,793; in 1920 it was approximately 9,910,000 square feet, valued at $3,147,281.
[b] Average value per thousand pieces.

Slate sold in Pennsylvania in 1919 and 1920, by counties and uses.

County.	Number of operators.	Roofing slate.			Mill stock.								Other (value).[b]	Total value.
					Structural and sanitary.[a]		Electrical.		Blackboards and bulletin boards.		School slates.			
		Number of squares (100 square feet).	Value.	Value per square.	Quantity (square feet).	Value.	Quantity (square feet).	Value.	Quantity (square feet).	Value.	Number.	Value.		
1919.														
Lehigh and Lancaster	14	22,287	$135,769	$6.09	74,199	$21,670	113,661	$64,823	223,466	$44,932	1,898,872	$31,992	$7,861	$307,047
Northampton	29	247,293	1,543,750	6.24	2,530,585	654,631	189,218	50,110	1,622,221	259,319	546,563	22,643	47,572	2,578,025
	43	269,580	1,679,519	6.23	2,604,784	676,301	302,879	114,933	1,845,687	304,251	2,445,435	54,635	55,433	2,885,072
1920.														
Berks and Lancaster	3	....	....	....	....	....	....	....	....	....	....	....	79,221	79,221
Lehigh	10	18,545	144,996	7.82	38,324	13,170	258,264	176,132	371,397	62,669	3,152,729	62,749	355	460,071
Northampton	31	201,821	1,601,030	7.93	2,971,225	992,230	380,293	265,594	1,880,249	321,462	1,149,661	20,240	110,419	3,310,975
	44	220,366	1,746,026	7.92	3,009,549	1,005,400	638,557	441,726	2,251,646	384,131	4,302,390	82,989	189,995	3,850,267

[a] Includes slate for grave covers and vaults.
[b] In 1919 includes 167,488 square feet of billiard-table material, valued at $45,417, and in 1920, 266,258 square feet of billiard-table material, valued at $108,033.

IMPORTS AND EXPORTS.[1]

IMPORTS.

Value of slate imported for consumption in the United States, 1916–1920.

1916	$2,200	1919	$691
1917	1,024	1920	4,512
1918	321		

EXPORTS.

Value of roofing slate exported from the United States, 1916–1920.

1916	$27,630	1919	$55,164
1917	27,113	1920	122,105
1918	65,224		

Value of roofing slate exported from the United States, 1919 and 1920, by countries.

Country.	1919	1920
Canada	$13,774	$91,992
Newfoundland and Labrador	34	
Mexico	1,934	1,951
Honduras	8	8
Nicaragua		19
West Indies:		
Bermuda	1,060	
Cuba	1,116	5,858
Dominican Republic	51	
Jamaica		2,510
Trinidad and Tobago	998	1,485
Panama	1,745	609
Argentina		160
Brazil		293
Colombia	545	454
Peru		350
England	15	10,329
Greece	39	
New Zealand		6,047
Australia	3,766	
British South Africa	79	
China		40
	55,164	122,105

The following figures for exports of slate other than roofing were collected by the United States Geological Survey from shippers of the products named. Some slate was also exported for structural use, but the Survey was unable to obtain the complete figures. It is understood that the greater part was material shipped to Canada.

[1] The figures of imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Slate other than roofing exported in 1919 and 1920, by destination.

Destination.	Electrical.		Structural.		Blackboards.		Billiard tables.		School slates.		Total value.
	Quantity (square feet).	Value.	Quantity (square feet).	Value.	Quantity (square feet).	Value.	Quantity (square feet).	Value.	Quantity (cases).[a]	Value.	
1919.											
Canada	12,646	$7,555	(b)	(b)	33,401	$7,259	b 2,001	b $1,031			$15,845
Mexico	2,280	1,527					1,145	343	28	$286	2,156
Central America	140	93					468	140			233
West Indies	3,760	2,525					2,529	759	1,000	9,980	13,264
South America	6,200	4,153					5,171	1,551	4,405	44,035	49,739
Europe	2,659	1,896			1,440	346	62	19			2,261
Africa	620	415							2,509	25,039	25,454
Oceania	2,240	1,500					39	12	4,821	48,091	49,603
Asia	10,940	7,327					97	29	1,000	9,980	17,336
	41,485	26,991	(b)	(b)	34,841	7,605	b 11,512	b 3,884	13,763	137,411	175,891
1920.											
Canada	10,738	8,752			(c)	(c)	c 21,893	c 5,949	3,016	28,379	43,080
Mexico	2,120	1,738					292	146	2,151	26,223	28,107
Central America	680	558					1,607	745			1,303
West Indies	6,580	5,395					2,684	1,211	248	3,023	9,629
South America	6,440	5,282					4,445	2,032	8,231	82,636	89,950
Europe	2,280	1,859							139	1,567	3,426
Africa	2,900	2,376							6,431	53,692	56,068
Oceania	6,500	5,332					1,281	576	6,252	57,438	63,346
Asia	15,800	12,956					120	67	7,763	68,332	81,355
	54,038	44,248	(d)	(d)	(c)	(c)	c 32,322	c 10,726	34,231	321,290	376,264

a Cases weigh from 130 to 165 pounds each; average is 135 pounds.
b Structural slate included under slate for billiard tables.
c Blackboard slate included under slate for billiard tables.
d Data on structural slate not collected for 1920.

Slate imported into Canada in 1916–1919.[a]

	1916	1917	1918	1919
Roofing slate	[b]$21,335	[b]$20,785	[b]$47,975	[b]$27,623
School writing slate	35,887	40,603	41,122	46,342
Slate pencils	11,309	8,717	10,361	10,059
Slate of all kinds and manufactures of	28,245	36,788	33,596	58,953
	96,776	106,893	133,054	142,977

[a] McLeish, John, Report of the mineral production of Canada during the calendar year 1919, Canada Dept. Mines.
[b] Represents 4,412 squares in 1916; 3,909 squares in 1917; 8,296 squares in 1918; and 4,036 squares in 1919.

SLATE GRANULES.

A feature of the slate industry which has been of much interest during the last four or five years is the use of crushed slate granules as a surfacer for prepared asphalt roofing. Besides the slate granules reported on page 137, 26,167 short tons of stones other than slate, valued at $112,332, was sold for this purpose in 1919, and about 40,000 short tons, valued at $240,000, in 1920. This quantity does not include stone crushed and used as a roofing gravel. The figures for New York and Pennsylvania, however, include a small quantity of slate "flour," used in the manufacture of plastic roofing slate and backing for rubber, linoleum, and oilcloth, and as a filler for asphalt.

The Prepared Roofing Association, through its secretary, has informed the Geological Survey that in 1920 approximately 375,000 tons of slate or stone granules were used in the manufacture of grit surface roofing and asphalt shingles. A little more than half of this quantity was used for roll roofing, and the remainder for shingles. About 30,000,000 squares of asphalt roofing were shipped in 1920, of which approximately 60 per cent was roll roofing, 20 per cent grit-surfaced roofing, and 20 per cent asphalt shingles. Slate granules have been used as a roofing surfacer for the last 10 or 15 years, but only during the war, when low-priced, easily applied roofing was in demand, did this use become very common. This roofing has therefore not been in use long enough to permit a comparison of its durability with that of regular roofing slate, which may be seen on buildings 50 to 75 years old in this country and more than 300 years old in England and Wales.

Until 1920 the granules used were obtained chiefly from the red and green slates of New York and Vermont. A small quantity, however, was obtained from colored slate from Utah and a "dark-blue" slate from Lancaster County, Pa. In 1920 slate "flour" and granules were also produced at Albany and Lenhartsville, Berks County, Pa., and were reported respectively as "red" and "green" slate. According to reports, a large plant has been erected in Rutland County, Vt., for quarrying and pulverizing purple slate to be used in the manufacture of a plastic composition to take the place of small sizes of natural slate used in the electrical industry. Besides other development work in the localities mentioned, preparations for the erection of mills to produce slate and manufacture granules in 1921 have been reported at Jemison, Chilton County, Ala. (purple and green slate); Fairmont, Bartow County, Ga. (green slate); Cardiff, Harford County, Md. ("black" slate); Tellico, Monroe County, Tenn. (green slate); and Esmont, Albemarle County, Va. ("black" slate).

Stone granules other than slate were obtained for use as roofing surfacer from deposits at Elsinore, Riverside County, Calif.; Marquette, Marquette County, Mich.; Iron Springs and Charmian, Adams County, Pa.; and Dresser Junction, Polk County, Wis. A green stone obtained near Front Royal, Warren County, Va., has also been used for this purpose.

The stone at most if not all of these places is "greenstone" or altered diabase. Efforts are reported to have been made to use "dunite" or olivine rock and rock composed largely of epidote, but the granules produced from these rocks were so extremely hard and sharp-edged that when rolled on the asphaltic base they cut it too deeply. The greenstone or altered diabase is inferior to olivine and epidote in depth of color but is composed for the most part of softer minerals. A few inquiries have been received by the United States Geological Survey concerning the distribution of rocks of certain colors, regardless of their mineral composition, and in view of the expected large demand for all roofing materials after the present protracted curtailment of building, it will not be surprising if the varieties of stone used for roofing granules as well as the total output of granules should increase considerably.

According to information received by the United States Geological Survey, the application of slate granules to sheet asphalt roofing began in an attempt to find a roofing product of more pleasing appearance than the old kind of roll roofing surfaced with talc and one which could be used on residences of the better class without destroying the artistic effect. Many different crushed materials were tried, but it was definitely proved by the manufacturers that surfacing made of nonfading slate met with the most uniform success. At the present time granules made from nonfading red or green slate have been almost universally adopted by the trade, although "gray" and "black" granules are being used when needed for color harmony.

The specifications for the material are based on a granule that is small enough to become embedded in the asphalt coating but not large enough to penetrate or puncture the asphalt-saturated felt on which the coating is placed. There must be enough fines in the granules to cover properly and hide the asphalt coating, but the fineness of the material allowable in the granules is materially reduced after passing a 40-mesh sieve. The presence of a large quantity of material that will go through a 40-mesh sieve and is known to the trade as "dust" is detrimental because this dust adheres to the asphalt coating before the granules can come into contact with it and prevents their adhesion to the coating. The dust or "flour," however, may be used for asphalt filler, as backing for rubber, linoleum, and oilcloth, and in the manufacture of plastic roofing slate shingles and plastic electrical insulators.

The average specifications for granules for the roofing industry are as follows: All to pass a 10-mesh sieve, from 40 to 65 per cent to be retained on a 20-mesh sieve, and from 25 to 50 per cent to be retained on a 40-mesh sieve; and not more than 1 per cent to pass a 60-mesh sieve.

The granules are usually received by the roofing manufacturers loaded in bulk in box cars. The material is moved by conveyors, which carry it to storage bins. Some storage bins are equipped with a device for further eliminating the dust content. From the storage bins the granules are led to hoppers on the roofing machine, which consists of a suitably arranged device for spreading a thin coating of hot asphalt (approximately 400° F.) on a sheet of roofing felt which has been previously saturated with asphalt of a softer consistency than the coating. Immediately after the coating has been applied to the asphalted felt, the slate is fed on it from the hoppers. The hoppers usually contain some device to heat the slate sufficiently to prevent chilling of the asphalt when it comes into contact with the granules. Immediately after the application of the slate, the asphalt coating is chilled by placing it in contact with revolving water-cooled drums. In some plants the temperature of the asphalt and the slate is high enough to give a smooth finish to the surface of the goods. In others it is necessary to use pressure rolls to obtain a smoother surface. After the roofing has cooled sufficiently it is wound into rolls or cut into shingle shapes for shipment. The rolls commonly known as slate or grit surface roll roofing have recently been used by elevated railroads as runners on the steps leading to the passenger platforms. These runners are said to reduce to a minimum the danger of slipping.

Experiments for determining the fitness of slate dust in asphalt road-surface mixtures have recently been made by the Bureau of Mines, Department of the Interior, under the direction of Oliver Bowles.[2]

[2] Bowles, Oliver, Slate dust in asphalt road-surface mixtures: Bur. Mines Rept. Inv., No. 2230, March, 1921.

CARBON BLACK PRODUCED FROM NATURAL GAS.

By E. G. Sievers.

An increasing demand for information on carbon black[1] in connection with the declining supply of natural gas caused the United States Geological Survey in 1919 to begin compiling annual statistics on carbon black produced from natural gas. This report for 1920 includes the statistics for 1919. The cooperation of the producers has made the completion of this report possible.

PRODUCTION.

The total quantity of carbon black produced from natural gas in the United States in 1920 decreased 1.4 per cent from 1919, and there was a decrease of 1 in the number of plants. In 1919 the plants were still operating at or near full capacity on account of the war, but since normal conditions have been restored the production has decreased. The output in 1920 was made by 19 producers. The prices received ranged from 4 to 27 cents a pound. The average daily production in 1918 was 119,178 pounds; in 1919 it was 142,621 pounds; and in 1920 it was 140,608 pounds.

Carbon black produced from natural gas in the United States, 1919-20, by States.

State.	Number of plants.	Carbon black produced.				Gas used.
		Quantity (pounds).	Value.	Average price per pound (cents).	Average yield of carbon black per M cubic feet (pounds).	Quantity (M cubic feet).
1919.						
West Virginia	23	29,925,614	$2,358,119	7.9	1.3	23,117,332
Louisiana	7	14,024,606	933,334	6.7	.7	20,291,021
Wyoming Montana	2	4,868,947	231,747	4.8	1.1	4,306,153
Oklahoma Kentucky	2	2,922,274	244,726	8.4	1.5	1,954,029
Pennsylvania	2	315,500	48,114	15.3	1.4	227,700
	36	52,056,941	3,816,040	7.3	1.04	49,896,235
1920.						
West Virginia	19	26,659,469	2,221,674	8.3	1.43	18,628,780
Louisiana	11	18,565,498	1,455,764	7.8	1.0	18,099,800
Wyoming	1					
Montana	1	5,850,313	326,424	5.6	1.6	3,673,108
Kentucky	1					
Pennsylvania	2	246,612	28,424	11.5	1.2	197,290
	35	51,321,892	4,032,286	7.9	1.26	40,598,978

[1] For a select bibliography of lampblack and carbon black, see McClelland, E. H., Lampblack, Pittsburgh, Pa., Carnegie Library, 1919.

About 45,000,000,000 cubic feet of natural gas was consumed in the manufacture of carbon black in 1918. In 1920 the production of carbon black per thousand cubic feet of gas consumed ranged from 0.45 to 2 pounds, but the average production during the year for all States was about 1.26 pounds.

Range in production of carbon black at plants in the United States in 1919 and 1920.

Production per M cubic feet of gas.	Plants.	
	1919	1920
Less than 1 pound	6	6
From 1 to 1.2 pounds	17	15
From 1.3 to 1.6 pounds	11	6
From 1.7 to 2.0 pounds	2	8
	36	35

The daily capacity of the plants in volume of gas treated ranges from 172,000 to 20,350,000 cubic feet and in quantity of carbon black produced from 90 to 23,250 pounds.

West Virginia remained the leading producing State in 1920, although its output decreased 11 per cent. The annual decrease in production in West Virginia and in Pennsylvania is due in part to the diminishing supply of gas, which has made it possible to sell for fuel at higher prices large volumes of gas that would otherwise be used in making carbon black.

Louisiana, which has made rapid growth in the carbon-black industry during the last few years and was second in rank, increased its production by 32 per cent in 1920. The great supply of gas in the Monroe field accounts for this marked increase in production. Louisiana will continue to be a large producer of carbon black unless prevented by legislation.

Oklahoma produced no carbon black in 1920. The combined output of Wyoming, Montana, and Kentucky decreased 4 per cent, so that Louisiana was the only State showing a substantial increase. The producing States, named in the order of production, and the percentage of the output they produced are West Virginia, 52 per cent of the total output; Louisiana, 36 per cent; Wyoming, Montana, and Kentucky, combined, 11 per cent; and Pennsylvania, less than 1 per cent.

The carbon-black industry migrates according to the available supplies of natural gas. West Virginia has long been the center of manufacture, but Louisiana and Wyoming have made rapid growth. As natural gas is an ideal domestic fuel, the consumers demand that it be reserved for domestic uses, and the carbon-black industry has therefore located itself where there are abundant supplies of natural gas for which there is little or no market.

In Wyoming the conditions are somewhat like those in Louisiana in that the gas has not yet found a complete market, but even there legislation has restricted the carbon-black industry.

NATURE AND COMPOSITION OF CARBON BLACK.

Carbon black as known to the American trade is a fluffy, velvety black pigment produced by the incomplete combustion of natural gas,[2] burned with a smoky flame against a metal surface. It is sometimes confused with lampblack, which differs from carbon black in molecular structure and is inferior to it in quality. Lampblack is made by burning oil or other carbonaceous material with insufficient air for complete combustion and collecting the smoke in settling chambers. It is gray in color in contrast to carbon black and when used in printing inks forms a totally different product from that formed by using carbon black. Carbon black is unique in its properties. Its lightness and fineness, freedom from gritty particles, miscibility with oil, remarkable covering power when mixed with other material, unique brilliance, and intensity of color are among its outstanding qualities.

Carbon black consists of 85 to 95 per cent of amorphous carbon, 1 to 7 per cent of water, 0.5 to 0.8 per cent of hydrogen, and 2 to 8 per cent of oxygen, present partly in CO and CO_2, and partly as fixed oxygen.

YIELD OF CARBON BLACK.

The yield of carbon black from natural gases very closely follows the percentage of ethane, heating value, and content of elementary carbon calculated from the hydrocarbons determined by analysis.

Composition of natural gas and quantity of carbon black recovered by channel process.[a]

	Louisiana.	West Virginia.		Wyoming.
		1	2	
Methane........per cent..	94.12	70.75	65.23	46.45
Ethane........do....	3.44	24.14	30.07	43.10
Carbon dioxide........do....	.50	.28	1.56	.96
Nitrogen........do....	1.94	4.83	3.14	9.49
Heating value........British thermal units..	962	1,086	1,134	1,176
Carbon per M cubic feet[b]........pounds..	33.80	39.90	42.30	44.30
Carbon black recovered per M cubic feet........do....	.80	1.00	1.10	1.40
Percentage of recovery........	2.40	2.50	2.60	3.10

[a] Hamor, W. A., and Padgett, F. W., The technical examination of crude petroleum, petroleum products, and natural gas, 1920.
[b] Calculated from the carbon contents of methane and ethane.

Louisiana gas has a low percentage of nitrogen and a percentage of hydrocarbons as high as 97.56, but still has a small yield of carbon black because of the large proportion of methane. Methane contains 33.5 pounds of carbon per M cubic feet of gas and ethane 67 pounds. The table shows that the two West Virginia gases are approximately similar in composition and yield of carbon black. The Wyoming gas has the largest yield of carbon black, the largest percentage of recovery, and the largest heating value. It is considerably lower in methane but higher in ethane.

[2] For theory of formation of carbon black see Perrott, G. St. J., and Thiessen, Rheinhardt, Carbon black, its properties and uses: Jour. Ind. and Eng. Chemistry, April, 1920, p. 325.

USES.

PRINTER'S INK.

Lampblack has been used as a pigment in printer's ink since the invention of printing and was used exclusively as a black pigment for that purpose until the advent of carbon black in 1864. Certain kinds of printing require a very fine grained ink that can best be made by using carbon black, which possesses properties that are especially adapted to the needs of modern printing. The rapid increase in the publication of books and newspapers demands a constantly increasing supply of carbon black for the manufacture of printing inks adapted to fast presswork. The modern rotary printing presses require an ink that will dry so rapidly as to permit the presses to be operated at a high speed, that will flow freely, possess great covering power, and make an instantaneous and legible impression. One pound of carbon black mixed with 8 pounds of oil and other chemicals will produce enough ink to print 2,250 copies of a 16-page newspaper of ordinary size, or 90 copies of a 300-page octavo book. Certain carbon blacks make an ink of buttery consistency, which does not flow freely and which is desirable in lithographic and half-tone work and for slow-speed presses. The same results can not be obtained by using lampblack, which lacks the right consistency and is too gray. About 35 per cent of the total annual output of carbon black is now used in the manufacture of printer's ink.

RUBBER TIRES.

Carbon black has been used as a coloring material in the rubber industry since 1914 and has greatly displaced lampblack for this purpose. When the price of zinc oxide increased during the World War, it was demonstrated that carbon black could be substituted successfully as a filler in rubber. The favorable results increased the use of carbon black tremendously. In the manufacture of rubber tires the addition of carbon black as a reinforcing agent has given the rubber a larger mileage and better traction by increasing the tensile strength and the elasticity of the tire about 25 per cent and 10 per cent, respectively. The present tendency is to manufacture "black-tread tires" instead of white tires. Approximately 40 per cent of the total output of carbon black is now consumed in the rubber industries.

PAINTS.

Carbon black is extensively used in the paint trade. It is considered unsurpassed for use in varnishes and enamels because of its high tinting strength and great covering power. In certain grayish paints lampblack is superior, owing to its bluish-gray tones.

MISCELLANEOUS USES.

About 10 per cent of the carbon black produced annually is distributed for miscellaneous uses, such as the manufacture of stove and shoe polish, phonograph records, black leather, bookbinder's board, buttons, carbon, and other black and gray papers, typewriter ribbons, carriage cloth, celluloid, electric insulators, cement colors, crayons, drawing and marking inks, artificial stone, black tile, and tarpaulins.

Approximate distribution, by uses, of carbon black, 1918–1920.

Use.	1918 [a]		1919		1920	
	Percentage.[b]	Quantity (pounds).	Percentage.[b]	Quantity (pounds).	Percentage.[b]	Quantity (pounds).
Rubber	45	20,000,000	40	20,822,400	40	20,528,000
Printer's ink	23	10,000,000	35	18,219,600	35	17,962,000
Miscellaneous	14	5,500,000	10	5,205,600	10	5,132,000
Exported	18	8,000,000	15	7,808,400	15	7,698,000
	100	43,500,000	100	52,056,000	100	51,320,000

[a] Estimated by Bureau of Mines.
[b] Percentages based on opinions of carbon-black producers and distributors.

EXPORTS.

The exports before the war were about 33 per cent of the output. At present only about 15 per cent is exported, and owing to the increased use of carbon black in this country probably still less will be exported in the future.

ECONOMIC ASPECTS.

The urgent demand for carbon black for making articles needed for military uses caused a substantial increase in its production during the World War, and the factories then established will doubtless be sufficient to supply the demand in the immediate future. The trend of the industry, however, will no doubt be to develop new gas fields and create a market for gas in areas already developed. The industry has materially aided the development of new and remote natural-gas fields. The best illustration is perhaps the Monroe field, in Louisiana, which about five years ago had only a few wells drilled in an unsuccessful search for oil. It is remote from large cities and towns, hence there was no market for the gas, so the wells were shut in, and no systematic attempt was made to develop the field. This being an ideal place for making carbon black, plants were constructed, and soon more wells were drilled. Pipe lines were laid and plants were built for removing the gasoline from the gas before its consumption in making carbon black, and to-day this field is one of the largest in the United States. An extension of the pipe line running from the field perhaps as far as New Orleans is being considered.

Its high calorific power, cleanliness, and cheapness for heating, lighting, and cooking make natural gas preeminent as a domestic fuel. In order to conserve the supplies of gas for such use, certain States have prohibited the use of natural gas for the manufacture of carbon black. The carbon-black industry always has migrated and probably will continue to migrate wherever the supplies of gas warrant its establishment, unless further retarded by legislation. The construction of carbon-black plants must be based upon careful investigation of conditions, such as depth of wells, gas pressure, open flow, capacity of wells, thickness of gas-bearing strata, type of gas (wet or dry), history of the production of the field, location of field in relation to domestic and industrial gas-distributing centers, proximity to pipe lines for transportation of gas, and probable yield of carbon black from the gas.

SILICA.

By L. M. Beach.

PRODUCTION.

Silica of the kinds considered in this report is used in the manufacture of wood filler, pottery, paints, and scouring soaps, as a polisher, as foundry mold wash, in metallurgic and chemical processes, and for cosmetics and dentifrices.

The following table summarizes the data available to show the silica of these forms marketed in the United States from 1918 to 1920, inclusive.

Silica sold for pottery, paints, fillers, polishers, abrasives, and other uses in the United States, 1918–1920.

Material.	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity. (short tons).	Value.	Quantity (short tons).	Value.
Quartz (vein quartz, pegmatite, and quartzite)	71,740	$259,330	63,332	$373,571	68,190	$320,350
Sand and sandstone [a]	98,956	620,584	47,277	288,890	158,395	1,183,014
Tripoli (ground and otherwise prepared)	19,982	199,854	24,292	181,541	40,233	569,677
Diatomaceous earth	[b] 2,965	[b] 24,947	42,642	531,960	61,922	1,079,693
	[b] 193,643	[b] 1,104,715	177,543	1,375,962	328,740	3,152,734

[a] Includes only finely ground material. Figures probably incomplete.
[b] Excludes California product used for filters and as insulating and fireproofing material, which the Survey is not at liberty to publish.

Vein and pegmatite quartz and quartzite amounting to 68,190 short tons, valued at $320,350, were sold in 1920. This was an increase of 8 per cent in quantity and a decrease of 14 per cent in value.

Quartz sold in the United States, 1916–1920.

Year.	Crude.		Ground.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1916	70,417	$78,283	18,097	$164,503	88,514	$242,786
1917	126,575	120,856	16,098	197,213	142,673	318,069
1918	61,008	121,888	10,732	137,442	71,740	259,330
1919	51,774	135,187	11,558	238,384	63,332	373,571
1920	59,423	142,397	8,767	177,953	68,190	320,350

Quartz sold in the United States, 1919-1920, by States.

State.	Crude.		Ground.		Total.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1919.						
Arizona, California, Colorado, Michigan, and Montana	16,578	$27,339	....	....	16,578	$27,339
Connecticut, Maine, Massachusetts, New York, Pennsylvania, Tennessee, and Wisconsin	30,788	91,487	7,436	$161,994	38,224	253,481
Maryland and North Carolina	4,408	16,361	4,122	76,390	8,530	92,751
	51,774	135,187	11,558	238,384	63,332	373,571
1920.						
Arizona, California, Colorado, and Nevada	5,401	12,183	....	....	5,401	12,183
Connecticut, Maine, Maryland, Massachusetts, and Wisconsin	2,099	10,998	8,767	177,953	10,866	188,951
Michigan, New York, North Carolina, Pennsylvania, and Tennessee	51,923	119,216	....	....	51,923	119,216
	59,423	142,397	8,767	177,953	68,190	320,350

IMPORTS.

The Bureau of Foreign and Domestic Commerce records imports of "flint, flints, and flint stones, unground," from several countries. These imports are partly flint pebbles for use in grinding mills and partly material for uses such as are listed in this report. The figures can not be accurately separated.

Value of pebbles and flint imported for consumption in the United States, 1916–1920.

1916	$313,120
1917	197,156
1918	127,808
1919	$250,096
1920	338,630

FELDSPAR.

By L. M. Beach.

PRODUCTION.

The quantity of feldspar marketed in 1920 was 114 per cent greater than in 1919 and 53 per cent greater than in 1918. Feldspar is used principally in the manufacture of pottery, chinaware, porcelain, enameled ware, and enameled brick and tile. These industries were considered nonessential during the World War, and their fuel supply was curtailed. After the war the plants again became active, and during 1920 the demand for feldspar was heavier than ever before. The production in Canada increased 151 per cent in 1920. Most of the Canadian feldspar is shipped into the United States.

Feldspar sold in 1919 and 1920, and value at price for crude feldspar.

State.	1919		1920	
	Quantity (long tons).	Value.	Quantity (long tons).	Value.
California	(a)	(a)	1,021	$4,797
Connecticut	9,715	$84,050	7,719	64,066
Maine	12,845	59,602	45,352	329,626
Maryland	6,982	39,610	17,999	100,822
New York	(a)	(a)	19,294	121,027
North Carolina	22,495	116,826	36,521	187,136
Pennsylvania	(a)	(a)	7,645	43,649
Undistributed	11,404	47,904		
	63,441	347,992	135,551	851,123

a Included under "Undistributed."

Many feldspar miners grind their spar and market it in ground form and by the short ton; hence the following table is given in short tons. The values for each State include both crude and ground feldspar sold and represent the money paid for the spar when first marketed.

Crude and ground feldspar sold in 1919 and 1920.

State.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
California	(a)	(a)	1,144	$24,436
Connecticut	10.880	$133,113	8,645	125,153
Maine	14,387	206,659	50,794	615,654
Maryland	7,820	39,610	20,159	312,292
New York	(a)	(a)	21,609	163,215
North Carolina	25,195	116,826	40,904	187,136
Pennsylvania	(a)	(a)	8,562	81,104
Undistributed	12,772	88,992		
	71,054	585,200	151,817	1,508,990

a Included under "Undistributed."

Crude and ground feldspar sold in 1916–1920.

Year.	Quantity (short tons).	Value.
1916	132,681	$702,278
1917	141,924	728,838
1918	99,120	674,346
1919	71,054	585,200
1920	151,817	1,508,990

Feldspar sold in Canada, 1916–1920.[a]

Year.	Quantity (short tons).	Value.
1916	19,488	$71,407
1917	11,493	54,555
1918	18,782	112,728
1919	14,679	86,231
1920 [b]	36,856	274,075

[a] Statistics taken from reports on the mineral production of Canada, Canada Dept. Mines.
[b] Figures for 1920 preliminary and subject to revision.

ABRASIVE MATERIALS.

By L. M. Beach and A. T. Coons.

This chapter is concerned with natural and artificial abrasives composed of one or more minerals and used for grinding, polishing, and other abrasive operations. Quartz and feldspar are excluded because the precise separation according to their uses can not be made, their principal uses being for purposes other than abrasives, and therefore they are considered in other chapters.

CONSUMPTION.

Value of all abrasive materials [a] consumed in the United States, 1916–1920.

	1916	1917	1918	1919	1920
Natural abrasives	$1,664,339	$2,385,165	$2,864,332	$2,887,902	$4,299,812
Artificial abrasives	2,935,909	8,137,242	[b] 6,940,000	[c] 5,019,779	[c] 6,269,084
Imports	555,850	812,303	1,187,632	2,237,077	4,425,409
	5,156,098	11,334,710	10,991,964	[c] 10,144,758	[c] 14,994,305
Exports	4,452,741	6,621,884	6,056,242	6,138,366	7,025,621
Apparent consumption	703,357	4,712,826	4,935,722	4,006,392	7,968,684

[a] Exclusive of feldspar and various forms of quartz. See chapters on feldspar and silica.
[b] Estimated and not including entire production during second half of 1918.
[c] Not including production of one large company.

IMPORTS AND EXPORTS.

Value of abrasive materials imported for consumption in the United States, 1916–1920.

Material.	1916	1917	1918	1919	1920
Millstones and burrstones	$19,816	$18,227	$20,017	$26,356	$20,954
Grindstones and pulpstones	63,277	57,950	27,361	50,551	77,046
Hones, oilstones, and whetstones	10,614	10,636	6,075	12,199	56,416
Emery and corundum	240,737	210,602	614,167	595,203	617,187
Diatomaceous earth, tripoli, and rottenstone	37,573	17,864	11,128	12,545	16,323
Pumice	116,543	147,278	33,014	119,781	249,995
Diamond dust and bort	67,290	349,746	475,870	1,420,442	3,387,488
	555,850	812,303	1,187,632	2,237,077	4,425,409

Value of domestic abrasive materials exported from the United States, 1916–1920.

Material.	1916	1917	1918	1919	1920
Grindstones	$176,563	$198,772	$210,889	$297,068	$424,322
Abrasive wheels, emery, and other	2,240,227	4,481,600	3,862,531	3,032,067	2,791,128
All other	2,035,951	1,941,512	1,982,822	2,809,231	3,810,171
	4,452,741	6,621,884	6,056,242	6,138,366	7,025,621

NATURAL ABRASIVES.

Natural abrasives were produced in 1920 in 26 States, which are listed below:

Alabama............Millstones.
Arkansas.............Oilstones.
California...........Diatomaceous (infusorial) earth, grinding pebbles, and pumice.
Connecticut.........Diatomaceous (infusorial) earth.
Idaho................Diatomaceous (infusorial) earth.
Illinois...............Tripoli.
Indiana.............Oilstones and rubbing stones.
Kansas...............Pumice.
Kentucky...........Hones.
Maryland...........Diatomaceous earth and millstones.
Michigan............Grindstones.
Minnesota...........Grinding pebbles and tube-mill lining.
Missouri.............Tripoli.
Nebraska............Pumice.
Nevada..............Diatomaceous (infusorial) earth and grinding pebbles.
New Hampshire.....Garnet and scythestones.
New York...........Diatomaceous (infusorial) earth, emery, garnet, and millstones.
North Carolina.......Millstones.
Ohio.................Grindstones, pulp stones, oilstones, and scythestones.
Oklahoma...........Tripoli.
Pennsylvania........Grinding pebbles and rottenstone.
Utah.................Diatomaceous (infusorial) earth.
Vermont............Scythestones.
Virginia.............Emery and millstones.
Washington..........Diatomaceous (infusorial) earth.
West Virginia.......Grindstones and pulp stones.

Natural abrasives sold by producers in the United States, 1918–1920.

Abrasive.	1918		1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Millstones	(a)	$92,514	(a)	$66,972	(a)	$63,325
Grindstones and pulp stones	65,339	1,776,282	46,865	1,336,015	53,484	1,707,004
Oilstones and scythestones	1,010	189,033	1,463	235,943	1,144	231,747
Emery and corundum	10,422	112,878	[b] 2,601	[b] 23,203	[b] 2,327	[b] 21,685
Garnet	4,696	248,161	4,944	310,131	5,476	434,425
Abrasive quartz and feldspar	(c)	(c)	(c)	(c)	(c)	(c)
Diatomaceous (infusorial) earth and tripoli [d]	22,947	224,801	66,934	713,501	102,155	1,649,370
Pumice	30,637	91,178	36,051	116,835	41,838	114,433
Grinding pebbles	9,934	82,851	9,448	85,302	10,924	77,823
Tube-mill lining	2,535	46,634				
	....	2,864,332	....	2,887,902	....	4,299,812

[a] Figures not available, as product was not reported by weight.
[b] Emery only. No corundum produced.
[c] See chapters on feldspar and silica.
[d] Includes rottenstone, but excludes for 1918 considerable production of diatomaceous earth for special uses, upon which the Survey is not at liberty to report.

Value of millstones produced and sold in the United States, 1916–1920, by States.

State.	1916	1917	1918	1919	1920
Alabama	(a)	(a)		(a)	(a)
Maryland			(a)		(a)
New York	$10,287	$22,103	$25,488	$10,155	$13,331
North Carolina	(a)	(a)	39,224	29,025	14,226
Pennsylvania	(a)	(a)	(a)	(a)	
Virginia	25,752	18,980	(a)	(a)	34,676
Undistributed	8,520	2,406	27,802	27,792	1,092
	44,559	43,489	92,514	66,972	63,325

[a] Included under "Undistributed."

Value of burrstones and millstones imported for consumption in the United States, 1917–1920.

Year.	Rough.	Made into millstones.	Total.	Year.	Rough.	Made into millstones.	Total.
1917	$17,048	$1,179	$18,227	1919	$8,996	$17,360	$26,356
1918	17,570	2,447	20,017	1920	9,007	11,947	20,954

Grindstones and pulp stones produced and sold in the United States, 1916–1920.

Year.	State.	Grindstones.		Pulp stones.	
		Quantity (short tons).	Value.	Quantity (pieces).	Value.
1916	Michigan, Ohio, and West Virginia	50,839	$631,497		
	Ohio			1,066	$134,643
1917	Michigan, Ohio, and West Virginia	54,432	806,896		
	Ohio and West Virginia			2,325	340,888
1918	Michigan, Ohio, and West Virginia	56,554	1,262,602		
	Ohio and West Virginia			2,921	513,680
1919	Michigan, Ohio, and West Virginia	40,755	993,959		
	Ohio and West Virginia			2,450	342,056
1920	Michigan, Ohio, and West Virginia	44,832	1,239,990		
	Ohio and West Virginia			2,321	467,014

Grindstones, pulp stones, and scythestones produced in Canada, 1917–1920.[a]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1917	2,523	$45,754	1919	2,020	$60,516
1918	3,072	83,005	1920 (preliminary)	2,319	78,136

[a] Figures taken from the annual reports on mineral production of Canada, Canada Dept. Mines.

Emery and corundum imported for consumption in the United States, 1916–1920.

Year.	Grains.		Ore and rock.		Other manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Pounds.		*Long tons.*			
1916	1,689,689	$90,646	7,623	$113,176	$36,915	$240,737
1917	2,207,912	119,033	1,056	50,087	41,482	210,602
1918	4,138,587	231,908	6,677	322,610	59,649	614,167
1919	547,349	32,128	11,401	522,036	41,039	595,203
1920	1,766,554	85,966	8,226	519,839	11,382	617,187

Canadian corundum shipped, 1917–1920.[a]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1917	188	$32,153	1919		
1918	137	26,112	1920 (preliminary)	195	(b)

[a] Figures taken from the annual reports on mineral production of Canada, Canada Dept. of Mines.
[b] Figures for value not yet available.

Tripoli produced and sold in the United States, 1919–20.

State.	1919			1920		
	Quantity (short tons).	Value.		Quantity (short tons).	Value.	
		Estimated (crude).	As sold (crude and finished).		Estimated (crude).	As sold (crude and finished).
Illinois	13,014	$32,961	$116,492	24,458	$66,509	$360,651
Missouri, Oklahoma, and Pennsylvania	11,278	65,049	65,049	15,775	97,567	209,026
	24,292	98,010	181,541	40,233	164,076	569,677

Diatomaceous earth produced and sold in the United States, 1917–1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1917	[a] 3,033	[a] $31,368	1919	42,642	$531,960
1918	[a] 2,965	[a] 24,947	1920	61,922	1,079,693

[a] Exclusive of considerable production upon which the Survey is not at liberty to report.

Value of general imports of pebbles and flint into the United States, 1916–1920, by countries.

Country.	1916	1917	1918	1919	1920
Belgium				$34,783	$65,097
British India	$2,440				
Canada			$700	1,742	430
Denmark	175,916	$122,883	86,664	95,254	131,028
France	117,649	65,311	38,519	117,691	131,950
Germany					9,528
Italy		39			
Japan	7,924				
Mexico					30
Netherlands					567
Norway	1,780				
Portugal	214				
Sweden	7,197	7,744	1,925	626	
	313,120	195,977	127,808	250,096	338,630

ARTIFICIAL ABRASIVES.

The artificial abrasives here considered are of three kinds—(1) metallic abrasives, manufactured by the Pittsburgh Crushed Steel Co., Pittsburgh, Pa., and including "diamond crushed steel" (crushed crucible steel), "angular grit" (crushed chilled iron), and "crushed cast iron"; (2) silicon carbides, including carborundum, manufactured by the Carborundum Co., at Niagara Falls, N. Y.; crystolon, manufactured by the Norton Co., at Chippewa, Ontario; and carbolon, manufactured by the Exolon Co., at Thorold, Ontario, and Blasdell, N. Y.; (3) aluminum oxides, including alundum, manufactured by the Norton Co., at Niagara Falls, N. Y., and Chippewa, Ontario; aloxite, manufactured by the Carborundum Co., at Niagara Falls, N. Y., Niagara Falls, Ontario, and Shawinigan, Quebec; exolon, manufactured by the Exolon Co., at Blasdell, N. Y., and Thorold, Ontario; lionite, manufactured by the General Abrasives Co. (Inc.), at Niagara Falls, N. Y.; coralox, manufactured by the D. A. Brebner Co. (Ltd.), at Hamilton, Ontario; and natite, manufactured by the National Abrasive Co., at Hamilton, Ontario.

So far as known to the Geological Survey, these are the only artificial abrasives manufactured in North America. Artificial abrasives sold under other names are merely the above-named products marketed under special trade names or are imported products.

In the following table the quantity and value reported for 1918, 1919, and 1920 are incomplete, as certain figures on production have not been obtained from one producing company.

Artificial abrasives produced in the United States and Canada, 1916–1920.

Year.	Quantity (pounds).	Value.	Year.	Quantity (pounds).	Value.
1916	77,612,000	$2,935,909	1919 [a]	56,562,000	$5,019,779
1917	115,822,000	8,137,242	1920 [a]	64,034,000	6,269,084
1918 [a]	87,600,000	6,940,000			

[a] Not including entire production.

MINERAL WATERS.

By W. D. Collins.[1]

SCOPE OF REPORT.

The term mineral water as here used applies to water that is bottled and sold in its natural state or only slightly altered from its natural state. It includes (*a*) natural carbonated waters that have lost part of their carbon dioxide; (*b*) natural waters that have been artificially carbonated; and (*c*) waters from which iron has been removed. It does not include artificial waters or natural waters that have been essentially modified in chemical character.

The statistics in this report refer only to domestic mineral waters that have been sold. Water that is given away, including water furnished free for drinking or bathing to guests at hotels or to patients at sanitariums, has been omitted even where data are available to show the quantity of water so used. Hence, as actual sales fall far short of the total quantity used, particularly of such waters as are drunk at resorts for their medicinal value, the totals do not represent the full magnitude of the trade.

Three uses of mineral waters are recognized in this report—table use, medicinal use, and use in the manufacture of soft drinks—but the quantity and value of water used in the manufacture of soft drinks are not included in the totals.

The distinction for statistical purposes between table and medicinal waters is entirely arbitrary and is based on the reports furnished by the owners and operators of springs stating the uses for which the waters are sold.

MINERAL-WATER TRADE IN 1920.

OUTPUT AND VALUE.

The number of mineral springs utilized commercially was smaller in 1920 than in 1919, as were also the quantity and value of water sold from them.

Wisconsin ranked first and New York second in quantity and value of mineral waters sold for all purposes and were followed in order of value by California, Maine, Indiana, Ohio, Virginia, Minnesota, Michigan, and Massachusetts. Massachusetts ranked first in the consumption of mineral waters for soft drinks; Indiana was first and California and New York were second and third, respectively, in value of medicinal waters. In value of table waters Wisconsin, in first place, and New York, in second place, were followed in order by Maine, California, Ohio, Minnesota, Michigan, and Massachusetts.

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[1] The statistics were compiled by Miss B. H. Stoddard, of the United States Geological Survey.

Water was sold from more than 25 springs in each of 7 States, more than 1,000,000 gallons of mineral water was sold in each of 11 States, and the value of the water sold amounted to more than $100,000 in each of 10 States.

Sales were reported from 479 springs in 1920, as compared with 527 springs in 1919. No reports of mineral-water sales were received from Arizona, Delaware, the District of Columbia, Idaho, or Utah; less than three commercially productive springs each were reported from Louisiana, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, South Dakota, and Washington; and three or more springs were commercially productive in every other State. Sales exceeded 5,000,000 gallons in Wisconsin and New York, and the total value of the water was more than $1,600,000 in Wisconsin and more than $670,000 in New York.

Ninety per cent of all the mineral waters sold in the United States in 1920 came from 20 States; all other States than those mentioned in the following table furnished less than 1 per cent each.

Not all of this water was consumed in the United States, a considerable quantity being exported, but no separate statistics of exports are available.

Mineral waters sold in the leading States and percentages, by States, of the total sold in the United States in 1920.

State.	Quantity (gallons).	Percentage of total.	State.	Quantity (gallons).	Percentage of total.
Wisconsin	5,259,447	15	Arkansas	900,597	2
New York	5,242,047	14	Maine	732,810	2
California	2,674,086	7	New Jersey	702,867	2
Minnesota	2,357,991	7	Pennsylvania	641,440	2
Ohio	2,337,437	6	Texas	597,233	2
Oklahoma	1,437,810	4	Indiana	571,293	2
Massachusetts	1,277,708	4	Kansas	422,069	1
Connecticut	1,275,451	4	West Virginia	392,950	1
Tennessee	1,265,286	3			
Virginia	1,248,382	3		32,475,939	90
Michigan	1,227,485	3	Other States	3,742,321	10
Maryland	986,000	3			
(a)	925,550	3		36,218,260	100

a Name of State may not be published, as there were less than 3 producers.

Value of medicinal and table waters sold in the United States in 1920.

State.	Medicinal waters.	Table waters.	Total.	State.	Medicinal waters.	Table waters.	Total.
Alabama	$832	$84	$916	New Jersey	$1,450	$66,586	$68,036
Arkansas	33,683	7,676	41,359	New York	97,284	573,782	671,066
California	124,104	202,191	326,295	North Carolina	13,463	2,082	15,545
Colorado	3,788	63,750	67,538	Ohio	5,297	164,103	169,400
Connecticut	78	72,719	72,797	Oklahoma	690	48,597	49,287
Florida	5,730	21,390	27,120	Oregon		701	701
Georgia	1,808	30,060	31,868	Pennsylvania	2,362	64,583	66,945
Illinois	1,432	15,779	17,211	Rhode Island	90	21,856	21,946
Indiana	165,844	18,095	183,939	South Carolina	47,438	3,674	51,112
Iowa	1,304	2,115	3,419	Tennessee	27,787	45,783	73,570
Kansas	46,524	10,837	57,361	Texas	84,221	7,762	91,983
Kentucky	28,460	11,140	39,600	Vermont	5,625	5,454	11,079
Maine	72,089	229,762	301,851	Virginia	63,644	83,956	147,600
Maryland		95,565	95,565	West Virginia	8,878	30,302	39,180
Massachusetts	3,877	101,131	105,008	Wisconsin	23,768	1,577,307	1,601,075
Michigan	1,485	120,525	122,010	Wyoming	1,150	200	1,350
Minnesota		136,632	136,632	Other States a	623	67,724	68,347
Mississippi	31,312		31,312				
Missouri	45,677	5,215	50,892		951,797	3,909,118	4,860,915

a Louisiana, Montana, Nevada, New Hampshire, New Mexico, North Dakota, South Dakota, and Washington.

Comparative production of mineral waters in the United States, 1919 and 1920.

State.	1919			1920				
	Commercial springs.	Quantity sold (gallons).	Value.	Commercial springs.	Quantity sold (gallons).	Value.	Percentage of increase or decrease.	
							Quantity.	Value.
Alabama	5	4, 694	$1, 548	3	1, 461	$916	− 69	− 41
Arkansas	7	1, 084, 373	50, 360	7	900, 597	41, 359	− 17	− 18
California	37	2, 693, 165	365, 997	33	2, 674, 086	326, 295	− .7	− 11
Colorado	9	391, 361	81, 087	10	227, 208	67, 538	− 42	− 17
Connecticut	28	1, 216, 184	61, 150	27	1, 275, 451	72, 797	+ 5	+ 19
District of Columbia	1	(a)	(a)	....	....	....	−100	−100
Florida	5	192, 935	12, 062	3	268, 470	27, 120	+ 39	+125
Georgia	9	364, 310	39, 282	8	343, 888	31, 868	− 6	− 19
Illinois	6	364, 934	21, 151	9	301, 953	17, 211	− 17	− 19
Indiana	10	538, 294	181, 495	10	571, 293	183, 939	+ 6	+ 1
Iowa	5	39, 661	5, 703	6	38, 877	3, 419	− 2	− 40
Kansas	8	394, 625	69, 482	10	422, 069	57, 361	+ 7	− 17
Kentucky	10	213, 436	37, 876	9	256, 959	39, 600	+ 20	+ 5
Louisiana	1	(a)	(a)	2	(a)	(a)	(a)	(a)
Maine	18	728, 606	309, 460	20	732, 810	301, 851	+ .6	− 2
Maryland	8	1, 077, 253	105, 397	6	986, 379	95, 565	− 8	− 9
Massachusetts	38	1, 630, 216	112, 213	32	1, 277, 708	105, 008	− 22	− 6
Michigan	10	1, 570, 906	132, 312	9	1, 227, 485	122, 010	− 22	− 8
Minnesota	12	2, 731, 967	113, 776	12	2, 357, 991	136, 632	− 14	+ 20
Mississippi	7	124, 788	29, 126	7	136, 175	31, 312	+ 9	+ 8
Missouri	26	212, 871	39, 641	28	323, 628	50, 892	+ 52	+ 28
Montana	3	499, 225	6, 811	2	(a)	(a)	(a)	(a)
Nebraska	2	(a)	(a)	1	(b)	(b)	−100	−100
Nevada	1	(a)	(a)	1	(a)	(a)	(a)	(a)
New Hampshire	3	197, 012	8, 941	2	(a)	(a)	(a)	(a)
New Jersey	14	1, 244, 983	143, 303	8	702, 867	68, 036	− 44	− 53
New Mexico	2	(a)	(a)	2	(a)	(a)	(a)	(a)
New York	44	6, 537, 966	815, 615	38	5, 242, 047	671, 066	− 20	− 18
North Carolina	9	62, 925	10, 895	8	115, 315	15, 545	+ 83	+ 43
North Dakota	3	110, 000	1, 100	2	(a)	(a)	(a)	(a)
Ohio	24	2, 341, 853	142, 970	22	2, 337, 437	169, 400	− .2	+ 18
Oklahoma	9	1, 368, 375	41, 825	8	1, 437, 810	49, 287	+ 5	+ 18
Oregon	3	2, 600	1, 140	3	2, 360	701	− 9	− 39
Pennsylvania	28	872, 595	83, 583	20	641, 440	66, 945	− 26	− 20
Rhode Island	6	317, 571	26, 039	6	370, 315	21, 946	+ 17	− 16
South Carolina	8	348, 242	38, 890	6	246, 418	51, 112	− 29	+ 31
South Dakota	3	785, 404	23, 961	2	(a)	(a)	(a)	(a)
Tennessee	14	752, 837	54, 259	16	1, 265, 286	73, 570	+ 68	+ 36
Texas	18	328, 913	60, 125	11	597, 233	91, 983	+ 82	+ 53
Vermont	5	107, 600	15, 755	4	88, 398	11, 079	− 18	− 30
Virginia	30	1, 418, 528	143, 199	27	1, 248, 282	147, 600	− 12	+ 3
Washington	2	(a)	(a)	2	(a)	(a)	(a)	(a)
West Virginia	5	271, 907	33, 796	6	392, 950	39, 180	+ 45	+ 16
Wisconsin	29	5, 113, 289	1, 446, 367	28	5, 259, 447	1, 601, 075	+ 3	+ 11
Wyoming	2	(a)	(a)	3	8, 576	1, 350	(a)	(a)
Undistributed c	....	440, 386	12, 494	....	1, 937, 491	68, 347	− 4	+ 31
	527	38, 697, 280	4, 880, 186	479	36, 218, 260	4, 860, 915	− 6	−0.4

a Included under "Undistributed."
b Manufacture of soft drinks only and therefore not included in totals.
c Includes in 1919: District of Columbia, Louisiana, Nebraska, Nevada, New Mexico, Washington, and Wyoming; 1920: Louisiana, Montana, Nevada, New Hampshire, New Mexico, North Dakota, South Dakota, and Washington.

RANGE OF PRICE.

Effort has been made in compiling the following table, which gives the quantity and value of mineral waters sold within certain ranges of price during 1919 and 1920, 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, 1919 and 1920.

Price per gallon (in cents).	Number of springs.	Quantity sold (gallons).	Value.	Percentage of number of springs.	Percentage of total quantity.	Percentage of total value.
1919.						
Not more than 2	17	4,742,442	$74,409	3	12	2
More than 2 and not more than 5	94	10,989,256	459,747	19	28	9
More than 5 and not more than 10	190	14,883,577	1,231,386	38	39	25
More than 10 and not more than 20	90	3,714,484	556,737	18	10	11
More than 20 and not more than 30	43	789,386	190,013	9	2	4
More than 30 and not more than 50	38	1,677,624	662,088	8	4	14
More than 50 and not more than 100	23	1,891,339	1,691,981	4	5	35
More than 100	6	9,172	13,825	1	(a)	(a)
	b 501	38,697,280	4,880,186	100	100	100
1920.						
Not more than 2	12	3,282,835	26,837	3	9	1
More than 2 and not more than 5	81	7,959,163	327,457	18	22	7
More than 5 and not more than 10	185	13,462,765	1,046,832	40	37	21
More than 10 and not more than 20	76	7,933,512	899,510	17	22	18
More than 20 and not more than 30	47	984,908	272,222	10	3	6
More than 30 and not more than 50	25	222,265	90,055	5	1	2
More than 50 and not more than 100	21	1,165,176	763,715	5	3	16
More than 100	10	1,207,636	1,434,287	2	3	29
	c 457	36,218,260	4,860,915	100	100	100

a Less than 1 per cent.
b Exclusive of 26 springs whose waters are used exclusively in the manufacture of soft drinks.
c Exclusive of 22 springs whose waters are used exclusively in the manufacture of soft drinks.

Practically four-fifths of the mineral waters sold from 1916 to 1920, inclusive, brought prices ranging from half a cent to 10 cents a gallon. The average price per gallon in 1920 was 13.4 cents.

CONDITION OF TRADE.

Mineral waters sold in the United States, 1914–1920.

Year.	Commercial springs.	Quantity sold (gallons).	Value.	Average price per gallon (cents).
1914	829	54,358,466	$4,892,328	9.0
1915	812	52,113,503	5,138,794	9.9
1916	802	55,928,461	5,735,035	10.3
1917	717	46,784,419	4,931,710	10.5
1918	569	40,709,722	4,533,001	11.1
1919	527	38,697,280	4,880,186	12.6
1920	479	36,218,260	4,860,915	13.4

The value of mineral waters sold in 1920 was only 0.4 per cent less than in 1919, but the quantity sold was 6.4 per cent less and the number of producers 9.1 per cent less. The corresponding decreases from 1914 to 1920 were 0.6, 33, and 42 per cent, respectively. These results indicate that the average quantity of water sold by those making reports is increasing and that the average return to the producers is increasing even more.

The present standards of sanitation with respect to bottled waters require fairly large sales to cover the expense involved in equipping and maintaining a satisfactory bottling plant, so that this tendency to concentration of the mineral-water trade seems likely to continue.

The value of the medicinal waters sold has decreased nearly every year since 1905, when medicinal waters and table waters were first reported separately. In 1905 the value of medicinal waters was 48 per cent of the total, and in 1920 it was only 19.6 per cent. Much of this loss can probably be explained by a decrease in sale of waters for which extravagant claims of curative properties were made, although the composition of the waters was not appreciably different from that of public or private supplies available where the waters were used.

For many years a considerable part of the mineral-water trade resulted from the unsatisfactory or dangerous quality of public supplies in large cities. Few communities now have public supplies which are unsafe, but knowledge of the pollution of the sources from which the water is taken and of the treatment necessary to make it safe undoubtedly helps the sale of unpolluted mineral waters, even though they may be no safer than the purified public supplies.

SOFT DRINKS.

Mineral waters used in the manufacture of soft drinks in 1920.

State.	Quantity (gallons).	State.	Quantity (gallons).
Massachusetts	1,692,897	Colorado	168,603
Wisconsin	1,646,682	Maine	106,938
Pennsylvania	462,321	Other States	1,410,160
Connecticut	323,908		
Minnesota	267,492		6,276,184
Iowa	197,183		

Nebraska and South Carolina used more than 175, 000 gallons each in the manufacture of soft drinks, but the figures for these States may not be shown separately, for the reason that there were less than three producers in each State. The figures are therefore included under "Other States."

IMPORTS.

The total imports of natural mineral waters entered for consumption in the United States in 1920, as reported by the Bureau of Foreign and Domestic Commerce, Department of Commerce, amounted to 466,547 gallons, valued at points of shipment at $177,992, the average value per gallon being 38 cents. During the entire year 833,206 pounds of mineral salts obtained by evaporation from natural mineral waters were imported for consumption in this country. These imports were valued at $13,572.

Mineral waters imported for consumption in the United States, 1916–1920.

Year.	Quantity (gallons).	Value.	Average value per gallon (cents).
1916	1,553,199	$624,302	40
1917	618,405	268,665	43
1918 {January to June	288,701	138,671	48
1918 {July to December [a]	200,786	102,970	51
1919 [a]	193,933	112,732	58
1920 [a]	466,547	177,992	38

[a] Natural mineral waters exclusively. Figures for first half of 1918 and for all preceding years include artificial mineral waters and imitation mineral waters, in addition to natural mineral waters.

The following table shows the general imports by principal countries. The figures include both natural and artificial mineral waters.

Mineral waters imported into the United States in 1920,[a] by countries.

[General imports.]

Country.	Quantity (gallons).	Value.	Country.	Quantity (gallons).	Value.
Australia	45	$21	Hongkong	3	$19
Austria	5,721	753	Hungary	6,717	717
Belgium	7,824	1,911	Italy	45,153	23,593
Canada	2,007	1,165	Japan	147	78
Canary Islands	624	74	Netherlands	10,005	7,154
Cuba	162	140	Norway	981	1,287
Czecho-Slovakia	8,472	948	Portugal	72	61
Denmark	63	59	Spain	1,485	1,884
England	426	89	Sweden	36	25
France	320,340	112,095			
Germany	191,892	49,741		602,175	201,814

[a] Include artificial and natural water.

"General imports" and "imports for consumption" for any period will differ to the extent that the value of entries for warehouse for the period differs from the value of withdrawals from warehouse for consumption. The term "entry for consumption" is the technical name of the import entry made at the customhouse and implies that the goods have been delivered into the custody of the importer and that the duties have been paid on the dutiable portion.

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.

SAND AND GRAVEL.

By L. M. Beach.

PRODUCTION.

In spite of such hampering conditions as an insufficient supply of cars, the high cost of transportation, and the disorder of the local markets the quantity of sand and gravel produced in the United States in 1920 increased 16 per cent and the value 43 per cent over 1919.

The customary tables on production by States and by uses follow, but the usual discussion of these tables is omitted on account of inadequate funds for printing. The production of gravel is subdivided by uses for the first time in this report.

Sand and gravel produced in the United States, 1916–1920, by kinds, in short tons.

Kind.	1916	1917	1918	1919	1920
Glass sand	2,018,317	1,942,675	2,172,887	1,827,409	2,165,926
Molding sand	4,662,649	4,660,968	4,910,178	3,774,612	5,128,075
Building sand	27,193,462	25,374,987	19,686,885	21,969,736	26,539,365
Grinding and polishing sand	1,370,354	1,179,190	975,265	988,240	1,132,810
Fire or furnace sand	426,654	604,035	472,733	355,458	400,953
Engine sand	1,383,034	1,410,222	1,462,465	1,481,481	1,754,897
Paving sand	3,998,548	4,348,474	2,722,144	4,431,306	5,920,328
Filter sand	76,053	62,170	51,111	58,342	83,983
Other sands	1,834,907	1,262,785	666,152	1,083,152	649,805
Railroad ballast	13,649,827	10,260,999	8,064,505	8,715,842	9,081,815
Gravel (exclusive of railroad ballast)	32,477,927	25,312,820	20,640,101	25,890,829	29,183,431
	89,091,732	76,419,325	61,824,426	70,576,407	82,041,388

Sand and gravel produced in the United States in 1919 and 1920, by States and uses, in short tons.

1919.

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire or furnace sand.		Engine sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			99,753	$59,653	255,520	$123,553					(a)	(a)
Arizona					(a)	(a)						
Arkansas	(a)	(a)	(a)	(a)	128,989	82,441	(a)	(a)			(a)	(a)
California	(a)	(a)	(a)	(a)	764,214	339,907					(a)	(a)
Colorado			(a)	(a)	89,936	45,191			(a)	(a)	(a)	(a)
Connecticut			1,918	2,474	192,753	127,469						
Delaware			(a)	(a)	2,544	1,315			(a)	(a)	(a)	(a)
Florida					74,980	47,955	(a)	(a)			(a)	(a)
Georgia	(a)	(a)	66,981	34,784	246,711	116,627	(a)	(a)			14,341	$4,988
Hawaii					(a)	(a)						
Idaho					(a)	(a)						
Illinois	521,286	$886,707	482,219	338,893	2,187,682	1,027,452	28,885	$82,303	44,421	$30,474	83,596	25,028
Indiana	88,030	27,338	572,292	243,199	1,093,836	434,085	(a)	(a)	(a)	(a)	191,227	65,884
Iowa			6,405	14,318	913,400	531,596	(a)	(a)	(a)	(a)	39,891	9,230
Kansas					855,077	465,300					35,217	15,073
Kentucky	(a)	(a)	15,622	24,767	423,350	320,871	(a)	(a)	(a)	(a)	(a)	(a)
Louisiana	(a)	(a)			183,419	96,000					(a)	(a)
Maine					17,168	8,598						
Maryland	(a)	(a)	(a)	(a)	873,952	685,403			(a)	(a)	(a)	(a)
Massachusetts	(a)	(a)	10,610	9,092	500,237	480,314	(a)	(a)	(a)	(a)	(a)	(a)
Michigan	(a)	(a)	124,006	66,877	539,800	251,733	(a)	(a)	(a)	(a)	6,958	2,268
Minnesota			6,751	9,328	343,537	186,353	(a)	(a)	(a)	(a)	(a)	(a)
Mississippi					120,187	68,181					(a)	(a)
Missouri	135,683	209,938	85,732	73,178	656,827	194,996	175,513	163,858	(a)	(a)	22,543	21,376
Montana					12,080	14,662	(a)	(a)			(a)	(a)
Nebraska			(a)	(a)	790,316	299,337					(a)	(a)
Nevada												
New Hampshire					2,803	3,403						
New Jersey	121,799	225,036	501,583	583,656	1,640,704	763,896	43,097	79,048	63,232	93,447	90,789	63,837
New Mexico											(a)	(a)
New York			418,319	609,730	1,974,827	705,603	(a)	(a)	(a)	(a)	43,102	24,997
North Carolina			(a)	(a)	80,942	28,445	(a)	(a)	(a)	(a)	(a)	(a)
North Dakota					(a)	(a)						
Ohio	79,580	191,565	689,555	1,137,356	2,063,918	1,173,324	32,469	107,733	56,955	127,185	55,868	31,515
Oklahoma	(a)	(a)			343,867	210,052					(a)	(a)
Oregon			(a)	(a)	163,574	157,396						
Pennsylvania	325,810	797,068	512,862	712,460	1,517,957	1,289,827	483,307	804,108	121,737	129,984	294,927	456,604
Rhode Island			(a)	(a)	(a)	(a)						
South Carolina			(a)	(a)	107,784	89,219						
South Dakota					59,286	50,920						

Tennessee	(a)	(a)	16,605	16,631	351,134	285,015	(a)	(a)	(a)	(a)	33,893	21,526
Texas	(a)	(a)	(a)	(a)	430,413	269,455	(a)	(a)	(a)	(a)	49,791	17,611
Utah					(a)	(a)					(a)	(a)
Vermont			4,012	2,919	(a)	(a)	44,241	9,106				
Virginia			7,817	12,377	685,988	453,701	(a)	(a)	(a)	(a)	86,944	35,543
Washington			(a)	(a)	122,930	66,151					9,724	6,446
West Virginia	407,918	933,863	(a)	(a)	176,829	218,700	(a)	(a)	(a)	(a)	148,237	147,973
Wisconsin	(a)	(a)	121,742	159,106	859,020	455,948	(a)	(a)			46,335	7,796
Wyoming					(a)	(a)						
Undistributed	147,303	321,856	29,828	43,192	121,245	126,270	180,728	80,679	69,113	54,947	228,098	185,160
	1,827,409	3,593,371	3,774,612	4,153,990	21,969.736	12,296,664	988,240	1,326,835	355,458	436,037	1,481,481	1,142,855

State.	Paving sand.		Filter sand.		Other sands.		Railroad ballast.		Gravel.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	(a)	(a)					349,401	$116,690	78,962	$99,215	785,479	$400,338
Arizona	(a)	(a)					(a)	(a)			(a)	(a)
Arkansas	(a)	(a)			(a)	(a)	382,661	93,769	281,880	163,724	871,328	406,802
California	520,296	$196,852	(a)	(a)	00,098	$17,852	571,402	111,231	1,242,220	684,256	3,168,517	1,426,517
Colorado	16,233	9,895							127,508	91,105	248,483	154,978
Connecticut	(a)	(a)							62,279	80,264	261,815	212,286
Delaware	15,753	7,737							(a)	(a)	34,843	19,404
Florida					(a)	(a)	(a)	(a)	(a)	(a)	271,794	164,101
Georgia	21,284	12,320			(a)	(a)			(a)	(a)	362,487	181,844
Hawaii									(a)	(a)	(a)	(a)
Idaho									(a)	(a)	(a)	(a)
Illinois	173,054	107,127	(a)	(a)	8,008	12,048	1,378,321	548,249	2,184,361	1,189,813	7,093,333	4,252,094
Indiana	453,487	242,779			509,107	128,445	1,013,950	306,340	2,256,905	1,226,863	6,187,741	2,680,968
Iowa	165,597	86,235	20,242	$13,224	134,828	65,315	50,394	19,712	755,289	636,497	2,093,471	1,383,764
Kansas	(a)	(a)			(a)	(a)			59,304	24,720	954,121	507,642
Kentucky	(a)	(a)			(a)	(a)	(a)	(a)	673,567	349,359	1,151,297	744,073
Louisiana									586,295	508,196	772,943	605,401
Maine	(a)	(a)							28,924	30,521	46,296	39,319
Maryland	(a)	(a)			(a)	(a)			792,716	985,686	1,747,587	1,800,882
Massachusetts	261,237	478,669			(a)	(a)	(a)	(a)	489,937	730,485	1,381,555	1,839,435
Michigan	204,045	75,228			9,446	3,220	67,916	21,861	2,639,483	1,378,929	3,772,535	1,944,143
Minnesota	162,985	87,344	(a)	(a)	(a)	(a)	129,649	21,544	603,200	546,121	1,304,395	905,341
Mississippi	(a)	(a)					517,913	88,837	983,405	487,271	1,624,538	645,795
Missouri					(a)	(a)	167,232	33,078	419,674	176,203	1,665,295	873,333
Montana					(a)	(a)	(a)	(a)	40,835	51,887	159,564	71,736
Nebraska	76,117	34,138			29,797	6,482	39,418	17,424	271,611	197,659	1,211,395	556,080
Nevada					(a)	(a)	(a)	(a)			70,569	7,011
New Hampshire	(a)	(a)			(a)	(a)	(a)	(a)	322,001	62,188	333,073	70,174
New Jersey	281,124	149,842	15,842	23,580	36,457	30,880			915,599	563,050	3,710,226	2,576,272

a Included in "Undistributed."

Sand and gravel produced in the United States in 1919 and 1920, by States and uses, in short tons—Continued.

1919—Continued.

State.	Paving sand.		Filter sand.		Other sands.		Railroad ballast.		Gravel.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New Mexico	(a)	(a)			(a)	(a)			(a)	(a)	(a)	(a)
New York	51,865	$36,013	(a)	(a)	(a)	(a)	(a)	(a)	1,441,161	$842,758	3,987,987	$2,246,880
North Carolina	(a)	(a)	(a)	(a)			310,404	$59,018	179,882	157,511	600,887	266,631
North Dakota									(a)	(a)	(a)	(a)
Ohio	444,161	260,330			19,703	$22,715	1,344,800	427,846	1,652,970	1,121,823	6,439,979	4,601,392
Oklahoma	(a)	(a)	(a)	(a)	(a)	(a)			79,445	48,852	467,482	304,029
Oregon	30,753	27,002			(a)	(a)	146,417	21,363	452,346	296,415	797,288	506,526
Pennsylvania	646,816	562,114	(a)	(a)	12,165	11,376			1,783,625	1,129,028	5,699,306	5,892,679
Rhode Island	(a)	(a)							(a)	(a)	8,950	11,142
South Carolina	(a)	(a)	(a)	(a)			(a)	(a)	(a)	(a)	298,787	157,220
South Dakota	(a)	(a)					510,893	127,386	77,763	51,584	648,939	231,390
Tennessee	41,178	33,325					(a)	(a)	452,051	324,954	1,006,708	734,212
Texas	(a)	(a)			(a)	(a)	317,630	110,014	806,273	562,939	1,673,119	991,798
Utah	(a)	(a)			(a)	(a)	138,314	16,082	153,163	110,628	383,372	190,606
Vermont							(a)	(a)	3,901	794	52,323	12,861
Virginia	(a)	(a)			(a)	(a)	(a)	(a)	677,355	787,414	1,565,592	1,349,148
Washington	283,391	98,989					242,375	58,250	573,331	306,226	1,231,814	536,132
West Virginia	143,754	146,557			(a)	(a)			299,535	293,188	1,183,606	1,750,201
Wisconsin	249,854	142,219			139,591	49,642	350,352	160,115	995,323	566,776	2,763,249	1,543,434
Wyoming									348,063	39,200	349,181	40,825
Undistributed	188,322	119,726	22,258	$49,488	153,952	91,219	686,400	232,244	98,687	66,722	133,158	114,717
	4,431,306	2,914,441	58,342	86,292	1,083,152	439,194	8,715,842	2,591,053	25,890,829	16,970,824	70,576,407	45,951,556

a Included in "Undistributed."

Sand and gravel produced in the United States in 1919 and 1920, by States and uses, in short tons—Continued.

1920.

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire or furnace sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			97,539	$62,921	244,379	$155,321	200	$160		
Arizona					3,795	3,276				
Arkansas					159,027	113,607				
California	10,353	$43,744	31,263	53,508	1,685,987	903,807	(a)	(a)	(a)	(a)
Colorado			(a)	(a)	61,724	45,166				
Connecticut			3,261	4,622	232,195	167,331				
Delaware			11,779	9,281	3,180	2,182				
District of Columbia					(a)	(a)				
Florida					46,649	23,501	1,400	910		
Georgia	(a)	(a)	39,031	20,481	263,467	161,521	4,443	2,231	(a)	(a)
Hawaii					(a)	(a)				
Idaho					(a)	(a)				
Illinois	714,353	1,380,711	763,590	915,190	2,211,776	1,440,761	33,443	158,250	40,524	$44,345
Indiana	52,857	33,401	490,901	287,181	951,050	464,783	8,284	4,955		
Iowa			10,566	13,254	1,058,990	788,184				
Kansas					1,175,500	825,588	(a)	(a)		
Kentucky	(a)	(a)	198,627	194,569	469,713	286,091			(a)	(a)
Louisiana	1,584	1,200			215,641	153,352				
Maine					19,442	11,359				
Maryland	28,444	64,717	(a)	(a)	828,729	636,000				
Massachusetts	(a)	(a)	8,873	9,065	612,961	576,255	15,673	29,943	(a)	(a)
Michigan	(a)	(a)	239,439	179,754	789,495	482,081	(a)	(a)	(a)	(a)
Minnesota			7,312	12,234	670,438	428,899	8,212	14,419	7,338	1,098
Mississippi					48,118	19,574				
Missouri	153,421	269,205	128,823	129,174	745,235	387,247	(a)	(a)		
Montana			(a)	(a)	10,430	13,463				
Nebraska			2,050	2,825	1,027,229	390,104				
Nevada										
New Hampshire					24,846	13,054				
New Jersey	141,079	300,489	735,930	1,191,523	1,794,424	1,065,999	76,803	200,941	69,761	132,657
New Mexico			(a)	(a)	(a)	(a)				
New York			590,577	1,232,721	3,211,044	1,526,248	3,272	1,878	21,524	19,574
North Carolina					110,783	70,507				
North Dakota					(a)	(a)				
Ohio	55,844	139,299	966,445	1,958,572	2,222,807	1,649,610	42,954	209,150	111,134	303,018
Oklahoma	31,804	74,494			430,203	250,043				
Oregon					300,067	327,534	6,128	7,915		
Pennsylvania	394,450	925,395	611,930	1,020,927	1,963,779	2,266,500	427,019	1,105,940	122,931	192,375
Rhode Island			12,651	22,802	3,763	4,848				
South Carolina					53,404	42,408				
South Dakota					75,128	81,857				

a Included in "Undistributed."

Sand and gravel produced in the United States in 1919 and 1920, by States and uses, in short tons—Continued.

1920—Continued.

State.	Glass sand.		Molding sand.		Building sand.		Grinding and polishing sand.		Fire or furnace sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Tennessee	(a)	(a)	29,069	$20,982	458,962	$443,507	14,071	$10,080	3,927	$2,779
Texas	7,073	$12,390	(a)	(a)	409,120	349,103	(a)	(a)		
Utah					67,783	37,205				
Vermont			4,164	3,915	2,069	648	(a)	(a)		
Virginia			12,499	15,493	496,753	301,183	(a)	(a)		
Washington					337,675	202,036			(a)	(a)
West Virginia	494,764	1,270,856	(a)	(a)	213,951	259,288	(a)	(a)	2,375	3,081
Wisconsin	(a)	(a)	128,562	137,646	563,276	403,519	(a)	(a)		
Wyoming					51,731	23,825				
Undistributed	79,900	232,789	3,194	6,119	212,647	158,260	490,908	290,307	21,439	25,529
	2,165,926	4,748,690	5,128,075	7,504,759	26,539,365	17,956,635	1,132,810	2,037,079	400,953	724,456

State.	Engine sand.		Paving sand.		Filter sand.		Other sand.		Total sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	4,025	$2,600	60,700	$48,891			16,100	$8,100	422,943	$277,993
Arizona									3,795	3,276
Arkansas	10,400	4,800	49,602	38,179			(a)	(a)	219,194	156,686
California	23,378	8,357	533,865	241,242	498	$1,499	6,420	6,857	2,308,347	1,263,825
Colorado	(a)	(a)	33,783	13,690					117,076	73,200
Connecticut			11,878	11,700	15,000	5,000			262,334	188,653
Delaware	(a)	(a)	(a)	(a)					31,320	20,337
District of Columbia									(a)	(a)
Florida	8,800	890			2,000	1,300			58,849	26,601
Georgia	10,323	4,480	43,654	31,420	(a)	(a)	(a)	(a)	375,052	231,858
Hawaii									(a)	(a)
Idaho									(a)	(a)
Illinois	139,273	49,529	359,849	270,236	1,200	3,850	22,860	28,901	4,286,868	4,291,773
Indiana	186,578	86,411	557,422	317,400			62,027	48,509	2,309,119	1,242,640
Iowa	27,334	16,366	205,893	152,337	41,084	28,130	159,514	109,364	1,503,381	1,107,635
Kansas	16,140	11,093	82,564	68,205					1,274,604	905,186
Kentucky	(a)	(a)	24,639	23,639					721,056	554,294
Louisiana	2,171	325	94,536	34,866					313,932	189,743
Maine									19,442	11,359
Maryland	40,809	91,892	(a)	(a)			(a)	(a)	908,886	814,198
Massachusetts	52,415	53,984	30,166	16,501	760	1,898	31,114	38,724	765,481	747,172
Michigan	5,547	2,943	460,438	254,723			1,594	1,266	1,708,770	1,148,380
Minnesota	7,337	2,926	202,871	135,403	6,587	17,036	15,144	12,057	925,239	624,072
Mississippi	5,565	1,670	45,900	34,000					99,583	55,244

Missouri	(a)	(a)	46,105	31,589			750	1,680	1,213,596	976,428
Montana			(a)	(a)					18,080	19,813
Nebraska	40,946	14,557					17,218	3,520	1,087,443	411,006
Nevada										
New Hampshire			42,000	9,000					66,846	22,054
New Jersey	124,519	93,175	563,855	328,210	14,889	43,707	35,529	42,196	3,556,789	3,398,897
New Mexico	9,121	5,449	(a)	(a)					37,465	25,946
New York	186,215	107,640	84,187	64,305			3,577	4,318	4,100,396	2,956,684
North Carolina	(a)	(a)	70,395	87,312					183,157	158,756
North Dakota									(a)	(a)
Ohio	64,589	45,552	428,925	269,308			23,591	42,779	3,916,289	4,617,288
Oklahoma			127,156	128,087			(a)	(a)	594,563	454,624
Oregon	(a)	(a)	44,808	42,500			(a)	(a)	353,934	382,124
Pennsylvania	333,686	484,249	756,753	725,595	(a)	(a)	46,402	54,631	4,657,950	6,776,862
Rhode Island									16,414	27,650
South Carolina	2,665	1,503	(a)	(a)	(a)	(a)			75,647	62,093
South Dakota			3,714	4,769					78,842	86,626
Tennessee	16,616	16,635	16,717	19,131			36,610	28,600	576,222	542,027
Texas	35,293	18,222	(a)	(a)					483,749	388,135
Utah	(a)	(a)	80,229	49,773			(a)	(a)	168,746	97,381
Vermont							(a)	(a)	38,409	5,964
Virginia	(a)	(a)	43,500	35,450	(a)	(a)	20,004	22,101	670,793	415,550
Washington	10,750	2,692	279,186	169,293			(a)	(a)	627,982	374,262
West Virginia	171,858	201,951	95,922	105,731			118,231	146,811	1,152,020	2,045,109
Wisconsin	55,655	19,002	394,676	252,519			3,285	1,957	1,224,863	853,782
Wyoming			(a)	(a)					(a)	(a)
Undistributed	162,889	86,270	44,440	35,948	1,965	3,900	29,835	32,189	240,676	165,428
	1,754,897	1,435,163	5,920,328	4,050,952	83,983	106,320	649,805	634,560	43,776,142	39,198,614

State.	Building gravel.		Roofing gravel.		Paving gravel.		Railroad ballast.		Total gravel.		Total sand and gravel.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	93,618	$109,067	26,364	$29,584	80,202	$44,770	263,210	$24,225	463,394	$207,646	886,337	$485,639
Arizona	9,480	5,152							9,480	5,152	13,275	8,428
Arkansas	87,064	109,568	(a)	(a)	293,289	181,806	308,860	104,143	689,813	397,317	909,007	554,003
California	999,544	735,899	545	530	748,383	565,474	623,130	141,929	2,371,602	1,443,832	4,679,949	2,707,657
Colorado	27,494	25,041	(a)	(a)	24,598	26,630	33,548	13,926	105,640	85,597	222,716	158,797
Connecticut	77,691	89,103	1,346	1,801					79,037	90,904	341,371	279,557
Delaware											31,320	20,337
District of Columbia	(a)	(a)			(a)	(a)			(a)	(a)	(a)	(a)
Florida					73,900	91,000			73,900	91,000	132,749	117,601
Georgia											375,052	231,858
Hawaii	(a)	(a)					(a)	(a)	(a)	(a)	42,500	53,500
Idaho	(a)	(a)			(a)	(a)			(a)	(a)	24,939	19,956
Illinois	1,702,631	1,039,952	37,574	31,502	563,322	456,381	1,079,105	319,561	3,382,632	1,847,396	7,669,500	6,139,169
Indiana	658,288	514,336	7,700	5,726	1,162,125	715,714	1,133,794	368,445	2,961,907	1,604,221	5,271,026	2,846,861

a Included in "Undistributed."

Sand and gravel produced in the United States in 1919 and 1920, by States and uses, in short tons—Continued.

1920—Continued.

State.	Building gravel.		Roofing gravel.		Paving gravel.		Railroad ballast.		Total gravel.		Total sand and gravel.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Iowa	256,600	$291,758	16,677	$26,202	499,072	$521,360	191,914	$46,486	964,263	$885,806	2,467,644	$1,993,441
Kansas	(a)	(a)							(a)	(a)	1,275,309	905,936
Kentucky	596,728	380,092	13,052	14,597	45,636	39,873	261,146	58,914	916,562	493,476	1,637,618	1,047,770
Louisiana	204,012	253,368	4,451	7,388	544,251	338,559	5,822	2,089	758,536	601,404	1,072,468	791,147
Maine	38,671	47,377			18,380	23,501			57,051	70,878	76,493	82,237
Maryland	584,163	789,344			50,742	24,347			634,905	813,691	1,543,791	1,627,889
Massachusetts	332,975	521,835	54,875	30,104	26,374	27,295	67,251	73,929	481,475	653,163	1,246,956	1,400,335
Michigan	1,201,710	878,959	12,793	11,531	1,229,493	766,924	233,816	61,672	2,677,812	1,719,086	4,386,582	2,867,466
Minnesota	423,690	408,051	11,279	15,129	257,695	239,257	188,465	45,006	881,129	707,443	1,806,368	1,331,515
Mississippi	254,180	201,790	5,000	4,440	1,249,287	751,918	162,931	77,557	1,671,398	1,035,705	1,770,981	1,090,949
Missouri	161,183	127,666	1,250	1,000	304,840	183,993	228,445	67,265	695,718	379,924	1,909,314	1,356,352
Montana	45,109	18,669	(a)	(a)	24,454	17,225	160,577	18,240	230,180	54,173	248,260	73,986
Nebraska	20,702	13,682	767	1,534	545,764	315,659	21,764	4,845	588,997	335,720	1,676,440	746,726
Nevada	(a)	(a)			(a)	(a)	(a)	(a)	7,640	2,797	7,640	2,797
New Hampshire	17,375	23,866			227,869	60,185	(a)	(a)	248,086	85,407	314,932	107,461
New Jersey	946,526	835,184	(a)	(a)	111,531	93,568			1,059,655	931,947	4,616,444	4,330,844
New Mexico	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	171,728	102,869	209,193	128,815
New York	1,706,213	1,208,404	7,770	5,583	230,677	120,486	81,962	47,300	2,026,622	1,381,773	6,127,018	4,338,457
North Carolina	122,249	146,408	3,591	8,351	32,414	35,438	178,714	54,840	336,968	245,037	520,125	403,793
North Dakota	(a)	(a)							(a)	(a)	(a)	(a)
Ohio	1,010,657	832,710	71,864	75,853	642,886	459,908	1,024,123	448,868	2,749,530	1,817,339	6,665,819	6,434,627
Oklahoma	92,980	67,045			44,940	60,217	(a)	(a)	281,114	171,475	875,677	626,099
Oregon	387,490	362,775	(a)	(a)	303,678	238,031	196,797	39,318	891,568	646,129	1,245,502	1,028,253
Pennsylvania	984,946	868,016	(a)	(a)	705,811	681,709	46,950	10,251	1,763,789	1,570,409	6,421,739	8,347,271
Rhode Island	1,565	1,892							1,565	1,892	17,979	29,542
South Carolina	(a)	(a)			31,744	35,320	(a)	(a)	187,983	123,952	263,630	186,045
South Dakota	6,962	3,742			50,050	35,200	436,405	128,046	493,417	166,988	572,259	255,614
Tennessee	232,299	200,242	(a)	(a)	209,815	174,420	(a)	(a)	541,023	470,330	1,117,245	1,012,357
Texas	1,154,334	1,702,116			656,330	344,160	554,896	242,472	2,365,560	2,288,748	2,849,309	2,676,883
Utah	21,224	5,472			245,639	137,264	84,046	12,410	350,909	155,146	519,655	252,527
Vermont					2,892	851	(a)	(a)	2,979	892	41,388	6,856
Virginia	376,251	534,842	2,149	7,550	82,328	126,069	82,306	49,268	543,034	717,729	1,213,827	1,133,279
Washington	146,928	113,273	(a)	(a)	952,210	474,167	248,488	53,827	1,348,987	642,664	1,976,969	1,016,926
West Virginia	193,384	252,304			202,401	216,121			395,785	468,425	1,547,805	2,513,534
Wisconsin	300,328	247,889	19,103	9,152	586,225	354,263	292,170	88,536	1,197,826	699,840	2,422,689	1,553,622
Wyoming	8,628	13,700			(a)	(a)	433,014	93,697	442,392	108,647	494,423	132,972
Undistributed	128,009	127,029	102,461	103,903	107,692	97,277	458,166	190,508	161,655	139,022	282,156	205,919
	15,613,881	14,107,618	400,611	391,460	13,168,939	9,076,340	9,081,815	2,887,573	38,265,246	26,462,991	82,041,388	65,661,605

[a] Included in "Undistributed."

IMPORTS AND EXPORTS.[1]

The quantity of sand imported and entered for consumption in the United States in 1920 was more than double that imported in 1919. Most of the sand imported was building sand brought in on scows from Canada, but some of it was carried as ship ballast and was entered at ocean ports. Included in this was glass sand from Belgium landed in California.

Sand imported for consumption in United States, 1917–1920, in short tons.

Year.	Quantity.	Value.	Average price per ton.
1917	(a)	$142,586	
1918	(a)	91,465	
1919	597,481	126,586	$0.21
1920	1,226,684	912,282	.74

a Not available.

The exports of sand and gravel have been negligible until recently. The largest quantity exported is that sent to Canada for use as building material. No information is at hand as to the kinds of sand sent to the other countries named in the following table. Much of it, doubtless, is building sand carried as ballast.

Value of sand and gravel exported from the United States in 1917–1920.

Destination.	1917	1918	1919	1920
Canada	$415,699	$599,876	$347,578	$583,574
Mexico	16,892	3,741	14,803	38,402
Panama	33,941	2,721	4,650	13,307
Japan	5,951	2,674	3,091	6,758
England	7,136	2,300	967	6,161
Cuba	1,743	1,788	2,438	10,746
Newfoundland	1,039	930	279	1,418
Brazil	226	393	40	66
China	217	132	130	833
Argentina	6		712	58
Other countries	11,401	4,859	7,382	8,622
	494,251	619,414	382,070	669,945

PRICES.

There was an increase in the average price of sand for each of the uses listed except filter sand, and the average price of all sand increased 23 per cent in 1920.

The prices given in this table for each use were obtained by dividing the total value of the sand sold by the total number of tons sold. High-grade glass sand in certain localities brought $2.50 a ton in 1920, and large quantities of low-grade silica sand used for making colored glass bottles and other cheap glass were sold for less than 50 cents a ton. Nevertheless the average price was more than $2 a ton. Although building sand sold in some of the large eastern cities in 1920 from $1 to $2 a ton, this was exceptional, and sand for

[1] Statistics of imports and exports compiled by J. A. Dorsey, United States Geological Survey, from records of Bureau of Foreign and Domestic Commerce.

building sold throughout the country, except in large cities, for less than 75 cents a ton.

The average price of most of the different sands listed in the table has either doubled or a little more than doubled in the last five years. The average price of grinding and polishing sand has nearly trebled.

Average price per short ton of sand and gravel marketed in the United States, 1916–1920.

Kind.	1916	1917	1918	1919	1920
Glass sand	$0.97	$1.38	$1.94	$1.97	$2.19
Molding sand	.69	.92	1.04	1.10	1.46
Building sand	.32	.39	.50	.56	.68
Grinding and polishing sand	.65	1.04	1.60	1.34	1.80
Fire or furnace sand	.90	1.15	1.48	1.23	1.81
Engine sand	.37	.59	.76	.77	.82
Paving sand	.36	.41	.54	.66	.68
Filter sand	.90	.76	1.47	1.48	1.27
Railroad ballast	.13	.17	.22	.30	.32
Gravel	.32	.46	.57	.66	.81
All kinds	.33	.46	.61	.65	.80

LIME.

By G. F. Loughlin and A. T. Coons.

GENERAL CONDITIONS.

Although more lime was produced in 1920 than in 1919, the supply was not large enough to meet the demand. The shortage was not due to the inability of the plants to increase their output, for many did not operate at full capacity, but to conditions beyond the control of the lime makers. The shortage of freight cars, although not so great as in 1919, was still so bad that many plants were forced to operate on part time; there was a continued lack of skilled and efficient labor, particularly in the early part of the year; and fuel was often scarce and always high in price.

Nearly all lime producers reported higher prices in 1920 than in 1919, owing to the increase in cost caused by the operation of the plants for only part of the time, to inefficiency of labor, and to the high price of coal.

There is every reason to predict better prospects for the lime industry. During the war and the period of readjustment the industry labored under difficulties, for it was not regarded as an essential war industry. There has been no overproduction of lime, and therefore there will probably be no great decrease in the output in the coming year. The conditions adverse to building, paper making, and the metal industries will react to some extent upon the production of lime, but any reduction in output from these causes will be only temporary.

Building lime.—Most of the reports from producers indicate that the demand for building lime was greater in 1920 than in 1919. The demand fell off a little in the last three months of 1920, undoubtedly on account of the general business depression that began to be severely felt about that time throughout the country. This slackening in demand can be only temporary.

Agricultural lime.—Producers of agricultural lime reported that the demand in 1920 was about the same or slightly less than in 1919. Lime for other uses was ordered so heavily that some producers found it impossible to fill orders for the cheaper agricultural lime. The production of burned lime for use in agriculture has decreased steadily since 1914, and the indications do not point to any early change for the better.

Chemical lime.—The strong demand for chemical lime during the war fell off soon after the armistice was declared. In the last half of 1919, however, the demand began to increase, and in 1920 it was as good as the demand for building lime, if not better. Michigan, Vermont, Indiana, Virginia, and West Virginia, most of whose lime output is sold for chemical uses, reported a much larger demand for chemical lime. Many producers found themselves unable to supply the demand, owing to shortage of labor and cars.

Metallurgical lime.—Although a comparatively small number of producers make lime for use in metallurgy, the call for this purpose was apparently better than in 1919. There was, however, a decided falling off in the orders during November and December, and a slackened call will undoubtedly continue, as many smelters and steel furnaces have shut down or have materially decreased their output.

Dolomite.—The unusual increase in the production of dead-burned dolomite is one of the interesting features of the lime industry in 1920. Dead-burned dolomite is used principally in lining basic open-hearth furnaces and is substituted for calcined magnesite for this purpose. In 1920 the imports of magnesite were renewed, although the quantity imported did not equal the average for pre-war years. The production of magnesite in California and Washington was greater than in 1919, but notwithstanding this increase and the increase in imports the production of dead-burned dolomite in 1920 was much greater than in 1919.

PRODUCTION.

Lime sold in the United States in 1916–1920.

Year.	Quantity (short tons).	Value.[a]	Average value per ton.	Number of plants in operation.
1916	4,073,433	$18,509,305	$4.54	778
1917	3,786,364	23,807,877	6.29	595
1918	3,206,016	26,808,909	8.36	496
1919	3,330,347	29,448,553	8.84	539
1920	3,570,141	37,543,840	10.52	515
Percentage of increase or decrease in 1920	+7.2	+27.5	+19.0	−4.5

[a] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Lime sold in the United States in 1919 and 1920, by States.

1919.

State.	Rank of State by quantity.	Quantity (short tons).	Percentage of total quantity.	Value.	Rank of State by value.	Average value per ton.	Number of plants in operation.
Alabama	7	135,095	4.1	$1,062,542	11	$7.87	10
Arizona	22	10,905	.3	138,062	22	12.66	3
Arkansas	23	10,794	.3	115,019	23	10.66	4
California	18	39,307	1.2	466,905	17	11.88	8
Colorado	36	2,136	.1	26,102	36	12.22	3
Connecticut	16	(a)	(a)	(a)	16	10.27	5
Florida	24	(a)	(a)	(a)	24	12.64	2
Hawaii	34	(a)	(a)	(a)	26	23.36	1
Idaho	38	(a)	(a)	(a)	37	14.76	2
Illinois	15	65,060	2.0	580,041	15	8.92	11
Indiana	12	107,460	3.2	902,469	13	8.40	6
Iowa	27	(a)	(a)	(a)	29	9.79	2
Kansas	41	(a)	(a)	(a)	42	15.04	1
Kentucky	40	988	(a)	9,275	40	9.39	3
Maine	14	96,582	2.9	1,207,508	8	12.50	4
Maryland	13	103,563	3.1	860,187	14	8.30	29
Massachusetts	8	131,762	4.0	1,339,464	6	10.17	11
Michigan	6	145,783	4.4	1,381,534	5	9.48	7
Minnesota	20	23,005	.7	294,313	20	12.79	6
Missouri	4	180,749	5.4	1,735,705	4	9.60	19

[a] Included under "Undistributed."

Lime sold in the United States in 1919 and 1920, by States—Continued.

1919—Continued.

State.	Rank of State by quantity.	Quantity (short tons).	Percentage of total quantity.	Value.	Rank of State by value.	Average value per ton.	Number of plants in operation.
Montana	32	3,340	0.1	$35,834	32	$10.73	3
Nevada	35	(a)	(a)	(a)	34	10.67	1
New Jersey	29	4,828	.1	29,098	35	6.03	7
New Mexico	37	1,758	.1	17,615	39	10.02	4
New York	9	126,404	3.8	1,131,860	9	8.95	16
North Carolina	26	(a)	(a)	(a)	27	9.59	2
Ohio	2	512,614	15.4	4,477,987	2	8.74	33
Oklahoma	33	(a)	(a)	(a)	33	11.03	2
Oregon	31	(a)	(a)	(a)	28	17.01	1
Pennsylvania	1	779,608	23.4	6,181,710	1	7.93	187
Porto Rico	28	5,407	.2	54,803	31	10.14	23
Rhode Island	39	(a)	(a)	(a)	38	15.91	1
South Dakota	30	4,205	.1	56,540	30	13.45	3
Tennessee	11	116,346	3.5	958,816	12	8.24	18
Texas	17	49,831	1.5	459,279	18	9.22	7
Utah	25	6,982	.2	94,027	25	13.47	12
Vermont	19	37,850	1.1	436,000	19	11.52	8
Virginia	3	223,768	6.7	1,805,627	3	8.07	36
Washington	21	19,534	.6	232,723	21	11.91	5
West Virginia	5	174,167	5.2	1,274,294	7	7.32	8
Wisconsin	10	123,620	3.7	1,094,725	10	8.86	23
Wyoming	42	(a)	(a)	(a)	41	24.61	2
Undistributed	....	86,896	2.6	988,489	....	....	....
	....	3,330,347	100.0	29,448,553	....	8.84	539

1920.

State.	Rank of State by quantity.	Quantity (short tons).	Percentage of total quantity.	Value.	Rank of State by value.	Average value per ton.	Number of plants in operation.
Alabama	6	151,595	4.2	$1,175,518	11	$7.75	12
Arizona	22	12,990	.4	184,850	22	14.23	3
Arkansas	23	11,479	.3	135,399	25	11.80	5
California	19	48,571	1.4	653,075	18	13.45	9
Colorado	39	1,914	.1	23,628	39	12.34	3
Connecticut	17	(a)	(a)	(a)	16	14.32	5
Florida	25	(a)	(a)	(a)	24	15.35	2
Georgia	40	(a)	(a)	(a)	40	11.57	1
Hawaii	38	2,120	.1	44,953	32	21.20	1
Idaho	37	(a)	(a)	(a)	36	13.48	2
Illinois	15	87,903	2.5	982,743	14	11.18	12
Indiana	9	134,672	3.7	1,348,819	10	10.02	7
Iowa	26	(a)	(a)	(a)	27	10.80	2
Kansas	42	(a)	(a)	(a)	42	15.04	1
Kentucky	40	1,757	(a)	18,063	41	10.28	4
Maine	12	101,503	2.8	1,495,625	8	14.73	4
Maryland	13	100,914	2.8	951,588	15	9.43	23
Massachusetts	10	129,108	3.6	1,753,110	6	13.58	11
Michigan	8	140,813	3.9	1,386,760	9	9.85	7
Minnesota	21	30,120	.8	356,906	20	11.85	6
Missouri	4	209,113	5.9	2,319,285	3	11.09	19
Montana	35	2,638	.1	30,020	35	11.38	3
Nevada	29	(a)	(a)	(a)	31	11.60	1
New Jersey	32	3,301	.1	27,407	38	8.30	7
New Mexico	33	3,034	.1	34,680	34	11.43	4
New York	14	92,357	2.6	1,047,261	13	11.34	15
North Carolina	27	(a)	(a)	(a)	26	17.04	1
Ohio	2	558,892	15.7	6,238,908	2	11.16	29
Oklahoma	36	(a)	(a)	(a)	37	11.39	2
Oregon	34	(a)	(a)	(a)	29	18.29	1
Pennsylvania	1	784,083	21.9	7,519,147	1	9.59	162
Porto Rico	31	3,392	.1	41,998	33	12.38	26
Rhode Island	30	(a)	(a)	(a)	28	15.54	1
South Dakota	28	(a)	(a)	(a)	30	11.29	2
Tennessee	11	119,034	3.3	1,098,603	12	9.23	17
Texas	16	56,489	1.6	569,135	19	10.08	8
Utah	24	9,797	.3	151,700	23	15.48	9
Vermont	18	50,192	1.4	716,137	17	14.27	9
Virginia	3	256,568	7.2	2,201,724	4	8.58	35
Washington	20	31,033	.9	324,042	21	10.44	7
West Virginia	5	193,490	5.4	1,813,666	5	9.37	10
Wisconsin	7	144,590	4.0	1,539,027	7	10.64	25
Wyoming	43	(a)	(a)	(a)	43	23.61	2
Undistributed	....	96,679	2.8	1,360,063	....	....	....
	....	3,570,141	100.0	37,543,840	....	10.52	515

a Included under "Undistributed."

Lime sold in the United States in 1919 and 1920, by uses.

Use.	Percentage of total quantity.	Quantity (short tons).	Value.	Average value per ton.
1919.				
Building	35.8	1,191,434	$11,484,318	$9.64
Agricultural	13.2	438,632	3,345,039	7.63
Chemical:				
Paper mills	10.1	335,813	2,836,347	8.45
Glass works	1.3	44,618	336,020	7.53
Sugar factories	.4	13,111	163,526	12.47
Tanneries	1.8	59,978	580,022	9.67
Metallurgy	8.9	295,622	2,152,554	7.28
Other uses [a]	25.8	861,022	7,595,818	8.82
Total chemical	48.3	1,610,164	13,664,287	8.49
Dealers	2.7	90,117	954,909	10.60
	100.0	3,330,347	29,448,553	8.84
Hydrated lime (included in totals)		777,408	7,061,146	9.08
1920.				
Building	36.6	1,305,412	15,269,683	11.70
Agricultural	9.9	351,851	3,096,705	8.80
Chemical:				
Paper mills	10.2	365,897	3,844,084	10.51
Glass works	1.5	54,747	551,945	10.08
Sugar factories	.4	14,145	175,798	12.43
Tanneries	1.7	61,162	668,999	10.94
Metallurgy	9.7	344,921	2,836,474	8.22
Other uses [a]	28.0	1,000,550	10,304,049	10.30
Total chemical	51.5	1,841,422	18,381,349	9.98
Dealers	2.0	71,456	796,103	11.14
	100.0	3,570,141	37,543,840	10.52
Percentage of increase in 1920		7.2	27.5	19.0
Hydrated lime (included in totals)		853,116	9,287,562	10.89
Percentage of increase of hydrated lime in 1920		9.7	31.5	19.9

[a] Details of distribution shown in following table.

Chemical lime sold for "other uses" in 1919 and 1920.

Use.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Refractories	222,036	$2,228,602	316,293	$3,732,522
Alkalies	136,896	879,203	104,250	687,907
Water purification			90,533	926,294
Sanitation	82,522	733,480	(a)	(a)
Calcium carbide	140,165	1,309,478	88,465	801,882
Manufacture of acids	8,178	81,380	48,361	485,449
Bleaching works	27,804	139,672	24,030	283,084
Calcium acetate	(a)	(a)	22,241	248,797
Silica brick	16,552	131,262	20,372	205,391
Sand-lime brick	5,096	65,684	19,520	208,984
Ammonia works	5,323	43,848	10,041	102,934
Coke and gas manufacture	17,207	142,552		
Coal and water gas purification			1,164	5,603
Coke-oven by-products			8,740	85,100
Gas-plant by-products			1,207	13,025
Oil, fat, and soap manufacture	29,205	241,525	3,238	35,224
Soap manufacture			18,607	171,912
Glue manufacture	4,499	45,707	5,641	67,065
Spraying			6,141	68,798
Cyaniding	5,206	61,107	4,295	50,115
Paint manufacture	2,275	22,788	1,954	18,528
Wood distillation	(a)	(a)	1,474	14,538
Sewage purification			1,361	14,842
Corn products	(a)	(a)	2,428	26,788
Explosives	7,196	58,770	(a)	(a)
Gelatine manufacture			1,183	14,884
Dairy products	(a)	(a)	1,207	34,227

[a] Included under "Undistributed," p. 181.

Chemical lime sold for "other uses" in 1919 and 1920—Continued.

Use.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons.)	Value.
Salt refining	(a)	(a)	921	$9,913
Flour mills	350	$2,810	313	3,861
Disinfectant			205	2,231
Manufacture of candles			114	1,067
Undistributed [b]	30,742	311,527	17,347	206,423
Unspecified	119,770	1,096,423	178,904	1,776,661
	861,022	7,595,818	1,000,550	10,304,049

[a] Included under "Undistributed."

[b] Includes in 1919: Lime used in the manufacture of calcium acetate, alcohol, phenol, salt, oxygen, corn products, dyes, rubber, textiles, baking powder, belting, lime pencils, dairy products, polishing and buffing compounds, distillation of wood; in 1920: Lime used in the manufacture of gypsum products, rubber, lubricating grease, polishing and buffing compounds, cyanide, pottery, textiles, explosives, cyanamid, phenol, barium products, basic magnesium carbonate, nitrates, alcohol, oxygen, dyes, for correcting the acidity of oils, for kalsomine, wire coating, purification of blast furnace gases, and for sanitation.

Lime sold in the United States in 1919 and 1920, by States and uses.

1919.

State.	Building.		Agriculture.		Chemicals.					
					Paper mills.		Glass works.		Sugar factories.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	38,492	$391,191	(a)	(a)	(a)	(a)				
Arizona	6,849	92,150	(a)	(a)			(a)	(a)		
Arkansas	10,614	113,364	(a)	(a)	(a)	(a)				
California	25,180	273,551	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Colorado	949	11,560								
Connecticut	(a)	(a)	(a)	(a)						
Florida	(a)	(a)								
Hawaii	(a)	(a)	(a)	(a)					(a)	(a)
Idaho	(a)	(a)			(a)	(a)				
Illinois	36,024	322,947			5,559	$52,644			(a)	(a)
Indiana	13,790	108,922	5,868	$49,461	26,489	209,940	(a)	(a)		
Iowa	(a)	(a)			(a)	(a)				
Kansas			(a)	(a)						
Kentucky	(a)	(a)	(a)	(a)						
Maine	41,918	664,186	8,763	59,558	39,379	407,623			(a)	(a)
Maryland	7,606	67,690	76,770	655,704	(a)	(a)			(a)	(a)
Massachusetts	53,958	663,504	4,673	25,532	48,959	442,240				
Michigan	10,427	105,731	(a)	(a)	9,945	90,478			(a)	(a)
Minnesota	22,273	279,409								
Missouri	46,646	444,304	1,123	8,540	9,430	84,619	1,428	$15,725	249	$2,650
Montana	(a)	(a)								
Nevada	(a)	(a)							(a)	(a)
New Jersey	(a)	(a)	4,154	21,997						
New Mexico	608	6,215								
New York	21,881	185,318	6,206	34,574	29,590	253,187			(a)	(a)
North Carolina	(a)	(a)	(a)	(a)						
Ohio	316,394	2,624,930	27,696	212,156	17,540	130,270	36,717	266,922	(a)	(a)
Oklahoma	(a)	(a)								
Oregon										
Pennsylvania	165,906	1,571,238	232,831	1,706,027	73,761	537,691	3,986	29,618	(a)	(a)
Porto Rico	2,587	21,945	1,650	14,590					1,170	18,268
Rhode Island	(a)	(a)	(a)	(a)			(a)	(a)		
South Dakota	(a)	(a)	(a)	(a)						
Tennessee	56,113	515,161	730	6,020	29,831	198,363			5,339	46,555
Texas	30,800	284,109	(a)	(a)					(a)	(a)
Utah	5,934	80,407			163	2,052				
Vermont	8,115	103,512	2,072	15,474	8,592	91,460				
Virginia	52,863	545,378	35,712	290,032	8,885	79,324	(a)	(a)	(a)	(a)
Washington	8,118	107,171	(a)	(a)	6,502	78,609			(a)	(a)
West Virginia	(a)	(a)	25,253	191,125						
Wisconsin	105,727	894,594	433	4,754	13,662	113,565				
Wyoming	(a)	(a)								
Undistributed	101,662	1,005,831	4,698	49,495	7,526	64,282	2,487	23,755	6,353	96,053
	1,191,434	11,484,318	438,632	3,345,039	335,813	2,836,347	44,618	336,020	13,111	163,526

[a] Included under "Undistributed."

Lime sold in the United States in 1919 and 1920, by States and uses—Continued.

1919—Continued.

State.	Chemicals—Continued.						Dealers.		Total.	
	Tanneries.		Metallurgy.		Other chemical uses.					
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	(a)	(a)	72,619	$475,158	18,927	$156,403			135,095	$1,062,542
Arizona	(a)	(a)	(a)	(a)	1,935	25,065			10,905	138,062
Arkansas					(a)	(a)	(a)	(a)	10,794	115,019
California	(a)	(a)	(a)	(a)	3,738	43,279			39,307	466,905
Colorado			(a)	(a)	(a)	(a)			2,136	26,102
Connecticut									(a)	(a)
Florida					(a)	(a)			(a)	(a)
Hawaii									(a)	(a)
Idaho									(a)	(a)
Illinois	(a)	(a)	(a)	(a)	18,071	157,411			65,060	580,041
Indiana	2,195	$20,552	3,415	26,533	46,339	409,850	7,809	$65,008	107,460	902,469
Iowa			(a)	(a)					(a)	(a)
Kansas									(a)	(a)
Kentucky									988	9,275
Maine	(a)	(a)	(a)	(a)	(a)	(a)			96,582	1,207,508
Maryland	(a)	(a)	(a)	(a)	1,534	14,767			103,563	860,187
Massachusetts			(a)	(a)	22,465	191,206	(a)	(a)	131,762	1,339,464
Michigan	4,152	38,908	1,364	12,930	118,218	1,118,545	(a)	(a)	145,783	1,381,534
Minnesota					(a)	(a)			23,005	294,313
Missouri	2,574	25,211	21,145	188,809	53,576	493,046	44,578	472,801	180,749	1,735,705
Montana			(a)	(a)	(a)	(a)			3,340	35,834
Nevada			(a)	(a)	(a)	(a)			(a)	(a)
New Jersey			(a)	(a)	(a)	(a)			4,828	29,098
New Mexico					(a)	(a)			1,758	17,615
New York	4,384	63,765	10,880	118,410	51,826	454,664	(a)	(a)	126,404	1,131,860
North Carolina	(a)	(a)							(a)	(a)
Ohio	(a)	(a)	6,973	52,007	106,912	1,188,790			512,614	4,477,987
Oklahoma									(a)	(a)
Oregon							(a)	(a)	(a)	(a)
Pennsylvania	11,416	88,629	84,489	530,923	204,210	1,696,659	2,235	15,507	779,608	6,181,710
Porto Rico									5,407	54,803
Rhode Island	(a)	(a)			(a)	(a)	(a)	(a)	(a)	(a)
South Dakota					(a)	(a)			4,205	56,540
Tennessee	2,815	24,032			20,456	161,776	1,062	6,909	116,346	958,816
Texas			(a)	(a)	(a)	(a)	(a)	(a)	49,831	459,279
Utah			885	11,568					6,982	94,027
Vermont	7,917	93,852	(a)	(a)	10,902	128,377	(a)	(a)	37,850	436,000
Virginia	4,546	38,212	8,431	74,807	109,318	733,484	(a)	(a)	223,768	1,805,627
Washington			(a)	(a)	1,294	12,940			19,534	232,723
West Virginia	(a)	(a)	54,562	416,177	(a)	(a)	(a)	(a)	174,167	1,274,294
Wisconsin	1,626	13,731			2,172	68,081			123,620	1,094,725
Wyoming									(a)	(a)
Undistributed	18,353	173,130	30,859	245,232	69,129	541,475	34,433	394,684	86,896	988,489
	59,978	580,022	295,622	2,152,554	861,022	7,595,818	90,117	954,909	3,330,347	29,448,553

[a] Included under "Undistributed."

Lime sold in the United States in 1919 and 1920, by States and uses—Continued.

1920.

State.	Building.		Agriculture.		Chemicals.					
					Paper mills.		Glass works.		Sugar factories.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	31,459	$381,181	......	......	(a)	(a)	......	......	......	......
Arizona	11,445	162,339	(a)	(a)	......	......	(a)	(a)	(a)	(a)
Arkansas	11,056	131,346	(a)	(a)	(a)	(a)	(a)	(a)	......	......
California	36,237	494,271	(a)	(a)	......	......	......	......	1,423	$22,889
Colorado	(a)	(a)	......	......	......	......	......	......	......	......
Connecticut	(a)	(a)	(a)	(a)	......	......	......	......	......	......
Florida	(a)	(a)	......	......	......	......	......	......	......	......
Georgia	(a)	(a)	......	......	......	......	......	......	......	......
Hawaii	150	3,750	475	$8,313	......	......	......	......	1,495	32,890
Idaho	(a)	(a)	(a)	(a)	(a)	(a)	......	......	......	......
Illinois	35,103	449,532	(a)	(a)	7,183	$73,062	......	......	(a)	(a)
Indiana	27,345	284,899	3,475	33,210	34,810	335,287	2,055	$22,340	(a)	(a)
Iowa	(a)	(a)	......	......	(a)	(a)	......	......	......	......
Kansas	......	......	(a)	(a)	......	......	......	......	......	......
Kentucky	1,757	18,063	......	......	......	......	......	......	......	......
Maine	40,730	749,147	7,810	39,157	45,477	606,452	......	......	(a)	(a)
Maryland	11,422	103,413	64,193	614,097	......	......	......	......	......	......
Massachusetts	65,708	1,021,242	4,552	26,096	43,364	523,151	......	......	(a)	(a)
Michigan	11,609	131,008	(a)	(a)	11,375	124,409	......	......	(a)	(a)
Minnesota	26,315	316,055	(a)	(a)	......	......	......	......	......	......
Missouri	57,184	632,068	1,891	20,770	14,909	157,842	1,376	15,722	(a)	(a)
Montana	(a)	(a)	......	......	......	......	......	......	......	......
Nevada	(a)	(a)	(a)	(a)	......	......	......	......	......	......
New Jersey	(a)	(a)	2,997	23,920	(a)	(a)	......	......	......	......
New Mexico	1,134	13,680	......	......	......	......	......	......	......	......
New York	22,082	266,639	3,323	23,912	25,796	280,110	(a)	(a)	207	2,781
North Carolina	(a)	(a)	......	......	......	......	......	......	......	......
Ohio	336,317	3,560,163	11,195	99,219	21,843	210,953	46,508	466,737	(a)	(a)
Oklahoma	(a)	(a)	......	......	......	......	......	......	......	......
Oregon	......	......	......	......	......	......	......	......	......	......
Pennsylvania	148,378	1,625,471	202,830	1,792,948	56,572	506,578	4,242	40,802	(a)	(a)
Porto Rico	858	9,093	922	11,392	......	......	......	......	1,502	18,963
Rhode Island	(a)	(a)	(a)	(a)	......	......	(a)	(a)	......	......
South Dakota	(a)	(a)	......	......	......	......	......	......	......	......
Tennessee	60,912	590,184	377	2,465	32,820	291,549	......	......	(a)	(a)
Texas	36,361	372,041	(a)	(a)	(a)	(a)	......	......	1,652	17,035
Utah	8,786	137,669	......	......	(a)	(a)	......	......	(a)	(a)
Vermont	17,700	264,843	752	5,157	14,426	196,090	......	......	......	......
Virginia	63,082	703,392	26,974	208,190	13,344	137,145	(a)	(a)	(a)	(a)
Washington	11,201	138,410	(a)	(a)	10,429	70,865	......	......	1,843	21,591
West Virginia	21,207	215,782	17,449	160,091	(a)	(a)	......	......	......	......
Wisconsin	127,856	1,331,467	356	1,824	11,464	113,972	......	......	......	......
Wyoming	(a)	(a)	......	......	......	......	......	......	......	......
Undistributed	82,018	1,162,535	2,280	25,944	22,085	216,619	566	6,344	6,023	59,649
	1,305,412	15,269,683	351,851	3,096,705	365,897	3,844,084	54,747	551,945	14,145	175,798

a Included under "Undistributed."

Lime sold in the United States in 1919 and 1920, by States and uses—Continued.

1920—Continued.

State.	Chemicals—Continued.						Dealers.		Total.	
	Tanneries.		Metallurgy.		Other chemical uses.					
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	(a)	(a)	87,485	$508,028	24,396	$204,684			151,595	$1,175,518
Arizona	(a)	(a)	(a)	(a)	1,039	15,326			12,990	184,850
Arkansas					255	2,700			11,479	135,399
California	1,495	$19,514	(a)	(a)	8,395	103,438			48,571	653,075
Colorado			(a)	(a)	1,060	13,020			1,914	23,628
Connecticut									(a)	(a)
Florida					(a)	(a)	(a)	(a)	(a)	(a)
Georgia									(a)	(a)
Hawaii									2,120	44,953
Idaho									(a)	(a)
Illinois	(a)	(a)	15,866	142,078	20,952	222,558	(a)	(a)	87,903	982,743
Indiana	(a)	(a)	8,614	84,299	56,734	570,853			134,672	1,348,819
Iowa									(a)	(a)
Kansas									(a)	(a)
Kentucky									1,757	18,063
Maine	(a)	(a)	(a)	(a)	2,301	32,161			101,503	1,495,625
Maryland			(a)	(a)	9,403	83,066			100,914	951,588
Massachusetts			(a)	(a)	12,251	148,238			129,108	1,753,110
Michigan	2,601	29,316	521	5,269	111,517	1,066,923	(a)	(a)	140,813	1,386,760
Minnesota			(a)	(a)	3,005	30,603			30,120	356,906
Missouri	(a)	(a)	24,107	257,249	68,289	750,507	37,812	$447,262	209,113	2,319,285
Montana			(a)	(a)	(a)	(a)			2,638	30,020
Nevada			(a)	(a)	(a)	(a)			(a)	(a)
New Jersey					(a)	(a)			3,301	27,407
New Mexico					1,930	21,000			3,034	34,680
New York	4,235	65,345	13,151	151,509	23,526	256,584			92,357	1,047,261
North Carolina	(a)	(a)							(a)	(a)
Ohio	(a)	(a)	10,550	109,797	132,030	1,787,176			558,892	6,238,908
Oklahoma									(a)	(a)
Oregon							(a)	(a)	(a)	(a)
Pennsylvania	21,245	198,706	89,689	675,529	260,140	2,669,800	(a)	(a)	784,083	7,519,147
Porto Rico					(a)	(a)			3,392	41,998
Rhode Island					(a)	(a)			(a)	(a)
South Dakota					(a)	(a)			(a)	(a)
Tennessee	4,838	45,870			16,007	134,035	(a)	(a)	119,034	1,098,603
Texas			(a)	(a)	12,391	121,320			56,489	569,135
Utah			(a)	(a)					9,797	151,700
Vermont	3,768	53,683	(a)	(a)	11,815	172,360	(a)	(a)	50,192	716,137
Virginia	1,915	22,455	7,573	68,439	138,162	1,006,783	(a)	(a)	256,568	2,201,724
Washington			(a)	(a)	3,395	43,759			31,033	324,042
West Virginia	4,491	45,067	56,472	509,666	71,646	685,459	(a)	(a)	193,490	1,813,666
Wisconsin	2,357	23,978	(a)	(a)	2,175	63,798			144,590	1,539,027
Wyoming									(a)	(a)
Undistributed	14,217	165,065	30,893	324,611	7,736	97,893	33,644	348,841	96,679	1,360,063
	61,162	668,999	344,921	2,836,474	1,000,550	10,304,049	71,456	796,103	3,570,141	37,543,840

[a] Included under "Undistributed."

HYDRATED LIME.

Hydrated lime sold in the United States, 1916–1920.

Year.	Quantity (short tons).	Value.	Average value per ton.	Number of plants reporting operations.
1916	717,382	$3,626,998	$5.06	89
1917	709,157	4,643,004	6.55	90
1918	620,216	5,342,113	8.61	90
1919	777,408	7,061,146	9.08	93
1920	853,116	9,287,562	10.89	98

Hydrated lime sold in the United States in 1919 and 1920, by uses.

Use.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Building	455,811	$4,086,089	562,153	$6,220,895
Agriculture	198,165	1,784,110	148,981	1,525,950
Chemical:				
Paper mills	6,000	61,120	7,237	87,382
Sugar factories	5,331	48,541	4,111	42,131
Tanneries	15,268	146,447	14,828	163,941
Glass factories	2,002	19,398	3,232	36,529
Metallurgy	2,393	19,754	1,521	16,198
Other uses	65,012	637,150	85,819	951,841
Total chemical	96,006	932,410	116,748	1,298,022
Dealers	27,426	258,537	25,234	242,695
	777,408	7,061,146	853,116	9,287,562

Hydrated lime sold in the United States in 1919 and 1920, by States.

State.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	6,939	$72,802	8,491	$109,890
Arizona	(a)	(a)	(a)	(a)
California	(a)	(a)	(a)	(a)
Connecticut	(a)	(a)	(a)	(a)
Florida	(a)	(a)	(a)	(a)
Georgia	....	....	(a)	(a)
Hawaii	(a)	(a)	150	3,750
Idaho	(a)	(a)		
Illinois	(a)	(a)	(a)	(a)
Indiana	30,931	284,796	37,997	404,356
Maine	(a)	(a)	(a)	(a)
Maryland	38,044	366,695	38,422	386,056
Massachusetts	5,386	52,923	4,699	63,780
Michigan	(a)	(a)	(a)	(a)
Minnesota	....	....	(a)	(a)
Missouri	39,245	402,620	51,987	584,283
Nevada	(a)	(a)	(a)	(a)
New Jersey	(a)	(a)	(a)	(a)
New York	(a)	(a)	(a)	(a)
Ohio	303,771	2,526,120	321,570	3,420,781
Pennsylvania	166,282	1,607,090	169,639	1,884,787
Rhode Island	(a)	(a)	(a)	(a)
South Dakota	(a)	(a)	(a)	(a)
Tennessee	21,253	229,545	29,525	308,381
Texas	18,895	174,910	22,116	221,845
Utah	(a)	(a)	(a)	(a)
Vermont	(a)	(a)	(a)	(a)
Virginia	(a)	(a)	(a)	(a)
Washington	(a)	(a)	(a)	(a)
West Virginia	57,294	452,547	55,807	547,762
Wisconsin	23,470	202,587	31,719	348,303
Undistributed	65,898	688,511	80,994	1,003,588
	777,408	7,061,146	853,116	9,287,562

a Included under "Undistributed."

CONSUMPTION.

Lime consumed in the United States in 1920, by States, in short tons.

State.	Sales.	Shipments from State.	Shipments into State.	Consumption.			Per capita (estimated).		Population in 1920.
				Quick lime.	Hydrated lime.	Total. lime.	1919	1920	
Alabama	151,595	29,425	5,278	122,066	5,382	127,448	0.04	0.05	2,348,174
Alaska	....	....	45	45	....	45	.0012	.0008	55,036
Arizona	12,990	9,254	4,159	7,609	286	7,895	.0017	.02	334,162
Arkansas	11,479	5,056	4,875	8,761	2,537	11,298	.005	006	1,752,204
California	48,571	2,315	11,102	51,029	6,329	57,358	.013	.017	3,426,861
Colorado	1,914	32	11,298	11,841	1,339	13,180	.014	.014	939,629
Connecticut	(a)	(a)	19,397	27,689	4,327	32,016	.024	.023	1,380,631
Delaware	....	....	37,689	22,272	15,417	37,689	.206	.169	223,003
District of Columbia	....	....	11,704	6,681	5,023	11,704	.027	.026	437,571
Florida	(a)	(a)	9,376	8,431	9,228	17,659	.015	.018	968,470
Georgia	(a)	(a)	28,361	15,341	13,910	29,251	.01	.01	2,895,832
Hawaii	2,120	....	2,420	3,930	610	4,540	.01	.02	255,912
Idaho	(a)	(a)	1,474	2,059	204	2,263	.004	.005	431,866
Illinois	87,903	25,078	172,587	184,818	50,594	235,412	.028	.036	6,485,280
Indiana	134,672	83,285	44,514	60,045	35,856	95,901	.03	.03	2,930,390
Iowa	(a)	(a)	23,378	16,968	12,635	29,603	.01	.01	2,404,021
Kansas	(a)	....	(a)	16,229	7,330	23,559	.01	.01	1,769,257
Kentucky	1,757	....	23,217	19,054	5,920	24,974	.008	.01	2,416,630
Louisiana	....	....	32,489	20,252	12,237	32,489	.01	.02	1,798,509
Maine	101,503	47,149	36,580	88,673	2,261	90,934	.098	.12	768,014
Maryland	100,914	40,355	77,832	90,824	47,567	138,391	.098	.095	1,449,661
Massachusetts	129,108	96,794	74,565	95,369	11,510	106,879	.02	.03	3,852,356
Michigan	140,813	9,153	97,985	177,910	51,735	229,645	.05	.06	3,668,412
Minnesota	30,120	9,726	17,088	27,466	10,016	37,482	.01	.016	2,387,125
Mississippi	....	....	10,089	8,644	1,445	10,089	.006	.0056	1,790,618
Missouri	209,113	154,565	32,920	74,621	12,847	87,468	.019	.026	3,404,055
Montana	2,638	20	1,798	3,269	1,147	4,416	.007	.008	548,889
Nebraska	....	....	13,957	11,583	2,374	13,957	.01	.01	1,296,372
Nevada	(a)	(a)	1,281	4,711	445	5,156	.015	.067	77,407
New Hampshire	....	....	20,219	18,955	1,264	20,219	.06	.05	443,083
New Jersey	3,301	145	133,595	77,734	59,017	136,751	.03	.04	3,155,900
New Mexico	3,034	660	1,052	3,132	294	3,426	.007	.009	360,350
New York	92,357	24,311	215,223	206,510	76,759	283,269	.02	.03	10,385,227
North Carolina	(a)	(a)	52,475	44,939	12,036	56,975	.02	.02	2,559,123
North Dakota	....	....	3,233	1,794	1,439	3,233	.004	.004	646,872
Ohio	558,892	333,203	83,165	188,822	120,032	308,854	.047	.053	5,759,394
Oklahoma	(a)	(a)	16,975	11,257	6,900	18,157	.01	.009	2,028,283
Oregon	(a)	(a)	4,321	3,471	1,822	5,293	.004	.006	783,389
Pennsylvania	784,083	269,876	172,994	542,789	144,412	687,201	.081	.078	8,720,017
Porto Rico	3,392	....	110	3,392	110	3,502	.004	.003	1,299,809
Rhode Island	(a)	(a)	14,602	16,016	1,579	17,595	.017	.003	604,397
South Carolina	....	....	16,246	10,369	5,877	16,246	.011	.0096	1,683,724
South Dakota	(a)	....	(a)	6,346	2,509	8,855	.01	.01	636,547
Tennessee	119,034	82,713	5,424	33,577	8,168	41,745	.012	.018	2,337,885
Texas	56,489	15,764	795	24,669	16,851	41,520	.007	.009	4,663,228
Utah	9,797	2,259	180	6,427	1,291	7,718	.015	.017	449,396
Vermont	50,192	41,724	477	8,690	255	8,945	.01	.025	352,428
Virginia	256,568	103,471	30,115	159,777	23,435	183,212	.069	.079	2,309,187
Washington	31,033	6,554	2,568	24,052	2,995	27,047	.014	.02	1,356,621
West Virginia	193,490	184,779	48,155	43,764	13,102	56,866	.02	.04	1,463,701
Wisconsin	144,590	77,329	40,613	87,338	20,536	107,874	.034	.040	2,632,067
Wyoming	(a)	....	(a)	1,534	696	2,230	.01	.01	194,402
Undistributed	96,679	49,746	30,039	....	....	....	....	....	....
	3,570,141	[b]1,704,741	1,700,034	2,713,544	851,890	3,565,434	.031	.033	107,321,377

[a] Included under "Undistributed."
[b] Includes 20 tons shipped to England, 162 tons to China, 50 tons to South America, 150 tons to the Philippine Islands, 4,025 tons to Canada, and 300 tons to Mexico.

CALCAREOUS MARL.

Calcareous marl sold in the United States, 1916–1920.

Year.	Quantity (short tons).	Value.	Average value per ton.
1916	58,088	$144,768	$2.49
1917	73,900	165,223	2.24
1918	98,694	261,082	2.65
1919	91,437	327,294	3.58
1920	97,487	322,339	3.31
Percentage of increase or decrease in 1920	+6.6	−1.5	−7.5

Most of the marl sold in 1920 was used in agriculture, in the same manner as pulverized limestone and agricultural lime, but some was used as a filler in patent fertilizer. In Arkansas, where the product included chalk, a small quantity was sold as whiting, which brought a much higher price than the agricultural material.

Nearly one-half of the total output—42,510 short tons—was produced in Virginia and was valued at $143,373. The other producing States were Arkansas, California, New York, North Carolina, Ohio, South Carolina, and West Virginia.

OYSTER-SHELL LIME.

There was 38,506 short tons of oyster-shell lime, valued at $311,695, produced in the United States in 1920. This was an increase of 12.4 per cent in quantity but a decrease of 14.4 per cent in value compared with 1919. The average value per ton was $8.09 in 1920 and $10.63 in 1919. The greater part of this material is sold for use on land. Virginia produced 28,439 short tons, valued at $232,083, and Maryland 8,391 short tons, valued at $65,390, in 1920. The remainder was manufactured in South Carolina, Pennsylvania, and New Jersey.

IMPORTS AND EXPORTS.[1]

IMPORTS.

Lime imported and entered for consumption in the United States, 1916–1920.[a]

Year.	Quantity (short tons).	Value.	Average value per ton.
1916	7,959	$71,663	$9.00
1917	7,353	70,505	9.59
1918	6,650	73,458	11.05
1919	8,679	128,519	14.81
1920	22,688	392,137	17.28

[a] Most of the lime imported into the United States comes from Canada.

[1] Statistics of imports and exports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

EXPORTS.

Lime exported from the United States, 1916–1920.

Year.	Quantity (short tons).	Value.	Average value per ton.
1916	23,973	$132,769	$5.54
1917	18,794	168,671	8.97
1918	7,191	105,803	14.71
1919	6,372	108,370	17.01
1920	5,921	128,296	21.67

Lime exported in 1919–1920, by countries.

Country.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Canada	4,676	$68,157	3,034	$50,646
Newfoundland and Labrador	1	27	1	47
Mexico	665	12,133	735	17,014
Central America:				
British Honduras	10	201	7	188
Guatemala	(a)	4	15	359
Honduras	48	928	379	9,139
Nicaragua	79	1,546	10	241
Panama	75	2,132	115	3,248
West Indies:				
Cuba	67	1,620	175	4,743
Dominican Republic	117	3,727	366	11,534
Virgin Islands of the United States	69	1,552	80	1,700
Barbados	10	400	35	720
Bermuda	(a)	15	(a)	14
Jamaica			11	393
Trinidad and Tobago			2	60
Other British West Indies	4	94	16	513
French West Indies			3	130
South America:				
Bolivia	1	25		
Brazil			61	1,326
Colombia	10	210	5	138
French Guiana	(a)	7		
Peru	222	6,656	376	12,644
England	44	1,200	49	2,209
Denmark			(a)	5
Netherlands			107	2,943
Spain	34	393		
Portugal			3	156
China			132	2,640
Japan			28	1,455
New Zealand	5	75		
Other British Oceania	2	53	2	65
French Oceania	7	195	5	138
Philippine Islands			169	3,888
Portuguese Africa	226	7,020		
	6,372	108,370	5,921	128,296

a Less than 1 ton.

BARYTES AND BARIUM PRODUCTS.[1]

By George W. Stose.

CRUDE BARYTES.

PRODUCTION.

The barytes industry had its banner year in 1920, as the sales exceeded the greatest previous output (1916) by more than 6,000 short tons. This unprecedented sale was caused by the general demand for paints and pigments, and therefore for the crude material, barytes. So great was this demand that it exceeded the supply, and during most of 1920 the producers of barytes were months behind in filling orders. In November, however, the demand for barytes suddenly ceased, with the result that, although most of the plants were busy to the end of the year filling old orders, some ceased operation in December.

The value of the crude barytes produced and sold in 1920 exceeded $2,000,000 and surpassed the highest preceding record (1919) by more than $414,000. This large value was due chiefly to high prices, the average price for 1920 being $9.39 a ton, compared with $8.25 in 1919.

Crude barytes produced and marketed in the United States, 1880–1920.

	Quantity (short tons).	Value.	Average price per ton f. o. b. mine shipping point.
Annual average for 10 years 1880-1889	21,410		
Annual average for 10 years 1890-1899	27,523		
Annual average for 10 years 1900-1909	58,310		
Annual average for 5 years 1910-1914	43,389		$3.31
1915	108,547	$381,032	3.51
1916	221,952	1,011,232	4.56
1917	206,888	1,171,184	5.66
1918	155,368	1,044,905	6.73
1919	209,330	1,727,822	8.25
1920	228,113	2,142,464	9.39

Missouri and Georgia produced about 80 per cent of the output in 1920. The Missouri production increased greatly, but the Georgia production decreased slightly, so that Missouri apparently produced and marketed 15,000 tons more than Georgia. Because of the great number of small producers in Missouri who sell to both middlemen and users of barytes—by whom the sales are also generally reported—it is difficult to eliminate all duplication and at the same time to avoid

[1] The statistical data in this report were prepared by Mrs. E. R. Phillips, of the United States Geological Survey, who also assisted in writing the report.

omitting the output of many small producers. Tennessee had the next largest output, about one-third that of Georgia, although it was about 5,000 tons less than in 1919. The increase in the number and output of barytes mines in California seems to indicate that the western barytes-paint industry is becoming established on a permanent footing. South Carolina maintained about the same production as in recent years, but Kentucky, which held fourth place in 1919, had only a small production in 1920. South Carolina, Virginia, North Carolina, and Alabama together produced and sold 11,707 tons; Kentucky, Illinois, and Wisconsin together sold 506 tons.

Of the 94 barytes mines that reported production in 1920, 70 were in Missouri, 6 in Tennessee, 5 in Georgia, 3 in California, 2 each in Alabama and North Carolina, and 1 each in Illinois, Kentucky, Nevada, South Carolina, Virginia, and Wisconsin. Although only one operator in Kentucky reported production, purchases of barytes were reported by dealers, apparently from other small producers, and these sales are included in the State's total.

Crude barytes produced and marketed in the United States, 1918–1920, by States.

State.	1918			1919			1920		
	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.	Quantity (short tons).	Value.	Average price per ton.
Alabama	1,794	$9,976	$5.56	(a)	(a)	(a)	(a)	(a)	(a)
California				(a)	(a)	(a)	2,250	$20,850	$9.27
Georgia	69,318	418,178	6.03	85,303	$667,521	$7.83	84,644	790,362	9.34
Kentucky	(a)	(a)	(a)	5,435	36,408	6.70	(a)	(a)	(a)
Missouri	49,094	393,738	8.02	73,247	640,398	8.74	99,654	1,013,570	10.17
Tennessee	22,542	141,844	6.29	34,700	288,622	8.32	29,319	213,657	7.29
Other States [b]	12,620	81,169	6.43	10,645	94,873	8.91	12,246	104,025	8.49
	155,368	1,044,905	6.73	209,330	1,727,822	8.25	228,113	2,142,464	9.39

[a] Included under "Other States."

[b] States having less than three active producers are grouped together to avoid disclosing confidential information. 1918: Kentucky, Nevada, New Mexico, North Carolina, South Carolina, Virginia, and Wisconsin; 1919: Alabama, California, Illinois, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin; 1920: Alabama, Illinois, Kentucky, Nevada, North Carolina, South Carolina, Virginia, and Wisconsin.

STOCKS AT MINES.

From the reports of producers it is estimated that only about 9,450 tons of barytes was in storage at the mines at the end of 1920, whereas on December 31, 1919, the stocks were about 22,500 tons. Such a depletion of stock was to be expected because of the excess of demand over supply during the greater part of the year. In the earlier part of the year the congestion of transportation prevented the delivery of sufficient ore to satisfy the needs of the paint manufacturers, so that stocks accumulated at shipping points, but these were quickly exhausted after railroad conditions improved. In November the demand for ore ceased, and after advance orders were filled stocks again began to accumulate.

Of the 9,450 tons of barytes that apparently remained in stock at the mines at the end of 1920, about 3,150 tons was held in Missouri, 1,700 tons in Georgia, 915 tons in Tennessee, and the remainder was distributed in smaller lots in the other producing States.

IMPORTS.

The renewal of the importation of barytes, which began in a small way in the last weeks of 1919, did not get into full swing until late in 1920. By the middle of the year only 2,227 short tons had been imported, but in the third quarter 9,230 tons was imported, and in the fourth quarter 13,417 tons. The total quantity of barytes imported in 1920 surpassed that imported in 1914, before such shipments were stopped by the war, and the value of these imports was more than three times the value of the imports in 1914. Most of this foreign ore came from Germany; a little apparently came from Italy.

The manufacturers of barium products report only 7,600 tons of foreign ore used in their plants, so that the bulk of the imported ore must have been used directly by manufacturers of paint and by other plants equipped with grinding mills, but not reporting as manufacturers of barium products. A considerable quantity of ore imported late in the year, however, was not used in 1920.

Crude barytes imported for consumption, 1912–1920.

Year.	Quantity (short tons).	Value.[a]	Average price per ton.	Year.	Quantity (short tons).	Value.[a]	Average price per ton.
1912	26,186	$52,467	$2.00	1917	6	$63	$10.50
1913	35,840	61,409	1.71	1918			
1914	24,423	46,782	1.92	1919	118	594	5.03
1915	2,504	4,877	1.95	1920	24,874	146,858	5.90
1916	17	245	14.41				

[a] Value at port of shipment on which duty is levied. Does not include railroad and ship freight charges to this country or import duty.

MARKETS.

In the following table the total of 229,443 tons for 1920 includes 7,600 tons of imported ore reported purchased by the manufacturers of barium products. For the reasons given above the bulk of the imported ore is probably not represented in the table.

Crude domestic and imported barytes used in the manufacture of barium products in the United States, 1916–1920, in short tons.[a]

Year.	Product.			Total.
	Ground barytes.	Lithopone.	Barium chemicals.	
1916	75,507	71,898	38,283	185,688
1917	60,132	86,065	49,842	196,039
1918	62,440	85,282	38,041	185,763
1919	64,922	103,688	32,976	201,586
1920	79,052	113,181	37,210	229,443

[a] Compiled from reports made by the manufacturers of barium products.

About 49 per cent of the barytes used in 1920 was made into lithopone, about 35 per cent was ground and refined, and 16 per cent was used in the manufacture of barium chemicals other than lithopone. Missouri led in the quantity of crude barytes used, of which 86 per cent was ground and refined and 14 per cent was manufactured into lithopone and chemicals. New Jersey ranked second and Illinois third. The other States have less than three producers each and their statistics may not be given separately without divulging confidential information. They are therefore combined in the accompanying table, in related groups, with the exception of California, which is the only western State that used barytes for manufacturing purposes, and it is combined with the nearest group of States.

Barytes used by manufacturers of barium products in 1920.

State.	Product manufactured.	Number of plants.	Barytes used (short tons).
Missouri	Lithopone, ground barytes, and barium chemicals.	5	73,920
New Jersey	Chiefly lithopone	7	40,158
Illinois	do	5	19,671
Pennsylvania, Delaware, and New York	Lithopone and barium chemicals	6	46,468
Maryland	Lithopone	3	21,845
Georgia and South Carolina	Ground barytes		
Kentucky	do	5	27,381
West Virginia, Tennessee, and California	Chiefly barium chemicals		
		31	229,443

PRICES.

The prices obtained for crude barytes in 1920 were higher than in any previous year. Since 1915 there has been an increase of more than $1 each year in the average price per ton received for ore f. o. b. at point of shipment from the mines, and since 1916 the price has more than doubled. The average price received by the 70 operators reporting in Missouri in 1920 was $10.17 a ton, a higher average than in any other State. The prices reported by producers in Missouri ranged from $7.50 to $11, except for one small lot which was reported to have brought $15. This great range in prices was due in part to the fact that the lower prices were received by small mines in remote places. The lowest selling price reported by an individual operator was $6.55 in Tennessee. The average price received in the different States is given in the table on page 190.

CONSUMPTION.

The consumption of crude barytes as given in the following table was determined by adding to the quantity of domestic ore mined and sold the quantity of ore imported. No barytes was exported. These figures are considerably larger than those derived from the reports of manufacturers of barium products, the difference being approximately represented by imports of barytes in excess of the foreign ore reported as having been used by these manufacturers.

Crude barytes consumed in the United States, 1913–1920, in short tons.

Year.	Sales of domestic barytes.	Imports for consumption.	Consumption.
1913	45,298	35,840	81,138
1914	52,747	24,423	77,170
1915	108,547	2,504	111,051
1916	221,952	17	221,969
1917	206,888	6	206,894
1918	155,368	....	155,368
1919	209,330	118	209,448
1920	228,113	24,874	252,987

BARYTES INDUSTRY BY STATES.

Alabama.—The Bertha Mineral Co. purchased the property of the Glidden Barytes Co. in May, 1920, and its mine at Jacksonville, Calhoun County, Ala., had a greater production under the new management than it had in 1919. No other mine in the State reported production.

Alaska.—No report of production from the Alaska mines has been received since 1916, when 50 tons were mined but not sold. In 1919 the Alaska Treadwell Gold Mining Co. purchased the Walters barytes mine at Wrangell, but it made no production in 1920.

California.—A. R. Haskins mined barytes at Salinas, Monterey County, Calif., in 1920 and the Metals & Chemicals Extraction Corporation (Lewis, Gilman & Moore) operated the deposit of William Maguire, about 5 miles from Alta, Nevada County, on the Southern Pacific Railroad. The Western Rock Products Co. began on April 1 to operate the mine of the El Portal Mining Co., near El Portal, Mariposa County. The ore from all three of these companies was shipped to San Francisco, where it was made into barium products.

Georgia.—Five companies reported extensive operations in Georgia in 1920, all near Cartersville and Emerson, in Bartow County. These companies were the Bertha Mineral Co., Du Pont de Nemours & Co., Nulsen Corporation, Paga Mining Co. (controlled by the Thompson-Weinman Co.), and the Thompson-Weinman Co. The sales in 1920 were a little less than those in 1919.

Illinois.—The Mundy Mineral Sales Co.'s mine, at Golconda, Pope County, Ill., was operated by James Wardrop in 1920. This is the only mine in the United States where fluorspar and barytes are successfully separated into commercial products.

Idaho.—The Barytes Rare Minerals Manufacturing Co. has started developing a barytes mine near Muldoon, Blaine County, Idaho, but had no production in 1920.

Kentucky.—Many mines in Kentucky were inactive, and the production decreased greatly. The Superior Barytes Mining Co., of Paris, has been incorporated by G. D. Speaks and others.

Missouri.—Barytes was produced and sold by more than 70 plants in Missouri, and the sales amounted to 99,654 tons, valued at more than $1,000,000. These figures include an estimate for sales of many small producers who did not report, based upon purchases of ore in Missouri by manufacturers of barium products. The difficulty of obtaining the reports of all small producers in Missouri may be understood from the statement by one producer that "nearly every able-bodied man in Washington County collects barytes when not otherwise employed."

Washington County, as usual, led in the number of mines operated and the quantity of ore sold. Forty-three operators in the county reported sales, and probably much of the undistributed sales estimated, as stated above, came from other small operators in this county.

Barytes produced and marketed in Missouri, 1920, by counties.

County.	Number of mines.	Quantity (short tons).	Value.
Washington	43	57,290	$583,207
Cole	4	6,482	64,017
Jefferson	8	3,773	38,796
St. Francois	8	1,320	13,588
Miller, Franklin, and Morgan	7	2,997	31,317
Undistributed		27,792	282,645
	70+	99,654	1,013,570

Nevada.—The mines of the American Barium Co., at Blair and Kinkead, in Esmeralda County, Nev., have not been worked since the early part of 1919, and House & Mallory appear to have also discontinued operations at Kinkead. There was, however, a small quantity of barytes reported indirectly as having been shipped in 1920 from Nevada, possibly from stock at one of these mines.

New Mexico.—No barytes ore was produced in New Mexico in 1920, although some new deposits were reported.

North Carolina.—In North Carolina the Rollin Chemical Corporation mined barytes on the Stackhouse property and on the adjoining Washburn land, in Madison County, and Anson G. Betts & Co. reported operations near Sandy Bottom, also in Madison County.

South Carolina.—The Cherokee Chemical Co. continued shipments from its mine at Kings Creek, Cherokee County, S. C., and its product is quoted by paint journals in New York.

Tennessee.—Large quantities of barytes were mined in Loudon, McMinn, and Monroe counties, Tenn., in 1920, and a small quantity was produced in Cocke County. The Krebs Mining Co., Durex Chemical Corporation, J. J. Fitzgerald, M. F. Nicholls, W. I. Hale, and National Barium Corporation were the chief operators, and H. J. Moore also appears to have mined and sold considerable ore. The total sales, however, were somewhat less than in 1919.

Virginia.—The Rollin Chemical Corporation operated its mine near Evington, Campbell County, Va., and the ore was shipped to its chemical plant at Charleston, W. Va. The McLanahan-Watkins Co. opened up the old barytes mine at Toshes, Pittsylvania County, and mined considerable ore, but made no shipments. In October the mine was sold to the Bertha Mineral Co., which devoted the rest of the year to developing it.

Wisconsin.—The Porter Mining Co. operated its mine at Cuba City, Lafayette County, Wis., and somewhat increased the output over that in 1919. The ore was shipped to an Illinois manufacturer of lithopone.

BARIUM PRODUCTS.

The total quantity of barium products manufactured in the United States, including refined ground barytes, lithopone, and other barium chemicals, has increased steadily since 1915, the year in which the Geological Survey began to publish the records of their production and the first year in which any considerable quantity of barium chemicals was made in the United States. Prior to 1915 barium chemicals for domestic use were largely imported from Germany and England and to some extent from France.

The quantities of the several barium products sold each year in the United States have fluctuated considerably. Prior to 1920 the sale of refined ground barytes reached its highest mark in 1916 and of .barium chemicals in 1918. Each year since 1917, when sales of refined ground barytes dropped nearly 13,000 tons, there has been a steady increase in the quantity sold, and in 1920 the high record of 1916 was exceeded. The sales of lithopone, except in 1918 when there was a slight retrograde movement, have steadily increased each year since 1915. A somewhat smaller quantity of barium chemicals other than lithophone was made and sold in both 1919 and 1920 than in either 1918 or 1917, but there was a slight increase in 1920 over 1919. It will thus be seen that the barium-products industries have been prospering in the United States notwithstanding the competition of the foreign barium products, which was renewed in 1920 with vigor. To what extent they will continue to withstand this influence remains to be seen.

Barium products of domestic manufacture (from either domestic or imported crude ore) marketed [a] in the United States, 1915–1920, in short tons.

Product.	1915	1916	1917	1918	1919 [a]	1920		
						Quantity.	Value.	Average price.
Ground barytes	51,557	65,440	52,694	55,086	57,985	65,748	$1,381,868	$21.02
Lithopone	46,494	51,291	63,713	62,403	79,643	89,373	12,484,925	139.69
Barium chemicals [b]	8,823	16,792	22,503	23,186	20,013	20,760	1,743,634	83.99
	106,874	133,523	138,910	140,675	157,641	175,881	15,610,427	88.76

[a] Figures of production, not sales, are given for 1919. Sales are in general 1 to 5 per cent less than production.
[b] Barium chemicals manufactured from secondary barium products bought in open market are not included in table.

REFINED GROUND BARYTES.

Uses.—Barytes is ground to an impalpable powder and purified by washing and leaching for use as a white pigment and filler and as an inert base in colored paints. As a pigment it is much used with lithopone and other pigments in interior flat white paint. It is extensively used as a filler in rubber goods, linoleum, oilcloth, highly glazed paper, and other articles. The highest grade of ground barytes is obtained by flotation on water, the finest impalpable material being thus separated.

Production.—Eight plants in five States made and sold refined ground barytes in 1920. The sales exceeded those of 1919 by nearly 8,000 tons, or more than 13 per cent. Nearly 80 per cent of the output came from three large producers in Missouri. The rest was produced by plants in California, Georgia, Kentucky, and South Carolina. The quantity of refined ground barytes made and sold is given in the preceding table.

Price.—The average price per short ton f. o. b. at the plant of all refined ground barytes made and sold in the United States in 1920 was $21.02, which was about $1 more than that received in 1919. The prices received by individual concerns ranged from $16.67 to $35 a ton. Pure white floated ground domestic barytes in bags at New York was quoted by the Oil, Paint, and Drug Reporter at $30 to $31 a short ton in January; $34 to $36 from February to April; no quotations in May or June; $35 to $40 from July to October; $32 to $40 in November; and $32 to $38 in December. Off-color ground barytes in bags at New York was quoted at $21 to $24 from January to April; no quotation in May and June; $20 to $30 from July to November; and $20 to $28 in December. There was no foreign ground barytes on the market during the year.

LITHOPONE.

Lithopone is a pigment prepared chemically from barytes and zinc. It is composed of about 70 per cent of barium sulphate and 30 per cent of zinc sulphide, being an intimate mixture of chemical precipitates of these two compounds and therefore exceedingly fine and suitable as a pigment. It is used not only in paint but as a filler in rubber goods, linoleum, oilcloth, window shades, and paper.

Production.—Lithopone was manufactured in 1920 in 17 plants in seven States. This is an increase of two plants during the year—the Metals & Chemicals Extraction Corporation, of Oakland, Calif., successors to the Barbour Chemical Co., which was idle in 1919, and the Collinsville Zinc Corporation, of Collinsville, Ill. The Glidden Co. succeeded the Chemical Pigments Corporation at St. Helena, Md., July 1, 1920. Eleven plants were in operation in the Philadelphia district—four in Pennsylvania, five in New Jersey, and one each in Delaware and Maryland. Illinois had four producing plants, and Missouri and California one each. The Philadelphia district, comprising adjacent parts of Pennsylvania, Delaware, New Jersey, and Maryland, marketed 80 per cent of the total output of lithopone in 1920. Illinois and California shared in the prosperous growth of the industry.

Lithopone manufactured and sold in 1920, by States.

State.[a]	Number of plants.	Quantity (short tons).	Value.
New Jersey	5	32,860	$4,505,380
Delaware, Pennsylvania, and Maryland	6	38,495	5,527,804
Illinois, Missouri, and California	6	18,018	2,451,741
	17	89,373	12,484,925

[a] States are combined where necessary to avoid disclosing confidential information.

Price.—The average price of lithopone made and sold in the United States in 1920 was $139.69 a short ton, or nearly 7 cents a pound, which is more than $15 a ton higher than the average price in 1919. The prices received by individual plants ranged from $132.88 to $152.98. The higher prices were received for special grades for which unusual paint qualities are claimed. The price of lithopone in barrels at New York was quoted by the Oil, Paint, and Drug Reporter at 7¼–7½ cents a pound in January; 7¼–7¾ cents in February; 7½–7¾ cents in March; 7¾–8¼ cents in April; 8–8¼ cents from May to September; 7¾–8¾ cents in October; 7¼–8¼ cents in November; and 7½–8 cents in December.

BARIUM CHEMICALS OTHER THAN LITHOPONE.

Production.—The manufacture of barium chemicals other than lithopone, which increased rapidly in the United States from 1915 to 1918, reached its maximum in that year, and the quantity marketed has been from 2,000 to 3,000 tons below this maximum in the last two years. Nine plants were operated in eight States in 1920. The production can not be given by individual States without divulging confidential information.

Barium chemicals, other than lithopone, manufactured and sold in 1920, by groups of States.

States.	Number of plants.	Quantity (short tons).
New Jersey, New York, and Pennsylvania	3	3,054
Tennessee, West Virginia, and California	3	13,704
Illinois and Missouri	3	4,002
	9	20,760

Blanc fixe (barium sulphate) was made in five plants in 1920, and the quantity produced and sold exceeded the quantity of any other barium chemical manufactured and sold. Barium carbonate was made in four plants and ranked second. Barium chloride ranked third in quantity sold and was made in five plants.

Barium chemicals of domestic manufacture sold, 1915–1920, in short tons.

Chemical.	1915	1916	1917	1918	1919	1920	Average price per pound, 1920.
Barium binoxide	([a])	1,980	([a])	([a])	([a])	([a])	([a])
Barium carbonate	2,746	6,844	8,238	7,661	7,135	7,484	$0.039
Barium chloride	2,106	3,643	4,870	4,530	4,509	3,084	.051
Barium nitrate	971	446	165	([a])	([a])	([a])	([a])
Barium sulphate (blanc fixe)	([a])	3,337	6,314	9,522	5,227	8,046	.027
Other barium chemicals [b]	3,000	542	2,916	1,473	3,142	2,146	.098
	8,823	16,792	22,503	23,186	20,013	20,760	.042

[a] Included under "Other barium chemicals."
[b] The quantities of chemicals manufactured in less than three plants are combined in the table to avoid divulging confidential information. 1915: Binoxide, hydroxide, sulphate, sulphide, and other barium chemicals not specified; 1916: Hydroxide and sulphide; 1917: Binoxide, hydroxide, and sulphide; 1918: Binoxide, hydroxide, nitrate, and sulphide; 1919: Binoxide, nitrate, and sulphide; 1920: Binoxide, nitrate, sulphide, and hydroxide.

Price.—The average prices received in 1920 by manufacturers for barium chemicals are given in the preceding table, and the wholesale market prices in New York are given below. Prices generally tended upward during the year, some showing material increase, but a few decrease.

Prices of barium chemicals quoted in New York wholesale market, 1919 and 1920.[a]

Chemical.	Unit.	1919	Jan. 1, 1920	Dec. 31, 1920
Barium chlorate	Pound	\$0.50 -\$0.60	\$0.50 -\$0.60	\$0.40 - \$0.45
Barium chloride (white crystals)	Short ton.	67.00 -95.00	90.00 -95.00	75.00 -110.00
Barium dioxide	Pound	.21½- .27	.21½- .22	.22½- .25
Barium nitrate	do	.10 - .12	.10 - .11	.11½- .13½
Barium sulphate (blanc fixe), dry, in barrels	do	.03½- .06	.04 - .05	.05½- .05¾
Barium sulphate (blanc fixe), pulp	Short ton.	35.00 -60.00	35.00 -50.00	30.00 - 40.00

[a] Oil, Paint, and Drug Reporter.

IMPORTS.

The importation of barium products increased greatly in 1920, especially toward the end of the year, the quantity imported in the last quarter almost equaling that of the first three-quarters. The total quantity imported was greater than that in any other year since 1915, and although it does not closely approach the quantity received in 1914, before the war, the rate of importation in the last quarter of 1920 leads to the belief that imports for 1921 will equal if not exceed those of 1914.

Only a small quantity of ground barytes was imported in 1920. The quantity of lithopone imported nearly equaled that received in 1916. All other manufactured chemicals, which ceased to be imported in one or more of the years of the war (1916–1918), were again imported in large quantities in 1920. None, however, except barium chloride, has closely approached the quantity imported before the war. The importation of natural barium carbonate (ground witherite) showed a marked advance in 1920, exceeding 3,000,000 pounds, with a value of over \$61,000. This is approximately twice as much as was imported in any of the normal years and in value more than three times that of any of them.

Barium compounds imported for consumption in the United States, 1913–1920.[a]

[Values at port of shipment are given.]

Year.	Ground barytes.			Lithopone.[b]		
	Quantity (short tons).	Value.	Price per ton.	Quantity (pounds).	Value.	Price per pound.
1913	5,463	\$38,155	\$6.98	4,725,000	\$146,474	\$0.03
1914	4,323	30,483	7.05	7,980,000	271,310	.03⅖
1915	1,308	10,736	8.21	4,087,826	137,816	.03⅖
1916	147	2,072	14.10	4,681,560	405,730	.08¾
1917	88	1,743	19.81	448,000	29,199	.06½
1918						
1919				1,477,296	122,708	.08½
1920	274	3,017	11.01	3,427,321	263,240	.07⅗

[a] Compiled from records of Bureau of Foreign and Domestic Commerce, Department of Commerce.
[b] Prior to October, 1913, imported as zinc sulphide white. Figures for 1913 and 1914 have been adjusted on basis of some lithopone having been listed under that name. Since 1914 apparently no lithopone has been imported as zinc sulphide white.

Barium compounds imported for consumption in the United States, 1913–1920—Continued.

Year.	Barium binoxide.			Blanc fixe (precipitated barium sulphate).		
	Quantity (pounds).	Value.	Price per pound.	Quantity (pounds).	Value.	Price per pound.
1913	4,173,188	$239,000	$0.05¾	4,883,014	$62,785	$0.01¼
1914	5,741,752	332,709	.05⅘	2,847,791	32,619	.01
1915	2,397,359	218,776	.09	1,441,989	18,501	.01¼
1916	106,863	6,590	.06⅕	676,908	17,810	.02⅗
1917	....	....	....	229,040	3,333	.01½
1918	....	....	....	....	....	....
1919	....	....	....	1,285	90	.07
1920	501,673	64,447	.12⅘	329,299	8,485	.02⅗

Year.	Artificial barium carbonate (chemically precipitated).			Natural barium carbonate (ground witherite).		
	Quantity (pounds).	Value.	Price per pound.	Quantity (pounds).	Value.	Price per pound.
1913	4,085,878	$38,949	$0.01	1,795,396	$13,116	$0.00¾
1914	3,065,362	28,221	.01	1,187,284	8,084	.00¾
1915	286,504	2,786	.01	1,211,310	12,165	.01
1916	....	....	....	1,607,352	18,169	.01
1917	107,092	1,554	.01½	1,186,260	17,321	.01½
1918	....	....	....	723,676	14,134	.02
1919	8,549	2,666	.31⅕	224,000	4,739	.02
1920	951,501	37,462	.03⅘	3,020,304	61,284	.02

Year.	Barium chloride.			Total.	
	Quantity (pounds).	Value.	Price per pound.	Quantity (short tons).	Value.
1913	3,725,239	$37,620	$0.01	17,159	$576,099
1914	5,921,370	68,866	.01⅕	17,696	772,292
1915	2,561,056	31,295	.01⅕	7,302	432,075
1916	6,614	608	.09⅕	3,686	450,979
1917	....	....	....	1,074	53,150
1918	....	....	....	362	14,134
1919	1,099,686	19,846	.01⅘	1,406	150,049
1920	3,190,255	151,778	.04⅗	5,984	589,713

TALC AND SOAPSTONE.

By Edward Sampson.[1]

FIGURES OF PRODUCTION COMBINED.

For several years the figures for the production of talc and soapstone have been kept separate. The Geological Survey has often found that material classed by producers as soapstone should more properly be classed as talc, or vice versa. Recently the distinction has become more difficult because of the use of pure and massive talc and impure but dense soapstone for the same purposes—for example, for the cores of electrical resistance coils. Furthermore, some rock classed as soapstone is ground and the product goes under the name of talc. The inevitable changes in classification have made the figures of the production of talc and of soapstone for any one year not strictly comparable with those of other years. In the accompanying tables the figures for the total production of talc and of soapstone have been combined, as they were up to 1916. Manufactured talc and manufactured soapstone are kept distinct, for it is believed that there is a demand for the separation of these figures, particularly in the soapstone industry. Some statistical tables go back to 1913 to give pre-war figures for comparison and to make all figures of the present report comparable with those of other years.

PRODUCTION.

The total sales of domestic talc and soapstone in 1920 exceeded in value those of any previous year and increased 14 per cent in quantity and 29 per cent in value over the figures for 1919. The value was 13 per cent higher than in 1918, the year of next greatest value, and the quantity was only 4 per cent less than in 1917, the record year for quantity produced.

There was an increased output in 1920 in every State except North Carolina, but the reduction of 13 per cent in North Carolina in 1920 followed an increase of 57 per cent in 1919 and leaves the output 36 per cent above that of 1918.

The total production since 1880 is shown in figure 8, and the production since 1913, classified by grades, is shown in the table at the top of page 203. Most of the material reported as crude is eventually ground, but it is not ground by those who mine it and consequently is reported to the Geological Survey as crude. Probably more talc was ground in 1920 than in any previous year. The soapstone industry shows a larger production, which, although not the largest on record, brought a record price, the total value being 15 per cent higher than in 1913, the year of next highest value.

[1] The author wishes to acknowledge his obligation to Mr. J. S. Diller, who for 12 years has had charge of the U. S. Geological Survey work on talc and soapstone. Although now engaged on other work he has given much assistance in the preparation of this report. Mrs. E. R. Phillips, of the Geological Survey, has aided in preparing the statistical data. Figures of imports are compiled from records of the Department of Commerce.

Talc and soapstone mined and sold in the United States, 1918–1920, by States.

State.	1918		1919		1920				
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Per cent of total quantity.	Percentage of increase or decrease in 1920. Quantity.	Percentage of increase or decrease in 1920. Value.
Vermont	90,612	$778,012	78,661	$665,652	86,489	$816,794	41	+10	+23
New York	71,167	902,100	62,495	750,765	68,168	977,228	33	+ 9	+30
Virginia	18,520	597,782	17,663	542,022	21,715	729,767	10	+23	+35
Maryland	(a)	(a)	(a)	(a)	4,372	17,948	2	....	....
California	11,864	185,775	9,837	147,470	13,199	232,182	6	+34	+57
Pennsylvania } New Jersey	8,047	64,742	(a)	(a)	11,183	121,302	5	....	....
North Carolina	1,661	72,348	2,602	76,158	2,267	75,474	1	−13	− 1
Other States [b]	6,436	80,260	13,585	170,608	3,242	64,754	2	....	....
	208,307	2,681,019	184,843	2,352,675	210,635	3,035,449	100	+14	+29

[a] Included under "Other States."
[b] 1918: Georgia, Maryland, Massachusetts; 1919: Georgia, Maryland, Massachusetts, Pennsylvania, Washington; 1920: Georgia, Massachusetts.

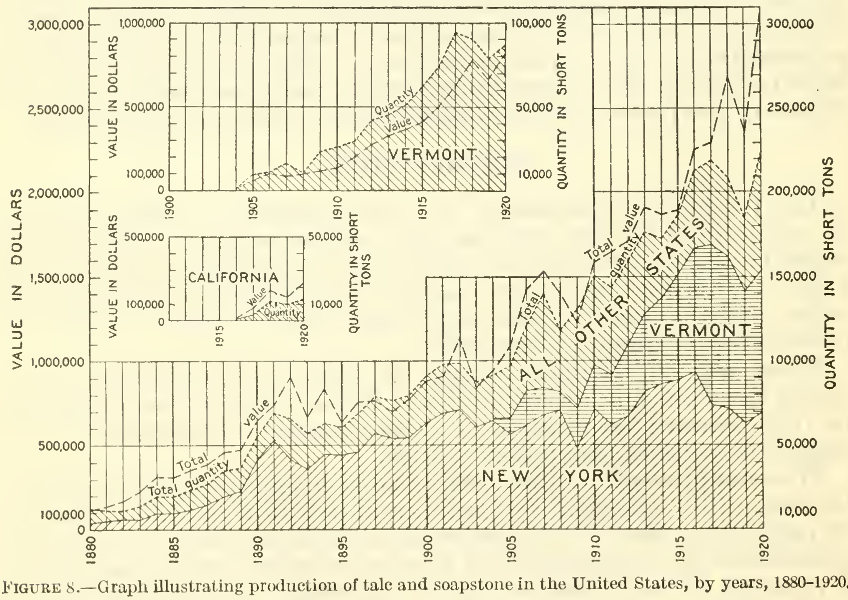

FIGURE 8.—Graph illustrating production of talc and soapstone in the United States, by years, 1880–1920.

Talc and soapstone mined and sold in the United States, 1913–1920.

Year.	Crude.		Sawed and manufactured.				Ground.		Total.	
			Talc.		Soapstone.					
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	3,898	$14,687	138	$36,272	24,698	$618,410	147,099	$1,238,728	175,833	$1,908,097
1914	3,080	17,941	698	59,380	20,039	519,660	148,479	1,268,106	172,296	1,865,087
1915	8,535	59,392	39	11,941	18,139	479,808	160,178	1,340,441	186,891	1,891,582
1916	11,824	108,283	828	102,674	19,127	489,606	181,182	1,553,240	212,961	2,253,803
1917	12,619	69,140	5,781	176,404	19,885	402,506	180,563	1,644,828	218,848	2,292,878
1918	17,633	193,278	1,075	116,952	12,330	501,059	177,269	1,869,730	208,307	2,681,019
1919	15,625	73,437	921	147,339	16,504	530,163	151,793	1,601,736	184,843	2,352,675
1920	11,008	43,820	1,415	139,335	19,707	709,400	178,505	2,142,894	210,635	3,035,449

The most significant average selling prices are those for ground talc and sawed and manufactured soapstone. These figures from 1913 to 1920 were as follows:

Average selling price per ton of ground talc and of sawed and manufactured soapstone, 1913–1920.

	1913	1914	1915	1916	1917	1918	1919	1920
Ground talc	$8.42	$8.54	$8.37	$8.57	$9.11	$10.55	$10.55	$12.00
Sawed and manufactured soapstone	25.04	25.93	26.45	25.60	20.24	40.64	32.12	36.00

PRODUCTION BY STATES.

CALIFORNIA.

The output of California has shown a marked increase since 1915. Figure 8 gives a visual representation of the quantity and value of the material marketed, and the statistics for the last three years are shown in the table on page 202.

The product of the California mines is talc rather than soapstone. Nearly all the talc is of very high grade, and much of it is used for toilet powder. The two principal producing districts are at Keeler, on Owens Lake, in Inyo County, and along the Tonopah & Tidewater Railroad in Inyo and San Bernardino counties. Talc has also been mined in Amador, Eldorado, Los Angeles, and Riverside counties.

The mine of the Inyo Talc Co. is 18 miles from the mill at Keeler, the nearest railroad station. The crude talc, which is hauled to the mill by motor truck, is exceptionally massive and has been used with success for cores of electric heating apparatus and for other purposes. The mill as described by Ladoo [2] consists of two units—one in which selected blocks of the massive talc are cut and the other in which most of the material mined is ground. The rock as mined contains well-defined slip planes along which it breaks readily, but blocks large enough for cutting blanks for refractory purposes may be obtained. Specimens examined by the United States

[2] Ladoo, R. B., High-grade talc and the California talc industry: Bur. Mines Repts. Inv., May, 1921.

Geological Survey appear to be free from schistosity and in thin section are seen to be composed of a felt of interlocking, somewhat fibrous grains whose structure appears to be inherited from a silicate mineral which they have replaced. Such tests as have been made on small machined pieces of the fine-grained talc show that at a high temperature minute cracks are formed. However, the material is much used in electrical insulation work, where it successfully withstands the temperature of dull-red heat, which is below the temperature of dehydration.

The talc deposits in a belt along the Tonopah & Tidewater Railroad appear to be similar to those near Keeler. The district was visited and described by Diller [3] at the time when its importance was just being realized. Most of the talc is pure white, and this color, with its purity and good slip, renders it suitable for talcum powder. The talc occurs in upturned beds of limestone at and near contacts of intrusive diorite. Talc has been formed by the replacement of tremolite, which in turn was formed by the action of the diorite magma. The talc appears to be the result of hydrothermal metamorphism that closely followed and was probably continuous with the igneous metamorphism, tremolite being stable under the earlier conditions and talc under the later conditions. Some of the talc of this district displays a distinct fibrous structure as a result of its replacement of prismatic tremolite.

In 1920 the Pacific Coast Talc Co. mined and shipped talc from Riggs to be ground in its mill at Los Angeles; G. W. Morton shipped crude talc from Acme to other companies for grinding; and the Talc Products Co. mined a small quantity from its property, 12 miles north of Silver Lake. Mining near Acme was discontinued by the Pacific Minerals & Chemical Co., of Los Angeles, which now purchases its crude talc.

In Eldorado County there were two producers. C. S. Swift has been marketing crude talc from his mine near Latrobe, and a small quantity was marketed by A. W. Prouty, of Shingle Springs. The Talc Products Co. mined a little talc from the property of Charles G. Debney in Bouquet Canyon, 15 miles north of Saugus, in Los Angeles County.

GEORGIA.

The only producing company in Georgia was the Georgia Talc Co., of Asheville, N. C., whose property is on the lower slopes of Cohutta Mountain, 3 miles southeast of Chatsworth. Crayons form the most valuable part of the output. The Chatsworth talc district and the deposit and mill of the Georgia Talc Co. have been described by Hopkins.[4]

A band of talcose rock lying conformably in a series of quartzite and arkose crops out for a considerable distance on the side of Cohutta Mountain. The talc is light green and somewhat schistose. The minable talc is of variable thickness and grades off into a mixture of talc, chlorite, and other minerals, locally known as "blue john." Hopkins presents conclusive evidence that the talc has been formed by the alteration of an intrusive igneous rock of basic composition.

[3] Diller, J. S., U. S. Geol. Survey Mineral Resources, 1913, pt. 2, pp. 157-160, 1914.

[4] Hopkins, O. B., Asbestos, talc, and soapstone deposits of Georgia: Georgia Geol. Survey Bull. 29, pp. 262-267, 1914.

MARYLAND.

Three companies were active in Maryland during 1920—the Harford Talc Co., of Baltimore; the Maryland Mineral Co., of Conowingo; and Herbert I. Ousler, of Marriottsville.

The property of the Harford Talc Co. lies near Dublin and not far from the Conowingo crossing of Susquehanna River. The talc has been formed by the alteration of a dike of basic igneous rock. The property and product of the company have been described by Diller, Fairchild, and Larsen.[5] The talc is sufficiently fine grained to be of a refractory character. An analysis of this talc and comparative analyses of the best imported talcs were given by Diller in the chapter on talc in Mineral Resources for 1919. The talc after baking is free from cracks but of a rather dark color. It is the only domestic refractory talc now in use which, so far as known to the Geological Survey, has successfully met the rigorous requirements in undergoing complete dehydration. This is the only known occurrence of refractory talc formed by the alteration of a basic igneous rock. Usually the product is too coarse grained or impure. The other workable deposits of refractory talc are all in limestone. The talc is shipped from the mine in the form of blanks whose machining is completed by the consumers. The quantity marketed in 1920 greatly exceeded that of the two previous years in which the mine has been in operation, and W. L. Boswell, manager of the company, states that recent deeper quarrying shows an improvement of the quality and of the proportion of the whole suitable for cutting.

The Maryland Mineral Co. continued to operate its property near Conowingo. Herbert I. Ousler shipped from his quarry near Henryton. Samples submitted by Mr. Ousler show that the material is a rather impure talc schist. It was shipped in the crude state.

MASSACHUSETTS.

The only producing mine in Massachusetts is that of the Foliated Talc Co., at Rowe. The talc occurs as an alteration product of basic dikes, which in many places in western Massachusetts are included in the metamorphosed sediments. Geologically the talc region of northwestern Massachusetts is a continuation of the talc belt of Vermont.

NEW JERSEY.

In New Jersey operations at the mine of the Rock Products Co., of Easton, Pa., successors to the Lizzie Clay & Pulp Co., were resumed after a year's inactivity and production was much in excess of that of the last few years. This property is above Marble Hill, on Delaware River, a few miles above Phillipsburg, Warren County.

NEW YORK.

The value of the talc sold in New York was the largest on record, being 30 per cent larger than in 1919. The quantity in 1920 was 9 per cent larger than in 1919. The active companies were the Inter-

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[5] Diller, J. S., Fairchild, J. G., and Larsen, E. S., High-grade talc for gas burners: Econ. Geology, vol. 15, pp. 665-673, 1920.

national Pulp Co., the Uniform Fibrous Talc Co., the W. H. Loomis Talc Co., all near Gouverneur; the St. Lawrence Talc Co., and the Carbola Chemical Co. The Carbola company took over the property and mill of the St. Lawrence Talc Co. at Natural Bridge May 1, 1920. The Loomis Talc Co., which marketed only crude talc in 1920, has nearly completed a mill for grinding its product.

The talc region of New York has been described by Smyth[6] and by Newland.[7] The talc occurs in a series of limestones of Grenville age, which are found more or less continuously from Gouverneur to Fowler, in St. Lawrence County. The limestone is included in intrusive gneissic granite. In the Gouverneur region the talc has been formed by the alteration of tremolite. This alteration, according to Smyth, was not of the ordinary replacement type, but consisted rather in gradual and simultaneous change of all the molecules. Indeed, the resulting product, the "talc" as mined, has not the usual composition of talc, but contains considerably less water and is sometimes known as agalite. The talc of the Natural Bridge region has not the fibrous quality of that of the Gouverneur region and is said to be associated with more or less serpentine.

An extended description of the mines and properties of four producing companies by Ladoo[8] has recently been published.

NORTH CAROLINA.

The commercial talc of North Carolina includes two distinct minerals, talc and pyrophyllite. Pyrophyllite is mined in Moore County, in the central part of the State, and talc has been mined in several of the western counties.

In 1920 the Biltmore Talc Co. and the Georgia Talc Co., both of Asheville, N. C., mined talc, and the Oliver Quartz Co., of Charlotte, and the Talc Products Co., of Glendon, both in Moore County, mined pyrophyllite. All four companies produced manufactured articles, the most important of which were pencils and metal-workers' crayons. Much of the material was sold ground. T. J. Mauney mined talc at the mine of the Cherokee Iron & Marble Co., 3 miles from Murphy, on Valley River in Cherokee County; the product was sold crude. John D. Field reported the completion of a 20-ton mill, near Hemp, Moore County.

The geology of the deposits has been described by Pratt.[9] In Cherokee County the talc belt runs close to the railroad in the northeastern part of the county. "The rocks of the region are for the most part marble and quartzite, bordered by crystalline schists." Metamorphism has been intense, and in places tremolite has been formed in the marble, especially near the quartzite contact. Talc has been formed in lenses by the alteration of the tremolite. The deposit of the Biltmore Talc Co. is at Marble, in the central part of this region.

The pyrophyllite of Moore County is associated with slates but not in direct contact with them, being usually separated by bands of siliceous iron breccia, which are probably 100 to 150 feet thick.

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[6] Smyth, C. H., jr., Preliminary examination of the general and economic geology of four townships in St. Lawrence and Jefferson counties, N. Y.: New York State Mus. Ann. Rep., vol. 47, pp. 685–709, 1894; Report on the talc industry of St. Lawrence County: Idem, vol. 49, pp. 661–671, 1898; Genesis of the zinc ores of the Edwards district, St. Lawrence County, N. Y.: New York State Mus. Bull. 201, 1918.

[7] Newland, D. H., New York State Mus. Bull. 178, pp. 78–80, 1915.

[8] Ladoo, R. B., Talc mining in New York; Bur. Mines Repts. Inv., No. 2171, October, 1920.

[9] Pratt, J. H., Talc and pyrophyllite deposits of North Carolina: North Carolina Geol. Survey Econ. Paper 3, 1900.

Buddington[10] has recently thrown much light on the origin of pyrophyllite by his description of the pyrophyllite deposits of southeastern Newfoundland. In these deposits the pyrophyllite occurs as an alteration product of rhyolite in an extensive shear zone near a large mass of intrusive granite. He shows that the alteration took place under thick cover by the action of solutions given off by the granite magma.

PENNSYLVANIA.

The production of the Pennsylvania-New Jersey field, which lies on both sides of Delaware River near Easton, was the largest since 1913, and the value in 1920 far surpassed that of any previous year. All the talc mined in this region is ground. The average price per ton of the ground talc for 1920 in the Pennsylvania-New Jersey field was $10.85. On the Pennsylvania side of the river C. K. Williams & Co. and J. O. Wagner continued operations.

VERMONT.

The Eastern Talc Co., the Magnesia Talc Co., the American Mineral Co., the Vermont Talc Co., and the American Soapstone Finish Co., producers in 1920, market their product ground, except the Magnesia Talc Co., which uses some of its talc for the manufacture of crayons. The Pioneer Talc Co. purchased from the receiver the property of the Vermont Talc Products Co., at Fayston. The average selling price of the Vermont ground talc was the highest on record, being $9.26 a ton in 1920, as compared with $8.39 in 1919.

The quantity and value of the talc and soapstone produced in Vermont since 1904 are shown graphically in figure 8.

The talc and serpentine deposits of Vermont lie in a belt of highly metamorphic rocks which extend in a northerly direction through the whole central part of the State. The geology of the talc deposits has been described by Jacobs.[11] The talc and soapstone occur as alteration products of masses of basic igneous rock that intruded conformably the schists with which they are associated. The deposits, although of very irregular shape, are more or less tabular in a vertical direction. Many of the deposits have a central core of "grit" which contains considerable dolomite, and they are usually bordered by a "blackwall" of chloritic schist, which Jacobs compares to the "blue john" of the Georgia talc deposits. Jacobs states that the talc of Vermont is in part an alteration product of serpentine, which in turn is the first alteration product of the fresh igneous rock. This dual process of alteration is of rather general occurrence, as has been pointed out by Benson,[12] who considers that it is an after effect of the igneous metamorphism, and therefore not related to the present land surface.

The mines and mills of the active talc companies have been described by Ladoo.[13]

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[10] Buddington, A. F., Pyrophyllitization, pinitization, and silicification of rocks around Conception Bay, Newfoundland; Jour. Geology, vol. 24, pp. 130-152, 1916.

[11] Jacobs, E. C., The talc and verd antique deposits of Vermont: Vermont State Geologist Rept. 1915-16, pp. 232-280; Progress in talc production: Idem, 1917-18, pp. 148-157.

[12] Benson, W. N., The origin of serpentine, a historical and comparative study: Am. Jour. Sci., 4th ser., vol. 46, pp. 711-714, 1918.

[13] Ladoo, R. B., Talc mining in Vermont: Bur. Mines Repts. Inv., No. 2026, September, 1919.

VIRGINIA.

The talc and soapstone producers of Virginia numbered four, as in 1919, and made a large increase in sales. The Virginia Alberene Corporation, whose active property is at Schuyler, Nelson County, and the Oliver Bros. (Inc.), whose property is at Arrington, also in Nelson County, produced only sawed and manufactured soapstone. The other two companies marketed principally ground talc, which was used mostly for foundry facings, plastic cement, and roll-roofing dust, purposes for which a high degree of purity and whiteness of powder are not required. The mine of the Bull Run Talc & Soapstone Co. is at Clifton, in Fairfax County. The property of the Franklin Soapstone Products Co. at Henry, in Franklin County, was taken over by the Blue Ridge Talc Co. Both companies produced during the year.

The soapstone and talc deposits of Virginia have all been formed by the alteration of dikes of basic rocks. These rocks are exposed at many places in a belt running southwestward from Fairfax County through Albemarle and Nelson counties to Franklin County. The belt is continued in North Carolina and forms part of a great series of peridotites which have been intruded discontinuously from Alabama to Newfoundland. In Virginia, as elsewhere, the rocks may be found in a fairly fresh condition or they may be altered to serpentine or to talc, the degree of alteration varying greatly. Where altered to serpentine asbestos has been found, as in Fairfax and Bedford counties.

Where the peridotite has been altered to talc more or less chlorite and other iron-bearing minerals may be present. If the amount of chlorite is low the product is suitable for grinding. If the amount of chlorite is high and if the alteration from the original hard minerals has not been complete soapstone may result. If chlorite is the only impurity the resulting soapstone is soft and readily worked, though it does not take a high polish. If remnants of the original minerals remain the rock is less easily worked but takes a better polish and resists wear better.

IMPORTS AND EXPORTS.

No soapstone is imported. The imports of talc in 1920, shown in the following tables, were the largest on record. The increase was largely in talc from the mines of Modoc, Ontario, Canada. The imports from Italy are back to pre-war quantities, and those from France show a substantial recovery.

Talc imported for consumption in the United States, 1916-1920.

Year.	Crude and unground steatite and French chalk.[a]			Talc, steatite, and French chalk—cut, ground, or washed.[b]			Total.	
	Quantity (short tons).	Value.	Average value per ton.	Quantity (short tons).	Value.	Average value per ton.	Quantity (short tons).	Value.
1916	2,027	$12,645	$6.24	16,855	$218,230	$12.95	18,882	$230,875
1917	2,452	10,710	4.37	16,157	258,787	16.02	18,609	269,497
1918	1,434	9,253	6.45	12,735	251,323	19.73	14,169	260,576
1919	1,641	10,105	6.16	12,961	248,899	19.20	14,602	259,004
1920	941	7,206	7.57	21,739	443,514	20.40	22,680	450,720

[a] Duty free. [b] 15 per cent duty.

General imports of talc, ground or unground, into the United States, 1913–1920, in short tons.

Country.	1913	1914	1915	1916	1917	1918	1919	1920		
								Quantity.	Value in country of origin.	
									Total.	Average per ton.
Austria-Hungary	391	587	138					22	$600	$27
Belgium	8									
British South Africa				10						
Canada	3,348	5,006	4,797	5,964	10,287	12,185	11,852	15,123	248,158	16
Denmark								11	146	13
England	34	62		1	55			34	1,696	50
France	5,466	4,398	3,734	3,570	1,512	22	163	1,834	29,222	16
French Africa					33			22	758	34
Germany	15	53	8					2	146	73
India								1	34	23
Italy	4,510	5,535	7,268	7,105	4,167	490	958	4,619	160,606	35
Japan		3			10					
Jamaica					66			33	726	22
Netherlands	2									
Other British West Indies								28	638	23
Spain				11	1					
Sweden				22				(a)	2	
	13,774	15,644	15,945	16,683	16,131	12,697	12,973	21,729	442,732	20

a Less than 1 ton.

General imports and imports for consumption for any period will differ to the extent that the entries for warehouse for the period differ from the withdrawals from warehouse for consumption. The term "entry for consumption" is the technical name of the import entry made at the customhouse and implies that the goods have been delivered into the custody of the importer and that the duties have been paid on the dutiable portion. Some of them may be afterward exported.

The imported talc is used principally for toilet powder for which a prejudice in favor of the European talc appears to exist out of proportion to its present value. However, the California talc, which is the chief competitor, is under the great disadvantage of a freight rate of about $25 a ton to the eastern market.

No talc was exported in 1920.

APPARENT CONSUMPTION.

The apparent consumption of talc and soapstone, sales of domestic material plus imports for consumption, increased from 204,960 short tons in 1915 to 233,315 tons in 1920. In the same period the average value per ton of all material used increased from $10.20 to $14.94.

The Geological Survey has no record of the quantity of talc in the hands of consumers, so that, as there are no exports, the apparent consumption is arrived at by adding the domestic material sold and the imports.

WORLD'S PRODUCTION.

The production of talc and soapstone by countries is shown in the next table. The figures for Great Britain and Germany represent soapstone. Practically all the remainder of the product is eventually ground as talc.

In 1919 the United States produced 69 per cent and consumed 77 per cent of the world's supply of talc and soapstone.

World's production of talc and soapstone, 1913–1919, by countries, in metric tons.

Country.	1913	1914	1915	1916	1917	1918	1919 Quantity.	1919 Per cent of total.
Austria [a]	[a] 16,000	15,000	[a] 12,000	[a] 12,000	[a] 12,000	(b)	(b)	....
Canada [c]	11,113	9,805	10,782	11,888	14,336	16,483	16,912	7
France [d]	60,175	(d)	(d)	(d)	(d)	(d)	35,600	15
Germany [e]	(b)	1,734	1,843	1,897	2,170	9,305	(b)	....
India [f]	2,565	1,015	1,094	1,233	7,955	13,191	2,169	1
Italy [g]	24,001	22,478	23,931	27,483	21,863	18,111	17,550	7
Norway [h]	1,500	2,100	2,990	5,500	7,084	15	....	....
Spain [i]	4,407	4,612	963	3,561	3,450	3,328	3,024	1
Union of South Africa [j]	....	....	40	120	712	608	687	....
United Kingdom [k]	41	183	864	306	1,253	951	699	....
United States	159,512	156,303	169,544	193,194	198,535	188,972	167,686	69
World's total (approximate)	279,314	....	....	....	....	....	244,327	100

[a] Statistics for Austria not available for years mentioned in table. Department of Commerce reports talc exported from Austria-Hungary in 1913 as 80,828 metric quintals, or 8,083 metric tons. Much talc is used in Austria, especially for paper. If we assume that somewhat less than half of the total output is used in Austria, the total production in 1913 was about 16,000 tons. As talc is rather a peace mineral and war delayed production, the output in 1915–1917, inclusive, would probably average less than 12,000 metric tons annually, although the capacity of the mines apparently is greater.
[b] Figures not yet available.
[c] 1913–1919: Canada Dept. Mines, Mines Branch, Ann. Repts.
[d] 1913: Statistique de l'industrie minérale en France. Statistics from 1914–1918 not separately recorded. 1919: Information furnished by Director of Mines, Paris.
[e] Imperial Mineral Resource Bureau. Figures cover Bavaria only.
[f] 1913–1918: India Geol. Survey Rec.; 1919: Statistics furnished by Director of Geological Survey of India.
[g] 1913–1918: Rivista del servizio minerario; 1919: Revista minera, metalúrgica y de ingeniería, año 72, No. 2769, 1921.
[h] Norges Officielle Statistik, Norges Bergverksdrift.
[i] 1913–1919: Estadística minera de España.
[j] Ann. Repts. Government Mining Engineer, Union of South Africa, Dept. Mines.
[k] Mines and quarries.

USES.

Ground talc and soapstone are used as a filler in the manufacture of paper and rubber, as toilet and foot powders, as an extender in paint manufacture, as foundry facings, and with other products, such as roofing paper, to prevent sticking.

Massive fine-grained talc is used for pencils and metal workers' crayons, cores for electrical heating apparatus, "lava tips" for gas burners, and French chalk.

The best quality of soapstone is used for some of the purposes listed in the preceding paragraph. For such purposes as electric heating appliances a prejudice is occasionally expressed in favor of either soapstone or massive talc by those who consider that they are different substances and do not realize that they are practically the same thing. Ordinary soapstone is widely used in slabs for laboratory tables, laundry tubs, and switchboards. It is also used for refractory blocks in the metallurgic industry and in fireless cookers.

REFRACTORY TALC.

High-grade massive talc has been used in increasing quantity in the last few years for various refractory purposes, as it is an excellent nonconductor of heat and electricity. Before 1914 most of the talc of this grade used in the United States was imported from Germany, France, Italy, or India. When the foreign supply was cut off domestic supplies were found which are still supplying the market. The talc produced by the Harford Talc Co. at Conowingo, Md., has been found to be satisfactory. Several years ago the American Lava Corporation, of Chattanooga, Tenn., operated a mine in the San Andres Mountains, 40 miles west of Tularosa, N. Mex. The material was reported satisfactory but the cost excessive. The Inyo Talc Co., whose mine is at Keeler, Calif., produces a very pure massive talc. In thin section under the microscope it is seen to contain a small proportion of grains larger than those found in the imported talc. The material machines remarkably well, but hitherto difficulty has been experienced in baking it so as to avoid cracks. However, much of this talc is said to be suitable for use in electric heating apparatus which is not run at a higher temperature than dull red heat.

The analysis of pure talc corresponds closely to the empirical formula $H_2Mg_3Si_4O_{12}$, according to which talc contains silica (SiO_2) 63.5 per cent, magnesia (MgO) 31.7 per cent, and water (H_2O) 4.8 per cent. The work of Clarke and Schneider,[14] followed by that of McNeil,[15] indicates that talc is probably an acid double salt of orthosilicic acid (H_4SiO_4) and polysilicic acid ($H_4Si_3O_8$). When talc is heated to bright redness the molecule breaks down, the water of constitution is liberated, and free silica is formed. McNeil considers that the remaining magnesium silicate is in the form of $MgSi_2O_5$. The material resulting from this intense heating has shrunk slightly and become hard enough to scratch glass readily. Massive talc possesses then the desirable features that it can be readily machined because of its extreme softness and that after the machining it can be converted into a hard, tough, and durable substance.

Refractory talc as mined must be free from cracks, slip surfaces, and schistosity. It should be extremely fine grained and should not contain hard minerals. On heating to a temperature sufficiently high to drive off the water, the talc should not crack. The properties of refractory talc were investigated recently by Diller, Fairchild, and Larsen.[16] As regards soft impurities, they showed that some of the best talc contains 8 per cent of chlorite and that satisfactory talc contains as much as 15 per cent; furthermore, they showed that the water content of the talcs most used for refractory purposes was subject to very little variation. They concluded that one of the most important properties of the high-grade talc is its extremely fine grain.

The qualities upon which refractory talc is dependent do not yet seem to be thoroughly understood by all concerned in its production. The greatest difficulty is found in obtaining a talc which will not develop shrinkage cracks after baking. The cause of cracking is

[14] Clarke, F. W., and Schneider, E. A., Experiments upon the constitution of the natural silicates: U. S. Geol. Survey Bull. 78, pp. 11-42, 1891.

[15] McNeil, H. C., The constitution of certain natural silicates: Am. Chem. Soc. Jour., vol. 28, pp. 590-602, 1906.

[16] Diller, J. S., Fairchild, J. G., and Larsen, E. S., High-grade talc for gas burners: Econ. Geology, vol. 15, pp. 665-673, 1920.

frequently attributed to a high water content, but analyses do not bear out this contention. It has just been pointed out that a high degree of purity is not essential. During the winter of 1920–21 J. G. Fairchild and the writer made an investigation as to the manner in which talc loses its water. In figure 9 are shown two curves that indicate the range of temperature over which the water is lost. The horizontal distance indicates the temperature and the vertical distance indicates the quantity of water that has been driven off. The upper curve represents the best German talc and the lower curve a domestic talc which, as yet, it has not been possible to dehydrate without cracking. Nearly all the water of the German talc is lost between about 640° and 740° C. (1,184°–1,364° F.), whereas the American talc loses its water at 700°–800° C. (1,292°–1,472° F.). The temperature control during this work was ±15° C. (34° F.) so that a great degree of refinement could not be attempted. Nevertheless the results

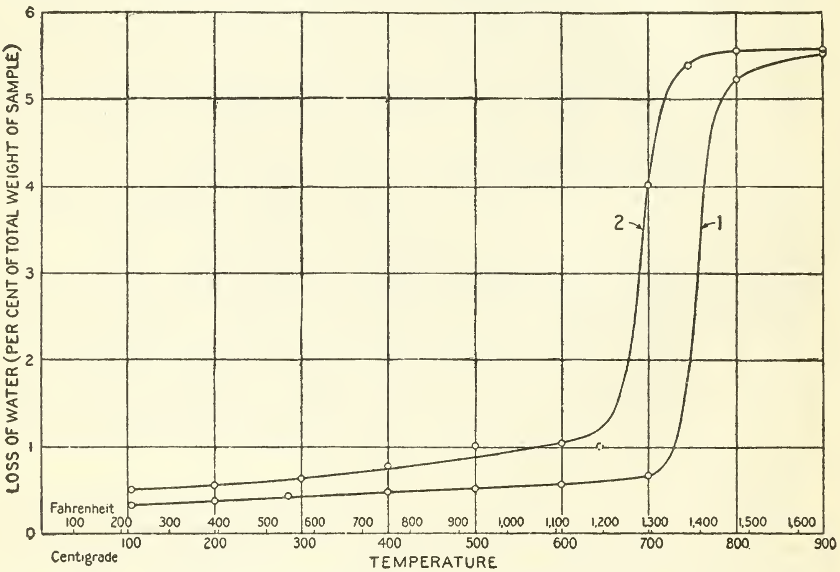

FIGURE 9.—Curve showing loss of water on heating sample of talc from Germany (2) and sample of domestic talc (1).

show that the water is lost over a small range of temperature and that the range may be even less than that just indicated. The temperature represented by the steep part of these curves will be referred to as the critical range in the discussion that follows.

An attempt was made to determine the rate of the loss of water during the critical range of temperatures, and the result is shown in figure 10. The German talc is represented by the lower curve and the same sample of American talc by the upper curve. Although the lower curve is not strictly comparable with the upper one, owing to the necessity of using a fresh sample which had not previously been brought up to the temperature of the lower extreme of the critical range, it is believed that this does not impair the results, for the water given off below the critical range appears to be rather loosely held. The dotted circles in figure 9 indicate values obtained from a supplementary sample. It will be seen that the two curves in figure 10 are very similar. The German talc loses its water a little more slowly than the American sample, but it loses most of it at about the same rate. It is thought that the difference is not enough to account for the superior qualities of the German talc. What, then, is the controlling

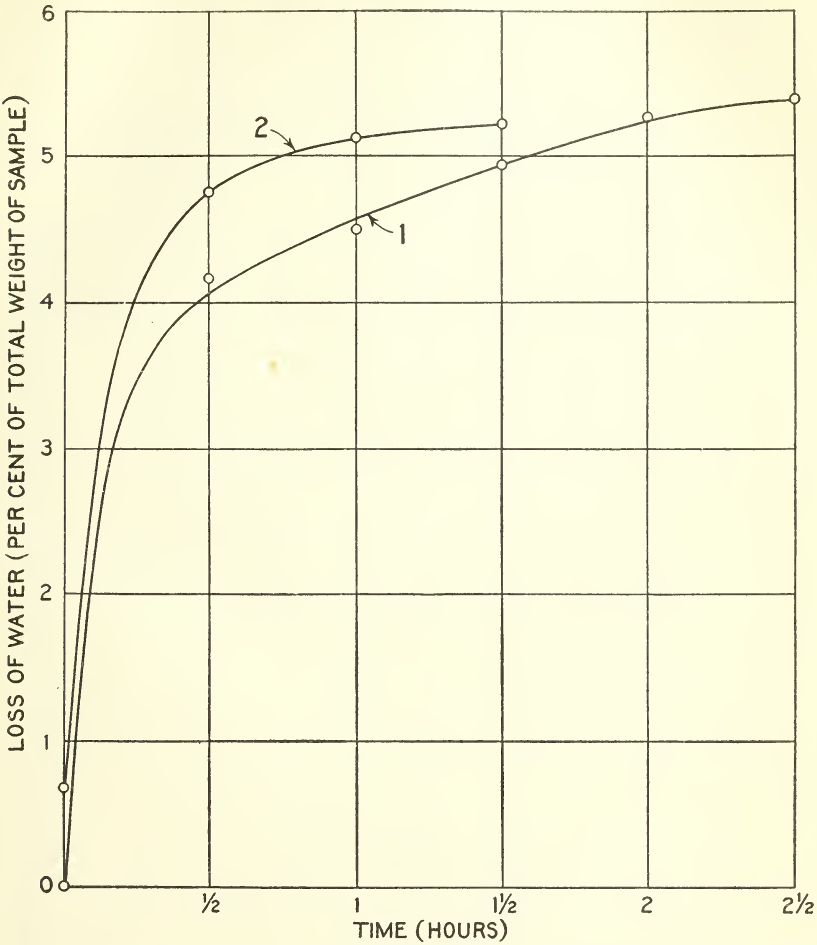

FIGURE 10.—Curve showing rate of loss of water during "critical range of temperature" on heating samples shown in figure 9.

feature? It is believed to be fineness of grain, in which the German sample was much superior to the American specimen. The work of Diller, Fairchild, and Larsen showed that the various samples tested, when arranged in order of excellence, were arranged in order of their fineness of grain, the finest grained being the best.

GEMS AND PRECIOUS STONES.

By B. H. Stoddard.

PRODUCTION.

Value of precious stones produced in the United States, 1916–1920.

Variety.	1916	1917	1918	1919	1920
Agalmatolite	...		...	...	(a)
Andalusite	...	(a)	(a)	...	...
Beryl	$2,031	$2,178	$1,906	(a)	$3,440
Calamine	...	...	(a)	...	...
Chlorastrolite	(a)	45	146	$53	(a)
Copper-ore gems	1,713	2,857	2,299	(a)	(a)
Corundum (sapphire)	99,180	54,204	42,414	40,304	214,705
Datolite	(a)	(a)	(a)	(a)	(a)
Diamond	2,680	4,175	1,910	(a)	(a)
Epidote	(a)	(a)	(a)	...	(a)
Feldspar	305	(a)	(a)	(a)	520
Fluorite	...	...	(a)	...	...
Fossil coral	(a)	(a)	...	(a)	...
Garnet	1,542	624	1,277	1,630	331
Hematite	(a)	(a)	138	(a)	45
Iceland spar	(a)	(a)	(a)	(a)	398
Jet	...	...	...	(a)	(a)
Kyanite	(a)	...	...	...	...
Lapis lazuli	...	(a)	(a)	(a)	...
Lazulite	(a)	...		...	...
Mariposite	...	...	(a)	...	...
Meerschaum (sepiolite)	(a)	(a)	(a)	(a)	...
Obsidian	134	(a)	(a)	...	40
Olivine	455	458	1,018	...	100
Opal	1,838	805	6,304	(a)	(a)
Phenacite	...	(a)	(a)	...	...
Pyrite	2,075	(a)	(a)	...	(a)
Quartz	25,707	28,273	15,211	17,632	14,676
Rhodonite	(a)	512	515	160	(a)
Rutile	(a)	(a)	...	...	...
Satin spar (gypsum)	...	...	(a)	...	...
Serpentine	(a)	...	...	...	...
Smithsonite	...	(a)	...	...	...
Spinel	...	...	...	(a)	(a)
Spodumene	(a)	(a)	281	(a)	...
Staurolite	(a)	(a)	(a)	...	(a)
Thomsonite	47	(a)	(a)	(a)	10
Topaz	1,005	230	907	210	767
Tourmaline	50,807	12,452	6,206	17,700	4,869
Turquoise	21,811	14,171	20,667	22,750	16,865
Variscite	3,140	2,350	753	925	(a)
Vesuvianite	(a)	2,765	320	...	...
Willemite	...	(a)	(a)	...	...
Zircon	...	...	...	...	144
Zoisite	...	(a)	(a)	...	...
Undistributed	3,323	4,913	4,251	10,399	8,295
	217,793	131,012	106,523	111,763	265,205

a Less than three producers; figures included under "Undistributed."

Value of precious stones produced in the United States in 1920, by States.

Montana	$223,196
Nevada	12,920
California	5,504
Arizona	5,328
Maine	3,738
Oregon	2,475
Arkansas, Colorado, New Mexico, Utah	$8,435
Other States [1]	3,609
	265,205

[1] Connecticut, Georgia, Idaho, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, South Dakota, Texas, Virginia, and Wyoming.

AMETHYST AND TOPAZ.

Amethyst and topaz are reported by J. E. Reed, 431 South Main Street, Butte, Mont., to have been found in 1920 about 18 miles southeast of Butte. The claims are undeveloped, but sufficient work is said to have been done to expose the gem material.

CORUNDUM (SAPPHIRE).

The mines of the American Gem Mining Syndicate, in Granite County, and those of the New Mine Sapphire Syndicate, in Fergus County, Mont., were operated in 1920, and their output, which includes nearly all the sapphire produced in the United States, was greater than in any previous year except 1913. According to a statement of an official of the New Mine Sapphire Syndicate, the demand for industrial sapphire is increasing every year, and the output of the syndicate's mines is engaged for two years ahead.

DIAMOND.

The Arkansas Diamond Co., Little Rock, Ark., which owns the Arkansas mine, in Pike County, continued testing by pits and washing by hand in 1920 and is reported to have recovered several hundred carats of diamonds, valued in the rough at several thousand dollars. Operations on a larger scale have been planned, and at the present time (October, 1921) the company is reported to be installing new machinery in its screening and jigging plant for washing the surface material in the field. The concentrates from this plant will go to the grease tables. In September, 1921, the laborers digging test pits on the property are reported to have picked up a white diamond weighing 20¼ carats. S. H. Zimmerman, the engineer and general manager of the company, is quoted in the Arkansas Gazette of October 9, 1921, as stating that it was a "fairly good stone." The property of the Arkansas Diamond Co. is described in an article entitled "Diamonds in Arkansas," by Samuel W. Reyburn and Stanley H. Zimmerman, published in the Engineering and Mining Journal of April 24, 1920.

Howard A. Millar [2], of the Kimberlite Diamond Mining & Washing Co., 2014 Railway Exchange Building, St. Louis, Mo., reports that the company holds a lease on the Mauney mine and owns the Ozark and Kimberlite mines, at Murfreesboro, Ark. Its two testing plants, which were destroyed by fire January 13, 1919, have not been rebuilt, but further exploration work was carried on, and as soon as conditions become normal activities will be resumed on a larger scale. In the recoveries of gem material the deep canary color and the mahogany shade of brown are said to be especially worthy of mention; blue or pink stones and occasionally a "frosted" or etched white stone are also reported. Mr. Millar states that fragments and fractures were noticeable in the surface material but that with slight depth in the undisturbed volcanic ground these features have almost disappeared. From a careful analysis of several thousand diamonds it is reported by Mr. Millar that on a color basis the mine-run yields white stones 40 per cent, brown 37 per cent, yellow 22 per cent, and bort 1 per cent. The policy of the company has been to withhold information on pro-

[2] Personal letter, Mar. 7, 1921.

duction. Accordingly, in the table giving the production of diamonds the output of this company is not included.

OPAL.

F. M. Myrick, Johannesburg, Calif., reported the discovery of a deposit of canary-colored moss opal 18 miles southwest of Johannesburg. Several years ago Mr. Myrick submitted to the United States Geological Survey specimens of precious opal which he had obtained from a prospect 15 miles west of his bloodstone mine on Brown Mountain in the Death Valley region. It was light colored and showed flashes of green, blue, and red.

IMPORTS.[3]

The precious stones (excluding pearls) imported into the United States in 1920 were valued at $66,100,742, the highest value ever reported except that for 1919, from which it shows a decrease of 28 per cent. The value of the pearls produced is omitted from the total, for pearls are not a mineral but an animal product, being deposited in the shells of mollusks. They are lustrous calcareous concretions with animal membrane between successive layers, and they owe their beauty and value in part to their organic structure; but as they are among the most desired of gems, their value is given in a separate column in the table of imports.

General imports and imports for consumption for any period will differ to the extent that the value of entries for warehouse for the period differs from the value of withdrawals from warehouse for consumption. The term "entry for consumption" is the technical name of the import entry made at the customhouse and implies that the goods have been delivered into the custody of the importer and that the duties have been paid on the dutiable portion. Some of them may be afterwards exported.

Gems and precious stones imported and entered for consumption in the United States, 1910–1920.

Year.	Diamonds.				Other stones not set.	Total, excluding pearls.	Pearls.
	Glazier's.	Dust and bort.	Rough or uncut.	Cut but not set.			
1910	$213,701	$54,701	$8,991,890	$25,593,641	$4,237,232	$39,091,165	$1,626,083
1911	199,930	110,434	9,654,219	25,676,302	3,820,703	39,461,588	1,384,376
1912	452,810	94,396	9,414,514	22,865,686	3,433,163	36,260,569	5,130,376
1913	471,712	100,704	12,268,543	24,812,604	2,805,963	40,459,526	5,002,624
1914	579,332	77,408	2,851,933	11,976,871	1,649,875	17,135,419	2,090,018
1915	366,793	75,944	7,020,646	13,177,919	1,078,391	21,719,693	4,513,909
1916	836,018	67,290	11,441,328	24,282,140	2,303,351	38,930,127	11,336,971
1917	1,098,102	349,746	13,092,855	18,421,838	1,883,810	34,846,351	4,947,509
1918	718,397	475,870	12,636,024	7,734,150	1,102,398	22,666,839	765,929
1919	984,381	1,420,442	20,306,758	64,085,610	5,161,639	91,958,830	11,008,973
1920	1,527,753	3,387,488	10,526,125	45,240,013	5,419,363	66,100,742	7,879,384

[3] Statistics compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Diamonds imported into the United States in the calendar years 1919 and 1920.

[General imports.]

Country.	1919				1920			
	Uncut.		Cut but not set.		Uncut.		Cut but not set.	
	Carats.	Value.	Carats.	Value.	Carats.	Value.	Carats.	Value.
Argentina			17	$2,933				
Australia							1	$710
Austria							121	13,325
Belgium	46	$2,913	13,133	1,793,815	2,343	$185,965	63,390	8,345,615
Bolivia			5	1,745				
Brazil	13,940	529,272	298	27,969	7,679	503,236	737	67,445
British Guiana	588	29,613			2,242	118,483	5	1,112
British South Africa	8,263	469,999	62	16,572	3,374	334,618	171	39,599
Canada	1	22	681	59,600			41	5,945
Cuba			40	3,361				
Czecho-Slovakia							18	3,215
Denmark			991	23,627			485	86,276
Egypt							9	1,592
England	245,207	17,921,148	66,758	6,664,911	102,339	9,283,918	22,104	3,003,534
France	857	22,818	8,995	2,033,268	1,875	55,342	16,247	2,506,090
Germany							144	16,374
Greece							50	6,565
Italy							306	48,857
Japan					80	4,748	68	34,456
Jugoslavia							21	4,431
Mexico							1	250
Netherlands	20,998	1,337,775	434,340	53,561,019	1,146	40,189	198,477	31,024,241
Panama			6	1,275				
Poland and Danzig.							486	48,898
Portugal							333	69,376
Rumania							100	8,448
Siam	897	2,198						
Switzerland			230	32,064			758	108,090
Turkey in Europe			3	788	4	863	3	555
	290,797	20,315,758	525,559	64,222,947	121,082	10,527,362	304,076	45,444,999

CONCRETE STONE AND CONCRETE BLOCKS.

By R. W. Stone.[1]

INTRODUCTION.

The materials discussed in this report are movable concrete products as distinguished from concrete poured during the construction of buildings and pavements. The compilation of statistics on concrete stone and blocks by the United States Geological Survey was begun in 1917 and concludes with this report. The information is only supplemental to other statistics of building materials, the data are bound to be incomplete, the information wanted has been acquired, and there seems to be no call for continuing the inquiry.

The result of this canvass for four years shows that a large number of people have made concrete products on a small scale and have gone out of the business at the end of one season. It has been impossible to procure reports from many of them. Reports of production were received from 609 firms in 1917, 920 in 1918, 1,511 in 1919, and 1,268 in 1920.

This report on concrete products is supplemental to the regular annual reports on natural stone, cement, and sand and gravel, and the figures contained in it are not added to the annual summary of mineral resources of the United States, because that would involve duplication of both aggregate and cement.

DEFINITION OF TERMS.

The term "concrete" as usually understood implies a compact mass of sand and gravel or crushed stone bound together by Portland cement. Concrete molded into various shapes is here reported under different heads determined by shape or use of the blocks.

Architectural concrete stone includes material of various shapes and sizes, which serves the same purpose as natural cut stone and terra cotta in the facings and trimmings of the larger and more elaborate buildings. These blocks are molded and faced so as to imitate cut stone.

Concrete blocks are molded by hand or machine, are solid or hollow, usually rectangular, and are used principally for foundations, partitions, and walls, or as facings and trimmings of dwellings and other small buildings. They serve the same purpose as rubblestone, brick, and monolithic concrete.

Concrete brick are small, rectangular, solid concrete blocks, and serve the same purpose as common clay brick.

Silo blocks are rectangular or slightly curved concrete blocks specially designed for the construction of silos.

Silo staves are long, thin, slightly curved concrete slabs used in the construction of silos.

Miscellaneous products include such articles as tile, fence posts, burial vaults, and lawn decorations.

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[1] The statistical data in this report were prepared by Misses E. A. Menaugh and K. W. Cottrell, of the United States Geological Survey.

Concrete stone of domestic manufacture sold in the United States in 1920, by States.

State.	Architectural stone (high grade).		Concrete blocks.				Concrete bricks.		Silo blocks and staves.		Miscellaneous (value).	Total.	
			Hollow.		Solid.								
	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.		Quantity (cubic feet).	Value.
Arkansas			21,176	$10,490	1,907	$1,564	(a)	(a)			$1,237	24,643	$14,171
California	(a)	(a)	61,784	30,024	(a)	(a)	(a)	(a)			95,845	87,861	161,735
Colorado	(a)	(a)	17,902	7,921	32,113	22,136	(a)	(a)			2,056	58,618	45,145
Connecticut	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)			110	101,976	258,980
Florida	5,580	$7,600	109,447	66,394	25,529	12,704	13,200	$6,769			38,241	153,756	131,708
Georgia			(a)	(a)	(a)	(a)					3,533	7,701	9,113
Illinois	2,193	12,257	980,912	456,755	38,790	21,604	10,849	4,868	41,743	$52,020	290,007	1,074,487	837,511
Indiana	(a)	(a)	1,146,820	497,173	15,471	6,064	8,068	3,247	271,786	236,051	95,961	1,443,069	840,196
Iowa	6,358	12,873	854,020	386,116	34,643	16,490	10,633	6,276	66,330	60,994	914,517	971,984	1,397,266
Kansas	14,780	33,200	115,774	44,049	18,910	5,382	1,982	1,150	(a)	(a)	2,094	153,106	86,475
Kentucky			16,605	7,284	3,179	1,669	(a)	(a)	(a)	(a)	8	22,415	9,844
Louisiana			(a)	(a)	(a)	(a)					8,100	12,933	15,155
Maine			21,970	15,848	(a)	(a)	(a)	(a)				33,730	20,948
Maryland			43,720	22,967	(a)	(a)	(a)	(a)			18,025	48,960	43,792
Massachusetts	116,384	276,825	106,770	56,782	(a)	(a)	1,884	1,342	(a)	(a)	5,335	228,050	341,706
Michigan	(a)	(a)	747,379	311,617	58,340	15,347	5,200	1,618	45,267	27,413	64,873	953,793	579,795
Minnesota	6,560	6,724	1,361,288	338,727	37,970	17,606	7,350	3,824	152,732	110,967	447,615	1,565,900	925,463
Mississippi					(a)	(a)					1,400	2,268	2,730
Missouri	(a)	(a)	62,125	27,221	11,096	4,672	1,267	748	(a)	(a)	4,305	154,651	257,397
Montana			(a)	(a)	(a)	(a)	(a)	(a)				1,154	830
Nebraska	(a)	(a)	1,045,798	409,980	15,651	6,308	3,803	2,886	(a)	(a)	16,084	1,069,120	441,308
New Hampshire			(a)	(a)	(a)	(a)						5,535	2,777
New Jersey	(a)	(a)	306,725	151,149	(a)	(a)	(a)	(a)			2,550	331,093	223,825
New York	(a)	(a)	388,470	215,018	17,721	5,758	7,200	3,163	(a)	(a)	37,221	483,881	661,470
North Carolina							(a)	(a)			13,412	279	19,001
North Dakota			(a)	(a)					(a)	(a)	2,725	3,806	4,565
Ohio	58,600	113,180	1,475,289	745,954	40,744	18,926	31,271	15,945	35,920	49,280	135,723	1,641,824	1,079,008
Oklahoma			28,898	16,138	21,992	11,845	(a)	(a)	(a)	(a)	4,928	51,140	33,098
Oregon	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)			1,360	28,201	68,193
Pennsylvania	45,121	62,573	581,974	244,289	27,593	12,085	(a)	(a)	(a)	(a)	398,980	661,840	720,088
Rhode Island	(a)	(a)	(a)	(a)								37,464	35,398
South Dakota			19,789	11,794					(a)	(a)		26,592	16,053
Tennessee			31,700	29,230								31,700	29,230
Texas	(a)	(a)	21,843	19,281	(a)	(a)	4,432	3,799			7,579	70,932	90,381
Utah	(a)	(a)	(a)	(a)							4,211	14,500	10,513

Virginia	....	....	(a)	(a)	....	....	....	....	....	....	....	21,580	6,656
Washington	....	....	9,148	4,816	....	....	(a)	(a)	(a)	(a)	746	17,452	17,108
West Virginia	....	....	67,410	41,429	(a)	(a)	(a)	(a)	....	....	6,000	69,038	48,629
Wisconsin	11,050	11,970	585,751	262,579	59,768	19,318	14,049	9,283	33,645	12,488	96,677	704,263	412,315
Undistributed [b]	428,871	1,262,431	109,848	56,372	50,134	33,797	41,451	34,962	13,850	8,720	....	....	....
	695,497	1,799,633	10,340,335	4,487,397	511,551	233,275	162,639	99,880	661,273	557,933	2,721,458	12,371,295	9,899,576

[a] Included under "Undistributed."

[b] Includes all products reported by less than 3 operators.

PRODUCTION.

The statistics presented in the table of production indicate the quantity sold by the manufacturers during the year and the value received by the producer for these manufactured products free on board at point of shipment. For miscellaneous products, such as fence posts, burial vaults, lawn ornaments, and tile, only the value is given, because their quantity can not be adequately expressed.

According to reports received the total value of all products represented in 1920 showed an increase of 25 per cent as compared with 1919, but the total quantity of concrete products, except the miscellaneous material not measurable, showed a loss of 28 per cent.

Production is shown in the preceding table in as much detail as possible without disclosing individual output. Ohio, Minnesota, and Indiana ranked first, second, and third, respectively, in quantity of concrete products. In value of all products Iowa was first, followed by the three States named in the same order. Iowa's leading position is explained by a production of drain tile valued at more than $800,000.

ARCHITECTURAL CONCRETE STONE.

Architectural concrete stone is used like natural stone and terra cotta in facing and trimming buildings. The quantity sold in 1920 increased apparently about 10 per cent. There was also an apparent increase of 44 per cent in total value and an increase in value per cubic foot from $1.98 in 1919 to about $2.60. In value of products New York led, followed by Massachusetts, Connecticut, and Missouri.

CONCRETE BLOCKS.

The principal product in the concrete-stone industry is building blocks. The blocks vary in size; the size most commonly used, however, is 8 by 8 by 16 inches, with about 30 per cent air space or "core." There was a wide range in the value of these products also, owing to difference in aggregates used and to difference in size and finish, whether plain or ornamental. Sand and gravel were the aggregates most commonly used, but a great variety of materials were employed, such as crushed stone, chats, slag, screenings, cinders, coquina (crushed shell rock), crushed clay brick, and plaster.

The sales of building blocks in the United States in 1920 reported to the Geological Survey were 10,851,886 cubic feet, valued at $4,720,672. As most of the blocks have a "core," the hollow and solid blocks are shown separately in the table. There was a decrease of about 30 per cent in quantity and 10 per cent in value from the production in 1919, although the average value per cubic foot increased from 33 to nearly 44 cents. The greatest sales were made in Ohio, Minnesota, Indiana, Nebraska, and Illinois, the output in each of these States being more than 1,000,000 cubic feet.

CONCRETE BRICK.

Concrete brick are made of the same size and are used for the same purposes as common clay brick. They are supplied in natural concrete color and also tinted with mineral pigments. Buff and red are popular colors for concrete brick. Colored brick sell for a few dollars a thousand more than plain brick.

The production showed an increase of 7 per cent in quantity and 50 per cent in value as compared with 1919. The average value increased from 44 to 61 cents a cubic foot, or from $18 to about $31 a thousand. Ohio led, with a production of 31,000 cubic feet, followed by Florida, with 13,000 cubic feet.

SILO BLOCKS AND STAVES.

Concrete silo blocks and staves are manufactured principally in the Central States. The total quantity sold in 1920 showed a decrease of 17 per cent from the output in 1919. The average value was 84 cents a cubic foot.

MISCELLANEOUS CONCRETE PRODUCTS.

The total value of miscellaneous products reported was approximately 27 per cent of the value of all concrete products. This figure is probably less nearly correct than those for other forms of concrete here reported, because this group includes a variety of products, some of which are made in small number or quantity on many farms or by individuals for home use and not for sale. The production of tile was the largest item under miscellaneous products; burial vaults ranked second. The following variety of products is suggestive of the wider and larger application of concrete:

ash-pit blocks
baseboards
bier blocks
building slabs
burial vaults
cesspool covers
chimney blocks
cistern blocks and covers
columns
copings
culvert tile
curbing
door and window sills
drain tile
fence posts
fire blocks
floor tile
flower boxes and urns
garden ornaments
hog troughs
laundry trays
lawn seats
lintels
meter boxes
oil plug
ornamental balls and caps
pier blocks and caps
poles for street signs
porch columns
reinforced culvert pipe
roof tile
sewer pipe
sidewalk blocks
sills
urns
vases
veranda posts
water table
water troughs
well curbing and tile.

PROPORTION OF CEMENT TO AGGREGATE.

The report for 1919 showed 885,000 barrels of cement used with 891,000 tons of aggregate, or approximately 1 barrel of cement to 1 ton of aggregate. To verify this proportion and get other information that might be of value, the individual reports from producers in Ohio, Indiana, Illinois, Michigan, Minnesota, and Iowa were scrutinized. Many reports do not give the proportion of the mixture, and comparatively few give the quantity of cement and of aggregate used. However, from several hundred reports that gave these details it was found that 474,000 barrels of cement was used with approximately 368,000 cubic yards of aggregate, or 1.28 barrels per yard. As 1 yard of sand weighs about 2,600 pounds, the proportion 1 barrel of cement to 1 short ton of aggregate is the same as 1.28 barrels of cement to 1 cubic yard of aggregate. This is the average for all the products contained in this report and includes mixtures ranging from 3 to 6 parts of aggregate to 1 part of cement. Of 393 mixtures stated in the reports from these six States, 145 were 1 part cement to 5 parts aggregate and 141 were 1 part cement to 4 parts aggregate. Producers in Iowa seem to use richer mixtures than the average of the other five States, for of 105 mixtures reported from Iowa 56 were 1:4 and 25 were 1:3.

Portland cement used per cubic yard of aggregate in certain States.

State.	Cement (barrels).	Aggregate (cubic yards).	Barrels of cement to yard of aggregate.
Illinois	50,385	40,385	1.25
Indiana	65,148	47,577	1.37
Iowa	173,319	115,521	1.50
Michigan	32,332	32,308	1.00
Minnesota	95,566	64,181	1.49
Ohio	57,075	68,171	.84
	473,825	368,143	1.28

These figures represent only a part of the cement and aggregate used in these States in 1920, and only the conclusion is of value—that about 1¼ barrels of cement to 1 cubic yard of aggregate is the commonest proportion.

MACHINES.

Many different machines are used for molding concrete blocks and other products. Of 504 producers in the six Central States who named the machine in use, 209 specified the Ideal, 34 the Hobbs, 28 the Anchor, and 23 the Wizard. The remaining 200 are divided among many makes.

STONE.

By G. F. Loughlin and A. T. Coons.

PRODUCTION.

GENERAL CONDITIONS.

The stone sold in the United States in 1920 showed an increase over 1919 of 20 per cent in quantity and of 38 per cent in value. This output was nevertheless 14 per cent less in quantity than in 1916, but the value was nearly 69 per cent greater and the largest ever attained. The industry was fairly prosperous, and the material was in good demand until the last quarter of 1920, when stone suffered with other industries in the general business depression. The same industrial conditions affected the quarrymen as in 1918 and 1919. According to the reports of the producers their trade was greatly restricted by shortage of cars, high freight rates, shortage of coal, and high cost of all materials. Labor was perhaps not quite so hard to obtain, but the high wages paid caused prices for all kinds of stonework to be higher than ever before. The paving-block output increased less than 1 per cent. Much of the paving material used in the United States comes from the New England States and is shipped by water. The paving-block producers stated that they found difficulty in obtaining vessels to carry their product and that the freight rates almost prohibited shipment by rail. Building stone which recovered a little of its former prominence in 1919, continued to gain in 1920, its output being 24 per cent larger than in 1919.

Monumental stone, which has shown a general increase in the last four years, decreased about 4 per cent in quantity. Curbing, flagging, and rubble decreased 17, 28, and 17 per cent, respectively, in quantity. All other stone products increased in quantity, as may be seen in the following tables.

The average value for all products increased, and the total average advanced from $1.48 a short ton in 1919 to $1.70 in 1920.

PRODUCTION BY KINDS AND USES.

Stone sold in the United States, 1916–1920.

Year.	Granite.		Basalt and related rocks (trap rock).		Sandstone.		Marble.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1916	9,270,800	$17,456,838	10,233,640	$7,666,297	4,681,590	$5,603,778	409,970	$7,033,171
1917	5,564,200	15,544,957	9,103,580	7,570,885	3,880,500	5,512,421	310,130	6,330,387
1918	3,827,400	14,466,423	6,859,200	7,782,280	2,858,100	4,529,298	305,720	5,496,389
1919	4,221,220	19,345,714	7,410,770	8,944,686	2,623,270	5,283,842	333,400	8,042,297
1920	4,760,000	24,954,908	9,219,200	12,260,148	3,343,000	7,310,290	431,500	11,069,585
Percentage of increase in 1920	12.8	29.0	24.4	37.1	27.4	38.4	29.4	37.6

Year.	Limestone.		Other stone.[a]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1916	67,235,000	$41,309,599	....	....	91,831,000	$79,069,683
1917	63,481,500	46,263,379	1,234,990	$993,642	83,574,900	82,215,671
1918	53,868,200	49,453,006	844,740	973,034	68,563,360	82,700,430
1919	49,759,800	53,171,701	1,190,540	1,920,903	65,539,000	96,709,143
1920	59,290,000	75,655,260	1,483,300	2,291,769	78,527,000	133,541,960
Percentage of increase in 1920	19.2	42.3	24.6	19.3	19.8	38.1

[a] Includes mica schist used for furnace lining, conglomerate, argillite, and various light volcanic rocks used mainly for crushed stone, which can not be properly classified in any of the main groups.

Stone sold in the United States in 1919 and 1920.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone.......cubic feet..	12,764,516	$10,613,683	15,870,530	$18,948,588
Approximate equivalent in short tons......	996,840	....	1,266,380	....
Monumental stone.......cubic feet..	4,759,995	15,042,369	4,549,430	17,488,765
Approximate equivalent in short tons......	399,070	....	383,910	....
Paving blocks.......number..	35,630,885	2,590,690	35,959,200	2,898,459
Approximate equivalent in short tons......	386,530	....	389,980	....
Curbing.......cubic feet..	1,826,663	1,288,828	1,508,480	1,297,058
Approximate equivalent in short tons......	150,060	....	127,710	....
Flagging.......cubic feet..	962,173	502,871	688,890	463,718
Approximate equivalent in short tons......	78,870	....	56,460	....
Rubble.......short tons..	601,146	818,565	501,570	791,177
Riprap.......do....	1,751,677	1,922,823	2,211,170	2,431,723
Crushed stone.......do....	33,673,339	36,405,186	40,365,860	50,846,693
Furnace flux (limestone and marble).long tons..	19,031,520	19,419,438	22,402,100	26,635,977
Equivalent in short tons.......	21,315,300	....	25,090,350	....
Refractory stone[a].......short tons..	1,060,741	1,429,775	1,735,440	2,393,537
Manufacturing industries (limestone and marble).......short tons..	4,370,936	5,179,387	4,592,280	4,591,559
Other uses.......do....	754,491	1,495,528	1,805,890	4,754,706
Total (quantities approximate, in short tons).......	65,539,000	96,709,143	78,527,000	133,541,960

[a] Ganister, mica schist, and dolomite.

PRODUCTION BY STATES.

Stone sold in the United States in 1919, by States.

State.	Number of plants.	Quantity (approximate).		Value.	
		Short tons.	Per cent.	Dollars.	Per cent.
Pennsylvania	405	13,262,310	20.2	16,529,971	17.1
Vermont	51	273,130	.4	8,219,459	8.5
Ohio	126	8,011,530	12.2	8,009,649	8.3
New York	102	4,093,210	6.2	5,856,875	6.1
Indiana	83	1,645,450	2.5	4,953,903	5.1
Massachusetts	81	1,370,830	2.1	4,363,813	4.5
Michigan	24	7,222,200	11.0	3,859,930	4.0
Illinois	51	5,035,770	7.7	3,790,133	3.8
Wisconsin	92	1,556,880	2.4	3,179,894	3.3
California	109	2,851,820	4.4	2,798,918	2.9
Georgia	27	380,020	.6	2,741,616	2.8
New Jersey	61	1,625,870	2.5	2,521,860	2.6
Minnesota	54	462,040	1.0	2,345,162	2.4
West Virginia	35	1,995,210	3.0	2,270,618	2.3
Missouri	96	1,146,040	1.7	2,190,884	2.3
Tennessee	48	677,110	1.0	1,762,596	1.8
Virginia	52	1,632,960	2.5	1,705,749	1.7
North Carolina	26	629,550	1.0	1,683,203	1.7
Connecticut	39	1,288,650	2.0	1,505,748	1.6
Alabama	20	945,910	1.4	1,465,733	1.5
Kentucky	74	1,215,330	1.8	1,447,352	1.5
New Hampshire	24	104,690	.2	1,443,204	1.5
Maryland	41	871,750	1.3	1,331,710	1.4
Maine	48	173,050	.3	1,327,330	1.4
Kansas	41	680,400	.6	860,851	1.0
Oregon	36	523,040	.8	728,863	.9
Oklahoma	22	664,710	1.0	726,059	.9
Colorado	36	529,800	.8	723,430	.8
South Carolina	10	403,780	.6	721,215	.7
Rhode Island	16	117,700	.2	635,112	.7
Texas	23	650,360	1.0	630,584	.7
Arkansas	14	408,830	.6	547,646	.6
Iowa	29	513,030	.8	508,606	.5
Washington	21	261,310	.4	423,653	.4
Arizona	13	566,610	1.0	399,271	.4
Utah	13	318,730	.5	333,342	.4
Nebraska	9	203,550	.3	280,662	.3
Hawaii	5	183,730	.3	250,538	.2
Idaho	12	112,510	.2	248,789	.2
South Dakota	11	140,400	.2	222,490	.2
Wyoming	11	118,040	.2	212,608	.2
Florida	6	129,030	.2	185,531	.2
Montana	13	209,140	.3	183,703	.1
Delaware	3	88,730	.1	148,267	.1
Porto Rico	17	67,000	.1	101,186	.1
Louisiana	1	(a)	.1	(a)	(a)
Nevada	2	53,720	.1	88,566	.1
Alaska	1	(a)	....	(a)	(a)
New Mexico	4	52,990	.1	56,373	(a)
District of Columbia	3	5,700	....	15,627	(a)
Mississippi	1	(a)	....	(a)	(a)
Undistributed	....	64,850	.1	170,861	.2
	2,142	65,539,000	100.0	96,709,143	100.0

a Included under "Undistributed."

Stone sold in the United States in 1920, by States.

State.	Number of plants.	Quantity (approximate). Short tons.	Per cent.	Value. Dollars.	Per cent.
Pennsylvania	443	a 14,296,630	18.2	a 20,615,316	15.4
Ohio	130	9,105,630	11.5	10,856,468	8.1
Vermont	47	301,980	.4	10,065,759	7.5
Indiana	84	2,382,200	3.0	9,228,755	6.9
New York	112	5,969,730	7.6	8,014,446	6.0
Michigan	31	9,812,780	12.5	6,054,276	4.5
Illinois	65	5,103,700	6.5	5,673,831	4.2
California	116	4,424,640	5.6	5,618,777	4.2
Massachusetts	87	1,294,770	1.6	5,397,782	4.0
Wisconsin	107	1,564,940	2.0	3,729,236	2.8
Georgia	31	508,370	.6	3,651,415	2.7
Missouri	111	1,457,960	1.8	3,518,387	2.6
West Virginia	37	2,459,030	3.1	3,155,942	2.4
Minnesota	55	685,810	.9	3,149,751	2.3
Tennessee	46	1,098,660	1.4	2,962,725	2.2
New Jersey	58	1,679,720	2.1	2,777,018	2.0
Alabama	25	1,355,170	1.7	2,544,334	1.9
North Carolina	29	a 672,810	.8	a 2,088,266	1.6
New Hampshire	27	122,980	.1	2,033,113	1.5
Maine	41	192,440	.2	1,924,990	1.4
Connecticut	33	1,284,440	1.6	1,796,724	1.3
Virginia	56	1,466,920	1.9	1,796,620	1.3
Kentucky	82	1,422,530	1.8	1,756,176	1.3
Maryland	36	a 811,500	1.0	a 1,273,741	.9
Oklahoma	28	875,560	1.1	1,056,136	.8
Oregon	47	805,950	1.0	1,030,220	.8
Kansas	40	699,190	.9	1,013,891	.8
Arkansas	21	a 643,000	.8	a 908,969	.7
Texas	23	680,450	.9	890,316	.7
South Carolina	18	272,460	.3	860,000	.6
Washington	26	712,680	.9	821,842	.6
Colorado	39	553,040	.7	810,590	.6
Rhode Island	16	a 123,470	.2	a 786,815	.6
Iowa	34	612,150	.8	749,692	.6
Idaho	13	254,490	.3	616,066	.5
Utah	14	304,290	.4	509,740	.4
South Dakota	8	196,880	.2	489,753	.4
Hawaii	6	289,550	.4	479,279	.4
Nebraska	9	220,530	.3	453,179	.3
Florida	9	340,470	.4	430,130	.3
Arizona	14	431,390	.5	329,264	.2
Montana	15	275,150	.3	296,019	.2
New Mexico	3	331,690	.4	297,271	.2
Wyoming	10	123,100	.1	230,556	.2
Alaska	1	(b)	(b)	(b)	(b)
Nevada	2	(b)	(b)	(b)	(b)
Louisiana	2	(b)	(b)	(b)	(b)
Porto Rico	7	54,670	.1	93,276	.1
Delaware	1	(b)	(b)	(b)	(b)
District of Columbia	4	5,050	(b)	11,900	(b)
Mississippi	2	(b)	(b)	(b)	(b)
Undistributed	......	246,450	1.1	693,208	1.0
	2,301	78,527,000	100.0	133,541,960	100.0

a Output of certain kinds of stone included under "Undistributed" to conform to other tables.
b Included under "Undistributed."

EXPORTS AND IMPORTS.[1]

Stone exported from the United States, 1916–1920.

Kind.	1916	1917	1918	1919	1920
Marble and stone, unmanufactured	$403,303	$572,097	$552,261	$770,392	$774,442
All other, manufactured	1,077,447	1,108,185	1,208,164	1,508,997	2,158,764
	1,480,750	1,680,282	1,760,425	2,279,389	2,933,206

[1] The tables of exports and imports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Stone (including marble) exported from the United States in 1919 and 1920.

Country.	Manufactured.	Unmanufactured.
1919.		
Europe:		
Belgium	$5,849	....
Denmark	1,852	....
France	52,831	....
Iceland and Faroe Islands	1,396	....
Italy	4,660	....
Netherlands	18,020	$800
Norway	7,163	....
Portugal	1,500	....
Russia	2,474	....
Spain	37,391	....
Sweden	6,960	....
Switzerland	3,065	....
United Kingdom—		
England	114,042	100
Scotland	23,578	....
Ireland	268	....
Other Europe	474	....
	281,523	900
North America:		
British West Indies—		
Barbados	4,443	....
Jamaica	4,215	....
Other	10,855	....
Canada	555,998	635,924
Central America	36,234	65
Cuba	161,687	83,924
Dominican Republic	11,268	116
Dutch West Indies	842	....
French West Indies	589	243
Haiti	1,229	30
Mexico	55,125	37,123
Miquelon, Langley, etc	14	....
Newfoundland and Labrador	10,653	7,730
Virgin Islands	1,542	....
	854,694	765,155
South America:		
Argentina	26,995	....
Brazil	48,809	....
Chile	26,531	....
Colombia	11,452	160
Ecuador	5,193	....
Peru	13,351	....
Venezuela	3,277	....
Other South America	5,236	....
	140,844	160
Asia:		
British India	26,054	....
China	8,868	....
Dutch East Indies	42,810	35
Japan	46,130	2,949
Other Asia	7,118	....
	130,980	2,984
Oceania:		
Australia	34,856	20
New Zealand	17,649	1,153
Philippine Islands	8,633	20
Other Oceania	1,412	....
	62,550	1,193
Africa:		
British West Africa	4,328	....
British South Africa	32,727	....
Other Africa	1,351	....
	38,406	....
Total exports	1,508,997	770,392
Grand total	2,279,389	

Country.	Manufactured.	Unmanufactured.
1920.		
Europe:		
Belgium	$1,080	....
Denmark	1,261	....
France	3,631	$360
Germany	2,048	....
Italy	7,020	....
Netherlands	1,321	....
Norway	462	3,961
Portugal	877	....
Spain	844	....
Sweden	5,824	....
Switzerland	205	....
United Kingdom—		
England	10,652	465
Scotland	830	593
Ireland	98	....
Other Europe	925	....
	37,078	5,379
North America:		
British West Indies—		
Bermuda	9	....
Jamaica	476	....
Other	903	....
Canada	211,867	702,017
Central America	5,710	60
Cuba	62,981	24,213
Dominican Republic	11,257	352
Dutch West Indies	....	8
French West Indies	851	....
Haiti	391	....
Mexico	12,905	31,975
Newfoundland and Labrador	4,004	132
Panama	2,681	....
Virgin Islands	909	....
	314,944	758,757
South America:		
Argentina	25,441	1,194
Brazil	1,310	....
Chile	12,293	....
Colombia	2,857	132
Ecuador	1,114	....
Peru	2,211	322
Venezuela	1,042	97
Other South America	2,023	....
	48,291	1,745
Asia:		
China	1,529	275
Dutch East Indies	1,200	....
Japan	4,035	10
Other Asia	1,032	....
	7,796	285
Oceania:		
Australia	6,593	1,871
New Zealand	1,751	....
Philippine Islands	3,346	6,330
Other Oceania	156	75
	11,846	8,276
Africa:		
British South Africa	2,660	....
Other Africa	1,707	....
	4,367	....
Total exports	424,322	774,442
Grand total	1,198,764	

Stone imported for consumption in the United States in 1918–1920.

Kind.	1918		1919		1920	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Marble:						
In blocks, rough, etc.......cubic feet..	96,478	$192,641	209,945	$593,340	468,845	$1,258,192
Sawed..........................do....	....	....	9	90	102	922
Slabs or paving tiles......square feet..	26,118	5,304	104,102	25,841	49,013	27,097
All other manufactures................	....	28,798	....	46,622	....	83,768
Mosaic cubes:						
Loose.................................	....	5,508	....	3,888	....	18,221
Attached to paper.....................	....	....	....	974	....	63
	....	232,251	....	670,755	....	1,388,263
Onyx:						
In blocks, rough, etc.......cubic feet..	1,398	3,046	2,040	9,517	6,395	36,840
Slabs or paving tiles.....square feet..	....	....	....	....	4,200	4,009
All other manufactures................	....	133	....	2,053	....	2,960
	....	3,179	....	11,570	....	43,809
Granite:						
Dressed...............................	....	1,328	....	9,983	....	108,193
Rough......................cubic feet..	18,473	9,653	23,240	17,796	43,805	42,162
	....	10,981	....	27,779	....	150,355
Stone (other):						
Dressed...............................	....	5,060	....	21,444	....	17,622
Rough (monumental or building stone)....................cubic feet..	11,995	12,716	13,807	14,228	110,940	98,327
Rough (other).........................	....	4,390	....	42,185	....	97,199
	....	22,166	....	77,857	....	213,148
Grand total........................	....	268,577	....	787,961	....	1,795,575

General imports of marble and onyx, rough and manufactured, into the United States in 1919 and 1920.

Country.	1919				1920			
	Rough marble, breccia, and onyx.		Manufactured.	Total value.	Rough marble, breccia, and onyx.		Manufactured.	Total value.
	Quantity (cubic feet).	Value.	Value.		Quantity (cubic feet).	Value.	Value.	
Belgium....................	10,114	$18,863	$3,222	$22,085	12,686	$22,046	$5,156	$27,202
France.....................	6,878	10,384	9,566	19,950	22,607	37,336	16,892	54,228
Germany....................	....	....	....	....	1,424	2,400	2,224	4,624
Greece.....................	3,568	12,422	....	12,422	8,891	32,594	....	32,594
Italy......................	188,391	546,428	59,829	606,257	422,990	1,163,482	100,039	1,263,521
Netherlands................	477	923	121	1,044	....	....	152	152
Spain......................	....	....	65	65	....	....	367	367
England....................	....	....	3,225	3,225	....	....	4,867	4,867
Other Europe [a]...........	....	....	....	....	47	84	898	982
Total Europe..........	209,428	589,020	76,028	665,048	468,645	1,257,942	130,595	1,388,537
Canada.....................	250	2,003	2,175	4,178	....	....	663	663
Mexico.....................	1,366	6,147	6	6,153	7,846	43,878	173	44,051
Guatemala..................	....	....	....	....	200	250	....	250
Total North America...	1,616	8,150	2,181	10,331	8,046	44,128	836	44,964
China......................	....	....	74	74	....	....	3,112	3,112
Cuba.......................	....	....	3,125	3,125	....	....	16	16
Japan......................	....	....	686	686	....	....	688	688
Other countries [b]........	30	423	435	858	....	....	1,247	1,247
	30	423	4,320	4,743	....	....	5,063	5,063
Grand total............	211,074	597,593	82,529	680,122	476,691	1,302,070	136,494	1,438,564

[a] Includes Austria, Gibraltar, Poland and Danzig, Switzerland, and Turkey in Europe.
[b] In 1919 includes Brazil, Venezuela, British India, Hongkong, and New Zealand; in 1920, Peru, British India, Hongkong, Straits Settlements, Australia, and other British East Indies.

GRANITE.

Value of granite sold in the United States, 1916–1920.

State.	1916	1917	1918	1919	1920
Arizona	$203,702	$135,080	$76,287	$155,889	$109,600
Arkansas				13,270	74,609
California	1,433,022	844,453	838,786	935,716	2,118,300
Colorado	78,823	113,800	112,461	142,993	201,406
Connecticut	270,740	212,665	148,317	205,124	197,760
Delaware	121,354	216,346	(a)	148,267	(a)
District of Columbia	3,315	4,615	7,585	15,627	11,900
Georgia	813,068	568,143	558,296	866,922	934,182
Idaho					(a)
Maine	1,068,485	1,254,529	1,211,743	1,274,474	1,824,652
Maryland	633,218	603,062	180,199	355,889	327,033
Massachusetts	1,997,150	1,932,511	1,805,396	2,477,938	3,370,562
Minnesota	1,048,816	1,102,493	1,167,873	1,765,308	2,118,784
Missouri	80,390	58,241	54,523	(a)	114,663
Montana	18,175	25,831	28,894	12,401	40,483
New Hampshire	1,141,810	909,700	1,003,328	1,443,204	2,007,465
New Jersey	71,421	47,372	31,500	57,198	106,858
New Mexico	(a)	(a)	(a)		(a)
New York	368,119	182,515	191,551	94,820	204,491
North Carolina	1,798,087	1,486,541	1,155,626	1,542,020	1,896,210
Oklahoma	80,597	37,071	116,231	64,363	70,407
Oregon	17,080	(a)	(a)	(a)	(a)
Pennsylvania	446,868	290,748	310,050	444,330	472,529
Rhode Island	631,237	477,779	525,052	426,868	586,874
South Carolina	447,570	427,531	599,864	721,215	860,000
South Dakota	(a)	(a)	(a)	(a)	(a)
Texas	84,379	95,867	46,297	103,158	90,943
Utah	(a)	(a)	(a)		
Vermont	2,598,835	2,850,615	2,689,652	4,031,735	4,793,935
Virginia	451,697	307,224	336,696	189,564	148,300
Washington	90,525	52,053	65,293	74,958	85,365
Wisconsin	1,390,968	1,248,112	962,869	1,634,895	1,808,023
Undistributed	67,387	60,060	242,054	147,568	379,574
	17,456,838	15,544,957	14,466,423	19,345,714	24,954,908

a Included under "Undistributed."

Granite sold in the United States in 1919 and 1920.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone (rough and dressed)..cubic feet..	3,651,200	$2,267,875	4,895,880	$4,492,482
Approximate equivalent in short tons	303,950		411,170	
Monumental stone..cubic feet..	3,658,422	10,143,313	3,379,330	11,543,255
Approximate equivalent in short tons	304,890		283,910	
Paving..number of blocks..	33,601,520	2,369,521	32,230,270	2,582,934
Approximate equivalent in short tons	364,260		351,260	
Curbing and flagging..linear feet..	822,967	641,726	997,950	755,540
Approximate equivalent in short tons	50,800		62,100	
Rubble..short tons..	97,635	140,694	90,760	154,036
Riprap..do....	379,424	373,728	525,470	478,128
Crushed stone..do....	2,700,074	3,300,280	3,016,960	4,831,776
Other stone..do....	20,187	108,577	18,370	116,757
Total (quantities approximate, in short tons)	4,221,220	19,345,714	4,760,000	24,954,908

Granite sold in the United States in 1919.

State.	Number of plants.	Building.				Monumental.				Paving blocks.		Curbing and flagging.	
		Rough.		Dressed.		Rough.		Dressed.					
		Quantity (cubic feet).	Value	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Number of blocks.	Value.	Quantity (linear feet).	Value.
Arizona	5							(a)	(a)				
Arkansas	3			(a)	(a)	(a)	(a)						
California	40	35,860	$76,418	27,639	$129,065	34,383	$55,757	21,865	$168,333	(a)	(a)	6,218	$5,896
Colorado	10	(a)	(a)			(b)	(b)	b 29,671	b 133,410				
Connecticut	14	17,335	7,332	3,270	12,900	25,765	60,371	2,118	19,058	243,239	$23,422	15,750	8,438
Delaware	3	c 311,587	c 69,403	(c)	(c)							(a)	(a)
District of Columbia	3	(a)	(a)										
Georgia	19	33,411	22,410	24,200	139,586	49,261	59,833	7,150	25,120	2,669,600	153,553	360,478	205,572
Maine	44	243,696	142,301	48,599	223,863	75,503	90,141	60,688	172,396	8,331,436	547,128	64,956	57,980
Maryland	9	c 166,148	c 49,634	(c)	(c)	c 25,150	c 34,765	(c)	(c)	(a)	(a)		
Massachusetts	45	239,965	212,294	86,075	254,176	495,012	741,039	11,546	104,781	6,122,089	513,422	196,980	175,710
Minnesota	31			(a)	(a)	135,706	326,820	226,538	1,352,887	200,000	16,000		
Missouri	2					(a)	(a)			(a)	(a)		
Montana	3	(a)	(a)	(a)	(a)	(b)	(b)	b 3,117	b 8,176			(a)	(a)
New Hampshire	24	95,351	78,858	71,141	347,897	181,892	208,840	83,463	397,975	4,510,958	287,718	46,887	79,378
New Jersey	3	(a)	(a)										
New York	6	c 19,794	c 8,673	(c)	(c)	c 1,928	c 6,703	(c)	(c)	(a)	(a)		
North Carolina	20	12,766	17,800	17,785	67,005	79,146	83,219	35,596	288,454	2,269,004	146,780	105,326	91,228
Oklahoma	5	(a)	(a)	(a)	(a)	(b)	(b)	b 15,950	b 62,463				
Oregon	2							(a)	(a)				
Pennsylvania	33	c 2,060,742	c 253,814	(c)	(c)	30,802	47,393			868,705	82,069	(a)	(a)
Rhode Island	10	(b)	(b)	b 4,715	b 12,235	c 121,058	c 322,686	(c)	(c)	(a)	(a)		
South Carolina	10			(a)	(a)	c 136,050	c 194,580	(c)	(c)			(a)	(a)
South Dakota	1							(a)	(a)				
Texas	8	18,521	27,188			19,135	31,140						
Vermont	29	(b)	(b)	b 31,891	b 54,950	1,480,903	3,227,888	90,209	744,234	41,500	2,800	(a)	(a)
Virginia	5	(a)	(a)			(a)	(a)					(a)	(a)
Washington	6	(b)	(b)	b 3,510	b 16,180	10,786	13,743	8,975	36,238				
Wisconsin	15					32,250	54,032	101,762	942,880	6,855,718	491,286	(a)	(a)
Undistributed		72,561	27,668	4,638	16,225	15,344	38,222	9,700	89,736	1,489,271	105,343	26,372	17,524
	408	3,338,367	1,000,338	312,833	1,267,537	2,975,894	5,625,657	682,528	4,517,656	33,601,520	2,369,521	822,967	641,726
Average value			0.30		4.05		1.89		6.62		d 70.52		0.78

a Included under "Undistributed." b Rough stone included under dressed stone. c Dressed stone included under rough stone. d Per M.

State.	Number of plants.	Rubble. Quantity (short tons).	Rubble. Value.	Riprap. Quantity (short tons).	Riprap. Value	Crushed stone. Road metal and concrete. Quantity (short tons).	Crushed stone. Road metal and concrete. Value.	Crushed stone. Railroad ballast. Quantity (short tons).	Crushed stone. Railroad ballast. Value.	Other. Quantity (short tons).	Other. Value.	Total. Quantity (approximate short tons).	Total. Value.
Arizona	5					(a)	(a)	(a)	(a)			323,800	$155,889
Arkansas	3			(a)	(a)	(a)	(a)					6,770	13,270
California	40	(a)	(a)	162,818	$79,053	524,999	$354,481	(a)	(a)	(a)	(a)	852,080	935,716
Colorado	10									(a)	(a)	2,800	142,993
Connecticut	14	(a)	(a)	10,293	12,013	(a)	(a)			(a)	(a)	52,730	205,124
Delaware	3			(a)	(a)	(a)	(a)			(a)	(a)	88,730	148,267
District of Columbia	3	(a)	(a)									5,700	15,627
Georgia	19	30,317	$39,565	(a)	(a)	63,710	132,577	41,845	$73,706	(a)	(a)	209,560	866,922
Maine	44	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	1,351	$10,402	149,820	1,274,474
Maryland	9	(a)	(a)	(a)	(a)	42,433	99,644	51,047	98,284	(a)	(a)	138,360	355,889
Massachusetts	45	17,393	24,511	(a)	(a)	208,996	439,604	(a)	(a)			383,760	2,477,938
Minnesota	31	(a)	(a)	3,658	3,984	38,926	53,893					75,590	1,765,308
Missouri	2			(a)	(a)	(a)	(a)					(a)	(a)
Montana	3											570	12,401
New Hampshire	24			(a)	(a)	12,643	25,193	(a)	(a)	(a)	(a)	104,690	1,443,204
New Jersey	3			(a)	(a)	19,375	34,875					33,740	57,198
New York	6					21,836	24,459	(a)	(a)	(a)	(a)	49,670	94,820
North Carolina	20	(a)	(a)	7,900	4,200	400,675	701,029	(a)	(a)	(a)	(a)	547,350	1,542,020
Oklahoma	5			(a)	(a)					(a)	(a)	2,900	64,363
Oregon	2											(a)	(a)
Pennsylvania	33	1,396	4,176	(a)	(a)	29,527	45,714	(a)	(a)			215,670	444,330
Rhode Island	10	(a)	(a)			25,922	67,427					40,500	426,868
South Carolina	10	9,235	13,444	(a)	(a)	377,661	499,572			(a)	(a)	403,780	721,215
South Dakota	1											(a)	(a)
Texas	8			(a)	(a)							50,990	103,158
Vermont	29					(a)	(a)					133,630	4,031,735
Virginia	5	(a)	(a)	(a)	(a)	71,934	98,215	(a)	(a)			100,760	189,564
Washington	6	(a)	(a)							(a)	(a)	8,450	74,958
Wisconsin	15	5,628	4,146	27,342	13,162	113,070	123,631			(a)	(a)	229,800	1,634,895
Undistributed		33,666	54,852	167,413	261,316	171,366	154,341	484,109	273,635	18,836	98,175	9,020	147,568
	408	97,635	140,694	379,424	373,728	2,123,073	2,854,655	577,001	445,625	[b] 20,187	[b] 108,577	4,221,220	19,345,714
Average value			1.44		0.98		1.34		0.77		5.38		4.58

a Included under "Undistributed."

b Includes 2,056 tons of durax paving blocks, valued at $18,509.

Granite sold in the United States in 1920.

State.	Number of plants.	Building.						Monumental.				Paving blocks.		Curbing and flagging.	
		Rough construction.		Rough architectural.		Dressed.		Rough.		Dressed.					
		Quantity (short tons).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Number of blocks.	Value.	Quantity (linear feet).	Value.
Arizona	4			(a)	(a)										
Arkansas	5	(a)	(a)			(a)	(a)	(a)	(a)						
California	45	(a)	(a)	10,400	$12,435	33,680	$320,324	65,890	$157,676	24,710	$150,194	35,500	$2,395	(a)	(a)
Colorado	9			(a)	(a)			b 30,850	b 180,506	(b)	(b)				
Connecticut	13	(a)	(a)	(a)	(a)	(a)	(a)	49,260	98,400	3,280	15,620	393,490	37,496	17,970	$16,946
Delaware	1														
District of Columbia	4														
Georgia	22	(a)	(a)	8,560	12,520	15,520	60,602	43,630	60,545	16,510	147,910	1,154,100	65,485	354,400	179,339
Idaho	3							(a)	(a)	(a)	(a)				
Maine	35	4,450	$24,590	220,450	251,259	61,530	449,810	95,650	112,432	49,230	165,456	8,676,350	726,280	66,640	65,754
Maryland	8	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)			(a)	(a)		
Massachusetts	49	26,770	206,795	81,310	145,838	128,390	786,926	345,270	742,118	27,470	137,018	5,509,540	511,961	193,620	226,703
Minnesota	32					13,700	68,555	110,760	302,634	282,470	1,573,691	319,000	39,034		
Missouri	6			(a)	(a)			17,100	57,733			222,150	18,091		
Montana	5			(a)	(a)	(a)	(a)	b 3,690	b 23,955	(b)	(b)	(a)	(a)	(a)	(a)
New Hampshire	26	(a)	(a)	18,380	18,031	80,650	705,897	153,090	289,670	78,340	432,909	5,209,180	372,419	143,500	145,160
New Jersey	3	(a)	(a)					(a)	(a)						
New Mexico	1														
New York	11	3,470	7,089	(a)	(a)	(a)	(a)	b 5,320	b 33,042	(b)	(b)	(a)	(a)		
North Carolina	22	(a)	(a)	(a)	(a)	28,910	143,580	(c)	(c)	c 120,500	c 404,983	2,153,520	163,764	213,700	112,052
Oklahoma	8			(a)	(a)	(a)	(a)	b 10,610	b 67,837	(b)	(b)				
Oregon	2							(c)	(c)	c 3,750	c 35,051				
Pennsylvania	33	133,540	244,582	84,540	14,572	29,410	20,590	b 31,460	b 121,796	(b)	(b)	(a)	(a)	(a)	(a)
Rhode Island	10	2,840	7,414	(a)	(a)	(a)	(a)	143,210	335,355	15,120	129,157	(a)	(a)		
South Carolina	10	9,670	18,313	(a)	(a)	(a)	(a)	(a)	(a)					(a)	(a)
South Dakota	2	(a)	(a)			(a)	(a)			(a)	(a)				
Texas	8	(a)	(a)			(a)	(a)	b 19,750	b 65,350	(b)	(b)				
Vermont	30			51,260	102,000	(a)	(a)	b 1,338,260	b 4,251,651	(b)	(b)	99,500	7,846		
Virginia	6														
Washington	5					(a)	(a)	10,770	15,911	9,200	37,953				
Wisconsin	18	5,800	55,511	(a)	(a)			44,800	232,563	67,190	796,307	7,218,950	535,342	1,630	1,120
Undistributed		132,870	150,964	129,820	130,741	95,370	533,544	149,550	254,803	12,610	113,029	1,238,990	102,821	6,490	8,466
	436	319,410	715,258	604,720	687,396	487,160	3,089,828	2,627,620	6,339,031	751,710	5,204,224	32,230,270	2,582,934	997,950	755,540
Average value			2.24		1.14		6.34		2.41		6.92		d 80.14		0.76

State.	Number of plants	Rubble. Quantity (short tons).	Rubble. Value.	Riprap. Quantity (short tons.)	Riprap. Value.	Crushed stone. Road metal and concrete. Quantity (short tons).	Crushed stone. Road metal and concrete. Value.	Crushed stone. Railroad ballast. Quantity (short tons).	Crushed stone. Railroad ballast. Value.	Other. Quantity (short tons).	Other. Value.	Total. Quantity (approximate short tons).	Total. Value.
Arizona	4			(a)	(a)	(a)	(a)	(a)	(a)			226,300	$109,600
Arkansas	5	(a)	(a)	(a)	(a)	(a)	(a)					49,800	74,609
California	45	(a)	(a)	267,730	$244,147	985,000	$1,125,770	97,400	$96,941	(a)	(a)	1,366,500	2,118,300
Colorado	9											4,200	201,406
Connecticut	13	(a)	(a)	3,110	3,418	(a)	(a)					17,750	197,760
Delaware	1					(a)	(a)					(a)	(a)
District of Columbia	4	5,050	$11,900									5,050	11,900
Georgia	22	40,440	46,508	(a)	(a)	138,760	326,508	(a)	(a)	(a)	(a)	234,490	934,182
Idaho	3											(a)	(a)
Maine	35	(a)	(a)	4,170	3,773	10,140	16,539	(a)	(a)	700	$4,362	154,100	1,824,652
Maryland	8	(a)	(a)	(a)	(a)	60,430	135,239	34,870	68,771	2,340	5,626	133,600	327,033
Massachusetts	49	13,990	44,854	2,560	4,065	187,940	512,491	(a)	(a)	(a)	(a)	383,340	3,370,562
Minnesota	32	(a)	(a)	9,050	11,866	79,480	122,598			(a)	(a)	126,480	2,118,784
Missouri	6	(a)	(a)	1,880	2,138	(a)	(a)					11,000	114,663
Montana	5					1,250	2,250					1,940	40,483
New Hampshire	26			6,630	7,198	14,930	25,600	(a)	(a)	(a)	(a)	120,600	2,007,465
New Jersey	3					(a)	(a)					75,740	106,858
New Mexico	1							(a)	(a)			(a)	(a)
New York	11			(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	78,270	204,491
North Carolina	22	6,880	16,541	14,540	21,246	409,110	860,205	(a)	(a)	9,330	80,788	561,680	1,896,210
Oklahoma	8			(a)	(a)							1,510	70,407
Oregon	2											(a)	(a)
Pennsylvania	33	(a)	(a)			24,150	45,970	(a)	(a)	(a)	(a)	174,240	472,529
Rhode Island	10			(a)	(a)	19,360	57,190			(a)	(a)	41,820	586,874
South Carolina	10	10,370	18,223	(a)	(a)	223,990	556,464	12,980	13,213	(a)	(a)	272,460	860,000
South Dakota	2											(a)	(a)
Texas	8											44,700	90,943
Vermont	30	(a)	(a)			(a)	(a)					127,230	4,793,935
Virginia	6					62,310	100,300	(a)	(a)			107,310	148,300
Washington	5			(a)	(a)							48,000	85,365
Wisconsin	18			(a)	(a)	102,370	148,750	(a)	(a)	2,990	16,270	208,700	1,808,023
Undistributed		14,030	16,010	215,800	180,277	96,260	204,825	456,230	412,152	3,010	9,711	183,190	379,574
	436	90,760	154,036	525,470	478,128	2,415,480	4,240,699	601,480	591,077	e 18,370	e 116,757	4,760,000	24,954,908
Average value			1.70		0.91		1.76		0.98		6.36		5.24

a Included under "Undistributed."
b Dressed stone included under rough stone.
c Rough stone included under dressed stone.
d Per M.
e Includes 12,090 tons of durax paving blocks valued at $101,347.

BASALT AND RELATED ROCKS (TRAP ROCK).

Value of basalt and related rocks (trap rock) sold in the United States, 1916–1920.

State.	1916	1917	1918	1919	1920
Arkansas	$185,360	(a)	(a)	(b)	(b)
California	938,140	$1,150,248	$1,005,112	$922,979	$1,946,791
Colorado	(a)	(a)	(a)	....	....
Connecticut	788,661	974,320	848,442	1,226,943	1,547,509
Hawaii	381,771	483,453	466,093	250,538	479,279
Idaho	(a)	....	(a)	(a)	(a)
Maryland	(c)	(c)	425,817	496,760	565,101
Massachusetts	647,044	535,437	610,161	787,333	1,028,698
Michigan	83,072	70,197	53,269	(a)	84,273
Minnesota	130,863	141,380	(a)	137,490	(a)
New Jersey	1,293,217	1,372,956	1,475,358	1,916,694	2,140,845
New York	956,100	684,550	621,750	619,799	(a)
Oregon	303,909	327,770	160,586	630,540	559,106
Pennsylvania	1,041,203	1,178,664	1,355,332	1,497,526	1,704,185
Texas	(a)	(a)	(a)	(a)	(a)
Virginia	(c)	(c)	(c)	(a)	(a)
Washington	754,831	328,331	154,205	252,435	521,179
Wisconsin	(a)	(a)	(a)	(a)	(a)
Undistributed	162,126	323,579	606,155	205,649	1,683,182
	7,666,297	7,570,885	7,782,280	8,944,686	12,260,148

[a] Included under "Undistributed."
[b] Included under Miscellaneous varieties of stone (pp. 258-259).
[c] Included under Granite.

Basalt and related rocks (trap rock) sold in the United States 1919 and 1920.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone ... cubic feet..	366,754	$27,403	292,520	$31,096
Approximate equivalent in short tons	29,900	....	26,650	....
Paving blocks ... number..	140,875	4,110	129,350	11,049
Approximate equivalent in short tons	1,550	....	1,070	....
Rubble ... short tons..	79,952	91,348	37,900	38,752
Riprap ... do....	231,780	285,633	250,450	305,761
Crushed stone ... do....	7,052,876	8,481,608	8,881,510	11,800,483
Other ... do....	14,712	54,584	21,620	73,007
Total (quantities approximate, in short tons)	7,410,770	8,944,686	9,219,200	12,260,148

Basalt and related rocks (trap rock) sold in the United States in 1919.

State.	Number of plants.	Building.		Paving blocks.		Riprap and rubble.		Crushed stone.				Other.		Total.	
								Concrete and road metal.		Railroad ballast.					
		Quantity (cubic feet).	Value.	Number of blocks.	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
California	26			(a)	(a)	(a)	(a)	1,181,946	$867,190	61,322	$43,681			1,269,980	$922,979
Connecticut	19	267,132	$17,227					1,130,649	1,155,688	49,074	54,028			1,203,760	1,226,943
Hawaii	5					70,625	$79,902	(a)	(a)			(a)	(a)	183,730	250,538
Idaho	1							(a)	(a)					(a)	(a)
Maryland	10	(a)	(a)					203,939	321,056	(a)	(a)			342,590	496,760
Massachusetts	17	(a)	(a)			(a)	(a)	542,585	752,511	33,290	33,009			577,060	787,333
Michigan	1							(a)	(a)			(a)	(a)	(a)	(a)
Minnesota	3					(a)	(a)	138,240	134,165			(a)	(a)	142,250	137,490
New Jersey	39			(a)	(a)	5,573	9,601	1,002,166	1,695,649	185,814	208,635			1,194,790	1,916,694
New York	4							512,810	602,599	(a)	(a)			527,910	619,799
Oregon	29					(a)	(a)	345,416	457,729	(a)	(a)			486,570	630,540
Pennsylvania	31	(a)	(a)			12,425	18,089	673,738	927,047	445,799	546,975			1,134,400	1,497,526
Texas	1					(a)	(a)	(a)	(a)	(a)	(a)				(a)
Virginia	1							(a)	(a)						(a)
Washington	10			(a)	(a)	94,093	109,190	116,404	142,544					210,680	252,435
Wisconsin	2							(a)	(a)			(a)	(a)	(a)	(a)
Undistributed		99,622	10,176	140,875	$4,110	129,016	160,199	231,204	319,743	198,480	219,359	14,712	$54,584	137,050	205,649
	199	366,754	27,403	140,875	4,110	311,732	376,981	6,079,097	7,375,921	973,779	1,105,687	14,712	54,584	7,410,770	8,944,686
Average value			0.07		b29.17		1.21		1.21		1.14		3.71		1.21

a Included under "Undistributed."

b Per M.

Basalt and related rocks (trap rock) sold in the United States in 1920.

State.	Number of plants.	Building.		Paving blocks.		Riprap and rubble.		Crushed stone.				Other.		Total.	
								Concrete and road metal.		Railroad ballast.					
		Quantity (cubic feet).	Value.	Number of blocks.	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
California	28			(a)	(a)	17,600	$9,407	1,871,600	$1,876,054	49,500	$58,685	(a)	(a)	1,939,200	$1,946,791
Connecticut	15	150,540	$10,327					1,180,910	1,475,376	53,540	61,806			1,248,000	1,547,509
Hawaii	6	(a)	(a)			(a)	(a)	250,910	435,403			(a)	(a)	289,550	479,279
Idaho	2							(a)	(a)					(a)	(a)
Maryland	10	(a)	(a)					224,670	408,043	133,730	154,440	(a)	(a)	359,530	565,101
Massachusetts	17	(a)	(a)					642,670	980,099	25,330	47,499	(a)	(a)	668,550	1,028,698
Michigan	4							(a)	(a)			(a)	(a)	33,500	84,273
Minnesota	1					(a)	(a)	(a)	(a)					(a)	(a)
New Jersey	39	(a)	(a)	(a)	(a)			1,021,800	1,868,999	193,650	262,374			1,216,810	2,140,845
New York	2							(a)	(a)					(a)	(a)
Oregon	39	(a)	(a)	(a)	(a)	113,330	150,683	279,090	318,752	96,600	77,821			498,940	559,106
Pennsylvania	26	(a)	(a)			(a)	(a)	727,740	1,103,639	431,860	597,657			1,161,260	1,704,185
Texas	1							(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Virginia	1							(a)	(a)					(a)	(a)
Washington	12					119,520	145,671	425,730	375,508					545,250	521,179
Wisconsin	2							(a)	(a)			(a)	(a)	(a)	(a)
Undistributed		141,980	20,769	129,350	$11,049	37,900	38,752	1,272,180	1,698,328			21,620	$73,007	1,258,610	1,683,182
	205	292,520	31,096	129,350	11,049	288,350	344,513	7,897,300	10,540,201	984,210	1,260,282	21,620	73,007	9,219,200	12,260,148
Average value			0.11		b85.42		1.19		1.33		1.28		3.38		1.33

a Included under "Undistributed."

b Per M.

MARBLE.

Value of marble sold in the United States, 1916–1920.

State.	1916	1917	1918	1919	1920
Alabama	(a)	(a)	b $319,040	b $395,195	$557,026
Alaska	(a)	(a)	b 80,059	(a)	c 278,890
Arkansas	(a)	(a)	(b)	(b)	c 97,977
California	$62,397	$109,504	50,776	66,670	60,310
Colorado	(a)	(a)	....	....	....
Georgia	903,343	1,073,783	1,152,444	1,574,687	2,255,557
Maryland	(d)	(d)	b 44,499	b 38,328	c 55,041
Massachusetts	154,090	118,808	93,433	123,978	222,916
Michigan	....	....	....	(a)	....
Missouri	156,942	227,520	238,111	360,287	616,550
Montana	....	....	....	....	(c)
Nevada	....	....	....	(a)	(c)
New Mexico	(a)	(a)	(b)	(b)	(c)
New York	268,391	249,180	135,756	250,244	220,773
North Carolina	(a)	(a)	b 31,779	....	(c)
Oregon	....	....	(b)	....	....
Pennsylvania	d 107,212	d 36,442	(b)	(b)	(c)
South Carolina	(a)	....	(b)	....	....
Tennessee	1,000,266	884,684	599,096	1,069,333	1,530,896
Texas	(a)	(a)	(b)	(b)	(c)
Utah	(a)	(a)	(b)	....	(c)
Vermont	3,062,743	3,024,315	2,751,396	4,083,866	5,173,649
Virginia	....	(a)	(b)	....	....
Washington	(a)	(a)	(b)	....	(c)
Undistributed	1,317,787	606,151	....	79,709	....
	7,033,171	6,330,387	5,496,389	8,042,297	11,069,585

a Included under "Undistributed."
b Alabama includes Arkansas, New Mexico, and Texas; Alaska includes Oregon, Utah, and Washington; Maryland includes Pennsylvania; North Carolina includes South Carolina and Virginia.
c Alaska includes Montana, Nevada, Utah, and Washington; Arkansas includes New Mexico and Texas; Maryland includes North Carolina and Pennsylvania.
d Pennsylvania includes Maryland.

Marble sold in the United States in 1919 and 1920.

Use.	1919			1920		
	Quantity.	Value.	Average value.	Quantity.	Value.	Average value.
Building stone:						
Rough—						
Exterior .... cubic feet..	209,582	$282,593	$1.35	147,090	$295,162	$2.01
Interior .... do....	542,802	1,127,892	2.08	694,990	1,851,480	2.66
Dressed—						
Exterior .... do....	83,974	371,196	4.42	101,420	569,395	5.61
Interior .... do....	163,586	1,103,294	6.74	221,400	1,854,054	8.37
Total exterior .... do....	293,556	653,789	2.23	248,510	864,557	3.48
Total interior .... do....	706,388	2,231,186	3.16	916,390	3,705,534	4.04
Total building stone ...... do....	999,944	2,884,975	2.89	a 1,164,900	a 4,570,091	3.92
Monumental stone:						
Rough .... do....	554,940	1,621,452	2.92	640,660	2,187,469	3 41
Dressed .... do....	546,633	3,277,604	6.00	529,440	3,758,041	7.10
Total monumental stone.. do....	1,101,573	4,899,056	4.45	a 1,170,100	a 5,945,510	5.08
Total building and monumental .... cubic feet..	2,101,517	7,784,031	3.70	2,335,000	10,515,601	4.50
Marble for other uses...... short tons..	153,719	258,266	1.68	231,500	553,984	2.39
Total marble sold: Cubic feet b..	3,899,420	8,042,297	2.06	5,035,000	11,069,585	2.20
Short tons b..	333,400	....	24.12	431,500	....	25.65

a Building stone figures may be somewhat less than given and monumental stone somewhat more, as some of the Tennessee producers were unable to divide their product according to use.
b Approximate.

SERPENTINE.

Serpentine (verde antique) sold in the United States in 1919 and 1920.

	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Cubic feet	32,650	$118,395	44,620	$192,310
Short tons	15,740	28,359	12,940	40,163
	....	146,754	....	232,473

LIMESTONE.

Value of limestone sold in the United States, 1916–1920.

State.	1916	1917	1918	1919	1920
Alabama	$917,559	$1,278,908	$1,370,667	$1,090,065	$1,925,704
Arizona	98,877	140,674	150,850	140,846	139,183
Arkansas	64,809	84,654	89,640	(a)	177,618
California	277,521	364,066	366,826	409,082	493,052
Colorado	406,974	532,539	570,649	532,973	531,357
Connecticut	(a)	(a)	(a)	(a)	(a)
Florida	479,837	494,568	256,807	133,747	430,130
Georgia	82,799	155,172	192,515	213,968	324,653
Hawaii	(a)	....	(a)	....	....
Idaho	27,721	37,942	21,377	155,716	(a)
Illinois	3,362,751	3,279,737	2,951,045	3,735,401	5,623,400
Indiana	4,657,813	4,449,809	2,819,083	4,945,903	9,223,573
Iowa	561,015	519,933	379,029	508,606	749,592
Kansas	599,995	673,706	561,012	860,851	1,013,491
Kentucky	1,315,702	1,022,317	932,667	1,357,618	1,635,785
Louisiana	(a)	(a)	(a)	(a)	(a)
Maine	....	(a)	(a)	52,856	100,338
Maryland	223,182	307,679	274,907	397,905	381,607
Massachusetts	(a)	68,392	92,804	269,718	311,810
Michigan	2,389,763	3,320,895	5,186,867	3,797,522	5,943,229
Minnesota	467,942	385,728	310,583	379,852	582,266
Mississippi	....	(a)	(a)	(a)	(a)
Missouri	1,990,419	1,679,677	1,359,755	1,759,029	2,776,936
Montana	237,923	224,986	246,650	159,079	247,946
Nebraska	405,867	475,507	314,280	280,602	453,179
Nevada	....	31,625	95,821	(a)	(a)
New Jersey	245,019	413,477	674,397	506,193	493,665
New Mexico	(a)	(a)	(a)	(a)	(a)
New York	3,035,786	3,513,874	3,918,982	4,406,721	6,103,890
North Carolina	75,418	109,719	58,055	133,198	135,675
Ohio	5,337,085	5,400,578	6,960,205	6,415,233	9,342,853
Oklahoma	516,230	575,165	574,795	656,843	977,949
Oregon	(a)	4,939	(a)	68,013	57,689
Pennsylvania	8,167,639	10,589,524	12,302,255	12,640,411	15,913,109
Porto Rico	(b)	(b)	(b)	101,186	93,276
Rhode Island	(a)	(a)	(a)	(a)	(a)
South Dakota	19,435	46,130	18,825	23,989	75,274
Tennessee	752,649	750,639	893,763	689,597	1,429,829
Texas	459,918	485,389	464,061	453,113	660,996
Utah	249,998	242,707	341,804	329,150	418,602
Vermont	68,098	45,869	64,847	103,858	98,175
Virginia	1,062,247	1,263,284	1,230,412	1,454,989	1,545,253
Washington	30,338	59,529	99,992	45,957	118,671
West Virginia	1,452,393	1,788,528	1,958,785	2,228,209	3,111,643
Wisconsin	1,089,111	1,172,567	1,065,678	1,246,837	1,359,631
Wyoming	(a)	130,497	155,792	185,909	202,188
Undistributed	179,766	142,450	126,524	300,956	452,043
	41,309,599	46,263,379	49,453,006	53,171,701	75,655,260

[a] Included under "Undistributed."
[b] Not collected.

Limestone sold in the United States in 1919 and 1920.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone......cubic feet..	5,477,220	$4,258,336	7,542,150	$8,197,866
Approximate equivalent in short tons......	393,650	....	564,670	....
Curbing, flagging, and paving......cubic feet..	77,238	44,498	41,870	22,841
Approximate equivalent in short tons......	6,560	....	3,550	....
Rubble......short tons..	328,295	430,113	274,630	425,279
Riprap......do....	833,622	908,595	892,610	907,616
Crushed stone......do....	21,761,946	21,709,206	25,807,800	30,608,799
Fluxing stone......long tons..	18,928,886	19,271,674	22,301,060	26,475,763
Equivalent in short tons......	21,200,350	....	24,977,190	....
Sugar factories......short tons..	503,835	821,912	637,090	1,200,394
Glass works......do....	166,106	278,467	196,150	400,873
Paper mills......do....	92,421	129,649	139,880	256,278
Agriculture......do....	1,392,914	2,409,460	1,364,260	2,724,209
Other uses [a]......do....	3,080,101	2,909,791	4,432,170	4,435,342
Total (quantities approximate, in short tons)....	49,759,800	53,171,701	59,290,000	75,655,260

[a] See table on p. 250 for further distribution of limestone products.

Limestone sold in the United States in 1919.

State.	Number of plants.	Building.				Paving and curbing.		Rubble.		Riprap.		Crushed stone.			
		Rough.		Dressed.								Concrete and road metal.		Railroad ballast.	
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	15	(a)	(a)									76,390	$90,880		
Arizona	5									73,177	$65,578	(a)	(a)		
Arkansas	2											(a)	(a)	(a)	(a)
California	20							(a)	(a)	(a)	(a)	21,820	42,927	(a)	(a)
Colorado	16														
Connecticut	2											(a)	(a)		
Florida	5											29,787	34,285	(a)	(a)
Georgia	6											54,755	104,684		
Idaho	6							(a)	(a)			(a)	(a)		
Illinois	49	b 11,912	b $5,802	(b)	(b)			35,897	$44,417	107,126	170,326	3,126,214	2,355,854	541,807	$351,048
Indiana	82	3,390,387	1,865,508	1,403,278	$1,933,610	(a)	(a)	4,531	6,124	25,852	15,517	873,437	749,432	76,741	53,188
Iowa	29	21,825	1,816					6,247	5,849	64,393	77,452	379,874	374,685	(a)	(a)
Kansas	41	b 99,655	b 19,711	(b)	(b)			19,461	16,854	25,214	27,597	414,089	555,228	144,730	119,889
Kentucky	69	b 148,729	b 47,415	(b)	(b)	(a)	(a)	1,637	3,106	26,586	22,997	386,871	579,713	728,393	553,871
Louisiana	1											(a)	(a)		
Maine	4											(a)	(a)		
Maryland	18											148,557	220,755	23,525	23,041
Massachusetts	5														
Michigan	18							(a)	(a)			1,056,570	594,862	(a)	(a)
Minnesota	17	27,476	18,767	41,063	95,446			13,793	14,178	36,814	36,110	152,199	206,624		
Mississippi	1														
Missouri	87	156,918	146,984	13,534	34,799	(a)	(a)	73,789	136,309	258,198	287,789	565,629	871,249	45,366	52,070
Montana	8											35,449	36,445	(a)	(a)
Nebraska	8									37,610	42,818	155,969	219,173		
Nevada	1														
New Jersey	14									(a)	(a)	8,476	12,442		
New Mexico	1											(a)	(a)		
New York	63	b 15,075	b 9,490	(b)	(b)			47,703	42,489	(a)	(a)	1,496,931	2,460,293	722,744	602,287
North Carolina	4											21,583	24,403		
Ohio	107	(a)	(a)					10,246	16,227	5,409	6,379	3,130,638	2,703,788	861,047	578,722
Oklahoma	15							(a)	(a)	52,803	45,928	375,622	425,607	204,388	178,468
Oregon	4											(a)	(a)		
Pennsylvania	241	(a)	(a)					36,771	59,630	4,944	9,488	1,660,402	2,228,902	181,383	185,976
Porto Rico	17											67,000	101,186		

Rhode Island	1														
South Dakota	4							(a)	(a)	(a)	(a)	(a)	(a)		
Tennessee	31											322,150	401,146	152,577	127,936
Texas	13	37,568	18,860			(a)	(a)	(a)	(a)	(a)	(a)	469,669	392,111	(a)	(a)
Utah	11	(a)	(a)							(a)	(a)	(a)	(a)		
Vermont	10	(a)	(a)									17,770	31,719	(a)	(a)
Virginia	43	(a)	(a)			(a)	(a)					384,964	355,324	730,375	677,910
Washington	4														
West Virginia	25											326,411	401,967	131,393	127,954
Wisconsin	61	(a)	(a)			23,959	$16,622	51,924	52,561	45,320	42,608	929,593	976,585	(a)	(a)
Wyoming	8														
Undistributed		109,800	60,128			53,279	27,876	26,296	32,369	70,176	58,008	268,067	334,899	260,586	184,628
	1,192	4,006,620	2,184,891	1,470,600	2,073,445	77,238	44,498	328,295	430,113	833,622	908,595	16,956,886	17,887,168	4,805,060	3,822,038
Average value			0.55		1.40		0.58		1.31		1.09		1.05		0.80

a Included under "Undistributed."

b Dressed stone included under rough stone.

Limestone sold in the United States in 1919—Continued.

State	Number of plants	Flux		Sugar factories		Glass works		Paper mills		Agriculture		Other		Total	
		Quantity (long tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
Alabama	15	667,342	$914,115							(a)	(a)	(a)	(a)	859,630	$1,090,065
Arizona	5	59,567	55,118											192,000	140,846
Arkansas	2									(a)	(a)			(a)	(a)
California	20	36,953	78,155	44,090	$81,236	(a)	(a)			15,733	$74,311	33,549	$112,127	170,220	409,082
Colorado	16	372,378	320,043	75,762	152,162							(a)	(a)	493,200	592,974
Connecticut	2	(a)	(a)											(a)	(a)
Florida	5									5,730	10,198	(a)	(a)	111,240	133,747
Georgia	6	(a)	(a)							19,763	47,479	11,232	56,292	89,420	213,968
Idaho	6	(a)	(a)	26,190	43,552									100,420	155,716
Illinois	49	667,982	394,283			(a)	(a)			323,963	339,469	67,992	67,962	4,959,420	3,735,401
Indiana	82	154,921	130,796	13,182	15,613	35,685	$53,528			68,490	76,218	12,990	20,822	1,624,950	4,945,903
Iowa	29	(a)	(a)	(a)	(a)					46,452	31,354	(a)	(a)	513,630	598,696
Kansas	41									(a)	(a)	(a)	(a)	690,400	890,851
Kentucky	69	15,646	18,513							31,467	58,147	(a)	(a)	1,200,610	1,357,612
Louisiana	1													(a)	(a)
Maine	4							10,475	$22,963	(a)	(a)			23,220	52,856
Maryland	18	155,836	137,515					(a)	(a)	(a)	(a)			352,450	281,965
Massachusetts	5	(a)	(a)							(a)	(a)	(a)	(a)	53,590	269,712
Michigan	18	3,585,440	1,257,695	(a)	(a)			41,458	45,706	(a)	(a)	1,578,494	891,491	7,196,760	3,737,522
Minnesota	17	(a)	(a)	(a)	(a)					(a)	(a)	(a)	(a)	215,490	279,852
Mississippi	1									(a)	(a)			(a)	(a)
Missouri	87	52,300	68,779	(a)	(a)	44,006	68,778	(a)	(a)	6,957	10,177	42,164	71,837	1,115,490	1,770,669
Montana	8	149,966	119,620	(a)	(a)									205,150	110,079
Nebraska	8	(a)	(a)	(a)	(a)					(a)	(a)	(a)	(a)	203,400	230,692
Nevada	1			(a)	(a)							(a)	(a)	(a)	(a)
New Jersey	14	284,038	346,102							44,636	142,890			374,090	596,193
New Mexico	1			(a)	(a)									(a)	(a)
New York	63	421,815	596,049					(a)	(a)	97,145	231,371	547,615	545,905	3,382,950	4,495,721
North Carolina	4	(a)	(a)							46,645	106,465	(a)	(a)	69,220	123,198
Ohio	107	2,784,183	2,483,841			19,346	25,068			76,610	78,891	479,650	592,317	7,763,190	6,415,223
Oklahoma	15									(a)	(a)	(a)	(a)	659,450	636,843
Oregon	4									(a)	(a)			35,760	68,013
Pennsylvania	241	7,997,131	9,547,016			58,509	100,316	(a)	(a)	65,612	243,529	122,092	229,843	10,965,500	12,640,411
Porto Rico	17	(a)	(a)											67,000	101,196
Rhode Island	1	(a)	(a)							(a)	(a)			(a)	(a)
South Dakota	4			(a)	(a)									17,750	23,599
Tennessee	31	120,679	125,731							15,678	30,214	(a)	(a)	630,300	689,547

Texas	13	2,268	2,177	......	......	(a)	(a)	......	......	(a)	(a)	(a)	(a)	548,000	453,113
Utah	11	151,679	138,630	84,169	143,989	......	......	......	......	......	......	......	......	315,310	329,150
Vermont	10	413	639	......	......	......	......	(a)	(a)	(a)	(a)	......	......	38,900	103,858
Virginia	43	246,267	293,972	......	......	......	......	......	......	55,582	126,895	(a)	(a)	1,446,870	1,454,989
Washington	4	7,966	11,255	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	23,750	45,957
West Virginia	25	1,305,568	1,576,010	......	......	......	......	(a)	(a)	50,710	121,618	(a)	(a)	1,971,170	2,228,209
Wisconsin	61	52,115	52,210	(a)	(a)	......	......	5,822	5,822	9,878	18,294	36,730	77,185	1,141,490	1,246,837
Wyoming	8	......	......	104,169	185,909	......	......	......	......	......	......	......	......	104,170	185,909
Undistributed	......	26,433	43,302	156,283	199,351	13,560	30,777	34,666	55,218	405,323	659,800	148,073	333,010	225,380	300,956
	1,192	18,928,886	19,271,674	503,835	821,912	166,106	278,467	92,421	129,649	1,392,914	2,409,460	3,080,101	2,909,791	49,759,800	53,171,701
Average value	......	......	1.02	......	1.63	......	1.68	......	1.40	......	1.73	......	0.95	......	1.07

a Included under "Undistributed."

Limestone sold in the United States in 1920.

State.	Number of plants.	Building.				Paving and curbing.		Rubble.		Riprap.		Crushed stone.			
		Rough.		Dressed.								Concrete and road metal.		Railroad ballast.	
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	17	(a)	(a)					(a)	(a)			71,860	$97,008		
Arizona	5							(a)	(a)	(a)	(a)	57,650	81,768		
Arkansas	3									(a)	(a)	(a)	(a)	(a)	(a)
California	23											41,050	38,803	(a)	(a)
Colorado	15														
Connecticut	1											(a)	(a)		
Florida	9											323,270	381,054	(a)	(a)
Georgia	5											115,200	240,159		
Idaho	2														
Illinois	61	(a)	(a)					16,800	$27,424	233,140	$174,818	3,144,070	3,596,934	462,100	$377,725
Indiana	83	4,851,740	$3,507,738	1,500,530	$3,810,773	(a)	(a)	(a)	(a)	35,090	30,463	1,194,760	1,216,701	210,860	180,853
Iowa	33	(a)	(a)					15,330	31,676	115,050	131,600	379,770	481,424	(a)	(a)
Kansas	38	61,700	12,323					12,980	15,722	42,710	56,538	402,280	615,906	131,720	138,732
Kentucky	78	b138,300	b127,060	(b)	(b)			5,160	7,586	22,260	28,059	582,060	764,519	699,180	615,462
Louisiana	2									(a)	(a)	(a)	(a)		
Maine	6											(a)	(a)		
Maryland	16					(a)	(a)	(a)	(a)			122,190	189,023	(a)	(a)
Massachusetts	5														
Michigan	24							(a)	(a)			1,572,910	1,038,408	154,050	122,960
Minnesota	15	68,070	81,925	57,600	73,045			8,530	11,783	21,190	23,010	213,120	339,018	(a)	(a)
Mississippi	2														
Missouri	96	b 203,140	b 351,134	(b)	(b)	(a)	(a)	113,670	199,435	120,710	139,146	805,100	1,454,613	150,970	169,301
Montana	6											45,750	48,616	(a)	(a)
Nebraska	9									76,930	94,628	124,750	316,233	(a)	(a)
Nevada	2														
New Jersey	12											36,960	50,586		
New Mexico	1														
New York	71	(a)	(a)	(a)	(a)			24,580	21,767	25,550	21,289	2,713,020	3,403,468	960,680	1,114,570
North Carolina	3											(a)	(a)		
Ohio	107	(a)	(a)					9,020	11,409	23,810	40,308	3,382,130	3,543,686	887,300	898,526
Oklahoma	18							2,480	2,905	15,000	14,685	399,760	531,770	450,830	425,224
Oregon	3											(a)	(a)		
Pennsylvania	267	222,240	41,901			(a)	(a)	7,760	14,012	8,640	10,651	1,879,750	2,989,994	124,590	207,993

Porto Rico	7											53,890	81,576		
Rhode Island	1														
South Dakota	5									(a)	(a)	(a)	(a)		
Tennessee	32							(a)	(a)	(a)	(a)	514,770	745,764	186,680	148,066
Texas	12	37,000	23,250			(a)	(a)	(a)	(a)	39,910	43,204	468,310	563,601	(a)	(a)
Utah	12	4,000	4,037					(a)	(a)	(a)	(a)				
Vermont	9	(a)	(a)			(a)	(a)					18,800	22,894		
Virginia	42							(a)	(a)	(a)	(a)	379,600	573,207	559,970	602,536
Washington	6														
West Virginia	28											260,940	385,095	260,030	217,899
Wisconsin	69	11,890	6,428	(a)	(a)	9,950	$8,106	22,240	33,933	20,140	24,096	838,760	1,085,780	51,210	52,955
Wyoming	8							(a)	(a)						
Undistributed		384,040	153,521	1,900	4,731	31,920	14,735	36,080	47,627	92,480	75,121	276,650	371,838	98,500	86,551
	1,269	5,955,320	4,239,912	1,586,830	3,957,954	41,870	22,841	274,630	425,279	892,610	907,616	20,419,130	25,249,446	5,388,670	5,359,353
Average value			0.71		2.49		0.55		1.55		1.02		1.24		0.99

a Included under "Undistributed."

b Dressed stone included under rough stone.

Limestone sold in the United States in 1920—Continued.

State.	Number of plants.	Flux.		Sugar factories.		Glass works.		Paper mills.		Agriculture.		Other.		Total.	
		Quantity (long tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
Alabama	17	1,024,410	$1,722,261							(a)	(a)	(a)	(a)	1,265,320	$1,925,704
Arizona	5	62,820	45,419											152,440	139,183
Arkansas	3													165,620	177,618
California	23	38,780	140,080	(a)	(a)	4,450	$13,114	(a)	(a)	19,900	$59,174	49,410	$163,937	192,120	493,052
Colorado	15	390,440	384,812	69,530	$146,545									506,820	531,357
Connecticut	1	(a)	(a)							(a)	(a)	(a)	(a)	(a)	(a)
Florida	9									7,200	11,818	(a)	(a)	340,470	430,130
Georgia	5	(a)	(a)							22,600	61,364	(a)	(a)	147,400	324,653
Idaho	2	(a)	(a)	(a)	(a)									(a)	(a)
Illinois	61	640,440	633,669			(a)	(a)			424,720	623,019	20,080	154,481	5,036,500	5,623,400
Indiana	83	270,820	233,651	(a)	(a)	43,180	78,061			86,650	104,245	21,390	24,149	2,376,200	9,223,573
Iowa	33	8,280	12,902	17,500	35,750					67,140	46,640			611,950	749,592
Kansas	38	980	990									101,940	173,280	698,590	1,013,491
Kentucky	78	44,250	51,374							24,030	38,715	1,010	3,010	1,395,000	1,635,785
Louisiana	2									(a)	(a)			(a)	(a)
Maine	6	(a)	(a)					26,370	$66,979	(a)	(a)	(a)	(a)	38,340	100,338
Maryland	16	166,390	174,672							(a)	(a)	(a)	(a)	318,370	381,607
Massachusetts	5	8,540	19,687							(a)	(a)	(a)	(a)	52,710	311,810
Michigan	24	4,800,400	2,963,095	(a)	(a)	(a)	(a)	51,010	81,718	170,460	191,146	2,312,850	1,373,010	9,766,550	5,943,229
Minnesota	15	(a)	(a)	(a)	(a)					(a)	(a)	(a)	(a)	271,550	582,266
Mississippi	2									(a)	(a)			(a)	(a)
Missouri	96	65,160	135,078	12,620	19,941	42,390	74,842			17,560	32,941	57,830	200,132	1,413,220	2,776,936
Montana	6	192,250	188,743	(a)	(a)									267,550	247,946
Nebraska	9	(a)	(a)	(a)	(a)					(a)	(a)	(a)	(a)	220,530	453,179
Nevada	2	(a)	(a)	(a)	(a)							(a)	(a)	(a)	(a)
New Jersey	12	287,420	433,182							(a)	(a)			361,370	493,665
New Mexico	1	(a)	(a)											(a)	(a)
New York	71	409,450	453,182			(a)	(a)	18,900	33,169	77,830	227,802	829,810	810,493	5,111,370	6,103,890
North Carolina	3									38,100	92,070	(a)	(a)	65,250	135,675
Ohio	107	3,518,670	4,089,200			(a)	(a)	(a)	(a)	38,750	54,751	541,000	560,574	8,867,110	9,342,853
Oklahoma	18					(a)	(a)			(a)	(a)			870,160	977,949
Oregon	3											(a)	(a)	36,950	57,689
Pennsylvania	267	8,228,970	11,967,561			67,690	158,626	(a)	(a)	70,710	281,196	112,910	203,642	11,531,540	15,913,109
Porto Rico	7									(a)	(a)			54,670	93,276
Rhode Island	1	(a)	(a)											(a)	(a)
South Dakota	5			22,470	38,757									43,350	75,274
Tennessee	32	185,570	231,088							93,140	196,945	21,920	103,816	1,030,890	1,429,829

Texas	12	15,470	8,944	....	....	(a)	(a)	....	....	(a)	(a)	(a)	(a)	565,000	660,996
Utah	12	150,260	158,887	92,570	230,112	....	....	....	....	....	....	(a)	(a)	302,500	418,602
Vermont	9	(a)	(a)	....	....	....	....	(a)	(a)	(a)	(a)	....	....	38,830	98,175
Virginia	42	267,400	306,800	....	....	....	....	....	....	25,960	53,545	(a)	(a)	1,269,080	1,545,253
Washington	6	74,780	73,619	(a)	(a)	....	....	(a)	(a)	(a)	(a)	(a)	(a)	103,280	118,671
West Virginia	28	1,411,350	1,978,901	....	....	....	....	....	....	67,180	163,198	267,110	366,550	2,435,970	3,111,643
Wisconsin	69	6,530	7,268	....	....	....	....	(a)	(a)	27,730	41,892	29,770	92,883	1,002,570	1,359,631
Wyoming	8	....	....	(a)	(a)	....	....	....	....	....	....	....	....	112,230	202,188
Undistributed	....	31,230	60,698	422,406	729,289	38,440	76,230	43,600	74,412	84,600	443,748	65,140	205,385	250,630	452,043
	1,269	22,301,060	26,475,763	637,090	1,200,394	196,150	400,873	139,880	256,278	1,364,260	2,724,209	4,432,170	4,435,342	59,290,000	75,655,260
Average value	....	....	1.19	....	1.88	....	2.04	....	1.83	....	2.00	....	1.00	....	1.28

a Included under "Undistributed."

Limestone sold for miscellaneous uses in 1919 and 1920.

Use.	1919		1920	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alkali works	2,215,660	$1,539,899	3,205,160	$2,229,680
Refractories	254,787	394,754	612,800	742,020
Whiting substitute	73,771	340,465	60,890	499,540
Magnesia works	62,652	82,619	57,300	107,107
Asphalt filler	21,103	65,296	71,970	309,075
Mineral wool	12,500	17,164	21,570	24,773
Carbonic acid works	(a)	(a)	10,570	31,894
Poultry grit	31,892	102,703	15,970	96,310
Lime burners	8,085	14,616	17,540	33,178
Stucco	(a)	(a)	10,530	79,300
Roofing gravel	4,925	17,230	4,310	15,046
Other uses [b]	394,726	335,045	343,560	267,419
	3,080,101	2,909,791	4,432,170	4,435,342

[a] Included under "Other uses."
[b] In 1919 includes stone sold for manufacture of ammonia, calcium carbide, carbolic acid, carbonic acid, powder, purification of copper, cobalt, and aluminum, for artificial stone, stucco, and other uses not specified; in 1920 includes stone sold for manufacture of aluminum, ammonia, calcium carbide, carbolic acid, clay and fertilizer filler, nitrates, powder, and for filter stone, artificial stone, and other uses not specified.

Besides the limestone mentioned in this report a considerable quantity of this stone is used in the manufacture of lime and cement; the approximate quantity of limestone used for all purposes is given in the following table:

Limestone used for all purposes, 1917–1920, in short tons.

Use.	1917	1918	1919	1920
Limestone (as given in this report)	63,481,500	53,868,200	49,759,800	59,290,000
Portland cement (including "cement rock")	24,640,230	17,658,700	19,864,000	24,747,000
Natural cement ("cement rock")	102,260	67,300	82,500	128,600
Lime	7,194,000	6,400,000	6,660,000	7,140,000
	95,417,990	77,994,200	76,366,300	91,305,600

In order to keep a continuous sequence of tables showing the limestone industry at Bedford-Bloomington, Ind., the following tables are inserted along with the general tables given in this report.

Limestone quarried and sold in the Bedford-Bloomington district (Lawrence and Monroe counties), Ind., in 1919 and 1920.

County.	Number of plants.	Rough blocks and rough sawed.		Dressed.		Total.		Other.		Total value.
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (short tons).	Value.	
1919.										
Lawrence..	10	2,582,343	$1,446,929	786,477	$1,364,950	3,368,820	$2,811,879	135,241	$124,141	$2,936,020
Monroe.....	22	806,318	417,422	613,501	557,850	1,419,819	975,272	39,222	35,040	1,010,312
	32	3,388,661	1,864,351	1,399,978	1,922,800	4,788,639	3,787,151	174,463	159,181	3,946,332
Average value....			0.55		1.37		0.79		0.91	
1920.										
Lawrence..	12	3,468,547	2,387,512	1,004,446	2,754,564	4,472,993	5,142,076	195,671	205,500	5,347,576
Monroe.....	22	1,378,481	1,113,682	492,062	1,030,921	1,870,543	2,144,603	82,564	87,700	2,232,303
	34	4,847,028	3,501,194	1,496,508	3,785,485	6,343,536	7,286,679	278,235	293,200	7,579,879
Average value....			0.72		2.53		1.15		1.05	
Percentage of increase		43.0	87.8	6.9	96.9	32.5	92.4	59.5	84.2	92.1

Indiana oolitic limestone shipped to different States and Canada in 1919 and 1920, in cubic feet.

Destination.	1919			1920		
	By milling companies.	By quarry companies.	Total.	By milling companies.	By quarry companies.	Total.
Alabama	863	6,614	7,477		12,801	12,801
Arkansas	528	29,221	29,749	31,513	39,029	70,542
California					8,688	8,688
Colorado		5,453	5,453		17,917	17,917
Connecticut	3,484	21,577	25,061	6,890	41,618	48,508
Delaware	5,938	9,833	15,771	16,991	22,546	39,537
District of Columbia	18,539	89,985	108,524	40,221	55,455	95,676
Florida		1,573	1,573		12,314	12,314
Georgia	7,663	39,926	47,589	6,716	57,917	64,633
Idaho					4,798	4,798
Illinois	83,456	869,242	952,698	131,065	1,142,449	1,273,514
Indiana	40,326	965,201	1,005,527	18,395	1,287,423	1,305,818
Iowa	11,547	88,250	99,797	12,959	87,125	100,084
Kansas	2,111	29,952	32,063	15,553	69,242	84,795
Kentucky	9,459	36,110	45,569	8,875	65,629	74,504
Louisiana	663	4,365	5,028	14,403	74,281	88,684
Maine					5,534	5,534
Maryland		26,650	26,650		31,823	31,823
Massachusetts	7,077	194,823	201,900	28,822	183,510	212,332
Michigan	326,150	341,790	667,940	158,372	442,530	600,902
Minnesota	15,414	145,798	161,212	20,720	174,783	195,503
Mississippi		27,621	27,621		6,775	6,775
Missouri	4,201	47,618	51,819	3,818	73,058	76,876
Montana	2,798	588	3,386		1,384	1,384
Nebraska	176	57,932	58,108	156	85,067	85,223
New Hampshire	275		275	5,958		5,958
New Jersey	11,001	16,896	27,897	13,698	58,841	72,539
New York	38,595	674,441	713,036	77,531	533,629	611,160
North Carolina	10,111	52,191	62,302	18,583	71,265	89,848
North Dakota	2,500	18,894	21,394	1,725	4,732	6,457
Ohio	39,275	225,722	264,997	94,846	390,317	485,163
Oklahoma	400	60,458	60,858	8,988	117,913	126,901
Pennsylvania	10,064	233,492	243,556	17,755	288,566	306,321
Rhode Island		21,254	21,254	3,873	15,044	18,917
South Carolina	652	28,670	29,322	364	43,686	44,050
South Dakota	8,456	18,064	26,520	3,715	8,566	12,281
Tennessee	1,994	44,731	46,725	6,983	66,267	73,250
Texas	2,671	33,032	35,703	37,146	99,740	136,886
Virginia	7,184	17,081	24,265	16,357	86,671	103,028
Washington		6,500	6,500		2,736	2,736
West Virginia	3,885	28,775	32,660	1,887	39,265	41,152
Wisconsin	4,856	80,638	85,494	7,402	202,287	209,689
Wyoming				1,758	3,303	5,061
Canada	4,400	187,678	192,078	2,260	307,012	309,272
	686,712	4,788,639	5,475,351	836,298	6,343,536	7,179,834

SANDSTONE.

Value of sandstone (including quartzite and bluestone) sold in the United States, 1916–1920.

State.	1916	1917	1918	1919	1920
Alabama	$20,995	$17,098	$14,484	$33,852	$61,604
Arizona	(a)	(a)	(a)	(a)	30,641
Arkansas	95,398	66,183	70,593	91,549	174,293
California	422,225	232,379	183,163	249,779	496,681
Colorado	53,902	90,646	81,226	47,464	77,827
Connecticut	(a)	(a)	(a)	44,914	(a)
Idaho	47,061	56,702	42,040	84,822	154,700
Illinois	40,343	42,304	(a)	(a)	50,431
Indiana	....	....	....	(a)	(a)
Iowa	(a)	(a)	....	....	(a)
Kansas	3,495	(a)	(a)	....	(a)
Kentucky	114,136	96,117	37,827	89,734	120,391
Maryland	6,003	(a)	(a)	(a)	....
Massachusetts	318,982	216,500	200,577	118,000	195,659
Michigan	21,449	(a)	(a)	24,413	(a)
Minnesota	186,179	81,717	(a)	62,512	232,901
Missouri	14,991	6,862	(a)	....	(a)
Montana	(a)	(a)	(a)	(a)	7,539
Nebraska	(a)	(a)	(a)	(a)	....
New Jersey	46,035	6,758	17,652	31,475	(a)
New Mexico	18,330	(a)	(a)	(a)	128,171
New York	b 714,558	b 760,582	b 325,351	b 384,516	b 547,424
North Carolina	(a)	228,048	288,681	(a)	56,381
Ohio	1,274,181	1,086,027	957,535	1,594,416	1,513,615
Oklahoma	24,229	5,096	(a)	(a)	(a)
Oregon	(a)	(a)	(a)	....	(a)
Pennsylvania	b 1,318,239	b 1,794,919	b 1,543,544	b 1,661,959	b 2,108,167
South Dakota	163,735	116,785	58,726	146,742	295,110
Tennessee	(a)	(a)	(a)	(a)	(a)
Texas	85,940	(a)	(a)	....	(a)
Utah	27,207	25,021	(a)	(a)	(a)
Virginia	66,217	34,058	47,309	28,654	77,448
Washington	(a)	(a)	45,368	(a)	(a)
West Virginia	48,416	52,543	65,740	42,409	44,299
Wisconsin	188,791	291,241	353,030	230,628	370,518
Wyoming	(a)	(a)	(a)	26,699	(a)
Undistributed	282,741	204,835	196,452	289,305	566,490
	5,603,778	5,512,421	4,529,298	5,283,842	7,310,290

a Included under "Undistributed."
b Includes bluestone.

Sandstone sold in the United States in 1919 and 1920.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone .... cubic feet..	1,841,198	$1,131,734	1,812,580	$1,619,724
Approximate equivalent in short tons	150,600	....	149,890	....
Paving blocks .... number..	1,888,490	172,561	3,599,580	304,476
Approximate equivalent in short tons	20,720	....	37,650	....
Curbing .... cubic feet..	1,131,425	647,102	718,150	518,677
Approximate equivalent in short tons	92,700	....	62,060	....
Flagging .... cubic feet..	962,173	502,871	688,890	463,718
Approximate equivalent in short tons	78,870	....	56,460	....
Crushed stone .... short tons..	1,179,213	1,432,842	1,394,270	2,043,621
Riprap .... do....	214,629	262,869	455,500	602,492
Rubble .... do....	92,000	149,425	86,770	153,298
Ganister .... do....	783,504	974,326	1,095,390	1,582,255
Other .... do....	11,034	10,112	5,010	22,029
Total (quantities approximate, in short tons)....	2,623,270	5,283,842	3,343,000	7,310,290

Sandstone sold in the United States in 1919.

State.	Number of plants.	Building.				Ganister.		Paving blocks.		Curbing.		Flagging.	
		Rough.		Dressed.									
		Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.	Quantity (short tons).	Value.	Number of blocks.	Value.	Quantity (cubic feet).	Value.	Quantity (cubic feet).	Value.
Alabama	3					(a)	(a)						
Arizona	2												
Arkansas	6			(a)	(a)					(a)	(a)		
California	10	(a)	(a)										
Colorado	10	b 12,825	b $7,122	(b)	(b)	27,960	$32,815					1,390	$870
Connecticut	4	35,621	4,933										
Idaho	3	(c)	(c)	c 46,763	c $84,822								
Illinois	2					(a)	(a)						
Indiana	1												
Kentucky	5	(c)	(c)	c 120,925	c 84,312								
Maryland	2	(a)	(a)										
Massachusetts	3			(a)	(a)								
Michigan	4	(a)	(a)										
Minnesota	3												
Montana	2			(a)	(a)	(a)	(a)						
Nebraska	1			(a)	(a)								
New Jersey	4												
New Mexico	2	(a)	(a)										
New York	19	63,055	78,726	31,830	59,110			430,000	$33,266	238,234	$131,232	51,815	23,543
North Carolina	2					(a)	(a)						
Ohio	19	b 1,055,216	b 598,534	(b)	(b)	17,056	28,013			819,128	465,043	879,466	439,444
Oklahoma	2												
Pennsylvania	79	261,966	45,726	43,088	60,020	573,244	718,317	930,240	84,570	68,863	48,201	29,502	39,014
South Dakota	5	(a)	(a)			16,183	18,256	(a)	(a)				
Tennessee	2	(a)	(a)			(a)	(a)						
Utah	2	(a)	(a)					(a)	(a)				
Virginia	3	(a)	(a)										
Washington	1	(a)	(a)										
West Virginia	10	75,900	14,830			(a)	(a)			(a)	(a)		
Wisconsin	14	(c)	(c)	c 18,780	c 26,320	(a)	(a)	508,250	53,507				
Wyoming	3												
Undistributed		70,978	51,531	4,251	15,748	149,061	176,925	20,000	1,218	5,200	2,626		
	228	1,594,535	809,146	246,663	322,588	783,504	974,326	1,888,490	172,561	1,131,425	647,102	962,173	502,871
Average value			0.51		1.31		1.24		d 91.38		0.57		0.52

a Included under "Undistributed." b Dressed stone included under rough stone. c Rough stone included under dressed stone. Per M.

Sandstone sold in the United States in 1919—Continued.

State.	Number of plants.	Rubble.		Riprap.		Crushed stone.				Other.		Total.	
						Road metal and concrete.		Railroad ballast.					
		Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
Alabama	3	(a)	(a)									20,680	$33,852
Arizona	2			(a)	(a)							(a)	(a)
Arkansas	6			(a)	(a)	14,610	$24,668	(a)	(a)	(a)	(a)	43,320	91,549
California	10	(a)	(a)	(a)	(a)	223,147	212,531	(a)	(a)	(a)	(a)	271,740	249,779
Colorado	10	(a)	(a)	(a)	(a)	(a)	(a)					33,800	47,464
Connecticut	4					15,860	33,845	(a)	(a)			23,690	44,914
Idaho	3											3,610	84,822
Illinois	2					(a)	(a)					(a)	(a)
Indiana	1			(a)	(a)							(a)	(a)
Kentucky	5			4,800	$5,422							14,720	89,734
Maryland	2	(a)	(a)	(a)	(a)							(a)	(a)
Massachusetts	3					(a)	(a)					57,660	118,000
Michigan	4	(a)	(a)	(a)	(a)	(a)	(a)					19,640	24,413
Minnesota	3	150	$100			28,559	62,412					28,710	62,512
Montana	2	(a)	(a)							(a)	(a)	(a)	(a)
Nebraska	1			(a)	(a)							(a)	(a)
New Jersey	4	19,750	31,475									19,750	31,475
New Mexico	2							(a)	(a)			(a)	(a)
New York	19	(a)	(a)	6,373	4,980	21,531	51,797	(a)	(a)	(a)	(a)	65,050	384,516
North Carolina	2											(a)	(a)
Ohio	19	14,395	17,201	48,163	44,910			(a)	(a)	(a)	(a)	308,350	1,594,416
Oklahoma	2	(a)	(a)			(a)	(a)					(a)	(a)
Pennsylvania	79	41,881	81,981	25,490	67,123	239,652	340,358	165,475	$169,981	9,277	$6,668	1,098,290	1,661,959
South Dakota	5			6,163	6,073	96,860	120,668					119,360	146,742
Tennessee	2											(a)	(a)
Utah	2					(a)	(a)					(a)	(a)
Virginia	3					(a)	(a)	(a)	(a)			64,910	28,654
Washington	1			(a)	(a)							(a)	(a)
West Virginia	10	(a)	(a)	(a)	(a)	5,600	9,400					24,040	42,409
Wisconsin	14	3,291	3,784	(a)	(a)	9,728	12,103	12,917	11,537			143,400	230,628
Wyoming	3			122	176	13,752	26,523					13,870	26,699
Undistributed		12,533	14,884	123,518	134,185	181,954	242,222	149,568	114,797	1,757	3,444	248,680	289,305
	228	92,000	149,425	214,629	262,869	851,253	1,136,527	327,960	296,315	11,034	10,112	2,623,270	5,283,842
Average value			1.62		1.22		1.34		0.90		0.92		2.01

a Included under "Undistributed."

Sandstone sold in the United States in 1920.

State.	Number of plants.	Building. Rough. Quantity (cubic feet).	Building. Rough. Value.	Building. Dressed. Quantity (cubic feet).	Building. Dressed. Value.	Ganister. Quantity (short tons).	Ganister. Value.	Paving blocks. Number of blocks.	Paving blocks. Value.	Curbing. Quantity (cubic feet).	Curbing. Value.	Flagging. Quantity (cubic feet).	Flagging. Value.
Alabama	5	(a)	(a)			(a)	(a)						
Arizona	3	(a)	(a)										
Arkansas	9												
California	8									(a)	(a)		
Colorado	15	22,250	$20,045			26,320	$29,350			(a)	(a)	2,500	$1,927
Connecticut	4	(a)	(a)										
Idaho	3			75,700	$154,700								
Illinois	4	(a)	(a)			(a)	(a)						
Indiana	1												
Iowa	1												
Kansas	2												
Kentucky	4	(b)	(b)	[b] 97,430	[b] 101,718								
Massachusetts	3	(a)	(a)	(a)	(a)								
Michigan	2	(a)	(a)										
Minnesota	7	(a)	(a)					(a)	(a)	(a)	(a)		
Missouri	1												
Montana	3	(a)	(a)			(a)	(a)						
New Jersey	3	(a)	(a)										
New Mexico	3												
New York	18	50,540	83,285	37,850	92,191			1,175,000	$90,482	276,210	$228,685	35,280	27,274
North Carolina	3					45,880	56,381						
Ohio	23	620,500	470,811	240,250	231,882	(a)	(a)			349,380	243,278	622,960	413,275
Oklahoma	2												
Oregon	1												
Pennsylvania	95	242,400	63,478	30,200	121,374	761,750	1,125,195	1,308,530	109,595	81,000	43,610	28,150	21,242
South Dakota	8					(a)	(a)	(a)	(a)				
Tennessee	1	(a)	(a)										
Texas	1												
Utah	2	(a)	(a)					(a)	(a)				
Virginia	7	(a)	(a)										
Washington	2	(a)	(a)	(a)	(a)								
West Virginia	9	(a)	(a)			(a)	(a)			(a)	(a)		
Wisconsin	18	[c] 33,060	[c] 45,445	(c)	(c)	182,680	216,609	745,550	82,174				
Wyoming	2												
Undistributed		353,380	162,006	9,020	72,789	78,760	154,720	370,500	22,225	11,560	3,104		
	273	1,343,700	858,821	468,880	760,903	1,095,390	1,582,255	3,599,580	304,476	718,150	518,677	688,890	463,718
Average value			0.64		1.62		1.44		[d] 84.59		0.72		0.67

[a] Included under "Undistributed." [b] Rough stone included under dressed stone. [c] Dressed stone included under rough stone. [d] Per M.

Sandstone sold in the United States in 1920—Continued.

State.	Number of plants.	Rubble.		Riprap.		Crushed stone.				Other.		Total.	
						Road metal and concrete.		Railroad ballast.					
		Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
Alabama	5	(a)	(a)	(a)	(a)							36,690	$61,604
Arizona	3			(a)	(a)							25,900	30,641
Arkansas	9			37,480	$66,150	12,940	$22,461	60,900	$85,682			111,320	174,293
California	8	13,370	$37,639	(a)	(a)	306,800	415,286	(a)	(a)			386,230	496,681
Colorado	15	1,620	3,300	(a)	(a)	(a)	(a)					42,020	77,827
Connecticut	4			(a)	(a)							(a)	(a)
Idaho	3											6,200	154,700
Illinois	4					(a)	(a)					67,200	50,431
Indiana	1			(a)	(a)							(a)	(a)
Iowa	1	(a)	(a)									(a)	(a)
Kansas	2	(a)	(a)									(a)	(a)
Kentucky	4	(a)	(a)	18,260	16,571					(a)	(a)	27,530	120,391
Massachusetts	3					(a)	(a)					47,200	195,659
Michigan	2					(a)	(a)			(a)	(a)	(a)	(a)
Minnesota	7	(a)	(a)	(a)	(a)	93,810	209,468			(a)	(a)	99,980	232,901
Missouri	1			(a)	(a)							(a)	(a)
Montana	3	(a)	(a)									5,640	7,539
New Jersey	3			(a)	(a)							(a)	(a)
New Mexico	3	(a)	(a)					(a)	(a)			168,740	128,171
New York	18	(a)	(a)	1,640	941	10,450	20,854					61,610	547,424
North Carolina	3											45,880	56,381
Ohio	23	21,700	30,522	32,030	36,115	(a)	(a)			(a)	(a)	238,520	1,513,615
Oklahoma	2	(a)	(a)									(a)	(a)
Oregon	1			(a)	(a)							(a)	(a)
Pennsylvania	95	25,600	46,080	5,900	11,900	201,270	321,101	169,780	241,373	300	$3,219	1,210,240	2,108,167
South Dakota	8	(a)	(a)	6,190	6,700	125,440	261,821			(a)	(a)	146,750	295,110
Tennessee	1											(a)	(a)
Texas	1			(a)	(a)							(a)	(a)
Utah	2											(a)	(a)
Virginia	7	(a)	(a)			35,000	56,000	(a)	(a)			75,730	77,448
Washington	2	(a)	(a)	(a)	(a)							(a)	(a)
West Virginia	9			(a)	(a)	17,860	25,722					23,060	44,299
Wisconsin	18	4,580	4,036	21,140	18,085	(a)	(a)			(a)	(a)	221,160	370,518
Wyoming	2			(a)	(a)	(a)	(a)					(a)	(a)
Undistributed		19,900	31,721	332,860	446,030	141,170	218,716	218,850	165,137	4,710	18,810	295,400	566,490
	273	86,770	153,298	455,500	602,492	944,740	1,551,429	449,530	492,192	5,010	22,029	3,343,000	7,310,290
Average value			1.77		1.32		1.64		1.09		4.40		2.19

a Included under "Undistributed.

BLUESTONE.

Value of bluestone sold in New York and Pennsylvania in 1919 and 1920.

State.	Building stone.	Flagging.	Curbing.	Other uses.[a]	Total value.
1919.					
New York	$136,374	$23,542	$82,511	$6,581	$249,008
Pennsylvania	(b)	38,912	30,138	840	69,890
	136,374	62,454	112,649	7,421	318,898
1920.					
New York	172,768	25,674	172,951	4,301	375,694
Pennsylvania	(b)	20,145	31,199	32,756	84,100
	172,768	45,819	204,150	37,057	459,794

[a] Includes crushed stone, rubble, riprap, unspecified, and also building stone for Pennsylvania.
[b] Included under "Other uses."

MISCELLANEOUS STONE.[a]

Miscellaneous varieties of stone sold in the United States in 1919 and 1920.

Use.	1919		1920	
	Quantity.	Value.	Quantity.	Value.
Building stone (rough and dressed) ... cubic feet	428,200	$43,360	162,500	$37,329
Approximate equivalent in short tons	33,240	....	14,000	....
Riprap and rubble ... short tons	95,486	98,983	98,650	157,538
Crushed stone ... do	979,230	1,481,250	1,265,320	1,562,014
Refractory stone ... do	22,450	60,695	27,250	69,262
Other ... do	60,134	236,615	78,080	465,626
	1,190,540	1,920,903	1,483,300	2,291,769

[a] Includes light-colored volcanic rocks, conglomerate, chert, cherty limestone, mica schist used for furnace lining, argillite, etc.

Miscellaneous varieties of stone sold in the United States in 1919.

State.	Number of plants.	Building.		Riprap and rubble.		Crushed stone.				Other.		Total.	
						Road metal and concrete.		Railroad ballast.					
		Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
Arizona	1					(a)	(a)					(a)	(a)
Arkansas	3					189,724	$240,057	(a)	(a)			259,940	$330,396
California	9	(a)	(a)	92,222	$91,998	192,293	120,467	(a)	(a)	(a)	(a)	285,740	214,692
Florida	1					(a)	(a)					(a)	(a)
Georgia	1									(a)	(a)	(a)	(a)
Idaho	2	(a)	(a)									(a)	(a)
Massachusetts	8			(a)	(a)	249,944	503,490	(a)	(a)			291,110	586,846
New Jersey	1	(a)	(a)			(a)	(a)					(a)	(a)
New York	3					24,620	30,848			(a)	(a)	33,590	100,775
Oregon	1	(a)	(a)									(a)	(a)
Pennsylvania	20	30,650	$36,627	(a)	(a)	71,746	92,896	(a)	(a)	33,804	$139,883	148,300	284,063
Rhode Island	5	(a)	(a)			76,691	207,532					76,990	207,732
South Dakota	1					(a)	(a)					(a)	(a)
Undistributed		2,590	6,733	3,264	6,985	52,898	103,843	121,314	$182,117	48,780	157,427	94,870	196,399
	56	[b] 33,240	43,360	95,486	98,983	857,916	1,299,133	121,314	182,117	82,584	297,310	1,190,540	1,920,903

a Included under "Undistributed."

b Approximately 428,200 cubic feet.

Miscellaneons varieties of stone sold in the United States in 1920.

State.	Number of plants.	Building.		Riprap and rubble.		Crushed stone.				Other.		Total.	
						Road metal and concrete.		Railroad ballast.					
		Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (approximate short tons).	Value.
Arizona	2					(a)	(a)					(a)	(a)
Arkansas	3			(a)	(a)	(a)	(a)	(a)	(a)			316,260	$482,449
California	11			91,070	$147,531	444,770	$308,622			2,620	$47,490	538,460	503,643
Georgia	1											(a)	(a)
Idaho	3	(a)	(a)	(a)	(a)							(a)	(a)
Massachusetts	8	(a)	(a)			122,470	264,999			(a)	(a)	124,550	268,137
Michigan	1					(a)	(a)			(a)	(a)	(a)	(a)
Missouri	1					(a)	(a)					(a)	(a)
New Hampshire	1									(a)	(a)	(a)	(a)
New Jersey	1	(a)	(a)			(a)	(a)			(a)	(a)	(a)	(a)
New York	4					(a)	(a)			(a)	(a)	(a)	(a)
Oregon	2	(a)	(a)					(a)	(a)	(a)	(a)	(a)	(a)
Pennsylvania	20	7,880	$21,725			119,860	107,639	48,140	$66,219	43,470	221,743	219,350	417,326
Rhode Island	5					81,650	199,941					81,650	199,941
South Dakota	1					(a)	(a)					(a)	(a)
Undistributed		6,120	15,604	7,580	10,007	378,500	572,054	69,930	42,540	59,240	265,655	203,030	420,273
	64	[b]14,000	37,329	98,650	157,538	1,147,250	1,453,255	118,070	108,759	105,330	534,888	1,483,300	2,291,769

[a] Included under "Undistributed."

[b] Approximately 162,500 cubic feet.

CRUSHED STONE.

Crushed stone sold in the United States in 1919 and 1920.

1919.

	Road metal and concrete.		Railroad ballast.		Total.		
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Average value per ton.
Granite	2,123,073	$2,854,655	577,001	$445,625	2,700,074	$3,300,280	$1.22
Basalt and related rocks (trap rock)	6,079,097	7,375,921	973,779	1,105,687	7,052,876	8,481,608	1.20
Limestone	16,956,886	17,887,168	4,805,060	3,822,038	21,761,946	21,709,206	1.00
Sandstone	851,253	1,136,527	327,960	296,315	1,179,213	1,432,842	1.22
Miscellaneous	857,916	1,299,133	121,314	182,117	979,230	1,481,250	1.51
	26,868,225	30,553,404	6,805,114	5,851,782	33,673,339	36,405,186	......
Average value per ton	....	1.14	....	0.86	....	1.08	......

1920.

	Road metal and concrete.		Railroad ballast.		Total.		
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Average value per ton.
Granite	2,415,480	$4,240,699	601,480	$591,077	3,016,960	$4,831,776	$1.60
Basalt and related rocks (trap rock)	7,897,300	10,540,201	984,210	1,260,282	8,881,510	11,800,483	1.33
Limestone	20,419,130	25,249,446	5,388,670	5,359,353	25,807,800	30,608,799	1.19
Sandstone	944,740	1,551,429	449,530	492,192	1,394,270	2,043,621	1.47
Miscellaneous	1,147,250	1,453,255	118,070	108,759	1,265,320	1,562,014	1.23
	32,823,900	43,035,030	7,541,960	7,811,663	40,365,860	50,846,693	......
Average value per ton	....	1.31	....	1.04	....	1.26	......

Crushed stone sold in the United States in 1919 and 1920.

1919.

State.	Concrete and road metal.		Railroad ballast.		Total crushed stone.	
	Quantity (short tons).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
Alabama	76,390	$90,880			76,390	$90,880
Arizona	(a)	(a)	(a)	(a)	375,576	204,303
Arkansas	287,120	337,725	101,265	$129,871	388,385	467,596
California	2,144,205	1,597,596	230,521	129,774	2,374,726	1,727,370
Colorado	(a)	(a)			(a)	(a)
Connecticut	(a)	(a)	(a)	(a)	1,230,805	1,293,919
Delaware	(a)	(a)			(a)	(a)
Florida	(a)	(a)	(a)	(a)	118,755	155,161
Georgia	118,465	237,261	41,845	73,706	160,310	310,967
Hawaii	(a)	(a)			(a)	(a)
Idaho	(a)	(a)			(a)	(a)
Illinois	[b] 3,126,214	[b] 2,355,854	541,807	351,048	[b] 3,668,021	[b] 2,706,902
Indiana	873,437	749,432	76,741	53,188	950,178	802,620
Iowa	379,874	374,685	(a)	(a)	(a)	(a)
Kansas	414,089	555,228	144,730	119,889	558,819	675,117
Kentucky	386,871	579,713	728,398	553,871	1,115,269	1,133,584
Louisiana	(a)	(a)			(a)	(a)
Maine	(a)	(a)	(a)	(a)	21,420	28,263
Maryland	(a)	(a)	(a)	(a)	628,151	984,973
Massachusetts	[b] 1,001,525	[b] 1,695,605	77,665	122,787	[b] 1,079,190	[b] 1,818,392
Michigan	(a)	(a)	(a)	(a)	1,192,109	705,092
Minnesota	357,924	457,094			357,924	457,094
Missouri	[b] 565,629	[b] 871,249	45,366	52,070	610,995	923,319
Montana	35,449	36,445	(a)	(a)	(a)	(a)
Nebraska	155,969	219,173			155,969	219,173
New Hampshire	12,643	25,193	(a)	(a)	(a)	(a)
New Jersey	[b] 1,030,017	[b] 1,742,966	185,814	208,635	[b] 1,215,831	[b] 1,951,601
New Mexico	(a)	(a)	(a)	(a)	(a)	(a)
New York	2,077,728	3,169,996	756,879	634,887	2,834,607	3,804,883
North Carolina	422,258	725,432	(a)	(a)	(a)	(a)
Ohio	3,130,638	2,703,788	[b] 861,047	[b] 578,722	[b] 3,991,685	[b] 3,282,510
Oklahoma	[b] 375,622	[b] 425,607	204,388	178,468	[b] 580,010	[b] 604,075
Oregon	(a)	(a)	(a)	(a)	402,162	503,253
Pennsylvania	2,675,065	3,634,917	804,457	915,542	3,479,522	4,550,459
Porto Rico	67,000	101,186			67,000	101,186
Rhode Island	102,613	274,959			102,613	274,959
South Carolina	377,661	499,572			377,661	499,572
South Dakota	118,446	135,558			118,446	135,558
Tennessee	322,150	401,146	152,577	127,986	474,727	529,132
Texas	[b] 469,669	[b] 392,111	(a)	(a)	(a)	(a)
Utah	4,855	5,460			4,855	5,460
Vermont	(a)	(a)	(a)	(a)	17,884	33,542
Virginia	478,670	487,831	818,481	726,734	1,297,151	1,214,565
Washington	116,404	142,544			116,404	142,544
West Virginia	332,011	411,367	131,393	127,954	463,404	539,321
Wisconsin	[b] 1,052,391	[b] 1,112,319	[b] 12,917	[b] 11,537	[b] 1,066,738	[b] 1,125,286
Wyoming	13,752	26,523			13,752	26,523
Undistributed	3,765,471	3,976,989	888,823	755,113	1,985,895	2,376,032
	26,868,225	30,553,404	6,805,114	5,851,782	33,673,339	36,405,186

[a] Included under "Undistributed."
[b] Output of certain kinds of stone included under "Undistributed" to conform to previous tables.

Crushed stone sold in the United States in 1919 and 1920—Continued.

1920.

State.	Concrete and road metal.		Railroad ballast.		Total crushed stone.	
	Quantity (short tons).	Value.	Quantity (short tons)	Value.	Quantity (short tons).	Value.
Alabama	71,860	$97,008			71,860	$97,008
Arizona	(a)	(a)	(a)	(a)	229,570	208,008
Arkansas	417,940	599,867	134,970	$169,881	552,910	769,748
California	3,649,220	3,764,535	161,420	176,457	3,810,640	3,940,992
Colorado	(a)	(a)			(a)	(a)
Connecticut	1,184,160	1,483,017	53,540	61,806	1,237,700	1,544,823
Delaware	(a)	(a)			(a)	(a)
Florida	323,270	381,054	(a)	(a)	(a)	(a)
Georgia	253,960	566,667	(a)	(a)	(a)	(a)
Hawaii	250,910	435,403			250,910	435,403
Idaho	(a)	(a)			(a)	(a)
Illinois	[b]3,144,070	[b]3,596,934	462,100	377,725	[b]3,606,170	[b]3,974,659
Indiana	1,194,760	1,216,701	210,860	180,853	1,405,620	1,397,554
Iowa	379,770	481,424	(a)	(a)	(a)	(a)
Kansas	402,280	615,906	131,720	138,732	534,000	754,638
Kentucky	582,060	764,519	699,180	615,462	1,281,240	1,379,981
Louisiana	(a)	(a)			(a)	(a)
Maine	[b]10,140	16,539	(a)	(a)	15,720	26,604
Maryland	407,290	732,305	172,600	228,666	579,890	960,971
Massachusetts	[b]953,080	[b]1,757,589	[b]25,330	[b]47,499	[b]1,008,730	[b]1,856,821
Michigan	1,603,170	1,095,196	154,050	122,960	1,757,220	1,218,156
Minnesota	(a)	(a)	(a)	(a)	579,070	893,153
Missouri	819,140	1,473,764	150,970	169,301	970,110	1,643,065
Montana	(a)	(a)	(a)	(a)	47,680	51,299
Nebraska	124,750	316,233	(a)	(a)	(a)	(a)
New Hampshire	14,930	25,600	(a)	(a)	(a)	(a)
New Jersey	1,075,310	1,951,960	193,650	262,374	1,268,960	2,214,334
New Mexico			329,830	280,380	329,830	280,380
New York	[b]3,407,050	[b]4,262,190	[b]960,680	[b]1,114,570	[b]4,367,730	[b]5,376,760
North Carolina	(a)	(a)	(a)	(a)	504,520	982,789
Ohio	[b]3,382,130	[b]3,543,686	887,300	898,526	[b]4,269,430	[b]4,442,212
Oklahoma	399,760	531,770	450,830	425,224	850,590	956,994
Oregon	(a)	(a)	(a)	(a)	459,940	464,416
Pennsylvania	2,952,770	4,568,343	775,610	1,114,544	3,728,380	5,682,887
Porto Rico	53,890	81,576			53,890	81,576
Rhode Island	101,010	257,131			101,010	257,131
South Carolina	223,990	556,464	12,980	13,213	236,970	569,677
South Dakota	141,840	287,113			141,840	287,113
Tennessee	514,770	745,764	186,680	148,066	701,450	893,830
Texas	[b]468,310	[b]563,601	(a)	(a)	[b]554,500	[b]676,489
Vermont	21,330	29,214			21,330	29,214
Virginia	[b]476,910	[b]729,507	644,870	671,284	[b]1,121,780	[b]1,400,791
Washington	425,730	375,508			425,730	375,508
West Virginia	278,800	410,817	260,030	217,899	538,830	628,716
Wisconsin	[b]941,130	[b]1,234,530	[b]51,210	[b]52,955	1,124,640	1,469,030
Wyoming	(a)	(a)			(a)	(a)
Undistributed	2,172,410	3,485,595	431,550	323,286	1,625,470	2,623,963
	32,823,900	43,035,030	7,541,960	7,811,663	40,365,860	50,846,693

[a] Included under "Undistributed."
[b] Output of certain kinds of stone included under "Undistributed" to conform to previous tables.

CEMENT.[1]

By Ernest F. Burchard.

INTRODUCTION.

Estimates of shipments, prices, production, and stocks of cement in 1920, published on February 14, 1921, by the United States Geological Survey in a press bulletin, indicated that the production had exceeded 100,000,000 barrels, which made a record and may be considered one of the milestones in the growth of the Portland cement industry. When the writer became interested in the subject of cement as assistant to E. C. Eckel, in 1907, the annual production of Portland cement in the United States had not reached 50,000,000 barrels.

In order to interpret the situation at the end of 1920, it is essential to review more than the one year and also to bear in mind that the production of cement was materially curtailed during the war and that after the armistice was declared the expectation of lower prices slackened building operations during the first half of 1919. The demand for cement was therefore so low that the output was below normal. Finally the "underbuilt" condition of the country forced building in spite of high prices, causing a demand for cement that resulted in a shortage of it locally late in 1919. The stocks dropped from a normal supply at the beginning of 1919 to less than 60 per cent of normal at the end of that year. At the beginning of 1920 there was the usual lull in building operations that comes in winter, but the demand for cement was more active than a year earlier and the production continued to rise until it reached its peak in October. During the last two months of 1920 there was a decline in activity after the building season had passed. In February only about 48 per cent of the total cement-manufacturing capacity of the country was utlilized, but in October the percentage had risen to 83, and the average for the year was about 68 per cent.

The stocks at the beginning of 1920 were lower than at the beginning of any other year since records have been kept by the United States Geological Survey; for four or five months they gained slowly, but from May until October they dwindled rapidly, almost vanishing at some plants. In November and December the production was not curtailed in proportion to the decline in demand and stocks once more began to accumulate, so that at the end of the year a normal quantity—more than a month's supply—was becoming seasoned for use in 1921. This is a most creditable record, for when future demand and price are uncertain the accumulation of large factory stocks of cement in winter at current costs becomes a serious problem. Though it might be desirable to have large stocks on hand ready for a possible spring demand, the uncertain conditions of the market during the last few years have caused a lack of confidence in the future.

[1] The statistics of the domestic cement industry were prepared by Miss B. W. Bagley. Those showing imports and exports of cement were compiled by J. A. Dorsey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

What is most needed by the cement industry in common with most other manufacturing industries is steadier demand. Efforts are being made to bring this about, but it is an exceedingly complicated problem. Building work is largely seasonal; prices of other commodities affect the demand for cement; so do freight rates; and, aside from market conditions, many other factors vitally influence the cement industry. Since the end of the World War transportation facilities both for raw materials and for finished products have proved inadequate during busy periods, especially when crops were being moved and the supply of coal and labor has been short. When these conditions prevail during the building season the result is a shortage of cement at points of consumption, which gives opportunity for dealers to increase greatly the price to the consumer.

Trade and manufacturing conditions were generally better in 1920 than in 1919, though most plants felt the cessation of demand and the lowered prices at the end of the year. The prevalent handicaps, especially labor troubles, proved too great for some plants, which were closed for long periods.

The advantages of basing the final statistics of the production of cement on returns from every manufacturing plant in the United States are obvious. Returns from all but eight plants had been received by the Geological Survey on April 15, 1921. Especial efforts to obtain the lacking figures caused visits to some companies in order that the relation of the Survey to the cement industry might be fully explained. When it became necessary to close the tabulation an estimate was made for the shipments into States of three plants and for sundry other items not included in certain reports. The prompt and hearty cooperation of the cement industry in general and the wide interest that is taken in the Survey reports on cement are greatly appreciated, and in order to promote early publication in the future it is urged that complete returns be made by all companies in January of each year.

PRINCIPAL HYDRAULIC CEMENTS.

The Portland, natural, and puzzolan cements marketed or shipped from the mills in the United States in 1920 increased 12.7 per cent in quantity and 32.8 per cent in value.

Hydraulic cements shipped from factories in the United States in 1918–1920.

Class.	1918		1919		1920	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.	Quantity (barrels).	Value.
Portland	70,915,508	$113,316,275	85,612,899	$146,734,844	96,311,719	$194,439,025
Natural Puzzolan	432,966	401,341	528,589	583,554	767,481	1,150,890
	71,348,474	113,717,616	86,141,488	147,318,398	97,079,200	195,589,915

The abridged historical table on page 266 gives the production and value of natural, Portland, and puzzolan cements for more than 100 years. The curves in figure 11 show graphically some of these data from 1890 to 1920.

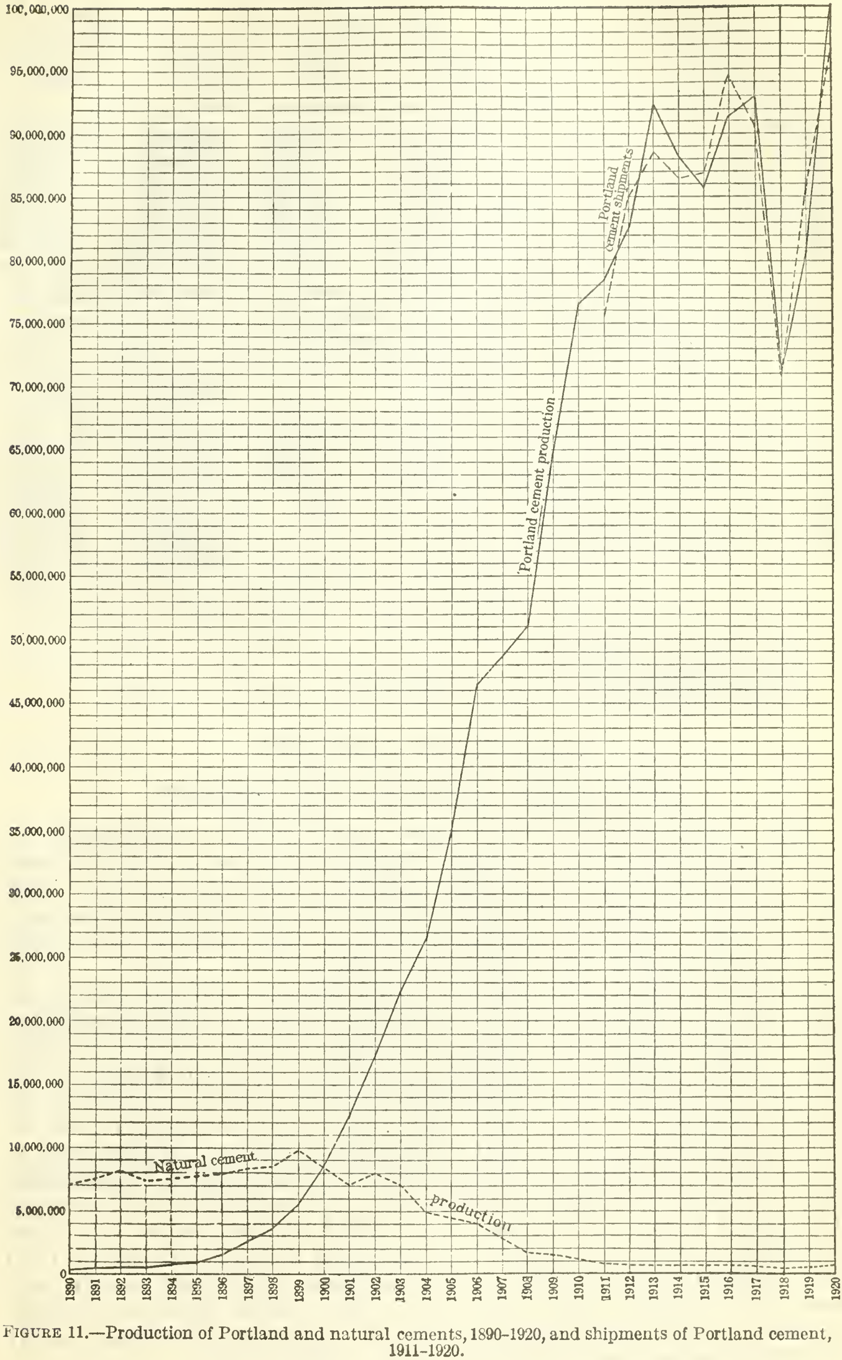


FIGURE 11.—Production of Portland and natural cements, 1890–1920, and shipments of Portland cement, 1911–1920.

Principal hydraulic cements produced in the United States, 1818–1920.[a]

Year.	Natural cement.		Portland cement.	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
1818–1912	232,076,611	$148,123,758	[b] 590,190,930	[b] $562,242,149
1913	744,658	345,889	92,097,131	92,557,617
1914	751,285	351,370	88,230,170	81,789,368
1915	750,863	358,627	85,914,907	73,886,820
1916	[c] 842,137	[c] 430,874	91,521,198	100,947,881
1917	[c] 639,456	[c] 435,370	92,814,202	125,670,430
1918	[c] 432,966	[c] 401,341	71,081,663	113,730,661
1919	[c] 528,589	[c] 583,554	80,777,935	138,130,269
1920	[c] 767,481	[c] 1,150,890	100,023,245	202,046,955
	[c] 237,534,046	[c] 152,181,673	1,292,651,381	1,491,002,150

Year.	Puzzolan cement.		Total.	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
1818–1912	[d] 4,588,455	[d] $3,736,873	826,855,996	$714,102,780
1913	107,313	97,663	92,949,102	93,001,169
1914	68,311	63,358	89,049,766	82,204,096
1915	42,678	39,801	86,708,448	74,285,248
1916	(c)	(c)	92,363,335	101,378,755
1917	(c)	(c)	93,453,658	126,105,800
1918	(c)	(c)	71,514,629	114,132,002
1919	(c)	(c)	81,306,524	138,713,823
1920	(c)	(c)	100,790,726	203,197,845
	[c] 4,806,757	[c] 3,937,695	1,534,992,184	1,647,121,518

[a] Statistics by years or decades between 1818 and 1912 have been published in the chapters on cement in Mineral Resources for 1915 and 1916.
[b] First recorded output in 1870.
[c] Figures for puzzolan cement from 1916 to 1920, inclusive, are included with natural cement.
[d] First recorded output in 1896.

PORTLAND CEMENT.

PRODUCTION, SHIPMENTS, AND STOCKS.

The total production of Portland cement in the United States in 1920, as reported to the United States Geological Survey, showed an increase of 24 per cent. The shipments from the mills showed an increase of 13 per cent, and the gross value of shipments increased 32.5 per cent. The average selling price at mills showed an increase of 31 cents a barrel, or about 18 per cent.

At the beginning of 1920 the rate of shipments of Portland cement from the mills was less than 4,000,000 barrels a month, the lowest for the year. From January to July there was an increase to more than 11,500,000 barrels, followed by a slight decline in August and a recovery in September and October; then by a steady drop to about 5,000,000 barrels in December. Production showed greater fluctuation, beginning at about 6,300,000 barrels in January, falling slightly in February, rising to about 9,000,000 barrels in May, and ranging from less than 9,000,000 barrels in July to a maximum of more than 10,000,000 barrels in October, from which it declined to less than 8,000,000 barrels in December. Stocks of finished cement in 1920 were highest in May, when they were about 10,500,000 barrels, and lowest in October, when they were only about 3,000,000 barrels, whereas at the beginning and end of the year they were about 5,250,000 barrels and 8,940,000 barrels, respectively.

PRODUCTION, SHIPMENTS, AND STOCKS, BY STATES AND BY COMMERCIAL DISTRICTS.

The statistics in the following table are arranged by States, provided there are three or more producers or shippers in a single State, or permission is given to publish figures where there are less than three. 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 27 States in 1920 (see Pl. I), but as a number of these States did not contain three or more plants it has been necessary to group together in this table several States that are not closely related geographically. In the table "Portland cement produced and shipped by districts," however, statistics are given for groups of States—generally not more than three—that are geographically related.

Of the 27 States in which Portland cement was manufactured in 1920, 21 showed increase in shipments and 6 showed decrease, as compared with 1919, while 25 showed increase in production and 2 showed decrease. The net change for the whole country was an increase in shipments of 13 per cent and in production of 24 per cent. In 1920 production exceeded shipments by 3,711,526 barrels.

Portland cement produced, shipped, and in stock in the United States, 1919 and 1920, by States.

State.	Production.					Stock (barrels).		
	Active plants.		Quantity (barrels).		Percentage of increase.	1919 (revised).	1920	Percentage of change.
	1919	1920	1919	1920				
California	8	9	4,642,679	7,098,084	53	430,003	463,930	+ 8
Illinois	4	4	4,206,918	5,538,558	32	25,125	403,640	+1,507
Indiana	5	6	7,262,454	10,787,751	49	448,451	1,047,960	+ 134
Iowa	4	4	3,573,278	4,849,228	36	126,162	553,607	+ 339
Kansas	7	7	2,927,270	4,340,794	48	220,994	399,059	+ 81
Michigan	11	11	4,675,244	4,891,457	5	219,641	666,071	+ 203
Missouri	5	5	5,216,347	6,017,517	15	160,123	571,697	+ 257
New York	8	9	4,383,579	5,885,058	34	721,304	553,989	− 23
Ohio	5	5	1,637,418	1,780,433	9	82,468	197,521	+ 140
Oklahoma	3	3	1,362,687	1,553,652	14	71,908	134,438	+ 87
Oregon and Washington	5	6	1,561,951	2,218,905	42	227,648	247,809	+ 9
Pennsylvania	21	21	25,325,173	28,269,314	12	1,781,997	2,388,836	+ 34
Texas	5	5	2,249,735	2,562,208	14	205,918	143,502	− 30
Utah	3	3	819,861	1,093,741	33	34,295	105,397	+ 207
Other States [a]	17	19	10,933,341	13,136,545	20	500,863	1,063,590	+ 112
	111	117	80,777,935	100,023,245	24	5,256,900	8,941,046	+ 70

[a] Alabama, Colorado, Georgia, Kentucky, Maryland, Minnesota, Montana, Nebraska, New Jersey Tennessee, Virginia, and West Virginia.

Portland cement produced, shipped, and in stock in the United States, 1919 and 1920, by States—Continued.

State.	Shipments.					Average factory price per barrel.	
	1919		1920		Percentage of change in quantity.		
	Quantity (barrels).	Value.	Quantity (barrels).	Value.		1919	1920
California	4,743,336	$8,860,196	7,064,010	$15,449,645	+49	$1.87	$2.19
Illinois	4,873,831	7,901,689	5,148,040	10,012,158	+ 6	1.62	1.94
Indiana	7,667,976	12,527,770	10,191,126	18,649,115	+33	1.63	1.83
Iowa	4,569,110	7,798,347	4,421,783	8,742,854	− 3	1.71	1.98
Kansas	3,023,901	5,467,284	4,158,399	8,649,157	+38	1.81	2.08
Michigan	4,990,308	8,468,196	4,442,455	10,939,633	−11	1.70	2.46
Missouri	5,496,164	9,264,017	5,605,952	10,980,453	+ 2	1.69	1.96
New York	4,441,250	7,700,406	6,049,150	12,206,698	+36	1.73	2.02
Ohio	1,821,597	3,311,179	1,670,958	3,561,490	− 8	1.82	2.13
Oklahoma	1,366,884	2,657,339	1,484,698	3,284,412	+ 9	1.94	2.21
Oregon and Washington	1,615,890	3,359,056	2,198,743	4,965,560	+36	2.08	2.26
Pennsylvania	26,250,077	43,126,528	27,662,116	52,632,082	+ 5	1.64	1.90
Texas	2,318,747	4,226,222	2,626,130	5,898,972	+13	1.82	2.25
Utah	935,305	1,906,816	1,022,639	2,314,413	+ 9	2.04	2.26
Other States [a]	11,498,523	20,159,799	12,565,520	26,152,383	+ 9	1.75	2.08
	85,612,899	146,734,844	96,311,719	194,439,025	+13	1.71	2.02

[a] Alabama, Colorado, Georgia, Kentucky, Maryland, Minnesota, Montana, Nebraska, New Jersey, Tennessee, Virginia, and West Virginia.

As shown by the accompanying table there were increases in all districts in production and in all except three in shipments, as compared with 1919.

Portland cement produced, shipped, and in stock in the United States, 1919 and 1920, by districts.

Commercial district.	Production.							
	Active plants.		Quantity (barrels).		Percentage of increase.	Stock (barrels).		
	1919	1920	1919	1920		1919 (revised).	1920	Percentage of change.
Lehigh district (eastern Pennsylvania and western New Jersey)	20	20	22,747,956	25,417,804	12	1,626,053	2,086,370	+ 28
New York	8	9	4,383,579	5,885,058	34	721,304	553,989	− 23
Ohio and western Pennsylvania	8	8	6,599,820	7,343,112	11	347,292	752,582	+117
Michigan and northeastern Indiana	12	13	5,047,395	5,379,187	7	273,641	727,927	+166
Kentucky and southern Indiana	3	3	2,490,497	3,293,090	32	99,626	326,193	+227
Illinois and western Indiana	6	6	9,088,081	13,106,011	44	322,190	1,094,358	+240
Maryland, Virginia, and West Virginia	4	4	2,469,768	3,044,691	23	124,093	256,476	+107
Tennessee, Alabama, and Georgia	4	6	2,744,646	2,888,811	5	37,235	191,319	+414
Iowa, Minnesota, and Missouri	10	10	10,038,625	12,406,745	24	366,331	1,261,131	+244
Nebraska, Kansas, Oklahoma, and central Texas	15	15	6,151,095	8,177,245	33	460,365	727,726	+ 58
Rocky Mountain States, (Colorado, Utah, Montana, and western Texas)	8	8	2,811,843	3,764,502	34	221,119	251,236	+ 14
Pacific Coast States (California, Oregon, and Washington)	13	15	6,204,630	9,316,989	50	657,651	711,739	+ 8
	111	117	80,777,935	100,023,245	24	5,256,900	8,941,046	+ 70

URAL, ANI

olan cement]

CEMENT PLANTS.

[Portland cement unless otherwise specified. N=Natural cement. Pz=Puzzolan cement.]

1. Glens Falls, Glens Falls, N. Y.
2. {Knickerbocker / N. Y. and N. Eng. (Atlas)} Hudson N. Y
3. Acme, Catskill, N. Y.
4. Alsen, Catskill, N. Y
5. Alpha, Cementon, N. Y.
6. Snyder (N), Rosendale, N. Y
7. Helderberg, Howes Cave, N. Y.
8. Alpha, Jamesville, N. Y
9. Cayuga, Portland Point, N. Y.
10. LEHIGH DISTRICT
    - Vulcanite, Vulcanite, N. J.
    - Edison, New Village, N. J.
    - Alpha, Alpha, N. J.
    - Allentown, Evansville, Pa
    - Alpha, Martins Creek, Pa.
    - Atlas, Coplay and Northampton, Pa
    - Beth, Bath, Pa
    - Coplay, Coplay, Pa.
    - Dexter, Nazareth, Pa
    - Grant, Egypt, Pa
    - Hercules, Stockertown Pa.
    - Lawrence (also N), Siegfried. Pa
    - Lehigh, Fogelsville, Ormrod, and W. Coplay, Pa
    - Nazareth, Nazareth, Pa
    - Penn-Allen, Penn Allen, Pa.
    - Pennsylvania, Bath, Pa
    - Phoenix, Nazareth, Pa.
    - Whitehall, Cementon, Pa
11. Sandusky, York, Pa.
12. Lehigh, New Castle, Pa
13. Bessemer, Bessemer, Pa
14. Crescent, Wampum, Pa.
15. Universal, Universal, Pa.
16. Tidewater, Union Bridge, Md
17. Security, Security, Md.
18. Alpha, Manheim, W. Va.
19. Virginia (Lehigh), Fordwick, Va
20. Giant Norfolk, Va
21. Clinchfield, Kingsport, Tenn.
22. Dixie, Richard City, Tenn
23. Southern States, Rockmart, Ga.
24. National, Ragland, Ala.
25. Standard (Atlas), Leeds, Ala
26. Southern (Pz), Birmingham, Ala.
27. Gulf States, Spocari, Ala
28. Kosmos, Kosmosdale, Ky.
29. Alpha, Ironton, Ohio.
30. Wellston, Superior, Ohio.
31. Lisbon (N), Lisbon, Ohio.
32. Diamond, Middle Branch, Ohio.
33. Castalia, Castalia, Ohio.
34. Sandusky, Baybridge, Ohio.
35. Huron, Alpena Mich
36. Petoskey, Petoskey, Mich
37. Newaygo, Newaygo, Mich.
38. {Aetna / New Egyptian} Fenton, Mich
39. Alpha, Bellevue, Mich.
40. Wyandotte, Wyandotte, Mich.
41. Michigan, Chelsea, Mich.
42. Peninsular, Cement City, Mich.
43. Wolverine, Coldwater and Quincy, Mich.

MAP OF UNITED STATES SHOWING DISTRIBUTION OF PORTLAND, NATURAL, AND PUZZOLAN CEMENT PLANTS

Prepared by Ernest F. Burchard

1921

• Portland cement plant • Natural cement plant ▲ Puzzolan cement plant

CEMENT PLANTS—CONTINUED.

44. Peerless, Union City, Mich.
45. Wabash, Stron, Ind.
46. Sandusky, Syracuse, Ind.
47. Indiana, Greencastle, Ind.
48. Lehigh, Mitchell, Ind.
49. Louisville (also N), Speeds, Ind
50. Universal, Buffington, Ind.
51. Utica (N), Utica, Ill.
52. {Alpha / Marquette} La Salle, Ill
53. Lehigh, Oglesby, Ill.
54. Sandusky, Dixon, Ill.
55. Universal, Morgan Park, Minn.
56. Carney (N), Mankato, Minn.
57. Austin (N), Austin, Minn.
58. {Lehigh / Northwestern States} Mason City, Iowa.
59. Gilmore, Gilmore City, Iowa.
60. {Hawkeye, Des Moines, Iowa / Pyramid (Constructing, 1921), Valley Junction, Iowa}
61. Atlas, Hannibal, Mo.
62. Missouri, Prospect Hill, Mo.
63. Continental, St. Louis, Mo.
64. Cape Girardeau, Cape Girardeau, Mo.
65. Missouri, Sugar Creek, Mo.
66. Nebraska, Superior, Nebr.
67. Bonner, Bonner Springs, Kans.
68. Great Western, Mildred, Kans.
69. Lehigh, Iola, Kans.
70. Monarch, Humboldt, Kans.
71. Fort Scott (N), Fort Scott, Kans
72. Ash Grove, Chanute, Kans.
73. Fredonia, Fredonia, Kans.
74. Western States, Independence, Kans.
75. Dewey, Dewey, Okla.
76. Choctaw, Hartshorne, Okla.
77. Oklahoma, Ada, Okla.
78. {Trinity / Texas} Eagle Ford and Cement, Tex.
79. Texas, Manchester, Tex.
80. San Antonio, San Antonio, Tex
81. Southwestern, El Paso, Tex.
82. United States, Concrete, Colo.
83. Colorado, Portland, Colo.
84. Three Forks, Hanover, Mont.
85. Three Forks, Trident, Mont.
86. Ogden, Bakers, Utah.
87. Union, Devils Slide, Utah.
88. Utah, Salt Lake City, Utah.
89. Riverside, Riverside, Calif.
90. California, Colton, Calif.
91. Golden State, Oro Grande, Calif.
92. Southwestern, Victorville, Calif.
93. United States Potash Co., Monolith, Calif
94. Old Mission, San Juan Bautista, Calif.
95. Santa Cruz, Davenport, Calif.
96. Cowell, Bay Point, Calif.
97. Standard, Napa Junction, Calif.
98. Pacific, Cement, Calif.
99. Beaver, Gold Hill, Oreg.
100. Oregon, Oswego, Oreg.
101. International, Irvin, Wash.
102. Lehigh, Metaline Falls, Wash.
103. Superior, Concrete, Wash
104. Olympic, Bellingham, Wash.

Portland cement produced, shipped, and in stock in the United States, 1919 and 1920, by districts—Continued.

Commercial district.	Shipments.					Average factory price per barrel.	
	1919		1920		Percentage of change in quantity.		
	Quantity (barrels).	Value.	Quantity (barrels).	Value.		1919	1920
Lehigh district (eastern Pennsylvania and western New Jersey)	23,501,560	$38,511,273	24,953,127	$47,875,881	+ 6	$1.64	$1.92
New York	4,441,250	7,700,406	6,049,150	12,206,698	+36	1.73	2.02
Ohio and western Pennsylvania	7,102,442	12,144,272	6,943,400	13,414,249	− 2	1.71	1.93
Michigan and northeastern Indiana	5,459,439	9,274,025	4,922,329	11,892,249	−10	1.70	2.42
Kentucky and southern Indiana	2,640,556	4,405,939	3,069,407	6,248,406	+16	1.67	2.04
Illinois and western Indiana	9,932,158	16,092,758	12,321,840	22,561,398	+24	1.62	1.83
Maryland, Virginia, and West Virginia	2,613,963	4,517,591	2,912,308	6,128,117	+11	1.73	2.10
Tennessee, Alabama, and Georgia	2,830,588	4,952,245	2,730,420	6,010,436	− 4	1.75	2.20
Iowa, Minnesota, and Missouri	11,440,645	19,314,646	11,511,954	22,259,081	+ 1	1.69	1.93
Nebraska, Kansas, Oklahoma, and central Texas	6,309,024	11,662,504	7,900,247	17,110,729	+25	1.85	2.17
Rocky Mountain States, (Colorado, Utah, Montana, and western Texas)	2,982,048	5,939,933	3,734,784	8,316,576	+25	1.99	2.23
Pacific Coast States (California, Oregon, and Washington)	6,359,226	12,219,252	9,262,753	20,415,205	+46	1.92	2.20
	85,612,899	146,734,844	96,311,719	194,439,025	+13	1.71	2.02

Portland cement shipped from mills in the United States, 1911–1920.

Year.	Quantity (barrels).	Value.	Year.	Quantity (barrels).	Value.
1911	75,547,829	$63,762,368	1916	94,552,296	$104,258,216
1912	85,012,556	69,109,800	1917	90,703,474	122,775,088
1913	88,689,377	89,106,975	1918	70,915,508	113,316,275
1914	86,437,956	80,118,475	1919	85,612,899	146,734,844
1915	86,891,681	74,756,674	1920	96,311,719	194,439,025

STOCKS AT MILLS.

The stock of Portland cement reported on hand at the mills at the end of 1920 showed an increase of about 70 per cent. The reports of stocks at a few mills in 1919 were revised by the producers. The totals by States and districts are shown in the general tables, pages 267–269.

The summary of stocks in the following table shows that in four of the ten years during which records have been kept by the Geological Survey the gross volume of finished cement on hand has fallen below 10,000,000 barrels. The average for the 10 years is 9,701,681 barrels, and the average for the last 5 years is 8,672,676 barrels.

Finished Portland cement in stock in the United States, December 31, 1911 to 1920.

	Barrels.		Barrels.
1911	10,385,789	1916	8,360,552
1912	7,811,329	1917	10,353,838
1913	11,220,328	1918	10,451,044
1914	12,773,463	1919	5,256,900
1915	11,462,523	1920	8,941,046

DOMESTIC CONSUMPTION OF PORTLAND CEMENT

An estimate of the total consumption of Portland cement in the United States may be made by adding the imports to the shipments and subtracting the exports from the sum. Of course, a variable but considerable stock of cement is at all times in transit, in warehouses at distributing points, and awaiting use at large jobs, so that the estimate thus made is at best only approximate. Still another uncertain element in this estimate is the fact that as imports and exports are classed as hydraulic cement the records do not discriminate between Portland and other cements and probably also include some plaster. Portland cement, however, constitutes by far the greater part of the exports, and, as the tables show, the imports are small. The apparent domestic consumption in 1920 showed an increase of nearly 13 per cent, as compared with the consumption in 1919.

The following table gives the figures necessary for estimates of consumption so far as available, as prior to 1911 no records are at hand for shipments.

Apparent domestic consumption of Portland cement, 1911–1920, 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	85,470	2,964,358	85,810,489
1914	86,437,956	120,906	2,140,197	84,418,665
1915	86,891,681	42,218	2,565,031	84,368,868
1916	94,552,296	1,836	2,563,976	91,990,156
1917	90,703,474	2,323	2,586,215	88,119,582
1918	70,915,508	305	2,252,446	68,663,367
1919	85,612,899	8,931	2,463,573	83,158,257
1920	96,311,719	524,604	2,985,807	93,850,516

PORTLAND CEMENT CONSUMED PER CAPITA.

The estimates of consumption of Portland cement in the States and the dependencies of the United States according to political divisions are of course only approximate, as they represent only the records of shipments by manufacturers into the several States. Also, the shipments of cement into a State may not equal the consumption in that State during the same period, but if taken for a long period they should afford a very fair index to the consumption.[3] The estimates of consumption in Alaska, Hawaii, and Porto Rico are based on the official statistics of exports to those countries from the United States and do not include small imports that may have come from foreign countries. The table of exports to other countries on page 280 shows the shipments of cement from the United States to the Philippines and the Virgin Islands, but there are no data available as to the imports of cement to the islands from foreign countries. Imports to the Philippines from Japan and Hongkong figure largely in their per capita consumption.

The simplest available common index is the estimated consumption per capita in barrels, which is obtained by comparing the shipments into States and certain possessions with the population for the States and those possessions in 1919 and 1920.

There is a discrepancy between the official figures of the Bureau of Foreign and Domestic Commerce for exports of cement, as given on page 280, and the exports reported by manufacturers, as given in the

[3] Data on per capita consumption of Portland cement by States beginning with the year 1914 are available in preceding volumes of Mineral Resources.

following table, owing to the fact that cement shipped from mills destined for foreign countries is reported by the shipper as exported, whether or not it leaves the country during that calendar year, but the Bureau of Foreign and Domestic Commerce bases its export figures on the cement that actually leaves the country, according to its records. The exports given by that bureau include all other hydraulic cement exported, whereas the table of per capita consumption relates only to Portland cement.

Estimated per capita consumption of Portland cement in the United States and certain outlying possessions in 1919 and 1920.

State.	1919			1920		
	Population, Dec. 31, 1919. [a]	Consumption (shipments to States).	Estimated consumption per capita.	Population (estimated as of Dec. 31, 1920). [a]	Consumption (shipments to States).	Estimated consumption per capita.
		Barrels.	*Barrels.*		*Barrels.*	*Barrels.*
Alabama	2,348,174	571,222	0.24	2,369,814	770,382	0.32
Alaska	55,036	12,192	.22	[b] 55,036	18,216	.33
Arizona	334,162	409,781	1.23	347,533	645,077	1.86
Arkansas	1,752,204	418,093	.24	1,770,514	530,482	.30
California	3,426,861	3,900,436	1.14	3,534,945	5,832,977	1.65
Colorado	939,629	680,802	.72	954,112	883,300	.93
Connecticut	1,380,631	1,311,829	.95	1,408,018	1,328,277	.94
Delaware	223,003	296,798	1.33	225,134	301,706	1.34
District of Columbia	437,571	410,305	.94	448,541	357,572	.80
Florida	968,470	513,125	.53	990,704	554,966	.56
Georgia	2,895,832	1,072,732	.37	2,925,365	1,209,422	.41
Hawaii	255,912	135,577	.53	262,504	204,760	.78
Idaho	431,866	380,929	.88	442,813	366,516	.83
Illinois	6,485,280	6,154,227	.95	6,572,493	7,407,388	1.13
Indiana	2,930,390	3,135,162	1.07	2,954,032	2,935,056	.99
Iowa	2,404,021	3,362,263	1.40	2,422,485	3,360,089	1.39
Kansas	1,769,257	1,900,921	1.07	1,777,324	2,341,323	1.32
Kentucky	2,416,630	773,011	.32	2,429,684	880,106	.36
Louisiana	1,798,509	593,459	.33	1,813,149	836,148	.46
Maine	768,014	330,448	.43	770,655	393,123	.51
Maryland	1,449,661	1,367,836	.94	1,465,556	1,326,692	.91
Massachusetts	3,852,356	2,377,677	.62	3,902,409	2,650,264	.68
Michigan	3,668,412	5,097,575	1.39	3,756,814	5,142,945	1.37
Minnesota	2,387,125	2,979,549	1.25	2,419,202	3,109,243	1.29
Mississippi	1,790,618	261,512	.15	1,789,949	262,656	.15
Missouri	3,404,055	1,932,119	.57	3,415,459	2,525,087	.74
Montana	548,889	376,690	.69	566,691	403,807	.71
Nebraska	1,296,372	1,472,603	1.14	1,307,100	1,575,471	1.21
Nevada	77,407	54,017	.70	76,947	97,792	1.27
New Hampshire	443,083	341,013	.77	444,371	335,632	.76
New Jersey	3,155,900	3,179,174	1.01	3,219,632	3,639,810	1.13
New Mexico	360,350	139,328	.39	363,754	201,827	.55
New York	10,385,227	7,078,888	.68	10,516,209	8,663,051	.82
North Carolina	2,559,123	790,020	.31	2,595,466	993,999	.38
North Dakota	646,872	358,675	.55	654,063	251,642	.38
Ohio	5,759,394	6,258,862	1.09	5,861,602	6,330,910	1.08
Oklahoma	2,028,283	1,302,870	.64	2,066,510	1,688,310	.82
Oregon	783,389	585,927	.75	794,783	795,292	1.00
Pennsylvania	8,720,017	7,571,085	.87	8,828,676	8,582,057	.97
Porto Rico	1,299,809	201,385	.15	1,318,534	229,633	.17
Rhode Island	604,397	468,539	.78	610,761	358,895	.59
South Carolina	1,683,724	527,652	.31	1,701,062	587,824	.35
South Dakota	636,547	727,958	1.14	641,971	587,562	.92
Tennessee	2,337,885	778,232	.33	2,353,654	925,393	.39
Texas	4,663,228	1,981,500	.42	4,742,200	2,450,278	.52
Utah	449,396	548,377	1.22	457,229	649,086	1.42
Vermont	352,428	175,797	.50	352,065	217,021	.62
Virginia	2,309,187	1,785,908	.77	2,334,688	1,369,287	.59
Washington	1,356,621	1,278,499	.94	1,378,729	1,834,019	1.33
West Virginia	1,463,701	764,135	.52	1,488,688	1,220,198	.82
Wisconsin	2,632,067	3,261,135	1.24	2,662,783	3,484,720	1.31
Wyoming	194,402	308,178	1.59	199,391	336,917	1.69
Unspecified	....	118,508	....	....	16,879	....
	107,321,377	82,814,535	.77	108,761,803	94,001,085	.86
Exports reported by manufacturers but not included above	....	2,798,364	....	....	2,310,634	....
Total shipped from cement plants	....	85,612,899	....	....	96,311,719	....

[a] Bureau of the Census.

[b] Estimated as of Dec. 31, 1919.

The per capita consumption shown by the table necessarily falls short of the total apparent consumption by the quantity of the imports. These, however, were insignificant until 1920, when 524,604 barrels was imported. This quantity increased the consumption in certain States near the Canadian border, such as Michigan, New York, North Dakota, Ohio, Vermont, and Washington, but it increased the general average per capita consumption by less than 0.005 barrel.

The highest per capita consumption in 1920 was that of Arizona, 1.86 barrels, and this State also showed the largest increase, 0.63 barrel. There were 17 States in 1920 in which the per capita consumption was 1 barrel or more, 6 of them east and 11 of them west of Mississippi River; none of them were in the South. Wyoming, which held the record, 1.59 barrels in 1919, increased to 1.69 barrels in 1920. There were changes in all the States except Mississippi, but only 13 decreases were recorded, most of them slight. The general average of consumption rose from 0.77 barrel in 1919 to 0.86 barrel in 1920, reflecting the revival of activity in building and public works.

It will be noted that there were slight decreases in population in only three States. The net change in population appears to have been a gain of 1,440,426 at the end of 1920.

LOCAL SUPPLIES OF PORTLAND CEMENT.

In connection with the study of consumption of cement it is of interest to compare the shipments from the mills within a State or group of States with the estimated consumption of that area and thus to ascertain the extent of the surplus or deficiency in the supply of cement locally available. The following table has therefore been arranged with that end in view. Data for 1916 to 1919 will be found in the chapters on cement in Mineral Resources for those years. The second table shows how much of the surplus product was consumed by each of the non cement-producing States and dependencies.

Among the cement-producing States there are, of course, fewer deficiencies than surpluses, and certain of the deficiencies indicated are due to local conditions which did not change materially from 1919 to 1920. For instance, in 1920 Illinois showed a deficiency of more than 2,250,000 barrels, while Indiana showed a surplus of more than 7,250,000 barrels. This was equalized in large part by the flow of cement from northern Indiana into the adjacent populous Chicago district in Illinois. Ohio showed a deficiency of more than 4,650,000 barrels, which was largely supplied from Pennsylvania's surplus of more than 19,000,000 barrels and from Indiana. New York State, though a large producer, had a deficiency of more than 2,600,000 barrels, which was mostly supplied from the Lehigh district. The Iowa-Minnesota-Nebraska group showed a deficiency of nearly 1,800,000 barrels in 1920, and in New Jersey, Maryland, Virginia, and West Virginia there was indicated a shortage of more than 2,000,000 barrels, probably supplied in large part from the Lehigh district in Pennsylvania. The quantities consumed in the nonproducing States and dependencies are of interest in comparison with the other data. Between 500,000 and 1,000,000 barrels was consumed in 1920 in each of the States of Arizona, Arkansas, Florida, Louisiana, North Carolina, South Carolina, and South Dakota. Connecticut consumed more than 1,300,000 barrels, Massachusetts more than 2,650,000 barrels, and Wisconsin more than 3,480,000 barrels. The quantity consumed in the nonproducing States plus the unspecified quantities and the exports (the surplus from the cement-producing States) amounted in 1920 to 18,460,740 barrels, compared with 17,722,294 barrels in 1919. In 1920 this total represented 19.2 per cent of the total shipments from mills in the United States.

Estimated surplus or deficiency in local supply of Portland cement in cement-producing States, 1919–1920, in barrels.

State or division.	1919			1920		
	Shipments from mills.	Estimated consumption.	Surplus or deficiency.	Shipments from mills.	Estimated consumption.	Surplus or deficiency.
California	4, 743, 336	3, 900, 436	+ 842, 900	7, 064, 010	5, 832, 977	+ 1, 231, 033
Illinois	4, 873, 831	6, 154, 227	− 1, 280, 396	5, 148, 040	7, 407, 388	− 2, 259, 348
Indiana	7, 667, 976	3, 135, 162	+ 4, 532, 814	10, 191, 126	2, 935, 056	+ 7, 256, 070
Kansas	3, 023, 901	1, 900, 921	+ 1, 122, 980	4, 158, 399	2, 341, 323	+ 1, 817, 076
Michigan	4, 990, 308	5, 097, 575	− 107, 267	4, 442, 455	5, 142, 945	− 700, 490
Missouri	5, 496, 164	1, 932, 119	+ 3, 564, 045	5, 605, 952	2, 525, 087	+ 3, 080, 865
New York	4, 441, 250	7, 078, 888	− 2, 637, 638	6, 049, 150	8, 663, 051	− 2, 613, 901
Ohio	1, 821, 597	6, 258, 862	− 4, 437, 265	1, 670, 958	6, 330, 910	− 4, 659, 952
Oklahoma	1, 366, 884	1, 302, 870	+ 64, 014	1, 484, 698	1, 688, 310	− 203, 612
Pennsylvania	26, 250, 077	7, 571, 085	+18, 678, 992	27, 662, 116	8, 582, 057	+19, 080, 059
Texas	2, 318, 747	1, 981, 500	+ 337, 247	2, 626, 130	2, 450, 278	+ 175, 852
Utah	935, 305	548, 377	+ 386, 928	1, 022, 639	649, 086	+ 373, 553
Washington and Oregon	1, 615, 890	1, 864, 426	− 248, 536	2, 198, 743	2, 629, 311	− 430, 568
Alabama, Georgia, Kentucky, and Tennessee	3, 330, 626	3, 195, 197	+ 135, 429	3, 262, 375	3, 785, 303	− 522, 928
Colorado and Montana	1, 530, 400	1, 057, 492	+ 472, 908	2, 003, 345	1, 287, 107	+ 716, 238
Iowa, Minnesota, and Nebraska	6, 060, 316	7, 814, 415	− 1, 754, 099	6, 245, 822	8, 044, 803	− 1, 798, 981
Maryland, New Jersey, Virginia, and West Virginia	5, 146, 291	7, 097, 053	− 1, 950, 762	5, 475, 761	7, 555, 987	− 2, 080, 226
	85, 612, 899	67, 890, 605	+17, 722, 294	96, 311, 719	77, 850, 979	+18, 460, 740

Estimated consumption of Portland cement in non cement-producing States, 1919–1920, in barrels.

State.	1919	1920
Alaska	12, 192	18, 216
Arizona	409, 781	645, 077
Arkansas	418, 093	530, 482
Connecticut	1, 311, 829	1, 328, 277
Delaware	296, 798	301, 706
District of Columbia	410, 305	357, 572
Florida	513, 125	554, 966
Hawaii	135, 577	204, 760
Idaho	380, 929	366, 516
Louisiana	593, 459	836, 148
Maine	330, 448	393, 123
Massachusetts	2, 377, 677	2, 650, 264
Mississippi	261, 512	262, 656
Nevada	54, 017	97, 792
New Hampshire	341, 013	335, 632
New Mexico	139, 328	201, 827
North Carolina	790, 020	993, 999
North Dakota	358, 675	251, 642
Porto Rico	201, 385	229, 633
Rhode Island	468, 539	358, 895
South Carolina	527, 652	587, 824
South Dakota	727, 958	587, 562
Vermont	175, 797	217, 021
Wisconsin	3, 261, 135	3, 484, 720
Wyoming	308, 178	336, 917
Unspecified	118, 508	16, 879
	14, 923, 930	16, 150, 106
Exports to foreign countries	2, 798, 364	2, 310, 634
Surplus from cement-producing States	17, 722, 294	18, 460, 740
Consumption in cement-producing States	67, 890, 605	77, 850, 979
Total shipments	85, 612, 899	96, 311, 719

PRICES.

AT FACTORIES.

Average prices of Portland cement sold in bulk at the factories, as reported to the Geological Survey, are shown in the tables of shipments by States and districts during 1919 and in 1920. According to these figures the average prices for the States and groups of States

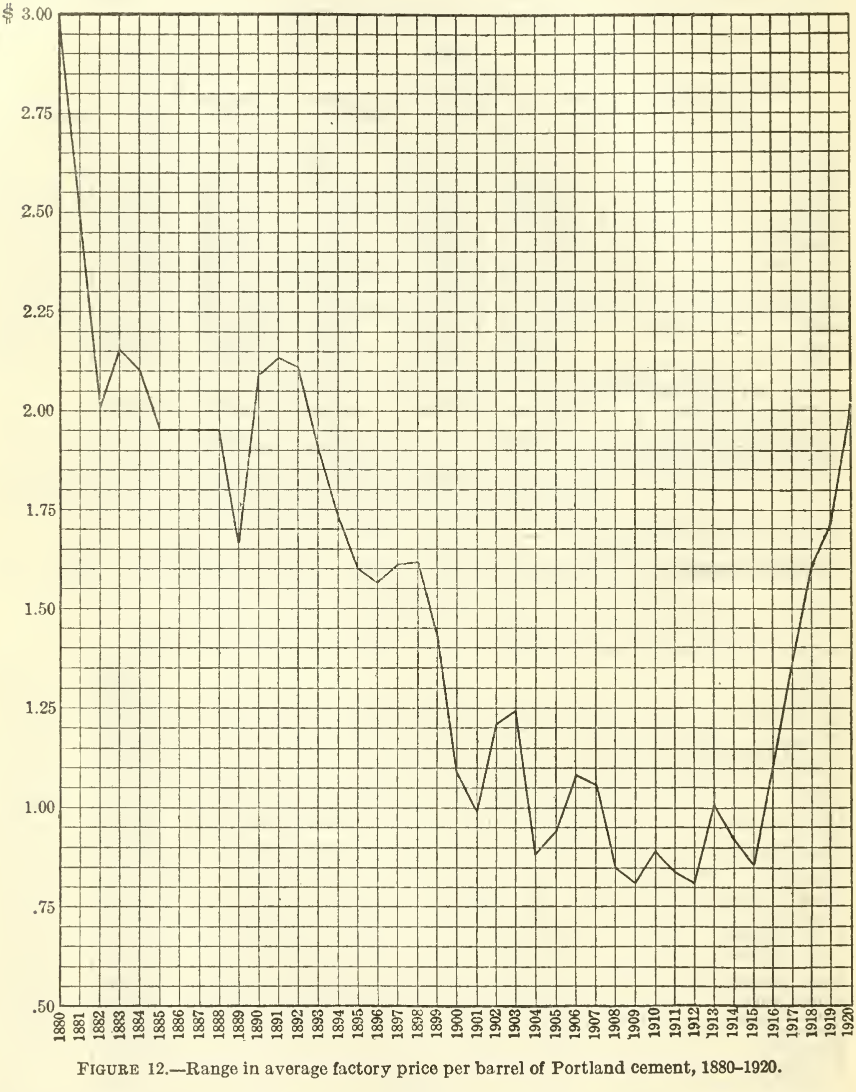


FIGURE 12.—Range in average factory price per barrel of Portland cement, 1880–1920.

appearing in the tables in 1920 ranged between $1.83 a barrel in Indiana and in the Illinois-western Indiana district and $2.46 a barrel in Michigan, as compared with $1.62 in Illinois and the Illinois-western Indiana district and $2.08 in the Oregon-Washington district in 1919. The general average price for the whole country showed an increase of about 18 per cent, and was the highest average price that has been realized since 1892. Average prices in all the districts, as well as in every State except Nebraska and Oregon, showed an increase.

Average factory price per barrel in bulk of Portland cement, 1870–1920.

1870–1880	$3.00	1896	$1.57	1909	$0.813
1881	2.50	1897	1.61	1910	.891
1882	2.25	1898	1.62	1911	.844
1883	2.15	1899	1.43	1912	.813
1884	2.10	1900	1.09	1913	1.005
1885–1888	1.95	1901	.99	1914	.927
1889	1.67	1902	1.21	1915	.860
1890	2.09	1903	1.24	1916	1.103
1891	2.13	1904	.88	1917	1.354
1892	2.11	1905	.94	1918	1.598
1893	1.96	1906	1.13	1919	1.71
1894	1.73	1907	1.11	1920	2.02
1895	1.60	1908	.85		

AT MARKETS.

In comparison with average factory prices the wholesale prices at the principal cities of the United States and at Montreal, Canada, are of much interest. These prices shown in the following table are published monthly quotations derived from the Engineering News-Record based on carload lots for Portland cement in bulk, except at Montreal, where the prices of bags is understood to be included. Quotations for natural cement are given on page 279.

Prices varied more in 1920 than in 1919. During the first five months of 1919 they were generally a little higher than in 1920, but beginning with June, 1920, they maintained higher levels. Here and there an abnormally high and inconsistent quotation is recorded, possibly because of temporary local shortage of cement, and possibly also because of typographic or other errors in the original quotations.

Wholesale quotations of minimum prices of Portland cement in New York City, published by Dun's Review, show prices from 50 cents to $1 a barrel higher than the prices tabulated below, probably because quoted on the basis of smaller quantities.

Wholesale prices of Portland cement per barrel in bulk in carload lots, 1919–20, by months.[a]

City.	January.		February.		March.		April.		May.		June.	
	1919 [b]	1920	1919 [b]	1920	1919 [b]	1920	1919	1920	1919 [b]	1920	1919	1920
Atlanta	......	$2.70	......	$2.70	$3.75	$2.70	$2.60	$2.70	$3.00	$2.70	$2.60	$2.70
Baltimore	......	2.45	......	2.45	......	2.90	......	[c]2.90	......	[c]3.85	......	[c]3.85
Boston	$3.67	2.42	$3.67	2.42	3.57	2.42	2.57	2.42	2.81	2.62	2.42	2.60
Cedar Rapids	3.28	2.18	3.28	2.18	3.28	2.18	2.28	2.18	2.60	2.18	2.18	2.40
Chicago	3.05	2.00	3.05	2.00	3.05	2.00	2.05	2.00	2.36	2.00	2.00	2.15
Cincinnati	2.80	2.35	2.80	2.80	2.80	3.00	......	3.00	......	2.90		2.90
Cleveland	3.32	2.32	3.32	2.32	3.32	2.32	2.32	2.32	2.59	2.32	2.32	2.42
Dallas	2.93	2.03	2.93	2.03	2.93	2.03	2.03	2.15	2.60	2.15	2.03	2.15
Davenport	3.24	2.14	3.24	2.14	3.24	2.14	2.24	2.14	2.55	2.14	2.14	2.33
Denver	3.67	3.12	3.67	3.12	3.67	2.82	2.67	2.82	3.40	2.82	2.67	2.82
Detroit	3.28	2.08	3.28	2.08	3.28	2.08	2.28	2.08	2.55	2.35	2.08	2.28
Duluth	3.20	2.10	3.20	2.10	3.20	2.10	2.20	2.10	2.51	2.10	2.10	2.20
Indianapolis	3.22	2.27	3.22	2.27	3.22	2.27	2.22	2.27	2.59	2.27	2.27	2.42
Jersey City [c]	3.64	2.47	3.64	2.47	3.62	2.47	2.62	2.47	2.50	2.47	2.27	2.47
Kansas City	3.30	2.36	3.30	2.36	3.30	2.36	2.30	2.36	2.59	2.56	2.26	2.56
Los Angeles	3.68	2.78	3.68	2.78	3.68	2.78	2.68	2.78	2.30	3.10	2.78	3.10
Milwaukee	3.16	2.11	3.16	2.11	3.16	2.11	2.16	2.11	2.48	2.11	2.11	2.20
Montreal	......	2.50	......	[b]3.45	......	[b]3.48	......	[b]3.48	......	[b]3.48	2.50	[b]3.48
New Orleans	3.77	2.36	3.77	2.36	3.77	2.36	2.70	2.36	3.10	2.96	2.44	2.96
New York [c]	4.00	2.80	4.00	2.80	3.45	2.80	2.45	2.80	2.59	3.20	2.30	3.30
Peoria	3.16	2.12	3.16	2.12	3.16	2.12	2.16	2.12	2.48	2.12	2.12	2.32
Pittsburgh	3.15	2.05	3.15	2.05	3.15	2.05	2.15	2.05	2.46	2.05	2.05	2.20
St. Louis	3.30	2.20	3.30	2.20	3.30	2.20	2.30	2.20	2.60	2.80	2.20	3.05
St. Paul (Minneapolis)	3.40	2.22	3.40	2.22	3.40	2.22	2.40	2.22	2.68	2.22	2.20	2.22
San Francisco	3.48	2.43	3.48	2.63	3.60	2.63	3.00	2.63	2.80	2.63	2.40	2.63
Seattle	3.33	2.68	3.33	2.68	3.13	2.78	2.13	2.78	3.75	3.03	2.53	3.03
Toledo	3.22	2.12	3.22	2.12	3.22	2.12	2.22	2.12	2.59	2.12	2.12	2.28

City.	July.		August.		September.		October.		November.		December.	
	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920
Atlanta	$2.60	$2.70	$2.50	$2.70	$2.50	$2.70	$2.50	$4.90	$2.50	$3.75	$2.50	$3.75
Baltimore	......	[c]3.85	......	[c]3.28	......	[c]4.56	......	[c]3.59	2.90	[c]4.59	2.90	4.08
Boston	2.42	2.60	2.42	3.32	2.42	3.32	2.42	3.32	2.42	3.32	2.42	3.63
Cedar Rapids	2.18	2.40	2.18	2.40	2.18	2.40	2.18	2.71	2.18	2.71	2.18	2.71
Chicago	2.00	2.15	2.00	2.15	2.00	2.15	2.00	2.35	2.00	2.35	2.00	2.35
Cincinnati	......	2.85	2.90	2.85	2.90	2.85	2.90	2.85	2.35	2.85	2.35	3.32
Cleveland	2.32	2.42	2.32	2.42	2.32	2.42	2.32	2.73	2.32	2.73	2.32	2.73
Dallas	2.03	2.15	2.03	2.15	2.03	2.92	2.03	2.92	2.03	3.85	2.03	3.85
Davenport	2.14	2.36	2.14	2.36	2.14	2.36	2.14	2.67	2.14	2.67	2.14	2.67
Denver	2.67	2.82	2.67	3.80	2.67	3.80	2.67	3.25	3.12	3.25	3.12	3.25
Detroit	2.08	3.00	2.08	3.00	2.08	3.00	2.08	2.71	2.08	2.71	2.08	2.78
Duluth	2.10	2.20	2.10	2.20	2.10	2.20	2.10	2.35	2.10	2.35	2.10	2.35
Indianapolis	2.27	2.42	2.27	2.42	2.27	2.42	2.27	2.57	2.27	2.61	2.27	2.61
Jersey City [c]	2.27	2.97	2.27	3.22	2.27	4.25	2.27	4.39	2.47	3.55	2.47	3.55
Kansas City	2.57	2.76	2.26	2.76	2.26	2.76	2.26	2.76	2.26	2.76	2.26	2.76
Los Angeles	2.78	3.10	......	3.10	2.78	3.10	2.78	3.10	2.78	3.10	2.78	3.10
Milwaukee	2.11	2.20	2.11	2.20	2.11	2.20	2.11	2.59	2.11	2.59	2.11	2.59
Montreal	2.50	[b]3.00	......	[b]3.00	......	[b]3.00	......	[b]3.00	2.50	[b]3.00	2.50	[b]3.52
New Orleans	2.36	3.52	2.36	3.24	2.36	3.52	2.36	5.00	2.36	4.60	2.36	4.60
New York [c]	2.30	3.80	2.30	4.10	2.30	{4.22– 4.25}	2.30	4.10	2.80	4.10	2.80	4.10
Peoria	2.12	2.32	2.12	2.32	2.12	2.32	2.12	2.63	2.12	2.63	2.12	2.63
Pittsburgh	2.05	2.20	2.05	2.20	2.05	2.20	2.05	2.42	2.05	2.42	2.05	2.42
St. Louis	2.20	2.65	2.20	2.85	2.20	2.85	2.20	3.00	2.20	3.45	2.20	3.45
St. Paul (Minneapolis)	2.20	2.22	2.20	2.42	2.20	3.30	2.20	3.42	2.22	3.30	2.22	3.50
San Francisco	2.40	2.88	2.43	2.88	2.43	2.88	2.43	3.09	2.43	3.09	2.43	3.09
Seattle	2.53	3.03	2.53	3.03	2.53	3.03	2.53	3.12	2.68	3.12	2.68	3.12
Toledo	2.12	2.28	2.12	2.28	2.12	2.28	2.12	2.71	2.12	2.71	2.12	2.71

[a] Prices quoted are without bags, unless otherwise designated.
[b] Includes bags. Bag charge, is sometimes quoted as 15 cents; at other times as 25 cents.
[c] Delivered. New York prices include delivery to Manhattan, the Bronx, or Brooklyn.

MANUFACTURING CONDITIONS.

PLANTS.

Portland cement was manufactured at 117 plants in 1920 as compared with 111 plants in 1919. Four plants that were formerly active manufactured no cement during the year—one each in California, Kansas, New Jersey, and Virginia. Two plants, one in New York and the other in Oregon, resumed production after a period of inactivity. The Gulf States Portland Cement Co. produced Portland cement in a newly rehabilitated plant at Spocari, Ala. This plant employs the dry process, uses chalk, limestone, and clay, burns coal, and is equipped with five 6½ by 60 foot kilns, and the daily clinker capacity is reported to be 1,000 barrels.

KILNS.

The total number of rotary kilns reported in plants that operated in 1920 was 753, compared with 720 in 1919. The data reported to the Survey on kilns and kiln capacities have not been consistent from year to year, but it is hoped to arrive at a better basis in the near future.

Lengths of rotary cement kilns in active plants in the United States, 1917–1920.

Length (feet).	Number of kilns.				Length (feet).	Number of kilns.			
	1917	1918	1919	1920		1917	1918	1919	1920
40 to 60	108	77	71	74	126 to 149	65	63	63	63
61 to 99	94	90	87	87	150 to 199	73	63	66	73
100 to 109	84	105	98	98	200 to 260		15	19	23
110	83	65	55	66					
120	88	88	95	97		789	749	720	753
125	194	183	166	172					

KILN FUELS.

Portland cement burned by different fuels in 1919 and 1920.

Fuel.	1919				1920			
	Number of plants.	Number of kilns.	Barrels of cement.	Percentage of total.	Number of plants.	Number of kilns.	Barrels of cement.	Percentage of total.
Coal	90	596	65,877,185	81.6	96	629	81,265,667	81.2
Coal and crude oil	3	32	6,985,271	8.6	1	24	6,676,029	6.7
Coal and gas	2	9			1	6		
Crude oil	14	73	6,634,775	8.2	16	79	9,495,798	9.5
Crude oil, coal and gas	1	5	1,280,704	1.6	2	9	2,585,751	2.6
Natural gas	1	5			1	6		
	111	720	80,777,935	100.0	117	753	100,023,245	100.0

CAPACITY.

The total annual manufacturing capacity of all the plants, either active or only temporarily closed, according to manufacturers' reports, increased about 9.2 per cent. According to these figures the total production of cement in 1920 (100,023,245 barrels) was about 68 per cent of the total capacity, whereas the production in 1919 represented about 60 per cent of the apparent total capacity in that year.

From the reported data, the following table of estimated capacities by districts has been prepared, and these figures, compared with the respective figures of production, give the apparent percentage of capacity utilized in 1919 and 1920. The reported capacity increased in all but three of the groups of States. The decrease in one of these groups was due to the dropping from the lists of a plant that has been idle for several years.

Portland cement manufacturing capacity of the United States, by commercial districts, 1919 and 1920.

District.	Estimated capacity (barrels).		Percentage of capacity utilized.	
	1919	1920	1919	1920
Lehigh district (eastern Pennsylvania and western New Jersey)	38,340,000	40,077,000	59.3	63.4
New York	8,450,000	8,320,000	51.9	70.7
Ohio and western Pennsylvania	8,850,000	10,626,000	74.6	69.1
Michigan and northeastern Indiana	7,923,000	8,211,000	63.7	65.5
Southern Indiana and Kentucky	4,450,000	4,275,000	56.0	77.0
Illinois and western Indiana	14,162,000	19,170,000	64.2	68.4
Maryland, Virginia, and West Virginia	4,700,000	4,550,000	52.5	66.9
Tennessee, Alabama, and Georgia	4,300,000	5,500,000	63.8	52.5
Iowa, Missouri, and Minnesota	13,975,000	14,636,000	71.8	84.8
Nebraska, Kansas, Oklahoma, and central Texas	10,390,000	11,700,000	59.2	69.9
Rocky Mountain States (Colorado, Utah, Montana, and western Texas)	4,285,000	4,585,000	65.6	82.1
Pacific Coast States (California, Washington, and Oregon)	14,267,700	14,750,000	43.5	63.2
	134,092,700	146,400,000	60.2	68.3

RECOVERY OF POTASH.

The production of potash salts as a by-product of the manufacture of Portland cement was reported by 8 cement plants—3 of them in California, 1 in Maryland, 1 in Missouri, 1 in New York, 1 in Ohio, and 1 in Pennsylvania. In 1920 the quantity of potash (K_2O) produced by cement plants was 1,147 short tons, valued at $239,344, compared with 1,258 short tons, valued at $270,505 in 1919.[4]

NATURAL AND PUZZOLAN CEMENTS.

Since 1916 only one manufacturer has reported an output of puzzolan or slag-lime cement, and in order that this quantity may be included in the cement totals for the United States without revealing confidential information it is added to the statistics of natural cement. The puzzolan cement plant is at Birmingham, Ala.

The natural cement and puzzolan cement in the United States marketed during 1920 showed an increase of more than 45 per cent in quantity and of more than 97 per cent in value. The average price of these cements per barrel at the mills in 1920 was $1.499, as compared with $1.104 in 1919. It is of interest to compare these prices with those of Portland cement in 1920 and 1919, which were, respectively, $2.02 and $1.71.

Natural cement was produced in 1920 in eight plants, distributed in seven States—near Rosendale, N. Y.; Siegfried, Pa; Lisbon, Ohio; Speeds, Ind.; Utica, Ill.; Fort Scott, Kans.; and Austin and Mankato, Minn.

The recent increase in the output of natural cement may be ascribed to the development of a cement manufactured especially for use as mortar. One of the natural cements is marketed almost exclusively for use in the walls of safes.

The next table gives such statistics as may be presented concerning the output of natural and puzzolan cements in 1919–1920, and the second table gives quotations of wholesale prices of natural cement in lots of 500 barrels or more, at six widely separated cities in the United States. The quotations were compiled from the Engineering News-Record, 1920.

[4] For production of potash salts see the chapter on potash in Mineral Resources for 1920.

Natural and puzzolan cement shipped, 1919 and 1920.

State.	1919			1920		
	Producing plants.	Quantity (barrels).	Value.	Producing plants.	Quantity (barrels).	Value.
Alabama [a]	1			1		
Illinois	1	226,671	$294,463	1	425,108	$631,340
Indiana	1			1		
Kansas	1			1		
Minnesota	2			2		
New York [b]	....	301,918	289,091	1	342,373	519,550
Ohio	1			1		
Pennsylvania	1			1		
	8	528,589	583,554	9	767,481	1,150,890

[a] Puzzolan only. [b] New York reported no shipments in 1919.

Wholesale prices of natural cement per barrel, 1919-20, by months.[a]

City.	January.		February.		March.		April.		May.		June.	
	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920
Atlanta (Magnolia)	......	$1.90	......	$1.90	......	$1.90	......	$1.90	......	$1.90	......	$1.90
Boston (Rosendale)	......	......	......	......	......	......	......	......	......	......	......	2.35
Cincinnati (Louisville)	[b]$1.80	1.35	[b]$1.80	1.35	$1.50	2.25	$1.50	2.25	$1.50	2.85	$1.50	2.85
Kansas City (Fort Scott)	[b]1.70	1.60	[b]1.70	1.70	1.30	1.75	1.30	1.75	1.30	1.60	1.40	1.60
Minneapolis-St. Paul:												
Austin	[b]1.93	1.50	[b]1.93	1.50	1.63	1.50	1.63	1.50	1.55	1.50	1.45	1.50
Rosendale	......	......	......	......	......	......	......	......	......	......	......	......
New Orleans	[b]3.52	2.52	[b]3.52	2.52	2.52	2.52	2.52	3.36	2.52	3.36	2.52	3.36

City.	July.		August.		September.		October.		November.		December.	
	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920
Atlanta (Magnolia)	......	$1.90	......	$1.90	......	$1.90	$1.85	$1.90	$1.85	$1.90	$1.85	$1.90
Boston (Rosendale)	......	2.35	......	2.35	......	2.35	......	2.35	......	2.35	......	2.35
Cincinnati (Louisville)	$1.50	2.85	$1.50	2.85	$1.50	2.85	1.35	2.85	1.35	2.85	1.35	2.85
Kansas City (Fort Scott)	1.40	1.60	1.40	1.60	1.40	1.60	1.40	1.60	1.50	1.60	1.50	1.60
Minneapolis-St. Paul:												
Austin	1.45	1.50	1.45	1.50	......							......
Rosendale	......	......	......	......	1.45	2.60	1.45	3.00	1.45	3.00	1.45	1.85
New Orleans	2.52	3.36	2.52	3.36	2.52	3.36	2.52	3.36	2.52	3.36	2.52	3.36

[a] Prices quoted are for 500 barrels, or over, f. o. b., exclusive of bags—unless otherwise designated.
[b] Including bags.

FOREIGN TRADE IN CEMENT.

EXPORTS.

In 1920 the hydraulic cement exported to foreign countries, including the Philippines and the Panama Canal Zone, most of it Portland cement, increased in quantity more than 21 per cent and in value about 34 per cent. The quantity exported in 1920 was nearly 3 per cent of the total production of hydraulic cement in that year.

The exports go mainly to South America, which received more than 1,250,000 barrels; the West Indies, which received more than 1,180,000 barrels; and Central America, including Mexico, to which were sent more than 400,000 barrels, leaving about 100,000 barrels for Canada, Europe, Africa, Asia, and Oceania. The export trade fluctuates exceedingly from year to year. The noteworthy increases in 1920 were in exports to Chile, Colombia, Cuba, the Dominican Republic, and Mexico.

Hydraulic cement exported from the United States in 1919 and 1920, by countries.

Destination.	1919		1920	
	Quantity (barrels).	Value.	Quantity (barrels).	Value.
Argentina	382,181	$1,139,984	271,844	$861,217
Azores and Madeira Islands			600	1,800
Belgian Kongo	2,251	7,153		
Belgium	226	784	495	1,546
Bermuda	580	1,812	2,234	8,514
Bolivia	9,921	31,470	8,779	28,380
Brazil	579,863	1,757,723	501,413	1,555,124
British East Africa			30	120
British East Indies:				
British India	764	2,403	5,590	17,094
Straits Settlements	82	321	884	3,798
British Guiana	15,544	45,358	7,452	25,529
British Honduras	1,219	3,850	2,676	8,625
British Oceania:				
Australia	296	1,276	4,689	20,758
New Zealand	107	576	735	3,809
Other	240	586	1,106	5,047
British South Africa	703	1,906	112	433
British West Africa	18,235	55,955	4,414	12,678
British West Indies:				
Barbados	1,419	4,405	503	1,962
Jamaica	18,279	54,334	33,914	132,291
Trinidad and Tobago	17,965	56,239	16,310	57,135
Other	7,623	23,671	24,742	82,486
Bulgaria			1,500	4,545
Canada	12,415	42,969	31,483	125,834
Canary Islands	1,600	4,500	2,710	8,260
Chile	59,700	198,303	97,609	314,977
China	60	290	902	4,710
Colombia	75,266	242,115	160,567	557,012
Costa Rica	9,371	31,732	14,718	55,533
Cuba	561,671	1,675,022	912,698	3,036,916
Dominican Republic	58,273	196,087	146,687	527,363
Dutch East Indies	2,299	11,434	9,703	41,810
Dutch Guiana	3,242	10,303	7,181	22,318
Dutch West Indies	6,145	20,995	16,181	56,934
Ecuador	17,816	54,604	27,443	85,548
England	4,192	12,252	2,017	11,062
France	6,667	21,091	135	400
French Africa	7,355	24,420	536	1,663
French Guiana	3,182	9,728	4,507	15,313
French Oceania	162	591	2,129	8,554
French West Indies	11,879	38,333	11,343	38,148
Greece	179	819	1,600	5,045
Guatemala	24,659	86,699	20,345	78,884
Haiti	27,924	84,956	18,083	66,341
Honduras	11,231	34,435	28,701	112,080
Hongkong	74	288	40	248
Iceland and Faroe Islands	1	4		
Ireland			80	478
Italy	100	407		
Japan	575	2,228	1,268	5,178
Kamerun, etc	90	275	120	360
Liberia	559	1,914	1,590	4,346
Madagascar	11,568	39,300		
Mexico	135,056	433,417	207,750	823,243
Miquelon, Langley, and St. Pierre Islands	164	589		
Netherlands	30	153	118	609
Newfoundland and Labrador	5,563	15,557	253	780
Nicaragua	10,593	37,014	9,627	37,536
Norway	51	288	386	1,640
Oceania (other Oceania)			439	1,857
Panama	117,445	288,678	118,014	354,428
Paraguay	7,650	22,735		
Peru	120,335	368,370	107,466	335,065
Philippine Islands	346	1,422	26,300	96,872
Portugal			101	487
Portuguese Africa	5,705	17,741	700	3,015
Salvador	21,540	75,296	32,444	127,013
Scotland			135	541
Siam			18	100
Spain	343	1,298	873	4,012
Turkey in Asia			312	1,050
Turkey in Europe	25	96	2,000	6,060
Uruguay	24,374	94,252	15,904	55,765
Venezuela	35,401	109,526	46,853	150,739
Virgin Islands of the United States	3,199	11,057	5,716	26,351
	2,463,573	7,513,389	2,985,807	10,045,369

Hydraulic cement exported from the United States, 1913–1920.

Year.	Quantity (barrels).	Value.	Percentage of total shipments.	Year.	Quantity (barrels).	Value.	Percentage of total shipments.
1913	2,964,358	$4,270,666	3.3	1917	2,586,215	$5,328,536	2.8
1914	2,140,197	3,088,809	2.5	1918	2,252,446	5,912,166	3.2
1915	2,565,031	3,361,451	2.9	1919	2,463,573	7,513,389	2.9
1916	2,563,976	3,828,231	2.7	1920	2,985,807	10,045,369	3.1

IMPORTS.

The following table shows the quantities of foreign cement imported for consumption in the United States during the years 1913 to 1920, inclusive. The quantities given include all kinds of hydraulic cement. Some of the imported cement evidently was not manufactured in the country from which it came to the United States.

The large increase in imports in 1920 is noteworthy, and it is significant that most of these imports came from Portland cement mills in Canada. The decrease in average price per barrel is explained also by the fact that the price of Canadian cement is lower than most of that imported from Europe.

Foreign cement imported for consumption, 1913–1920.

Year.	Quantity (barrels).[a]	Year.	Quantity (barrels).[a]
1913	85,470	1917	2,323
1914	120,906	1918	305
1915	42,218	1919	8,931
1916	1,836	1920	524,604

[a] Barrels of 376 pounds in 1920 and 380 pounds in earlier years.

Roman, Portland, and other hydraulic cement imported into the United States in 1920, by countries.

[General imports.]

Country.	Quantity (barrels).	Value.
Canada	516,332	$1,214,160
Denmark	211	1,400
England	384	1,984
France	18	77
Germany	1,033	5,900
Mexico	594	1,638
Poland and Danzig	2,459	4,919
Virgin Islands of the United States	106	836
Country not given	[a] 3,467	[a] 23,815
	524,604	1,254,729

[a] White, nonstaining cement.

PORTLAND CEMENT IN CANADA.

The following statement is quoted from the preliminary report on the mineral production of Canada in 1920, issued by the Canada Department of Mines, Mines Branch, February, 1921:

Cement.—The total quantity of cement sold from Canadian mills in 1920 was 6,651,980 barrels, valued at $14,798,070, or an average of $2.22 per barrel, as compared with sales in 1919 of 4,995,257 barrels, valued at $9,802,433, or an average of $1.96 per barrel, showing an increase in quantity of 1,656,723 barrels, or 33 per cent, and an increase in total value of $4,995,637, or 51 per cent.

The total quantity of cement made in 1920 was 6,498,550 barrels, as compared with 4,613,588 barrels made in 1919, an increase of 1,884,962 barrels, or 40.8 per cent.

Stocks of cement on hand January 1, 1920, were 1,089,603, and at the end of December this had been reduced to 936,173.

The exports of cement in 1920 were valued at $2,193,626, as against exports in 1919, valued at $465,954. In 1919 the value of cement exports greatly exceeded the imports for the first time. In 1920 the quantity is not reported for the first three months but is given as 2,701,584 hundredweight for the last nine months. At the average price of 74 cents per hundredweight given for the last nine months the estimated quantity exported during 1920 would be 2,964,360 hundredweight or 846,960 barrels of 350 pounds each.

The total imports of cement in 1920 were 115,370 hundredweight, equivalent to 32,963 barrels of 350 pounds each, valued at $112,466, or an average of $3.41 per barrel, as compared with imports of 14,066 barrels, valued at $51,314, or an average of $3.65 per barrel, in 1919.

The total consumption of cement in 1920 was therefore about 5,837,983 barrels, as compared with a consumption of 4,776,346 barrels in 1919, an increase of 1,061,637 barrels, or 22 per cent.

In view of the large imports of Portland cement from Canada to the United States in 1920 the following information concerning the Portland cement companies in Canada may be of interest:

Portland cement companies in Canada, 1921.

[From directory of cement, gypsum, and lime manufacturers, Chicago, Ill., 1921.]

Name.	Office.	Works.	Daily capacity (barrels).
British Columbia Cement Co. (Ltd.).	Belmont House, Victoria, British Columbia.	Bamberton and Tod Inlet, British Columbia.	5,000
Canada Cement Co. (Ltd.)	Herald Building, Montreal, Quebec.	Montreal, East Montreal, and Hull, Quebec; Belleville, Marlbank, Lakefield, Port Colborne and Shallow Lake, Ontario; Blairmore, Calgary, Sandstone, Exshaw, and Medicine Hat, Alberta; Winnipeg, Manitoba.	36,000
Edmonton Cement Co. (Ltd.)	McLeod Building, Edmonton, Alberta.	Marlboro, Alberta	1,500
Hanover Portland Cement Co. (Ltd.).	Hanover, Ontario	Hanover	1,200
Kirkfield Portland Cement Co. (Ltd.).	34 Victoria Street, Toronto, Ontario.	Raven Lake, Ontario	(a)
National Portland Cement Co. (Ltd.).	Durham, Ontario	This company is liquidating and has discontinued the manufacture of cement.	
Ontario Cement Co. (Ltd.)	Brantford, Ontario	Beachville and Blue Lake, Ontario.	1,200
St. Mary's Cement Co. (Ltd.)	49 Wellington Street, East Toronto, Ontario.	St. Mary's, Ontario	2,800
United Portland Cement Co. (Ltd.).	Brantford, Ontario		(a)

a No report.

MICA.

By B. H. Stoddard.

PRODUCTION.

The production of mica in the United States in 1920 was 13,129,480 pounds, valued at $713,989, the largest quantity recorded and the highest value, except for 1917 and 1918. The production came from 10 States—North Carolina, New Hampshire, Virginia, Alabama, Georgia, Texas, South Dakota, New Mexico, Idaho, and Colorado, named in order of value of mica sold. The quantity of sheet mica shown in the tables should not be directly compared with that of any previous year because the figures for 1920 represent uncut sheet only. The small quantity and value of mica reported as cut sheet have been converted into their approximate equivalents in uncut sheet. The figures represent as nearly as possible the value of the mica at or near the mine's mouth and not after it has been hauled in and prepared for the consumer's use. Mica prepared for consumers' use brings a much higher price; in 1920, according to reports received from several companies, the prices ranged from 1½ to 2 and occasionally 3 times as much as that of the uncut sheet mica—that is, the total value would be from $800,000 to $1,640,000 instead of $546,972. This difference in value between uncut and cut mica does not, however, represent the net profit to the dealer, as it is mostly accounted for by the cost of transportation from mine to factory, cutting and stamping, delivery to consumer, and ordinary overhead expenses.

The quantity and value of the scrap mica were higher than in any previous year. The production shows an increase of about 76 per cent in quantity and of about 188 per cent in value over that of 1919.

The figures for sheet mica shown in the following table represent uncut sheet and punch mica. A very small quantity of splittings is also included as uncut sheet.

Mica sold in the United States, 1913–1920.

Year.	Sheet mica.		Scrap mica.		Total.	
	Quantity (pounds).	Value.	Quantity (short tons).	Value.	Quantity (short tons).	Value.
1913	1,700,677	$353,517	5,322	$82,543	6,172	$436,060
1914	556,933	278,540	3,730	51,416	4,008	329,956
1915	553,821	378,259	3,959	50,510	4,236	428,769
1916	865,863	524,485	4,433	69,906	4,866	594,391
1917	1,276,533	753,874	3,429	52,908	4,067	806,782
1918	1,644,200	731,810	2,292	33,130	3,114	764,940
1919	1,545,709	483,567	3,258	58,084	4,031	541,651
1920	a1,683,480	a546,972	5,723	167,017	a6,565	a713,989

a The figures for quantity and value of sheet mica in 1920 are not strictly comparable with those of any previous year, for the reason that they represent uncut sheet mica exclusively. In previous years the totals have included some cut sheet mica, and the cutting has the twofold effect of reducing the quantity and of increasing the value.

The annual production of mica, by States, for the years 1913 and 1915–1920 is shown in the following table. Where less than three producers reported output, the figures are omitted, so that no individual production is disclosed. For some of the years, therefore, the figures of production may not be given.

Mica sold by chief producing States, 1913 and 1915–1920.

State and year.	Sheet mica.			Scrap mica.		Total.	
	Quantity.		Value.	Quantity.	Value.	Quantity.	Value.
North Carolina:	*Pounds.*	*Short tons.*		*Short tons.*		*Short tons.*	
1913	803,462	402	$230,674	2,729	$37,239	3,131	$267,913
1915	281,074	141	266,650	2,840	33,943	2,981	300,593
1916	546,553	273	380,700	2,755	41,880	3,028	422,580
1917	643,476	322	543,207	2,180	34,134	2,502	577,341
1918	941,200	471	460,450	1,046	12,930	1,517	473,380
1919	1,021,306	511	331,498	1,639	32,338	2,150	363,836
1920	1,084,946	542	405,654	2,823	91,653	3,365	497,307
New Hampshire:							
1913	731,478	366	65,765	692	13,906	1,058	79,671
1915	96,685	48	59,414	516	7,557	564	66,971
1916	125,502	63	64,386	724	10,853	787	75,239
1917	472,519	236	159,822	680	9,229	916	169,051
1918	376,900	188	106,200	530	7,040	718	113,240
1919	235,724	118	90,915	738	13,356	856	104,271
1920	284,862	142	83,811	435	12,877	577	96,688
Virginia:							
1913	4,585	2	4,578	30	572	32	5,150
1915	10,808	5	9,590	63	828	68	10,418
1916	39,978	20	18,251	182	2,703	202	20,954
1917	68,558	34	22,831	253	2,709	287	25,540
1918	78,500	39	46,200	404	4,280	443	50,480
1919	(a)	(a)	(a)	578	7,811	(a)	(a)
1920	179,339	90	26,189	(a)	(a)	(a)	(a)
Alabama:							
1913	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1915	8,400	4	5,545	23	395	27	5,940
1916	14,132	7	4,955	65	660	72	5,615
1917	18,476	9	3,528	12	280	21	3,808
1918	11,800	6	3,150	....	....	6	3,150
1919	(a)	(a)	(a)	....	....	(a)	(a)
1920	81,458	41	16,401	222	5,234	263	21,635
Georgia:							
1913	....	....	....	....	....	....	....
1915	4,949	2	635	....	....	2	635
1916	16,037	8	2,094	....	....	8	2,094
1917	30,534	15	12,141	26	1,400	41	13,541
1918	208,200	104	77,300	40	2,750	144	80,050
1919	47,018	24	19,682	51	778	75	20,460
1920	50,095	25	13,692	101	3,015	126	16,707
South Dakota:							
1913	19,225	10	2,206	591	10,403	601	12,609
1915	25,992	13	8,230	179	2,684	192	10,914
1916	115,392	58	49,298	527	10,472	585	59,770
1917	37,523	19	5,975	272	5,033	291	11,008
1918	(a)	(a)	(a)	(a)	(a)	(a)	(a)
1919	....	....	....	(a)	(a)	(a)	(a)
1920	....	....	....	(a)	(a)	(a)	(a)

[a] Figures may not be published, as there were less than three producers.

Domestic sheet mica (uncut) sold in the United States in 1920.

State.	Punch.		Larger than punch.[a]		Total.	
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	Quantity (pounds).	Value.
North Carolina	723,634	$70,155	361,312	$335,499	1,084,946	$405,654
New Hampshire	168,164	25,318	116,698	58,493	284,862	83,811
Virginia	152,126	8,858	27,213	17,331	179,339	26,189
Alabama	65,506	5,599	15,952	10,802	81,458	16,401
Georgia	42,000	5,620	8,095	8,072	50,095	13,692
Other States	(b)	(b)	(b)	(b)	2,780	1,225

[a] Includes in North Carolina a small quantity of splittings. [b] Figures may not be given.

The following table shows the production of uncut sheet mica by sizes, based on an aggregate of about 74 per cent of the total production of sheet mica. It was not possible to classify the total production of uncut sheet mica in this way, for the reason that some of the reports received do not give sufficient detailed information. The figures include all qualities from clear to stained.

Uncut sheet mica sold in the United States in 1920, by sizes.

Size.	Pounds.	Percentage.	Percentage, omitting punch.
Punch	964,505	77	....
1½ by 2 inches	133,747	11	47
2 by 2 inches	73,287	6	26
2 by 3 inches	44,826	4	16
3 by 3 inches	13,768	1	5
3 by 4 inches	8,014	1	2
Larger sizes	11,492		4
Splittings	(a)	(a)	(a)
	1,249,639	100	100

a Small quantity which may not be shown, as there were less than 3 producers.

PRICES.

Information received from several of the largest mica companies and quotations submitted by producers indicate that prices of mica in 1920 were comparatively high during the first half of the year but showed a tendency to drop during the last half. One company stated that the competition from the greatly increased imports in 1920, especially in the small sizes, tended to lower materially the value of small mica to the domestic miner. Several of the larger dealers reported that they were not buying any domestic mica on account of the high prices which prevailed. The price per ton of scrap mica was the highest on record, the average being $29, as against $18 in 1919.

Total value and average price of domestic mica marketed in the United States, 1913–1920.

Year.	Total value.	Average price per short ton of all mica mined.	Average price per pound of sheet mica.[a]
1913	$436,060	$71	$0.21
1914	329,956	82	.50
1915	428,769	101	.68
1916	594,391	122	.61
1917	806,782	198	.59
1918	764,940	246	.45
1919	541,651	134	.31
1920	713,989	109	.32

a 1913–1918 represent average prices of cut and uncut sheet mica as reported by producers. 1920 represents the average price in terms of uncut sheet mica only.

The following table is based in part on quotations received from the producers:

Average prices per pound paid in the South for rough-trimmed sheet mica of good quality, split and sorted to cut to the sizes indicated, 1917–1920.

Size (in inches).	1917	1918	1919	1920
Punch	$0.055	$0.07	$0.08	$0.10
1½ by 2	.40	.55	.55	.51
2 by 2	.70	.90	.95	.84
2 by 3	1.10	1.30	1.35	1.25
3 by 3	1.55	1.75	1.85	2.04
3 by 4	1.85	2.05	2.15	2.37
3 by 5	2.15	2.45	2.55	2.95
4 by 6	3.10	3.45	3.50	3.85
6 by 6	3.80	3.90	(a)	4.00
6 by 8	4.70	6.00		5.00
8 by 10	7.50	8.00		7.00

a Prices exceedingly variable.

CONSUMPTION.

The figures of imported mica do not separate the cut sheet and splittings, and, moreover, as only the value of such mica is given, the quantity has had to be estimated for the following table. The export figures represent the total mica exported and are also in part estimated.

Sheet mica consumed in the United States, 1918–1920, in short tons.

Year.	Production.	Imports.		Exports (estimated).	Apparent consumption.	Percentage of consumption represented by production.
		Sheet (unmanufactured).a	Splittings (estimated).			
1918	822	370	914	40	2,066	40
1919	773	362	1,049	60	2,124	36
1920	b 842	649	1,584	150	2,925	29

a Uncut trimmed sheets.
b Figures represent quantity of uncut sheet only. Figures for 1918 and 1919 include some cut sheet.

Value of sheet mica consumed in the United States, 1918–1920.

Year.	Production.	Imports.		Exports.	Apparent consumption.	Percentage of consumption represented by production.
		Sheet (unmanufactured).a	Splittings (estimated).			
1918	$731,810	$658,576	$758,000	$74,529	$2,073,857	35
1919	483,567	726,532	760,000	109,348	1,860,751	26
1920	b 546,972	1,177,943	1,939,000	316,169	3,347,746	16

a Uncut trimmed sheets.
b Figures represent value of uncut sheet only. Figures for 1918 and 1919 include some cut sheet.

Mica splittings consumed in the United States, 1918–1920, in short tons.

Origin.	1918	1919	1920
India	584	608	1,077
Canada	329	437	506
United States	64	13	33
South America	1	4	1
	978	1,062	1,617

IMPORTS AND EXPORTS.[1]

The imports of sheet mica in 1920, including cut mica, uncut mica, and splittings, showed the highest value ever reported. Imports of mica were received from 18 countries.

Mica imported for consumption in the United States, 1917–1920.

Year.	Sheet.			Ground.		Total.
	Unmanufactured.[a]		Cut and splittings.[b]			
	Quantity.	Value.	Value.	Quantity (pounds).	Value.	Value.
1917	656,391	$414,823	$1,014,181	92,963	$1,044	$1,430,048
1918	741,429	658,576	880,906	11,587	1,647	1,541,129
1919	723,713	726,532	762,228	62	9	1,488,769
1920	1,298,537	1,177,943	2,011,434			3,189,377

[a] Essentially uncut trimmed sheets.
[b] Includes the Madras square-shaped uncut sheets.

Mica was exported to 49 countries, but more than 75 per cent of it went to England, Canada, Belgium, Japan, Cuba, and Newfoundland and Labrador, in the order named. The total value of the mica exported in 1920 was much greater than for any previous year, being $316,169, as contrasted with $109,348 in 1919; $74,529 in 1918; $74,485 in 1917; $78,671 in 1916, and much smaller amounts in previous years.

[1] The statistical information on imports and exports given in this report has been compiled, as in earlier reports, by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce.

NATURAL-GAS GASOLINE.

By E. G. Sievers.

The term "natural-gas gasoline," as used by the United States Geological Survey, means gasoline recovered by all methods from both "wet" and "dry" natural gas and is synonymous with "casing-head gasoline" and "natural gasoline," terms used in the trade.

PRODUCTION.

The output of natural-gas gasoline in 1920 exceeded that in 1919 by 33,208,896 gallons, or 9 per cent, as compared with an increase of 24 per cent in 1919. The average daily production in 1920 was 1,054,093 gallons, as compared with 963,110 gallons in 1919.

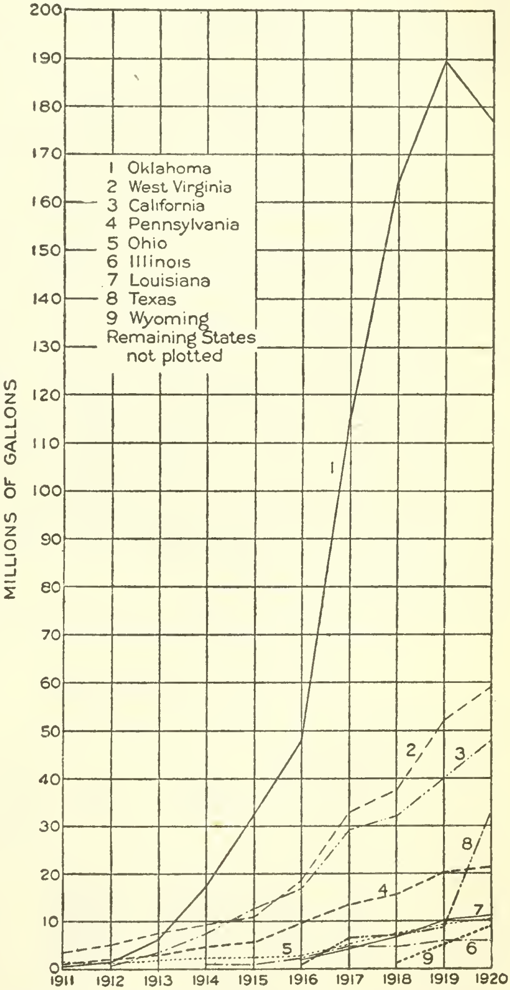


Figure 13.—Natural-gas gasoline produced in the nine leading States, 1911–1920.

Natural-gas gasoline is recovered from natural gas by two distinct methods—the compression method, which includes also refrigeration, and the absorption method. About 73 per cent of the output in 1920 was produced at the compression plants and the remainder at the absorption plants. The compression method is applied to the "wet" gas; the absorption method is used in treating "dry" gas, which contains only a small proportion of gasoline vapors—less than 1 gallon in 1,000 cubic feet of gas. Dry gas can not be treated successfully by the compression method.

The gasoline produced in the United States in 1920 amounted to 5,134,867,763 gallons, of which 7 per cent, according to statistics compiled by the Bureau of Mines, was obtained from natural gas. The annual output of natural-gas gasoline averages between 7 and 8 per cent of the total gasoline produced in the country. This production is small in itself, but as natural-gas gasoline has a high volatility it is blended with refinery products, such as naphtha, and therefore provides a means of utilizing these materials, which otherwise would have less value.

The value of the natural-gas gasoline produced in 1920, as computed from the prices received at the plants, showed an increase of $7,591,359. The gasoline produced by the compression method increased $4,709,503 in value, and that produced by the absorption method increased $2,881,856. The average prices were a trifle higher than in 1919. (See fig. 14, p. 295.)

The volume of natural gas treated in 1920 was 16,026,989,000 cubic feet greater than that treated in 1919. The volume treated at the compression plants was 4,781,530,000 cubic feet less than in 1919, but as the total for these plants in 1919 included 12,194,335,000 cubic feet of gas treated at combination plants first by compression and then by absorption and the gasoline from this gas was credited to absorption plants, the volume of gas treated at compression plants in 1920 and represented by gasoline credited to these plants was really an increase of 7,412,805,000 cubic feet. At the absorption plants the volume of gas used in 1920 exceeded that used in 1919 by 8,614,184,000 cubic feet, and the average yield of gasoline per thousand cubic feet of gas for all plants was 0.05 gallon greater.

The output of natural-gas gasoline in 1920 was made by the same 12 States as in 1919. The outstanding feature was the remarkable gain by Texas, which increased its production 253 per cent. The output increased in seven other States by the following percentages: Wyoming, 56; Kansas, 32; California, 19; Ohio, 14; West Virginia, 13; Louisiana, 5; Pennsylvania, 4. The output decreased in Kentucky, 12 per cent; New York, 10 per cent; Oklahoma, 6 per cent; and Illinois, 0.1 per cent.

Natural-gas gasoline produced in the United States, 1916–1920.

Year.	Number of operators.	Number of plants.	Gasoline produced.			Gas used (estimated).		
			Quantity (gallons).	Value.	Average price per gallon (cents).	Volume (M cubic feet).	Value.[a]	Average yield of gasoline per M cubic feet (gallon).
1916	460	596	103,492,689	$14,331,148	13.8	208,705,023	$14,609,300	0.50
1917	750	886	217,884,104	40,188,956	18.4	429,287,797	34,343,000	.51
1918	[b]503	1,004	282,535,550	50,363,535	17.8	449,108,661	40,419,700	.63
1919	[b]611	1,191	351,535,026	64,196,763	18.3	480,403,963	41,314,700	.73
1920	[b]576	1,154	384,743,922	71,788,122	18.7	496,430,952	41,700,000	.78

[a] The value of the gas is based on sales to gasoline producers, not on sales for domestic or industrial purposes.

[b] The figures for the number of operators in 1918, 1919, and 1920 are not comparable with those for earlier years, as the method of listing has been changed. See footnote [a], p. 296.

Unblended natural-gas gasoline produced in the United States in 1919 and 1920.

State.	Number of operators.	Number of plants.	Gasoline produced. Quantity (gallons).	Value.	Average price per gallon (cents).
Oklahoma	141	315	178,856,929	$31,334,493	17.5
West Virginia	74	211	58,941,488	13,049,551	22.1
California	30	70	48,207,976	8,323,819	17.3
Texas	20	42	32,956,028	5,770,809	17.5
Pennsylvania	207	306	21,151,135	4,382,380	20.7
Louisiana	14	31	10,609,629	1,712,613	16.1
Ohio	31	59	10,015,638	2,194,558	21.9
Wyoming	4	5	8,711,037	1,735,828	19.9
Illinois	38	92	6,054,916	1,307,980	21.6
Kentucky	6	9	4,497,320	1,071,628	23.8
Kansas	8	10	4,330,748	828,887	19.1
New York	4	4	411,078	75,576	18.4
	[a] 576	1,154	384,743,922	71,788,122	18.7
Total, 1919	[a] 611	1,191	351,535,026	64,196,763	18.3

State.	Gas used. Estimated volume (M cubic feet).	Average yield per M cubic feet (gallons).	Percentage of total production. State. Compression.	Absorption.	United States. Compression.	Absorption.	Total.
Oklahoma	85,167,518	2.10	92	8	58.3	14.4	46.5
West Virginia	174,320,058	.34	27	73	5.7	41.5	15.3
California	43,772,395	1.10	73	27	12.6	12.4	12.5
Texas	15,852,213	2.08	91	9	10.7	2.7	8.6
Pennsylvania	60,951,697	.35	52	48	3.9	9.8	5.5
Louisiana	37,754,043	.28	57	43	2.2	4.4	2.7
Ohio	40,215,329	.25	23	77	.8	7.4	2.6
Wyoming	4,809,277	1.81	94	6	2.9	.5	2.3
Illinois	2,889,334	2.10	100	....	2.1	....	1.6
Kentucky	18,939,285	.24	4	96	.1	4.2	1.2
Kansas	11,597,340	.37	36	64	.6	2.7	1.1
New York	162,463	2.53	100	....	.1	....	.1
	496,430,952	.78	73.1	26.9	100.0	100.0	100.0
Total, 1919	480,403,963	.73	74.3	25.7	100.0	100.0	100.0

[a] The figures for the number of operators in 1918, 1919, and 1920 are not comparable with those for years prior to 1918, as the method of listing has been changed. See footnote [a], p. 296.

Percentage of natural-gas gasoline produced by States, 1911–1920.

State.	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Ohio	23	14	9	6	3	3	3	2	3	3
Oklahoma	5	13	27	40	48	47	53	58	54	46
Pennsylvania	20	17	15	11	9	9	6	6	6	5
West Virginia	49	44	32	21	17	18	15	13	15	15
California		9	14	18	20	17	13	11	11	13
Illinois				3	2	2	2	2	2	2
Kentucky	3	3				1	1	1	1	1
New York			3	1					[a]1	[a]1
Colorado					1	1	2	1	......	......
Kansas	......	......							([a])	([a])
Louisiana	......	......	......	......		1	2	2	3	3
Texas	......	......	......	......		1	3	3	3	9
Wyoming	......	......	......	......	......	......	......	1	1	2
	100	100	100	100	100	100	100	100	100	100

[a] New York and Kansas together, 1 per cent.

Natural-gas gasoline produced in the United States in 1920, by principal methods of manufacture.

Produced by compression and by vacuum pumps.

State.	Number of plants.	Gasoline produced.			Gas used.	
		Quantity (gallons).	Value.	Average price per gallon (cents).	Estimated volume (M cubic feet).	Average yield per M cubic feet (gallons).
Oklahoma [a]	268	163,913,791	$28,433,105	17.3	48,671,472	3.37
California [b]	44	35,347,691	6,619,893	18.7	27,856,279	1.27
Texas	35	30,144,880	5,272,276	17.5	10,098,420	2.99
West Virginia [c]	163	15,972,833	3,169,859	19.8	11,605,174	1.38
Pennsylvania	279	10,981,461	2,128,774	19.4	5,391,467	2.04
Wyoming	4	8,175,825	1,609,762	19.7	2,345,048	3.49
Louisiana	18	6,077,093	831,086	13.7	1,917,159	3.17
Illinois	92	6,054,916	1,307,980	21.6	2,889,334	2.10
Ohio	47	2,294,996	466,747	20.3	916,075	2.51
Kansas	7	1,574,482	315,906	20.1	780,820	2.02
New York	4	411,078	75,576	18.4	162,463	2.53
Kentucky	6	182,927	41,997	23.0	254,091	.72
	967	281,131,973	50,272,961	17.9	112,887,802	2.49
Total, 1919	1,025	261,157,587	45,563,458	17.4	117,669,332	2.22

Produced by absorption.[d]

State.	Number of plants.	Quantity (gallons).	Value.	Average price per gallon (cents).	Estimated volume (M cubic feet).	Average yield per M cubic feet (gallons).
West Virginia [e]	48	42,968,655	$9,879,692	23.0	162,714,884	0.26
Oklahoma [a]	47	14,943,138	2,901,388	19.4	36,496,046	.41
California [f]	26	12,860,285	1,703,926	13.2	15,916,116	.81
Pennsylvania	27	10,169,674	2,253,606	22.2	55,560,230	.18
Ohio	12	7,720,642	1,727,811	22.4	39,299,254	.20
Louisiana [g]	13	4,532,536	881,527	19.4	35,836,884	.13
Kentucky	3	4,314,393	1,029,631	23.9	18,685,194	.23
Texas	7	2,811,148	498,533	17.7	5,753,793	.49
Kansas	3	2,756,266	512,981	18.6	10,816,520	.25
Wyoming	1	535,212	126,066	23.6	2,464,229	.22
	187	103,611,949	21,515,161	20.8	383,543,150	.27
Total, 1919	166	90,377,439	18,633,305	20.6	[h] 374,928,966	.24

[a] Includes two combination compression and absorption plants.
[b] Includes three combination compression and absorption plants.
[c] Includes six combination compression and absorption plants.
[d] Includes drip gasoline.
[e] Includes five combination compression and absorption plants.
[f] Includes seven combination compression and absorption plants.
[g] Includes four combination compression and absorption plants.
[h] Includes 12,194,335 M cubic feet of gas that was first treated at combination plants by compression and that is included in the total volume of gas treated at the compression plants but not duplicated in the total for the United States.

SOURCES OF GASOLINE.

Gasoline is produced in three ways, from crude oil by distillation, from heavy petroleum oils by cracking, and from natural gas by compression or absorption. It is with the last method that this report is concerned. The gasoline obtained by distillation of crude petroleum is commonly known as "straight-run" gasoline; that made by the decomposition under heat and pressure of heavy petroleum fractions is called "cracked" gasoline. By far the largest part of the gasoline marketed is a combination of one or more of the three kinds or a blend with other products, such as naphtha.

QUALITIES OF NATURAL-GAS GASOLINE.

Natural-gas gasoline, because of its high volatility, is rarely marketed in its original state, but is blended with other products, thus forming an ideal motor fuel. Owing to its larger percentage of low-boiling constituents, natural-gas gasoline possesses superior "starting" qualities, especially for use in cold weather.

ECONOMIC IMPORTANCE OF GASOLINE.

From a by-product of petroleum refining incident to the production of kerosene, gasoline has rapidly become the most important derivative of petroleum. It is now used chiefly for fuel in internal-combustion engines, but it is also used in dry cleaning, in the rubber industry, and for heating and lighting.

The remarkable growth in the demand for gasoline has been due to the immense development of automobiles, trucks, tractors, and airplanes. Owing to this rapid growth the turning point in the supply of gasoline was reached in 1917, when we began to require more gasoline than we could obtain from the domestic crude oil. The excess was provided by blending various petroleum products with the gasoline.

The automobile industry is expanding so rapidly that the production of gasoline must keep pace with it, and the importance of gasoline has also been augmented by the failure to develop any other equally satisfactory fuel. Much has been said about possible substitutes, but thus far none have been developed that affect the gasoline market appreciably, and therefore gasoline remains practically the only motor fuel.

The importance of the natural-gas gasoline industry lies not only in the actual quantity produced—about 8 per cent of the total—but in the fact that it renders available as motor fuel at least an equal quantity of naphtha, which alone does not possess sufficient low-boiling constituents for a satisfactory motor fuel. Many of the refiners buy large quantities of natural-gas gasoline for the purpose of blending it with their "straight-run" and "cracked" products and naphthas. It is for this reason that natural-gas gasoline rarely appears on the market in its original state.

The production of natural-gas gasoline is 100 per cent conservation. The total output of this gasoline is obtained without the destruction of any other product, such as takes place, for example, in the manufacture of carbon black, for the production of natural-gas gasoline is merely removing the gasoline vapors from the gas without injury to the gas. Practically all natural gases contain gasoline vapors that can be extracted, and the enormous waste of natural gas is also a waste of gasoline. The production of natural-gas gasoline is of especial importance in new oil fields, where gas occurring with the oil can be treated and the gasoline recovered from it before the gas is wasted or is used for power on the leases.

ECONOMIC ASPECTS OF THE INDUSTRY.

Gasoline is now the most valuable by-product of natural gas. Its commercial production has increased from 7,425,000 gallons in 1911 to 384,700,000 gallons in 1920. The natural-gas gasoline industry, however, has met many obstacles. In the first place, it has had to overcome the prejudices of the refiners and consumers, caused in part by misunderstanding and in part by the practices of some of the producers themselves. Natural-gas gasoline is highly volatile, and in the early stages of the development of the industry, when many of the facts were not known, some of the producers shipped the product in a condition to cause disastrous fires and explosions and heavy losses by weathering. Furthermore, both producers and refiners mixed too much low-grade gasoline or kerosene with the natural-gas gasoline.

The natural-gas gasoline industry was highly prosperous until the end of 1920, but in 1921 it had its first real depression, when the market was flooded with large quantities of natural-gas gasoline that was too volatile for use without blending with other products. The output of natural-gas gasoline is considerably greater in winter than in summer, and the large output in the winter of 1920–21, together with the general depression in the petroleum industry that began early in 1921, caused a surplus supply, which broke prices and brought about the worst condition that has ever prevailed in the market. Figure 14 shows at a glance the situation during 1921. Prices gradually rose in the last half of 1921, and it is expected that they will again reach the level of 1920.

The appearance of this highly volatile product caused the Bureau of Explosives to promulgate rules governing its shipment. In view of the low prices the regulations proposed appeared to be a hardship to the producers, for they caused many to operate at a loss. The stress thus caused was reflected in the immediate organization of the Association of Natural Gasoline Manufacturers for the purpose of reviving the industry. This association proposed specifications for the manufacture and marketing of natural-gas gasoline, the adoption of which has insured a uniform and satisfactory product and was also a distinct benefit to the smaller producer, for it put his product on the same basis as that of the larger producer. By the progressive step thus taken the industry is in a fair way to be again on a firm basis.

Natural-gas gasoline is now in great demand and is bringing a good price. The bulk of the shipments appear to go to the North and West. In Canada natural-gas gasoline is blended with Mexican gasoline, which is being shipped to Quebec, Montreal, and other cities. Natural-gas gasoline from the mid-continent field is also sent to California, where it is blended with gasoline produced from low-grade crude oil.

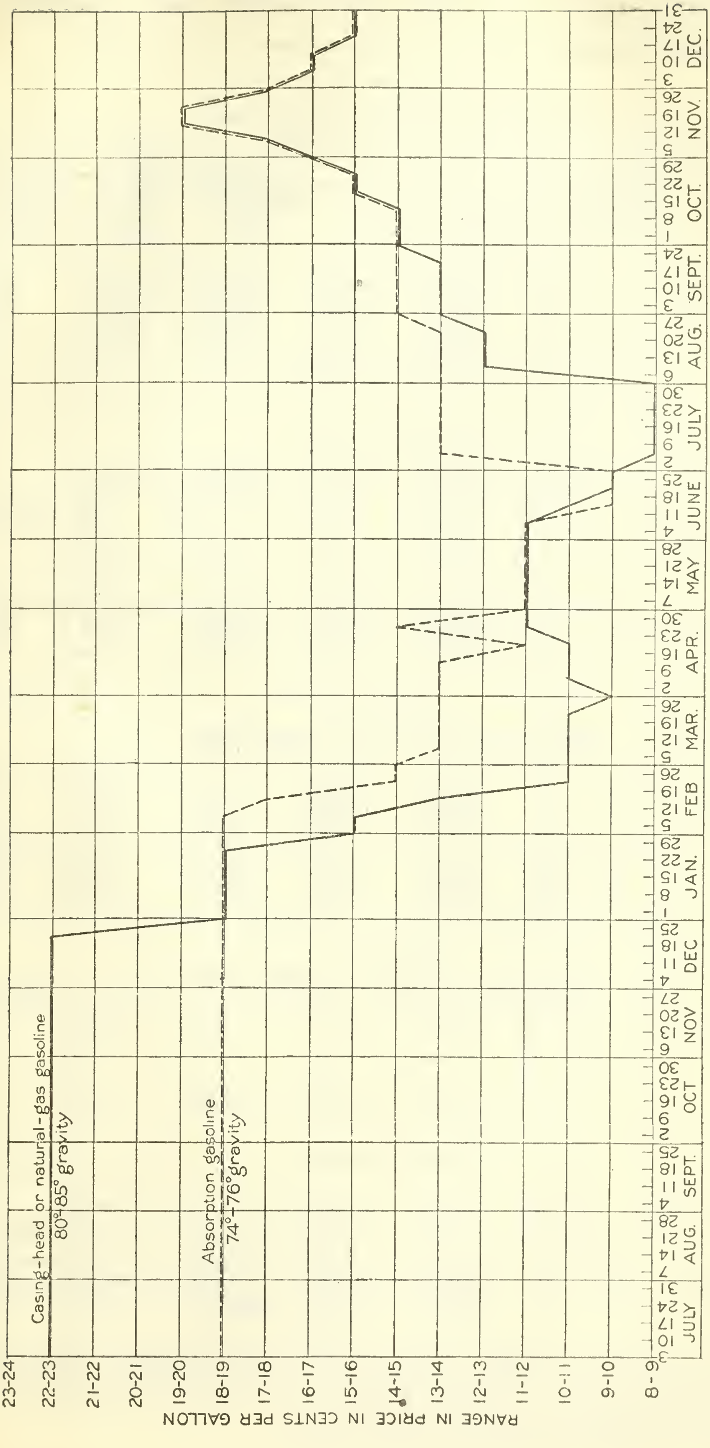


FIGURE 14.—Diagram showing the fluctuation in market price (Tulsa oil market) of natural-gas gasoline from July, 1920, to December, 1921. The range in price is shown from 8 to 9 cents, inclusive, from anything over 9 cents to 10 cents, inclusive, etc.

NATURAL-GAS GASOLINE INDUSTRY, BY STATES.

Natural-gas gasoline produced in the United States in 1920, by States.

CALIFORNIA.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Gasoline produced. Quantity (gallons).	Gasoline produced. Value.	Estimated volume of gas treated (M cubic feet).	Yield of gasoline per thousand cubic feet of gas (gallons).	Gravity of gasoline as produced and before blending (°Baumé).
Kern	6	19	18,224,835	$3,204,792	8,809,142	0.67-1.5	63-78
Santa Barbara	4	5	8,385,698	1,920,146	3,727,069	1.5 -2.0	72-83
Orange [b]	6	9	5,195,174	812,194	9,310,109	.30-4.0	67-82
Ventura	3	3	2,053,535	395,735	1,344,137	1.2 -1.7	80-87
Los Angeles	6	8	1,488,449	287,026	4,665,822	.06- .85	62-75
	[a] 21	44	35,347,691	6,619,893	27,856,279	.06-4.0	62-87

Produced by absorption.

Orange [b]	5	8	6,383,824	$695,796	8,987,281	0.6 -2.9	88
Kern [c]	6	13	4,952,198	706,133	5,805,689	.5 -1.0	43-65
Los Angeles	1	1				1.5	....
Fresno	1	1	1,367,227	269,738	976,214	.76	51
Santa Barbara	1	1				1.92	82
Ventura	2	2	157,036	32,259	146,932	.1 -1.4	83
	[a] 16	26	12,860,285	1,703,926	15,916,116	.1 -2.9	43-88
Grand total	[a] 30	70	48,207,976	8,323,819	43,772,395	.06-4.0	43-88
Total, 1919	[a] 30	60	40,385,796	5,744,867	39,647,251	.02-2.8	47-81
Total, 1918	[a] 29	56	32,268,933	5,009,152	50,490,019	.64	40-82

ILLINOIS.

Produced by compression and by vacuum pumps.

Crawford	25	53	2,907,859	$593,371	1,512,413	1.0-5.0	72-98
Lawrence	14	30	2,834,495	652,120	1,184,973	.4-6.0	66-98
Cumberland	2	4	167,084	33,066	101,465	1.5-1.7	81
Clark	4	5	145,478	29,423	90,483	1.4-2.0	72-81
	[a] 38	92	6,054,916	1,307,980	2,889,334	.4-6.0	66-98
Total, 1919	[a] 42	93	6,059,828	1,115,083	3,160,907	.5-6.0	70-98
Total, 1918	[a] 34	72	4,574,565	890,436	2,316,646	1.0-4.0	65-95

KANSAS.

Produced by compression and by vacuum pumps.

Chautauqua	3	4	1,190,776	$222,557	463,551	0.5-3.2	74-80
Butler	1	1				2.0	81
Cowley	1	1	383,706	93,349	317,269	2.5	76-80
Wilson	1	1				.5	....
	[a] 6	7	1,574,482	315,906	780,820	.5-3.2	74-81

Produced by absorption.

Montgomery	2	2	2,756,266	$512,981	10,816,520	0.10-0.46	72-82
Cowley	1	1				.15	82
	[a] 3	3	2,756,266	512,981	10,816,520	.10- .46	72-82
Grand total	[a] 8	10	4,330,748	828,887	11,597,340	.10-3.2	72-82
Total, 1919	[a] 10	13	3,283,850	620,876	10,432,079	.1- 2.13	64-85
Total, 1918	[a] 5	11	2,389,856	593,730	16,023,067	.10-3.0	64-90

[a] This number is irrespective of the kind, number, and location of the plants operated. The sum of the number of operators listed for each method employed and for each county will therefore not give the correct number of operators in the State. A comparison with the number of operators for years prior to 1918 can not be made because the method of listing has been changed.

[b] Includes three combination compression and absorption plants.

[c] Includes four combination compression and absorption plants.

Natural-gas gasoline produced in the United States in 1920, by States—Continued.

KENTUCKY.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Gasoline produced. Quantity (gallons).	Gasoline produced. Value.	Estimated volume of gas treated (M cubic feet).	Yield of gasoline per thousand cubic feet of gas (gallons).	Gravity of gasoline as produced and before blending (°Baumé).
Wayne	3	5	182,927	$41,997	254,091	0.25-3	62-84
Morgan	1	1				.28	38
	a 4	6	182,927	41,997	254,091	.25-3	38.84

Produced by absorption.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Boyd	2	2	4,314,393	$1,029,631	18,685,194	0.20-0.205	38-84
Martin	1	1				.28	38
	a 2	3	4,314,393	1,029,631	18,685,194	.20- .28	38-84
Grand total	a 6	9	4,497,320	1,071,628	18,939,285	.20-3	38-84
Total, 1919	a 7	9	5,136,326	1,144,746	20,216,945	.19-4.0	80-90
Total, 1918	a 5	6	3,330,986	660,108	19,816,518	.16	78-88

LOUISIANA.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Caddo	7	11	4,937,700	$668,171	1,556,941	1.6-9.0	58-80
De Soto	4	6	1,139,393	162,915	360,218	2.5-8.5	71-80
Claiborne	1	1				4.9	75
	a 7	18	6,077,093	831,086	1,917,159	1.6-9.0	58-80

Produced by absorption.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Caddo [b]	3	5	2,526,548	$522,482	22,372,780	0.08-1.3	72-88
Morehouse	1	2	1,056,471	202,620	7,908,393	.66	86
Bossier	1	1				1.06	73
Claiborne [c]	1	1				....	96
Ouachita	4	4	949,517	156,425	5,555,711	.06-4.0	82-86
	a 7	13	4,532,536	881,527	35,836,884	.06-4.0	72-96
Grand total	a 14	31	10,609,629	1,712,613	37,754,043	.06-9.0	58-96
Total, 1919	a 12	23	10,063,025	1,667,275	26,283,936	.03-9.7	58-88
Total, 1918	a 9	18	7,020,538	1,178,651	13,462,317	.52	60-82

NEW YORK.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Allegany	3	3	411,078	$75,576	162,463	2.5-5.5	68-80
Cattaraugus	1	1				1.5	103
	a 4	4	411,078	75,576	162,463	1.5-5.5	68-103
Total, 1919	a 6	6	457,985	84,083	237,241	.2-5.5	80-100
Total, 1918	a 5	3	218,131	55,405	99,487	1.5-2.4	88- 90

[a] See California table, footnote *a*.
[b] Includes three combination compression and absorption plants.
[c] Includes one combination compression and absorption plant.

Natural-gas gasoline produced in the United States in 1920, by States—Continued.

OHIO.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Gasoline produced. Quantity (gallons).	Gasoline produced. Value.	Estimated volume of gas treated (M cubic feet).	Yield of gasoline per thousand cubic feet of gas (gallons).	Gravity of gasoline as produced and before blending (°Baumé).
Monroe	13	25	1,487,365	$300,311	578,849	1.0 -9.0	76-88
Jefferson	9	10	380,488	75,817	134,248	2.0 -6.0	86-98
Washington	8	10	243,786	48,060	99,373	1.0 -4.0	76-86
Carroll	2	2	183,357	42,559	103,605	1.45-4.0	85-96
	[a] 24	47	2,294,996	466,747	916,075	1.0 -9.0	76-98

Produced by absorption.[b]

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Licking	2	2	3,941,450	$905,989	12,927,389	0.3 -0.42	69-84
Richland	2	2	1,650,154	344,904	9,326,870	.17- .19	68-83
Fairfield [c]	2	1	1,207,677	277,043	13,214,881	.09- .9	76-86
Lorain	1	1				.17	80
Hocking	1	1	557,563	123,999	3,029,739	.56	80
Wayne	1	1				.9	76
Knox	2	2	339,170	70,827	787,190	.41- .95	72-81
Washington	2	2	24,628	5,049	13,185	1.0 -1.5	78
	[a] 7	12	7,720,642	1,727,811	39,299,254	.09-1.5	68-86
Grand total	[a] 31	59	10,015,638	2,194,558	40,215,329	.09-9.0	68-98
Total, 1919	[a] 35	59	8,800,961	1,963,763	43,609,762	.07-8.0	72-98
Total, 1918	[a] 36	55	6,744,907	1,355,447	37,739,322	.18	68-94

OKLAHOMA.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Creek	42	79	88,993,379	$14,986,283	21,730,872	0.32-9.8	60-95
Nowata	14	20	12,542,098	2,173,882	3,390,174	1.4 -6.37	78-90
Tulsa	24	29	8,829,670	1,527,284	3,097,976	.85-7.38	64-86
Osage [d]	11	12	8,769,884	1,360,776	3,553,034	.87-3.6	72-85
Okmulgee	18	27	7,635,704	1,370,354	2,483,589	.9 -7.0	75-92
Washington	12	23	6,452,932	1,175,426	1,998,283	.31-8.4	74-91
Garfield	7	7	5,796,309	1,128,898	2,370,139	1.4 -3.1	84-89
Rogers	7	10	4,583,042	652,281	1,077,712	2.0 -7.96	80-88
Carter	7	10	4,161,638	787,650	2,931,195	.7 -1.55	75-90
Noble	1	1				5.0	89
Muskogee	17	19	3,827,173	709,086	1,346,180	1.3 -5.0	73-89
Wagoner	6	11	3,758,045	755,355	741,771	2.5 -7.7	80-90
Pawnee	7	7	3,182,810	497,014	1,427,684	.2 -3.8	76-84
Kay [d]	3	6	2,839,322	520,325	732,198	.9 -5.6	75-87
Payne	4	5	1,389,823	588,529	1,482,398	.85-2.0	75-85
Unclassified as to county	......	2	1,151,962	199,962	308,267	....	....
	[a] 121	268	163,913,791	28,433,105	48,671,472	.2 -9.8	60-95

Produced by absorption.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Creek	13	17	5,301,436	$1,051,257	8,912,191	0.3 -7.0	38-88
Osage	5	7	4,433,278	793,062	8,786,529	.2 -2.37	60-82
Pawnee	2	3	1,370,390	290,453	1,101,963	.75-1.5	42-75
Payne	2	3	1,186,966	234,050	9,072,800	.14-1.1	74-84
Lincoln	1	1				.13	42
Noble	1	1	827,398	166,162	2,514,180	2.8	....
Tulsa	1	1				....	....
Wagoner	1	1				3	78
Kay	2	4	804,951	161,588	4,417,098	.12-2.0	42-76
Okmulgee [e]	4	6	456,877	88,777	1,284,677	.19-1.2	70-76
Washington	2	2	281,699	61,998	167,623	1.87-2.0	60
Unclassified as to county	......	1	280,143	54,041	238,985	....	....
	[a] 32	47	[c] 14,943,138	2,901,388	36,496,046	.12-7	38-88
Grand total	[a] 141	315	178,856,929	31,334,493	85,167,518	.12-9.8	38-95
Total, 1919	[a] 161	329	189,995,038	32,564,532	100,776,135	.05-9.22	28-96
Total, 1918	[a] 133	276	163,700,550	28,389,045	78,322,307	2.09	52-96

[a] See California table, footnote *a*.
[b] Includes drip gasoline.
[c] One operator having drip gasoline only.
[d] Includes one combination compression and absorption plant.
[e] Includes two combination compression and absorption plants.

Natural-gas gasoline produced in the United States in 1920, by States—Continued.

PENNSYLVANIA.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Gasoline produced. Quantity (gallons).	Gasoline produced. Value.	Estimated volume of gas treated (M cubic feet).	Yield of gasoline per thousand cubic feet of gas (gallons).	Gravity of gasoline as produced and before blending (°Baumé).
Warren	39	52	2,855,984	$579,045	1,263,627	0.3 -8.0	72-94
McKean	8	11	1,703,018	370,947	906,125	.55-3.0	72-90
Butler	91	118	1,577,853	299,760	813,154	.2 -6.0	72-95
Allegheny	7	17	1,145,213	225,859	289,952	.4 -5.0	72-90
Forest	15	18	1,140,825	207,827	393,354	.5 -8.0	74-92
Crawford	11	12	876,932	135,617	507,083	.5 -4.0	76-90
Venango	10	12	890,706	138,798	351,276	.37-7.0	82-92
Clarion	14	17	432,180	85,909	709,198	.13-3.6	70-96
Beaver	11	11	260,126	46,904	93,587	1.0 -5.0	72-90
Washington	3	6	133,783	26,202	35,469	.75-5.0	81-82
Armstrong	4	5	54,841	11,906	28,642	.5 -5.0	72-84
	[a]189	279	10,981,461	2,128,774	5,391,467	.1 -8.0	70-96

Produced by absorption.[b]

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Greene	2	4	3,946,989	$864,005	18,269,807	0.21 -0.32	76-85
Armstrong	1	1	2,093,560	462,432	16,013,592	.11	80
Beaver	1	1				.13	...
McKean	1	1				.09	90
Warren	1	1				1.5	88
Washington	4	4	1,632,063	374,629	9,094,223	.125- .20	79-88
Venango	2	3	951,024	209,508	4,443,530	.21 - .5	88
Clarion	3	3	426,132	94,909	3,511,485	.13 -1.0	81-88
Elk	2	2	393,413	86,555	2,275,390	.15 - .5	81-85
Potter	3	3	305,772	66,632	659,792	.35 - .72	82-85
Forest	2	2	245,885	56,563	202,817	1.2 -1.5	85-88
Allegheny	1	2	173,186	38,133	1,089,594	.17	81
	[a]14	27	[c]10,169,674	[c]2,253,606	55,560,230	.09 -1.5	76-90
Grand total	[a]207	306	21,151,135	4,382,380	60,951,697	.09 -8.0	70-96
Total, 1919	[a]241	343	20,283,336	4,407,318	56,280,578	.08 -9.4	60-98
Total, 1918	[a]200	282	15,775,058	3,249,233	56,982,063	.28	55-95

TEXAS.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Wichita	14	22	24,361,981	$4,181,211	6,132,031	1.3 -8.06	75-90
Eastland	5	12	5,782,899	1,091,065	3,966,389	.83-6.0	75-92
Williamson	1	1				5.0	75-80
Total	[a]16	35	30,144,880	5,272,276	10,098,420	.83-8.06	75-92

Produced by absorption.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Clay	1	1	2,376,279	$415,775	3,784,443	1.0	84
Palo Pinto	1	1				...	...
Shackleford	1	1				...	...
Stephens	1	2				.4	76
Eastland	2	2	434,869	82,758	1,969,350	2.0 -2.5	72-78
	[a]5	7	2,811,148	498,533	5,753,793	.4 -2.5	72-84
Grand total	[a]20	42	32,956,028	5,770,809	15,852,213	.4 -8.06	72-92
Total, 1919	[a]15	24	9,336,437	1,772,503	8,732,133	.14-7.4	54-90
Total, 1918	[a]8	13	7,326,122	1,214,565	8,493,182	.86	70-84

[a] See California table, footnote [a].
[b] Includes drip gasoline.
[c] Includes 1,650 gallons of drip gasoline, valued at $240, produced in Butler County, not shown above.

Natural-gas gasoline produced in the United States in 1920, by States—Continued.

WEST VIRGINIA.

Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Gasoline produced. Quantity (gallons).	Gasoline produced. Value.	Estimated volume of gas treated (M cubic feet).	Yield of gasoline per thousand cubic feet of gas (gallons).	Gravity of gasoline as produced and before blending (°Baumé).
Kanawha[b]	8	14	5,481,299	$1,069,967	3,878,522	0.75–3.0	80–90
Tyler	19	54	4,506,767	863,850	1,310,184	1.0 –5.0	75–96
Roane[b]	7	11	1,723,821	332,392	1,099,916	1.0 –3.0	76–85
Marion	2	3	833,455	195,785	2,599,793	.25–2.0	80–90
Ritchie[c]	11	14	794,933	159,841	573,707	.5 –3.0	75–90
Brooke	10	14	624,575	119,313	182,664	1.0 –5.0	80–93
Wetzel	6	10	556,642	138,088	304,115	1.0 –2.1	75–80
Lincoln	1	1	435,770	85,679	407,833	1.0	80
Wirt	1	1				2.25	84
Pleasants	12	23	418,706	73,139	235,476	.5 –3.3	75–88
Clay	2	2	207,850	44,523	253,276	1.0 –1.5	80–90
Harrison	1	1	168,723	39,398	169,854	3.0	83
Lewis	1	1				.20	80
Marshall	1	2	91,978	22,505	29,959	4.0	82
Monongalia	1	1				3.0	80
Hancock	3	4	40,457	7,544	25,705	.5 – .4	88–90
Calhoun	2	2	36,734	7,337	256,415	1.3 –1.5	80–81
Doddridge[c]	2	2	33,351	7,533	268,265	.06–2.0	82–83
Wood	3	3	17,772	2,965	9,490	1.4 –4.0	80–86
	[a]68	163	15,972,833	3,169,859	11,605,174	.06–5.0	75–96

Produced by absorption.[d]

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Wetzel	4	7	10,805,512	$2,416,573	50,649,348	0.11–2.0	80–88
Lewis	2	5	8,159,920	1,896,537	22,424,200	.32–4.6	84–91
Kanawha[c]	4	6	5,411,721	1,231,757	17,009,899	.13– .75	38–92
Cabell	1	1	4,784,796	1,220,702	13,539,753	.28	38
Lincoln	1	1				6.5	85
Putnam	1	1				2.25	85
Harrison	2	5	3,361,799	774,102	16,063,093	.24– .25	83–88
Marion[c]	3	4	3,216,403	732,399	12,170,780	.12– .41	76–87
Doddridge	2	6	2,658,249	645,495	10,182,400	.32–1.8	84–87
Braxton	1	1	2,512,219	513,420	9,594,508	.25	....
Clay	1	1				.6	....
Calhoun[c]	1	1				.27	81
Jackson	1	1					38
Pleasants	2	3	1,011,872	229,165	7,033,345	.15–1.75	80–85
Marshall	2	2	696,335	152,584	3,648,975	.11– .25	80–83
Roane[b]	2	3	270,681	51,152	398,583	.65– .7	76–84
	[a]15	48	[e]42,968,655	[e]9,879,692	162,714,884	.11–6.5	38–92
Grand total	[a]74	211	58,941,488	13,049,551	174,320,058	.06–6.5	38–96
Total, 1919	[a]89	227	52,150,045	12,179,638	167,239,089	.07–9.0	62–98
Total, 1918	[a]79	208	37,603,903	7,498,804	163,929,550	.23	68–94

WYOMING.

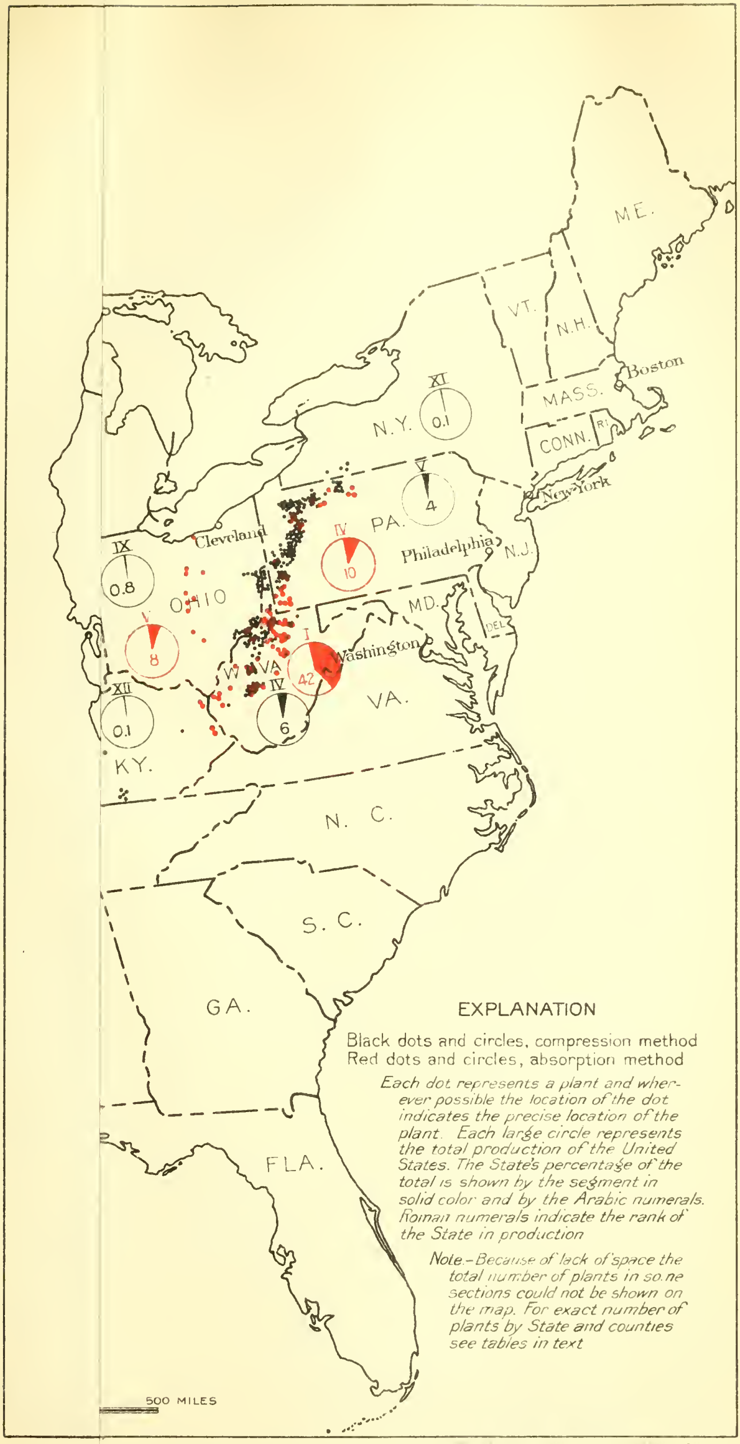
Produced by compression and by vacuum pumps.

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Natrona	2	2	6,738,362	$1,323,065	1,603,063	1.5 –4.5	90
Big Horn	1	1	1,437,463	286,697	741,985	.33	....
Park	1	1				3.3	90
	[a]4	4	8,175,825	1,609,762	2,345,048	.33–4.5	90

Produced by absorption.[d]

County.	Number of operators.[a]	Number of plants.	Quantity (gallons).	Value.	Estimated volume of gas treated (M cubic feet).	Yield (gallons).	Gravity (°Baumé).
Big Horn	[a]1	1	535,212	$126,066	2,464,229	0.22	76
Grand total	4	5	8,711,037	1,735,828	4,809,277	.22–4.5	76–90
Total, 1919	[a]3	5	5,580,599	931,722	3,687,907	.24–3.95	71–80
Total, 1918	[a]2	2	1,579,526	268,339	1,433,564	.33–2.13	76–90

[a] See California table, footnote [a].
[b] Includes two combination compression and absorption plants.
[c] Includes one combination compression and absorption plant.
[d] Includes drip gasoline.
[e] Includes 79,148 gallons of drip gasoline, valued at $15,806, not shown above.



PERCENTAGE OF PRODUCTION

MAP OF THE UNITED STATES SHOWING LOCATION OF NATURAL-GAS GASOLINE PLANTS AND PERCENTAGE OF PRODUCTION BY COMPRESSION AND ABSORPTION METHODS IN 1920

SULPHUR, PYRITES, AND SULPHURIC ACID.[1]

By Philip S. Smith.

GENERAL SITUATION.

The general situation in the sulphur, pyrites, and sulphuric-acid industries in 1920 showed no marked change from that in 1919. The production of sulphur increased, the production of pyrites continued to decrease, and the production of sulphuric acid remained about constant.

In the sulphur industry labor troubles at one of the large mines resulted in a considerable falling off in production, but the stocks on hand were sufficient to allow shipments to be continued at an even higher rate than normal. In fact, the shipments of domestic sulphur for the year were greater than ever before.

In spite of the large quantity of sulphur sold, many efforts were made to find new uses or to expand old uses for sulphur. The most promising field for an increase in the use of sulphur is in agriculture as a fertilizer, and many experiments have been made in a study of this use. Most of the agricultural experiment stations are aiding in this research. An interesting outgrowth of this work has been the establishment by the Gypsum Industries Association of several fellowships carrying stipends of $1,000 to $1,500 a year for the study of the relations of sulphur to crop nutrition and growth.[2] Experiments in the use of sulphur as a component of acid-proof cement and acid-proof construction material have yielded very promising results.[3]

The wisdom of these attempts to stimulate the use of sulphur, however, may perhaps be questioned, because so far as is now known only three deposits in the United States are capable of furnishing nearly pure sulphur at low cost. Doubtless other deposits will be discovered, but the "crop" of sulphur, like that of all our other mineral natural resources, is exhaustible and can not be replaced. Consequently the supply should be conserved for those uses in which sulphur is the best material and will do the most good.

The output of pyrites continued to decrease because of the substitution of sulphur in the manufacture of sulphuric acid, practically the only purpose for which pyrite is used in this country. The inevitable reaction from the stimulation of the production of pyrites during the war continued throughout the year with increasing effect and will doubtless not be overcome so long as large supplies of sulphur are available at low cost.

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[1] The statistics of production in this report were compiled by Miss Jane Hanna and the tables of imports and exports by J. A. Dorsey, both of the United States Geological Survey.

[2] Science, new ser., vol. 53, pp. 112-113, 1921.

[3] Bacon, R. F., and Davis, H. S., Recent advances in the American sulphur industry: Chem. and Met. Eng., vol. 24, pp. 65-71, Jan. 12, 1921.

No noteworthy new developments in the sulphuric-acid industry were reported during the year, but general business stagnation does not appear to have affected this industry so adversely as it did many others, and production at practically a normal rate was maintained.

SULPHUR.

DOMESTIC PRODUCTION.

Sulphur was reported to have been produced in 1920 by four mines, one each in Louisiana and Nevada and two in Texas. One mine in Wyoming reported shipping sulphur that had been produced in an earlier year. More than 99.5 per cent of the sulphur was produced by the mines of the Texas Gulf Sulphur Co., at Big Hill, Matagorda, Tex., the Freeport Sulphur Co., at Freeport, Brazoria County, Tex., and the Union Sulphur Co., at Sulphur, Calcasieu Parish, La.

The total domestic sulphur production for 1920 was about 65,000 tons more than the production in 1919, but about 100,000 tons less than the production in 1918, which was the largest ever recorded. The sulphur shipped from the mines in 1920 was far in excess of that shipped in any preceding year and more than 260,000 tons in excess of the quantity mined in 1920. This excess was taken from the stocks held at the mines, but in spite of this draft the stocks are still more than 1,100,000 tons.

Sulphur produced and shipped in the United States, 1916–1920.

Year.	Mined (long tons).	Shipped.		Year.	Mined (long tons).	Shipped.	
		Long tons.	Value.			Long tons.	Value.
1916	649,683	766,835	$12,246,000	1919	1,190,575	678,257	$10,252,000
1917	1,134,412	1,120,378	23,987,000	1920	1,255,249	1,517,625	30,000,000
1918	1,353,525	1,266,709	27,868,000				

The conditions under which sulphur occurs at the three large mines are essentially the same. From the surface to a depth of several hundred feet are unconsolidated sands and muds, beneath which in places is a limestone locally known as cap rock, because it covers the sulphur deposits. Beneath the cap rock is limestone, with some gypsum, and large quantities of sulphur; lower down the proportion of limestone decreases; in the next few hundred feet the beds are mainly gypsum with a little sulphur; still lower down the rock is a massive gypsum, which is said to rest on beds of salt of unknown thickness. The sulphur does not occur in massive beds, but in stringers and lenses that traverse the adjacent rocks irregularly.

At all these mines the sulphur is extracted by the process developed by Dr. Hermann Frasch, which is briefly as follows: Holes nearly a foot in diameter are bored to the deposit by drills similar to those used in boring for oil. The sulphur, which liquefies at about 116° C., is melted by the introduction of superheated water. After the sulphur has melted and collected at the bottom of the hole it is raised to the surface by the use of compressed air. The liquid sulphur is piped to large bins, where, on cooling, it consolidates. The solid sulphur in the bins is blasted down by powder, picked up by steam shovels, and loaded into railroad cars for shipment. The sulphur thus obtained is not further refined at the mine, but is sold with the guaranty that it is at least 99.5 per cent pure.

During 1920 labor troubles reduced the production of one of the mines far below the normal.

IMPORTS AND EXPORTS.[4]

The quantity of foreign crude sulphur imported into the United States in 1920 was insignificant, and was 43 per cent less than was imported in 1919. The stocks at the mines were so large as to discourage importation.

Crude sulphur imported into the United States in 1920.

Country.	Port of entry.	Long tons.	Value.
France	New York	....	$12
Canada	Washington	40	1,400
Japan	Hawaii	2	90
	Southern California	1	172
	Los Angeles	1	48
		44	1,722

The sulphur credited as imported from France and Canada was doubtless crude sulphur produced in some other country and reshipped, as neither France nor Canada produces crude sulphur.

The average value of the imported crude sulphur was about $39 a ton. In addition to the crude sulphur, 50 tons of refined sulphur, valued at $2,530, and 42 tons of all other kinds of sulphur, valued at $22,576, were imported. No flowers of sulphur are recorded as having been imported in 1920.

The sulphur exported in 1920 was about 250,000 tons more than the quantity exported in 1919, which was larger than in any year prior to that time.

Sulphur exported from the United States, 1916–1920.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	128,755	$2,505,857	1919	224,712	$6,325,552
1917	152,736	3,500,819	1920	477,450	8,994,350
1918	131,092	3,626,638			

Although the customs districts from which crude sulphur was cleared in 1920 are distributed around the entire border of the country, practically all the sulphur exported was produced by the large mines in Texas and Louisiana.

[4] Figures compiled from the records of the Bureau of Foreign and Domestic Commerce.

Sulphur exported from the United States in 1920, by ports of clearance, in long tons.

Destination.	New York City.	Maine, New Hampshire, Massachusetts, and Vermont.	St. Lawrence, Buffalo, Rochester, and Michigan.	Dakota, Minnesota, Idaho, Montana, and Washington.	California and Arizona.	Texas and Louisiana.	Florida and Mobile.	Total.
North America	927	37,312	46,602	10,434	382	44,172	110	139,939
South America	2,874					5,955		8,829
Europe	8,296					238,683	1,000	247,979
Asia and Oceanica	2,472				1,403	70,125		74,000
Africa	103					6,600		6,703
	14,672	37,312	46,602	10,434	1,785	365,535	1,110	477,450

Of the sulphur exported to North American countries and the adjacent islands, 124,301 tons went to Canada, 8,860 tons to Mexico, 2,498 tons to Cuba, and smaller quantities to the West Indies and Central America; of that exported to European countries, 105,381 tons went to France, 57,721 tons to Sweden, and smaller quantities to England, Portugal, Germany, Finland, Norway, Spain, Belgium, Denmark, and the Netherlands; of that sent to South American countries, 5,074 tons went to Argentina, 2,299 tons to Brazil, 1,173 tons to Uruguay, and insignificant quantities to Peru, Colombia, Venezuela, and Ecuador; of that sent to Africa, 4,200 tons went to British South Africa, 2,400 tons to French Africa, and 103 tons to Portuguese Africa; of that sent to Asia and Oceanica, 63,251 tons went to Australia, 7,158 tons to New Zealand, 2,483 tons to the Dutch East Indies, and smaller quantities to India, the British Straits Settlements, the Philippine Islands, Japan, China, and Hongkong.

PYRITES.

DOMESTIC PRODUCTION.

The domestic production of pyrites showed a decrease of about 110,000 tons in quantity and nearly a million dollars in value, compared with the production in 1919. This decrease indicates very clearly the depression in the pyrites industry, as this was the smallest production of pyrites since 1911. The decrease is largely attributable to the large quantity of sulphur available and its lower cost as compared with pyrites—not only in first cost but also throughout all the processes of manufacture.

The following table shows the production of pyrites in 1920 by 25 mines in 10 States, as against 47 mines in 12 States in 1919.

Pyrites produced in the United States in 1920, by States.

State.	Lump.		Fines.		Total.	
	Long tons.	Value.	Long tons.	Value.	Long tons.	Value.
California	(a)	(a)	(a)	(a)	128,114	$519,078
Colorado	25,523	$123,674			25,523	123,674
New York			30,753	$261,575	30,753	261,575
Virginia	(a)	(a)	(a)	(a)	100,545	610,085
Other States [b]	15,139	53,508	10,703	29,041	25,842	82,549
	[c] 119,597	[c] 617,476	[c] 191,180	[c] 979,485	310,777	1,596,961

[a] Output of lump and fines not shown separately, as there are less than three producers of one or the other.
[b] Includes Georgia, Illinois, Missouri, Pennsylvania, Tennessee, and Wisconsin.
[c] Includes quantity produced in States whose individual output may not be shown separately.

California continued to be the leading State and produced almost identically the same quantity as it did in 1919. Virginia was the second State and showed a falling off in production of about 20,000 tons. California and Virginia together furnished more than 70 per cent of the pyrites produced in this country.

The total sulphur content of the lump ore was equivalent to 38,970 tons of sulphur, or an average of about 32.5 per cent. The exceptionally low sulphur content of the lump ore was due to the fact that much of it was pyrrhotite containiug less than 30 per cent of sulphur. The sulphur content of the fines was equivalent to 84,998 tons of sulphur, which would indicate an average content of about 44 per cent. The average value per ton of the lump ore was $5.16 and that of the fines $5.12. According to these figures the average value per unit of sulphur in the lump ore was 15¾ cents and of that in the fines or concentrates 11½ cents.

Pyrites produced in the United States, 1916–1920.

Year.	Long tons.	Value.	Year.	Long tons.	Value.
1916	439,132	$2,038,002	1919	420,647	$2,558,172
1917	482,662	2,593,035	1920	310,777	1,596,961
1918	464,494	2,644,515			

IMPORTS AND EXPORTS.[5]

The imports of pyrites in 1920 were less than in any other year since 1900. They showed a decrease of about 56,000 long tons from the imports in 1919, and a great decrease compared with the imports from 1911 to 1917, when the average quantity imported each year was about a million tons. This decrease, like that in domestic production, has been caused very largely by the decreased use of pyrites in the sulphuric-acid industry through the substitution of native domestic sulphur.

[5] Figures compiled from the records of the Bureau of Foreign and Domestic Commerce.

Imports of sulphur ore as pyrites, containing more than 25 per cent of sulphur, in 1920, by countries and districts of entry.

Country.	Long tons	Value.	District of entry.	Long tons	Value.
Canada	100,672	$509,308	Buffalo	31,751	$142,880
			Chicago	34,000	177,850
			Ohio	28,240	130,901
			Philadelphia	6,504	57,237
			Vermont	177	440
Chile	8	[a] 597	New York	8	[a] 597
Cuba	29,500	208,368	Maryland	29,500	208,368
France	737	7,370	Philadelphia	737	7,370
Hongkong	983	[a] 28,704	Maryland	983	[a] 28,704
Spain	200,706	906,485	Georgia	28,403	113,416
			Maryland	65,215	261,875
			Massachusetts	2,864	8,658
			New Orleans	3,009	10,358
			New York	18,979	96,702
			Philadelphia	61,009	337,163
			South Carolina	21,227	78,313
	332,606	1,660,832		332,606	1,660,832

[a] The abnormally high value of these ores was due to the metals they carried.

A comparison of the foregoing table with the similar table for 1919 shows that imports of pyrites from Canada increased about 16,000 tons and that imports from Cuba increased about 6,000 tons, but that imports from Spain decreased about 80,000 tons. The ore reported as having come from France was probably produced in some other country and reshipped to the United States.

The value of the imported pyritic ore was over $500,000 less than in 1919, and the average value was $4.99 a ton, as against $5.60 in 1919. The average value of the ore imported from Canada was $5.06, as against $4.57 in 1919, and the average value of the Spanish ore in 1920 was about $4.52, as compared with $5.61 in 1919. The average sulphur content of the pyritic ore imported from Spain is about 48 per cent, which would make the average value per unit of sulphur a little more than 9⅓ cents. The Canadian ore, on the other hand, generally carries a much smaller content of sulphur, believed to average not over 42 per cent. It is significant to note that the average price per unit of sulphur for the domestic ores was about 12¾ cents, as against 10½ cents for the ores imported from Canada and Spain.

SULPHURIC ACID.

DOMESTIC PRODUCTION.

The production of sulphuric acid in 1920, expressed in terms of 50° Baumé acid, was 5,602,403 short tons, valued at $59,292,406, to which must be added 502,970 short tons of acids of strengths higher than 66° Baumé, which can not be expressed in terms of acid of 50° Baumé, valued at $10,624,049. The total value of the sulphuric acid produced in 1920 was therefore $69,916,455, or some $10,000,000 higher than that of the acid produced in 1919.

Of the acid of 66° and lower strength produced, 3,305,262 short tons, computed as 50° acid, was sold, and 2,297,141 short tons, also computed as 50° acid, was consumed by the producer.

Sulphuric acid produced in the United States in 1920.

Strength of acid.	Produced and sold.		Made and consumed by producer.		Total.	
	Short tons.	Value.	Short tons.	Estimated value.	Short tons, as 50° acid.	Estimated value.
50°	445,349	$4,749,452	1,719,740	$18,332,428	2,165,089	$23,081,880
60°	1,105,535	11,179,580	229,080	2,315,999	1,665,654	13,495,579
66°	964,119	18,978,522	189,859	3,736,425	1,771,660	22,714,947
Stronger acids	355,089	7,500,802	147,881	3,123,247	(a)	10,624,049
	....	42,408,356	....	27,508,099	....	69,916,455

a Data available not adequate for computing as 50° acid.

The manufacture of sulphuric acid was reported by 204 plants, distributed in 32 different States. The distribution of the production of sulphuric acid of 66° Baumé and lesser strengths, according to States, is given in the following table, which does not include the stronger acids:

Sulphuric acid of 66° and lower strength produced in 1920, in short tons.

[Computed as 50° acid.]

Alabama	141,404	New York	105,239
California	92,283	North Carolina	113,736
Florida	33,832	Ohio	421,763
Georgia	324,349	Pennsylvania	646,043
Illinois	548,048	South Carolina	207,616
Louisiana	52,282	Tennessee	529,426
Maryland	591,652	Virginia	183,276
Massachusetts	196,098	Other States [6]	660,777
Michigan	43,245		
Mississippi	43,527		5,602,403
New Jersey	667,807		

Sulphuric acid produced from gases given off by zinc and copper smelters in 1920.

	Number of plants operating.	50°–66° acid, computed as 60° acid.		Stronger acids.	
		Short tons.	Value.	Short tons.	Value.
Zinc smelters	18	707,974	$9,643,718	23,728	$475,538
Copper smelters	6	497,806	3,497,819	....	....
	24	1,205,780	13,141,537	23,728	475,538

Records of the materials used for the manufacture of sulphuric acid in 1920 show that 688,372 long tons of sulphur, 765,462 long tons of pyrites, 654,252 long tons of copper sulphides, and 425,655 long tons of zinc sulphides were used. The statistics for the materials used in the manufacture of sulphuric acid in 1919, collected by the Bureau of the Census, show that in that year 460,899 long tons of sulphur and 1,017,882 long tons of pyrites were used. The great

[6] Includes Arizona, Arkansas, Colorado, Connecticut, Delaware, Indiana, Kansas, Montana, Texas, Utah, West Virginia, Wisconsin.

increase in the use of sulphur in the sulphuric acid industry may be realized by comparing the foregoing figures. The figures for 1920 become even more significant when compared with those for 1915, when only 52,481 long tons was used, or with those for 1913, when only 16,318 long tons was used.

IMPORTS AND EXPORTS.[7]

Very little sulphuric acid is imported into the United States. In 1920 the imports were the smallest quantity received since 1916. The larger part of the acid imported came from Canada. The average value of the acid imported in 1920 was $16.27 a ton. This indicates that most of the acid was of medium strength.

Sulphuric acid imported for consumption in the United States, 1916–1920.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	706	$21,672	1919	7,373	$116,725
1917	10,071	228,982	1920	5,409	87,979
1918	5,687	176,223			

The average value of the sulphuric acid exported in 1920 was approximately $51 a ton and indicates that only acids of the highest strengths were exported.

Sulphuric acid exported from the United States, 1916–1920.

Year.	Short tons.	Value.	Year.	Short tons.	Value.
1916	33,232	$1,847,995	1919	10,648	$489,966
1917	31,761	1,006,125	1920	14,493	738,188
1918	40,147	1,278,027			

Of the acid exported, 8,156 short tons was shipped either to North American countries or to the islands lying adjacent to them, of which Mexico received more than 5,000 tons and Cuba nearly 2,500 tons; South American countries received 4,524 tons, of which 3,000 tons was shipped to Argentina; about 1,800 tons was sent to Asia and Oceanica, 6 tons to Africa, and 3 tons to Europe.

[7] Figures compiled from records of the Bureau of Foreign and Domestic Commerce.

ASBESTOS.

By Edward Sampson.[1]

DOMESTIC PRODUCTION.

The domestic asbestos mining industry was never so prosperous as in 1920. More asbestos has been produced in some other years, but never before have prices been so high and never before has there been so large an output of crude chrysotile.

The publication of this report has been long delayed by the refusal of the Johns-Manville Co. (Arizona Asbestos Association) to report its output directly to the Geological Survey, a refusal that necessitated the use of figures reported by that company to the Arizona State Tax Commission, as required by State law. The total quantity of asbestos sold in 1920 was 1,648 short tons, valued at $650,311, an increase of 42 per cent in quantity and of 162 per cent in value over the corresponding figures for 1919. These gains were due largely to increased activity in Arizona, where the number of operators increased from 4 to 7 and where the larger producers made a far greater output than in 1919.

The greatest annual output of asbestos, 7,604 tons, valued at $119,935, was made in 1911. Most of this was chrysotile mined in Vermont.

Domestic asbestos marketed in the United States, 1913–1920.

Year.	Chrysotile.		Amphibole.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1913	....	....	1,100	$11,000	1,100	$11,000
1914	(a)	(a)	(a)	(a)	1,247	18,965
1915	316	$65,148	1,415	11,804	1,731	76,952
1916	649	434,903	830	13,311	1,479	448,214
1917	1,116	494,312	567	11,744	1,683	506,056
1918	396	107,059	606	17,628	1,002	124,687
1919	502	229,265	659	19,000	[b]1,161	[b]248,265
1920	1,245	633,987	403	16,324	1,648	650,311

[a] Figures not shown in order to avoid disclosure of confidential information.
[b] Revised figures.

In this table chrysotile includes both crude and mill fiber, and as the relative quantities of material of these grades varies considerably from year to year the figures given represent a combination of

[1] The author wishes to acknowledge his obligation to Mr. J. S. Diller, who for 14 years has had charge of the U. S. Geological Survey work on asbestos. Although now engaged on other work he has given much assistance in the preparation of this report. Mrs. E. R. Phillips, of the Geological Survey, has aided in preparing the statistical data. Figures of imports are compiled from records of the Department of Commerce.

high-grade and low-grade fiber, so that the average value of the chrysotile marketed from year to year has no exact significance. The same statement will apply to the figures for amphibole for 1918 to 1920, inclusive. To avoid disclosing confidential returns the figures showing the high-grade long fiber used since 1918 for making chemical filters have been combined with those showing mass-fiber anthophyllite produced in Georgia and North Carolina.

Asbestos was mined in five States in 1920, two less than in 1919. These States, named in the order of quantity produced, are Arizona, Georgia, California, Wyoming, and Maryland. The order indicated by the value is Arizona, Maryland, Georgia, Wyoming, California. Arizona supplied 1,200 tons, valued at $625,822, which was 73 per cent of the total quantity and 96 per cent of the total value. In 1919 it is credited with 36 per cent of the total quantity and 89 per cent of the total value. Washington and North Carolina, in which there was one producer each in 1919, made no output in 1920.

Producers of asbestos in 1920.

State and name.	Address of owner or operator.	Location of mine.	Variety of asbestos mined and manner of occurrence.
ARIZONA.			
Alene Asbestos Association.	Young, Ariz	On Sloane Creek, a tributary of Canyon Creek, Gila County.	Chrysotile in limestone.
American Ores & Asbestos Co. (Inc.).	Globe, Ariz	Pocket Creek, Coon Creek Butte, near Roosevelt Reservoir, Gila County.	Do.
Arizona Asbestos Association.	Chrysotile, Ariz	Chrysotile, on Ash Creek, Gila County.	Do.
Globe Asbestos Co	A. E. Minium, Globe, Ariz.	Near Chrysotile, Gila County	Do.
Penn Asbestos Mines Co.	North Wales, Pa	South side Salt River canyon at bend of river known as "the Pen" or "Mule Shoe," Gila County.	Do.
Quist, E. L	283 El Molino Avenue, Pasadena, Calif.	Lessee, Bass mine, Hakatai Canyon, near Bass Camp, Grand Canyon, Coconino County.	Do.
Regal Mine	E. Schaaf Regelman, 220 Broadway, New York, N. Y.	South side Salt River canyon at Salt Bank, Gila County.	Do.
Wightman & Pierce.	Globe, Ariz	Near Rock House, Canyon Creek, Gila County.	Do.
CALIFORNIA.			
Stock Asbestos Co	Hazel Creek, Calif	Near Sims, Shasta County	Slip-fiber anthophyllite in altered peridotite.
Sierra Asbestos Co	710 Easton Building, Oakland, Calif.	Near Washington post office, Nevada County.	Chrysotile in altered peridotite.
GEORGIA.			
Sall Mountain Co	305 South LaSalle Street, Chicago, Ill.	Sall Mountain, White County	Mass-fiber anthophyllite.
MARYLAND.			
Powhatan Mining Co.	Woodlawn, Baltimore, Md.	Pylesville and Rocks, Harford County.	Slip-fiber anthophyllite.
WYOMING.			
American Fireproofing & Mining Co.	Lander, Wyo	23 miles southwest of Lander	Chrysotile in altered peridotite.
Wyoming Asbestos Producing Co.	Fred Patee, 1014 South Oak Street, Casper, Wyo.	Casper Mountain, near Casper	Do.

VARIETIES OF ASBESTOS.

Asbestos is a term now applied to any mineral that can readily be separated into flexible fibers. All such minerals are silicates which vary greatly in composition and geologic occurrence. The variety of asbestos in most common use is chrysotile; in fact, if not qualified, the term asbestos usually means chrysotile. The other varieties of asbestos belong to the amphibole group of minerals. The value of some of these other varieties, however, particularly in British South Africa, has recently been emphasized.

Chrysotile is a hydrous magnesium silicate whose composition may be represented empirically by the formula $H_4Mg_3Si_2O_9$ and which contains 12.9 per cent of water of constitution. When the mineral is heated to a high temperature it loses this water and crumbles. Contrary to rather general opinion, the quality of the fiber does not seem to depend upon its water of constitution, the quantity of which appears to be very constant. Chrysotile has the same composition as serpentine, with which it is always associated. Of all the varieties of asbestos, chrysotile has the silkiest and strongest fiber, though some chrysotile is "harsh" or bristly and its fiber may not be as strong as that of other varieties of asbestos.

Anthophyllite, which is mined only in the United States, is an anhydrous iron-magnesium silicate having the composition $(Fe,Mg)SiO_3$. Anthophyllite that occurs as long slip fiber in veins closely resembles tremolite, from which, however, with the aid of a microscope, it can be readily distinguished. The fiber is of low tensile strength and is usually rather brittle, so that it is used principally for purposes that can be served by material of low grade. Anthophyllite is more stable chemically than chrysotile and is more resistant to acids and heat, so that anthophyllite that contains little iron is especially suitable for making chemical filters. It seems possible that more uses might be found in the chemical industry for mass-fiber anthophyllite, which is a comparatively cheap product.

Crocidolite, a soda-bearing amphibole, has the composition $NaFe(SiO_3)_2.FeSiO_3$. Its color is a dark blue, and it is therefore often called "blue asbestos." The fiber is generally harsh, and its tensile strength is less than that of most chrysotile.

Amosite is a variety of anthophyllite that contains iron instead of magnesia. Its composition and mineralogic character have recently been discussed by Wherry,[1] who shows that it is not a new mineral but an iron-rich anthophyllite already described as ferro-anthophyllite. Amosite that contains considerable soda approaches crocidolite in composition. It is notable for the great length of its fiber, which is flexible though of no great tensile strength. Amosite is harder than chrysotile and is said to cause excessive wear on the teeth of carding machines.

Tremolite $(CaMg_3(SiO_3)_4)$ and actinolite $(Ca(Mg,Fe)_3(SiO_3)_4)$ are the minerals to which the name asbestos rightfully belongs. They were the first known and the earliest used asbestiform minerals, although they are now of little importance. Their fibers may be of great length and may be silky, but they are not strong. Tremolite is chemically so stable that, if pure, it may be used for making chemical filters.

[1] Wherry, E. T., Am. Mineralogist, vol. 6, p. 174, 1922.

TYPES OF STRUCTURE.

Most asbestos minerals are found in veins, but some may make up the whole mass of a rock. The veins contain both cross-fiber and slip-fiber asbestos. Cross-fiber asbestos lies perpendicular or nearly perpendicular to the walls of the vein. Chrysotile, crocidolite, and amosite occur in this way. Slip-fiber asbestos lies parallel to the walls of the vein. Chrysotile, tremolite, actinolite, and anthophyllite occur in this way. Much slip-fiber chrysotile is rather harsh. An excessively harsh slip-fiber chrysotile is known as picrolite. Anthophyllite, tremolite, and actinolite may occur as mass fiber, the minerals forming interlocking bundles or radial groups of fibers.

GEOLOGIC OCCURRENCE.

CHRYSOTILE.

Chrysotile asbestos is found in two entirely distinct geologic associations—in altered peridotite, an igneous rock very low in silica and high in magnesia and iron, and in limestone near its contact with sills or intrusive sheets of basic igneous rock.

Chrysotile occurs in peridotite in veins which either form a network in several directions through the rock or less commonly lie parallel. The peridotite near the veins is altered to serpentine. Few of the veins are more than an inch wide. The great deposits of this kind are those of Quebec and of the Ural Mountains, regions that before the World War furnished nearly all the world's supply of asbestos. Deposits are worked in California, Wyoming, and Vermont.

Deposits of chrysotile in limestone are rather widely distributed, but compared to those in peridotite they are small. The fiber may be rather harsh, but it is very long, unbroken fiber over 6 inches in length and of the finest quality having been found, whereas fiber over 2 inches in length is very rare in the deposits formed in peridotite. Chrysotile occurs with serpentine at or near its contact with sills of olivine diabase, usually the upper contact. The deposits in Arizona and in the Carolina district of the Transvaal are of this type. Deposits in limestone are found in Arizona, in southwestern Montana, and probably also in New Mexico.

ANTHOPHYLLITE.

Deposits of mass-fiber anthophyllite occur in Georgia, North Carolina, and Idaho. The occurrence of anthophyllite has been most fully described by Hopkins.[2] The anthophyllite in Georgia is a product of the alteration of peridotite. The altered rock consists almost entirely of anthophyllite. Hopkins points out that the fiber in the commercially valuable deposits has been greatly softened by weathering, which in this region has been very active. In fact, the anthophyllite appears to have been made fibrous by weathering, for the fresh anthophyllite, although it has a good prismatic cleavage, is splintery and of little or no value.

[2] Hopkins, O. B., A report on the asbestos, talc, and soapstone deposits of Georgia: Georgia Geol. Survey Bull. 29, 1914.

Two interesting deposits of slip-fiber anthophyllite in Maryland and California have recently been operated. They are described under those States.

CROCIDOLITE.

The only worked deposits of crocidolite and amosite are in the Union of South Africa.[3] Both occur as cross-fiber veins parallel to the bedding of an iron-rich siliceous argillite locally known as "ironstone." According to the published descriptions the material of which the vein minerals are composed has been derived from the inclosing rocks as a result of regional metamorphism. The deposits cover a wide area over which they occur at the same stratigraphic horizon.

ACTINOLITE AND TREMOLITE.

Actinolite and tremolite usually occur in veins as slip fiber, generally in highly magnesian rocks. They appear to have been formed by metamorphic agencies, which have also extensively affected the country rock.

REVIEW BY STATES.

ARIZONA.

Globe region.—In the Globe region, Arizona, there was much mining in 1920. As in previous years, the Arizona Asbestos Association, a subsidiary of the H. W. Johns-Manville Co., was the largest producer. Work on its property, which is at Chrysotile post office, on Ash Creek, was concentrated on an extraction tunnel driven in the diabase below the main asbestos-bearing limestone. This tunnel has several branches that are connected by raises with the workings above. It affords drainage for the upper workings and will greatly simplify the extraction of the asbestos. Veins of good fiber were discovered below the diabase on the west side of Ash Creek. The occurrence of asbestos at the lower contact of the diabase with the limestone is not common in the Globe field.

The Regal mine, owned by E. Schaaf-Regelman, of New York, is on the south side of the canyon of Salt River, high above the locally well-known Salt Bank, which is formed by some large salt springs. The mine is not far from Chrysotile. A road has been built from a point within about a mile of the mine to the road from Chrysotile to Rice, the nearest railroad station. The main workings of the Regal mine are at the precipitous head of a small canyon, where there are two fiber-bearing zones in limestone above an arched contact of the intrusive diabase. The main zone is 15 to 20 feet above the contact and a less valuable zone is about 45 feet higher. In 1920 the upper zone was not being worked. The main fiber zone contains two fiber-bearing layers about 5 feet apart. These layers consist principally of serpentine, which, as usual in this field, contain many discontinuous veins of chrysotile. The upper layer is about 12 inches thick and the lower one 8 to 10 inches

[3] Hall, A. L., Asbestos in the Union of South Africa: South Africa Geol. Survey Mem. 12, 1918; On the mode of occurrence and distribution of asbestos in the Transvaal: Geol. Soc. South Africa Trans., vol. 21, pp. 1–36, 1918.

thick. The upper one is said to yield about 50 per cent more fiber than the lower. On August 31, 1920, when the property was last visited, a new vein was being opened on the east side of the tributary canyon in which are the main workings, about halfway down to the river. The extent of the fiber zone had not been proved, but it did not appear to be great. The fiber was of excellent quality, and much of it was 2 inches or more long. Prospecting was active in the summer of 1920, and several other deposits of fiber had been found on the property.

Two new deposits were opened in 1920 near Salt River canyon in the vicinity of the Regal mine. The operators are Shanley & Morrison and the Canadian Mining Co., with which is associated E. E. Miller, formerly superintendent of the Regal mine. These properties were not visited but are said to be of promise.

The Penn mine, on the San Carlos Reservation boundary near the top of the south side of Salt River canyon, above the bend in the river locally known as the Pen or Mule Shoe, was not operated during most of 1920.

Another new development in the region south of Salt River was that by A. E. Minium and associates (Globe Asbestos Co.). The most active operations of the company were at a place about 2 miles north of Chrysotile, on an eastward flowing tributary of Ash Creek. The largest workings on the property when visited in August, 1920, are the Locke workings, which are about a mile upstream from the camp site, on a limestone-capped spur that projects southward from the hillside. The limestone is bounded to the north by diabase and is also underlain by diabase, as shown in exposures on the east, south, and west slopes of the spur. The limestone appears to be cut off by an intrusive contact to the north, and the whole limestone cap is probably only a block that was engulfed in the diabase. The work was done principally on the north side of the limestone, where three openings gave access to several hundred feet of tunnels and several stoped chambers. The fiber occurs almost altogether in one layer near the floor of the workings and consists of 1 to 2 feet of serpentine, through which veins of asbestos are distributed rather irregularly. The fiber is pure white and of good quality. The maximum length of the fiber appeared to be about 1½ inches, though as usual partings and inclusions of slivers of serpentine reduced the length of most of the unbroken fiber to less than three-fourths of an inch.

Several other workings on the property, the largest of which was the Bonanza, were opened in small blocks of limestone engulfed in diabase. At the Bonanza two inclines, the longer about 75 feet long, were run close to the diabase contact. Some excellent fiber had been obtained, but the deposit appeared to have been worked out. In the fall the company worked the Clark property, on the south side of Coon Creek Butte, which forms the south end of the Sierra Ancha.

In the country north of Salt River the American Ores & Asbestos Co. was the principal operator. In 1920 a compressor was installed at Pocket Creek and a 4-inch pipe line was run from the compressor to the mine. Operations were actively pushed under the direction of E. B. Shutts and H. E. Hacker. Near the Rock House, in the region east of Cherry Creek that drains into Canyon Creek, the properties of the Alene Asbestos Association and Wightman & Pierce were producing in 1920.

Fort Apache and San Carlos Indian Reservations.—Asbestos occurs at several places in the Fort Apache and San Carlos Indian reservations. It is reliably reported to occur on Sloan Creek, a tributary of Canyon Creek, near the Fort Apache Reservation line and not far from the mine of the Alene Asbestos Association. Above the canyon of Canyon Creek, in the country east of the upper part of Sloan Creek, conditions appear to be unfavorable for the occurrence of asbestos. On the east side of Canyon Creek, in the region opposite the mouth of Rock House Canyon, a small amount of serpentine has been formed in the limestone, but no asbestos was seen. East of the mouth of Canyon Creek several small deposits of asbestos were found on the north side of Salt River between the Salt Bank and Salt River Draw. The fiber is of very good quality, but the deposits observed are small.

A deposit was found about 2 miles up Salt River Draw on the west side of the canyon, just above the first box canyon. Here a 20-foot bed of limestone included in diabase contains two zones of cream-colored serpentine. Fiber occurs in the upper zone through a thickness of about 8 inches. In few places is there more than 2 inches of fiber in the aggregate, although the zone appears to be rather persistent. The longest observed unbroken fiber measured 0.6 inch, although some may be a little longer. The fiber is rather harsh. The Apache Asbestos Co., of Indianapolis, Ind., and Globe, Ariz., has acquired 32 claims in Salt River Draw. These claims probably cover the deposit seen by the writer.

Extravagant reports of the occurrence of fiber on Cibique Creek have been widely circulated. For about 7 miles Cibique Creek flows through an almost impassable canyon. It was traversed by the writer to and beyond the place where the asbestos-bearing rocks pass beneath the ground. No asbestos was found either in place or in the float, but serpentine is abundantly developed where the asbestos-bearing limestone is last seen. This locality might repay prospecting, although the entire absence of asbestos float in the bed of the stream is discouraging. Careful prospecting of at least the lower part of the canyon subsequent to the writer's visit failed to discover more than a trace of asbestos.

The most promising deposits seen on the Fort Apache and San Carlos reservations are in the vicinity of the bend of Salt River known as the Pen or Peninsula or Mule Shoe. One deposit occurs on the north side of the canyon high above the river, and one on the south side. The deposit on the north side lies just below the trail leading out of the canyon. The asbestos occurs in a long sliver of limestone engulfed in diabase. The fiber, which is of excellent quality, is found at several horizons. It is reliably reported that fiber 4 inches long has been found on this property. In January, 1922, two applications were pending for the lease of this deposit. L. R. Jacobson and G. W. Adams, both of Sunlow, Ariz., claim the Horse Shoe group and E. E. Swan and John Carter, of Cibique, claim the Casey Jones group. Both groups cover the same ledge.

Other locations in this region are the Bluff and Cyax groups, which, according to location notices, lie 1 mile northeast of the Pen, and the Ring Cone and Apache groups, which lie "300 yards from Salt River" and apparently below the Horse Shoe group.

On the south side of Salt River, in the San Carlos Reservation, nearly opposite the above-mentioned deposits, there are several promising outcrops of asbestos. The fiber seen is of fair quality, although it is somewhat harsh. A good showing was seen about a third of a mile south of the southeasternmost bend of the river and about 800 feet above it. Two applications for leases have been made in this vicinity, one for the Great View group, by Geo. P. Bartlett and others, and the other for the Pen group, by the Apache Asbestos Co.

In the drainage basin of Salt River, within the reservations, the asbestos-bearing limestone crops out only in the canyons, the mesas being capped by younger rocks. For this reason the limit of the field may be given with some accuracy. On Canyon Creek the limestone extends more than 3 miles above the mouth of Sloan Creek. It extends about 2 miles up Salt River draw and about 3 miles up Cibique Creek. It does not extend up Salt River farther than the mouth of Sawmill Canyon.

One other notable occurrence of asbestos on the San Carlos Indian Reservation is that on Bear Creek, 3 miles east of Cassadero Springs. This deposit has been leased to the Apache Asbestos Co. There are two well-developed and persistent zones of serpentine, each of which contains fiber. The fiber is exceedingly harsh and very little of it is more than three-fourths of an inch long. However, a considerable quantity of shorter fiber is exposed.

Grand Canyon.—In the Grand Canyon asbestos was mined at the mine of W. W. Bass, on the north side of Colorado River in Hakatai Canyon, opposite Bass Camp, which is 23 miles by road west of Grand Canyon station. Mr. Bass mined a small quantity of fiber and later leased the mine to E. L. Quist, who operated during the winter of 1920. A cable crossing has been installed near the mine, which permits the transfer of asbestos, men, and light supplies. The fiber is rather harsh, but the length is good.

New district.—A new deposit of asbestos on the property of Joseph Bowyer, 12 miles northeast of Quartzsite and 9 miles east of Colorado River, has been reported by the Arizona Bureau of Mines. The fiber occurs through a 5-foot bed in limestone into which diabase has been intruded.

CALIFORNIA.

In 1920 asbestos deposits were being developed in four districts in California. The only producers were in Nevada and Shasta counties.

In Nevada County the Sierra Asbestos Co. operated its mill near Washington post office for a short time only. The deposits in Shasta County include both amphibole and chrysotile asbestos. The only output in 1920 was made by the Stock Asbestos Co., which mined some amphibole asbestos from its property near Hazel Creek post office. The deposits of this district were described by J. S. Diller in Mineral Resources for 1914. He states that many small veins of cross-fiber chrysotile are found in a peridotite, now largely altered to serpentine, but the most noteworthy feature of the district is "a remarkable deposit of slip fiber. * * * This clear white fiber, softened by weathering at the outcrop but hard underneath, has a variable thickness, ranging up to 3 or 4 feet. Lengthwise it has been traced more or less continuously for nearly a mile." As the asbestos produced in 1920 is reported to be amphibole, it probably came from this vein. Tests of material collected by Mr. Diller show that the material is anthophyllite. Mr. Diller's reference to the softening of the fiber, by weathering is of much interest, for it supports the view that the fiberization in anthophyllite by weathering may be a far more widespread process than is ordinarily recognized and one which is of much importance in the formation of a commercially valuable deposit of this material.

In Calaveras County the Pacific Asbestos Corporation, an amalgamation of several companies, is building a large mill and is said to have an extensive body of rock carrying about 2 per cent of fiber. The work done in 1920 consisted largely of construction.

There was considerable activity in the newly developed field in Fresno and San Benito counties, although no production was reported for 1920. The California Asbestos Mining Co. operated the property of the San Benito Asbestos Co. on Clear Creek, 3 miles from Samson Mountain, 36 miles west of Coalinga, and 36 miles east of Kings City. The property has been developed by quarries, and a 200-ton mill, which was expected to be in operation early in 1922, was being erected.

In Fresno County the National Magnesia Co. prospected a property on Los Gatos Creek, near Coalinga, with an option to purchase. The property has been developed by 200 feet of tunnel and by open cuts.

WYOMING.

The American Fireproofing & Mining Co. reported a small production of "crude" chrysotile from its property south of Lander. Fred Patee, of Casper, mined from his asbestos property near that city a considerable quantity of serpentine, which was used in making sectional blocks for chimneys. The manufactured product has been classed by the United States Geological Survey as artificial stone and has not been included in the figures showing the production of asbestos. It should be noted, however, that massive serpentine is of the same chemical composition as chrysotile and at high temperatures would probably be even less affected than the delicate fibers of chrysotile.

The Survey has recently received information of the activity of the American Asbestos Milling & Mining Co., of Idaho Falls, Idaho. The property of the company is in Lincoln County, Wyo., near Berry Creek, on the north side of Forellen Peak, which is 7 miles in a direct line south of Yellowstone Park. The company acquired possession of the property in 1917 and has developed it by tunnels and open cuts. In 1920 it built 13 miles of road joining the road to Ashton, Idaho, which is 35 miles from the mine. The descriptions and specimens furnished by the company indicate that the deposit is of the peridotite type. A large mass of peridotite forms the north shoulder of Forellen Peak, and certain zones of this peridotite contain cross-fiber veins of asbestos. Veins of slip-fiber are also common. The slip fiber is somewhat harsh but is the longest on the property and will probably make up a large proportion of the crude. The cross fiber is harsh, and if the specimens shown to the Survey are typical the principal value of the property should lie in the slip fiber.

MONTANA.

The property of the Idaho-Montana Asbestos Co., with offices at Idaho Falls, Idaho, and West Yellowstone, Mont., lies on the headwaters of East Mile Creek, just north of the Idaho-Montana State line and north of Henry Lake. The company was incorporated in 1917, began work that winter, and has done considerable work since then, including diamond drilling.

The asbestos of these deposits is chrysotile and occurs with serpentine in limestone near the contact with intrusive diabase. The serpentine-chrysotile zone lies parallel to the diabase contact, though not directly on it, and in developing this deposit it should be held clearly in mind that the asbestos-bearing zone has a definite relation to the diabase contact, the inner boundary of the zone commonly lying within 15 feet of it.

GEORGIA.

The Sall Mountain Company continued to operate its deposit of mass-fiber anthophyllite at Sall Mountain, in White County, Ga. The mill of the company is at Gainesville, about 27 miles south of the mine.

MARYLAND.

The Powhatan Mining Co. has continued to mine asbestos suitable for chemical filters from deposits in Harford County, Md. A recent microscopic examination of the material shows that it is anthophyllite. The anthophyllite occurs in slip-fiber veins. The fresh mineral is harsh and splintery, but near the surface of the ground, where it has been affected by weathering, fiberization has taken place and the mineral is soft and flexible. The fiber is treated by a process that frees it from impurities. So far as known to the Geological Survey this is the only domestic asbestos that is suitable for making filter mats.

VERMONT.

In 1920 the Asbestos Corporation of America acquired the property on the southwestern slope of Belvidere Mountain, Lamoille County, Vt., which formerly belonged to the New England & United States Asbestos Corporation. This company also controls the Vermont & Quebec Power Corporation, which has developed power at Stevens Mills. A 21-mile transmission line was constructed, and a mill has been built at the property on Belvidere Mountain. This mill is connected by an inclined railroad over a mile long with the storehouse at the foot of the mountain. At the end of 1920 surface development was under way, although production had not yet been started. The deposit is of the slip-fiber type, and a large body of fiber-bearing rock is said to be in sight.

IMPORTS AND EXPORTS.

Asbestos (unmanufactured) imported into the United States, 1913-1920, in short tons.

[General imports.]

Source.	1913	1914	1915	1916	1917	1918	1919	1920	
								Quantity.	Value.
Australia								3	$1,313
British India							1		
British South Africa				112	1,791	837	900	2,233	403,950
Canada	96,951	71,781	93,565	114,978	131,525	134,813	133,662	162,717	7,690,165
China							1	17	3,441
Colombia						1			
England	1			1,072	296		156	746	236,361
France							450		
Germany	19	11	1						
Greece								81	6,052
Italy	6	2						3	1,034
Japan								100	30,000
Portuguese Africa					496	2,049	100	1,584	722,197
Russia in Europe	168	72							
Turkey in Asia								74	25,740
	97,145	71,866	93,566	116,162	134,108	137,700	135,270	167,558	
Value (dollars)	1,928,705	1,407,758	1,981,483	3,303,470	4,521,172	6,337,585	7,369,685		9,120,253

The exports of asbestos manufactured in the United States were valued at $4,431,132, which represents an increase of 25 per cent over the exports in 1919.

WORLD'S PRODUCTION.

The table below shows the asbestos mined and sold in all countries since 1913. This table shows clearly the dominant position of Canada, which in 1913 and 1920 produced 86 per cent of the total output of the world. In 1913 Russia produced 12 per cent of the total, but there appears to have been no output from Russia in 1920. This loss is offset by the gain in the output of British South Africa, which rose between 1913 and 1920 from 0.8 per cent of the total to 12.4 per cent. The output of British South Africa in 1920 is equivalent to 16.2 per cent of the world's total in 1913. About one-third of the South African output, however, is crocidolite and amosite. Although these minerals are inferior to chrysotile of "crude" length yet they compete with short-fiber chrysotile, and even after mining is resumed in Russia British South Africa will probably be a keen competitor.

World's production of asbestos, 1913-1920, by countries, in metric tons.

Country.	1913	1914	1915	1916	1917	1918	1919	1920
Australia:								
New South Wales[a]					5		145	(b)
South Australia[c]				22				5
Tasmania[d]				15	275	2,900	52	
West Australia[e]							54	159
British South Africa:								
Rhodesia[f]	263	442	1,823	5,586	8,675	7,778	8,889	17,076
Union[g]	873	1,080	1,940	4,221	5,642	3,333	3,567	6,452
Canada[h]	124,239	87,580	100,826	121,053	122,925	128,334	124,070	162,037
China[i]					378	243	69	(b)
Chosen[j]							118	(b)
Cyprus[k]	1,187	250	1,117	1,312	1,086	232	1,352	910
India[l]					150	363	394	(b)
Italy[m]	175	171	163	82	85	60	98	(b)
Philippine Islands[n]						70	375	(b)
Russia[o]	17,494	15,691	9,779	8,192	(b)			
United States	998	1,131	1,570	1,342	1,527	909	1,053	1,495
	145,229	106,345	117,218	141,828	140,748	144,222	140,236	[p] 189,000

[a] New South Wales, Dept. Mines Repts.
[b] Figures not yet available.
[c] South Australia Dept. Mines, Review of mining operations.
[d] Tasmania, Repts. Secretary Mines.
[e] Western Australia, Repts. Secretary Mines. 1913-1918.
[f] Southern Rhodesia Secretary Mines, Ann. Repts.
[g] Union of South Africa Secretary Mines, etc., Ann. Repts.
[h] Canada Dept. Mines, Mines Branch, Ann. Repts. of mineral production.
[i] U. S. Dept. Commerce, Commerce Rept. 77, Apr. 1, 1920. Figures in table above in part estimated from values.
[j] American consul, Tokyo. Data from Japan Dept. Agr. and Commerce, Mining Bur.
[k] Imperial Mineral Resources Bur., The mineral industry of the British Empire and foreign countries—Asbestos, war period (1913-1919), p. 28, 1921. Official figures for 1919-1920 furnished to the American diplomatic agency, Cairo, Egypt.
[l] India Geol. Survey Records.
[m] 1913-1918, Rivista del servizio minerario. 1919, Revista minera, metalúrgica y de ingeniería, Jan. 24, 1921.
[n] Philippine Bur. Sci., Div. Mines, Mineral Resources.
[o] Mining Jour., London, Feb. 9, 1918. Figures for 1915 and 1916 are estimated.
[p] Total includes estimates for figures not yet available.

As the United States depends so largely on Canada for its supply of asbestos, the result of a study of some of the figures showing the Canadian production and prices is given in the accompanying diagram. The figures on which the curves are based have been obtained from the annual reports of the departments of mines of Canada and Quebec.

Curve 1 shows the proportion of asbestos recovered from all the rock broken. The recovery is very uniform, ranging from about 5 to 5.5 per cent. Much waste rock is sorted in the pits, so the rock actually milled is considerably richer in fiber than the average rock broken. Curve 2 shows the total material extracted from rock sufficiently rich in fiber to repay treatment. This rock is also of very uniform grade, its asbestos content ranging only from about 6 to 6.5 per cent. These figures, showing the quantity of material extracted both from rock broken and from mill rock, prove the high grade of the Quebec deposits.

Anyone who is planning to develop a deposit of mill-fiber asbestos in the United States should take into consideration the high content of asbestos in the deposits in Quebec, the vast quantity of rock handled there (which makes the cost of extraction extremely low), and the high quality of the Quebec fiber.

As a large part of the asbestos produced in the United States is of the grade known as "crude" and as the prices of the domestic material are governed by the Canadian prices, the figures showing the production of Canadian "crude" are analyzed and the average prices given as shown in the official reports above mentioned. Curve 3 shows the proportion of "crude" in the total rock broken during the period for which figures are available. The figures showing production prove that, although the quantity of rock treated and consequently the total amount of fiber produced has greatly increased, yet the actual quantity of "crude" produced annually has remained nearly constant. In the Canadian field "crude" is to be considered simply a valuable by-product, the strength of the industry being based on the output of mill fiber.

Curve 4 shows the proportion of "crude" and "fiber" produced. The figures for 1910 to 1920 represent the actual output, but those

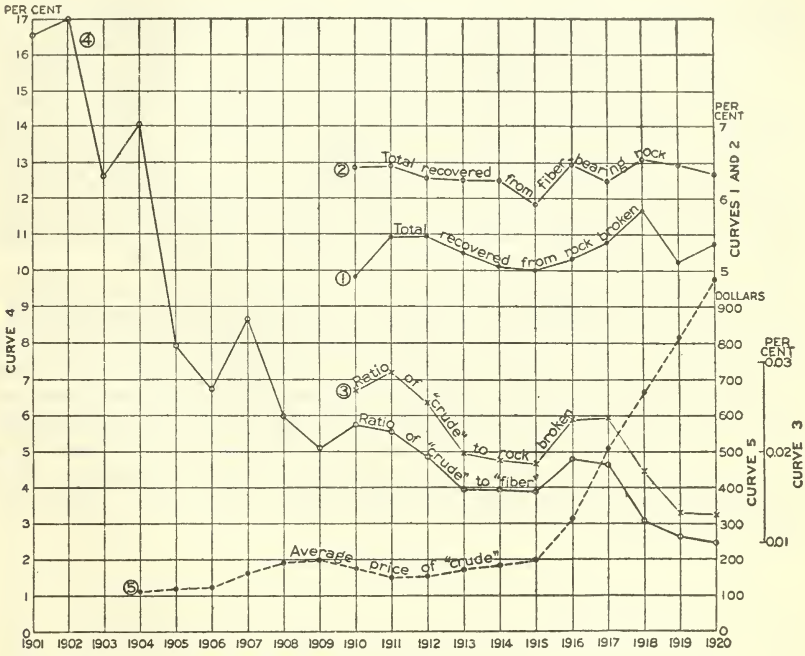

FIGURE 15.—Diagram showing recovery and price of Canadian crude asbestos.

for 1901 to 1910 represent sales. Although the sales for any one year are not quite the same as the output, yet a curve plotted for a number of years from figures representing sales will show the same trend as one plotted from figures representing output.

As the ratio of "crude" to "fiber" is directly proportionate to the quantity of "crude" in the rock broken, as shown by the parallelism of curves 3 and 4, curve 4 indicates the great decrease in the proportion of "crude" in the rock broken.

Curve 5 shows the average price of all "crude" sold. It seems to indicate that the recent great rise in the price of "crude" was due not so much to a decrease or lack of increase in supply as to an increase in demand, which was due in part to the ever-increasing use of asbestos textiles.

PREPARATION AND GRADING.

"Crude" asbestos is invariably cobbed and sorted by hand, although simple screening may supplement the handwork. The mill fiber is separated from the crushed rock by the well-known pneumatic processes. Experimental work has recently been done on a wet process of concentration, which is claimed to give satisfactory results. In the Arizona field it has been customary to grade the crude fiber as run of mine between certain lengths. The grades have not been well standardized, but the common practice is to grade all material in which the fiber is over three-fourths inch in length as crude No. 1. However, fiber more than 2 inches long is occasionally graded separately. The material known as crude No. 2 usually includes that in which the fiber ranges in length from three-eighths to three-fourths inch. In this field a further distinction is sometimes made by grading the harsh and the soft fiber separately. In the Canadian field, where the product is almost entirely mill fiber, the practice of grading the fiber by screen tests has recently become common. The screens used are one-half, one-fourth, and one-tenth inch mesh. One pound of fiber is used in a test. After shaking the machines in a specified manner for two minutes, the number of ounces remaining on each screen and passing through the smallest is recorded. Thus 1–8–5–2 indicates that 1 ounce remained on the one-half-inch screen, 8 ounces on the one-fourth-inch screen, and so on.

The table below shows screen tests of several grades of asbestos. The grades in the left-hand section are taken from the catalog of a leading dealer. The screen tests given are rough average figures for the qualities listed under each grade. The right-hand section gives the figures for certain grades adopted by the Asbestos Mine Operators' Association of the Province of Quebec at a meeting held in September, 1921. Although Canadian fiber has been sold for some time on a basis of screen tests, there have been no standard grades. This standardization of grades will therefore be a great help to the consumers of asbestos.

Screen tests of grades of asbestos.

Dealer's catalog.		Operators' Association.	
Grade.	Screen tests.	Grade.	Screen tests.
Crude No. 1	Average 1 inch.		
Crude No. 2	Average ½ inch.		
		Mill 2 B	4–7–4–1.
Long spinning fibers	2–9–4–1.		
Short spinning fibers	0–8–6–2.	Mill X	0–8–6–2.
Magnesia and compressed sheet fiber	0–6–6–4.		
		No. 1	0–2–10–4.
Shingle stock	0–1½–9½–5.	No. 2	0–1½–9½–5.
		No. 1	0–0–9–7. [a]
Paper stock	0–0–10–6.	No. 2	0–0–10–6.
Cement stock	0–0–6–10.		
Floats	0–0–0–16.		

[a] Half an ounce on No. 2 screen.

CLAY-WORKING INDUSTRIES IN 1919 AND 1920.

By Jefferson Middleton.

GENERAL CONDITIONS.

This report deals with the products of the clay-working industries as well as with clay mining, and the tables are made up to show the output of manufactured clay products in their first form as best expressing the commercial production of clay.

The increase in value of clay products in recent years—from \$160,000,000 in 1915 to nearly \$374,000,000 in 1920—has been steady, except in 1918. This increase is due largely to increase in price, although most of the products have increased in quantity also. The average increase in price per unit in the clay wares for which statistics of prices are available was about 115 per cent from 1916 to 1920.

The clay-working industry was one of the few that were subjected to Government restriction in output during the World War. This restriction had a marked effect on the production during 1918, except in the pottery branch of the industry. The use of some pottery products in war industries and the decrease in imports caused an unusual demand for domestic pottery, and it has increased steadily in value of output since 1914.

The removal of war-time restrictions, the partial return to normal conditions, and the crying need of the country for buildings of all kinds, which consume the greater portion of the clay products, caused a great increase in the output and value of brick and tile products marketed in 1919. Every kind of brick and tile product, except fire brick, made a gain in quantity as well as value in that year. These increases were made in spite of the shortage of labor, fuel, and transportation and the timidity of capital to invest in new buildings on account of the high cost of construction and the consequent small returns on the investment. The large decrease in 1919 in the output and value of fire brick, which was used in immense quantities in the manufacture of munitions during the war, was only natural, and another cause for the decrease was the strike in the steel industry, the principal consumer of fire brick. In 1920 the fire-brick industry rallied to a value higher than that of 1918.

In 1920 the clay-working industries experienced no general or prolonged strikes, though minor strikes occurred in the brick-making and pottery industries, which were also affected adversely by strikes in the building industries; but the high cost of the products, the shortage of coal and cars (especially early in the year), and the high and increasing freight rates were the greater handicaps. Some of these conditions improved during the year, but the high freight rates seem to be the greatest obstacle to the larger development of the brick industry and if continued may cause the industry to become again only local—a result which might not, however, prove to be an unmixed evil, as it might lead to the establishment of plants nearer the points of consumption and thus reduce the cost to the consumer.

The fact that housing conditions improved but little during these years, owing chiefly to the high cost of construction, accounts largely for the smallness of the increase in the output of the principal clay structural materials. The cost, and consequently the selling price, of these materials rose steadily in 1919 and reached their peak in the summer of 1920, after which there was a decline, but at the end of 1920 prices were far above normal, though still declining.

The number of firms reporting sales continues to decrease, the number for 1920 being the smallest in the history of the industry and less than half of the maximum number reporting for 1899. The decrease, which has been a steady one for many years, is caused principally by the elimination or inactivity of the smaller plants, which is ascribed to the encroachment of cement or concrete and to the consolidation of plants for more efficient management. The increase in the size of the operations is shown by the increase in the average value of the output per active operator reporting, which was $13,760 in 1899 and $137,581 in 1920. The number of operators does not indicate the number of plants, as one operator may have more than one plant—in fact, some operators have a half dozen or more. Clay products, except those of the highest grades, are restricted in distribution because their low value precludes transportation for any considerable distance. Hence local conditions, including weather, seriously affect some branches of the clay-working industries.

The total value of clay products of domestic manufacture in the United States rose from $220,573,493 in 1918 to $275,346,378 in 1919 and to $373,670,102 in 1920, the yearly increases being about 25 per cent and 36 per cent, respectively. In 1919 the increase in value of brick and tile products—structural, engineering, and miscellaneous heavier products—was 26 per cent and in pottery products 22 per cent, and in 1920 the increases were 35 per cent and 37 per cent, respectively.

The structural clay products as a whole (mainly brick and tile) produced in 1920 were valued at $153,202,547, or 57.4 per cent of the total of all brick and tile products, as compared with $110,632,569, or 56 per cent in 1919, and with $66,209,300 in 1918. Engineering products (vitrified brick, sewer pipe, and draintile) rose in value from $30,675,231 in 1918 to $39,315,919 in 1919 and to $50,574,213 in 1920, when they constituted 18.9 per cent of the total brick and tile products; refractories (fire brick, stove lining, and some special shapes), which decreased considerably in 1919, increased in value from $38,976,093 in 1919 to $54,978,575 in 1920, when they constituted 20.6 per cent of the total; and the value of miscellaneous products, excluding some refractory special shapes, constituted 3.1 per cent of the total value of brick and tile in 1920.

PRODUCTION.

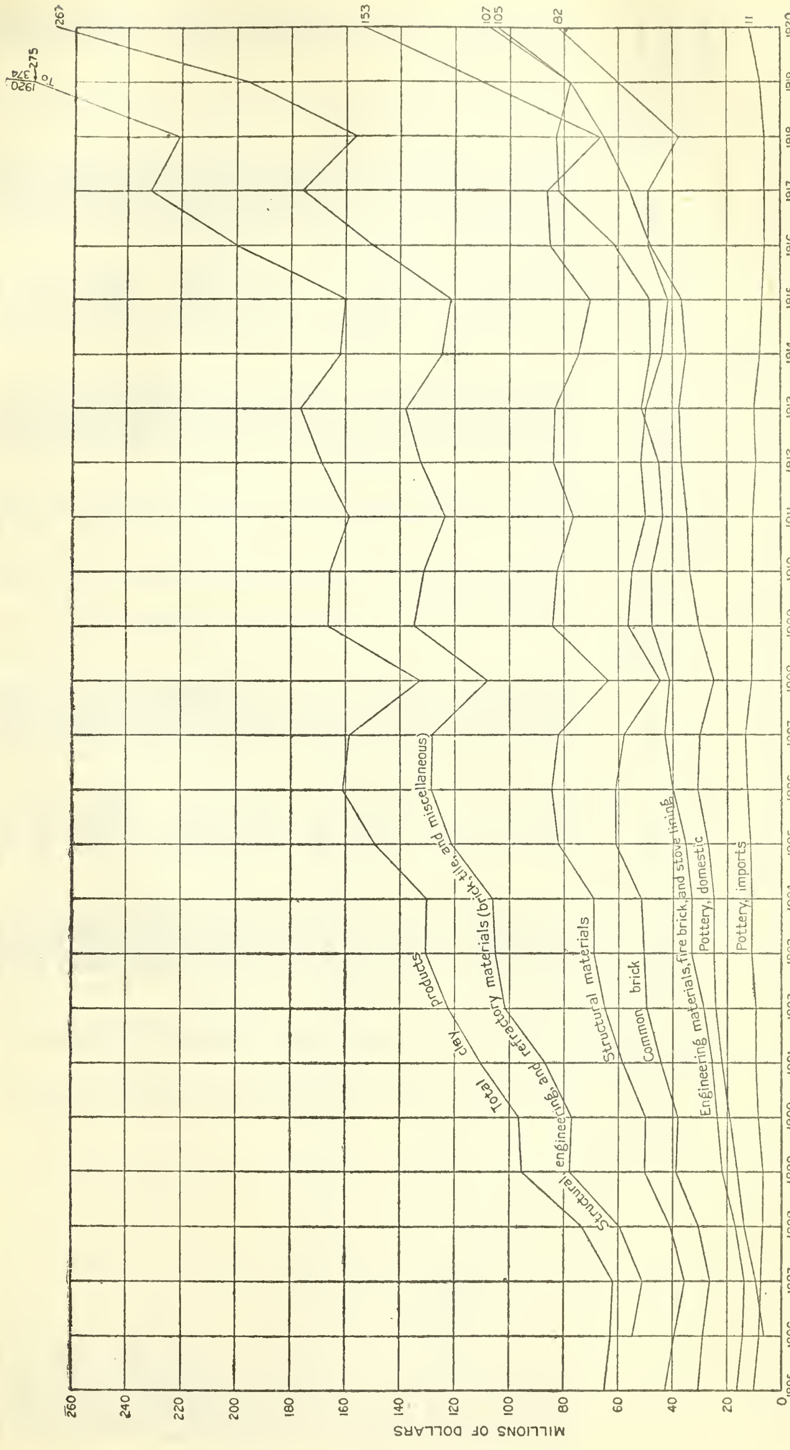

FIGURE 16.—Value of clay products sold in the United States, 1895–1920.

Value of clay products sold in the United States in 1919 and 1920, with increase or decrease.

State.	1919						1920						Increase or decrease, 1920 (per cent).
	Rank of State.	Number of firms reporting sales.	Brick and tile.	Pottery.	Total.	Percentage of total value.	Rank of State.	Number of firms reporting sales.	Brick and tile.	Pottery.	Total.	Percentage of total value.	
Alabama	18	50	$2,748,071	$33,253	$2,781,324	1.0	21	53	$3,386,806	$35,340	$3,422,146	0.9	+23.0
Arizona	43	13	a 188,034	1,182	a 189,216	.1	45	13	162,489	840	163,329	......	−13.7
Arkansas	27	24	a 1,229,296	(b)	a b 1,229,296	b .4	28	24	1,353,761	(b)	b 1,353,761	b .4	+10.1
California	10	66	4,911,271	923,377	5,834,648	2.1	9	65	9,322,633	1,623,790	10,946,423	2.9	+87.6
Colorado	21	49	2,469,693	192,978	2,662,671	1.0	19	49	3,353,190	318,051	3,671,241	1.0	+37.9
Connecticut and Rhode Island	22	32	2,350,329	(c)	b 2,350,329	b .9	24	31	3,051,521	(c)	b 3,051,521	b .8	+29.8
Delaware } District of Columbia }	40	26	284,429	(d)	b 284,429	b .1	42	13	279,005	......	279,005	.1	......
							47	3	60,880	(b)	b 60,880	......	......
Florida and Porto Rico	44	14	185,135	(b)	b 185,135	b .1	41	16	313,150	(b)	b 313,150	b .1	+69.1
Georgia	14	68	3,772,632	23,528	3,796,160	1.4	14	63	5,548,609	24,390	5,572,999	1.5	+46.8
Idaho and Nevada	38	13	310,192	......	310,192	.1	39	15	355,197	......	355,197	.1	+14.5
Illinois	4	142	15,303,913	2,104,109	17,408,022	6.3	4	156	23,187,613	2,950,806	26,138,419	7.0	+50.2
Indiana	7	163	9,567,305	2,066,792	11,634,097	4.2	8	149	12,383,513	3,111,282	15,494,795	4.1	+33.2
Iowa	9	115	8,107,601	(b)	b 8,107,601	b 2.9	10	109	10,439,957	(b)	b 10,439,957	b 2.8	+28.8
Kansas	16	30	3,426,002	......	3,426,002	1.2	15	33	4,921,740	(b)	b 4,921,740	b 1.3	+43.7
Kentucky	12	49	5,501,070	210,187	5,711,257	2.1	11	45	7,064,770	244,424	7,309,194	2.0	+28.0
Louisiana	33	21	759,386	(b)	b 759,386	b .3	33	19	955,608	(b)	b 955,608	b .3	+25.8
Maine	35	19	612,562	......	612,562	.2	34	20	838,258	......	838,258	.2	+36.9
Maryland	20	37	2,247,092	487,049	2,734,141	1.0	17	33	3,405,335	567,843	3,973,178	1.1	+45.3
Massachusetts	24	41	1,940,825	313,325	2,254,150	.8	20	51	3,076,294	422,084	3,498,378	.9	+55.2
Michigan	11	60	3,699,929	2,096,874	5,796,803	2.1	13	55	3,979,691	2,592,625	6,572,316	1.8	+13.4
Minnesota	23	36	2,287,906	(b)	b 2,287,906	b .8	23	38	3,341,477	(b)	b 3,341,477	b .9	+46.0
Mississippi	32	34	934,827	16,334	951,161	.4	32	30	1,058,285	17,467	1,075,752	.3	+13.1
Missouri	8	65	10,977,132	20,817	10,997,949	4.0	6	73	17,443,458	31,084	17,474,542	4.7	+58.9
Montana	36	10	394,899	......	394,899	.1	37	20	407,984	......	407,984	.1	+3.3
Nebraska	31	31	1,038,668	(b)	b 1,038,668	b .4	30	33	1,211,868	(b)	b 1,211,868	b .3	+16.7
New Hampshire e	e 34	e 15	e 712,551	(f)	b e 712,551	b e .3	36	11	650,697	......	650,697	.2	......
New Jersey	3	126	10,228,430	16,317,529	26,545,959	9.6	3	137	15,423,652	24,597,376	40,021,028	10.7	+50.8
New Mexico	41	7	234,218	900	235,118	.1	38	8	369,850	3,750	373,600	.1	+58.9
New York	5	120	8,835,231	5,633,355	14,468,586	5.2	5	142	11,805,401	7,308,283	19,113,684	5.1	+32.1
North Carolina	17	109	3,238,249	17,240	3,255,489	1.2	18	102	3,869,981	15,007	3,884,988	1.0	+19.3
North Dakota	39	6	303,657	......	303,657	.1	40	4	350,548	......	350,548	.1	+15.4
Ohio	1	416	33,503,302	30,284,017	63,787,319	23.2	1	386	40,832,157	41,229,803	82,061,960	21.9	+28.6
Oklahoma	25	27	2,190,129	......	2,190,129	.8	26	31	2,769,013	......	2,769,013	.7	+26.4
Oregon	37	24	378,963	(b)	b 378,963	b .1	35	26	719,486	(b)	b 719,486	b .2	+89.9
Pennsylvania	2	336	34,601,486	4,669,127	39,270,613	14.3	2	307	45,369,339	5,614,649	50,983,988	13.6	+29.8

South Carolina	30	26	1,058,196	13,275	1,071,471	.4	29	22	1,256,047	16,100	1,272,147	.3	+18.7
South Dakota	45	4	73,571	......	73,571	......	46	3	69,237	......	69,237	......	-5.9
Tennessee	15	53	2,882,740	564,646	3,447,386	1.3	16	43	3,796,978	649,708	4,446,686	1.2	+29.0
Texas	13	76	4,357,673	95,324	4,452,997	1.6	12	67	6,164,854	133,553	6,298,407	1.8	+41.4
Utah	29	25	1,071,997	(b)	b 1,071,997	b .4	31	16	1,107,204	(b)	b 1,107,204	b 3	+3.3
Vermont e	(e)	(e)	(e)	......	(e)	(e)	44	3	186,752	......	186,752	......	......
Virginia	19	46	2,724,629	49,944	2,774,573	1.0	22	50	3,267,017	68,205	3,335,222	.9	+20.2
Washington	26	31	1,736,190	28,074	1,764,264	.6	25	34	2,863,030	60,657	2,923,687	.8	+65.7
West Virginia	6	59	2,711,098	a 10,386,500	a 13,097,598	4.8	7	55	3,507,130	13,660,713	17,167,843	4.6	+31.1
Wisconsin	28	52	1,203,757	(b)	b 1,203,757	b .4	27	51	1,413,255	(b)	b 1,413,255	b .4	+17.4
Wyoming	42	10	194,350	......	194,350	.1	43	9	258,706	......	258,706	.1	+33.1
Undistributed	......	......	......	1,308,026	1,308,026	.5	......	......	......	1,418,846	1,418,846	.4	+8.5
	......	2,776	a 197,488,616	a 77,857,762	a 275,346,378	......	......	2,716	266,953,426	106,716,676	373,670,102	......	+35.7
Percentage of total	......	......	71.7	28.3	100.0	......	......	......	71.4	28.6	100.0	......	......

a Revised figures.
b Pottery included under "Undistributed."
c Produced in Connecticut alone and included under "Undistributed."
d Produced in the District of Columbia alone and included under "Undistributed."
e In 1919, figures for Vermont are included with those under New Hampshire.
f Produced in New Hampshire alone and included under "Undistributed."

Clay products sold in the United States in 1918–1920.

[Quantity is given in thousands and average price is given per thousand, except as otherwise specified.]

Product.	1918	1919 [a]	1920	Increase or decrease (per cent). 1919	Increase or decrease (per cent). 1920
Common brick:					
Quantity	3,556,519	4,751,881	4,851,626	+33.6	+2.1
Value	$38,782,458	[a] $63,584,748	$82,216,230	+64.0	+29.3
Average price	$10.90	$13.38	$16.95	+22.8	+26.6
Face brick:					
Quantity	356,394	791,068	786,614	+122.0	-.6
Value	$6,095,120	$16,033,059	$19,440,968	+163.0	+21.3
Average price	$17.10	$20.27	$24.71	+18.5	+21.9
Enameled brick:					
Quantity	(b)	14,166	11,178	....	-21.1
Value	$480,772	[a] $846,676	$1,040,323	+76.1	+22.9
Average price	....	$59.77	$93.07	....	+55.7
Fancy or ornamental brick:					
Quantity	(b)	2,198	1,017	....	-53.7
Value	$73,086	$77,879	$71,081	+6.6	-8.7
Average price	....	$35.43	$69.89	....	+97.3
Hollow building tile or block:					
Quantity (short tons)	1,953,392	2,329,217	2,579,068	+19.2	+10.7
Value	$13,037,102	[a] $17,964,573	$27,112,007	+37.8	+50.9
Average price per ton	$6.67	$7.71	$10.51	+15.5	+36.3
Tile, not drain	$5,082,069	$8,137,452	$12,470,036	+60.1	+53.2
Architectural terra cotta:					
Quantity (short tons)	(b)	(b)	77,826	....	....
Value	$2,658,693	[a] $3,988,182	$10,851,902	+50.0	+172.1
Average price per ton	....	....	$139.44	....	....
Vitrified brick or block:					
Quantity	402,816	489,242	468,494	+21.5	-4.2
Value	$7,145,359	$11,615,144	$12,678,557	+52.6	+9.2
Average price	$17.74	$23.74	$27.06	+33.8	+14.0
Sewer pipe:					
Quantity (short tons)	(b)	1,155,131	1,187,378	....	+2.8
Value	$15,333,673	[a] $16,754,832	$25,371,015	+9.3	+51.4
Average price	....	$14.50	$21.37	....	+47.4
Draintile:					
Quantity (short tons)	(b)	1,241,168	1,191,290	....	-4.0
Value	$8,196,199	[a] $10,945,943	$12,524,641	+33.5	+14.4
Average value per ton	....	$8.82	$10.51	....	+19.2
Fire brick:					
Quantity	1,222,352	963,439	1,114,809	-21.2	+15.7
Value	$51,647,639	$38,015,792	$53,415,888	-26.4	+40.5
Average price	$42.25	$39.46	$47.91	-6.6	+21.4
Stove lining	$673,953	$683,844	$779,710	+1.5	+14.0
Miscellaneous	$7,455,577	$8,840,492	$8,981,068	+18.6	+1.6
Total brick and tile	$156,661,700	[a] $197,488,616	$266,953,426	+26.1	+35.2
Total pottery	[a] $63,911,793	[a] $77,857,762	$106,716,676	+21.8	+37.1
Grand total	[a] $220,573,493	[a] $275,346,378	$373,670,102	+24.8	+35.7

[a] Revised figures. [b] Figures not available.

Clay products sold in the United States, 1911–1920.

Year.	Number of firms reporting sales.	Common brick. Thousands.	Common brick. Value.	Common brick. Average price.	Vitrified brick or block. Thousands.	Vitrified brick or block. Value.	Vitrified brick or block. Average price.
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
1915	3,636	6,851,099	42,145,292	6.15	953,335	12,230,899	12.83
1916	3,412	7,394,202	49,357,411	6.68	941,553	12,236,890	13.00
1917	3,153	5,864,909	47,936,344	8.17	706,934	10,664,560	15.09
1918	2,783	3,556,519	38,782,458	10.90	402,816	7,145,359	17.74
1919	2,776	4,751,881	[a] 63,584,748	13.38	489,242	11,615,144	23.74
1920	2,716	4,851,626	82,216,230	16.95	468,494	12,678,557	27.06

[a] Revised figures.

Clay products sold in the United States, 1911–1920—Continued.

Year.	Face brick. Thousands.	Face brick. Value.	Face brick. Average price.	Fancy or ornamental brick.	Enameled brick.	Architectural terra cotta.	Hollow building tile and fireproofing.	Tile, not drain.
1911	724,911	$8,648,877	$11.93	$177,015	$1,038,865	$6,017,801	$5,660,172	$5,356,184
1912	814,007	9,455,297	11.62	225,367	1,027,314	8,580,436	7,174,148	5,809,495
1913	827,665	9,614,138	11.62	109,703	1,225,708	7,733,306	8,620,216	6,109,180
1914	810,395	9,289,623	11.46	124,459	1,075,026	6,087,652	8,385,337	5,705,583
1915	855,668	9,535,536	11.14	109,425	835,808	4,796,062	7,800,938	5,186,055
1916	1,002,762	11,464,614	11.43	109,072	827,443	6,466,336	9,942,912	6,475,464
1917	757,618	10,391,368	13.72	192,072	889,899	6,173,550	13,255,433	6,821,221
1918	356,394	6,095,120	17.10	73,086	480,772	2,658,693	13,037,102	5,082,069
1919	791,068	16,033,059	20.27	77,879	a 846,676	a3,988,182	a17,964,573	8,137,452
1920	786,614	19,440,968	24.71	71,081	1,040,323	10,851,902	27,112,007	12,470,036

Year.	Draintile.	Sewer pipe.	Stove lining.	Fire brick.b	Miscellaneous.	Total brick and tile.b	Pottery.	Grand total.b
1911	$8,826,314	$11,454,616	$614,116	$13,553,870	$2,847,971	$125,196,805	$34,518,560	$159,715,365
1912	8,010,250	12,147,677	516,874	14,954,455	2,764,783	133,383,937	36,504,164	169,888,101
1913	8,558,320	14,872,103	535,667	16,811,316	3,018,316	139,480,951	37,992,375	177,473,326
1914	8,522,039	14,014,767	520,585	13,476,022	3,165,814	126,637,297	35,398,161	162,035,458
1915	8,879,264	11,259,349	459,341	15,800,062	3,716,944	122,754,975	37,325,388	160,080,363
1916	10,083,647	13,577,006	601,776	24,436,873	7,094,149	152,673,593	48,217,242	200,890,835
1917	11,008,163	17,307,211	619,882	42,501,669	8,588,879	176,350,251	56,162,522	232,512,773
1918	8,196,199	15,333,673	673,953	51,647,639	7,455,577	156,661,700	a63,911,793	a220,573,493
1919	a10,945,943	a16,754,832	683,844	38,015,792	8,840,492	a197,488,616	a77,857,762	a275,346,378
1920	12,524,641	25,371,015	779,710	53,415,888	8,981,068	266,953,426	106,716,676	373,670,102

a Revised figures. b Figures for 1911 to 1915, inclusive, revised to exclude silica brick.

Value of refractory and nonrefractory clay products of the United States, 1916–1920.

Class.	1916	1917	1918	1919	1920
Refractory:					
Fire brick, including refractory block or tile, boiler and locomotive tile and tank blocks, and similar refractory products	$24,436,873	$42,501,669	$51,647,639	$38,015,792	$53,415,888
Other fire brick, including some special shapes	311,052	473,713	404,657	276,457	782,977
Stove lining	601,776	619,882	673,953	683,844	779,710
Zinc retorts	1,553,691	1,514,027	1,181,334	949,820	951,571
Glass melting pots and other glasshouse refractories	1,989,754	3,179,336	2,791,908	2,294,152	2,273,386
Gas retorts	35,821	(a)	(a)	(a)	(a)
Charcoal furnaces (portable)	27,280	40,568	34,552	43,230	29,566
Muffles, scorifiers, assay supplies, and crucibles. (Other crucibles are included with chemical porcelain and chemical stoneware)	364,563	178,941	152,222	64,955	139,173
Saggers. (Prior to 1917 statistics for saggers were not collected from the sagger consumer manufacturing for his own use)	34,476	122,000	593,623	2,115,637	1,666,551
Chemical porcelain and chemical stoneware	1,054,061	1,099,432	1,769,710	805,321	1,273,511
Mantle, rings, and special ware for gas lighting and heating, including magnesia ware and refractory porcelain for electric ranges and heaters	220,849	247,997	247,207	294,750	756,444
Potters' supplies (pins, stilts, and spurs)	188,643	224,343	275,545	345,494	255,058
Undistributed	....	16,854	20,666	754,554	84,895
	30,818,839	50,218,762	59,793,016	46,644,006	62,408,730

a Reported by less than 3 producers; included under "Undistributed" refractory products.

Value of refractory and nonrefractory clay products of the United States, 1916–1920—Con.

Class.	1916	1917	1918	1919	1920
Nonrefractory:					
Common brick	$49,357,411	$47,936,344	$38,782,458	[a]$63,584,748	$82,216,230
Vitrified brick or block	12,236,890	10,664,560	7,145,359	11,615,144	12,678,557
Face brick	11,464,614	10,391,368	6,095,120	16,033,059	19,440,968
Fancy or ornamental brick	109,072	192,072	73,086	77,879	71,081
Enameled brick	827,443	889,899	480,772	[a] 846,676	1,040,323
Draintile	10,083,647	11,008,163	8,196,199	[a]10,945,943	12,524,641
Sewer pipe	13,577,006	17,307,211	15,333,673	[a]16,754,832	25,371,015
Architectural terra-cotta	6,466,336	6,173,550	2,658,693	[a] 3,988,182	10,851,902
Fireproofing and hollow building tile or block	9,942,912	13,255,433	13,037,102	[a]17,964,573	27,112,007
Conduits	([b])	1,227,668	354,601	490,249	1,380,926
Roofing tile	914,240	871,872	729,981	1,283,901	1,532,588
Floor tile	1,438,231	1,325,516	1,075,474	1,535,287	2,253,848
Ceramic mosaic tile	1,308,861	1,481,505	956,456	1,824,372	3,188,321
Faïence tile	814,077	1,007,005	724,734	881,241	816,047
Wall tile	2,000,055	2,135,323	1,595,424	2,612,651	4,679,232
Zinc condensers	512,453	496,691	408,794	634,199	519,941
Chemical or acid-proof brick, block, and tile, cylinders, rings, and other forms of tower packing used in the manufacture of acids at nitrate plants, and in petroleum refineries	([c])	([c])	764,588	3,951	20,714
Red earthenware	1,156,351	1,065,185	906,861	1,298,311	1,766,919
Red and brown white-lined cooking ware	([c])	([c])	([c])	723,981	715,902
Stoneware and yellow and Rockingham ware	3,696,288	3,865,825	4,454,164	4,603,018	5,475,660
White ware, including C. C. ware, white granite, semiporcelain ware, and semivitreous porcelain ware	18,191,390	20,920,469	25,305,926	29,847,261	38,323,880
China, bone china, delft and belleek ware	3,478,372	4,805,906	6,307,349	7,708,832	11,340,093
Sanitary ware	11,111,417	12,636,217	11,241,138	14,872,364	22,014,651
Porcelain electrical supplies	7,034,420	9,451,586	[a]11,194,812	12,614,794	20,218,924
Turpentine cups	284,218	([c])	25,289	255,666	280,845
Art pottery	619,558	870,229	722,586	812,038	933,370
Tobacco pipes	44,921	72,827	66,459	9,132	58,602
Hardware supplies and trimmings and door knobs	78,168	43,275	([b])	164,962	157,371
Toy marbles	75,304	77,243	([b])	161,623	188,553
Cooking ware, including porcelain cooking utensils (other cooking ware probably is included under stoneware)	478,805	316,991	425,822	([b])	([b])
Miscellaneous (mostly nonrefractory) [d]	2,769,536	1,804,078	1,717,557	4,553,503	4,088,261
	170,071,996	182,294,011	160,780,477	228,702,372	311,261,372
Grand total	200,890,835	232,512,773	[a]220,573,493	[a]275,346,378	373,670,102

[a] Revised figures.
[b] Included under "Miscellaneous."
[c] Not separately classified.
[d] Including adobes, aquarium ornaments, arch brick for foundations, bitumenized block, burnt-clay ballast, chemical brick, pipes, rings, and tiling for acid towers, chimney pots, pipes, crocks, tops, and thimbles, chuck (broken ware), clay pigeons, crushed tile for roofing, doll heads, drop bombs, porcelain filter tubes, water filters and filter stones, flue lining, garden pottery, gas logs, grave and lot markers, Indian pottery, interlocking sewer blocks, jardinieres, Holland splits, lead corroding pots, lidded pipe, light weight aggregate for concrete ships, patent rail brick to connect street railway tracks with street paving, porcelain interiors for refrigerators, porcelain shuttle eyes and thread guides, radial chimney brick and block, radial sewer brick, ruffled brick, rustic stumps, segment block, sewer brick and block souvenirs, stock feeders, stone sewer-trap covers, sundials, tunnel brick, umbrella stands, wall and chimney coping, and water tables.

BRICK AND TILE.

PRODUCTION BY STATES.

Brick and tile products in the United States in 1919.

Rank.	State.	Common brick.			Vitrified brick or block.		
		Thousands.	Value.	Average price.	Thousands.	Value.	Average price.
17	Alabama	86,465	$1,183,917	$13.69	21,891	$524,025	$23.94
42	Arizona	11,744	174,234	14.84			
26	Arkansas	64,465	952,843	14.78			
10	California	126,892	1,545,558	12.18	(a)	(a)	24.56
20	Colorado	55,357	723,527	13.07	3,822	64,398	16.84
21	Connecticut and Rhode Island	143,280	2,160,254	15.08	(a)	(a)	27.04
40	Delaware and District of Columbia	13,006	225,346	17.32			
44	Florida	16,067	185,135	11.52			
12	Georgia	165,572	2,158,627	13.04	3,490	82,788	23.72
38	Idaho and Nevada	14,052	186,522	13.27			
3	Illinois	567,714	5,675,936	10.00	88,244	1,864,235	21.13
6	Indiana	102,817	1,242,629	12.09	26,985	683,316	25.32
8	Iowa	66,632	941,489	14.12	(a)	(a)	20.75
14	Kansas	62,189	700,800	11.27	32,961	808,834	24.53
9	Kentucky	53,215	698,114	13.12	(a)	(a)	21.30
33	Louisiana	50,547	715,779	14.16			
35	Maine	19,536	322,546	16.51	(a)	(a)	29.66
23	Maryland	88,643	1,306,318	14.74	(a)	(a)	30.00
25	Massachusetts	84,003	1,297,637	15.45			
13	Michigan	200,352	2,734,503	13.64	(a)	(a)	19.43
22	Minnesota	56,010	655,024	11.69			
32	Mississippi	57,115	880,014	15.41			
4	Missouri	82,010	1,159,198	14.13	17,770	361,181	20.32
36	Montana	13,302	170,959	12.85	(a)	(a)	18.00
31	Nebraska	62,194	727,278	11.69	(a)	(a)	30.00
34	New Hampshire and Vermont	33,959	583,636	17.19			
5	New Jersey	213,250	2,489,876	11.68			
41	New Mexico	13,059	149,006	11.41	(a)	(a)	15.00
7	New York	479,405	6,374,979	13.30	17,437	420,165	24.10
15	North Carolina	187,976	2,822,813	15.02			
39	North Dakota	7,672	85,703	11.17			
2	Ohio	293,757	4,083,877	13.90	125,491	3,135,716	24.98
24	Oklahoma	99,697	1,232,791	12.37	14,217	308,333	21.69
37	Oregon	13,435	192,981	14.36			
1	Pennsylvania	450,144	6,780,052	15.06	66,204	1,676,052	25.33
30	South Carolina	67,331	935,482	13.89			
45	South Dakota	4,419	65,667	14.86			
16	Tennessee	111,776	1,670,759	14.95	(a)	(a)	23.69
11	Texas	155,026	2,104,600	13.58	(a)	(a)	22.00
29	Utah	29,270	411,096	14.04	(a)	(a)	21.33
18	Virginia	155,526	2,408,165	15.48			
27	Washington	44,436	627,015	14.11	(a)	(a)	34.23
19	West Virginia	46,079	704,954	15.30	30,094	730,442	24.27
28	Wisconsin	71,904	947,124	13.17			
43	Wyoming	10,581	189,985	17.95			
	Undistributed [b]				40,636	955,659	
		4,751,881	[d]63,584,748	13.38	[c]489,242	[c]11,615,144	23.74
	Percentage of brick and tile products		32.2			5.9	
	Percentage of total clay products		23.1			4.2	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.
[c] These totals are composed of 392,526,000 vitrified brick or block sold for paving and valued at $9,371,763; and 96,716,000 vitrified brick or block sold for other purposes and valued at $2,243,381.
[d] Revised figures.

Brick and tile products in the United States in 1919—Continued.

Rank.	State.	Face brick.			Fancy or ornamental brick and enameled brick.		
		Thousands.	Value.	Average price.	Thousands.	Value.	Average price.
17	Alabama	(a)	(a)	$24.22			
42	Arizona	(a)	(a)	40.00			
26	Arkansas	(a)	(a)	21.03			
10	California	7,688	$191,162	24.86	1,254	$89,052	$71.01
20	Colorado	16,011	288,669	18.02	(a)	(a)	47.55
21	Connecticut and Rhode Island	(a)	(a)	23.64	(a)	(a)	56.00
40	Delaware and District of Columbia						
44	Florida						
12	Georgia	11,517	208,095	18.07			
39	Idaho and Nevada	2,650	67,068	25.31			
3	Illinois	104,090	1,862,407	17.89	(a)	(a)	82.00
6	Indiana	67,817	1,234,009	18.20			
8	Iowa	20,603	449,491	21.82			
14	Kansas	30,429	531,298	17.46	(a)	(a)	67.00
9	Kentucky	(a)	(a)	20.24			
33	Louisiana	(a)	(a)	14.22			
35	Maine						
23	Maryland	(a)	(a)	19.67	(a)	(a)	43.70
25	Massachusetts	(a)	(a)	20.00			
13	Michigan						
22	Minnesota	(a)	(a)	22.78			
32	Mississippi	(a)	(a)	25.01			
4	Missouri	32,278	762,470	23.62	(a)	(a)	74.55
36	Montana	(a)	(a)	20.73			
31	Nebraska	(a)	(a)	24.99			
34	New Hampshire and Vermont	(a)	(a)	20.91			
5	New Jersey	24,611	605,764	24.61	(a)	(a)	50.55
41	New Mexico	(a)	(a)	19.00			
7	New York	2,709	48,457	17.89			
15	North Carolina	(a)	(a)	20.00			
39	North Dakota	(a)	(a)	21.15			
2	Ohio	148,747	2,937,282	19.75	(a)	(a)	19.34
24	Oklahoma	8,114	145,545	17.94			
37	Oregon	(a)	(a)	14.96			
1	Pennsylvania	190,309	4,012,728	21.09			
30	South Carolina	(a)	(a)	20.57			
45	South Dakota	(a)	(a)	25.01			
16	Tennessee	11,533	244,374	21.19			
11	Texas	25,767	659,935	25.61			
29	Utah	7,790	166,451	21.37			
18	Virginia	(a)	(a)	17.01	(a)	(a)	17.02
27	Washington	3,528	91,947	26.06			
19	West Virginia	4,297	86,586	20.15			
28	Wisconsin	6,447	104,444	16.20			
43	Wyoming						
	Undistributed [b]	64,133	1,334,877		15,110	835,503	
		791,068	16,033,059	20.27	[c]16,364	[c]924,555	
	Percentage of brick and tile products		8.1			0.5	
	Percentage of total clay products		5.8			0.3	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.
[c] These totals include 14,166,000 enameled brick, valued at $846,676 (revised figures) made in California, Illinois, Maryland, Missouri, and New Jersey.

Brick and tile products in the United States in 1919—Continued.

Rank.	State.	Terra cotta.	Hollow building tile.			Tile (not drain).
			Short tons.	Value.	Average price.	
17	Alabama		31,706	$293,111	$9.24	
42	Arizona		(a)	(a)	12.50	
26	Arkansas					
10	California	$356,474	54,166	444,299	8.20	$491,228
20	Colorado	80,648	22,586	160,641	7.11	(a)
21	Connecticut and Rhode Island		(a)	(a)	9.94	
40	Delaware and District of Columbia		(a)	(a)	7.00	
44	Florida					
12	Georgia	(a)	(a)	(a)	7.82	
38	Idaho and Nevada					
3	Illinois	(a)	267,608	1,820,325	6.80	
6	Indiana	41,320	199,922	1,555,859	7.78	990,724
8	Iowa		294,335	2,475,291	8.40	
14	Kansas		60,873	501,068	8.23	315,593
9	Kentucky		(a)	(a)	7.02	(a)
33	Louisiana		(a)	(a)	4.48	
35	Maine					
23	Maryland	(a)	(a)	(a)	7.76	
25	Massachusetts		(a)	(a)	11.34	(a)
13	Michigan		861	6,901	8.02	(a)
22	Minnesota		70,306	527,241	7.50	
32	Mississippi		(a)	(a)	8.65	
4	Missouri	391,032	44,869	361,555	8.06	(a)
36	Montana		18,457	113,063	6.13	
31	Nebraska		38,025	275,796	7.25	
34	New Hampshire and Vermont					
5	New Jersey	1,104,715	173,933	1,623,628	9.33	1,679,451
41	New Mexico		(a)	(a)	7.24	
7	New York	629,213	20,856	162,425	7.79	(a)
15	North Carolina					
39	North Dakota		(a)	(a)	9.17	
2	Ohio		664,744	4,755,610	7.15	3,075,346
24	Oklahoma					
37	Oregon		11,645	107,750	9.25	(a)
1	Pennsylvania	255,915	175,780	1,247,311	7.10	(a)
30	South Carolina		(a)	(a)	7.11	
45	South Dakota					
16	Tennessee		2,641	27,795	10.52	(a)
11	Texas		45,680	438,601	9.60	(a)
29	Utah		(a)	(a)	8.68	
18	Virginia		(a)	(a)	8.00	
27	Washington	118,274	15,114	136,609	9.04	
19	West Virginia		5,485	36,135	6.59	(a)
28	Wisconsin		719	5,934	8.25	(a)
43	Wyoming		(a)	(a)	8.01	
	Undistributed [b]	1,010,591	108,906	887,625		1,585,110
		[c] 3,988,182	2,329,217	[c] 17,964,573	7.71	8,137,452
	Percentage of brick and tile products	2.0		9.1		4.1
	Percentage of total clay products	1.5		6.5		3.0

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.
[c] Revised figures.

Brick and tile products in the United States in 1919—Continued.

Rank.	State.	Drain tile.			Sewer pipe.		
		Short tons.	Value.	Average price.	Short tons.	Value.	Average price.
17	Alabama	(a)	(a)	$8.83	(a)	(a)	$11.08
42	Arizona						
26	Arkansas	(a)	(a)	17.24			
10	California	6,053	$76,480	12.63	33,106	$671,851	20.29
20	Colorado	8,669	90,000	10.38	(a)	(a)	18.42
21	Connecticut and Rhode Island						
40	Delaware and District of Columbia	1,074	9,509	8.85	(a)	(a)	14.00
44	Florida						
12	Georgia	(a)	(a)	12.01	62,372	927,467	14.87
38	Idaho and Nevada						
3	Illinois	154,194	1,203,586	7.80	47,833	824,002	17.23
6	Indiana	249,360	1,885,218	7.56	69,138	918,845	13.29
8	Iowa	335,587	3,127,378	9.32	43,698	902,008	20.64
14	Kansas	(a)	(a)	5.72	(a)	(a)	19.30
9	Kentucky	17,265	108,854	6.30	(a)	(a)	13.01
33	Louisiana						
35	Maine	(a)	(a)	20.00	(a)	(a)	20.19
23	Maryland						
25	Massachusetts						
13	Michigan	68,967	737,124	10.69	(a)	(a)	20.01
22	Minnesota	32,114	347,082	10.81	(a)	(a)	18.70
32	Mississippi	(a)	(a)	9.38			
4	Missouri	10,218	90,163	8.82	142,038	2,086,278	14.69
36	Montana	(a)	(a)	21.43			
31	Nebraska						
34	New Hampshire and Vermont						
5	New Jersey	1,703	15,108	8.87			
41	New Mexico						
7	New York	11,269	113,859	10.10	2,900	58,000	20.00
15	North Carolina	(a)	(a)	15.56			
39	North Dakota						
2	Ohio	246,158	2,042,452	8.30	481,219	6,198,589	12.88
24	Oklahoma						
37	Oregon	4,119	41,527	10.08	(a)	(a)	27.82
1	Pennsylvania	1,005	8,005	7.97	115,152	1,296,815	11.26
30	South Carolina						
45	South Dakota						
16	Tennessee	11,767	128,961	10.96	(a)	(a)	14.53
11	Texas	(a)	(a)	9.80	27,796	584,774	21.04
29	Utah	10,775	179,320	16.64	(a)	(a)	22.85
18	Virginia	(a)	(a)	8.73	(a)	(a)	11.15
27	Washington	7,291	57,509	7.89	18,823	430,198	22.85
19	West Virginia	370	3,587	9.69			
28	Wisconsin	17,527	143,899	8.21			
43	Wyoming	(a)	(a)	8.00			
	Undistributed [b]	45,683	536,322		111,056	1,856,005	
		1,241,168	[c] 10,945,943	8.82	1,155,131	[c] 16,754,832	14.50
	Percentage of brick and tile products		5.5			8.5	
	Percentage of total clay products		3.9			6.1	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.
[c] Revised figures.

Brick and tile products in the United States in 1919—Continued.

Rank.	State.	Stove lining.	Fire brick. Thousands.	Fire brick. Value.	Fire brick. Average price.	Miscellaneous.[a]	Total.	Percentage of total.
17	Alabama	(b)	10,162	$373,836	$36.79	$8,375	$2,748,071	1.4
42	Arizona						c188,034	.1
26	Arkansas		(b)	(b)	36.40	152,577	c1,229,296	.9
10	California		19,654	743,117	37.81	289,179	4,911,271	2.5
20	Colorado	(b)	14,908	483,517	32.43	141,946	2,469,693	1.2
21	Connecticut and Rhode Island	(b)	(b)	(b)	97.27		2,350,329	1.2
40	Delaware and District of Columbia					2,000	284,429	.1
44	Florida						185,135	.1
12	Georgia		4,030	91,411	22.68	27,319	3,772,632	1.9
38	Idaho and Nevada		(b)	(b)	40.13		310,192	.2
3	Illinois	(b)	19,269	732,114	37.99	493,721	15,303,913	7.7
6	Indiana		6,318	194,046	30.71	821,339	9,567,305	4.8
8	Iowa					31,975	8,107,601	4.1
14	Kansas					210,021	3,426,002	1.7
9	Kentucky		100,165	3,841,458	38.35	4,260	5,501,070	2.8
33	Louisiana					27,257	759,386	.4
35	Maine		(b)	(b)	111.08	47,481	612,562	.3
23	Maryland	$35,925	15,256	671,532	44.02	29,165	2,247,092	1.1
25	Massachusetts	208,979	1,585	95,898	60.50	20,259	1,940,825	1.0
13	Michigan		1,242	89,147	71.78	75,150	3,699,929	1.8
22	Minnesota		(b)	(b)	40.24	92,053	2,287,906	1.1
32	Mississippi					9,405	934,827	.4
4	Missouri	13,774	126,574	5,121,077	40.46	274,975	10,977,132	5.5
36	Montana		938	46,412	49.48	4,335	394,899	.2
31	Nebraska					4,904	1,038,668	.5
34	New Hampshire and Vermont	(b)					712,551	.4
5	New Jersey	(b)	28,716	2,018,624	70.30	245,171	10,228,430	5.2
41	New Mexico		1,056	34,931	33.07		234,218	.1
7	New York	(b)	10,595	782,009	73.81	86,688	8,835,231	4.5
15	North Carolina						3,238,249	1.6
39	North Dakota		(b)	(b)	31.82		303,657	.2
2	Ohio		154,922	4,958,219	32.00	2,299,054	33,503,302	16.9
24	Oklahoma					503,460	2,190,129	1.1
37	Oregon		(b)	(b)	68.31		378,963	.2
1	Pennsylvania	165,530	394,154	16,236,155	41.19	2,396,609	34,601,486	17.5
30	South Carolina		(b)	(b)	30.00		1,058,196	.5
45	South Dakota						73,571	
16	Tennessee		2,348	64,029	27.27	43,656	2,882,740	1.5
11	Texas		7,009	199,820	28.51	241,922	4,357,673	2.2
29	Utah		(b)	(b)	29.07	5,502	1,071,997	.5
18	Virginia		(b)	(b)	31.81		2,724,629	1.4
27	Washington	3,472	3,889	153,170	39.39	36,055	1,736,190	.9
19	West Virginia		31,861	624,080	19.59	214,679	2,711,098	1.4
28	Wisconsin						1,203,757	.6
43	Wyoming						194,350	.1
	Undistributed [d]	166,164	8,788	461,190			(e)	
		683,844	963,439	38,015,792	39.46	8,840,492	c197,488,616	
	Percentage of brick and tile products	0.3		19.3		4.5	100.0	100.0
	Percentage of total clay products	0.3		13.8		3.2	71.7	71.7

a Including adobes, air cell brick, brickbats, burnt clay ballast, charcoal furnaces, chemical brick or block, chimney pipe, clay targets, condensers, conduits, crucibles, crushed brick, flue lining, gas logs, glass pots and glasshouse supplies, larsite, lot markers, monuments, muffles, radial brick and block, rail brick, refractory brick or block (special shapes), retorts, segment brick and block, stock feeders, wall coping, etc.

b Included under "Undistributed."

c Revised figures.

d Includes all products made by less than 3 producers in one State.

e The total of "Undistributed" is distributed among the States to which it belongs in order that they may be fully represented in the totals.

Brick and tile products in the United States in 1920.

Rank.	State.	Common brick. Thousands.	Common brick. Value.	Common brick. Average price.	Vitrified brick or block. Thousands.	Vitrified brick or block. Value.	Vitrified brick or block. Average price.
19	Alabama	93,455	$1,513,012	$16.19	(a)	(a)	$28.06
44	Arizona	9,483	152,490	16.08			
28	Arkansas	60,258	1,044,609	17.34			
9	California	163,782	2,823,304	17.24	2,464	$71,736	29.11
20	Colorado	54,137	810,003	14.96	857	22,861	26.68
24	Connecticut and Rhode Island	129,019	2,724,417	21.12	(a)	(a)	33.72
41	Delaware and District of Columbia	13,422	282,540	21.05			
42	Florida and Porto Rico	21,249	313,150	14.73			
12	Georgia	166,648	2,864,315	17.19	4,742	113,983	24.04
39	Idaho and Nevada	13,271	186,173	14.03			
3	Illinois	609,433	7,582,460	12.44	106,247	2,887,898	27.18
6	Indiana	109,040	1,533,575	14.06	15,718	454,552	28.92
8	Iowa	60,470	1,146,182	18.95	6,116	176,430	28.85
13	Kansas	69,701	1,092,460	15.67	42,116	1,217,718	28.91
10	Kentucky	48,629	748,588	15.39	(a)	(a)	27.31
33	Louisiana	54,583	906,329	16.60			
34	Maine	20,848	453,521	21.75	(a)	(a)	53.15
18	Maryland	99,361	1,882,967	18.95	(a)	(a)	40.00
23	Massachusetts	92,490	1,944,060	21.02			
14	Michigan	186,526	3,062,660	16.42			
21	Minnesota	47,555	722,816	15.20			
32	Mississippi	55,560	1,002,638	18.05			
4	Missouri	88,238	1,507,414	17.08	(a)	(a)	30.36
37	Montana	14,942	216,088	14.46			
30	Nebraska	65,494	912,347	13.93	(a)	(a)	26.45
35	New Hampshire and Vermont	33,363	740,449	22.19			
5	New Jersey	160,549	3,075,388	19.16			
38	New Mexico	8,067	160,892	19.94	(a)	(a)	17.48
7	New York	488,703	8,346,530	17.08	6,063	189,228	31.21
15	North Carolina	183,339	3,289,635	17.94			
40	North Dakota	10,131	124,900	12.33			
2	Ohio	306,541	5,689,158	18.56	99,787	2,621,985	26.28
25	Oklahoma	99,491	1,686,941	16.96	13,868	368,519	26.57
36	Oregon	14,692	273,251	18.60			
1	Pennsylvania	480,399	8,838,303	18.40	63,846	1,768,580	27.70
29	South Carolina	60,164	1,030,661	17.13			
45	South Dakota	3,631	63,627	17.52			
16	Tennessee	127,292	2,196,646	17.26	(a)	(a)	28.67
11	Texas	167,937	3,054,736	18.19	(a)	(a)	22.63
31	Utah	25,422	384,606	15.13			
22	Virginia	149,590	2,731,572	18.26			
26	Washington	46,163	752,241	16.30	(a)	(a)	42.03
17	West Virginia	61,856	992,977	16.05	36,813	775,163	21.06
27	Wisconsin	64,931	1,119,445	17.24			
43	Wyoming	11,771	236,154	20.06			
	Undistributed [b]				69,857	2,009,904	
		4,851,626	82,216,230	16.95	[c] 468,494	[c] 12,678,557	27.06
	Percentage of brick and tile products		30.8			4.7	
	Percentage of total clay products		22.0			3.4	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.
[c] These totals are composed of 366,205,000 vitrified brick or block sold for paving and valued at $10,380,821; and 102,289,000 vitrified brick or block sold for other purposes and valued at $2,297,736.

Brick and tile products in the United States in 1920—Continued.

Rank.	State.	Face brick.			Fancy or ornamental brick.		
		Thousands.	Value.	Average price.	Thousands.	Value.	Average price.
19	Alabama	8,013	$221,986	$27.70			
44	Arizona	(a)	(a)	34.26			
28	Arkansas	5,730	144,343	25.19	(a)	(a)	$19.91
9	California	8,380	340,487	40.63	1,421	$145,241	102.21
20	Colorado	20,702	509,511	24.61	(a)	(a)	27.84
24	Connecticut and Rhode Island	(a)	(a)	34.92	(a)	(a)	87.18
41	Delaware and District of Columbia	(a)	(a)	30.00			
42	Florida and Porto Rico						
12	Georgia	10,830	286,740	26.47			
39	Idaho and Nevada	943	21,978	23.31			
3	Illinois	86,844	2,013,067	23.18	(a)	(a)	60.73
6	Indiana	75,151	1,634,972	21.76	(a)	(a)	85.31
8	Iowa	13,678	346,164	25.31			
13	Kansas	31,463	662,849	21.07			
10	Kentucky	1,971	46,964	23.82			
33	Louisiana	(a)	(a)	24.47			
34	Maine	(a)	(a)	30.00			
18	Maryland	(a)	(a)	26.08	(a)	(a)	48.65
23	Massachusetts	1,445	41,620	28.80			
14	Michigan	(a)	(a)	21.00			
21	Minnesota	13,653	422,472	30.94			
32	Mississippi	(a)	(a)	36.03			
4	Missouri	36,891	912,535	24.74	(a)	(a)	98.95
37	Montana	2,761	71,786	26.00			
30	Nebraska	(a)	(a)	27.02			
35	New Hampshire and Vermont						
5	New Jersey	15,850	493,655	31.15	(a)	(a)	103.75
38	New Mexico	(a)	(a)	23.46	(a)	(a)	135.27
7	New York	9,089	217,042	23.88	(a)	(c)	15.00
15	North Carolina	(a)	(a)	27.53			
40	North Dakota	2,568	81,659	31.80	(a)	(a)	19.00
2	Ohio	147,513	3,508,824	23.79			
25	Oklahoma	7,400	179,865	24.31			
36	Oregon	436	16,762	38.44			
1	Pennsylvania	187,891	4,487,311	23.88	407	33,433	82.14
29	South Carolina	(a)	(a)	31.56			
45	South Dakota	(a)	(a)	30.00			
16	Tennessee	14,404	368,423	25.58			
11	Texas	21,879	768,760	35.14			
31	Utah	7,875	220,717	28.03			
22	Virginia	19,041	464,881	24.41	(a)	(a)	32.91
26	Washington	3,895	151,059	38.78			
17	West Virginia	2,537	57,436	22.64			
27	Wisconsin	7,090	158,432	22.35			
43	Wyoming	413	9,718	23.53	(a)	(a)	40.00
	Undistributed [b]	20,278	578,950		10,367	932,730	
		786,614	19,440,968	24.71	[c] 12,195	[c] 1,111,404	
	Percentage of brick and tile products		7.3			0.4	
	Percentage of total clay products		5.2			0.3	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.
[c] Includes 11,178,000 enameled brick, valued at $1,040,323, made in California, Illinois, Missouri, New Jersey, and New York, and 1,017,000 fancy or ornamental brick, valued at $71,081, made in Arkansas, California, Colorado, Indiana, Maryland, New Mexico, North Dakota, Pennsylvania, Virginia, and Wyoming.

Brick and tile products in the United States in 1920—Continued.

Rank.	State.	Architectural terra cotta.			Hollow building tile.		
		Short tons.	Value.	Average price.	Short tons.	Value.	Average price.
19	Alabama				31,787	$333,595	$10.49
44	Arizona				(a)	(a)	10.00
28	Arkansas						
9	California	8,649	$1,242,570	$143.67	94,997	968,087	10.19
20	Colorado	(a)	(a)	164.77	19,205	174,773	9.10
24	Connecticut and Rhode Island						
41	Delaware and District of Columbia				(a)	(a)	8.00
42	Florida and Porto Rico						
12	Georgia	(a)	(a)	168.65	33,929	361,394	10.65
39	Idaho and Nevada				(a)	(a)	10.63
3	Illinois	22,659	2,984,210	131.70	310,713	2,869,432	9.23
6	Indiana	(a)	(a)	165.71	209,693	2,023,317	9.65
8	Iowa				293,081	3,048,776	10.40
13	Kansas	(a)	(a)	158.91	89,165	817,226	9.17
10	Kentucky				17,555	371,586	10.06
33	Louisiana						
34	Maine						
18	Maryland	(a)	(a)	140.68	15,070	151,683	10.07
23	Massachusetts				(a)	(a)	17.86
14	Michigan				2,610	25,486	9.76
21	Minnesota				74,450	704,751	9.47
32	Mississippi				(a)	(a)	9.94
4	Missouri	(a)	(a)	108.45	49,193	572,200	11.63
37	Montana				9,887	78,648	7.95
30	Nebraska				32,491	279,646	8.61
35	New Hampshire and Vermont						
5	New Jersey	17,434	2,735,042	156.88	228,026	3,553,944	15.59
38	New Mexico				9,455	80,588	8.52
7	New York	9,566	1,294,534	135.33	23,343	282,128	12.09
15	North Carolina				(a)	(a)	10.00
40	North Dakota				12,786	141,570	11.07
2	Ohio				672,007	6,572,408	9.78
25	Oklahoma						
36	Oregon				18,264	186,278	10.20
1	Pennsylvania	(a)	(a)	118.25	159,703	1,516,898	9.50
29	South Carolina				(a)	(a)	10.53
45	South Dakota						
16	Tennessee				11,944	174,259	14.59
11	Texas				50,241	680,797	13.55
31	Utah				(a)	(a)	9.55
22	Virginia						
26	Washington	3,056	461,770	151.10	42,868	471,423	11.00
17	West Virginia				17,389	171,297	9.85
27	Wisconsin				947	10,050	10.61
43	Wyoming				(a)	(a)	17.57
	Undistributed [b]	16,462	2,133,776		48,269	684,767	
		77,826	10,851,902	139.44	2,579,068	27,112,007	10.51
	Percentage of brick and tile products		4.1			10.1	
	Percentage of total clay products		2.9			7.3	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.

Brick and tile products in the United States in 1920—Continued.

Rank.	State.	Tile, not drain.	Draintile.		
			Short tons.	Value.	Average price.
19	Alabama		(a)	(a)	$20.00
44	Arizona				
28	Arkansas		(a)	(a)	11.33
9	California	$978,773	5,834	$59,604	10.22
20	Colorado	(a)	5,187	86,226	16.62
24	Connecticut and Rhode Island				
41	Delaware and District of Columbia		(a)	(a)	17.77
42	Florida and Porto Rico				
12	Georgia		181	2,818	15.57
39	Idaho and Nevada				
3	Illinois		160,647	1,666,150	10.37
6	Indiana	1,787,094	189,775	1,888,801	9.95
8	Iowa		453,122	4,760,115	10.51
13	Kansas	(a)	(a)	(a)	12.70
10	Kentucky	571,932	6,780	61,551	9.08
33	Louisiana				
34	Maine		(a)	(a)	24.51
18	Maryland				
23	Massachusetts	(a)			
14	Michigan	(a)	67,225	690,816	10.28
21	Minnesota		40,741	485,800	11.92
32	Mississippi		(a)	(a)	9.76
4	Missouri	(a)	16,343	184,056	11.26
37	Montana		(a)	(a)	15.16
30	Nebraska		(a)	(a)	9.20
35	New Hampshire and Vermont				
5	New Jersey	2,918,817	665	9,613	14.46
38	New Mexico	(a)			
7	New York	(a)	3,689	52,113	14.13
15	North Carolina		(a)	(a)	10.00
40	North Dakota				
2	Ohio	3,908,603	165,190	1,581,072	9.57
25	Oklahoma				
36	Oregon		5,946	68,494	11.52
1	Pennsylvania	965,801	(a)	(a)	8.85
29	South Carolina				
45	South Dakota				
16	Tennessee	(a)	5,567	72,535	13.03
11	Texas		4,621	82,324	17.82
31	Utah		(a)	(a)	13.07
22	Virginia		(a)	(a)	10.00
26	Washington		3,747	58,585	15.64
17	West Virginia	607,871	342	5,260	15.38
27	Wisconsin		12,737	123,228	9.67
43	Wyoming		(a)	(a)	20.01
	Undistributed [b]	731,145	42,951	585,480	
		12,470,036	1,191,290	12,524,641	10.51
	Percentage of brick and tile products	4.7		4.7	
	Percentage of total clay products	3.3		3.3	

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.

Brick and tile products in the United States in 1920—Continued.

Rank.	State.	Sewer pipe. Short tons.	Sewer pipe. Value.	Sewer pipe. Average price.	Stove lining.
19	Alabama	(a)	(a)	$23.17	(a)
44	Arizona				
28	Arkansas				
9	California	37,888	$1,016,240	26.82	
20	Colorado	(a)	(a)	23.48	
24	Connecticut and Rhode Island				(a)
41	Delaware and District of Columbia	(a)	(a)	20.00	
42	Florida and Porto Rico				
12	Georgia	61,068	1,383,601	22.66	
39	Idaho and Nevada				
3	Illinois	62,977	1,321,102	20.98	(a)
6	Indiana	62,324	1,398,310	22.44	
8	Iowa	41,634	918,669	22.07	
13	Kansas	(a)	(a)	24.95	
10	Kentucky	(a)	(a)	25.00	
33	Louisiana				
34	Maine	(a)	(a)	33.27	
18	Maryland				(a)
23	Massachusetts				$371,463
14	Michigan	(a)	(a)	20.00	
21	Minnesota	(a)	(a)	24.75	
32	Mississippi				
4	Missouri	177,214	3,707,233	20.92	(a)
37	Montana				
30	Nebraska				
35	New Hampshire and Vermont				(a)
5	New Jersey	(a)	(a)	20.01	(a)
38	New Mexico				
7	New York	(a)	(a)	21.31	109,343
15	North Carolina	(a)	(a)	20.55	
40	North Dakota				
2	Ohio	410,049	7,996,565	19.50	
25	Oklahoma				
36	Oregon	(a)	(a)	33.17	(a)
1	Pennsylvania	113,637	2,192,135	19.29	145,438
29	South Carolina				
45	South Dakota				
16	Tennessee	(a)	(a)	20.33	
11	Texas	(a)	(a)	29.43	(a)
31	Utah	(a)	(a)	20.56	
22	Virginia	(a)	(a)	15.92	
26	Washington	18,394	522,976	28.43	
17	West Virginia	(a)	(a)	20.89	
27	Wisconsin				
43	Wyoming	(a)	(a)	20.00	
	Undistributed [b]	202,193	4,914,184		153,466
		1,187,378	25,371,015	21.37	779,710
	Percentage of brick and tile products		9.5		0.3
	Percentage of total clay products		6.8		0.2

[a] Included under "Undistributed."
[b] Includes all products made by less than 3 producers in one State.

Brick and tile products in the United States in 1920—Continued.

Rank.	State.	Fire brick.			Miscellaneous.[a]	Total.	Percentage of total.
		Thousands.	Value.	Average price.			
19	Alabama	9,518	$440,180	$46.25	$67,248	$3,386,806	1.3
44	Arizona					162,489	.1
28	Arkansas	(b)	(b)	37.63	114,137	1,353,761	.5
9	California	29,235	1,343,375	45.95	333,216	9,322,633	3.5
20	Colorado	21,814	780,475	35.78	203,003	3,353,190	1.3
24	Connecticut and Rhode Island	(b)	(b)	104.45		3,051,521	1.1
41	Delaware and District of Columbia				8,000	339,885	.1
42	Florida and Porto Rico					313,150	.1
12	Georgia	4,291	163,730	38.16	55,817	5,548,609	2.1
39	Idaho and Nevada	(b)	(b)	51.17		355,197	.1
3	Illinois	24,625	1,120,784	45.51	596,967	23,187,613	8.7
6	Indiana	17,703	585,087	33.05	939,977	12,383,513	4.6
8	Iowa				43,621	10,439,957	3.9
13	Kansas				236,976	4,921,740	1.8
10	Kentucky	110,259	4,950,825	44.90	7,500	7,064,770	2.6
33	Louisiana				10,000	955,608	.4
34	Maine	(b)	(b)	110.13	13,980	838,258	.3
18	Maryland	19,972	1,018,147	50.98	18,000	3,405,335	1.3
23	Massachusetts	1,567	94,757	60.47	170,583	3,076,294	1.2
14	Michigan	(b)	(b)	63.50	135,112	3,979,691	1.5
21	Minnesota	(b)	(b)	50.00	165,765	3,341,477	1.3
32	Mississippi				9,822	1,058,285	.4
4	Missouri	176,708	8,525,807	48.25	304,193	17,443,478	6.5
37	Montana	775	39,825	51.39		407,984	.2
30	Nebraska					1,211,868	.5
35	New Hampshire and Vermont					837,449	.3
5	New Jersey	27,807	2,001,988	72.00	227,306	15,423,652	5.8
38	New Mexico	1,456	43,341	29.77		369,850	.1
7	New York	10,439	867,598	83.11	174,344	11,805,401	4.4
15	North Carolina					3,869,981	1.4
40	North Dakota	(b)	(b)	38.71		350,548	.1
2	Ohio	180,142	7,473,034	41.48	1,480,508	40,832,157	15.3
25	Oklahoma	205	7,820	38.15	525,868	2,769,013	1.0
36	Oregon	(b)	(b)	58.08	1,980	719,486	.3
1	Pennsylvania	429,068	21,929,602	51.11	2,888,049	45,369,339	17.0
29	South Carolina	(b)	(b)	30.00		1,256,047	.5
45	South Dakota					69,237	
16	Tennessee	(b)	(b)	42.86	37,426	3,796,978	1.4
11	Texas	6,159	217,628	35.33	147,097	6,164,854	2.3
31	Utah	(b)	(b)	39.68	4,802	1,107,204	.4
22	Virginia	(b)	(b)	36.67		3,267,017	1.2
26	Washington	4,863	265,206	54.54	54,854	2,863,030	1.1
17	West Virginia	27,087	894,121	33.01	2,817	3,507,130	1.3
27	Wisconsin				2,100	1,413,255	.5
43	Wyoming	(b)	(b)	40.00		258,706	.1
	Undistributed [c]	11,116	652,558			(d)	
		1,114,809	53,415,888	47.91	8,981,068	266,953,426	
	Percentage of brick and tile products		20.0		3.4	100.0	100.0
	Percentage of total clay products		14.3		2.4	71.4	71.4

[a] Including bats, burned clay ballast, burned crushed clay for roofing, charcoal furnaces, chemical brick, chimney pipe, coke-oven tile, condensers, conduits, crucibles, crushed brick, decorative terra cotta, dobies, duro brick, fire brick, special shapes, fire places, floor brick, flue lining, flux blocks, gas logs, glass melting pots and glasshouse supplies, grave markers, green brick, grog, kiln furniture, ladel brick, larsite, retorts, salt-glazed tile, scorifiers, segment brick or block, sewer block, sleeves and nozzles, and wall coping.

[b] Included under "Undistributed."

[c] Includes all products made by less than 3 producers in one State.

[d] The total of "Undistributed" is distributed among the States to which it belongs, in order that they may be fully represented in the totals.

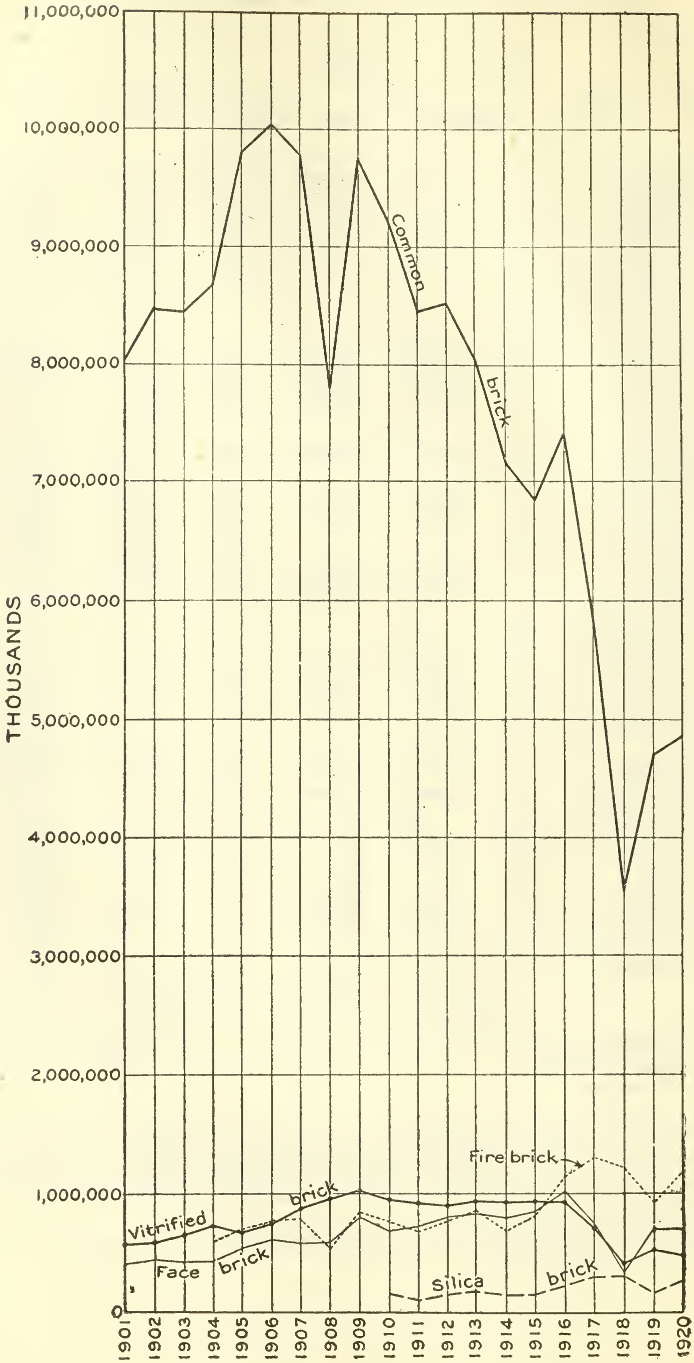

FIGURE 17.—Brick sold in the United States, 1901-1920.

TILE, NOT DRAIN.

Tile, not drain, of domestic production sold in the United States in 1919 and 1920.

State.	Roofing.		Floor.		Ceramic mosaic.		Faience.		Wall.		Total value.
	Square feet.	Value.	Square feet.	Value.	Square feet.	Value.	Square feet.	Value.	Square feet.	Value.	
1919.											
California	706,100	$154,035	187,605	$53,215	389,918	$95,649	76,717	$48,849	266,630	$139,480	$491,228
Colorado	(a)	(a)									(a)
Indiana			982,655	215,582	968,350	242,087	62,000	32,240	1,327,476	500,815	990,724
Kansas	2,063,600	315,593									315,593
Kentucky	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Massachusetts							(a)	(a)			(a)
Michigan							(a)	(a)			(a)
Missouri	(a)	(a)									(a)
New Jersey			1,469,765	310,370	2,224,840	542,538	321,102	174,338	1,988,266	652,205	1,679,451
New York			(a)	(a)							(a)
Ohio	(a)	(a)	2,298,344	570,627	2,258,018	565,220	729,717	461,048	2,450,396	833,013	3,075,346
Oregon			(a)	(a)							(a)
Pennsylvania	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Tennessee			(a)	(a)							(a)
Texas			(a)	(a)							(a)
West Virginia	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Wisconsin			(a)	(a)							(a)
Undistributed b	6,645,100	814,273	2,852,598	385,493	1,630,641	378,878	360,585	164,766	1,462,850	487,138	1,585,110
	9,414,800	1,283,901	7,790,967	1,535,287	7,471,767	1,824,372	1,550,121	881,241	7,495,618	2,612,651	8,137,452
1920.											
California	2,280,619	373,236	162,895	40,905	775,373	233,594	164,857	115,105	401,917	215,933	978,773
Colorado	(a)	(a)	(a)	(a)			(a)	(a)			(a)
Indiana			536,299	136,764	2,784,675	832,571			1,878,359	817,759	1,787,094
Kansas	(a)	(a)									(a)
Kentucky	500,000	36,000	60,000	50,000	496,642	144,590	195,629	124,342	420,689	217,000	571,932
Massachusetts							(a)	(a)			(a)
Michigan							(a)	(a)			(a)
Missouri	(a)	(a)									(a)
New Jersey			1,692,214	510,945	3,178,930	918,615	165,823	137,186	2,922,495	1,352,071	2,918,817
New Mexico	(a)	(a)									(a)
New York			(a)	(a)							(a)
Ohio	1,531,307	612,523	2,595,745	860,983	2,178,311	589,020	629,829	365,702	3,189,373	1,480,375	3,908,603
Pennsylvania	427,000	36,725	928,804	158,310	482,000	153,108	37,194	21,564	1,404,000	596,094	965,801
Tennessee			(a)	(a)							(a)
West Virginia	1,000,000	10,330	1,150,605	256,900	1,052,735	316,823	43,243	23,818			607,871
Undistributed b	4,097,140	463,774	880,382	239,041			53,046	28,330			731,145
	9,836,066	1,532,588	8,006,944	2,253,848	10,948,666	3,188,321	1,289,621	816,047	10,216,833	4,679,232	12,470,036

a Included under "Undistributed."

b Includes all products made by less than 3 producers in one State.

HUDSON RIVER REGION.

Common brick produced and sold in the Hudson River district,[a] 1912–1920.

Year.	Number of firms reporting.	Thousands.	Value.	Average price.
1912	136	1,233,187	$7,133,177	$5.78
1913	132	1,025,308	5,636,061	5.50
1914	129	888,266	4,350,832	4.90
1915	120	960,527	5,009,065	5.21
1916	113	893,552	5,915,254	6.62
1917	99	584,184	4,427,934	7.58
1918	78	314,196	3,078,805	9.80
1919	78	480,349	6,063,841	12.62
1920	78	439,149	7,700,512	17.54

[a] Including Raritan district (Middlesex County), N. J.

Common brick sold in the Hudson River district (from Cohoes to New York City) and in the Raritan district, N. J., in 1919 and 1920.

County.	1919				1920			
	Number of firms reporting.	Thousands.	Value.	Average price.	Number of firms reporting.	Thousands.	Value.	Average price.
Albany	10	34,779	$441,137	$12.68	10	49,168	$942,122	$19.16
Columbia	[a] 4	[a] 24,795	[a] 286,262	[a] 11.55	[a] 6	[a] 21,883	[a] 399,879	[a] 18.27
Dutchess	9	28,670	395,817	13.81	10	28,035	438,727	15.65
Greene	4	13,056	149,668	11.46	4	19,428	287,153	14.78
Orange	3	30,809	379,757	12.33	3	26,339	468,749	17.80
Rensselaer	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Rockland	15	46,238	692,760	14.98	15	63,785	1,043,584	16.36
Ulster	17	143,861	1,976,497	13.74	19	125,757	2,117,466	16.84
Westchester	4	5,949	65,741	11.05	(a)	(a)	(a)	(a)
Total for New York portion of the district	66	328,157	4,387,639	13.37	67	334,395	5,697,680	17.04
Bergen County, N. J	7	34,025	453,729	13.34	6	34,345	605,557	17.63
Raritan district (Middlesex County), N. J	5	118,167	1,222,473	10.35	5	70,409	1,397,275	19.85
Total for New Jersey portion of district	12	152,192	1,676,202	11.01	11	104,754	2,002,832	19.12
Grand total	78	480,349	6,063,841	12.62	78	439,149	7,700,512	17.54

[a] In 1919 Rensselaer County and in 1920 Rensselaer and Westchester counties are included under Columbia.

POTTERY.

GENERAL CONDITIONS.

The demand for domestic pottery during 1919 and 1920 was unprecedented. The dearth caused by the lack of imports during the war and the inability of the domestic producers to supply the demand prevailed throughout both years. Some plants had enough orders on hand at the beginning of 1920 to keep them busy nearly the whole year. In view of the large increase of imports of pottery in 1920 the continuation of the demand is the more remarkable and augurs well for the increasing popularity of American-made pottery.

Notwithstanding the great demand and the large value of the output, the potters had many handicaps, chief among which were the shortage of fuel, especially in the Ohio Valley, and the shortage of materials from lack of transportation, both causes of considerable loss in production, and it was well toward the middle of 1920 before anything like normal conditions of fuel and transportation were restored. The refusal of operatives to work full time and the consequent decrease in output per man were further handicaps which it was impossible to overcome.

There were no general strikes in the industry, but the few that occurred were sufficient to cause considerable loss in production.

PRODUCTION.

Value of pottery products in the United States, 1909–1920.

Year.	Number of firms reporting sales.	Red earthenware.	Red and brown white-lined cooking ware.	Stoneware and yellow and Rockingham ware.	Chemical stoneware and porcelain.	White ware, including C. C. ware, etc.
1909	466	$805,906	....	$3,993,859	(a)	$13,728,316
1910	463	854,196	....	3,796,688	(a)	14,780,980
1911	449	893,678	....	4,120,608	(a)	14,366,251
1912	434	958,270	....	3,919,778	(a)	14,829,431
1913	426	1,000,529	....	3,683,567	(a)	15,066,811
1914	412	1,059,904	....	3,349,301	(a)	14,968,079
1915	416	1,072,061	....	3,575,603	(a)	15,324,242
1916	393	1,156,351	....	3,696,288	$1,054,061	18,191,390
1917	394	1,065,185	....	3,865,825	1,099,432	20,920,469
1918	384	906,861	....	4,454,164	1,769,710	25,305,926
1919	394	1,298,311	$723,981	4,603,018	805,321	29,847,261
1920	379	1,766,919	715,902	5,475,660	1,273,511	38,323,880

Year.	China, bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.	Total.
1909	[b] $1,766,766	$5,989,295	$3,047,499	[b] $1,717,800	$31,049,441
1910	1,962,126	6,758,996	3,794,153	1,837,539	33,784,678
1911	2,057,985	7,031,458	4,232,101	1,816,479	34,518,560
1912	2,177,305	7,902,255	4,927,316	1,789,809	36,504,164
1913	2,424,060	8,214,838	5,737,741	1,864,829	37,992,375
1914	2,384,686	7,874,269	4,130,270	1,631,652	35,398,161
1915	2,330,156	7,993,216	4,671,202	2,358,908	37,325,388
1916	3,478,372	11,111,417	7,034,420	2,494,943	48,217,242
1917	4,805,906	12,636,217	9,451,586	2,317,902	56,162,522
1918	6,307,349	11,241,138	[c] 11,194,812	2,731,833	[c] 63,911,793
1919	7,708,832	14,872,364	12,614,794	5,383,880	[c] 77,857,762
1920	11,340,093	22,014,651	20,218,924	5,587,136	106,716,676

[a] Not separately classified prior to 1916.
[b] China, bone china, delft, and belleek ware for Ohio are included under "Miscellaneous."
[c] Revised figures.

Value of pottery products in the United States, 1919.

Rank.	State.	Number of firms reporting sales.	Red earthenware.	Red and brown white-lined cooking ware.	Stoneware and yellow and Rockingham ware.	Chemical stoneware and porcelain.	White ware, including C. C. ware, etc.
21	Alabama	11	$5,122		$25,131		
36	Arizona	(a)					
20	Arkansas	1			(b)		
8	California	a 17	74,222		152,308	(b)	(b)
15	Colorado	5	(b)		(b)	(b)	
12	Connecticut	2	(b)				
29	District of Columbia	1	(b)				
33	Florida	2					
24	Georgia	19	5,780		14,088		
16	Illinois	17	(b)		808,188		(b)
7	Indiana	9	(b)		17,268		(b)
31	Iowa	2	(b)			(b)	
14	Kentucky	7	19,889		188,230		
32	Louisiana	1					
11	Maryland	5	(b)				(b)
13	Massachusetts	9	(b)			(b)	(b)
6	Michigan	8	(b)				(b)
9	Minnesota	2	(b)		(b)		
27	Mississippi	6	2,728		13,606		
25	Missouri	4	19,817		(b)		
23	Nebraska	1	(b)				
28	New Hampshire	1					(b)
2	New Jersey	57	34,235	(b)	(b)	(b)	$1,542,947
37	New Mexico	(a)					
4	New York	19	(b)			(b)	(b)
26	North Carolina	15	2,592		14,648		
1	Ohio	101	293,249	$632,844	2,050,864	$270,138	18,664,031
19	Oregon	2	(b)		(b)		
5	Pennsylvania	25	232,880		318,394	(b)	1,331,094
30	South Carolina	3	(b)		(b)		
10	Tennessee	4	(b)		(b)		(b)
17	Texas	10	7,563		86,979		
35	Utah	2	(b)				
18	Virginia	3	(b)				
22	Washington	3	18,110		(b)		
3	West Virginia	19		(b)			6,328,877
34	Wisconsin	1	(b)				
	Undistributed c		582,124	91,137	913,314	535,183	1,980,312
		a 394	1,298,311	723,981	4,603,018	d 805,321	29,847,261
	Percentage of pottery products		1.7	0.9	5.9	1.1	38.3
	Percentage of total clay products		.5	.3	1.7	.3	10.8
	Number of firms reporting each variety		97	8	111	16	62

a Under "Miscellaneous" is included Indian pottery valued at $2,097 manufactured on reservations and distributed by States as follows: Arizona, $1,182; California, $15; and New Mexico, $900. This represents the work of several hundred Indians, but as its manufacture is largely a pastime, the number of producers is not definitely known.

b Included under "Undistributed."

c Includes all products made by less than 3 producers in one State.

d Of this total $147,881, represents the value of chemical porcelain manufactured in Colorado and Ohio. The remainder is chemical stoneware.

Value of pottery products in the United States, 1919—Continued.

Rank.	State.	China, bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.	Percentage of total.
21	Alabama				$3,000	$33,253	
36	Arizona				[b] 1,182	1,182	
20	Arkansas				(c)	(c)	
8	California		$561,666		[b] 68,466	923,377	1.2
15	Colorado				27,378	192,978	.2
12	Connecticut		(c)		(c)	(c)	
29	District of Columbia					(c)	
33	Florida				(c)	(c)	
24	Georgia				3,660	23,528	
16	Illinois		(c)	(c)	214,203	2,104,109	2.7
7	Indiana		1,190,622	(c)	101,568	2,066,792	2.7
31	Iowa				(c)	(c)	
14	Kentucky				2,068	210,187	.2
32	Louisiana				(c)	(c)	
11	Maryland		(c)	(c)	11,300	487,049	.6
13	Massachusetts				37,742	313,325	.4
6	Michigan		(c)	(c)	60,208	2,096,874	2.7
9	Minnesota				(c)	(c)	
27	Mississippi					16,334	
25	Missouri					20,817	
23	Nebraska					(c)	
28	New Hampshire				(c)	(c)	
2	New Jersey	$1,870,542	7,931,371	$3,447,830	1,131,852	16,317,529	21.0
37	New Mexico				[b] 900	900	
4	New York	2,787,364		2,189,352	396,040	5,633,355	7.2
26	North Carolina					17,240	
1	Ohio	(c)	1,301,024	3,717,207	2,537,465	30,284,017	38.9
19	Oregon					(c)	
5	Pennsylvania	1,317,127	622,635	(c)	128,240	4,669,127	6.0
30	South Carolina					13,275	
10	Tennessee				262,246	564,646	.7
17	Texas				782	95,324	.1
35	Utah					(c)	
18	Virginia		(c)		4,200	49,944	.1
22	Washington				400	28,074	
3	West Virginia	(c)	1,678,760	1,034,863	337,859	[d]10,386,500	13.3
34	Wisconsin					(b)	
	Undistributed[e]	1,733,799	1,586,286	2,225,542	53,121	1,308,026	1.7
		7,708,832	14,872,364	12,614,794	5,383,880	[d]77,857,762	
	Percentage of pottery products	9.9	19.1	16.2	6.9	100.0	
	Percentage of total clay products	2.8	5.4	4.6	1.9	28.3	
	Number of firms reporting each variety	17	47	45	180		

[a] Including aquarium ornaments, art pottery, corroding pots, doll heads, majolica ware, filter stones and tubes, gas and electric lighting and heating appliances, garden furniture, Guernsey and Oxford ware, Indian, Niloak, Omar Khayyam, Pewabic and Rookwood pottery, pins, stilts and spurs for potters' use, porcelain door knobs, porcelain hardware supplies, porcelain guides for use on textile machinery, refrigerator linings, X-ray and levigating tanks, saggers, shuttle eyes and thread guides, tobacco pipes, toy marbles, turpentine cups, and vases, etc.

[b] Under "Miscellaneous" is included Indian pottery valued at $2,097, manufactured on reservations and distributed by States as follows: Arizona $1,182; California, $15; and New Mexico $900. This represents the work of several hundred Indians, but as its manufacture is largely a pastime, the number of producers is not definitely known.

[c] Included under "Undistributed."

[d] Revised figures.

[e] Includes all products made by less than 3 producers in one State.

Value of pottery products in the United States, 1920.

Rank.	State.	Number of firms reporting sales.	Red earthenware.	Red and brown white-lined cooking ware.	Stoneware and yellow and Rockingham ware.	Chemical stoneware and porcelain.	White ware, including C. C. ware, etc.
23	Alabama	8	$16,250		$19,090		
27	Arizona	(a)					
20	Arkansas						
9	California	14	77,838		308,900	(b)	(b)
15	Colorado	5	(b)		(b)	(b)	
13	Connecticut		(b)				
29	District of Columbia	(b)					
36	Florida						
25	Georgia	14	8,140		16,250		
7	Illinois	17	191,908		1,080,993		(b)
6	Indiana	9	(b)		88,736		(b)
32	Iowa	(b)					
26	Kansas	(b)			(b)		
16	Kentucky	4	35,335		206,429		
31	Louisiana						
12	Maryland	3	(b)				(b)
14	Massachusetts	10	(b)		(b)	(b)	(b)
8	Michigan	8	(b)				(b)
10	Minnesota		(b)		(b)		
27	Mississippi	6	4,603		(b)		
24	Missouri	4	(b)		(b)		
22	Nebraska		(b)				
2	New Jersey	57	46,421	(b)	(b)	(b)	$2,087,008
35	New Mexico	(a)					
4	New York	17	(b)				
30	North Carolina	14	775		13,532		
1	Ohio	102	267,520	$564,772	2,356,508	$562,945	24,362,372
21	Oregon		(b)	(b)	(b)		
5	Pennsylvania	26	358,671		363,556		1,620,231
28	South Carolina	4	12,688		3,412		
11	Tennessee	5	(b)		(b)		(b)
17	Texas	8	9,517		122,436		
34	Utah		(b)				
18	Virginia	4	(b)				(b)
19	Washington	3	40,396		(b)		
3	West Virginia	16					7,803,117
33	Wisconsin		(b)				
	Undistributed c	21	696,857	151,130	895,818	710,566	2,451,152
		a 379	1,766,919	715,902	5,475,660	d 1,273,511	38,323,880
	Percentage of pottery products		1.7	.7	5.1	1.2	35.9
	Percentage of total clay products		.5	.2	1.5	.3	10.3
	Number of firms reporting each variety		99	7	85	7	63

a Under "Miscellaneous" is included Indian pottery, valued at $4,590, made on reservations and distributed as follows: Arizona, $840; New Mexico, $3,750. This represents the work of many Indians, but the number of producers is not known.
b Included under "Undistributed."
c Includes all products made by less than 3 producers in one State.
d Of this total $258,888 represents the value of chemical porcelain made in Colorado and Ohio.

Value of pottery products in the United States, 1920—Continued.

Rank.	State.	China, bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous. [a]	Total.	Percentage of total.
23	Alabama					$35,340	
27	Arizona				[b] $840	840	
20	Arkansas				(c)	(c)	
9	California		$1,057,882	(c)	53,970	1,623,790	1.5
15	Colorado				47,608	318,051	.3
13	Connecticut			(c)		(c)	
29	District of Columbia					(c)	
36	Florida					(c)	
25	Georgia					24,390	
7	Illinois			$583,583	35,672	2,950,806	3.8
6	Indiana		[d] 1,878,071	(c)	116,687	3,111,282	2.9
32	Iowa				(c)	(c)	
26	Kansas					(c)	
16	Kentucky				2,660	244,424	.2
31	Louisiana				(c)	(c)	
12	Maryland				8,510	567,843	.5
14	Massachusetts				62,419	422,084	.4
8	Michigan			(c)	21,908	2,592,625	2.4
10	Minnesota					(c)	
27	Mississippi					17,467	
24	Missouri					31,084	
22	Nebraska					(c)	
2	New Jersey	$2,829,379	12,763,442	5,058,518	1,289,346	24,597,376	23.0
35	New Mexico				[b] 3,750	3,750	
4	New York	3,809,499		3,220,762	219,522	7,308,283	6.8
30	North Carolina				700	15,007	
1	Ohio	1,994,949	1,966,109	6,105,683	3,048,945	41,229,803	38.6
21	Oregon					(c)	
5	Pennsylvania	1,396,446	727,120	(c)	144,168	5,614,649	5.3
28	South Carolina					16,100	
11	Tennessee				290,809	649,708	.6
17	Texas				16,000	133,553	.1
34	Utah					(c)	
18	Virginia		(c)		5,156	68,205	.1
19	Washington				1,600	60,657	.1
3	West Virginia	1,309,820	2,339,923	1,884,909	174,471	13,660,713	12.8
33	Wisconsin					(c)	
	Undistributed [d]		1,282,104	3,365,469	56,795	1,418,846	
		11,340,093	22,014,651	20,218,924	5,587,136	106,716,676	
	Percentage of pottery products	10.6	20.6	19.0	5.2	100.0	
	Percentage of total clay products	3.0	5.9	5.4	1.5	28.6	
	Number of firms reporting each variety	21	47	49	166		

[a] Including aquarium ornaments, art pottery, clay pipes for smoking and for shooting galleries, corroding pots, cracqule porcelain, doll heads, electric heating and lighting appliances, filter stones and filters, fire clay cooking utensils, fittings for textile mills, garden pottery, hardware trimmings, door knobs and caster cups, Indian pottery, lead pots, novelties, pins, stilts, and spurs for potters' use, saggers, toy marbles, toys, turpentine cups, and umbrella stands, etc.

[b] Under "Miscellaneous" is included Indian pottery, valued at $4,590, made on reservations and distributed as follows: Arizona, $840; New Mexico, $3,750. This represents the work of many Indians, but the number of producers is not known.

[c] Included under "Undistributed."

[d] Includes all products made by less than 3 producers in one State.

IMPORTS AND EXPORTS.[1]

The value at the principal markets of the country from which they were shipped of the clay products imported and entered for consumption in the United States in 1920 was $11,269,870, which represents an increase of 52 per cent over 1919. Except that of 1910 this value was the greatest recorded since 1907, the year of largest imports. Brick, tile, and pottery each increased in value as compared with 1919. As in domestic products, part of the increase was due to the enhanced value of the ware, though the bulk of imports also increased very considerably. Of the value of the imports 96 per cent was represented by pottery and 4 per cent by brick and tile. The pottery imported, which consists principally of high-grade wares, was valued at $10,850,772, an increase of 50 per cent as compared with 1919. The brick and tile imports, valued at $419,098, increased 113 per cent as compared with 1919 and reached the highest value recorded since 1890.

The exports of clay products increased considerably in 1920; they were valued at $9,397,623, an increase of $2,815,339. The exports of brick and tile increased in value from $3,625,038 in 1919 to $5,608,163 in 1920. Fire brick, the largest item, was valued at $4,200,266 and constituted 45 per cent of all exports of clay products and 75 per cent of brick and tile exports—an increase of $1,452,754. The average price per thousand of building brick exported in 1920 was $29.76; in 1919 it was $20.44. The quantity of building brick exported in 1920 was 12,863,000, an increase of 694,000. As this quantity, however, probably includes both common and face brick, possibly mostly face brick, the price is not so high as might be thought. The quantity of fire brick exported was 82,570,000, an increase of 31,318,000 and the average price per thousand was $50.87. The exports of pottery also increased considerably, notwithstanding the large home demand, being valued at $2,837,469, an increase of 27 per cent.

The value of the brick and tile exported in 1920 constituted 60 per cent of the value of all clay products exported; pottery amounted to 30 per cent and "all other" clay products to 10 per cent. In 1919 these percentages were, respectively, 55, 34, and 11.

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[1] Figures for imports and exports compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Value of clay products imported and entered for consumption in the United States, 1911–1920.

Year.	Pottery.								Brick, fire brick, tile, etc.	Grand total.
	Brown earthen and common stone ware.[a]	Tobacco pipes and pipe bowls of clay.	Earthenware and crockery composed of a nonvitrified absorbent body.		China and porcelain.		Sanitary earthenware, decorated and not decorated.	Total.		
			Not decorated.	Decorated.	Not decorated.	Decorated.				
1911	$164,871	$61,244	....	....	$1,221,756	$9,251,989	....	$10,699,860	$208,966	$10,908,826
1912	152,166	66,292	....	....	1,094,152	8,309,212	....	9,621,822	215,379	9,837,201
1913	238,611	31,806	[b]$81,978	[b] $523,803	[c]1,067,209	[c] 8,273,681	....	10,217,088	276,677	10,493,765
1914	312,934	40,548	438,460	1,968,561	727,725	4,910,365	....	8,398,593	207,644	8,606,237
1915	227,017	15,155	272,795	1,538,732	458,302	4,116,085	....	6,628,086	171,801	6,799,887
1916	264,715	10,378	173,192	1,669,712	289,219	3,177,998	$15,371	5,600,585	165,080	5,765,665
1917	518,965	8,209	235,104	1,960,150	157,658	3,409,527	43,701	6,333,314	309,259	6,642,573
1918	436,207	4,716	317,501	2,147,486	200,328	3,269,008	18,334	6,393,580	290,620	6,684,200
1919	293,120	15,852	350,644	2,476,210	359,560	3,726,695	7,980	7,230,061	196,839	7,426,900
1920	390,962	12,091	340,676	3,805,955	431,636	5,856,384	13,068	10,850,772	419,098	11,269,870

[a] Including Rockingham ware and miscellaneous pottery products.
[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.

Value of clay products of domestic manufacture exported from the United States, 1911–1920.

Year.	Building brick.	Fire brick.	Tile (except drain).	Earthern and stone ware.	China.	Sanitary earthenware.	All other.	Total.
1911	....	$1,057,725	....	$1,278,892	$122,474	....	$1,206,629	$3,665,720
1912	[a]$448,939	1,117,161	[a] $539,116	1,037,637	140,147	....	1,717,895	5,000,895
1913	689,515	1,121,590	851,463	410,050	149,281	....	1,566,340	4,788,239
1914	524,239	734,134	[a] 658,695	390,693	136,209	....	1,134,035	3,578,005
1915	279,336	975,089	276,785	297,127	160,710	[a] $105,615	610,578	2,705,240
1916	189,668	2,406,184	403,184	600,377	262,119	214,076	779,922	4,855,530
1917	196,207	4,011,546	450,422	805,784	422,641	323,558	743,105	6,953,263
1918	117,263	5,001,057	582,051	783,577	318,448	377,527	752,651	7,932,574
1919	248,690	2,747,512	628,836	1,148,051	523,861	563,734	721,600	6,582,284
1920	382,814	4,200,266	1,025,083	1,241,938	816,817	778,714	951,991	9,397,623

[a] Figures cover period from July 1 to Dec. 31.

Clay products of domestic manufacture exported from the United States in 1919 and 1920.

	Building brick.		Fire brick.		Tile (not drain).	Earthen and stone ware.	China.	Sanitary.	All other.	Total.
	Thousands.	Value.	Thousands.	Value.						
1919.										
Europe	....	....	1,263	$129,907	$24,168	$40,572	$73,207	$45,001	$34,052	$346,907
Central America and West Indies	952	$22,915	8,054	422,572	221,318	221,969	126,868	155,042	178,631	1,349,315
Canada	9,569	195,569	34,170	1,667,220	231,495	642,823	91,388	111,224	316,901	3,256,620
Mexico	1,436	23,754	5,171	206,800	31,892	84,769	91,074	22,894	53,566	514,749
Newfoundland	3	138	....	....	1,242	5,135	3,158	4,200	706	14,579
South America	200	6,120	1,155	154,338	92,745	67,174	95,643	97,101	37,697	550,818
Asia	....	....	847	102,386	15,515	51,647	17,676	97,287	77,676	362,187
Oceania	9	194	589	64,210	9,907	30,780	21,722	30,771	21,496	179,080
Africa	....	....	3	79	554	3,182	3,125	214	875	8,029
	12,169	248,690	51,252	2,747,512	628,836	1,148,051	523,861	563,734	721,600	6,582,284
1920.										
Europe	45	2,538	325	19,366	24,470	91,819	52,651	18,130	29,526	238,500
Central America and West Indies	2,848	94,428	16,144	936,633	530,434	414,085	259,074	329,245	345,533	2,909,432
Canada	5,285	178,067	50,230	2,250,434	243,854	382,321	237,060	111,285	345,279	3,748,300
Mexico	4,225	96,730	11,094	527,625	46,221	111,602.	104,632	54,568	94,013	1,035,391
Newfoundland	41	1,975	11	2,477	3,313	2,442	4,133	2,877	8,745	25,962
South America	402	8,723	2,270	283,672	92,150	154,715	114,665	121,599	74,902	850,426
Asia	....	....	1,688	125,520	62,978	54,715	18,829	63,897	36,035	361,974
Oceania	17	353	634	41,199	21,347	23,509	21,951	73,809	16,000	198,168
Africa	....	....	174	13,340	316	6,730	3,822	3,304	1,958	29,470
	12,863	382,814	82,570	4,200,266	1,025,083	1,241,938	816,817	778,714	951,991	9,397,623

CLAY.

GENERAL CONDITIONS.

Clay available for the manufacture of clay products is widely distributed, and there are clay-working plants in every State in the Union. Miners of the lower-grade clays are usually also the manufacturers, but as to the higher grades the rule is that fewer and fewer miners are also manufacturers, until nearly every manufacturer of the highest grades of ware buys his clay. The following tables represent clay that is mined and sold as clay. The quantity thus sold is small compared with the total output and includes mainly clay used for high-grade pottery and tile, for paper making, and for refractory products.

The total production of the clay sold as such decreased in 1919, compared with 1918, but rallied and reached the maximum in 1920, when the increase in quantity was 37 per cent and in value 63.8 per cent. Every variety of clay shared in the increase. Fire clay increased 33.4 per cent in quantity and 60.4 per cent in value; kaolin 75.5 per cent in quantity and 94.2 per cent in value.

Fire clay, judged by volume and value, is the most important clay mined and marketed in the United States; in 1920 it constituted 75 per cent of the total output and nearly 64 per cent of the total value.

PRODUCTION.

Clay marketed in the United States, 1911–1920.

Year.	Kaolin.		Paper clay.		Ball clay.		Slip clay.		Fire clay.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1911	27,400	$221,045	99,265	$454,435	65,072	$220,710	8,393	$16,770	1,526,921	$2,112,827
1912	25,852	220,747	119,857	522,924	64,939	227,545	16,339	27,573	1,695,337	2,363,357
1913	28,834	235,457	126,377	567,977	67,134	237,672	10,902	24,505	1,820,379	2,592,591
1914	34,191	284,817	116,328	558,334	67,927	255,767	8,237	17,731	1,409,467	2,147,277
1915	28,031	241,520	113,033	539,622	75,348	301,910	7,646	18,774	1,570,481	2,361,482
1916	47,723	306,819	153,434	768,911	89,761	391,152	14,064	47,939	2,057,814	3,708,009
1917	31,885	301,378	174,449	962,421	107,406	569,240	16,972	70,505	2,347,972	5,625,095
1918	37,969	391,109	141,725	1,068,420	89,896	590,631	13,552	49,898	2,305,033	5,664,064
1919	38,758	490,510	114,070	985,171	65,026	520,849	5,149	17,556	1,755,331	4,628,605
1920	[a]268,203	[a]2,865,407	([a])	([a])	69,477	584,611	9,006	41,519	2,341,076	7,425,674

Year.	Stoneware clay.		Brick clay.		Miscellaneous clay.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
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
1915	134,297	126,429	101,968	93,863	332,150	288,341	2,362,954	3,971,941
1916	135,958	137,779	97,164	76,854	336,672	314,311	2,932,590	5,751,774
1917	81,352	113,839	93,779	94,703	260,029	305,365	3,113,844	8,042,546
1918	86,800	147,098	([b])	([b])	301,386	421,421	2,976,361	8,332,641
1919	60,236	80,367	([b])	([b])	236,530	367,573	2,275,100	7,090,631
1920	106,350	229,221	([b])	([b])	322,100	467,856	3,116,212	11,614,288

[a] Paper clay included under "Kaolin." [b] Included under "Miscellaneous clay."

Clay marketed in the United States in 1919.

State.	Kaolin and paper clay.		Fire clay.		Stoneware clay.		Miscellaneous.[a]		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Alabama			49,372	$46,497	(b)	(b)	19,858	$28,634	69,303	$75,138
California	3,061	$41,101	82,084	118,900	(b)	(b)	40,471	54,432	141,174	235,971
Colorado			135,089	135,427			3,617	3,881	138,706	139,308
Delaware	3,838	56,729	(b)	(b)					8,058	69,539
Florida							(b)	(b)	(b)	(b)
Georgia	81,466	682,467	14,121	21,172					95,587	703,639
Idaho			(b)	(b)					(b)	(b)
Illinois			89,872	192,086	21,586	$26,220	28,000	84,000	139,458	302,306
Indiana			42,483	44,058			34,423	36,209	76,906	80,267
Iowa							8,506	5,600	8,506	5,600
Kentucky			35,701	140,168	(b)	(b)	148	74	52,690	223,550
Maryland	(b)	(b)	18,150	53,766					20,650	57,516
Massachusetts			(b)	(b)					(b)	(b)
Michigan									568	2,123
Minnesota							22,907	35,827	22,907	35,827
Mississippi			(b)	(b)			(b)	(b)	2,560	10,780
Missouri	1,189	21,544	339,833	982,126			363	363	341,385	1,004,033
Montana			5,077	30,551					5,077	30,551
Nebraska			(b)	(b)	(b)	(b)			(b)	(b)
Nevada	(b)	(b)							(b)	(b)
New Jersey			271,952	1,048,313	(b)	(b)	4,164	13,713	278,190	1,078,482
New Mexico			1,609	7,504					1,609	7,504
New York							(b)	(b)	(b)	(b)
North Carolina	(b)	(b)					(b)	(b)	(b)	(b)
Ohio			187,228	429,445	21,885	28,909	1,222	2,150	212,534	464,901
Oregon			(b)	(b)					(b)	(b)
Pennsylvania	21,618	232,232	367,621	1,089,910			25,858	27,324	415,097	1,349,466
South Carolina	23,487	211,138	(b)	(b)					25,706	224,415
South Dakota							(b)	(b)	(b)	(b)
Tennessee			26,732	85,490					42,482	189,705
Texas			1,981	13,697			19,860	29,790	21,841	43,487
Utah			4,112	16,643			12	175	4,124	16,818
Vermont	(b)	(b)	(b)	(b)					(b)	(b)
Virginia			(b)	(b)					(b)	(b)
Washington			(b)	(b)	(b)	(b)	19,728	15,782	20,518	21,964
West Virginia			71,979	123,951					71,979	123,951

Wyoming	....	....	(b)	(b)	....	....	(b)	(b)	(b)	(b)
Undistributed c	18,169	230,470	10,335	48,901	16,765	25,238	7,393	29,619	57,485	593,790
	152,828	1,475,681	1,755,331	4,628,605	60,236	80,367	d 306,705	d 905,978	2,275,100	7,090,631
Average price per ton	....	9.66	....	2.64	....	1.33	....	....	....	3.12

a Including adobe, bentonite, brick, cement, draintile, and foundry clay and shale.
b Included under "Undistributed."
c Includes all clay reported by less than 3 producers in one State.
d These totals include 65,026 short tons of ball clay, valued at $520,849, or $8.01 per ton, from California, Florida, Kentucky (14,729 tons, valued at $80,795), New Jersey, and Tennessee (15,750 tons, valued at $104,215); and 5,149 tons of slip clay, valued at $17,556, or $3.41 per ton, from Kentucky, Michigan (568 tons, valued at $2,123), New York, Ohio, and Washington.

Clay marketed in the United States in 1920.

State.	Kaolin and paper clay.		Fire clay.		Stoneware clay.		Miscellaneous.[a]		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
Alabama			45,612	$51,220	(b)	(b)			47,512	$91,010
Arkansas			(b)	(b)	(b)	(b)			(b)	(b)
California	3,786	$60,412	170,838	306,832	6,860	$11,249	30,980	$52,780	214,799	437,078
Colorado			124,531	162,858	(b)	(b)	6,266	7,010	131,797	172,378
Connecticut					(b)	(b)	(b)	(b)	(b)	(b)
Delaware	4,345	70,682					(b)	(b)	10,007	97,492
Florida	(b)	(b)							(b)	(b)
Georgia	116,420	1,025,819	1,703	9,282			69,241	36,693	187,364	1,071,794
Idaho			873	8,802					873	8,802
Illinois			156,700	371,636	32,200	45,900	6,521	15,428	195,421	432,964
Indiana			54,412	98,878	(b)	(b)	21,879	25,197	76,341	124,200
Iowa							36,577	36,275	36,577	36,275
Kentucky			69,924	287,944			(b)	(b)	93,491	469,302
Maryland	(b)	(b)	20,632	102,450	(b)	(b)	(b)	(b)	27,772	116,280
Massachusetts							(b)	(b)	(b)	(b)
Michigan							4,561	9,046	5,066	11,295
Minnesota							(b)	(b)	(b)	(b)
Mississippi					(b)	(b)			(b)	(b)
Missouri	606	7,309	440,728	1,397,080	(b)	(b)	(b)	(b)	448,984	1,413,189
Montana			2,582	15,614					2,582	15,614
Nebraska			(b)	(b)					(b)	(b)
Nevada	(b)	(b)							(b)	(b)
New Jersey			285,842	1,423,159	20,627	91,067	43,164	99,484	354,613	1,656,867
New Mexico			1,916	7,119					1,916	7,119
New York			(b)	(b)			(b)	(b)	8,545	43,672
North Carolina	(b)	(b)			(b)	(b)			15,679	244,695
North Dakota			(b)	(b)					(b)	(b)
Ohio			254,422	650,796	28,897	44,641	28,487	34,190	311,806	729,617
Oregon							(b)	(b)	(b)	(b)
Pennsylvania	20,164	298,213	543,610	1,946,772	9,833	17,814	29,393	69,426	603,000	2,332,225
South Carolina	49,892	459,951	(b)	(b)					50,131	462,819
South Dakota							(b)	(b)	(b)	(b)
Tennessee			66,902	283,961			6,631	11,172	110,479	603,374
Texas			3,328	23,103	(b)	(b)	(b)	(b)	3,478	23,503
Utah			(b)	(b)			(b)	(b)	3,814	16,337
Vermont	4,716	52,697							4,716	52,697
Virginia	(b)	(b)	(b)	(b)			(b)	(b)	12,094	131,883
Washington			763	8,854			(b)	(b)	1,319	10,377
West Virginia			86,360	211,029					86,360	211,029
Wisconsin			(b)	(b)			(b)	(b)	(b)	(b)

Wyoming	....	....	(b)	(b)	....	....	(b)	(b)	(b)	(b)
Undistributed c	68,274	890,324	9,398	58,285	7,933	18,550	38,400	71,155	69,676	590,401
	268,203	2,865,407	2,341,076	7,425,674	106,350	229,221	d 400,583	d 1,093,986	3,116,212	11,614,288
Average price per ton	....	10.68	....	3.17	....	2.16	....	....	....	3.72

a Including ardmorite, bentonite, brick clay, clay for cement, hollow ware, paint, plaster, pencil leads, red earthenware, roofing tile, sewer pipe, stove polish, terra cotta, and shale.

b Included under "Undistributed."

c Includes all clay reported by less than 3 producers in one State.

d These totals include 69,477 short tons of ball clay, valued at $584,611, or $8.41 per ton, from Alabama, California, Kentucky (23,404 tons, valued at $181,195), Maryland, Mississippi, New Jersey (4,980 tons, valued at $43,157), and Tennessee (36,946 tons, valued at $308,241); and 9,006 short tons of slip clay, valued at $41,519, or $4.61 per ton, from California, Massachusetts, Michigan (505 tons, valued at $2,249), New York, and Washington.

IMPORTS AND EXPORTS.[1]

The imports of clay in 1920—403,580 short tons, valued at $4,008,669 at the principal markets of the countries from which the clay was exported—increased 97 per cent in quantity and 86 per cent in value, as compared with 1919. There was an increase in both the quantity and the value of every kind of clay imported. Kaolin or china clay rose from 180,592 tons, valued at $1,965,393, in 1919, to 361,800 tons, valued at $3,568,677, in 1920. The imports of kaolin in 1920 were 10 per cent greater than those in 1914, the year of largest imports prior to 1920. The average price per ton was $9.86, as compared with $10.88 in 1919. This price, however, which is the price abroad, is only a fraction of the price of foreign clay in New York, where, in 1920, imported kaolin was quoted as high as $25 a ton. Only 4 tons of common blue and Gross Almerode clays, valued at $133, were imported in 1919, but in 1920 the imports of these clays increased to 6,837 tons, valued at $157,201. This was only a little more than one-fourth of the imports of these clays in 1913, the year of maximum imports. The imports of unwrought or unmanufactured clay, which is thought to be chiefly English ball clay, were 34,252 tons, valued at $272,524, an increase of about 45 per cent in quantity and value.

Clay imported and entered for consumption in the United States, 1911–1920.

Year.	Kaolin or china clay.			Common blue and Gross Almerode glass pot clay.		All other clays.				Total.	
						Unwrought.		Wrought.			
	Short tons.	Value.	Average price.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1911..	255,107	$1,461,068	$5.73	17,193	$124,278	26,086	$100,540	1,032	$10,436	299,418	$1,696,322
1912..	278,276	1,629,105	5.85	23,112	184,018	32,473	127,004	794	12,109	334,655	1,952,236
1913..	268,666	1,623,993	6.04	24,986	204,911	42,582	155,693	1,889	22,178	338,123	2,006,775
1914..	328,038	1,927,425	5.88	16,761	122,325	50,069	195,956	3,232	41,712	398,100	2,287,418
1915..	209,132	1,152,778	5.51	8,864	62,569	23,718	90,367	1,343	12,433	243,057	1,318,147
1916..	253,707	1,326,684	5.23	2,501	12,134	42,478	163,421	180	1,994	298,866	1,504,233
1917..	241,029	1,315,769	5.46	88	709	26,581	123,439	338	2,142	268,036	1,442,059
1918..	168,100	1,153,240	6.86	114	983	26,984	163,484	137	1,087	195,335	1,318,794
1919..	180,592	1,965,393	10.88	4	133	23,759	187,550	498	4,262	204,853	2,157,338
1920..	361,800	3,568,677	9.86	6,837	157,201	34,252	272,524	691	10,267	403,580	4,008,669

The total quantity of clay exported in 1920 was 120,160 tons, valued at $1,168,399, an increase of 75 per cent in quantity and 128 per cent in value. Fire clay, the only kind designated, constituted 45 per cent of the clay exported.

Clay exported from the United States, 1916–1920.

Year.	Fire clay.		All other.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1916	45,752	$144,552	27,941	$145,970	73,693	$290,522
1917	54,023	268,093	29,194	178,764	83,217	446,857
1918	60,206	333,880	24,348	192,053	84,554	525,933
1919	37,486	262,501	30,983	249,571	68,469	512,072
1920	54,125	393,177	66,035	775,222	120,160	1,168,399

[1] Figures for imports and exports compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

SILICA BRICK.

PRODUCTION.

The production of silica brick in the United States has made considerable progress in the last 10 years, as is shown in the following table:

Silica brick produced and sold in the United States, 1911–1920.

Year.	Thousands.	Value.	Average price.
1911	104,483	$2,520,816	$24.13
1912	135,578	2,923,174	21.56
1913	174,246	3,815,806	21.90
1914	129,693	2,951,525	22.76
1915	130,244	3,039,869	23.34
1916	232,673	6,369,256	27.37
1917	327,030	15,510,595	47.43
1918	336,562	19,987,803	59.39
1919	211,420	10,914,898	51.63
1920	250,582	15,076,821	60.17

In 1920 silica brick was reported from 12 States, an increase of 1—Maryland—compared with 1919; the States reporting were Alabama, California, Colorado, Illinois, Indiana, Maryland, Missouri, Montana, Ohio, Pennsylvania, Utah, and Washington. Pennsylvania, the leading State, reported the equivalent of 182,811,000 9-inch brick, valued at $10,629,769, an increase of 22,753,000 brick and of $2,787,453; this production was 73 per cent of the total output and 71 per cent of the total value in 1920.

COKE AND BY-PRODUCTS IN 1919 AND 1920.

By R. S. McBride and F. G. Tryon.

SCOPE OF REPORT.

It is now possible for the first time to present fairly complete statistics of the production of coke in beehive and by-product ovens in the United States during and since the World War, though it is not yet possible to present a complete analysis of many phases of the coke industry, as the time available for the preparation of this report has been too short to permit a thorough study of the subject. The results of such a study, particularly an account of the engineering features of the industry, must therefore be reserved for incorporation in the report for 1921, which is already under way.

The present report deals with the production and distribution and, to some extent, the use of the coke and by-products obtained from ovens operated in the United States during the calendar years 1919 and 1920. It includes, however, for comparison, many data taken from reports for earlier years, particularly those of the war period.

This report includes no statistics of the production of coke made in public-utility plants as an incident to the manufacture of gas in horizontal, vertical, or inclined retorts, as distinct from chamber ovens, for distribution through city mains, because their contribution to the coke industry is only an incident of their work. In other words, in the public-utility plants coke is a by-product of the manufacture of gas rather than gas a by-product of the manufacture of coke, as it is in the coke industry.

The relation of beehive and by-product coke to the gas industry is not limited to the production of coke from gas works. In the carbonization of coal for the manufacture of coal gas and in the manufacture of oil gas and water gas by entirely different processes, many products are obtained that are very similar to the products obtained from by-product coke ovens. In order to furnish some basis for comparison between the industries this report includes a brief section on the manufactured-gas industry in 1920, in which are given together corresponding data for coke, coke by-products, and the products of city gas works. (See p. 434.)

This report likewise does not include any statistics of the production of coke from the refining of petroleum. The output of that material is small, and it is not marketed in any way as a competitor or substitute for beehive, by-product, or gas-works coke.

The unit of measurement employed in this report is the short or net ton of 2,000 pounds, unless otherwise specified.

The term "coke," except as otherwise indicated, does not include the breeze or fine coke screenings, because operators in general, especially in the beehive industry, regard as coke only that portion of their output which is salable for furnace, foundry, or domestic use. No effort has been made to define accurately the distinction by size between coke and breeze or screenings. The usual local practice of each operator has been followed by him in reporting the output of this fine material from each plant.

The coke industries in the United States are of importance in any consideration of the mineral industries as a whole, not only because the coke business is a large user of coal but also because the products of the coke industry are really mineral raw materials in a semi-finished state. Just as pig iron is a finished product from the standpoint of those engaged in the blast-furnace industry, so coke, tar, ammonium sulphate, gas, and crude light oils are the finished products of coking. However, the pig iron becomes a raw material for steel manufacture and for all branches of ferrous metallurgy, and so also coke becomes a raw material fuel both in metallurgy and in our domestic fuel supply as a substitute for anthracite. Similarly, tar, ammonium sulphate, and crude light oils enter the chemical and fertilizer industries as raw materials just as copper, lead, and zinc do among the metals, and feldspar, barite, lime, bauxite, and phosphate rock among the well-known nonmetallic minerals. No picture of the mineral industries of the country would be at all complete without a thorough analysis of coke and these important by-products of its manufacture.

ACKNOWLEDGMENTS.

The statistics in this report were collected and analyzed by Mrs. Helen L. Bennit, of the United States Geological Survey, except the data for imports and exports, which were compiled by James A. Dorsey, also of the Survey, from the records of the Bureau of Foreign and Domestic Commerce. The statistical work has been done under the supervision of F. G. Tryon; the text has been prepared by R. S. McBride, with the cooperation of several members of the Survey staff.

IMPORTANT FACTS OF THE COKE INDUSTRY IN 1919 AND 1920.

The most important data for the calendar years 1919 and 1920 are summarized in Table 1, from which it is possible to gain quickly an idea of the general scope of the production and distribution of coke. The same data are analyzed in much greater detail in the many tables that follow. Figure 18 gives graphically a historical outline of the production of both beehive and by-product coke and of its relation to the production of pig iron during the period from 1880 to 1920. The increases and decreases in the production of coke closely follow the corresponding changes in the output of pig iron, as seems quite natural when it is realized that the producers of pig iron are by far the largest users of both beehive and by-product coke.

The year 1918 still remains the year of maximum production of coke in the United States. The output of 1919 fell materially below that of 1918, thus reflecting clearly the decreased activity in the metallurgical industries that naturally followed the World War. This decrease in 1919 was counterbalanced somewhat by an increase of about 15 per cent in 1920, although the production in 1920 was still approximately 10 per cent below that of 1918.

As will be seen from Table 8, which shows the production of beehive coke by months, the operations during both 1919 and 1920 were by no means uniform. The tremendous boom of war-time activity extended into 1919, but before the middle of that year the average daily output was less than half the daily average for the three preceding years. As business, especially the metallurgical industries, regained confidence and resumed activity to a certain extent, the production of beehive coke increased steadily from May, 1919, until the spring of 1920, when it was realized that a period of subnormal business was in prospect, and production began to decline. The decline continued slowly through the rest of 1920 and well into 1921, the daily average for July, 1921, being less than 7 per cent of the daily average during each of the three years 1916, 1917, and 1918.

Data for the output of by-product coke by months are not available to show the variations in this branch of the industry during the two years under discussion, but the annual reports show that there was little decrease in output in 1919 as compared with 1918 and that the production in 1920 was the maximum reached. The contrast between the two branches of the industry is discussed elsewhere in this report.

After the expiration of the war-time regulation of fuel prices it might have been expected that the price of coke would increase materially, but the prices for 1919 as a whole do not show this result, for the average value indicated by the prices realized from sales was less for both beehive and by-product coke than during 1918. In 1920, however, the prices realized for the coke sold from beehive and by-product ovens reached the highest figures that have been recorded in the industry, and as usual the average value of the beehive coke was slightly less than that of the by-product coke.

The output of by-products from the coal coked in by-product ovens was greater in 1919 and 1920 than ever before. This condition was the natural result of increasing efficiency in plant operation consequent upon increased knowledge of methods of carbonizing coal. It was also in part the result of the operation of many new plants that are provided with better facilities for the recovery of by-products. The average value of the by-products recovered per ton of coal carbonized in by-product ovens has increased materially during recent years. However, the notable increase in average receipts from sales of ammonia and gas was offset to a considerable extent by the decline in the average receipts from the sale of benzol products, which is the natural consequence of the decreased demand for benzol, toluol, and xylol for the production of high explosives. The increased quantity of crude light oil and derived products that resulted from the increase in plant efficiency and in the quantity of coal carbonized during 1920 was not sufficient to offset the very great decline in the average price per gallon obtained for the products. Thus the over-all effect of changing market conditions and changing production has been a considerable decrease in the average return to operators for the light-oil products produced per ton of coal handled.

TABLE 1.—*Salient figures of the coke industry in 1919 and 1920.*

	1919	1920
New ovens completed and put in operation:		
Beehive	(a)	....
By-product	(a)	757
	(a)	757
Ovens dismantled:		
Beehive	2,779	6,706
By-product	68	300
	2,847	7,006
Ovens in existence Dec. 31:		
Beehive	82,560	75,298
By-product	10,379	10,881
	92,939	86,179
Daily coke capacity of ovens in existence Dec. 31:		
Beehive ... net tons	(a)	196,065
By-product ... do	(a)	117,319
	(a)	313,384
Ovens in course of construction Dec. 31:		
Beehive	164	332
By-product	877	396
	1,041	728
Coal charged into ovens:		
Beehive ... net tons	29,730,499	31,985,836
By-product ... do	35,857,419	44,204,996
	65,587,918	76,190,832
Average value of coal charged into ovens:		
Beehive	$2.17	$3.14
By-product	3.96	5.40
	3.14	4.44
Coke produced:		
Beehive ... net tons	19,042,936	20,511,092
By-product ... do	25,137,621	30,833,951
	44,180,557	51,345,043
Average yield of coke from coal:		
Beehive ... per cent	64.1	64.1
By-product ... do	70.1	69.9
	67.4	67.3
Screenings and breeze produced:		
Beehive ... net tons	63,865	245,977
By-product ... do	1,848,547	2,460,835
	1,912,412	2,706,812
Furnace coke sold:		
Beehive ... do	14,574,264	13,128,237
By-product ... do	4,677,497	4,054,964
	19,251,761	17,183,201
Foundry coke sold:		
Beehive ... do	1,349,483	1,807,256
By-product ... do	1,480,516	1,715,982
	2,829,999	3,523,238
Domestic and other coke sold:		
Beehive ... do	[b] 143,930	192,142
By-product ... do	[b] 2,885,270	2,361,737
	[b] 3,029,200	2,553,879
Screenings and breeze sold:		
Beehive ... do	(b)	44,040
By-product ... do	(b)	563,019
	(b)	607,059
Average value of furnace coke sold:		
Beehive	$4.94	$8.30
By-product	6.63	10.57
	5.35	8.83

[a] Statistics not available. [b] Screenings and breeze included with domestic and other coke.

TABLE 1.—*Salient figures of the coke industry in 1919 and 1920*—Continued.

	1919	1920
Average value of foundry coke sold:		
Beehive	$6.20	$9.52
By-product	8.69	13.80
	7.50	11.60
Average value of domestic and other coke sold:		
Beehive	[b] $5.39	$8.04
By-product	[b] 5.41	8.93
	[b] 5.41	8.86
Average value of screenings and breeze sold:		
Beehive	([b])	$3.82
By-product	([b])	2.22
	([b])	2.33
Coke used by producer:		
Beehive...net tons	3,023,828	3,204,884
By-product...do	17,767,066	22,848,461
	20,790,894	26,053,345
Screenings and breeze used by producer:		
Beehive...do	([a])	59,171
By-product...do	([a])	1,692,186
	([a])	1,751,357
By-products obtained from by-product ovens.		
Tar produced...gallons	288,901,739	360,664,124
Sold:		
Quantity...do	217,707,157	174,363,696
Value	$6,918,549	$6,378,040
Used as fuel under boilers...gallons	([a])	23,947,848
Used in open-hearth or other affiliated plants...do	([a])	167,855,300
Average yield per ton of coal coked...do	8.1	8.2
Ammonia produced (sulphate equivalent)...pounds	746,446,383	938,925,522
Sold (sulphate equivalent):		
Quantity...do	764,079,749	874,321,063
Value	$26,751,694	$35,695,433
Average yield per ton of coal coked...pounds	20.8	21.4
Gas produced...M cubic feet	415,655,098	476,485,744
Used in heating ovens...do	212,221,693	235,701,859
Used under boilers or other coke-plant equipment...do	([a])	25,430,288
Used in steel or other affiliated plant...do	([a])	151,764,807
Distributed through city mains...do	49,464,601	53,220,824
Wasted...do	10,609,311	10,367,966
Value of gas sold or used (exclusive of that used for heating ovens)	$16,650,195	$32,234,318
Average yield per ton of coal coked...M cubic feet	11.6	10.8
Crude light oil produced...gallons	92,473,409	109,709,915
Sold:		
Quantity...do	....	1,067,045
Value	....	$126,158
Refined on premises...gallons	....	106,564,417
Average yield per ton of coal coked...do	2.7	2.7
Crude benzol produced...do	[c] 44,060,970	8,747,572
Sold:		
Quantity...do	[c] 44,673,554	1,510,420
Value	[c] $7,860,093	$401,296
Refined benzol produced...gallons	17,006,532	16,977,556
Sold:		
Quantity...do	18,403,909	15,720,356
Value	$3,783,552	$4,096,527
Motor fuel produced...gallons	([c])	57,645,462
Sold:		
Quantity...do	([c])	55,764,265
Value	([c])	$12,644,931
Crude toluol produced...gallons	....	287,142
Refined toluol produced...do	1,160,136	2,710,649
Sold:		
Quantity...do	1,353,827	2,470,364
Value	$355,990	$740,722
Solvent naphtha produced...gallons	3,920,489	5,678,525
Sold:		
Quantity...do	3,625,978	4,695,464
Value	$552,853	$851,048
Crude naphthalene produced...pounds	3,579,998	11,246,807
Sold:		
Quantity...do	4,038,455	11,507,703
Value	$82,244	$307,999
Refined naphthalene produced...pounds	2,763,271	2,921,282
Sold:		
Quantity...do	2,663,585	2,941,059
Value	$109,120	$179,975

[a] Statistics not available.
[b] Screenings and breeze included with domestic and other coke.
[c] Motor fuel included with crude benzol.

PRODUCTION OF COKE.

Table 2 summarizes the production and sales of coke during 1918, 1919, and 1920. In this table the production of both beehive and by-product coke and the total of the two are shown separately from the production of breeze and screenings. The interesting relation between the production, the use by the producer, and the sales in the two branches of the industry is also brought out by this table. Only a small proportion, usually about 12 to 15 per cent, of the beehive coke is used by the producer, whereas more than two-thirds of the by-product coke is used by the producer. This condition results from the fact that a large number of the by-product ovens have been installed by producers of steel or pig iron for the purpose of supplying themselves with fuel for their metallurgical operations.

Table 2 also indicates the extent to which sales of furnace coke, foundry coke, and other products have contributed to the income of each branch of the industry. Practically all the beehive coke is sold for furnace or foundry use. Considerable by-product coke, however, is sold for "domestic and other" uses, mainly by operators of plants engaged in supplying gas for public utilities.

TABLE 2.—*Beehive and by-product coke produced, sold, and used in the United States in 1918, 1919, and 1920.*

	1918			1919			1920		
	Beehive.	By-product.	Total.	Beehive.	By-product.	Total.	Beehive.	By-product.	Total.
Produced:									
Coke—									
Quantity ....tons..	30,480,792	25,997,580	56,478,372	19,042,936	25,137,621	44,180,557	20,511,092	30,833,951	51,345,043
Value	[a]$189,305,583	[a]$193,018,785	[a]$382,324,368	$98,094,972	$160,244,768	$258,339,740	[a]$181,217,522	[a]$313,028,732	[a]$494,246,254
Screenings and breeze—									
Quantity ....tons..	124,142	1,999,370	2,123,512	63,865	1,848,547	1,912,412	245,977	2,460,835	2,706,812
Value	[a] $766,898	[a] $12,230,019	[a] $12,996,917	$109,522	$2,450,871	$2,560,393	[a]$703,896	[a]$4,434,818	[a]$5,138,714
Sold:									
Furnace coke—									
Quantity ....tons..	23,216,627	4,147,695	27,364,322	14,574,264	4,677,497	19,251,761	13,128,237	4,054,964	17,183,201
Value	$137,782,308	$30,792,247	$168,574,555	$72,007,820	$31,028,251	$103,036,071	$108,943,650	$42,841,222	$151,784,872
Foundry coke—									
Quantity ....tons..	2,230,156	1,631,052	3,861,208	1,349,483	1,480,516	2,829,999	1,807,256	1,715,982	3,523,238
Value	16,802,144	$15,849,017	$32,651,161	$8,364,256	$12,865,927	$21,230,183	$17,209,737	$23,678,225	$40,887,962
Domestic and other coke—									
Quantity ....tons..	[b] 210,511	[b] 2,537,059	[b] 2,747,570	[b]143,930	[b] 2,885,270	[b] 3,029,200	192,142	2,361,737	2,553,879
Value	[b] $1,319,053	[b] $18,907,079	[b] $20,226,132	[b] $775,467	[b] $15,607,752	[b] $16,383,219	$1,545,147	$21,080,429	$22,625,576
Screenings and breeze—									
Quantity ....tons..	(b)	(b)	(b)	(b	(b)	(b)	44,040	563,019	607,059
Value	(b)	(b)	(b)	(b)	(b)	(b)	$168,036	$1,249,004	$1,417,040
Total sales—									
Quantity ....tons..	25,657,294	8,315,806	33,973,100	16,07,677	9,043,283	25,110,960	15,171,675	8,695,702	23,867,377
Value	$155,903,505	$65,548,343	$221,451,848	$81,147,543	$59,501,930	$140,649,473	$127,866,570	$88,848,880	$216,715,450
Used by producer: Coke ....tons..	4,885,318	17,753,348	22,638,666	3,023,828	17,767,066	20,790,894	3,204,884	22,848,461	26,053,345
Screenings and breeze ....do....	(b)	(b)	(b)	(b)	(b)	(b)	59,171	1,692,186	1,751,357

[a] Estimated on basis of sales.

[b] Not asked for specifically. Bulk of screenings and breeze included with domestic coke.

Table 3 outlines the operation of the beehive and by-product coke industries in each of the coke-producing States in 1918, 1919, and 1920, showing the number of ovens active (for 1920, the number of ovens in existence), the coal used, the percentage yield of coke, the quantity produced, and the value of the coke at the ovens.

TABLE 3.—*Coke produced in beehive and by-product coke ovens in the United States, 1918–1920.*

1918.

State.	Beehive coke.					By-product coke.					Total.			
	Active ovens.	Coal used (net tons).	Average yield (per cent).	Coke produced (net tons).	Value of coke at ovens.[a]	Active ovens.	Coal used (net tons).	Average yield (per cent).	Coke produced (net tons).	Value of coke at ovens.[a]	Coal used (net tons).	Coke produced (net tons).	Percentage of total production.	Value of coke at ovens.[a]
Alabama	5,570	2,949,992	58.2	1,717,721	$13,973,660	807	3,877,634	67.9	2,634,451	$15,108,576	6,827,626	4,352,172	7.7	$29,082,236
Colorado	1,431	1,216,154	62.4	758,784	(b)	120	345,877	69.5	230,663	(b)	1,562,031	989,447	1.8	7,450,136
Georgia	101	38,280	57.6	22,048	193,317						38,280	22,048		193,317
Illinois						605	3,199,620	71.4	2,285,610	18,625,436	3,199,620	2,285,610	4.0	18,625,436
Indiana						945	5,318,900	73.3	3,898,215	31,462,493	5,318,900	3,898,215	6.9	31,462,493
Kentucky	798	533,346	56.4	301,036	1,798,389	108	723,113	73.9	517,749	2,657,606	1,256,459	818,785	1.4	4,455,995
Maryland						180	696,576	74.8	474,368	(b)	696,576	474,368	.8	(b)
Massachusetts						400	676,866	82.2	556,397	(b)	676,866	556,397	1.0	(b)
Michigan						269	(b)	75.9	(b)	(b)	(b)	(b)	(b)	(b)
Minnesota						214	1,069,775	73.3	784,065	6,806,468	1,069,775	784,065	1.4	6,806,468
Missouri						56	(b)	75.2	(b)	(b)	(b)	(b)	(b)	(b)
New Jersey						260	994,300	68.6	682,148	(b)	994,300	682,148	1.2	(b)
New Mexico	1,053	1,047,675	57.0	597,072	3,729,312						1,047,675	597,072	1.1	3,729,312
New York						615	1,516,580	70.5	1,069,587	9,920,419	1,516,580	1,069,587	1.9	9,920,419
Ohio	198	223,200	62.2	138,909	(b)	1,610	7,775,623	67.2	5,226,334	(b)	7,998,823	5,365,243	9.5	36,691,406
Oklahoma	304	(b)	58.2	(b)	(b)						(b)	(b)	(b)	(b)
Pennsylvania	37,730	34,059,026	65.0	22,136,664	130,739,138	2,189	6,514,868	70.4	4,586,981	29,618,136	40,573,894	26,723,645	47.3	160,357,274
Tennessee	1,101	564,920	53.6	302,637	2,156,591	24	166,157	74.9	124,469	1,020,023	731,077	427,106	.8	3,176,614
Utah	819	(b)	56.3	(b)	(b)						(b)	(b)	(b)	(b)
Virginia	3,135	2,042,429	60.4	1,234,256	8,046,115						2,042,429	1,234,256	2.2	8,046,115
Washington	250	154,460	60.6	93,659	910,459	20	47,410	74.8	30,129	286,226	201,870	123,788	.2	1,196,685
West Virginia	8,827	4,516,108	60.2	2,716,613	17,421,639	214	853,684	70.7	603,393	4,731,205	5,369,792	3,320,006	5.9	22,152,844
Wisconsin						268	(b)	73.4	(b)	(b)	(b)	(b)	(b)	(b)
Combined States		814,707		461,393	10,336,963		3,090,738		2,293,021	72,782,197	3,905,445	2,754,414	4.9	38,977,618
	61,317	48,160,297	63.3	30,480,792	189,305,583	8,904	36,867,721	70.5	25,997,580	193,018,785	85,028,018	56,478,372	100.0	382,324,368

[a] Estimated on basis of sales.

[b] Included under "Combined States."

TABLE 3.—*Coke produced in beehive and by-product coke ovens in the United States, 1918–1920*—Continued.

1919.

State.	Beehive coke.					By-product coke.					Total.			
	Active ovens.	Coal used (net tons).	Average yield (per cent).	Coke produced (net tons).	Value of coke at ovens.	Active ovens.	Coal used (net tons).	Average yield (per cent).	Coke produced (net tons).	Value of coke at ovens.	Coal used (net tons).	Coke produced (net tons).	Percentage of total production.	Value of coke at ovens.
Alabama	4,104	1,915,760	60.0	1,149,838	$7,949,048	821	3,255,118	68.5	2,230,933	$11,226,513	5,170,878	3,380,771	7.7	$19,175,561
Colorado	385	300,919	65.1	200,890	(a)	92	594,943	69.4	412,863	(a)	895,862	613,753	1.4	4,383,169
Georgia	101	33,030	54.9	18,149	149,022						33,030	18,149		149,022
Illinois						591	2,446,029	70.0	1,703,903	13,206,405	2,446,029	1,703,903	3.9	13,206,405
Indiana						1,039	5,012,542	73.9	3,702,180	27,543,179	5,012,542	3,702,180	8.4	27,543,179
Kentucky	793	473,204	60.0	283,691	1,819,991	108	579,770	70.4	408,278	2,081,490	1,052,974	691,969	1.6	3,901,481
Maryland						180	503,617	70.7	356,237	(a)	503,617	356,237	0.8	(a)
Massachusetts						274	477,782	82.3	393,331	(a)	477,782	393,331	0.9	(a)
Michigan						287	1,093,791	73.9	808,729	6,204,747	1,093,791	808,729	1.8	6,204,747
Minnesota						181	812,963	72.1	586,094	3,969,068	812,963	586,094	1.3	3,969,068
Missouri						56	(a)	75.2	(a)	(a)	(a)	(a)	(a)	(a)
New Jersey						315	1,132,903	69.6	788,465	(a)	1,132,903	788,465	1.8	(a)
New Mexico	587	476,566	54.6	260,162	1,777,769						476,566	260,162	0.6	1,777,769
New York						430	1,092,368	68.8	751,067	5,754,699	1,092,368	751,067	1.7	5,754,699
Ohio	203	167,024	64.4	107,633	(a)	1,368	7,785,818	69.0	5,374,027	(a)	7,952,842	5,481,660	12.4	30,703,614
Oklahoma	84	(a)	57.7	(a)	(a)						(a)	(a)	(a)	(a)
Pennsylvania	24,201	22,364,899	65.4	14,634,990	69,861,837	2,281	8,592,133	68.3	5,866,841	33,041,083	30,957,032	20,501,831	46.4	102,902,920
Rhode Island						33	(a)	73.3	(a)	(a)	(a)	(a)	(a)	(a)
Tennessee	817	289,231	54.0	156,166	1,064,690	24	138,820	75.4	104,749	842,980	428,051	260,915	0.6	1,907,670
Utah	512	(a)	55.9	(a)	(a)						(a)	(a)	(a)	(a)
Virginia	2,409	1,495,214	62.2	930,516	5,391,367						1,495,214	930,516	2.1	5,391,367
Washington	103	54,800	65.7	35,999	324,044	19	44,091	60.2	26,547	207,116	98,891	62,546	0.1	531,160
West Virginia	4,342	1,724,713	59.2	1,021,120	5,921,685	207	571,741	68.7	392,812	1,750,908	2,296,454	1,413,932	3.2	7,672,593
Wisconsin						268	(a)	70.1	(a)	(a)	(a)	(a)	(a)	(a)
Combined States		435,139		243,782	3,835,519		1,722,990		1,230,565	54,416,580	2,158,129	1,474,347	3.3	23,165,316
	38,641	29,730,499	64.1	19,042,936	98,094,972	8,574	35,857,419	70.1	25,137,621	160,244,768	65,587,918	44,180,557	100.0	258,339,740

[a] Included under "Combined States."

1920.

State.	Beehive coke. Ovens in existence.[a]	Beehive coke. Coal used (net tons).	Beehive coke. Average yield (per cent).	Beehive coke. Coke produced (net tons).	Beehive coke. Value of coke at ovens.[b]	By-product coke. Ovens in existence.[a]	By-product coke. Coal used (net tons).	By-product coke. Average yield (per cent).	By-product coke. Coke produced (net tons).	By-product coke. Value of coke at ovens.[b]	Total. Coal used (net tons).	Total. Coke produced (net tons).	Total. Percentage of total production.	Total. Value of coke at ovens.[b]
Alabama	8,482	1,488,755	59.8	890,001	$9,300,510	1,081	4,542,279	68.8	3,123,890	$25,959,526	6,031,034	4,013,891	8.0	$35,260,036
Colorado	1,793	422,244	64.6	272,826	2,073,478	120	730,870	70.7	516,673	4,588,056	1,153,114	789,499	1.5	6,661,534
Georgia	151	29,804	55.4	16,523	197,285						29,804	16,523		197,285
Illinois						794	3,090,862	69.1	2,136,793	25,791,092	3,090,862	2,136,793	4.2	25,791,092
Indiana						1,216	6,355,846	71.6	4,553,697	46,994,153	6,355,846	4,553,697	8.9	46,994,153
Kentucky	855	447,418	60.9	272,592	1,961,742	108	671,866	69.5	466,985	3,614,463	1,119,284	739,577	1.4	5,576,205
Maryland						300	953,404	71.5	682,132	3,785,833	953,404	682,132	1.2	3,785,833
Massachusetts						400	630,365	77.4	488,089	(c)	630,365	488,089	1.0	(c)
Michigan						389	1,902,224	73.2	1,393,445	15,731,994	1,902,224	1,393,445	2.7	15,731,994
Minnesota						220	942,869	71.6	674,801	10,675,352	942,869	674,801	1.3	10,675,352
Missouri						56	(c)	72.0	(c)	(c)	(c)	(c)	(c)	(c)
New Jersey						315	1,012,562	71.7	725,571	(c)	1,012,562	725,571	1.4	(c)
New Mexico	1,030	(c)	54.4	(c)	(c)						(c)	(c)	(c)	(c)
New York						732	1,504,902	69.1	1,040,192	12,066,227	1,504,902	1,040,192	2.1	12,066,227
Ohio	222	139,144	62.5	86,933	686,771	1,558	8,151,987	68.9	5,614,877	52,555,249	8,291,131	5,701,810	11.0	53,242,020
Oklahoma	300													
Pennsylvania	44,569	24,344,157	65.3	15,908,483	139,822,353	3,006	11,325,505	68.3	7,730,256	77,843,678	35,669,662	23,638,739	46.0	217,666,031
Rhode Island						40	(c)	66.3	(c)	(c)	(c)	(c)	(c)	(c)
Tennessee	1,848	310,583	52.3	162,587	1,560,998	24	183,200	75.9	139,121	1,367,559	493,783	301,708	0.6	2,928,557
Utah	819	(c)	56.8	(c)	(c)						(c)	(c)	(c)	(c)
Virginia	3,906	1,645,253	62.5	1,027,788	9,106,202						1,645,253	1,027,788	2.0	9,106,202
Washington	407	47,876	69.2	33,111	354,097	20	44,594	58.9	26,284	273,354	92,470	59,395	0.1	627,451
West Virginia	10,916	2,283,737	60.4	1,380,944	12,266,370	274	626,196	71.4	447,392	4,608,138	2,909,933	1,828,336	3.6	16,874,508
Wisconsin						228	(c)	70.0	(c)	(c)	(c)	(c)	(c)	(c)
Combined States		826,865		459,304	3,887,716		1,535,465		1,073,753	27,174,058	2,362,330	1,533,057	3.0	31,061,774
	75,298	31,985,836	64.1	20,511,092	181,217,522	10,881	44,204,996	69.9	30,833,951	313,028,732	76,190,832	51,345,043	100.0	494,246,254

a No data on active ovens.

b Estimated on basis of sales.

c Included under "Combined States."

Table 4 shows the rank of the several States in the production of all coke and of by-product coke. Pennsylvania retained, as for many years, first place in total output of coke. In 1918 Ohio, formerly in second place as a producer of by-product coke, took the lead, but in 1919 and 1920 Pennsylvania again led and Ohio returned to second place. Most of the other changes in rank represent only normal fluctuations, for an increase or decrease of only a few per cent may be sufficient to change the rank of a State, and the installation of a large by-product coke-oven plant may advance a State many places in rank.

TABLE 4.—*Rank of the States in the production of coke, 1914–1920.*

State.	1914		1915		1916		1917	
	Total.	By-product.	Total.	By-product.	Total.	By-product.	Total.	By-product.
Pennsylvania	1	1	1	1	1	1	1	1
Ohio	11	9	7	7	6	5	3	2
Indiana	3	2	3	2	3	2	4	3
Alabama	2	3	2	3	2	3	2	4
Illinois	4	4	4	4	5	4	6	5
West Virginia	5	14	5	13	4	15	5	12
Michigan	9	6	6	5	10	6	11	8
New York	12	8	8	6	11	7	9	6
Virginia	6	....	10	....	7	....	7	....
Colorado	7	....	9	....	8	....	8	....
Kentucky	13	11	12	12	9	12	12	10
New Jersey	17	10	17	11	20	14	17	14
Wisconsin	8	5	11	8	12	8	10	7
Maryland	19	13	16	10	15	10	15	11
Minnesota	18	12	21	15	16	11	16	13
Massachusetts	10	7	13	9	13	9	13	9
Tennessee	16	....	18	17	18	16	18	16
New Mexico	14	....	14	....	14	....	14	....
Missouri	....	....	20	14	19	13	20	15
Utah	15	....	15	....	17	....	19	....
Washington	20	15	19	16	21	17	21	17
Georgia	21	....	22	....	22	....	22	....

State.	1918		1919		1920	
	Total.	By-product.	Total.	By-product.	Total.	By-product.
Pennsylvania	1	2	1	1	1	1
Ohio	2	1	2	2	2	2
Indiana	4	3	3	3	3	3
Alabama	3	4	4	4	4	4
Illinois	6	5	5	5	5	5
West Virginia	5	11	6	14	6	15
Michigan	9	7	9	7	7	6
New York	8	6	11	9	8	7
Virginia	7	....	7	....	9	....
Colorado	11	16	13	11	10	12
Kentucky	12	13	12	12	11	14
New Jersey	14	10	10	8	12	8
Wisconsin	10	8	8	6	13	9
Maryland	17	14	16	15	14	10
Minnesota	13	9	14	10	15	11
Massachusetts	16	12	15	13	16	13
Tennessee	18	17	17	18	17	17
New Mexico	15	....	18	....	18	....
Missouri	20	15	19	16	19	16
Utah	19	....	20	....	20	....
Rhode Island	....	....	21	17	21	18
Washington	21	18	22	19	22	19
Georgia	23	....	23	....	23	....
Oklahoma	22	....	24	....	....	....

Table 5 shows the tendency toward increase or decrease in production in the several States during 1915 to 1920. In 1919 there was a general decrease in the production of coke, only two States reporting increases—New Jersey 15.6 per cent and Ohio 2.2 per cent. In both these States the increase was due to an increase in the production of by-product coke. In Colorado, Pennsylvania, and Washington also there were increases in the production of by-product coke in 1919, but these increases were not sufficient to offset the decrease in beehive coke in the same States.

The increase in 1920 as compared with 1919 was very general, only three States recording a decrease, and again the increase was due almost wholly to an increase in the production of by-product coke, as is evident from Tables 2 and 3. Only two States, Washington and New Jersey, reported a decrease in by-product output, but the number of States reporting a decrease in beehive coke was almost the same as the number reporting an increase.

TABLE 5.—*Coke produced in the United States, 1915–1920, in net tons.*

State.	1915	1916	1917	1918	1919	Increase or decrease, 1919.			
						Quantity.	Percentage.		
							Total.	Beehive.	By-product.
Alabama	3,071,811	4,298,417	4,892,589	4,352,172	3,380,771	−971,401	−22.3	−33.1	−15.3
Colorado	670,938	1,053,553	1,112,449	989,447	613,753	−375,694	−38.0	−73.5	+79.0
Georgia	20,039	47,127	39,589	22,048	18,149	−3,899	−17.7	−17.7	......
Illinois	1,686,998	2,320,400	2,289,833	2,285,610	1,703,903	−581,707	−25.4	......	−25.4
Indiana	2,768,099	3,489,660	3,540,718	3,898,215	3,702,180	−196,035	− 5.0	......	− 5.0
Kentucky	526,097	802,526	863,071	818,785	691,969	−126,816	−15.5	− 5.8	−21.1
Maryland	313,283	489,982	518,810	474,368	356,237	−118,131	−24.9	......	−24.9
Massachusetts	504,438	563,048	595,113	556,397	393,331	−163,066	−29.3	......	−29.3
Michigan	(a)	(a)	(a)	(a)	808,729	(a)	(a)	......	(b)
Minnesota	127,847	431,319	490,272	784,065	586,094	−197,971	−25.2	......	−25.2
Missouri	(a)	(a)	(a)	(a)	(a)	(a)	(a)	......	(b)
New Jersey	269,448	210,766	423,361	682,148	788,465	+106,317	+15.6	......	+15.6
New Mexico	389,411	502,812	577,679	597,072	260,162	−336,910	−56.4	−56.4	......
New York	684,461	775,014	993,184	1,069,587	751,067	−318,520	−29.8	......	−29.8
Ohio	684,658	1,803,268	3,694,302	5,365,243	5,481,660	+116,417	+ 2.2	−22.5	+ 2.8
Oklahoma	....	....	....	(a)	(a)	(a)	(a)	(b)	......
Pennsylvania	25,622,862	31,279,695	27,912,025	26,723,645	20,501,831	−6,221,814	−23.3	−33.9	+27.9
Rhode Island	....	....	....	....	(a)	(a)	(a)	......	(b)
Tennessee	256,973	382,175	411,326	427,106	260,915	−166,191	−38.9	−48.4	−15.8
Utah	(a)	(c)	(c)	(a)	(a)	(a)	(a)	(b)	......
Virginia	629,807	1,242,332	1,304,230	1,234,256	930,516	−303,740	−24.6	−24.6	......
Washington	136,552	[c] 534,653	[c] 497,533	123,788	62,546	−61,242	−49.4	−61.6	+11.9
West Virginia	1,391,446	2,521,309	3,349,761	3,320,006	1,413,932	−1,906,074	−57.4	−62.4	−34.9
Wisconsin	(a)	(a)	(a)	(a)	(a)	(a)	(a)	......	(b)
Combined States	1,825,982	1,785,529	2,100,983	2,754,414	1,474,347	−471,338	−17.1	......	......
	41,581,150	54,533,585	55,606,828	56,478,372	44,180,557	−12,297,815	−21.8	−37.5	− 3.3

[a] Included under "Combined States."
[b] Survey not at liberty to show.
[c] Utah included with Washington.

TABLE 5.—*Coke produced in the United States, 1915–1920, in net tons*—Continued.

State.	1920	Increase or decrease, 1920.			
		Quantity.	Percentage.		
			Total.	Beehive.	By-product.
Alabama	4,013,891	+633,120	+18.7	−22.6	+40.0
Colorado	789,499	+175,746	+28.6	+35.8	+25.1
Georgia	16,523	−1,626	−9.0	−9.0	....
Illinois	2,136,793	+432,890	+25.4	....	+25.4
Indiana	4,553,697	+851,517	+23.0	....	+23.0
Kentucky	739,577	+47,608	+6.9	−3.9	+14.4
Maryland	682,132	+325,895	+91.5	....	+91.5
Massachusetts	488,089	+94,758	+24.1	....	+24.1
Michigan	1,393,445	+584,716	+72.3	....	+72.3
Minnesota	674,801	+88,707	+15.1	....	+15.1
Missouri	(a)	(a)	(a)	....	(b)
New Jersey	725,571	−62,894	−8.0	....	−8.0
New Mexico	(a)	(a)	(a)	(b)	....
New York	1,040,192	+289,125	+38.5	....	+38.5
Ohio	5,701,810	+220,150	+4.0	(b)	+4.5
Oklahoma	....	....	....	(b)	....
Pennsylvania	23,638,739	+3,136,908	+15.3	+8.7	+31.8
Rhode Island	(a)	(a)	(a)	....	(b)
Tennessee	301,708	+40,793	+15.6	+4.1	+32.8
Utah	(a)	(a)	(a)	(b)	....
Virginia	1,027,788	+97,272	+10.5	+10.5	....
Washington	59,395	−3,151	−5.0	−8.0	−1.0
West Virginia	1,828,336	+414,404	+29.3	+35.2	+13.9
Wisconsin	(a)	(a)	(a)	....	(b)
Combined States	1,533,057	−201,452	−11.6	....	....
	51,345,043	+7,164,486	+16.2	+7.7	+22.7

[a] Included under "Combined States." [b] Survey not at liberty to show.

The production of beehive coke is estimated weekly from the reports of the railroad shipments and is stated in the weekly coal report of the United States Geological Survey. These weekly estimates for 1919 and 1920 have been corrected in accordance with the annual returns of all producers. The corrected figures for beehive coke produced each week are given in Tables 6 and 7, which show clearly the great variation in output during these two years. The tables also show that there is no particular seasonal factor that can be noted. If there were any such factor, it would be obscured by the much greater influence of the condition of business and of the activity in the metallurgical industries, which always dominate the market for beehive coke and therefore the production.

TABLE 6.—*Beehive coke produced in the United States in 1919, by weeks.*

[Estimated from railroad shipments.]

Week ended—	Net tons.	Week ended—	Net tons.	Week ended—	Net tons.
Jan. 1–4	317,000	May 3	290,000	Sept. 6	434,000
11	522,000	10	252,000	13	432,000
18	540,000	17	204,000	20	436,000
25	557,000	24	243,000	27	333,000
Feb. 1	517,000	31	256,000	Oct. 4	303,000
8	486.000	June 7	263,000	11	296,000
15	409,000	14	277,000	18	371,000
22	432,000	21	277,000	25	355,000
Mar. 1	425,000	28	275,000	Nov. 1	336,000
8	427,000	July 5	256,000	8	364,000
15	416,000	12	315,000	15	387,000
22	392,000	19	333,000	22	390,000
29	351,000	26	360,000	29	432,000
Apr. 5	339,000	Aug. 2	366,000	Dec. 6	444,000
12	309,000	9	377,000	13	350,000
19	286,000	16	375,000	20	368,000
26	255,000	23	402,000	27	313,000
		30	405,000	28–31	193,000
					19,043,000

TABLE 7.—*Beehive coke produced in the United States in 1920, by weeks.*

[Estimated from railroad shipments.]

Week ended—	Net tons.	Week ended—	Net tons.	Week ended—	Net tons.
Jan. 1-3	191,000	May 1	353,000	Sept. 4	390,000
10	421,000	8	365,000	11	432,000
17	439,000	15	338,000	18	397,000
24	430,000	22	409,000	25	396,000
31	467,000	29	432,000	Oct. 2	370,000
Feb. 7	425,000	June 5	406,000	9	394,000
14	433,000	12	394,000	16	398,000
21	420,000	19	366,000	23	385,000
28	426,000	26	400,000	30	416,000
Mar. 6	407,000	July 3	369,000	Nov. 6	380,000
13	401,000	10	355,000	13	383,000
20	460,000	17	358,000	20	358,000
27	474,000	24	379,000	27	361,000
Apr. 3	469,000	31	389,000	Dec. 4	369,000
10	469,000	Aug. 7	377,000	11	368,000
17	242,000	14	412,000	18	329,000
24	337,000	21	418,000	25	268,000
		28	413,000	31	273,000
					20,511,000

Table 8 gives by months the total production and the average production per working day of beehive coke in the United States for 1915 to 1920. The importance of using daily average figures for appraising the activity of the industry is well illustrated by these data. Totals for months are misleading unless the number of working days within the month is considered. For example, the production of beehive coke in February, 1918, was less than in January, 1918, but the average daily output was distinctly greater. If only the monthly total had been considered it might have been inferred that the activity in the industry was continuing to decline, as had been indicated by the January figures. As a matter of fact, the industry was resuming operations during February, as was clear from the daily average figure; and the prophecy from this figure that the production of beehive coke was beginning to improve was borne out clearly by the figures for March and succeeding months.

Table 8 shows clearly the rapid decline in the production of beehive coke that followed the declaration of the armistice and reached the minimum for the five-year period in May, 1919, when the daily average was only 41,000 tons. After that month the production began to increase as optimism in business produced increased activity in the metallurgical industries, so that during the second half of 1919 and practically all 1920 the output of beehive coke was 60,000 to 65,000 tons a day. However, at the very end of 1920 there was evidence of declining production, which the figures for 1921 bring out more strongly. Although the operations in 1921 are beyond the scope of this report it is of interest to point out here that the decline in the production of beehive coke forecast by the falling off in the last two months of 1920 continued with ever-increasing speed until July, 1921, in which only 7,000 tons a day of beehive coke was produced. Since July there has been a slow but steady increase in the production of beehive coke, reflecting the increase in activity in the production of pig iron.

TABLE 8.—*Beehive coke produced in the United States, 1915–1920, by months, and average production per working day, in net tons.*[a]

Month.	1915		1916		1917	
	Monthly.	Daily average.	Monthly.	Daily average.	Monthly.	Daily average.
January	1,446,000	55,000	2,919,000	112,000	2,923,000	108,000
February	1,583,000	66,000	2,887,000	115,000	2,490,000	104,000
March	1,865,000	69,000	3,263,000	121,000	3,139,000	116,000
April	1,841,000	71,000	2,875,000	115,000	2,814,000	113,000
May	1,936,000	74,000	3,044,000	113,000	2,861,000	106,000
June	2,210,000	85,000	2,918,000	112,000	2,755,000	106,000
July	2,345,000	90,000	2,721,000	109,000	2,754,000	110,000
August	2,553,000	98,000	2,999,000	111,000	2,650,000	98,000
September	2,582,000	99,000	3,016,000	116,000	2,727,000	109,000
October	3,029,000	116,000	3,079,000	118,000	2,780,000	103,000
November	3,025,000	116,000	2,934,000	113,000	2,677,000	103,000
December	3,093,000	119,000	2,809,000	108,000	2,598,000	104,000
	27,508,000	88,000	35,464,000	114,000	33,168,000	107,000

Month.	1918		1919		1920	
	Monthly.	Daily average.	Monthly.	Daily average.	Monthly.	Daily average.
January	2,256,000	87,000	2,366,000	88,000	1,946,000	72,000
February	2,225,000	93,000	1,767,000	74,000	1,705,000	71,000
March	2,652,000	102,000	1,714,000	66,000	1,976,000	73,000
April	2,591,000	100,000	1,277,000	49,000	1,579,000	61,000
May	2,743,000	102,000	1,101,000	41,000	1,671,000	64,000
June	2,713,000	109,000	1,143,000	46,000	1,683,000	65,000
July	2,835,000	109,000	1,457,000	56,000	1,666,000	64,000
August	2,650,000	98,000	1,681,000	65,000	1,749,000	67,000
September	2,591,000	104,000	1,736,000	67,000	1,731,000	67,000
October	2,621,000	97,000	1,504,000	56,000	1,716,000	66,000
November	2,348,000	90,000	1,629,000	65,000	1,605,000	62,000
December	2,256,000	87,000	1,668,000	64,000	1,484,000	57,000
	30,481,000	98,000	19,043,000	61,000	20,511,000	66,000

[a] Based on railroad shipments and prorated to the total production reported by operators.

It is not practicable to discuss here the extent to which the beehive-coke industry serves as a balance wheel in the production of metallurgical fuels. However, it is evident at once from the data which have been presented that by-product coke has altogether supplanted beehive coke as the mainstay in the coke supply. The output of beehive coke will, it appears, from now on serve to make up the deficit in the supply of coke rather than furnish the principal part of this supply. There are several conspicuous reasons for this fact. A by-product coke-oven plant requires an elaborate organization and a large investment per unit of coke produced per day. Operators of such plants can not afford to close them down and start them up with every minor change in market conditions. It is not altogether a question whether beehive coke or by-product coke can be produced at a lower price at any particular time. Often by-product coke will be produced and sold at less than cost simply in order to maintain an organization and give some measure of financial return upon the large investment, which would otherwise remain entirely unproductive. As a natural consequence of this relationship of investments in the two types of plants it may be expected that in the future most of the fluctuations in production will occur in the beehive branch of the industry. In other words, the beehive ovens will serve the purpose of stand-by equipment, and the by-product ovens will be the normal operating agents in the supply of metallurgical fuel. These facts are more fully demonstrated by the data for 1921, which are now available only in preliminary form, and the subject will therefore be more appropriately discussed at length in the report for that year.

HISTORY OF THE INDUSTRY.

Figure 18 shows graphically the development of the by-product and beehive industries in the United States as indicated by the production. Table 9 gives the data upon which these curves are based and shows more fully the relation of the two branches of the industry to the total. With minor exceptions, both the production and the value of by-product coke have increased steadily since 1893. In 1919, for the first time in the history of the industry the production of by-product coke exceeded that of beehive coke, and in 1920 the proportion of the total from by-product ovens was still greater, reaching 60 per cent. In each of the two years the value of the by-product coke exceeded 60 per cent of the total value.

TABLE 9.—*Coke produced in the United States, 1880–1920.*

Year.	By-product coke.				Beehive coke.				Total.	
	Quantity.		Value.		Quantity.		Value.		Quantity (net tons).	Value.
	Net tons.	Per cent.	Dollars.	Per cent.	Net tons.	Per cent.	Dollars.	Per cent.		
1880	....	......	....	......	3,338,300	100.0	6,631,267	100.0	3,338,300	$6,631,267
1885	....	......	....	......	5,106,696	100.0	7,629,118	100.0	5,106,696	7,629,118
1890	....	......	....	......	11,508,021	100.0	23,215,302	100.0	11,508,021	23,215,302
1893	12,850	0.1	(a)	(a)	9,464,730	99.9	(a)	(a)	9,477,580	16,523,714
1900	1,075,727	5.2	2,635,531	5.6	19,457,621	94.8	44,807,800	94.4	20,533,348	47,443,331
1905	3,462,348	10.7	10,851,730	15.0	28,768,781	89.3	61,624,466	85.0	32,231,129	72,476,196
1910	7,138,734	17.1	24,793,016	24.9	34,570,076	82.9	74,949,685	75.1	41,708,810	99,742,701
1911	7,847,845	22.1	27,297,897	32.4	27,703,644	77.9	56,832,952	67.6	35,551,489	84,130,849
1912	11,115,164	25.3	42,632,930	38.1	32,868,435	74.7	69,172,183	61.9	43,983,599	111,805,113
1913	12,714,700	27.5	48,637,852	37.7	33,584,830	72.5	80,284,421	62.3	46,299,530	128,922,273
1914	11,219,943	32.5	38,080,167	43.1	23,335,971	67.5	50,254,050	56.9	34,555,914	88,334,217
1915	14,072,895	33.8	48,558,325	46.0	27,508,255	66.2	56,945,543	54.0	41,581,150	105,503,868
1916	19,069,361	35.0	75,373,070	44.1	35,464,224	65.0	95,468,127	55.9	54,533,585	170,841,197
1917	22,439,280	40.4	138,643,153	46.5	33,167,548	59.6	159,599,864	53.5	55,606,828	298,243,017
1918	25,997,580	46.0	193,018,785	50.5	30,480,792	54.0	189,305,583	49.5	56,478,372	382,324,368
1919	25,137,621	56.9	160,244,768	62.0	19,042,936	43.1	98,094,972	38.0	44,180,557	258,339,740
1920	30,833,951	60.0	313,028,732	63.3	20,511,092	40.0	181,217,522	36.7	51,345,043	494,246,254

a Figures not available.

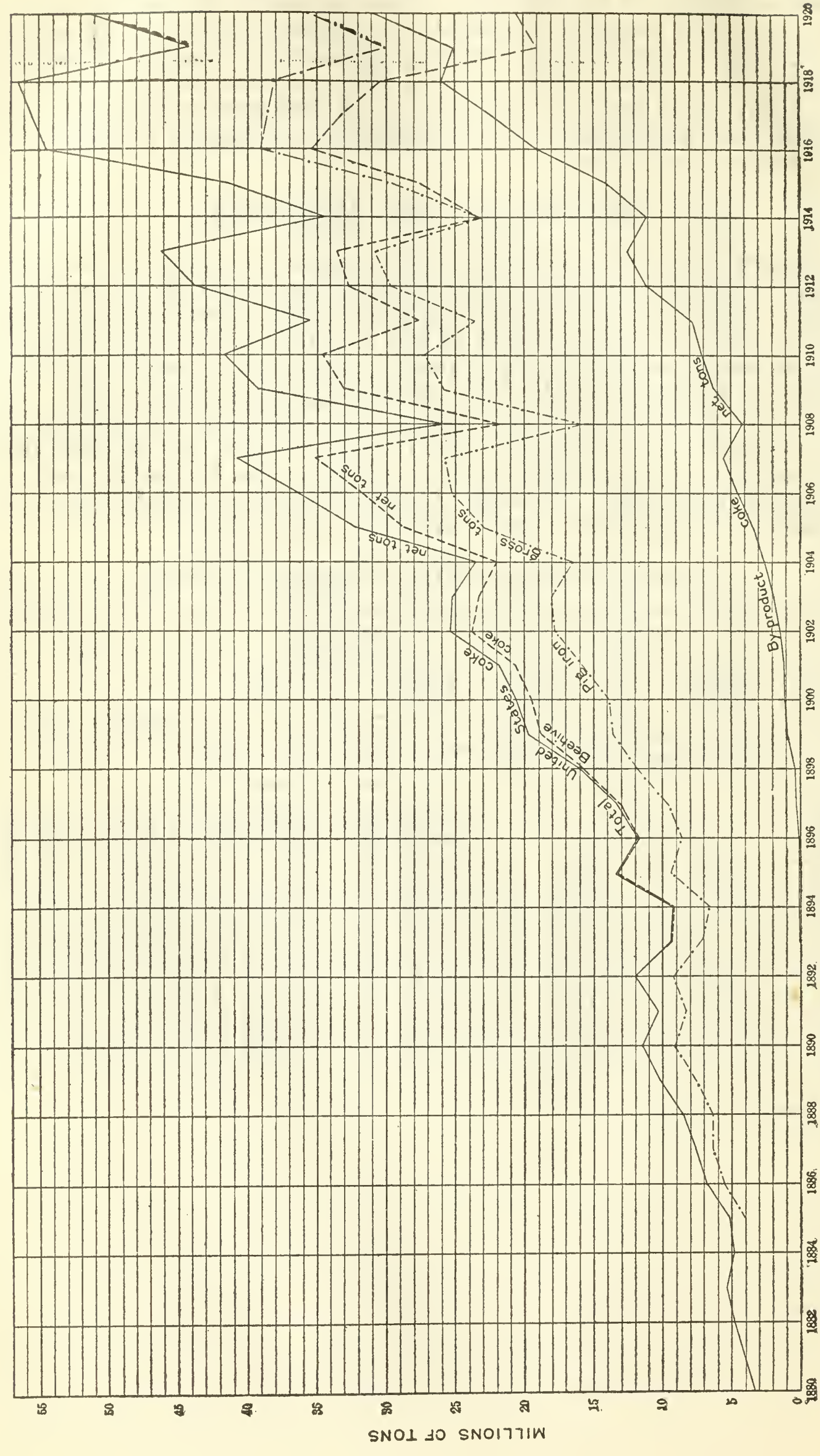

FIGURE 18.—Beehive and by-product coke and pig iron produced in the United States, 1880–1920.

Table 10 gives additional statistics with regard to the manufacture of coke during the period 1880 to 1920. The number of establishments producing coke is tending to decline, although the number of ovens in existence continues to increase slightly. The percentage yield of coke from the coal carbonized has not changed materially for many years past, but there was a slight upward tendency during 1919 and 1920, as compared with the war years. This point is discussed in more detail on pages 412–413.

In Table 10 figures of production, value, and average value per ton of all the coke produced are given. These data show that the magnitude of the industry has not changed greatly for ten years. In fact, if the results for 1921 were taken into account, it might seem that the industry has been suffering a serious decline since the close of the war. However, it is believed that this decline does not really reflect a long-time tendency, for it appears that there is still a slight upward trend if conditions over long periods are taken into account and that this trend will continue the increases of the decades between 1880 and 1910, although at a distinctly decreased rate.

The average value of the coke at the ovens is an interesting example of the wide fluctuation in the unit price of fuels which has occurred during the years just preceding, during, and subsequent to the World War.

TABLE 10.—*Statistics of the manufacture of coke in the United States, 1880–1920.*

Year.	Active plants.	Active ovens.	Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens.	
						Total.	Per ton.
1880	a 186	a 12,372	5,237,741	63.7	3,338,300	$6,631,267	$1.99
1890	a 253	a 37,158	18,005,209	64.9	11,508,021	23,215,302	2.02
1900	345	43,039	32,113,553	63.9	20,533,348	47,443,331	2.31
1910	478	96,067	63,088,327	66.1	41,708,810	99,742,701	2.39
1911	391	63,480	53,278,248	66.7	35,551,489	84,130,849	2.37
1912	439	73,058	65,577,862	67.1	43,983,599	111,805,113	2.54
1913	444	72,008	69,239,190	66.9	46,299,530	128,922,273	2.78
1914	359	54,638	51,623,750	66.9	34,555,914	88,334,217	2.56
1915	354	54,967	61,832,898	67.2	41,581,150	105,503,868	2.54
1916	389	72,888	81,609,460	66.8	54,533,585	170,841,197	3.13
1917	398	75,985	83,752,371	66.4	55,606,828	298,243,017	5.36
1918	403	70,221	85,028,018	66.4	56,478,372	382,324,368	6.77
1919	373	47,215	65,587,918	67.4	44,180,557	258,339,740	5.85
1920	a 416	a 86,179	76,190,832	67.3	51,345,043	494,246,254	9.62

a Total in existence. No statistics available showing idle plants.

In order that the distribution of the industry throughout the country during the last decade may be clear, figures of production by States for beehive and by-product coke are presented in Tables 11 and 12. These tables bring out in great detail the rank of the States in the production of coke, which has already been discussed in connection with Table 4.

TABLE 11.—*Beehive coke produced in the United States in 1910–1920, in net tons.*

State.	1910	1911	1912	1913	1914	1915
Alabama	2,691,879	2,092,088	1,625,692	1,300,705	1,052,614	1,001,477
Colorado	1,199,248	951,748	972,941	879,461	666,083	670,938
Georgia	43,814	37,553	43,158	42,747	24,517	20,039
Illinois	(a)	....	....	....	....	....
Kansas	(a)	(a)	(a)	....	....	....
Kentucky	53,857	66,099	191,555	248,061	247,182	284,516
Montana	(a)	....	....	....	....	....
New Mexico	401,646	381,927	413,906	467,945	362,572	389,411
Ohio	118,828	109,084	146,944	115,814	67,838	19,101
Oklahoma	(a)	....	....	....	....	....
Pennsylvania	24,262,634	20,430,426	25,464,074	26,124,764	18,074,057	22,530,567
Tennessee	322,756	330,418	370,076	364,578	264,127	233,705
Utah	(a)	(a)	(a)	(a)	(a)	(a)
Virginia	1,493,655	910,411	967,947	1,303,603	780,984	629,807
Washington	59,337	40,180	(a)	(a)	(a)	(a)
West Virginia	3,725,873	2,125,950	2,277,613	2,336,600	1,381,675	1,250,235
Wisconsin	(a)	(a)	....	....	....	....
Combined States	196,549	227,760	394,529	400,552	414,322	478,459
	34,570,076	27,703,644	32,868,435	33,584,830	23,335,971	27,508,255

State.	1916	1917	1918	1919	1920
Alabama	1,828,067	2,151,828	1,717,721	1,149,838	890,001
Colorado	1,053,553	1,112,449	758,784	200,890	272,826
Georgia	47,127	39,589	22,048	18,149	16,523
Illinois	....	....	....	....	....
Kansas	....	....	....	....	....
Kentucky	362,164	331,532	301,036	283,691	272,592
Montana	....	....	....	....	....
New Mexico	502,812	577,679	597,072	260,162	(a)
Ohio	104,102	147,826	138,909	107,633	86,933
Oklahoma	....	....	(a)	(a)	....
Pennsylvania	27,159,438	23,816,420	22,136,664	14,634,990	15,908,483
Tennessee	329,702	376,080	302,637	156,166	162,587
Utah	(a)	(a)	(a)	(a)	(a)
Virginia	1,242,332	1,304,230	1,234,256	930,516	1,027,788
Washington	(a)	(a)	93,659	35,999	33,111
West Virginia	2,327,502	2,838,728	2,716,613	1,021,120	1,380,944
Wisconsin	....	....	....	....	....
Combined States	507,425	471,187	461,393	243,782	459,304
	35,464,224	33,167,548	30,480,792	19,042,936	20,511,092

a Included under "Combined States."

TABLE 12.—*By-product coke produced in the United States, 1910–1920, in net tons.*

State.	1910	1911	1912	1913	1914	1915
Alabama	557,148	669,433	1,349,797	2,022,959	2,031,535	2,070,334
Illinois	1,513,126	1,610,212	1,764,944	1,859,553	1,425,168	1,686,998
Indiana	84,046	916,411	2,616,339	2,727,025	2,276,652	2,768,099
Kentucky	....	....	....	69,023	196,777	241,581
Maryland	335,373	343,451	304,715	236,423	87,852	313,283
Massachusetts	450,001	477,564	511,596	531,384	540,631	504,438
Michigan	(a)	(a)	(a)	(a)	(a)	(a)
Minnesota	(a)	(a)	(a)	(a)	(a)	127,847
Missouri	....	....	....	....	....	(a)
New Jersey	250,153	255,334	304,715	255,792	255,283	269,448
New York	652,459	686,172	794,618	758,486	457,370	684,461
Ohio	163,487	202,298	241,725	236,032	453,800	665,557
Pennsylvania	2,052,973	1,493,509	1,974,619	2,628,680	2,184,336	3,092,295
Tennessee	....	....	....	....	....	23,268
Washington	....	....	....	....	(a)	(a)
West Virginia	77,977	165,099	188,373	136,152	46,287	141,211
Wisconsin	528,660	577,619	578,875	645,822	(a)	(a)
Combined States	473,331	450,743	484,848	607,369	1,264,252	1,484,075
	7,138,734	7,847,845	11,115,164	12,714,700	11,219,943	14,072,895

a Included under "Combined States."

TABLE 12.—*By-product coke produced in the United States, 1910–1920, in net tons*—Continued.

State.	1916	1917	1918	1919	1920
Alabama	2,470,350	2,740,761	2,634,451	2,230,933	3,123,890
Colorado	....	....	230,663	412,863	516,673
Illinois	2,320,400	2,289,833	2,285,610	1,703,903	2,136,793
Indiana	3,489,660	3,540,718	3,898,215	3,702,180	4,553,697
Kentucky	440,362	531,539	517,749	408,278	466,985
Maryland	489,982	518,810	474,368	356,237	682,132
Massachusetts	563,048	595,113	556,397	393,331	488,089
Michigan	(a)	(a)	(a)	808,729	1,393,445
Minnesota	431,319	490,272	784,065	586,094	674,801
Missouri	(a)	(a)	(a)	(a)	(a)
New Jersey	210,766	423,361	682,148	788,465	725,571
New York	775,014	993,184	1,069,587	751,067	1,040,192
Ohio	1,699,166	3,546,476	5,226,334	5,374,027	5,614,877
Pennsylvania	4,120,257	4,095,605	4,586,981	5,866,841	7,730,256
Rhode Island	....	....	....	(a)	(a)
Tennessee	52,473	35,246	124,469	104,749	139,121
Washington	27,228	26,346	30,129	26,547	26,284
West Virginia	193,807	511,033	603,393	392,812	447,392
Wisconsin	(a)	(a)	(a)	(a)	(a)
Combined States	1,785,529	2,100,983	2,293,021	1,230,565	1,073,753
	19,069,361	22,439,280	25,997,580	25,137,621	30,833,951

a Included under "Combined States."

Figure 21 (p. 394) shows the distribution of by-product plants throughout the country. No distinction is made on the map between ovens of different types.

The large table in the pocket shows the production for each State during each calendar year, in so far as these data can be published without revealing figures from individual operations. The table affords more detailed historical analysis of the industry, by States, than would otherwise be possible.

COKE IN PENNSYLVANIA.

Pennsylvania holds first rank in the production of both beehive and by-product coke and therefore deserves special attention. Moreover, the production of that State may logically be divided among several districts, and useful data can be separately reported for each.

Table 13 summarizes important items in the production of coke—the number of ovens, the coal used, and so on—for the State of Pennsylvania as a whole during the four decades from 1880 to 1920. In this table the results for 1919 and 1920 compared with those for earlier years exhibit few unusual or striking contrasts. The number of establishments, ovens, quantity of coal carbonized, yield of coke from coal, quantity and value of output all followed closely the corresponding figures for the country as a whole. In fact, the percentage of Pennsylvania's output in the total output of the country is so great that it would be strange to find marked contrast between them.

TABLE 13.—*Coke produced in Pennsylvania, 1880–1920.*

Year.	Plants.	Ovens.		Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens.	
		Built.	Under construction.				Total.	Per ton.
1880	124	2,501	836	4,347,558	64.9	2,821,384	$5,255,042	$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	54,075	867	30,286,961	66.9	20,258,393	42,447,886	2.10
1915	273	54,856	752	38,273,744	66.9	25,622,862	52,667,018	2.06
1916	251	54,372	710	46,950,086	66.6	31,279,695	84,710,305	2.71
1917	240	51,905	703	42,310,784	66.0	27,912,025	135,698,040	4.86
1918	230	50,956	698	40,573,894	65.9	26,723,645	160,357,274	6.00
1919	225	50,225	284	30,957,032	66.2	20,501,831	102,902,920	5.02
1920	226	47,575	450	35,669,662	66.2	23,638,739	217,666,031	9.28

Table 14 shows the production of beehive coke in Pennsylvania by districts in 1918, 1919, and 1920. There has been a slight decrease both in the number of plants and in the number of ovens in existence in the State. This reduction has not been general but has occurred mainly in the Connellsville and Lower Connellsville districts. In these as in previous years, there has been considerable variation in the yield of coke per ton of coal, which was lowest each year in the Pittsburgh district, doubtless as a result of the use of much high-volatile coal in that territory. So also the difference in the average value of the coke per ton at the ovens has been considerable. In 1920, for the first time in the period covered by this report, the average value per ton of the coke in the Pittsburgh district was greatest. Hitherto the average value had been greatest in the Allegheny Mountain and Allegheny Valley district; but in 1920 that district was second in rank. The other districts do not vary greatly, in comparison one with another, in the average value of the coke produced.

In 1880 Pennsylvania produced 85 per cent of the country's total output of coke; by 1900 the proportion had fallen to 65 per cent, and in 1915 it was 62 per cent. In 1918, for the first time, Pennsylvania produced less than half of the total output, namely, 47.3 per cent; the proportion declined to 46.4 per cent in 1919 and to 46 per cent in 1920. The State is, however, still far in the lead of its nearest competitor, Ohio, which produced only 11 per cent of the total in 1920.

The very great decline in the production of beehive coke in Pennsylvania in 1919 and 1920, as compared with 1918, was the result of decreases of output in every district of the State; these decreases, however, left the several districts in the same relative rank in 1919 and 1920 as in 1918.

TABLE 14.—*Beehive coke produced in Pennsylvania in 1918, 1919, and 1920.*

District.	Plants.	Ovens.		Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens per ton.[a]
		Built.	Under construction.				
1918.							
Allegheny Mountain and Allegheny Valley	8	770	....	341,126	64.9	221,250	$7.17
Connellsville	95	20,365	....	14,325,959	66.3	9,501,692	5.44
Lower Connellsville	71	16,234	....	11,875,495	65.4	7,761,295	6.28
Pittsburgh	10	3,711	....	3,871,162	62.0	2,401,392	5.81
Upper Connellsville	13	2,028	....	961,131	66.7	641,236	6.90
Other districts[b]	24	5,480	60	2,684,153	60.0	1,609,799	6.49
	221	48,588	60	34,059,026	65.0	22,136,664	5.91
1919.							
Allegheny Mountain and Allegheny Valley	8	810	....	191,873	64.5	123,856	6.93
Connellsville	92	19,825	....	10,454,353	65.5	6,844,561	4.52
Lower Connellsville	71	16,300	....	7,297,405	67.6	4,933,368	4.77
Pittsburgh	10	3,318	....	2,285,930	60.5	1,384,014	5.13
Upper Connellsville	12	1,820	....	540,787	64.2	347,048	5.70
Other districts[b]	21	5,306	64	1,594,551	62.8	1,002,143	4.88
	214	47,379	64	22,364,899	65.4	14,634,990	4.77
1920.							
Allegheny Mountain and Allegheny Valley	8	711	....	297,426	63.2	187,984	10.24
Connellsville	91	19,245	....	10,743,658	66.4	7,134,781	8.87
Lower Connellsville	69	15,146	....	7,592,680	66.0	5,008,158	7.96
Pittsburgh	10	3,314	....	2,648,064	59.8	1,583,029	11.26
Upper Connellsville	13	1,709	....	941,001	65.2	613,767	8.22
Other districts[b]	22	4,444	302	2,121,328	65.1	1,380,764	8.55
	213	44,569	302	24,344,157	65.3	15,908,483	8.79

[a] For 1918 and 1920, average price realized on coke sold.
[b] Includes Bedford, Cameron, Clearfield, Elk, Huntingdon, Jefferson, and parts of Allegheny, Indiana, and Westmoreland counties.

Table 15 shows shipments of coke from the Connellsville and Lower Connellsville districts, by months; it shows also the fluctuation in shipments during the various seasons. The output of these important coke districts follows very closely, it appears, the output of the country as a whole, as exhibited in Tables 6, 7, and 8.

TABLE 15.—*Coke shipped from the Connellsville and Lower Connellsville districts, 1915–1920, in net tons.*[a]

Month.	1915	1916	1917	1918	1919	1920
January	940,781	1,793,951	1,564,173	1,021,055	1,224,220	1,082,289
February	1,045,739	1,781,068	1,288,763	991,871	890,922	967,122
March	1,258,559	2,038,812	1,618,969	1,436,821	864,903	1,110,550
April	1,268,292	1,861,290	1,558,247	1,459,248	645,028	799,578
May	1,310,639	1,937,404	1,649,989	1,532,634	470,475	749,537
June	1,486,845	1,842,521	1,563,616	1,438,700	536,381	796,698
July	1,618,199	1,748,365	1,539,931	1,578,130	760,475	778,345
August	1,657,203	1,806,422	1,554,935	1,492,065	1,010,887	909,270
September	1,683,414	1,771,405	1,464,200	1,423,236	1,021,096	879,297
October	1,851,938	1,768,800	1,509,903	1,410,403	699,156	921,753
November	1,873,405	1,719,715	1,350,374	1,136,355	1,140,109	889,173
December	1,926,202	1,584,749	1,221,257	1,160,072	1,026,312	854,615
	17,921,216	21,654,502	17,884,357	16,080,590	10,289,964	10,738,227

[a] Statistics from the Weekly Courier, Connellsville, Pa.

Table 16 shows the operation of the by-product coke industry of Pennsylvania in 1918, 1919, and 1920. The increase in the number of plants, the number of ovens, and the quantity of coal and coke handled is marked. It is rather surprising, however, to find that the yield of coke per ton of coal carbonized decreased in 1919 and 1920 in comparison with 1918. However, this decline in yield seems to have occurred chiefly in the Pittsburgh district, probably as the result of a very marked increase in that district in the quantity of coal having a high percentage of volatile matter used for making coke. It is now regarded as not only possible but often very desirable to use such coal for the production of metallurgical coke, whereas formerly it was not believed that coke of good characteristics for use in blast furnaces could be obtained from such high-volatile coal alone.

The United States Steel Corporation demonstrated by a large-scale series of trials at its Farrell plant that it was entirely feasible to coke Pittsburgh coal without the admixture of low-volatile coal. This corporation and others in the same district and elsewhere are now following this practice successfully. This results not only in economy of plant operation, because a single coal is handled instead of a mixture, but also in the recovery of larger quantities of gas and by-products per ton of coal treated, a factor on which may hinge the financial success of operation under many market conditions. It should not be inferred from the decrease in yield of coke per ton of coal that there has been any decrease in operating efficiency, for quite the contrary is probably the case. The decrease in yield represents simply a change in choice of coal and in operating practice in order to take the maximum advantage of the condition of the market for coke and by-products.

TABLE 16.—*By-product coke produced in Pennsylvania in 1918, 1919, and 1920.*

District.	Plants.	Ovens.		Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens per ton.
		Built.	Under construction.				
1918.							
Pittsburgh	4	1,524	528	3,516,050	68.0	2,389,698	[a] $5.73
Other districts	5	844	110	2,998,818	73.3	2,197,283	[a] 6.69
	9	2,368	638	6,514,868	70.4	4,586,981	[a] 6.46
1919.							
Pittsburgh	5	1,892	220	6,366,361	67.0	4,267,849	4.95
Other districts	6	954	....	2,225,772	71.8	1,598,992	7.46
	11	2,846	220	8,592,133	68.3	5,866,841	5.63
1920.							
Pittsburgh [b]	7	2,052	148	8,239,850	56.2	5,508,802	([d])
Other districts [c]	6	954	....	3,085,655	71.2	2,221,454	([d])
	13	3,006	148	11,325,505	68.3	7,730,256	[a] 10.07

[a] Average price realized on coke sold.
[b] Includes plants at Glassport, Franklin, Rosedale, Clairton, Farrell, Pittsburgh, and Midland.
[c] Includes plants at Bethlehem, Lebanon, Steelton, Chester, Dunbar, and Swedeland.
[d] Data not available.

COKE IN WEST VIRGINIA.

Coke making in West Virginia is worthy of special analysis, as it can be grouped according to districts. Because of the close relations of beehive coking in this State to certain coal fields or districts this analysis is of greater value than a similar study for some other States that outrank West Virginia in the quantity of coke produced.

The output of beehive coke in West Virginia by districts and the State total output of by-product coke are given in Table 17.

The same total number of coke plants was in existence in West Virginia in 1918 and 1919, but there has been slight change in the distribution of these plants among the districts. In 1920 there was one addition to the list of by-product plants, but a considerable decrease in total number of plants. The number of ovens in the State has continued to decrease. No beehive ovens were reported as under construction at the end of any of these three years, and the by-product ovens reported in the two earlier years as under construction were completed.

The production of coke in West Virginia in 1919 was less than half that of 1918, showing that the State participated in the general reduction of operating activity. It also participated in the partial resumption of activity in 1920. The output of by-product coke in the State during the three years was correspondingly variable, being greatest in 1918 and smallest in 1919.

The average value per ton of the coke produced fluctuated during the three-year period in much the same way, there being a decline from \$6.67 in 1918 to \$5.43 in 1919 and a large increase to \$9.23 in 1920. Both beehive and by-product coke participated in these changes to about the same extent, as may be seen from data given in Table 30.

TABLE 17.—*Coke produced in West Virginia in 1918, 1919, and 1920.*

District.	Plants.	Ovens.		Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens per ton.[a]
		Built.	Under construction.				
1918.							
Beehive:							
Flat Top	36	6,315	....	2,418,371	59.3	1,433,736	\$5.91
Tug River	1	2,137	....				
Kanawha	7	1,374	....	435,475	58.2	253,258	6.57
New River	14	1,298	....	395,663	59.0	233,520	8.10
Upper Monongahela and Panhandle	23	2,241	....	960,924	61.3	589,342	6.90
Upper Potomac and Tygarts Valley	8	765	....	305,675	67.6	206,757	6.73
By-product:							
Benwood and Follansbee	2	214	120	853,684	70.7	603,393	7.84
	91	14,344	120	5,369,792	61.8	3,320,006	6.67
1919.							
Beehive:							
Flat Top	36	6,215	....	915,974	57.9	530,792	5.42
Tug River	1	2,137	....				
Kanawha	6	869	....	166,692	60.6	100,921	5.45
New River	14	1,308	....	340,614	58.3	198,601	7.32
Upper Monongahela and Panhandle	24	2,270	....	175,000	60.7	106,168	5.79
Upper Potomac and Tygarts Valley	8	765	....	126,433	66.9	84,638	5.04
By-product:							
Benwood and Follansbee	2	214	60	571,741	68.7	392,812	4.46
	91	13,778	60	2,296,454	61.6	1,413,932	5.43

[a] For 1918, average price realized on coke sold.

TABLE 17.—*Coke produced in West Virginia in 1918, 1919, and 1920*—Continued.

District.	Plants.	Ovens.		Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens per ton.[a]
		Built.	Under construction.				
1920.							
Beehive:							
Flat Top	23	3,941	....	922,095	59.5	549,258	$7.06
Tug River	1	2,137	....				
Kanawha	4	583	....	307,372	62.1	190,997	8.88
New River	13	1,261	....	350,297	58.4	204,399	10.97
Upper Monongahela and Panhandle	24	2,228	....	524,099	60.5	316,833	10.08
Upper Potomac and Tygarts Valley	8	766	....	179,874	66.4	119,457	8.70
By-product:							
Fairmont, Benwood, Follansbee	3	[b] 274	....	626,196	71.4	447,392	10.30
	76	11,190	....	2,909,933	62.8	1,828,336	9.23

[a] Average price realized on coke sold. [b] Includes 154 Koppers and 120 Semet-Solvay ovens.

COKE IN OHIO.

As the second largest producer of coke, Ohio also deserves special attention. The coking business in Ohio, however, is notably different from that in Pennsylvania and West Virginia, for the production of beehive coke in Ohio is relatively small, and the high place that the State occupies depends altogether upon its large output of by-product coke. The number of plants making by-product coke in Ohio remained at 13 in 1918 and 1919 and declined to 12 in 1920, and the number of ovens decreased from 1,658 in 1918 to 1,558 in 1920. The quantity of coal handled and of coke produced, however, increased slightly each year, showing a stability of operation which is rather exceptional. Despite the general reduction in operations in 1919, as compared with 1918, Ohio did not suffer but did a little better than hold its own. The State was no exception, however, with respect to the price realized at the oven per ton of coke produced, for the average value in 1919 was distinctly less than in 1918; but in 1920 the average value rose more than 60 per cent. These changes correspond in magnitude with the average changes for the country as a whole.

Table 18 presents for 1918, 1919, and 1920 the data for plants, ovens, coal used, coke produced, and average value of coke at ovens. These data are divided to show separately the result of operations in the Canton-Cleveland district, the Youngstown district, and the other parts of the State.

The average yield of coke from the coal carbonized has not varied greatly from 69 per cent, except in 1918, when it was 67.2 per cent. This low yield is probably accounted for largely by the fact that during the war period practically all by-product producers were compelled to use coal not so well suited to their plants as is normally available, and also perhaps by a tendency to use a higher-volatile coal which yielded less coke but more by-products.

TABLE 18.—*By-product coke produced in Ohio in 1918–1920.*

District.	Plants.	Ovens. Built.	Ovens. Under construction.	Coal used (net tons).	Yield of coke from coal (per cent).	Coke produced (net tons).	Value of coke at ovens per ton.[a]
1918.							
Canton and Cleveland	4	531	....	2,737,188	66.5	1,821,334	$7.93
Youngstown	3	533	....	2,992,778	67.7	2,024,875	5.49
Other districts	6	594	....	2,045,657	67.5	1,380,125	6.70
	13	1,658	....	7,775,623	67.2	5,226,334	6.82
1919.							
Canton and Cleveland	4	531	....	2,283,018	69.7	1,590,701	6.34
Youngstown	3	533	....	2,586,974	68.3	1,766,139	5.36
Other districts	6	544	....	2,915,826	69.2	2,017,187	5.26
	13	1,608	....	7,785,818	69.0	5,374,027	5.61
1920.							
Canton and Cleveland	4	531	....	2,669,412	69.2	1,847,933	([b])
Youngstown	3	533	....	2,649,793	68.8	1,823,452	([b])
Other districts	5	494	....	2,832,782	68.6	1,943,492	([b])
	12	1,558	....	8,151,987	68.9	5,614,877	9.36

[a] For 1918 and 1920, average price realized on coke sold. [b] Data not available.

NUMBER OF COKE OVENS IN THE UNITED STATES.

The number of beehive coke ovens in the United States reached the maximum (100,362) in 1910; since that year the number has declined steadily until at the end of 1920 it was only 75,298, or 75 per cent of the maximum. The number of these ovens in existence, the number active during the period 1911–1919, and the number under construction at the end of each year, 1880–1920, are shown in figure 19. Table 19 gives corresponding figures for the number of beehive ovens in existence at the end of each year from 1914 to 1920, by States. From these State totals it is easy to see that the decline in the number of ovens has been general throughout the country and not confined to any single region.

TABLE 19.—*Beehive coke ovens in the United States at end of each year, 1914–1920.*

State.	1914	1915	1916	1917	1918	1919	1920
Alabama	8,535	8,568	8,806	8,813	8,586	8,734	8,482
Colorado	3,573	3,573	3,573	3,573	2,724	2,724	1,793
Georgia	201	201	201	201	201	151	151
Kansas	2	2	2	2	2	....	....
Kentucky	1,097	1,097	1,097	1,097	1,077	1,127	855
Montana	351	112	....	....	....	....	....
New Mexico	1,030	1,030	1,060	1,204	1,154	1,030	1,030
Ohio	321	321	321	332	272	272	222
Oklahoma	260	50	50	50	304	304	300
Pennsylvania	52,553	53,112	52,416	49,949	48,588	47,379	44,569
Tennessee	2,303	2,302	2,228	2,228	2,328	2,328	1,848
Utah	726	726	726	726	819	819	819
Virginia	5,435	5,229	5,146	4,979	4,042	3,762	3,906
Washington	331	331	331	331	408	366	407
West Virginia	17,000	16,228	15,396	14,314	14,130	13,564	10,916
Wisconsin	228	228	228	228	....	....	....
	93,946	93,110	91,581	88,027	84,635	82,560	75,298

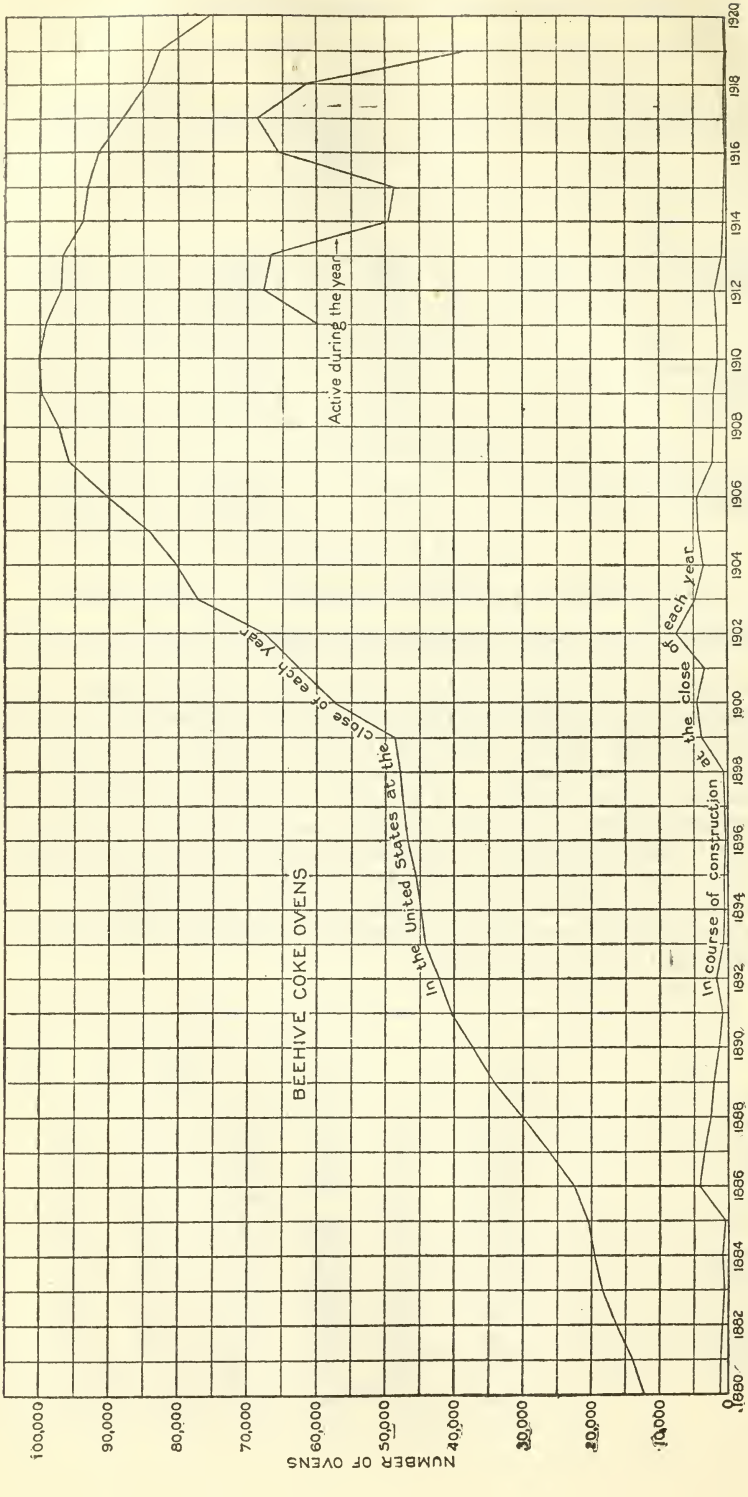

FIGURE 19.—Beehive coke ovens completed and under construction in the United States at the end of each year, 1880-1920.

The history of by-product coke-oven construction in the United States since 1893, graphically presented in figure 20 (p. 392), is quite different from that of the beehive ovens. There has been a rapid and continuous increase in the number of by-product ovens in existence at the end of each year; and the number of ovens under construction at the end of each year has continued at all times to be a considerable percentage of the total in existence. Table 20 presents statistics showing by States the number of by-product ovens built and those under construction at the end of each year from 1914 to 1920.

TABLE 20.—*By-product coke ovens in the United States at end of each year, 1914–1920.*

State.	1914		1915		1916		1917	
	Built.	Under construction.	Built.	Under construction.	Built.	Under construction.	Built.	Under construction.
Alabama	750		750		743	97	847	
Colorado						120		120
Illinois	586	40	626		626		626	
Indiana	789	33	812	30	842	44	886	260
Kentucky	54		54	54	108		108	
Maryland	120		120		120	240	120	240
Massachusetts	400		400		400		400	
Michigan	205		205	24	229	40	269	
Minnesota	140	90	120	20	155	65	155	65
Missouri		56	56		56		56	
New Jersey	150		150		150	110	260	55
New York	555	100	555	100	555	160	615	
Ohio	217	51	343	657	916	472	1,108	760
Pennsylvania	1,522	262	1,744	212	1,956	700	1,956	700
Rhode Island								
Tennessee		12	12		12		12	24
Washington	5		5		5		5	
West Virginia	120		120	94	214		214	
Wisconsin	196		196		196	36	232	36
	5,809	644	6,268	1,191	7,283	2,084	7,869	2,260

State.	1918		1919		1920	
	Built.	Under construction.	Built.	Under construction.	Built.	Under construction.
Alabama	847	324	906	247	1,081	90
Colorado	120		120		120	
Illinois	626	88	714	80	794	100
Indiana	1,026	190	1,216		1,216	
Kentucky	108		108		108	
Maryland	180	180	300	60	300	
Massachusetts	400		400		400	
Michigan	269	120	389		389	
Minnesota	220		220		220	
Missouri	56		56		56	8
New Jersey	260	55	315		315	
New York	615	60	615	210	732	
Ohio	1,658		1,608		1,558	
Pennsylvania	2,368	638	2,846	220	3,006	148
Rhode Island		40	40		40	
Tennessee	24		24		24	
Washington	20		20		20	
West Virginia	214	120	214	60	274	
Wisconsin	268		268		228	50
	9,279	1,815	10,379	877	10,881	396

A still more detailed summary of the situation during the three years 1918, 1919, and 1920 is given in Tables 21 and 22. Table 21 shows for 1918 and 1919 by States the number of ovens active, the number idle, the total number in existence, the number abandoned, and the number under construction at the end of the year. The returns for 1920 did not include any statement by the operators of the number of ovens active during the year, but Table 22 shows the number of new ovens, those abandoned, those under construction, and those in existence at the end of the year, by States. This table shows that during 1920 the number of beehive ovens decreased 8 per cent whereas the number of by-product ovens increased 5 per cent.

For a more complete historical view of the situation the data in Table 10 are a useful supplement to the two illustrations.

TABLE 21.—*Coke ovens in the United States, 1918 and 1919.*

State.	Active.		Idle.		Total.		Abandoned.		Under construction.	
	Beehive.	By-product.	Beehive.	By-product.	Beehive.	By-product.	Beehive.	By-product.	Beehive.	By-product.
1918.										
Alabama	5,570	807	3,016	40	8,586	847	278		49	324
Colorado	1,431	120	1,293		2,724	120	849			
Georgia	101		100		201					
Illinois		605		21		626				88
Indiana		945		81		1,026				190
Kansas			2		2					
Kentucky	798	108	279		1,077	108	20		50	
Maryland		180				180				180
Massachusetts		400				400				
Michigan		269				269				120
Minnesota		214		6		220				
Missouri		56				56				
New Jersey		260				260				55
New Mexico	1,053		101		1,154		50			
New York		615				615				60
Ohio	198	1,610	74	48	272	1,658	60			
Oklahoma	304				304		50			
Pennsylvania	37,730	2,189	10,858	179	48,588	2,368	943	376	60	638
Rhode Island										40
Tennessee	1,101	24	1,227		2,328	24		12	90	
Utah	819				819					
Virginia	3,135		907		4,042		988		120	
Washington	250	20	158		408	20	25			
West Virginia	8,827	214	5,303		14,130	214	242			120
Wisconsin		268				268	228			
	61,317	8,904	23,318	375	84,635	9,279	3,733	388	369	1,815
1919.										
Alabama	4,104	821	4,630	85	8,734	906	61	18		247
Colorado	385	92	2,339	28	2,724	120				
Georgia	101		50		151					
Illinois		591		123		714				80
Indiana		1,039		177		1,216				
Kansas							2			
Kentucky	793	108	334		1,127	108				
Maryland		180		120		300				60
Massachusetts		274		126		400				
Michigan		287		102		389				
Minnesota		181		39		220				
Missouri		56				56				
New Jersey		315				315				
New Mexico	587		443		1,030		124			
New York		430		185		615				210
Ohio	203	1,368	69	240	272	1,608		50		
Oklahoma	84		220		304					
Pennsylvania	24,201	2,281	23,178	565	47,379	2,846	1,267		64	220
Rhode Island		33		7		40				
Tennessee	817	24	1,511		2,328	24				
Utah	512		307		819					
Virginia	2,409		1,353		3,762				100	
Washington	103	19	263	1	366	20				
West Virginia	4,342	207	9,222	7	13,564	214	1,325			60
Wisconsin		268				268				
	38,641	8,574	43,919	1,805	82,560	10,379	2,779	68	164	877

CAPACITY OF COKE OVENS.

For the first time in a study of the coke industry it is now possible to present reliable estimates of the coke capacity of both the beehive and the by-product branches of the business. These data are presented in Table 22 by States. The capacity is reported by each operator as "the maximum quantity of coke, of the grade desired by the operator, which can be produced when all conditions are favorable, with all ovens active." Considerable leeway is allowed by this definition, but in general it appears that the capacities thus reported represent the quantity of coke that would be produced from coal of the average volatile content normally used in the minimum coking time deemed practicable for each plant.

TABLE 22.—*Status of coke ovens in the United States at the end of 1920.*

State.	New.		Abandoned.	In existence.		Under construction.	
	Number.	Capacity per day.		Number.	Capacity per day.	Number.	Capacity per day.
Beehive ovens.							
Alabama			253	8,482	13,571		
Colorado			931	1,793	6,007		
Georgia				151	242		
Kansas			2				
Kentucky			272	855	1,684		
New Mexico				1,030	1,710		
Ohio			50	222	444		
Oklahoma				300	335		
Pennsylvania			2,412	44,569	140,638	302	1,750
Tennessee			480	1,848	2,033		
Utah				819	819		
Virginia			135	3,906	7,270	30	60
Washington			25	407	545		
West Virginia			2,146	10,916	20,767		
			6,706	75,298	196,065	332	1,810
By-product ovens.							
Alabama	247	4,707	90	1,081	11,665	90	777
Colorado				120	1,656		
Illinois	80	1,600		794	9,347	100	1,500
Indiana				1,216	14,390		
Kentucky				108	1,400		
Maryland				300	4,200		
Massachusetts				400	1,800		
Michigan				389	4,660		
Minnesota				220	1,952		
Missouri				56	980	8	140
New Jersey				315	3,077		
New York	210	2,454	70	732	7,822		
Ohio			100	1,558	19,234		
Pennsylvania	160	1,710		3,006	29,973	148	1,694
Rhode Island				40	456		
Tennessee				24	252		
Washington				20	70		
West Virginia	60	699		274	2,028		
Wisconsin			40	228	2,357	50	583
	757	11,170	300	10,881	117,319	396	4,694

Table 23 summarizes the estimates of the annual carbonizing capacity of the ovens as completely as available data now permit. The estimated capacity of by-product ovens at the end of 1918 is that recorded in the work of the United States Fuel Administration and the United States Geological Survey in cooperation. The capacities for by-product and beehive ovens at the end of 1920 are those estimated by the Geological Survey from the individual reports of the operators.

In practice it is of course impossible to realize 100 per cent operation, even though conditions are reasonably favorable throughout the country. Average operation in by-product plants will seldom exceed, even for short periods, 90 per cent of the maximum capacity, and even in times of great demand for coke operation can not continue very long at much above 85 per cent for the country as a whole. These percentages have therefore been applied to the estimated capacity of by-product ovens and indicate that at the end of 1920 about 52,000,000 tons of coal a year could be carbonized in such ovens for the production of about 36,000,000 tons of coke, if market demand and coal supply were continuously favorable for all districts of the

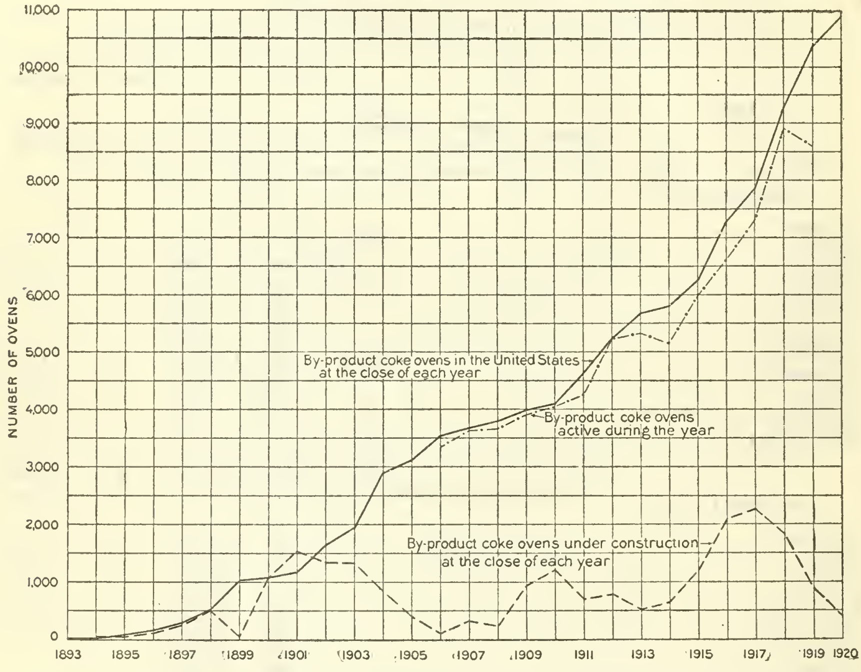

FIGURE 20.—By-product coke ovens completed and under construction in the United States at the end of each year, 1893–1920, and by-product ovens active, 1906–1919.

country. Operating capacity is not so likely to be reached in beehive ovens as in by-product ovens. In fact, present conditions indicate that it is very unlikely that the percentage of capacity attained in beehive ovens will ever equal the percentage attained in by-product ovens during the same period. The data in Table 23 show that when the existing beehive ovens are operating at 50 per cent of their maximum capacity, the quantity of coal handled and the output of coke at these ovens will be practically the same as the quantities for all by-product ovens operating at 85 per cent of their capacity. As a matter of fact, the output from beehive ovens has reached 50 per cent of capacity only once in recent years, namely, in 1916, when 35,500,000 tons of beehive coke was produced. In other words, we still have in existence, despite a decrease in the number of ovens every year, more than twice the beehive-oven capacity that has ever been operated. Hence it can safely be predicted that the tendency in the future will be to reduce the number and the capacity of beehive ovens. This tendency will of course be accelerated by increase in the number or the capacity of by-product ovens. In fact, if existing by-product ovens were operated at 85 per cent of their capacity throughout the year, there would be needed, on the assumption of a total demand equal to the maximum of recent years, only a fifth or a fourth of the present beehive-oven capacity.

TABLE 23.—*Estimated annual carbonizing capacity of coke ovens in the United States at the end of 1918 and of 1920, in millions of net tons.*

Percentage of maximum capacity.	1918, by-product.		1920, by-product.		1920, beehive.	
	Coke.	Coal for charge.[a]	Coke.	Coal for charge.[a]	Coke.	Coal for charge.[a]
100	33.7	48.1	42.8	61.2	71.6	111.8
90	30.3	43.3	38.5	55.0	64.4	100.6
85	28.6	40.9	36.4	52.0	60.9	95.2
75	25.3	36.1	32.1	45.9	53.7	83.9
50	16.8	24.0	21.4	30.6	35.8	55.9

[a] Coal for charge estimated for by-product ovens on basis of 70 per cent yield in coke; for beehive, on basis of 64 per cent yield.

LOCATION OF BY-PRODUCT PLANTS.

Table 24 gives a list of all domestic by-product coke plants in existence at the end of 1920, and Table 25 shows the by-product ovens under construction on January 1, 1921. The location of the plants is shown on figure 21, the numbers of which correspond to those in the following list:

	Number of ovens.
Alabama:	
1. Alabama City	37
2. Birmingham (Alabama By-Products Corporation)	50
3. Birmingham (Sloss-Sheffield Steel & Iron Co.)	120
4. Ensley	240
5. Fairfield	434
6. Tuscaloosa	60
7. Woodward (includes 90 under construction)	230
	1,171
Colorado:	
1. Minnequa	120
Illinois:	
1. Chicago (Chicago By-Products Coke Co.; under construction)	100
2. Chicago (Semet-Solvay Co.)	280
3. Granite City	80
4. Joliet (Coal Products Manufacturing Co.)	53
5. Joliet (Illinois Steel Co.)	280
6. South Chicago	88
7. Waukegan	13
	894
Indiana:	
1. Gary	700
2. Indiana Harbor (Inland Steel Co.)	130
3. Indiana Harbor (Steel & Tube Co. of America)	120
4. Indianapolis	181
5. Linton	3
6. Muncie	22
7. Terre Haute	60
	1,216
Kentucky:	
1. Ashland	108

FIGURE 21.—Map of the United States showing location of by-product coke plants at the end of 1920.

	Number of ovens.
Maryland:	
1. Sparrows Point	300
Massachusetts:	
1. Everett	400
Michigan:	
1. Dearborn	120
2. Detroit	215
3. Wyandotte	54
	389
Minnesota:	
1. Duluth	90
2. St. Paul	65
3. West Duluth	65
	220
Missouri:	
1. St. Louis (includes 8 under construction)	64
New Jersey:	
1. Camden	150
2. Jersey City	165
	315
New York:	
1. Buffalo (Donner Union Coke Corporation)	150
2. Buffalo (Semet-Solvay Co.)	60
3. Geneva	46
4. Lackawanna	436
5. Solvay	40
	732
Ohio:	
1. Canton	47
2. Cleveland (American Steel & Wire Co.)	180
3. Cleveland (McKinney Steel Co.)	204
4. Cleveland (Semet-Solvay Co.)	100
5. Dover	24
6. Ironton	60
7. Lorain	208
8. Portsmouth	108
9. Toledo	94
10. Youngstown (Brier Hill Steel Co.)	84
11. Youngstown (Republic Iron & Steel Co.)	143
12. Youngstown (Youngstown Sheet & Tube Co.)	306
	1,558
Pennsylvania:	
1. Bethlehem	424
2. Chester	40
3. Clairton	768
4. Dunbar	110
5. Farrell	212
6. Glassport	120
7. Johnstown (includes 148 building)	700
8. Lebanon	90
9. Midland	100
10. Pittsburgh	300
11. Steelton	180
12. Swedeland	110
	3,154
Rhode Island:	
1. Sassafras Point	40
Tennessee:	
1. Alton Park	24
Washington:	
1. Seattle	20
West Virginia:	
1. Benwood	120
2. Fairmont	60
3. Follansbee	94
	274
Wisconsin:	
1. Mayville	108
2. Milwaukee (includes 50 under construction)	170
	278

TABLE 24.—*By-product coke plants in the United States December 31, 1920.*

State.	Town.	Name of company owning plant.	Number of ovens.	Type of oven.	Year put in operation.[a]
Alabama	Alabama City	Gulf States Steel Co	37	Koppers	1917.
	Birmingham	Alabama By-Products Corporation.	50	do	1920.
	do	Sloss Sheffield Steel & Iron Co.	120	Semet-Solvay	1898–1902.
	Ensley	Tennessee Coal, Iron & R. R. Co.	240	do	1920.
	Fairfield	do	434	Koppers	1912–1920.
	Tuscaloosa	Central Iron & Coal Co	60	Semet-Solvay	1906–1914.
	Woodward	Woodward Iron Co	80	Koppers	1917–1914.
	do	do	60	Wilputte	1917.
Colorado	Minnequa	Colorado Fuel & Iron Co.	120	Koppers	1918.
Illinois	Granite City	St. Louis Coke & Chemical Co.	80	Roberts	1921.[b]
	Joliet	Coal Products Manufacturing Co.	18	Wilputte	1914.
	do	do	35	Koppers	1912.
	do	Illinois Steel Co	280	do	1908–1909.
	South Chicago	By-Products Coke Corporation.	280	Semet-Solvay	1905–1915.
	do	International Harvester Co.	88	Wilputte	1919.
	Waukegan	North Shore Gas Co	13	Semet-Solvay	1912.
Indiana	Gary	Illinois Steel Co	700	Koppers	1911–1918.
	Indiana Harbor	Inland Steel Co	130	do	1913–1917.
	do	Steel & Tube Co. of America.	120	Semet-Solvay	1919.
	Indianapolis	Citizens Gas Co	100	United-Otto	1909–1913.
	do	do	41	Semet-Solvay	1914.
	do	do	40	Wilputte	1919.
	Linton	Linton Gas Co	3	Gas Machinery	1917.
	Muncie	Central Indiana Gas Co.	22	Klönne	1912.
	Terre Haute	Indiana Coke & Gas Co.	30	Gas machinery	1916.
	do	do	30	Koppers	1919.
Kentucky	Ashland	Kentucky Solvay Coke Co.	108	Semet-Solvay	1913–1916.
Maryland	Sparrows Point	Bethlehem Steel Co	300	Koppers	1914–1919.
Massachusetts	Everett	New England Fuel & Transportation Co.	400	United-Otto	1899.
Michigan	Detroit	Solvay Process Co	215	Semet-Solvay	1901–1917.
	Dearborn	Ford Motor Co	120	do	1919.
	Wyandotte	Michigan Alkali Co	54	United-Otto	1902–1916.
Minnesota	Duluth	Minnesota Steel Co	90	Koppers	1915–16.
	St. Paul	Minnesota By-Product Coke Co.	65	do	1918.
	West Duluth	Zenith Furnace Co	65	United-Otto	1904–1916.
Missouri	St. Louis	Laclede Gas Light Co	56	Koppers	1915.
New Jersey	Camden	Camden Coke Co	150	United-Otto	1903–1906.
	Kearny	Seaboard By-Product Coke Co.	165	Koppers	1917–1919.
New York	Buffalo	Donner Union Coke Corporation.	150	do	1920.
	do	Wickwire Spencer Steel Corporation.	60	Semet-Solvay	1917.
	Geneva	Empire Coke Co	46	do	1904–1909.
	Lackawanna	Lackawanna Steel Co	94	United-Otto	1904.
			60	Semet-Solvay	1920.
	do	do	282	Rothberg	
	Solvay	Solvay Process Co	40	Semet-Solvay	1893–1903.
Ohio	Canton	United Furnace Co	47	Koppers	1916.
	Cleveland	American Steel & Wire Co.	180	do	1918.
	do	Otis Steel Co	100	Semet-Solvay	1910–1915.
	do	McKinney Steel Co	204	Koppers	1916.
	Canal Dover	Penn. Iron & Coal Co	24	Roberts	1916.
	Ironton	Ironton Solvay Coke Co.	60	Semet-Solvay	1918.
	Lorain	National Tube Co	208	Koppers	1918.
	Portsmouth	Portsmouth Solvay Coke Co.	108	Semet-Solvay	1917.
	Toledo	Toledo Furnace Co	94	Koppers	1910.
	Youngstown	Brier Hill Steel Co	84	do	1917.
	do	Republic Iron & Steel Co.	143	do	1914–15.
	do	Youngstown Sheet & Tube Co.	306	do	1916–1918.

[a] The first and last years are given for those plants that have two or more installations.
[b] Completed in 1920 but not put in operation until January, 1921.

TABLE 24.—*By-product coke plants in the United States December 31, 1920*—Continued.

State.	Town.	Name of company owning plant.	Number of ovens.	Type of oven.	Year put in operation.[a]
Pennsylvania	Chester	Philadelphia Suburban Gas & Electric Co.	40	Semet-Solvay	1904.
	Clairton	Carnegie Steel Co.	768	Koppers	1918–19.
	Farrell	....do	212	Otto-Hoffmann.	1903.
	Dunbar	American Manganese Manufacturing Co.	110	Semet-Solvay	1896–1903.
	Glassport	Allegheny By-Product Coke Co.	120	United-Otto	1897.
	Johnstown	Cambria Steel Co.	92	Koppers	1915.
	....do	....do	210	United-Otto	1895–1907.
	....do	....do	250	Cambria	1918–1920.
	South Bethlehem	Bethlehem Steel Co.	424	Koppers	1915–16.
	Lebanon	....do	80	Semet-Solvay	1904.
	Steelton	....do	120	....do	1907.
	....do	....do	60	Koppers	1918.
	Midland	Pittsburgh Crucible Steel Co.	100	....do	1920.
	Pittsburgh	Jones & Laughlin Steel Co.	300	....do	1919–20.
	Swedeland	Rainey-Wood Coke Co.	110	....do	1919.
Rhode Island	Sassafras Point	Providence Gas Co.	40	....do	1919.
Tennessee	Altonpark	Chattanooga Coke & Gas Co.	24	Semet-Solvay	1918.
Washington	Seattle	Seattle Lighting Co.	20	Klönne	1914.
West Virginia	Benwood	National Tube Co.	120	Semet-Solvay	1898–1901.
	Follansbee	La Belle Iron Works	94	Koppers	1917.
	Fairmont	Domestic Coke Corporation.	60	....do	1920.
Wisconsin	Mayville	Steel & Tube Co. of America.	108	Otto-Hoffmann.	1914–1917.
	Milwaukee	Milwaukee Coke & Gas Co.	120	Semet-Solvay	1904–1906.

[a] The first and last years are given for those plants that have two or more installations.

TABLE 25.—*By-product ovens under construction in the United States December 31, 1920.*

State.	Town.	Name of company owning plant.	Number of ovens.	Type of oven.	Probable date of operation.
Alabama	Woodward	Woodward Iron Co.	90	Koppers	May, 1921.
Illinois	Chicago	Chicago By Products Coke Co.	100	....do	June, 1921.
Missouri	St. Louis	Laclede Gas Light Co.	8	Piette	February, 1921. Trial installation.
Pennsylvania	Johnstown	Cambria Steel Co.	88	Semet-Solvay	January, 1922.
	....do	....do	60	Cambria	May, 1921.
Wisconsin	Milwaukee	Milwaukee Coke & Gas Co.	50	Koppers	August, 1921.

TYPES OF BY-PRODUCT COKE OVENS.

There has been a considerable variety in the types of by-product coke oven used in the United States, and at the end of 1920 nine distinct types still remained in operation. Table 26 summarizes for each State the number of ovens of each type in existence and shows the increase in number of the two principal types, the Koppers and the Semet-Solvay. The United Otto oven, though third in rank, is no longer so numerous as in earlier years. Even if the Otto-Hoffmann and Schniewind types are included with it the total for the group is less than two-thirds of the number of Semet-Solvay ovens and only one-fourth the number of Koppers ovens.

TABLE 26.—*By-product ovens in the United States at the end of the year in 1918–1920.*

1918.

State.	Koppers.	United-Otto.[a]	Semet-Solvay.	Rothberg.	Didier.	Gas machinery.	Roberts	Klönne.	Wilputte.	Total.
Alabama	487		300						60	847
Colorado	120									120
Illinois	315		293						18	626
Indiana	830	100	41			33		22		1,026
Kentucky			108							108
Maryland	180									180
Massachusetts		400								400
Michigan		54	215							269
Minnesota	155	65								220
Missouri	56									56
New Jersey	110	150								260
New York		188	146	281						615
Ohio	1,266	100	268				24			1,658
Pennsylvania	1,216	675	360		90	27				2,368
Tennessee			24							24
Washington								20		20
West Virginia	94		120							214
Wisconsin		108	160							268
	4,829	1,840	2,035	281	90	60	24	42	78	9,279

[a] Includes the Otto-Hoffmann and Schniewind types.

1919.

State.	Koppers.	United-Otto.[a]	Semet-Solvay.	Rothberg.	Gas machinery.	Roberts.	Klönne.	Wilputte.	Piron.	Cambria-Belgian.	Total.
Alabama	534		300					60	12		906
Colorado	120										120
Illinois	315		293					106			714
Indiana	860	100	161		33		22	40			1,216
Kentucky			108								108
Maryland	300										300
Massachusetts		400									400
Michigan		54	335								389
Minnesota	155	65									220
Missouri	56										56
New Jersey	165	150									315
New York		188	146	281							615
Ohio	1,266	50	268			24					1,608
Pennsylvania	1,694	675	360		27					90	2,846
Rhode Island	40										40
Tennessee			24								24
Washington							20				20
West Virginia	94		120								214
Wisconsin		108	160								268
	5,599	1,790	2,275	281	60	24	42	206	12	90	10,379

1920.

State.	Koppers.	United-Otto.[a]	Semet-Solvay.	Rothberg.	Gas machinery.	Roberts.	Klönne.	Wilputte.	Piron.	Cambria-Belgian.	Total.
Alabama	601		420					60			1,081
Colorado	120										120
Illinois	315		293			80		106			794
Indiana	860	100	161		33		22	40			1,216
Kentucky			108								108
Maryland	300										300
Massachusetts		400									400
Michigan		54	335								389
Minnesota	155	65									220
Missouri	56										56
New Jersey	165	150									315
New York	150	94	206	282							732
Ohio	1,266		268			24					1,558
Pennsylvania	1,854	542	360							250	3,006
Rhode Island	40										40
Tennessee			24				20				24
Washington											20
West Virginia	154		120								274
Wisconisn		108	120								228
	6,036	1,513	2,415	282	33	104	42	206	....	250	10,881

[a] Includes the Otto-Hoffman and Schniewind types.

Table 27 summarizes, by States, the ovens under construction at the end of the three calendar years 1918, 1919, and 1920. In 1920 a new type of oven, the Piette, appeared for the first time, just as in 1919 an experimental installation of Piron ovens had been made for the first time in the United States. These two small batteries of ovens were thus tried out on a commercial scale under American conditions. The Piron ovens were installed temporarily on existing foundations at the plant of the Woodward Iron Co., Woodward, Ala. The need for extension of the regular equipment of that company, however, required the removal of the Piron ovens in 1920. The results of their operation are reported to have been favorable, and their early removal does not imply that the oven was a failure. The experimental installation of Piette ovens was made in connection with the plant of the Laclede Gas Light Co., St. Louis, Mo., and this installation has been thoroughly tested by its builders in cooperation with the engineers of the local company. The results of that operating trial have recently been published.[1]

In 1919 also another type of coke oven appeared for the first time, the Cambria-Belgian oven, and this type has increased in number from 90 in 1919 to 250 in 1920. The other increases or decreases in ovens represent in general only normal changes in installation, which require no special comment.

TABLE 27.—*By-product ovens under construction in the United States at the end of the year in 1918–1920.*

1918.

State.	Koppers.	Semet-Solvay.	Wilputte.	Cambria.	Total.
Alabama	204	120			324
Illinois			88		88
Indiana	30	120	40		190
Maryland	180				180
Michigan		120			120
New Jersey	55				55
New York		60			60
Pennsylvania	578			60	638
Rhode Island	40				40
West Virginia	60	60			120
	1,147	480	128	60	1,815

1919.

	Koppers.	Semet-Solvay.	Roberts.	Cambria-Belgian.	Total.
Alabama	127	120			247
Illinois			80		80
Maryland	60				60
New York	150	60			210
Pennsylvania	160			60	220
West Virginia	60				60
	557	180	80	60	877

1920.

	Koppers.	Semet-Solvay.	Roberts.	Cambria-Belgian.	Piette.	Total.
Alabama	90					90
Illinois	100					100
Missouri					8	8
Pennsylvania		88		60		148
Wisconsin	50					50
	240	88		60	8	396

[1] Chem. and Met. Eng., vol 26, p. 794, 1922.

DISPOSAL OF COKE.

A considerable percentage of the coke produced is used by the producer—about 15 per cent of the beehive coke and 75 per cent of the by-product coke. The remainder is sold. The screenings and breeze are either used or sold, as local conditions may make most advantageous to the producer. About 25 per cent of the beehive screenings is used by the producer, almost as much more is sold, and the remainder is either put in stock or wasted. Of the screenings and breeze from by-product ovens, about two-thirds is used by the producer and one-third is sold.

The larger sizes of coke sold are classified as "furnace," "foundry," and "domestic and other." Tables 28 and 29 summarize for each State the production, sales according to size, and use by producer of beehive coke and by-product coke. The figures for 1920 are not exactly comparable with the figures for 1918 and 1919, as during the earlier years the sales of breeze and the use of breeze were not separately reported to the Geological Survey by all producers. Some apparently included the sales of this small coke with the sales of "domestic and other" sizes; others included the breeze used by the producer with the coke so used. The figures for 1920 are therefore somewhat more comprehensive and more significant with respect to the sale or other disposition of the fine coke.

TABLE 28.—*Beehive coke produced and sold or used by the producer in the United States, 1918–1920.*

State.	Produced.				Sold.								Used by producer.	
	Coke.		Screenings and breeze.		Furnace.		Foundry.		Domestic and other.		Screenings and breeze.		Coke (net tons).	Screenings and breeze (net tons).
	Net tons.	Value.[a]	Net tons.	Value.[a]	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.		
1918.														
Alabama	1,717,721	$13,973,660	100	$739	107,753	$671,587	152,749	$1,475,728	37,710	$278,559			1,412,617	
Colorado	758,784	5,737,925	3,629	10,560	137,657	1,051,896	37,194	279,448	1,954	5,688			581,044	
Georgia	22,048	193,317					22,048	193,307						
Kentucky	301,036	1,798,389	924	5,738	276,940	1,648,848	55	292	23,664	146,979				
New Mexico	597,072	3,729,312	2,120	16,960	596,495	3,725,769			76	608				
Ohio	138,909	(b)					6,850	(b)					137,299	
Pennsylvania	22,136,664	130,739,138	106,551	667,009	18,823,133	109,419,074	1,344,748	9,673,491	78,153	489,599			1,930,364	
Tennessee	302,637	2,156,591	2,268	14,016	105,301	749,372	736	6,195					196,835	
Virginia	1,234,256	8,046,115	4,228	28,624	595,967	3,664,201	202,547	1,540,489	4,228	28,619			435,637	
Washington	93,659	910,459			75,505	691,532	18,334	220,705	27	202				
West Virginia	2,716,613	17,421,639	4,322	23,252	2,045,779	12,691,751	426,590	3,220,375	54,843	295,204			191,522	
Combined States[c]	461,393	[d]4,599,038			452,097	3,468,278	18,305	[d]192,114	9,856	73,595				
	30,480,792	189,305,583	124,142	766,898	23,216,627	137,782,308	2,230,156	16,802,144	210,511	1,319,053			4,885,318	
1919.														
Alabama	1,149,838	7,949,048			174,099	1,178,999	66,362	580,050					909,560	
Colorado	200,890	(b)	688	463	196,651	1,403,087	3,496	29,003	1,431	(b)				
Georgia	18,149	149,022					18,149	149,022						
Kentucky	283,691	1,819,991			271,442	1,751,134			10,784	59,330				
New Mexico	260,162	1,777,769	7,528	14,006	258,317	1,694,662	1,607	9,973	7,528	23,905				
Ohio	107,633	(b)											107,633	
Pennsylvania	14,634,990	69,861,837	49,533	68,722	12,200,766	56,894,670	1,005,940	5,766,389	61,959	331,577			1,415,036	
Tennessee	156,166	1,064,690			15,264	66,896	22,706	158,859					118,196	
Virginia	930,516	5,391,367	3,391	18,983	544,949	3,206,741	93,825	660,224	3,381	18,929			287,982	
Washington	35,999	324,044			24,236	205,850	11,763	118,178						
West Virginia	1,021,120	5,921,685	161	1,050	668,747	3,753,052	119,045	841,186	49,205	287,093			185,421	
Combined States[c]	243,782	[e]3,835,519	2,564	6,298	219,793	1,852,729	6,590	51,372	9,642	[f]54,633				
	19,042,936	98,094,972	63,865	109,522	14,574,264	72,007,820	1,349,483	8,364,256	143,930	775,467			3,023,828	

[a] Value for 1918 estimated on basis of sales.
[b] Included under "Combined States."
[c] Oklahoma and Utah.
[d] Includes also Ohio.
[e] Includes also Colorado and Ohio.
[f] Includes also Colorado.

TABLE 28.—*Beehive coke produced and sold or used by the producer in the United States, 1918–1920*—Continued.

State.	Produced.				Sold.								Used by producer.	
	Coke.		Screenings and breeze.		Furnace.		Foundry.		Domestic and other.		Screenings and breeze.		Coke (net tons).	Screenings and breeze (net tons)
	Net tons.	Value.[a]	Net tons.	Value.[a]	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.		
1920.														
Alabama	890,001	$9,300,510	689	$2,756	....	....	77,173	$806,265	....	....	11	$44	674,022	178
Colorado	272,826	2,073,478	1,523	4,219	175,405	$1,269,652	21,035	(b)	24,477	(b)	1,470	(b)	51,909	53
Georgia	16,523	197,285	....	....	....	....	16,489	196,881	....	....	....	....	....	....
Kentucky	272,592	1,961,742	....	....	272,592	1,961,742	....	....	....	....	....	....	....	....
Ohio	86,933	686,771	3,000	(b)	....	....	....	....	10	(b)	1,815	(b)	86,758	300
Pennsylvania	15,908,483	139,822,353	193,563	448,606	10,693,334	88,974,833	1,288,842	11,811,664	90,585	$737,418	17,670	35,906	1,778,099	56,500
Tennessee	162,587	1,560,998	2,536	11,919	3,719	(b)	24,462	243,099	....	....	350	(b)	135,145	2,140
Virginia	1,027,788	9,106,202	3,387	22,659	569,555	4,866,512	142,038	1,435,405	....	....	3,387	22,661	316,750	....
Washington	33,111	354,097	....	....	32,230	341,132	881	(b)	....	....	....	....	....	....
West Virginia	1,380,944	12,266,370	4,276	37,280	955,426	7,898,179	231,928	2,463,880	36,624	255,677	2,169	18,907	162,036	....
Combined States [c]	459,304	3,887,716	37,003	[d] 176,457	425,976	[e] 3,631,600	4,408	[f] 252,543	40,446	[g] 552,052	17,168	[h] 90,518	165	....
	20,511,092	181,217,522	245,977	703,896	13,128,237	108,943,650	1,807,256	17,209,737	192,142	1,545,147	44,040	168,036	3,204,884	59,171

a Estimated on basis of sales.
b Included under "Combined States."
c New Mexico and Utah.
d Includes also Ohio.
e Includes also Tennessee.
f Includes also Colorado and Washington.
g Includes also Colorado and Ohio.
h Includes also Colorado, Ohio, and Tennessee.

TABLE 29.—*By-product coke produced and sold or used by the producer in the United States, 1918–1920.*

State.	Produced.				Sold.								Used by producer.	
	Coke.		Screenings and breeze.		Furnace.		Foundry.		Domestic and other.		Screenings and breeze.		Coke (net tons).	Screenings and breeze (net tons).
	Net tons.	Value.[a]	Net tons.	Value.[a]	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.		
1918.														
Alabama	2,634,451	$15,108,576	217,349	$1,091,092	109,417	$663,586	10,503	$58,659	48,333	$242,760			2,483,463	
Colorado	230,663	230,663	9,701	(b)					9,701	(b)			230,663	
Illinois	2,285,610	18,625,436	187,698	1,379,580	525,538	4,376,183	247,520	2,162,760	298,674	2,194,149			1,236,571	
Indiana	3,898,215	31,462,493	290,175	1,967,387	28,377	259,155	187,493	1,862,230	293,952	1,993,325			3,502,061	
Kentucky	517,749	2,657,606	16,320	109,670	334,467	1,411,586	103,956	714,036	78,598	528,078				
Maryland	474,368	(b)	46,336	(b)	4,957	48,434							456,258	
Massachusetts	556,397	(b)					263,713	(b)	269,754	(b)				
Minnesota	784,065	6,806,468	38,054	341,344	54,178	371,867	23,714	231,877	249,737	2,240,247			433,747	
New Jersey	682,148	(b)	74,725	(b)	458,013	(b)	69,794	(b)	162,336	(b)			54,869	
New York	1,069,587	9,920,419	53,362	513,876	360,914	3,304,433	8,137	91,063	76,401	736,052			617,743	
Ohio	5,226,334	35,627,919	505,438	2,461,483	946,763	6,795,533	36,496	(b)	195,150	950,358			3,952,163	
Pennsylvania	4,586,981	29,618,136	327,177	1,648,972	562,034	3,770,419			100,148	505,064			3,935,199	
Tennessee	124,469	1,020,023			108,335	872,969	13,739	127,827	1,412	11,189				
Washington	30,129	286,226	5,314	50,483			3,563	33,849	15,416	146,453			10,132	
West Virginia	603,393	4,731,205	36,179	274,960	72,378	570,426			12,090	91,888			517,763	
Combined States [c]	2,293,021	[d]36,923,615	191,542	[e]2,391,172	582,324	[f]8,347,656	662,424	[g]10,566,716	725,357	[h]9,267,516			322,716	
	25,997,580	193,018,785	1,999,370	12,230,019	4,147,695	30,792,247	1,631,052	15,849,017	2,537,059	18,907,079			17,753,348	
1919.														
Alabama	2,230,933	11,226,513	174,015	221,793	41,193	223,478			53,660	171,779			2,298,098	
Colorado	412,863	(b)	37,945	(b)					14,631	(b)			417,397	
Illinois	1,703,903	13,206,405	172,034	307,754	396,410	3,283,772	298,720	2,544,872	424,355	2,307,357			780,860	
Indiana	3,702,180	27,543,179	249,449	235,438	823,702	6,127,486	171,591	1,498,287	288,073	1,900,628			2,628,260	
Kentucky	408,278	2,081,490	38,876	16,751	267,252	1,234,270	74,651	495,502	96,553	335,892				
Maryland	356,237	2,269,230	20,592	60,540	3,626	23,097			12,736	37,440			360,467	
Massachusetts	393,331	(b)					217,888	(b)	133,300	(b)			42,238	
Michigan	808,729	6,204,747	74,528	105,203	208,222	1,555,193	236,895	2,070,131	351,795	2,334,027				
Minnesota	586,094	3,969,068	21,295	29,094	7,859	60,012			236,955	1,262,805			379,772	
New Jersey	788,465	(b)	86,827	(b)	371,912	(b)	65,183	(b)	402,122	(b)			60,369	
New York	751,067	5,754,699	44,361	73,794	274,913	2,261,637			71,026	448,822			403,285	
Ohio	5,374,027	30,163,614	358,663	375,543	1,530,924	8,735,602	29,995	206,063	278,047	606,049			3,872,335	
Pennsylvania	5,866,841	33,041,083	446,465	639,546	255,124	1,567,856			166,364	653,453			5,876,792	

[a] Value for 1918 estimated on basis of sales.
[b] Included under "Combined States."
[c] Michigan, Missouri and Wisconsin.
[d] Includes also Maryland, Massachusetts, New Jersey.
[e] Includes also Colorado, Maryland, and New Jersey.
[f] Includes also New Jersey.
[g] Includes also Massachusetts, New Jersey, and Ohio.
[h] Includes also Coloraod, Massachuetts, and New Jersey.

TABLE 29.—*By-product coke produced and sold or used by the producer in the United States, 1918–1920*—Continued.

State.	Produced.				Sold.								Used by producer.	
	Coke.		Screenings and breeze.		Furnace.		Foundry.		Domestic and other.		Screenings and breeze.		Coke (net tons).	Screenings and breeze (net tons).
	Net tons.	Value.[a]	Net tons.	Value.[a]	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.		
1919—Contd.														
Tennessee	104,749	$842,980	3,603	$7,901	77,646	$538,835	26,303	$208,872	4,403	$13,554				
Washington	26,547	207,116	4,253	4,261			9,104	86,840	527	4,599			21,625	
West Virginia	392,812	1,750,908	34,050	19,087	87,372	475,260			2,945	12,475			335,020	
Combined States[b]	1,230,565	[c]21,983,736	81,591	[d]354,166	331,342	[e]4,941,753	350,186	[f]5,755,360	347,778	[c]5,518,872			290,548	
	25,137,621	160,244,768	1,848,547	2,450,871	4,677,497	31,028,251	1,480,516	12,865,927	2,885,270	15,607,752			17,767,066	
1920.														
Alabama	3,123,890	25,959,526	206,847	382,667	228,798	1,890,345	27,514	301,000	21,300	115,428	40,053	$74,035	2,836,509	163,116
Illinois	2,136,793	25,791,092	197,746	405,379	387,790	5,008,243	216,537	3,040,733	267,755	2,479,078	103,208	211,686	1,259,168	118,186
Indiana	4,553,697	46,994,153	326,546	568,190	180,718	2,120,703	196,208	2,667,306	385,842	3,083,628	37,100	64,520	3,840,900	292,454
Kentucky	466,985	3,614,463	42,283	27,061	364,266	2,623,676	44,098	501,462	64,278	534,466	42,283	27,265		
Maryland	682,132	3,785,833	50,360	175,756	7,437	(g)					2,520	(g)	678,989	59,255
Massachusetts	488,089	(g)	33,150	(g)			355,365	(g)	132,410	(g)	50,629	(g)		
Michigan	1,393,445	15,731,994	92,388	185,700	291,793	3,227,253	400,696	5,553,922	448,752	4,107,026	20,524	41,168	282,799	17,902
Minnesota	674,801	10,675,352	45,504	118,310	106,085	1,127,699	57,229	744,511	163,765	1,719,202	8,884	23,077	360,806	42,730
New Jersey	725,571	(g)	72,330	(g)	453,831	(g)	95,164	(g)	221,837	(g)	23,841	(g)	10,683	49,213
New York	1,040,192	12,066,227	38,980	126,685	297,628	3,471,321	8,036	99,003	90,220	1,022,880	35,102	113,999	639,445	20,613
Ohio	5,614,877	52,555,249	423,887	623,114	651,654	6,547,341	632	4,418	169,216	1,135,150	142,586	209,542	4,783,002	268,285
Pennsylvania	7,730,256	77,843,678	777,027	924,662	544,152	6,291,166			173,763	941,251	32,743	38,935	7,100,823	492,586
Tennessee	139,121	1,367,559	5,141	2,108	98,677	900,300	39,702	460,490			3,126	1,274		
Washington	26,284	273,354	6,014	19,546	1,057	10,993					85	276	23,344	5,929
West Virginia	447,392	4,608,138	7,512	15,024	36,348	397,569			9,110	70,989	100	200	344,957	37,677
Combined States[h]	1,590,426	[f]31,762,114	135,120	[f]860,616	404,730	[i]9,224,613	274,801	[f]10,305,380	213,489	[f]5,871,331	20,235	[j]443,027	687,036	124,240
	30,833,951	313,028,732	2,460,835	4,434,818	4,054,964	42,841,222	1,715,982	23,678,225	2,361,737	21,080,429	563,019	1,249,004	22,848,461	1,692,186

[a] Value for 1920 estimated on basis of sales.
[b] Missouri, Rhode Island, and Wisconsin.
[c] Includes also Colorado, Massachusetts, and New Jersey.
[d] Includes also Colorado and New Jersey.
[e] Includes also New Jersey.
[f] Includes also Massachusetts and New Jersey.
[g] Included under "Combined States."
[h] Colorado, Missouri, Rhode Island, and Wisconsin.
[i] Includes also Maryland and New Jersey.
[j] Includes also Maryland, Massachusetts, and New Jersey.

PRICES REALIZED FOR COKE.

The average price per ton realized for coke sold in 1918, 1919, and 1920 is given, by sizes, in Table 30. This table shows for each State the fluctuations from year to year and the price of the principal market sizes. It shows the widely distributed tendency toward lower prices for all sizes of coke, both beehive and by-product, after the end of the war and the marked increase in prices for all sizes in 1920. There are some examples of higher prices for certain sizes in certain States in 1919 than in 1918, and also a few examples of lower prices in 1920 than in 1919. However, these examples are decidedly the exception and are negligible in their influence on the general change in the market.

TABLE 30.—*Average price per ton realized for coke sold in the United States in 1918–1920.*

State.	Beehive.				By-product.			
	Furnace.	Foundry.	Domestic.	Average, all grades.	Furnace.	Foundry.	Domestic.	Average, all grades.
1918.								
Alabama	$6.23	$9.66	$7.39	$8.14	$6.06	$5.58	$5.02	$5.74
Colorado	7.64	7.51	2.91	7.56			7.42	7.42
Georgia		8.77		8.77				
Illinois					8.33	8.74	7.35	8.15
Indiana					9.13	9.93	6.78	8.07
Kentucky	5.95	5.31	6.21	5.97	4.22	6.87	6.72	5.13
Minnesota					6.86	9.78	8.97	8.68
New Mexico	6.25		8.00	6.25				
New York					9.16	11.19	9.63	9.28
Ohio					7.18	7.88	4.87	6.82
Pennsylvania	5.81	7.19	6.26	5.91	6.71		5.04	6.46
Tennessee	7.12	8.42		7.13	8.06	9.30	7.92	8.20
Virginia	6.15	7.61	6.77	6.52				
Washington	9.16	12.04	7.48	9.72		9.50	9.50	9.50
West Virginia	6.20	7.55	5.38	6.41	7.88		7.60	7.84
	5.93	7.53	6.27	6.21	7.42	9.72	7.45	7.42
1919.								
Alabama	6.77	8.74		7.31	5.43		3.20	4.16
Colorado	7.13	8.30		7.14				
Georgia		8.21		8.21				
Illinois					8.30	8.52	5.44	7.27
Indiana					7.44	8.73	6.60	7.42
Kentucky	6.45		5.50	6.41	4.62	6.64	3.48	4.71
Maryland					6.37		2.94	3.70
Michigan					7.47	8.74	6.63	7.48
Minnesota					7.64		5.33	5.40
New Mexico	6.56	6.21	3.18	6.46				
New York					8.23		6.32	7.83
Ohio					5.70	6.87	2.18	5.19
Pennsylvania	4.66	5.73	5.35	4.75	6.14		3.93	5.27
Tennessee	4.38	6.99		5.95	6.94	7.94	3.08	7.02
Virginia	5.88	7.04	5.60	6.05				
Washington	8.49	10.05		9.00		9.54	8.72	9.49
West Virginia	5.61	7.06	5.83	5.83	5.44		4.23	5.39
	4.94	6.20	5.39	5.05	6.63	8.69	5.41	6.58
1920.								
Alabama		10.45		10.45	8.26	10.94	5.42	8.31
Colorado	7.23	9.63	8.49	7.60			8.88	8.88
Georgia		11.94		11.94				
Illinois					12.91	14.04	9.26	12.07
Indiana					11.73	13.59	7.99	10.32
Kentucky	7.20			7.20	7.20	11.37	8.31	7.74
Maryland					5.55			5.55
Michigan					11.06	13.86	9.15	11.29
Minnesota					10.62	13.01	10.50	15.82
New Mexico	8.45	8.16		8.45				
New York					11.66	12.32	11.34	11.60
Ohio			7.90	7.90	10.05	6.99	6.71	9.36
Pennsylvania	8.32	9.16	8.14	8.79	11.56		5.42	10.07
Tennessee	7.50	9.93		9.60	9.12	11.60		9.83
Virginia	8.54	10.10		8.86				
Washington	10.58	14.72		10.69	10.40			10.40
West Virginia	8.27	10.62	6.98	8.88	10.94		7.79	10.30
	8.30	9.52	8.04	8.83	10.57	13.80	8.93	10.15

Table 31 gives for the years 1908–1920 the average price realized for each type of coke and the mean average for both types. It is evident from this table how greatly the war has affected prices; for before 1916 the change in the mean average from one year to the next was seldom more than 20 cents, but since 1916 it has ranged from almost $1 to almost $4.

TABLE 31.—*Average prices per net ton realized for beehive and by-product coke sold in the United States, 1908–1920.*

Year.	Beehive.	By-product.	Mean average.	Year.	Beehive.	By-product.	Mean average.
1908	$2.20	$3.44	$2.40	1915	$2.07	$3.45	$2.54
1909	2.10	3.27	2.29	1916	2.69	3.95	3.13
1910	2.17	3.47	2.39	1917	4.81	6.18	5.36
1911	2.05	3.48	2.37	1918	6.21	7.42	6.77
1912	2.10	3.84	2.54	1919	5.05	6.58	5.85
1913	2.39	3.82	2.78	1920	8.83	10.15	9.62
1914	2.15	3.39	2.56				

The prices of Connellsville furnace and foundry coke are more or less basic reference prices for the industry. The market figures for both spot and contract deliveries in the Connellsville territory are therefore particularly interesting. Table 32 summarizes such data for 1915–1920, giving both spot and contract market prices of furnace coke and foundry coke, as published by the Iron Age. From these quotations it is evident that annual averages should not be trusted too far in judging coke prices, for in almost every year there have been fluctuations from one month to the next greater than the changes from year to year. Such fluctuations were especially noticeable in 1920, when the extreme high level of $19 per ton for spot delivery of foundry coke was quoted. In 1920 there was probably the widest fluctuation in price, measured in percentage of the minimum, that had ever occurred in the history of the industry. The quotations for spot deliveries ranged from $6.50 to $19 for foundry coke, and from $6 to $18 for furnace coke. During 1919 the prices were of course much more stable, for they were not affected by the disturbing influence of strike conditions, which entirely upset the fuel market of 1920. In 1919 the market prices ranged from $4 to $6 for spot delivery for foundry coke, and from $3.50 to $6.50 for furnace coke.

Further information regarding the price realized for coke in earlier years can be found in the historical summary of the industry, Table 10, in which data back to 1880 are given.

Table 32.—*Prices of Connellsville furnace and foundry coke per net ton at the ovens, 1915–1920.*[a]

Month.	1915		1916		1917	
	Spot.	Contract.	Spot.	Contract.	Spot.	Contract.
Furnace.						
January	$1.50-$1.60	$1.65-$1.75	$2.75-$3.50	$2.50-$2.75	$8.50-$9.50	$6.00-$7.00
February	1.50- 1.60	1.65- 1.75	2.75- 4.00	2.50- 4.00	8.00-11.50	6.00- 7.00
March	1.50- 1.60	1.65- 1.75	3.25- 3.75	2.75- 3.00	8.00-12.00	....
April	1.50- 1.60	1.65- 1.75	2.00- 3.00	2.40- 3.00	7.00- 8.50	8.00
May	1.50- 1.60	1.65- 1.75	2.00- 3.00	2.50- 3.50	7.00- 9.00	8.00
June	1.50- 1.60	1.65- 1.75	2.30- 2.60	2.35- 2.75	10.00-13.00	9.00- 9.50
July	1.55- 1.75	1.70- 1.85	2.50- 2.75	2.35- 2.65	11.00-16.00	....
August	1.50- 1.60	1.75- 1.85	2.50- 3.00	2.35- 2.60	10.00-15.00	....
September	1.50- 1.75	1.75- 1.85	2.85- 3.10	2.50- 3.00	6.00-13.50	6.00- 9.00
October	1.75- 2.60	2.25- 2.40	3.25- 7.50	3.00- 4.00	6.00	6.00
November	2.10- 2.50	2.25- 2.50	6.50- 8.00	3.75- 4.00	6.00	6.00
December	2.10- 3.50	2.40- 2.50	7.00-10.00	4.00- 5.00	6.00	6.00
Foundry.						
January	2.00	2.15- 2.25	3.50- 3.75	3.25- 3.50	10.00	7.00- 8.00
February	2.00	2.15- 2.50	3.50- 3.75	3.25- 3.50	10.00-12.00	7.00- 9.00
March	2.00	2.15- 2.50	3.75- 4.00	3.50- 3.75	10.00-14.00	7.00- 8.00
April	2.00- 2.25	2.15- 2.30	3.00- 4.00	3.25- 3.75	8.50-10.00	9.00
May	1.90- 2.25	2.15- 2.50	2.75- 3.25	3.25- 3.50	8.50-10.00	8.50- 9.50
June	1.90- 2.25	2.15- 2.50	2.75- 3.25	3.25- 3.50	10.50-13.00	10.00-11.00
July	2.00- 2.25	2.25- 2.50	2.75- 3.25	3.00- 3.50	13.00-14.00	10.00
August	2.00- 2.25	2.25- 2.50	3.00- 3.50	3.25- 3.75	11.50-14.00	12.50
September	2.00- 2.25	2.25- 2.50	3.25- 3.50	3.50- 3.75	6.00	6.00
October	2.15- 2.75	2.40- 2.75	3.25- 6.00	3.75- 4.50	6.00	6.00
November	2.75- 3.00	2.60- 3.25	6.00- 8.00	4.00- 6.00	6.00	6.00
December	2.75- 3.50	3.00- 3.25	7.50-10.00	5.00- 7.00	7.00	7.00

Month.	1918, Government maximum.	1919		1920	
		Spot.	Contract.	Spot.	Contract.
Furnace.					
January	$6.00	$5.00-$6.00	$6.00	$6.00	$6.00
February	6.00	4.25- 5.00	6.00	6.00	6.00
March	6.00	4.00- 4.25	$4.75- 5.00	6.00	6.00
April	6.00	3.50- 4.00	4.00- 5.00	$10.00-11.00	$10.00-11.00
May	6.00	3.50- 4.00	4.00- 4.50	11.00-14.00	11.00-14.00
June	6.00	4.00	4.50- 4.75	14.00-17.00	11.50-15.00
July	6.00	3.85- 4.25	5.00	17.00-18.00	11.50
August	6.00	3.90- 4.85	5.00- 5.50	17.00-18.00	11.50-14.00
September	6.00	4.00- 4.85	5.50- 6.00	16.50-17.00	14.00
October	6.00	4.00- 5.50	6.00- 7.00	11.00-17.00	12.00-14.00
November	6.00	5.50- 6.00	7.00	7.50- 9.00	9.00-12.00
December	6.00	6.00- 6.50	7.00	5.50- 6.50	6.60
Foundry.					
January	7.00	6.00	7.00	7.00	7.00
February	7.00	6.00	7.00	7.00	7.00
March	7.00	4.25- 6.00	5.50- 7.00	7.00	7.00
April	7.00	4.00- 4.50	4.50- 5.50	11.00	11.00
May	7.00	4.00	4.50- 5.00	12.00-15.00	12.00-15.00
June	7.00	4.00	5.00	15.00-17.00	15.00-16.00
July	7.00	4.12	5.00	17.00-19.00	14.00
August	7.00	4.12	5.00- 5.50	18.00-19.00	14.00
September	7.00	4.12- 4.75	5.50- 5.75	17.50-18.00	14.00
October	7.00	4.75- 6.00	5.75- 6.50	13.00-18.00	13.00-14.00
November	7.00	6.00	6.50- 7.00	8.50-11.00	10.00-13.00
December	7.00	6.00	7.00	6.50- 7.50	8.50

[a] The Iron Age.

COAL USED IN MANUFACTURE OF COKE.

Table 3 presents data for the quantity of coal used in the production of coke by States. Table 10 shows that for many years the coke industry has been a very large consumer of coal, having used more than 50,000,000 tons each year since 1910 and reaching a maximum consumption of 85,000,000 tons in 1918. In 1919 only 65,000,000 tons was used, and in 1920 the consumption was 76,000,000 tons.

Further details of the consumption of coal in the manufacture of by-product coke during the last decade are given in Table 33, which shows the quantity of coal used for this purpose in each State and indicates particularly well how the increases in the consumption of coal have been distributed throughout the country, following closely the increases in the number of by-product ovens installed.

TABLE 33.—*Coal used in the manufacture of by-product coke in the United States, 1910–1920, in net tons.*

State.	1910	1911	1912	1913	1914	1915
Alabama	769,212	928,255	1,873,581	2,832,282	2,909,348	2,987,710
Colorado						
Illinois	1,971,386	2,087,870	2,317,307	2,481,198	1,932,132	2,335,933
Indiana	107,402	1,137,257	3,198,874	3,535,136	3,125,207	3,685,774
Kentucky				98,846	280,456	337,679
Maryland	511,622	518,738	462,998	372,005	129,891	470,326
Massachusetts	581,955	616,614	677,793	696,679	707,718	666,930
Michigan	(a)	(a)	(a)	(a)	(a)	(a)
Minnesota	(a)	(a)	(a)	(a)	(a)	180,767
Missouri						(a)
New Jersey	328,722	335,166	462,998	339,351	328,921	349,976
New York	910,293	955,067	1,095,198	1,067,207	659,418	975,656
Ohio	227,327	285,836	337,987	327,694	643,169	956,656
Pennsylvania	2,696,645	1,969,950	2,676,751	3,492,227	2,964,559	4,301,726
Tennessee						32,084
Washington					(a)	(a)
West Virginia	114,779	221,609	252,849	192,270	64,314	202,762
Wisconsin	672,707	770,839	831,984	847,469	(a)	(a)
Combined States	636,992	619,383	579,223	813,005	1,754,888	2,070,403
	9,529,042	10,446,584	14,767,543	17,095,369	15,500,021	19,554,382

State.	1916	1917	1918	1919	1920
Alabama	3,635,683	3,980,243	3,877,634	3,255,118	4,542,279
Colorado			345,877	594,943	730,870
Illinois	3,182,650	3,233,669	3,199,620	2,446,029	3,090,862
Indiana	4,626,204	4,817,942	5,318,900	5,012,542	6,355,846
Kentucky	614,922	742,162	723,113	579,770	671,866
Maryland	749,936	733,184	696,576	503,617	953,404
Massachusetts	728,256	738,873	676,866	477,782	630,365
Michigan	(a)	(a)	(a)	1,093,791	1,902,224
Minnesota	573,371	676,881	1,069,775	812,963	942,869
Missouri	(a)	(a)	(a)	(a)	(a)
New Jersey	343,513	621,699	994,300	1,132,903	1,012,562
New York	1,098,249	1,401,458	1,516,580	1,092,368	1,504,902
Ohio	2,447,812	5,141,046	7,775,623	7,785,818	8,151,987
Pennsylvania	5,650,352	5,716,221	6,514,868	8,592,133	11,325,505
Rhode Island				(a)	(a)
Tennessee	68,451	63,793	166,157	138,820	183,200
Washington	45,756	45,025	47,410	44,091	44,594
West Virginia	276,481	727,778	853,684	571,741	626,196
Wisconsin	(a)	(a)	(a)	(a)	(a)
Combined States	2,482,866	2,865,785	3,090,738	1,722,990	1,535,465
	26,524,502	31,505,759	36,867,721	35,857,419	44,204,996

a Included under "Combined States."

Table 34 shows the cost of the coal used in the manufacture of coke—not only the total cost, by States, but the average cost of coal per ton and the average cost of coal per ton of coke produced. The wide fluctuations in the quantity of coal used per ton of coke made and the corresponding fluctuations in the cost of coal per ton of coke are due largely to the fact that the proportion of beehive and by-product coke in the several States is very different. In States where the output is principally by-product coke the yield per ton of coal is of course greater and the quantity of coal required per ton of coke is less. For these reasons it is not proper to make a comparison between the several States, or even between one year and another, without due consideration of the relative quantity of beehive and of by-product coke produced.

In comparing the cost of coal per ton of coke with the average price realized for the coke in 1918, 1919, and 1920, it is seen that the fluctuation in the two items, although not proportionate, is in the same direction from one year to the next. However, it is a rather striking fact that an average of only 6 cents less was paid for coal to produce a ton of coke in 1919 than in 1918, but that the price realized for the coke was 92 cents a ton less. Furthermore, of the increase in price for coke from 1918 to 1920, namely, $2.85, over two-thirds ($1.85) went to pay the increase in the cost of the coal used. The percentage of the price realized for a ton of coke that was used in paying for the coal to make it was as follows: In 1918, 70 per cent; 1919, 80 per cent; 1920, 68 per cent.

TABLE 34.—*Coal used in the manufacture of coke in the United States in 1918–1920.*

State.	Coal used (net tons).	Cost.		Coal per ton of coke.	
		Total.	Per ton.	Net tons.	Cost.
1918.					
Alabama	6,827,626	$20,947,917	$3.07	1.569	$4.82
Colorado	1,562,031	5,264,314	3.37	1.579	5.32
Georgia	38,280	133,498	3.49	1.736	6.06
Illinois	3,199,620	14,800,703	4.63	1.400	6.48
Indiana	5,318,900	23,953,483	4.50	1.364	6.14
Kentucky	1,256,459	3,973,203	3.16	1.535	4.85
Maryland	696,576	3,891,990	5.59	1.468	8.21
Minnesota	1,069,775	5,680,317	5.31	1.364	7.24
New Mexico	1,047,675	1,998,513	1.91	1.755	3.35
New York	1,516,580	6,764,085	4.46	1.418	6.32
Ohio	7,998,823	31,881,303	3.99	1.491	5.95
Pennsylvania	40,573,894	99,520,344	2.45	1.518	3.72
Tennessee	731,077	2,025,298	2.77	1.712	4.74
Virginia	2,042,429	4,978,692	2.44	1.655	4.04
Washington	201,870	1,122,692	5.56	1.631	9.07
West Virginia	5,369,792	13,410,043	2.50	1.617	4.04
Combined States:					
Oklahoma and Utah	814,707	2,080,726	2.55	1.766	4.50
Massachusetts, Michigan, Missouri, New Jersey, and Wisconsin	4,761,904	24,884,694	5.23	1.348	7.05
	85,028,018	267,311,815	3.14	1.505	4.73
1919.					
Alabama	5,170,878	$16,123,119	$3.12	1.529	$4.77
Colorado	895,862	3,900,561	4.35	1.459	6.35
Georgia	33,030	123,274	3.73	1.820	6.79
Illinois	2,446,029	11,579,341	4.73	1.436	6.79
Indiana	5,012,542	23,193,694	4.63	1.354	6.27
Kentucky	1,052,974	3,091,860	2.94	1.522	4.48
Maryland	503,617	2,500,898	4.96	1.414	7.01
Michigan	1,093,791	5,029,404	4.60	1.352	6.22
Minnesota	812,963	3,523,826	4.33	1.387	6.01
New Mexico	476,566	1,221,491	2.56	1.832	4.69

TABLE 34.—*Coal used in the manufacture of coke in the United States in 1918–1920*—Con.

State.	Coal used (net tons).	Cost.		Coal per ton of coke.	
		Total.	Per ton.	Net tons.	Cost.
1919—Continued.					
New York	1,092,368	$4,738,860	$4.34	1.454	$6.31
Ohio	7,952,842	30,414,726	3.82	1.451	5.54
Pennsylvania	30,957,032	71,307,107	2.30	1.510	3.47
Tennessee	428,051	1,369,941	3.20	1.640	5.25
Virginia	1,495,214	3,670,592	2.45	1.607	3.94
Washington	98,891	507,805	5.13	1.581	8.11
West Virginia	2,296,454	5,524,444	2.41	1.624	3.91
Combined States:					
Oklahoma and Utah	435,139	1,164,149	2.68	1.785	4.78
Massachusetts, Missouri, New Jersey, Rhode Island, and Wisconsin	3,333,675	17,299,424	5.19	1.382	7.17
	65,587,918	206,284,516	3.14	1.485	4.66
1920.					
Alabama	6,031,034	$23,903,853	$3.96	1.502	$5.95
Colorado	1,153,114	5,880,554	5.09	1.460	7.45
Georgia	29,804	152,648	5.12	1.803	9.23
Illinois	3,090,862	20,064,551	6.49	1.446	9.38
Indiana	6,355,846	37,633,801	5.92	1.395	8.26
Kentucky	1,119,284	4,660,248	4.16	1.513	6.29
Maryland	953,404	6,013,632	6.31	1.397	8.82
Michigan	1,902,224	13,363,816	7.03	1.365	9.60
Minnesota	942,869	6,135,070	6.50	1.397	9.08
New York	1,504,902	9,328,079	6.20	1.446	8.97
Ohio	8,291,131	47,625,210	5.74	1.454	8.35
Pennsylvania	35,669,662	119,312,015	3.34	1.508	5.04
Tennessee	493,783	1,730,133	3.50	1.636	5.73
Virginia	1,645,253	5,437,447	3.30	1.600	5.28
Washington	92,470	581,375	6.28	1.556	9.77
West Virginia	2,909,933	10,076,932	3.46	1.591	5.50
Combined States:					
New Mexico and Utah	826,865	2,392,187	2.89	1.800	5.20
Massachusetts, Missouri, New Jersey, Rhode Island, and Wisconsin	3,178,392	24,688,085	7.77	1.389	10.79
	76,190,832	338,979,636	4.44	1.483	6.58

The character of the coal used in the production of coke is shown in Table 35. For 1918 and 1919 the coal used for both beehive and by-product operations is reported together, by States, showing run of mine and slack, unwashed and washed coal, separately. For 1920 the corresponding classes of coal used at the by-product ovens and beehive ovens are separately recorded. From these tables it will be seen that the percentage of unwashed coal treated in coke ovens was substantially the same throughout the three-year period, namely, about 82 per cent of the total. The washed coal used formed nearly the same percentage of the total for beehive and by-product operations, as shown by the figures for 1920. The slack coal used has continued to be about the same percentage of the total each year, and the run of mine coal has very greatly exceeded the slack. Prepared sizes of coal have been used at one or two plants instead of run of mine, but the small quantity of such coal has been included with the run of mine. It appears that this use is a matter of convenience in the purchase of prepared sizes from dealers who prefer to size all the coal that they ship.

TABLE 35.—*Coal used in the manufacture of coke in the United States in 1918–1920, by kinds, in net tons.*

1918.

State.	Run of mine.		Slack.		Total.			
					Unwashed.		Washed.	
	Unwashed.	Washed.	Unwashed.	Washed.	Tons.	Per cent.	Tons.	Per cent.
Alabama	431,444	4,478,461	....	1,917,721	431,444	6.3	6,396,182	93.7
Colorado	51,365	1,240,081	....	270,585	51,365	3.3	1,510,666	96.7
Georgia	....	....	....	38,280	....	......	38,280	100.0
Illinois	3,077,518	19,400	102,702	....	3,180,220	99.4	19,400	.6
Indiana	5,318,900	....	....	....	5,318,900	100.0	....	......
Kentucky	880,324	....	308,285	67,850	1,188,609	94.6	67,850	5.4
Maryland	696,576	....	....	....	696,576	100.0	....	......
Massachusetts	676,866	....	....	....	676,866	100.0	....	......
Minnesota	851,090	....	218,685	....	1,069,775	100.0	....	......
New Jersey	994,300	....	....	....	994,300	100.0	....	......
New Mexico	....	....	394,964	652,711	394,964	37.7	652,711	62.3
New York	1,248,417	179,767	19,177	69,219	1,267,594	83.6	248,986	16.4
Ohio	7,569,702	....	336,331	92,790	7,906,033	98.8	92,790	1.2
Pennsylvania	34,719,458	2,129,747	1,141,547	2,583,142	35,861,005	88.4	4,712,889	11.6
Tennessee	26,070	141,814	54,489	508,704	80,559	11.0	650,518	89.0
Virginia	884,174	....	672,470	485,785	1,556,644	76.2	485,785	23.8
Washington	....	154,460	....	47,410	....	......	201,870	100.0
West Virginia	2,869,518	233,993	2,074,406	191,875	4,943,924	92.1	425,868	7.9
Combined States[a]	3,000,389	....	829,800	75,256	3,830,189	98.1	75,256	1.9
	63,296,111	8,577,723	6,152,856	7,001,328	69,448,967	81.7	15,579,051	18.3

1919.

State.	Run of mine: Unwashed.	Run of mine: Washed.	Slack: Unwashed.	Slack: Washed.	Total unwashed: Tons.	Per cent.	Total washed: Tons.	Per cent.
Alabama	123,986	1,545,095	113,230	3,388,567	237,216	4.6	4,933,662	95.4
Colorado	5,471	156,267	....	734,124	5,471	.6	890,391	99.4
Georgia	....	....	....	33,030	....	......	33,030	100.0
Illinois	2,227,826	135,524	82,679	....	2,310,505	94.4	135,524	5.6
Indiana	5,012,542	....	....	....	5,012,542	100.0	....	......
Kentucky	579,770	446,438	....	26,766	579,770	55.1	473,204	44.9
Maryland	503,617	....	....	....	503,617	100.0	....	......
Massachusetts	477,782	....	....	....	477,782	100.0	....	......
Michigan	1,047,763	....	46,028	....	1,093,791	100.0	....	......
Minnesota	688,347	....	124,616	....	812,963	100.0	....	......
New Jersey	1,132,903	....	....	....	1,132,903	100.0	....	......
New Mexico	....	....	258,716	217,850	258,716	54.3	217,850	45.7
New York	916,841	138,623	11,323	25,581	928,164	85.0	164,204	15.0
Ohio	7,580,547	372,295	....	....	7,580,547	95.3	372,295	4.7
Pennsylvania	27,172,342	2,577,741	236,649	970,300	27,408,991	88.5	3,548,041	11.5
Tennessee	16,628	120,741	16,019	274,663	32,647	7.6	395,404	92.4
Virginia	631,602	....	702,493	161,119	1,334,095	89.2	161,119	10.8
Washington	44,091	37,258	....	17,542	44,091	44.6	54,800	55.4
West Virginia	1,061,414	62,261	1,016,360	156,419	2,077,774	90.4	218,680	9.6
Combined States:								
Oklahoma and Utah	12,483	....	422,656	....	435,139	100.0	....	......
Missouri, Rhode Island, and Wisconsin	1,722,990	....	....	....	1,722,990	100.0	....	......
	50,958,945	5,592,243	3,030,769	6,005,961	53,989,714	82.3	11,598,204	17.7

1920.

State.	Run of mine: Unwashed.	Run of mine: Washed.	Slack: Unwashed.	Slack: Washed.	Total unwashed: Tons.	Per cent.	Total washed: Tons.	Per cent.
By-product coke.								
Alabama	172,756	1,489,861	29,223	2,850,439	201,979	4.5	4,340,300	95.5
Colorado	....	....	....	730,870	....	......	730,870	100.0
Illinois	2,839,296	251,566	....	....	2,839,296	91.9	251,566	8.1
Indiana	5,625,309	366,696	363,841	....	5,989,150	94.2	366,696	5.8
Kentucky	671,866	....	....	....	671,866	100.0	....	......
Maryland	953,404	....	....	....	953,404	100.0	....	......
Massachusetts	630,365	....	....	....	630,365	100.0	....	......
Michigan	1,902,224	....	....	....	1,902,224	100.0	....	......
Minnesota	748,615	....	194,254	....	942,869	100.0	....	......

[a] Michigan, Missouri, Oklahoma, Utah, and Wisconsin.

TABLE 35.—*Coal used in the manufacture of coke in the United States in 1918–1920, by kinds, in net tons*—Continued.

1920—Continued.

State.	Run of mine.		Slack.		Total.			
					Unwashed.		Washed.	
	Unwashed.	Washed.	Unwashed.	Washed.	Tons.	Per cent.	Tons.	Per cent.
By-product coke—Continued.								
New Jersey	1,012,562				1,012,562	100.0		
New York	1,240,872	218,350	4,568	41,112	1,245,440	82.8	259,462	17.2
Ohio	7,803,325		348,662		8,151,987	100.0		
Pennsylvania	10,003,902	1,256,656	64,947		10,068,849	88.9	1,256,656	11.1
Tennessee				183,200			183,200	100.0
Washington				44,594			44,594	100.0
West Virginia	518,713			107,483	518,713	82.8	107,483	17.2
Combined States [b]	1,535,465				1,535,465	100.0		
	[c]35,658,674	3,583,129	1,005,495	3,957,698	36,664,169	82.9	7,540,827	17.1
Beehive coke.								
Alabama	162,914	1,179,649	3,200	142,992	166,114	11.2	1,322,641	88.8
Colorado	11,766	410,478			11,766	2.9	410,478	97.1
Georgia				29,804			29,804	100.0
Kentucky	447,418				447,418	100.0		
Ohio	138,377		767		139,144	100.0		
Pennsylvania	20,348,879	2,048,609	645,671	1,300,998	20,994,550	86.0	3,349,607	14.0
Tennessee	5,721	118,131		186,731	5,721	1.9	304,862	98.1
Virginia	702,784		860,930	81,539	1,563,714	95.0	81,539	5.0
Washington	29,631	18,245			29,631	61.9	18,245	38.1
West Virginia	1,008,583		1,153,716	121,438	2,162,299	94.7	121,438	5.3
Combined States [d]			582,615	244,250	582,615	70.5	244,250	29.5
	[e]22,856,073	3,775,112	3,246,899	2,107,752	26,102,972	81.6	5,882,864	18.4

[b] Missouri, Rhode Island, and Wisconsin.
[c] Includes 917,637 tons of prepared sizes.
[d] New Mexico and Utah.
[e] Includes 296,345 tons of prepared sizes.

YIELD OF COKE.

The average percentage yield of coke from coal in beehive and by-product ovens from 1914 to 1920 is given in Table 36. This table shows that the slightly lower yield of coke in the beehive industry during the war years, 1917 and 1918, has been offset by an increase to a 64.1 per cent yield in both 1919 and 1920, but that the average thus attained is still below the average for each of the three years 1914 to 1916. The yield of by-product coke still continued markedly higher than that of beehive coke, although during the seven years represented in the table there has been a continual decrease in the yield from by-product ovens. Thus in 1914 the yield was 72.4 per cent, excluding breeze and screenings; in 1919 it was 70.1 per cent; and in 1920 it was 69.9 per cent. It does not appear, however, that this decrease in yield is at all the result of decreased efficiency in oven operation; it probably results almost altogether from a change in the choice of the coal used for the manufacture of by-product coke. For several years there has been a distinct tendency toward the use of smaller sizes of coke in the blast-furnace industry. This tendency has been encouraged greatly by the coke producer, for it enables him to use higher-volatile coal with correspondingly higher yields of by-products, and, furthermore, it permits operation of the ovens in shorter coking periods. The high-volatile coals, which give a maximum yield of by-products, naturally produce a smaller percentage of their weight in coke.

TABLE 36.—*Percentage yield of coke from coal in beehive and by-product ovens in the United States, 1914–1920.*[a]

State.	1914		1915		1916		1917	
	Beehive.	By-product.	Beehive.	By-product.	Beehive.	By-product.	Beehive.	By-product.
Alabama	59.5	69.8	58.6	69.3	57.9	67.9	58.9	68.9
Colorado	63.5	....	65.4	....	62.9	....	62.3	....
Georgia	54.1	....	56.6	....	54.1	....	54.5	....
Illinois	....	73.8	....	72.2	....	72.9	....	70.8
Indiana	....	72.8	....	75.1	....	75.4	....	73.5
Kentucky	63.0	70.2	61.6	71.5	61.4	71.6	55.3	71.6
Maryland	....	67.6	....	66.7	....	65.3	....	70.8
Massachusetts	....	76.4	....	75.6	....	77.3	....	80.5
Michigan	....	74.1	....	72.0	....	71.9	....	72.7
Minnesota	....	68.4	....	70.7	....	75.2	....	72.4
Missouri	....	....	....	77.0	....	76.9	....	76.9
New Jersey	....	77.6	....	77.0	....	61.4	....	68.1
New Mexico	54.9	....	53.1	....	59.6	....	61.7	....
New York	....	69.3	....	70.2	....	70.6	....	70.9
Ohio	66.6	70.6	66.3	69.6	66.3	69.4	65.7	69.0
Oklahoma	....	....	....	....	....	....	....	....
Pennsylvania	66.2	73.7	66.3	71.9	65.8	72.9	65.1	71.6
Rhode Island	....	....	....	....	....	....	....	....
Tennessee	54.2	....	53.9	72.5	54.5	76.7	54.0	55.3
Utah	55.9	....	57.3	....	55.0	....	55.9	....
Virginia	59.2	....	63.3	....	62.8	....	62.3	....
Washington	63.4	66.9	65.4	70.0	62.1	59.5	60.1	58.5
West Virginia	61.4	72.0	60.4	69.6	61.3	70.0	59.7	70.2
Wisconsin	....	70.8	....	70.3	....	70.5	....	72.9
Average	64.6	72.4	65.1	72.0	64.4	71.9	63.5	71.2

State.	1918		1919		1920	
	Beehive.	By-product.	Beehive.	By-product.	Beehive.	By-product.
Alabama	58.2	67.9	60.0	68.5	59.8	68.8
Colorado	62.4	69.5	65.1	69.4	64.6	70.7
Georgia	57.6	....	54.9	....	55.4	....
Illinois	....	71.4	....	70.0	....	69.1
Indiana	....	73.3	....	73.9	....	71.6
Kentucky	56.4	73.9	60.0	70.4	60.9	69.5
Maryland	....	74.8	....	70.7	....	71.5
Massachusetts	....	82.2	....	82.3	....	77.4
Michigan	....	75.9	....	73.9	....	73.2
Minnesota	....	73.3	....	72.1	....	71.6
Missouri	....	75.2	....	75.2	....	72.0
New Jersey	....	68.6	....	69.6	....	71.7
New Mexico	57.0	....	54.6	....	54.4	....
New York	....	70.5	....	68.8	....	69.1
Ohio	62.2	67.2	64.4	69.0	62.5	68.9
Oklahoma	58.2	....	57.7	....	....	....
Pennsylvania	65.0	70.4	65.4	68.3	65.3	68.3
Rhode Island	....	....	....	73.3	....	66.3
Tennessee	53.6	74.9	54.0	75.4	52.3	75.9
Utah	56.3	....	55.9	....	56.8	....
Virginia	60.4	....	62.2	....	62.5	....
Washington	60.6	74.8	65.7	60.2	69.2	58.9
West Virginia	60.2	70.7	59.2	68.7	60.4	71.4
Wisconsin	....	73.4	....	70.1	....	70.0
Average	63.3	70.5	64.1	70.1	64.1	69.9

[a] Screenings and breeze excluded in calculating the yield.

RECOVERY AND VALUE OF COKE BREEZE.

The quantity and value of coke breeze recovered at beehive plants in 1919 and 1920 are shown in Table 37. Table 38 gives corresponding figures for 1916–1920 for the by-product breeze. These tables show a remarkable range in value of this fine coke. Apparently an average of 43 cents a ton was realized for the breeze from by-product plants in Kentucky, and of more than $6.50 a ton for the breeze from beehive plants in West Virginia. This wide range shows clearly that local conditions at the plants that happened to recover breeze and sell it separately are much more a factor in determining its value than the real worth of the material. The figures in the two tables are useful in presenting in a general way, by States, the quantity of the fine coke and the income from it. However, only the totals for the country as a whole are really significant with respect to the value per ton. These totals show that there has not been much increase in value per ton of coke breeze during the few years for which figures are available. The usual practice at by-product plants is to burn the breeze under boilers or in auxiliary equipment, so that it will not accumulate about the plant; and as a matter of fact, if the equipment is properly planned for that purpose, the material is worth more to the producer than he can get for it under any ordinary market conditions. It finds a limited market and returns a poor price to the producer, but it does replace fairly well in the plant the good grades of fuel, such as steam coal. It seems likely that this tendency to use it as a substitute for fuel that would otherwise have to be purchased is on the increase throughout the industry.

TABLE 37.—*Coke breeze recovered at beehive plants in the United States, 1919–20.*

State.	1919		1920	
	Net tons.	Value.	Net tons.	Value.
Alabama			689	$2,756
Colorado	688	$463	1,523	4,219
New Mexico	7,528	14,006	(a)	(a)
Ohio			3,000	(a)
Oklahoma	(a)	(a)		
Pennsylvania	49,533	68,722	193,563	448,606
Tennessee			2,536	11,919
Utah			(a)	(a)
Virginia	3,391	18,983	3,387	22,659
West Virginia	161	1,050	4,276	37,280
Combined States	2,564	6,298	37,003	176,457
	63,865	109,522	245,977	703,896

[a] Included under "Combined States."

TABLE 38.—*Coke breeze recovered at by-product plants in the United States, 1916–1920.*

State.	1916		1917		1918	1919		1920	
	Net tons	Value.	Net tons	Value.	Net tons	Net tons	Value.	Net tons.	Value.
Alabama	118,541	$213,022	141,051	$290,317	217,349	174,015	$221,793	206,847	$382,667
Colorado	....	....	....	....	9,701	37,945	(a)	42,313	(a)
Illinois	162,585	329,294	201,478	295,139	187,698	172,034	307,754	197,746	405,379
Indiana	177,405	504,624	207,253	303,082	290,175	249,449	235,438	326,546	568,190
Kentucky	15,573	(a)	17,797	(a)	16,320	38,876	16,751	42,283	27,061
Maryland	42,221	(a)	21,448	(a)	46,336	20,592	60,540	50,360	175,756
Massachusetts	....	....	....	....	....	....	....	33,150	(a)
Michigan	(a)	(a)	(a)	(a)	(a)	74,528	105,203	92,388	185,700
Minnesota	6,629	(a)	24,563	(a)	38,054	21,295	29,094	45,504	118,310
Missouri	....	....	....	....	(a)	(a)	(a)	(a)	(a)
New Jersey	53,730	(a)	50,462	(a)	74,725	86,827	(a)	72,330	(a)
New York	32,023	29,867	70,484	71,319	53,362	44,361	73,794	38,980	126,685
Ohio	94,672	48,727	272,310	450,741	505,438	358,663	375,543	423,887	623,114
Pennsylvania	181,371	188,132	299,643	392,505	327,177	446,465	639,546	777,027	924,662
Rhode Island	....	....	....	....	....	(a)	(a)	(a)	(a)
Tennessee	....	....	15,106	(a)	....	3,603	7,901	5,141	2,108
Washington	3,411	(a)	3,339	(a)	5,314	4,253	4,261	6,014	19,546
West Virginia	8,294	(a)	9,947	(a)	36,179	34,050	19,087	7,512	15,024
Wisconsin	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Combined States	134,375	386,390	160,664	545,100	191,542	81,591	354,166	92,807	860,616
	1,030,830	1,700,056	1,495,545	2,348,203	1,999,370	1,848,547	2,450,871	2,460,835	4,434,818

[a] Included under "Combined States."

IMPORTS AND EXPORTS OF COKE.

Foreign trade in coke is not of great interest to the United States, as at no time has either export or import of this commodity been any large factor in our domestic business.

The recent exports of coke from the United States are shown in Tables 39 to 42, by years, by customs districts, by countries of destination, and by months. Similar data for the imports of coke during recent years are given in Tables 43 to 45, by customs districts, by countries of origin, and by years. It appears from these tables that the quantity of coke leaving the United States has again become about as great as during the pre-war years, namely, slightly less than 1,000,000 net tons a year. The imports, practically all of which come from Canada, are negligible, amounting, as in previous years, to less than 50,000 tons a year.

TABLE 39.—*Coke exported from the United States, 1909–1920.*

Year.	Net tons.	Value.	Year.	Net tons.	Value.
1909	1,002,916	$3,232,673	1915	895,509	$3,092,498
1910	984,618	3,053,293	1916	1,174,645	4,202,236
1911	1,023,727	3,215,990	1917	1,409,320	8,543,746
1912	912,576	3,002,742	1918	1,687,824	11,861,408
1913	987,395	3,309,930	1919	716,956	5,128,119
1914	663,585	2,233,686	1920	919,802	9,993,665

TABLE 40.—*Coke exported from the United States, 1916–1920, by customs districts.*

District.	1916		1917		1918	
	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.
Alaska			3	$60		
Arizona	166,886	$584,886	148,041	704,714	194,401	$1,316,020
Buffalo	502,862	1,273,137	417,807	2,094,284	579,372	3,338,648
Dakota	7,711	30,137	6,446	49,295	2,635	23,280
Duluth-Superior	1,654	6,528	1,446	12,919	617	5,406
Eagle Pass	4,247	14,845	3,693	15,096		
El Paso	6,199	38,292	4,362	23,530	41,763	288,590
Florida	99	438	105	1,291	5,406	38,715
Laredo	17,484	60,490	85,781	622,243		
Maine and New Hampshire	15	73	1,027	10,512	1,680	19,131
Maryland	105,811	557,743	125,225	1,317,819	92,188	728,760
Michigan	124,348	522,962	233,465	1,629,990	376,033	3,292,752
Mobile					30	640
New Orleans	1,378	8,637	1,403	22,570	1,512	35,477
New York	21,137	147,011	24,518	282,305	13,719	183,548
Ohio	49,232	110,727	223,266	763,996	178,264	970,160
Philadelphia	20,293	104,236	5,000	56,985	4,380	44,697
Porto Rico			6	152	6	166
Rochester	8,296	23,814	11,245	42,427	6,287	53,238
Sabine	11	114	28	382	21	324
San Antonio					122,289	1,011,297
San Diego						
San Francisco	7,679	96,759	10,307	123,296	148	4,184
St. Lawrence	24,810	104,531	44,634	313,311	37,794	223,173
South Carolina	5,426	26,183				
Southern California	609	2,575	249	5,613		
Vermont	411	1,431	9,785	64,369	5,089	53,185
Virginia	44,657	222,808	18,915	197,682	8,401	91,743
Washington	53,390	263,879	32,563	188,905	15,789	138,274
	1,174,645	4,202,236	1,409,320	8,543,746	1,687,824	11,861,408

District.	1919		1920	
	Net tons.	Value.	Net tons.	Value.
Alaska				
Arizona	134,816	$948,519	95,991	$765,120
Buffalo	214,863	1,422,309	312,359	3,080,027
Dakota	5,478	35,784	4,726	63,140
Duluth-Superior	744	6,431	4,980	56,638
Eagle Pass				
El Paso	40,467	263,517	68,496	403,950
Florida			4,501	79,942
Laredo				
Maine and New Hampshire	1,152	8,454	1,602	24,737
Maryland	75,124	552,432	78,889	842,558
Michigan	103,909	820,812	224,623	2,801,026
Mobile	1,410	11,500	239	5,538
New Orleans	811	15,002	786	19,278
New York	16,140	185,966	38,884	702,379
Ohio	23,671	131,562	18,450	178,178
Philadelphia	16,618	145,127	28,139	522,312
Porto Rico	22	492	66	1,294
Rochester	3,896	32,649	3,603	45,605
Sabine	94	1,182	381	5,602
San Antonio	23,192	178,237	4,294	75,677
San Diego			4	70
San Francisco	1,400	23,104	1,562	22,958
St. Lawrence	42,520	231,461	19,573	166,994
South Carolina			38	348
Southern California				
Vermont	1,402	9,252	2,691	33,353
Virginia	7,624	87,827	3,386	78,732
Washington	1,603	16,500	1,539	18,209
	716,956	5,128,119	919,802	9,993,665

TABLE 41.—*Coke exported from the United States in 1916–1920, by countries of destination.*

Country.	1916		1917		1918		1919		1920	
	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.
Austria-Hungary							557	$4,765		
Argentina	7,230	$41,619	2,690	$39,701	4,585	$57,646	1,245	13,571	4,943	$110,935
Azores and Madeira Islands			280	6,194						
Barbados	353	1,966								
Belgium									16,323	307,826
Bermuda	1	10	7	49	112	2,800	6	114	9	153
Bolivia			827	5,899						
Brazil	2,398	22,312	1,393	23,429	1,519	10,969	1,381	15,714	2,479	48,363
British Guiana			11	282						
British Honduras	31	123	6	126	4	90	7	161	6	137
British South Africa			2	44	17	420	26	480		
British West Africa									134	4,240
Bulgaria									622	18,315
Canada	772,523	2,336,182	981,671	5,170,002	1,200,002	8,085,424	399,093	2,713,584	594,143	6,467,875
Chile	85,445	413,370	91,274	853,837	78,309	602,913	42,352	291,689	56,785	574,234
China							34	330		
Colombia	82	645	64	1,638	74	1,570	39	898	133	3,386
Costa Rica	93	831	1,158	4,131	50	1,400	67	1,797	91	2,316
Cuba	12,450	57,198	8,761	85,106	14,162	147,522	6,877	80,241	6,880	132,232
Denmark									7,820	141,670
Dominican Republic	57	603	38	725	105	1,637	86	1,668	276	6,623
Dutch East Indies	908	6,472	263	5,859			112	2,632	473	10,003
Dutch West Indies	3	28								
Ecuador	58	547	87	1,264	111	1,925	72	1,473	108	2,737
Egypt									56	1,250
England	8,695	50,258	3,395	29,888	33	371			312	5,700
Falkland Islands							175	1,716		
Finland									5,659	107,393
France	8,242	47,021	10,403	80,028	7,997	79,940	5,366	71,452	15,346	252,608
French West Indies	56	431	215	3,701	214	4,955	60	1,720	32	866
Greece	2,752	16,498	373	4,995			523	4,670	392	7,450
Guatemala	186	1,070	78	1,161	48	1,102	62	1,504	56	1,401
Haiti					6	135	2	25		
Honduras	14	90	25	280	16	315	45	657	43	798
Italy	27,748	132,585	5,796	68,215	881	15,850	10,163	77,059	840	14,400
Jamaica	85	631	1	30	2	38	62	1,210		
Other British West Indies					4	106			3	70
Mexico	205,383	808,772	255,982	1,541,753	359,744	2,648,599	200,812	1,423,949	171,161	1,281,857
Netherlands							12,475	103,347	2,635	65,770
Nicaragua	11	119	6	135	11	275	18	484	12	300

TABLE 41.—*Coke exported from the United States in 1916–1920, by countries of destination*—Continued.

Country.	1916		1917		1918		1919		1920	
	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.
Norway	1,515	$12,184	2,336	$20,755			366	$6,216	1,988	$31,870
Panama	711	4,911	2,000	33,317	848	$22,318	334	4,871	249	4,653
Paraguay							4	115		
Peru	25,049	179,711	33,854	501,483	18,646	165,830	22,981	195,002	15,303	164,665
Philippine Islands			163	6,522	78	2,290	222	5,433		
Poland and Danzig									560	15,000
Portugal	1	6	1	27			92	1,468	200	5,728
Portuguese-Africa									12	245
Rumania									6,535	53,869
Russia in Asia	67	494								
Russia in Europe	22	160							560	14,000
Salvador	151	1,537	71	869	117	3,059	78	1,777	30	835
Scotland									376	5,800
Spain	7,158	35,826	5,784	48,393					515	10,481
Sweden							1,804	14,499	3,743	68,500
Switzerland	1,128	6,548					7,517	52,452	1,250	29,735
Trinidad and Tobago	18	128	53	985			13	155	28	560
Turkey in Europe									459	10,429
Uruguay	499	2,809	25	520	84	756	20	140	71	1,890
Venezuela	3,519	18,504	220	2,238	37	922	1,802	28,978	130	3,986
Virgin Islands of the United States[a]	3	37	7	165	8	231	6	103	21	511
	1,174,645	4,202,236	1,409,320	8,543,746	1,687,824	11,861,408	716,956	5,128,119	919,802	9,993,665

[a] Danish West Indies prior to Mar. 31, 1917.

TABLE 42.—*Coke exported from the United States, 1916–1920, by months, in net tons.*

Month.	1916	1917	1918	1919	1920	
					Quantity.	Value.
January	101,797	93,714	94,910	75,629	64,989	$513,240
February	98,689	88,591	93,809	54,663	67,050	518,432
March	105,257	145,688	158,158	37,799	62,087	510,577
April	93,686	89,330	157,923	50,269	59,027	551,983
May	102,085	150,181	164,349	37,295	47,126	472,009
June	100,615	171,302	158,137	63,317	62,071	637,217
July	64,262	58,985	162,949	42,227	89,726	937,896
August	90,669	120,934	147,561	69,120	79,891	944,941
September	107,039	98,641	148,459	71,424	90,022	1,133,930
October	93,508	127,696	133,052	91,797	115,755	1,552,158
November	103,102	79,697	164,245	74,898	95,696	1,215,444
December	113,936	184,561	104,272	48,518	86,362	1,005,838
	1,174,645	1,409,320	1,687,824	716,956	919,802	9,993,665

TABLE 43.—*Coke imported into the United States in 1916–1920, by customs districts.*

District.	1916		1917		1918	
	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.
Arizona			65	$309	272	$1,280
Buffalo	7,739	$34,478	6,720	41,065	9,218	67,355
Eagle Pass	1,053	2,855				
Maine and New Hampshire	215	853	394	2,352	575	4,513
Michigan	45	114	3,483	15,575		
Montana and Idaho	38,471	176,276	a 14,117	a 86,788	19,119	141,105
New York			6	99		
Oregon	28	100				
St. Lawrence			3	39	225	2,830
San Francisco	7,317	34,591				
Vermont	87	247	84	224	692	4,494
Washington					67	303
	54,955	249,514	24,872	146,451	30,168	221,880

District.	1919		1920	
	Net tons.	Value.	Net tons.	Value.
Alaska			86	$1,301
Arizona				
Buffalo	5,191	$46,018	1,713	23,355
Hawaii			268	3,908
Chicago				5
Maine and New Hampshire	362	1,967	280	2,125
Michigan	133	1,328	1,893	18,799
Montana and Idaho	10,674	90,683	36,636	352,056
New York		5		
San Francisco	2	23		
Vermont	94	466	142	739
Washington	30	163	125	887
	16,486	140,653	41,143	403,175

a Montana only.

TABLE 44.—*Coke imported into the United States in 1917–1920, by countries of origin.*

Country.	1917		1918		1919		1920	
	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.	Net tons.	Value.
Canada	24,801	$146,043	29,894	$220,520	16,484	$140,625	40,874	$399,256
Mexico	65	309	272	1,280				
England	6	99						2
Japan			2	80			1	6
Australia					2	23	268	3,911
China						5		
	24,872	146,451	30,168	221,880	16,486	140,653	41,143	403,175

TABLE 45.—*Coke imported and entered for consumption in the United States, 1908–1920.*

Year.	Net tons.	Value.	Year.	Net tons.	Value.
1908	147,427	$606,294	1915	53,222	$222,382
1909	191,253	736,120	1916	54,955	249,514
1910	172,716	625,130	1917	24,872	146,451
1911	77,923	254,455	1918	30,168	221,880
1912	123,614	488,398	1919	16,486	140,653
1913	101,212	435,157	1920	41,143	403,175
1914	133,226	551,104			

WORLD'S PRODUCTION OF COKE.

The coke industry is a handmaid of the manufacture of pig iron, and coke is made in most countries that produce iron. Table 46, prepared by W. I. Whiteside, of the United States Geological Survey, presents the available statistics of production. In its preparation trade sources have been consulted where official publications were not to be had.

The world's production of coke in beehive and by-product ovens was about 108,700,000 metric tons in 1913 and about 92,000,000 metric tons in 1920.

TABLE 46.—*Coke produced in the principal countries of the world, 1913–1920.*

[In metric tons of 2,204.6 pounds. Gas-house coke is not included.]

Country.	1913	1914	1915	1916
Australia (New South Wales)	303,405	309,692	424,458	444,610
Austria	2,598,782	2,201,985	1,907,619	2,584,674
Belgium	3,523,000	2,001,670	514,600	792,350
British India	(a)	(a)	(a)	442,961
Canada	1,388,438	928,825	1,061,830	1,333,320
China	(a)	(a)	(a)	(a)
Czechoslovakia	(b)	(b)	(b)	(b)
France	4,027,424	2,275,074	833,808	1,411,701
Germany [c]	[d] 35,065,847	[d] 29,038,170	[d] 27,677,183	[d] 34,643,123
Hungary	160,073	128,118	95,119	(a)
Italy	498,442	453,043	448,720	515,561
Japan (natural coke)	129,101	108,391	98,275	119,166
Netherlands				
Rhodesia (southern)	20,137	18,935	27,384	53,972
Russia (Donetz basin)	4,437,000	4,552,000	4,174,000	4,423,000
Spain	595,677	597,315	623,353	759,754
Union of South Africa	8,478	5,890	6,603	9,710
United Kingdom [e]	13,004,420	11,227,612	12,100,078	13,502,754
United States	42,002,008	31,348,434	37,721,588	49,471,778

[a] Data not available.
[b] See under Austria.
[c] Includes Saar district.
[d] Includes Lorraine.
[e] In Great Britain the production of gas-house coke, not included above, is especially important. The output has been as follows, in metric tons: 1913, 7,956,419; 1914, 8,047,796; 1915, 8,281,011; 1916, 8,230,908.

TABLE 46.—*Coke produced in the principal countries of the world, 1913–1920*—Con.

Country.	1917	1918	1919	1920
Australia (New South Wales)	462,899	618,258	431,591	576,678
Austria	2,618,485	1,692,051	(g)	(g)
Belgium	676,040	522,210	756,890	1,835,400
British India	422,117	433,104	596,460	365,465
Canada	1,130,221	1,134,650	1,028,452	1,203,991
China	(a)	(a)	(a)	(a)
Czechoslovakia	(b)	(b)	1,393,189	1,431,267
France	1,534,036	1,873,969	d 1,667,253	d 782,334
Germany c	d 33,639,000	d 33,411,000	22,015,486	h 25,416,676
Hungary	78,664	(a)	(a)	(a)
Italy	447,387	371,405	302,737	(a)
Japan (natural coke)	113,177	e 105,449	e 112,535	(a)
Netherlands	....	....	25,940	138,987
Rhodesia (southern)	71,215	78,275	94,109	94,526
Russia (Donetz basin)	3,723,000	704,000	49,000	10,000
Spain	542,767	630,210	331,000	280,717
Union of South Africa	13,935	28,793	20,392	20,813
United Kingdom f	13,772,610	13,331,908	11,868,635	12,813,845
United States	50,445,402	51,236,050	40,079,718	46,579,196

a Data not available.
b See under Austria.
c Includes Saar district.
d Includes Lorraine.
e Figures represent natural coke. Some coke is also manufactured, but no statistics concerning it are available. In 1918 and 1919 the quantity of coal made into coke was 802,000 and 829,000 tons, respectively, suggesting a production of coke of about 519,000 and 540,000 tons.
f In Great Britain the production of gas-house coke, not included above, is especially important. The output has been as follows, in metric tons: 1917, 8,575,537; 1918, 8,072,573; 1919, 8,009,868; 1920, 8,440,471.
g See under Czechoslovakia.
h Exclusive of Saar district, for which figures are not yet available.

TRANSPORTATION OF COKE.

Tables 47 and 48 show the quantities of beehive coke shipped in 1919 and 1920 by way of the railroads and waterways in the United States. From these tables may be estimated the quantities handled on each of the originating carriers, grouped first by the States in which the coke originated, and grouped also by railway of origin independent of the State in which the shipments originated.

TABLE 47.—*Beehive coke shipped by originating railroads and waterways in the United States, 1919 and 1920, by States, in net tons.*

State.	Railroad.	Shipments.	Production.	Percentage of production shipped.
1919.				
Alabama	Louisville & Nashville	196,719		
	St. Louis-San Francisco	18,417		
	Southern	341,465		
	Seaboard Air Line	2,026		
		558,627	1,149,838	48.6
Colorado	Colorado & Southern; Colorado & Wyoming; Denver & Rio Grande.	a 201,578	200,890	100.3
Georgia	Central of Georgia	18,149	18,149	100.0
Kentucky	Chesapeake & Ohio	114,668		
	Louisville & Nashville	167,558		
		282,226	283,691	99.5
New Mexico	Atchison, Topeka & Santa Fe; El Paso & Southwestern.	259,853	260,162	99.9
Ohio			107,633	
Oklahoma and Utah.	Denver & Rio Grande; Kansas City Southern	236,025	243,782	96.8

a Shipped a small quantity from stock.

TABLE 47.—*Beehive coke shipped by originating railroads and waterways in the United States, 1919 and 1920, by States, in net tons*—Continued.

State.	Railroad.	Shipments.	Production.	Percentage of production shipped.
1919—Continued.				
Pennsylvania	Baltimore & Ohio	1,372,624		
	Buffalo, Rochester & Pittsburgh	114,921		
	Huntingdon & Broad Top Mountain	65,148		
	Ligonier Valley	178,571		
	Monongahela	3,586,202		
	Pennsylvania	7,188,778		
	Pittsburgh & Lake Erie	578,080		
	Buffalo & Susquehanna; Reynoldsville & Falls Creek; Washington Run.	573,010		
		13,657,334	14,634,990	93.3
Tennessee	Southern	11,082		
	Chesapeake & Ohio; Louisville & Nashville; Nashville, Chattanooga & St. Louis.	29,155		
		40,237	156,166	25.8
Virginia	Interstate	547,638		
	Louisville & Nashville	84,947		
	Norfolk & Western	215,854		
	Southern	70,410		
		918,849	930,516	98.7
Washington	Northern Pacific	35,999	35,999	100.0
West Virginia	Baltimore & Ohio	70,766		
	Chesapeake & Ohio	201,393		
	Kanawha & Michigan	97,314		
	Morgantown & Kingwood	40,454		
	Norfolk & Western	531,924		
	Western Maryland	81,536		
		[a] 1,023,387	1,021,120	100.2
	Total railroad shipments	17,232,264		
	Total waterway shipments (Monongahela River, Pa.).	3,171		
	Grand total	17,235,435	19,042,936	90.5
1920.				
Alabama	Louisville & Nashville	244,095		
	St. Louis-San Francisco	16,880		
	Southern	103,405		
		364,380	890,001	40.9
Colorado	Colorado & Wyoming; Denver & Rio Grande	[b] 274,349	272,826	100.6
Georgia	Central of Georgia	16,489	16,523	99.9
Kentucky	Chesapeake & Ohio	122,829		
	Louisville & Nashville	149,763		
		272,592	272,592	100.0
New Mexico and Utah.	Atchinson, Topeka & Santa Fe; Denver & Rio Grande; El Paso & Southwestern.	487,998	459,304	106.2
Ohio			86,933	
Pennsylvania	Baltimore & Ohio	1,607,235		
	Buffalo, Rochester & Pittsburgh	127,091		
	Ligonier Valley	278,126		
	Monongahela	3,291,857		
	Pennsylvania	8,133,935		
	Pittsburgh & Lake Erie; Buffalo & Susquehanna.	609,677		
	Huntingdon & Broad Top Mountain; Reynoldsville & Falls Creek; Washington Run.	764,305		
		14,812,226	15,908,483	93.1

[a] Shipped a small quantity from stock.

[b] Includes a small quantity of screenings.

TABLE 47.—*Beehive coke shipped by originating railroads and waterways in the United States, 1919 and 1920, by States, in net tons*—Continued.

State.	Railroad.	Shipments.	Production.	Percentage of production shipped.
1920—Continued.				
Tennessee	Southern	23,810		
	Louisville & Nashville; Nashville, Chattanooga & St. Louis.	28,181		
		51,991	162,587	32.0
Virginia	Chesapeake & Ohio	13,798		
	Interstate	559,210		
	Louisville & Nashville	92,239		
	Norfolk & Western	280,123		
	Southern	86,280		
		1,031,650	1,027,788	100.4
Washington	Northern Pacific	33,111	33,111	100.0
West Virginia	Baltimore & Ohio	320,623		
	Chesapeake & Ohio	190,836		
	Norfolk & Western	548,699		
	Western Maryland	52,991		
	Kanawha & Michigan; Morgantown & Kingwood.	269,053		
		1,382,202	1,380,944	100.1
	Total railroad shipments	18,726,988		
	Total waterway shipments (Monongahela River, Pa.)	14,289		
	Grand total	18,741,277	20,511,092	91.4

TABLE 48.—*Beehive coke shipped by originating railroads and waterways in the United States in 1919 and 1920, by routes, in net tons.*

Route.	State.	Quantity. By States.	Quantity. Total.	Percentage of total.
1919.				
Railroads:				
Atchison, Topeka & Santa Fe; El Paso & Southwestern.	New Mexico	259,853	259,853	1.5
Baltimore & Ohio	Pennsylvania	1,372,624	1,443,390	8.4
	West Virginia	70,766		
Buffalo & Susquehanna; Reynoldsville & Falls Creek; Washington Run.	Pennsylvania	573,010	573,010	3.3
Buffalo, Rochester & Pittsburgh	do	114,921	114,921	0.7
Central of Georgia	Georgia	18,149	18,149	0.1
Chesapeake & Ohio	West Virginia	201,393	322,510	1.9
	Kentucky and Tennessee.	121,117		
Colorado & Southern; Colorado & Wyoming.	Colorado	133,582	133,582	0.8
Denver & Rio Grande; Kansas City Southern.	Colorado, Oklahoma, and Utah.	304,021	304,021	1.8
Huntingdon & Broad Top Mountain	Pennsylvania	65,148	65,148	0.4
Interstate	Virginia	547,638	547,638	3.2
Kanawha & Michigan	West Virginia	97,314	97,314	0.6
Ligonier Valley	Pennsylvania	178,571	178,571	1.0
Louisville & Nashville	Alabama	196,719	451,394	2.6
	Virginia	84,947		
	Kentucky and Tennessee	169,728		
Monongahela	Pennsylvania	3,586,202	3,586,202	20.8
Morgantown & Kingwood	West Virginia	40,454	40,454	0.2
Nashville, Chattanooga & St. Louis; Seaboard Air Line.	Alabama and Tennessee.	22,562	22,562	0.1

TABLE 48.—*Beehive coke shipped by originating railroads and waterways in the United States in 1919 and 1920, by routes, in net tons*—Continued.

Route.	State.	Quantity. By States.	Quantity. Total.	Percentage of total.
1919—Continued.				
Railroads—Continued.				
Norfolk & Western	Virginia	215,854	747,778	4.3
	West Virginia	531,924		
Northern Pacific	Washington	35,999	35,999	0.2
Pennsylvania	Pennsylvania	7,188,778	7,188,778	41.8
Pittsburgh & Lake Erie	do	578,080	578,080	3.3
St. Louis-San Francisco	Alabama	18,417	18,417	0.1
Southern	do	341,465	422,957	2.4
	Tennessee	11,082		
	Virginia	70,410		
Western Maryland	West Virginia	81,536	81,536	0.5
Total railroad shipments		17,232,264	17,232,264	100.0
Waterways: Monongahela River	Pennsylvania	3,171	3,171	
Grand total		17,235,435	17,235,435	100.0
1920.				
Railroads:				
Atchison, Topeka & Santa Fe and El Paso & Southwestern.	New Mexico	253,245	253,245	1.4
Baltimore & Ohio	Pennsylvania	1,607,235	1,927,858	10.3
	West Virginia	320,623		
Buffalo & Susquehanna-Huntingdon & Broad Top Mountain-Reynoldsville & Falls Creek and Washington Run.	Pennsylvania	764,305	764,305	4.1
Buffalo, Rochester & Pittsburgh	do	127,091	127,091	0.7
Central of Georgia	Georgia	16,489	16,489	0.1
Chesapeake & Ohio	Kentucky	122,829	327,463	1.7
	Virginia	13,798		
	West Virginia	190,836		
Colorado & Wyoming and Denver & Rio Grande.	Colorado	509,102	509,102	2.7
Interstate	Virginia	559,210	559,210	3.0
Kanawha & Michigan and Morgantown & Kingwood.	West Virginia	269,053	269,053	1.4
Ligonier Valley	Pennsylvania	278,126	278,126	1.5
Louisville & Nashville	Alabama	244,095	486,627	2.6
	Virginia	92,239		
	Kentucky and Tennessee.	150,293		
Monongahela	Pennsylvania	3,291,857	3,291,857	17.6
Nashville, Chattanooga & St. Louis	Tennessee	27,651	27,651	0.1
Norfolk & Western	Virginia	280,123	828,822	4.4
	West Virginia	548,699		
Northern Pacific	Washington	33,111	33,111	0.2
Pennsylvania	Pennsylvania	8,133,935	8,133,935	43.4
Pittsburgh & Lake Erie	do	609,677	609,677	3.2
St. Louis-San Francisco	Alabama	16,880	16,880	0.1
Southern	do	103,405	213,495	1.1
	Tennessee	23,810		
	Virginia	86,280		
Western Maryland	West Virginia	52,991	52,991	0.3
Total railroad shipments		18,726,988	18,726,988	99.9
Waterways: Monongahela River	Pennsylvania	14,289	14,289	0.1
Grand total		18,741,277	18,741,277	100.0

BY-PRODUCTS FROM THE MANUFACTURE OF COKE.

The distinctive feature of the by-product coke industry is the fact that gas, tar, ammonia, light-oil products, and other miscellaneous materials are recovered for sale in addition to the coke. Facilities for the recovery and preparation of these products for the market represent about half of the investment in the total plant equipment. This investment, however, permits the recovery of by-products of great value, amounting in recent years to constantly increasing sums, usually from $75,000,000 to $100,000,000 annually. Thus the value of the by-products alone was about half as great in 1920 as the total value of all coke produced in beehive ovens. In Table 49 are summarized the more significant data regarding production, sales, and value of these products in 1918, 1919, and 1920.

In 1919 the aggregate value of the by-products produced was more than 10 per cent below the value in 1918. This resulted largely from the decrease in the unit value of the light-oil products, particularly toluol, a decrease which was only partly offset by a distinct increase in the value of the gas sold. In 1920 market conditions improved, but the income from light-oil products was still below that of 1918. The gas and the ammonia products sold in 1920 represented, however, very large gains in aggregate value over 1919, and the general result in 1920 was a total value of by-products which was the greatest in the history of the industry.

TABLE 49.—*By-products obtained from coke-oven operations in the United States in 1918–1920.*

Product.	Production.	Sales.		
		Quantity.	Value.	Average value.
1918.				
Tar.....gallons..	263,299,470	200,233,002	$6,364,972	$0.032
Ammonia:				
Sulphate.....pounds..	436,388,134	423,515,836	19,061,777	.045
Anhydrous or free ammonia [a].....do....	65,230,159	61,442,933	7,381,174	.120
Sulphate equivalent.....do....	697,308,770	669,287,568	26,442,951	.040
Gas:				
For illuminating and household purposes, ...M cubic feet..	385,085,154	33,437,991	7,130,113	.213
For industrial purposes.....do....		124,920,488	6,569,402	.053
	385,035,154	158,358,479	13,699,515	.087
Benzol products:				
Crude light oil.....gallons..	87,222,450	3,764,272	963,042	.256
Secondary light oil.....do....	339,644	121,191	15,472	.128
Benzol.....do....	44,804,900	43,441,980	11,966,367	.275
Toluol.....do....	8,861,948	8,541,366	12,249,702	1.434
Solvent naphtha.....do....	3,540,162	3,123,815	439,983	.141
Other oils.....do....	636,707	571,752	53,880	.094
	58,183,361	59,564,376	25,688,446	.431
Naphthalene, crude.....pounds..	10,614,799	10,403,758	287,581	.028
refined.....do....	5,472,699	5,486,689	362,648	.066
	16,087,498	15,890,447	650,229	.040
Other products [b].....	.....	.....	1,756,345	.....
			74,602,458	.....
1919.				
Tar.....gallons..	288,901,739	217,707,157	6,918,549	.032
Ammonia:				
Sulphate.....pounds..	544,303,827	557,492,773	21,058,744	.038
Anhydrous or free ammonia [a].....do....	50,535,639	51,646,744	5,692,950	.110
Sulphate equivalent.....do....	746,446,383	764,079,749	26,751,694	.035
Gas:				
For illuminating and household purposes, ...M cubic feet	415,655,098	5,238,486	2,106,806	.402
For industrial purposes.....do....		138,121,007	8,078,442	.058
To public service corporations.....do....		49,464,601	6,464,947	.131
	415,655,098	192,824,094	16,650,195	.086

[a] Includes liquor and sulphate sold on pound basis of NH_3.
[b] Includes sodium ferrocyanide, pyridin oil, nut coke, drip oil, spent oxide, residue, coal tar paint, and wash oil.

TABLE 49.—*By-products obtained from coke-oven operations in the United States in 1918–1920*—Continued.

Product.	Production.	Sales.		
		Quantity.	Value.	Average value.
1919—Continued.				
Benzol products:				
Crude light oil........gallons..	92,473,409	....	....	....
Benzol, crude [c]........do....	44,060,970	44,673,554	$7,860,093	$0.176
refined........do....	17,006,532	18,403,909	3,783,552	.206
Toluol, crude........do....	....	....	....	....
refined........do....	1,160,136	1,353,827	355,990	.263
Solvent naphtha........do....	3,920,489	3,625,978	552,853	.152
Other refined oils........do....	575,885	127,483	18,358	.144
	66,724,012	68,184,751	12,570,846	.184
Naphthalene, crude........pounds..	3,579,998	4,038,455	82,244	.020
refined........do....	2,763,271	2,663,585	109,120	.041
	6,343,269	6,702,040	191,364	.029
Other products [d]........	....	....	645,142	....
			63,727,790	....
1920.				
Tar........gallons..	360,664,124	174,363,696	6,378,040	.037
Ammonia:				
Sulphate........pounds..	675,816,486	626,013,975	27,110,260	.043
Anhydrous or free ammonia [a]........do....	65,777,259	62,076,772	8,585,173	.138
Sulphate equivalent........do....	(938,925,522)	(874,321,063)	35,695,433	.041
Gas:				
Distributed through city mains..M cubic feet..	476,485,744	53,220,824	15,716,888	.295
Used in steel or affiliated plant........do....		151,764,807	14,301,095	.094
Used under boilers, etc........do....		25,430,288	2,216,335	.087
	476,485,744	230,415,919	32,234,318	.140
Light oil and derivatives:				
Crude light oil [e]........gallons..	109,709,915	1,067,045	126,158	.118
Benzol, crude........do....	8,747,572	1,510,420	401,296	.266
refined........do....	16,977,556	15,720,356	4,096,527	.260
Motor fuel [f]........do....	57,645,462	55,764,265	12,644,931	.227
Toluol, crude........do....	287,142	....	....	....
refined........do....	2,710,649	2,470,364	740,722	.300
Solvent naphtha........do....	5,678,525	4,695,464	851,048	.181
	92,046,906	81,227,914	18,860,682	.232
Naphthalene:				
Crude........pounds..	11,246,807	11,507,703	307,999	.027
Refined........do....	2,921,282	2,941,059	179,975	.061
	14,168,089	14,448,762	487,974	.034
Other products [g]........	....	....	36,317	....
			93,692,764	

[a] Includes liquor and sulphate sold on pound basis of NH_3.
[c] Mainly motor fuel containing varying percentages of other constituents.
[d] Includes sodium ferrocyanide, retort carbon, residue, coal tar paint, sodium prussiate, extil covering, crude heavy solvent, and ammonium chloride.
[e] The quantity of crude light oil refined by the producer amounted to 106,564,417 gallons.
[f] The benzol content of motor fuel ranged from 50 to 100 per cent.
[g] Includes coal tar oil, crude heavy solvent, carbon, and pyridin oil.

Table 50 shows the average yield of the several by-products per net ton of coal charged into the by-product ovens, and Table 51 shows the average receipts from sales of these by-products per ton of coke produced. These two tables indicate relations between the important by-products which are discussed more fully in the following sections.

TABLE 50.—*Average yield of by-products per net ton of coal charged in by-product ovens in the United States, 1918–1920.*

Product.	1918	1919	1920
Coke....pounds..	1,410	1,402	1,398
Tar....gallons..	7.1	8.1	8.2
Ammonium sulphate (or equivalent)....pounds..	18.9	20.8	21.4
Light oil....gallons..	2.4	2.7	2.7
Gas:			
Total....M cubic feet..	10.4	11.6	10.8
Surplus sold or used....do....	4.3	5.4	5.2
Burned in coking process....do....	5.7	5.9	5.4
Wasted....do....	.4	.3	.2

TABLE 51.—*Receipts from sales of by-products per ton of coke produced in the United States, 1918–1920.*

Product.	1918	1919	1920
Ammonia....	$1.02	$1.06	$1.16
Benzol group....	.99	.50	.62
Gas....	.53	.66	1.05
Tar....	.24	.28	.20
Miscellaneous products....	.09	.03	.01
	2.87	2.53	3.04

TAR.

The aggregate value of the tar sold from by-product coke ovens did not change greatly during the three years 1918, 1919, and 1920, although the production was greater each year than in the year preceding. The value of the tar per gallon was less in 1919 than in 1918, but it was 15 per cent greater in 1920 than in 1919.

Much of the tar produced in 1920 was not sold but was used for fuel in the operation of the coke-oven plants or of affiliated metallurgical plants. It is reported to the Geological Survey that 24,000,000 gallons of tar was used as fuel under boilers and 168,000,000 gallons in open-hearth or other metallurgical furnaces. The value of the tar so used as fuel does not appear in any of the returns, owing to the fact that usually no money transaction is involved in such transfer of tar for use as fuel. From these figures it is evident that the total of sales and of fuel used was a slightly greater aggregate than the production of the year. The extra tar so employed came from stocks on hand, which were depleted during the year by approximately 7,000,000 gallons.

Table 52 shows the production, sales, and value of sales of coke-oven tar in 1920, by States. In considering this table it should be borne in mind that the value recorded does not by any means represent the total value of the product, as the sales represent less than half of the total output.

If the equivalent value of the tar as a fuel is taken as 4 cents a gallon, the quantity so used in 1920 represented almost $8,000,000. In considering the receipts from the sale of by-products shown in Table 51, the item for tar, about 20 cents per ton of coke produced, could very properly be doubled to indicate the real value of the by-product tar which is recovered.

The quantity of tar recovered per ton of coal carbonized has increased each year recently. The increase indicates greater care in the operation of ovens, the use of coal containing higher percentages of volatile matter, the use of a larger number of more modern types of coke ovens, and greater care in the recovery and application of tar, which formerly was of so little value that in many plants it was not carefully handled. All these factors will doubtless continue to operate in the future, and it is to be expected that the yield per ton of coal treated will increase still more.

TABLE 52.—*Coke-oven tar produced and sold in the United States in 1920, in gallons.*

State.	Produced.	Sold.	Value of sales.
Alabama	35,583,000	24,079,479	$649,989
Colorado	7,256,000	103,984	(a)
Illinois	19,238,065	15,258,992	561,721
Indiana	41,631,320	6,558,123	268,395
Kentucky	4,924,439	5,554,819	(a)
Maryland	7,225,191	....	....
Massachusetts	5,184,164	4,894,946	(a)
Michigan	15,161,169	11,141,320	543,652
Minnesota	7,204,182	4,049,945	176,973
Missouri	(a)	(a)	(a)
New Jersey	10,642,804	10,595,050	(a)
New York	11,872,911	12,017,344	504,258
Ohio	67,881,776	41,620,072	1,456,296
Pennsylvania	106,862,576	17,693,346	726,441
Rhode Island	(a)	(a)	(a)
Tennessee	1,329,798	1,297,794	(a)
Washington	310,655	309,965	15,498
West Virginia	6,147,946	5,941,230	190,163
Wisconsin	(a)	(a)	(a)
Combined States	12,208,128	12,347,287	[b] 1,284,654
	360,664,124	174,363,696	6,378,040

[a] Included under "Combined States."
[b] Includes also value of tar sales in Colorado, Kentucky, Massachusetts, New Jersey, and Tennessee.

AMMONIA.

During the coking process much of the nitrogen in the coal is converted into ammonia, which is present in the crude gas as it leaves the ovens and is removed either by washing the gas thoroughly with water or by bubbling the gas through dilute solutions of sulphuric acid. The latter process is known as the "direct-recovery process," for it yields ammonium sulphate directly. The ammonia that is removed from the gas by washing with water forms an ammonia liquor, which is then concentrated and subsequently distilled with lime for the recovery of the ammonia. The production of ammonia as ammonium sulphate or as ammonia liquor is separately reported. The bulk of the output is ammonium sulphate, as is shown in Table 49.

Table 53 summarizes, by States, in so far as separate data can be given, the production, sales, and value of sales of by-product ammonia. In this table all the ammonia recovered in liquor and sold as such or sold as anhydrous ammonia is calculated as the equivalent ammonium sulphate. The total production thus recorded—almost 940,000,000 pounds of ammonium sulphate—included 676,000,000 pounds of sulphate produced as such, the remainder being the sulphate equivalent of ammonia in other forms. The production in 1920 was 25 per cent more than in 1919 and was the greatest on record. The production in 1919 exceeded that of 1918 by 7 per cent.

The value of the sulphate made in 1918 and 1919 was about the same, but in 1920 the value increased 30 per cent. This increase in aggregate value resulted from the great increase in sales, for the price realized per pound in 1918 and in 1920 was about the same. The price per pound in 1919 was slightly less than in either 1918 or 1920. The yield of ammonia per ton of coal carbonized has increased markedly since 1918. The returns for 1920 indicate 21.4 pounds of ammonium sulphate or equivalent recovered per ton of coal charged into by-product ovens. This is equivalent to 5.3 pounds of ammonia (NH_3) recovered per ton of coal processed. The greater efficiency in the recovery of ammonia in recent years is probably the result of more careful operation of ovens, which in general are of more modern types. The ammonia from by-product ovens represents a very large percentage of the total income from the sale of all by-products. It has always been the largest single revenue producer, as is seen from Table 51. In 1918 it was almost equaled in value by the benzol group of derivatives, but in 1919 the benzol group did not yield quite half as much as the ammonia. In 1920 for the first time the value of the by-product gas sold approached the value of the ammonia, but the ammonia still holds first place.

TABLE 53.—*Ammonium (sulphate equivalent) produced and sold at by-product coke plants in the United States in 1920, in pounds.*

State.	Produced.	Sold.	Value of sales.
Alabama	94,420,775	89,739,872	$3,858,414
Colorado	15,909,157	13,149,074	(a)
Illinois	58,617,540	55,156,896	2,094,393
Indiana	123,474,952	117,624,629	4,164,654
Kentucky	13,488,420	12,179,868	(a)
Maryland	19,226,789	16,323,821	(a)
Massachusetts	11,705,800	10,502,400	(a)
Michigan	43,207,928	37,397,141	1,654,056
Minnesota	18,753,550	17,286,929	740,032
Missouri	(a)	(a)	(a)
New Jersey	27,775,469	26,706,133	(a)
New York	25,746,016	25,947,796	1,128,658
Ohio	191,678,808	176,949,169	7,216,295
Pennsylvania	242,308,762	225,692,473	9,782,184
Rhode Island	(a)	(a)	(a)
Tennessee	3,486,408	2,705,025	(a)
Washington	1,490,788	1,473,988	36,739
West Virginia	14,628,452	11,992,745	529,411
Wisconsin	(a)	(a)	(a)
Combined States	33,005,908	33,493,104	b 4,490,597
	938,925,522	874,321,063	35,695,433

a Included under "Combined States."
b Includes also value of ammonia sales in Colorado, Kentucky, Maryland, Massachusetts, New Jersey, and Tennessee.

GAS.

The production of gas at by-product coke ovens has increased each year recently—8 per cent in 1919 and 15 per cent in 1920. The disposition of this gas is shown by Tables 54 and 55. The production and sales, by States, are shown in Table 56, and the average yield per ton of coal treated in Table 50.

The sales of by-product gas have increased markedly; in the three years considered they amounted respectively to 158, 192, and 230 billion cubic feet. The income from the sales in 1919 was about 20 per cent greater than in 1918. The sales in 1920 represent almost double the value of those in 1919, but the data for 1920 in Table 55 are not exactly comparable with those for the two preceding years. The improved form of query sent to producers doubtless obtained more complete and more accurate returns in 1920 than before, and some of the great apparent increase in the sale and use of gas may therefore be a result of greater accuracy, so that only part of the increase represents an actual change in operation. It is not possible to make any estimate of the relative importance of these two factors.

The yield of by-product gas per ton of coal treated was greater in 1920 than in any preceding year except 1919. The reason for the decrease in yield from 1919 to 1920 is not evident. The receipts from the sales of gas in 1920 were by far the greatest ever recorded, having for the first time exceeded $1 a ton of coke produced. This represents an increase of 50 per cent in the value per ton of coke over the value in 1919.

Of the total output of by-product gas a certain proportion is generally used for heating the coke ovens. Only a very few plants use for this purpose gas made otherwise—for example, producer gas or blue water gas. In 1920, for the first time, less than 50 per cent of the total output was required for heating the ovens. Previously about 55 per cent had been regarded as a normal quantity. The decrease in heating gas required is almost entirely the result of improved battery construction. The choice of high-volatile coal has undoubtedly affected this percentage somewhat, but it is difficult to say how much, for an increase in the volatile content of the coal produces two effects—the higher-volatile coal requires more heat for its carbonization, but it also produces more gas per pound of coal treated. These two factors tend to offset each other; under some circumstances one would be more influential, and under other circumstances the other.

After so much gas as is needed for heating the ovens has been used, the remainder is regarded as "surplus." This surplus is used, sold, or wasted, as local conditions may determine. At many plants the bulk of the surplus is sold locally for use by public-utility companies to be distributed through city mains. About 11 per cent of the total production of the country was so used in 1920. In many places the steel plants or other affiliated metallurgical works take from the coke-oven department the surplus gas for use in furnaces. About 32 per cent of the total produced in the United States was so utilized in 1920. The use of surplus gas under boilers for raising steam is also common at by-product works, more than 5 per cent of the total production of the country being so used in 1920.

In general a coke-oven operator will choose to sell his surplus gas for public-utility distribution in preference to other uses, as he thus gets the highest price per unit sold. Under certain circumstances, however, a contract for the disposal of gas in this fashion is an embarrassment. Several contracts made in 1921 compelled the operation of coke works simply to maintain the city gas supply, though the market for coke and other by-products was so poor that it would have been desirable to close down the works. It is said that at half a dozen localities exactly those conditions resulted in the production of at least a million tons of coke which simply had to be put in stock for sale later. Such conditions show why the use of by-product coke-oven gas for city supply has not been extended more rapidly. It certainly is not sound business to establish conditions that will make it necessary to continue operations involving millions of dollars a year even though the income that can be immediately realized is only a fraction of the total income that could normally be expected.

In general the value of gas disposed of by coke works to metallurgical plants is greater per unit than the value credited for gas used under boilers. These unit values are contrasted in the last column of Table 55. All the values there recorded are in striking contrast with the average price received for gas sold to customers of the public-utility companies. However, it must be remembered in making such a comparison that coke-oven gas sold at the works involves only the expense of production, which in public-utility operation is usually less than one-third of the total necessary expense incident to production, distribution, commercial departments, and interest and return upon investment.

The great decrease in the percentage of the total by-product gas which is wasted is a most encouraging sign. Even after the most vigorous effort on the part of the Fuel Administration authorities, slightly more than 4 per cent of the by-product gas produced in 1918 was wasted. This waste was unavoidable, because under local conditions where coke had to be produced there was no useful application for some of the surplus gas. The waste in 1919 was a third less than in 1918 and amounted to 2.6 per cent of the total production. There was a still further reduction of waste in 1920, during which only 2.2 per cent of the total was neither used nor sold.

TABLE 54.—*Disposition of gas from by-product coke ovens in the United States in 1918 and 1919.*

	Millions of cubic feet.	Percentage.
1918.		
Wasted	15,800	4.1
Burned in coking process	210,876	54.8
Surplus sold or used:		
For illuminating and household use	33,437	8.7
For industrial purposes	124,920	32.4
	385,035	100.0
1919.		
Wasted	10,609	2.6
Burned in coking process	212,222	51.0
Surplus sold or used:		
For illuminating and household use	5,238	1.3
For industrial purposes	138,121	33.2
To public service corporations	49,465	11.9
	415,655	100.0

TABLE 55.—*Disposition of gas from by-product ovens in the United States in 1920.*

	Millions of cubic feet.	Percentage of total production.	Value.	Unit value (cents per M).
Used under boilers	25,430	5.3	$2,216,335	8.7
Used in steel or other related plant	151,765	31.8	14,301,095	9.4
Distributed through city mains (sold)	53,221	11.2	15,716,888	29.5
Total sold or used (not for ovens)	230,416	48.3	32,234,318	14.0
Used in heating ovens	235,701	49.5		
Wasted	10,368	2.2		
	476,485	100.0		

TABLE 56.—*Coke-oven gas produced and sold in the United States in 1920, by States.*

State.	Number of plants.	Produced (M cubic feet).	Used in process (M cubic feet).	Sold.			Wasted (M cubic feet).
				M cubic feet.	Value.	Average price.	
Alabama	7	51,752,917	27,422,049	21,331,670	$1,565,603	$0.07	2,999,198
Colorado	1	8,122,365	3,513,151	4,470,986	(a)	(b)	138,228
Illinois	5	32,692,774	18,064,052	13,783,152	2,162,467	.16	845,570
Indiana	6	69,368,533	32,218,849	35,137,150	4,898,865	.14	2,012,534
Kentucky	1	7,365,332	4,171,288	3,194,044	124,762	.04	
Maryland	1	9,647,393	3,145,023	6,502,370	(a)	(b)	
Massachusetts	1	6,310,113	3,546,297	2,763,816	(a)	(b)	
Michigan	3	19,657,878	10,277,573	9,189,942	1,179,993	.13	190,363
Minnesota	3	9,117,677	4,631,619	4,429,535	755,637	.17	56,523
New Jersey	2	10,505,589	1,020,829	9,484,760	(a)	(b)	
New York	4	18,784,074	14,684,388	4,099,686	585,884	.14	
Ohio	12	85,893,628	38,773,882	44,470,762	4,035,070	.09	2,648,984
Pennsylvania	13	122,840,496	60,967,169	60,541,987	6,282,329	.10	1,331,340
Tennessee	1	1,769,527	834,400	935,127	70,670	.08	
Washington	1	415,556		392,866	506,890	1.29	22,690
West Virginia	3	6,501,268	2,954,583	3,438,965	239,766	.07	107,720
Combined States: Missouri, Rhode Island, Wisconsin.	4	15,740,624	9,476,707	6,249,101	[b]9,826,382	[b].33	14,816
	68	476,485,744	235,701,859	230,415,919	32,234,318	.14	10,367,966

[a] Included with combined States.
[b] Includes also value of Colorado, Maryland, Massachusetts, and New Jersey sales.

LIGHT OILS.

With the end of the World War came a marked reduction in the demand for and use of light-oil products obtained from the coking of coal. The great demand during the war for these products was occasioned by their use in making explosives—toluol for TNT, solvent naphtha for TNX, benzol for picric acid, and so on. In 1919 the production of crude light oil was greater than in 1918, but the value of the crude light-oil products sold was less than half as much. New applications for the light-oil products had to be discovered and developed. The automotive industry proved to be the logical user of the bulk of these materials, and with the uses that were developed during 1919 and early in 1920 came increases in the value of sales, so that the aggregate income for 1920 from sales of light-oil products was almost 80 per cent of the income in 1918. Some of the increased income came through an increase in the total quantity of light oil produced, but the increasing unit value of the products sold was quite as influential a factor.

Data presented in Tables 49 to 51 summarize the important points with respect to this industry. The quantity of crude light oil produced is in each year the significant group figure. The quantities of each of the other items listed in this group are those of derived products made by refining the crude light oil. In general the sales consist largely of these refined products, less than 1 per cent of the total crude light oil produced in 1920 being sold without some refining.

The present practice in refining crude light oil seems generally to require production of the maximum percentage in the form of motor-fuel constituents. These constituents are largely benzol with small percentages of other related liquid hydrocarbons. The crude benzol serves splendidly for admixture with gasoline or alcohol or both. Such mixtures are sold under a wide variety of trade names, such as "Lightning fuel," "B-zol," and "Alco-gas." The market price of the products thus used varied widely during the three years under consideration. It seems now to have reached a more nearly stable figure, being in general about equal to or a trifle below the retail price of gasoline. The margin between the price thus realized at the coke oven and the market price of the special motor fuel provides for the necessary expense of blending the fuel, transportation, and sale, together with a profit for each of the agencies handling the material.

After the armistice was declared the market price of toluol, which dominated all other market conditions in the group of benzol products during the war period, fell off very rapidly from $1.50 a gallon, the Government war price. The average price realized in 1919 for refined toluol was only 26.3 cents, or about one-sixth the war-time price. This price remained substantially the same for some time but has since advanced slightly. In 1920 the sales of refined toluol were made at the average of 30 cents a gallon. This hydrocarbon is finding wide application in the chemical industries, but the demand for the refined product is by no means equal to the potential supply. Before the war half a million gallons of refined toluol a year met the entire need. During the war the productive capacity approached 30,000,000 gallons a year. The output of crude and refined toluol from by-product coke ovens in 1920 was about 3,000,000 gallons. Doubtless additional quantities were made by refining tar or by further refining crude light-oil products after their sale by coke-oven producers. However, the industry by no means attained the magnitude of that during the war, and with present prospects it will not again reach that maximum for many years.

The yield of light oil per ton of coal charged in by-product ovens increased in 1919 and 1920 to 2.7 gallons a ton, exceeding by about 10 per cent the recovery during 1918. This result undoubtedly came from the use of a larger number of ovens of modern type as well as from the use of more high-volatile coal in coke ovens than was formerly the custom.

The discrepancy between the total production of crude light oil and the total recorded production or sale of derivatives is accounted for by the loss during refining. It is reported that about 92,000,000 gallons of liquid derivatives were obtained in 1920 from the refining of 110,000,000 gallons of crude light oil. The loss does not represent waste, except in part. Much of the loss is unavoidable, as it results from treatment of the oil fractions with acid and with alkali in order to remove objectionable substances that can not be permitted in the motor fuel or other refined oils that are to be marketed.

Of the total production of 110,000,000 gallons, more than 106,000,000 gallons was refined on the premises of the producers, about 1,000,000 gallons went into stock, and the remainder represented handling losses or sales.

MISCELLANEOUS PRODUCTS.

In addition to the sales of important by-products reported to the Geological Survey from by-product coke-oven plants some sales of miscellaneous products are reported. Those which have been reported do not represent by any means all the miscellaneous transactions, but they indicate a few interesting facts. Table 57 shows the quantities and values of the miscellaneous products sold as reported to the Survey.

One reason why the average receipts from the sales of these miscellaneous products are so small now in contrast with the receipts reported for earlier years is the fact that a more careful analysis of the returns by the operators has shown that some products that had been known as miscellaneous should be grouped with benzol or tar. The average value of 1 cent a ton in 1920 for these miscellaneous products is therefore not reckoned on exactly the same basis as that of 9 cents a ton reported to the Survey in 1918. Some of the "miscellaneous" liquid products are perhaps still the secondary products from the light-oil or tar departments of the by-products works. But this fact has not been indicated by the operator, and no effort has been made by the Survey to classify accurately these few returns. In the aggregate the miscellaneous products represent only $36,000 in value, and therefore they are not significant in comparison with the totals of the industry.

TABLE 57.—*Miscellaneous products reported from by-product coke ovens in the United States in 1920.*

	Produced.	Sold.	Value of sales.
Pyridin oils....gallons..	15,628	10,444	$8,462
Residues....do....	812,944	242,473	15,177
Other oils....do....	119,827	87,525	12,338
Carbon....pounds..	44,000	44,000	340
Ammonium chloride....do....	350,423	....	....
	....	....	36,317

RELATION OF THE COKE AND MANUFACTURED GAS INDUSTRIES.

As has been pointed out earlier in this report, the by-product coke industry and the manufactured gas industry produce the same or similar products. It is not feasible at this time to discuss the interrelationship of the two industries in any detail, but for convenience of comparison of the two the salient facts regarding the manufactured gas industry in 1920 are given in Tables 58 and 59.

TABLE 58.—*Summary of gas and by-products from manufactured gas and by-product-coke plants in the United States in 1920.*

Product.	Produced.	Sold.	
		Quantity.	Value.
Gas:			
Coal gas .... M cubic feet..	47,378,501	42,948,127	$49,933,179
Water gas .... do....	220,078,821	200,490,272	210,043,126
Oil gas .... do....	22,269,815	19,041,777	18,853,818
Coke-oven gas .... do....	476,485,744	230,415,919	32,234,318
	766,212,881	492,896,095	311,064,441
Coke:			
Coal gas .... net tons..	3,137,332	1,378,537	11,638,525
Coke-oven .... do....	30,833,951	(a)	(a)
	33,971,283	....	....
Tar:			
Coal gas .... gallons..	51,264,956	46,604,133	2,010,186
Water gas .... do....	114,410,107	58,907,980	2,100,838
Oil gas .... do....	1,663,800	330,750	8,550
Coke-oven gas .... do....	360,664,124	174,363,696	6,378,040
	528,002,987	280,206,559	10,497,614
Ammonia (sulphate equivalent):			
Coal gas .... pounds..	57,970,606	55,350,961	1,252,726
Coke-oven gas .... do....	938,925,522	874,321,063	35,695,433
	996,896,128	929,672,024	36,948,159
Retort carbon:			
Coal gas .... do....	1,025,466	783,985	5,739
Water gas .... do....	....	....	....
Coke-oven gas .... do....	44,000	44,000	340
	1,069,466	827,985	6,079
Lampblack:			
Oil gas .... do....	203,281,411	[b] 71,292,159	295,149
Drip or holder oils:			
Coal gas .... gallons..	146,427	118,307	9,781
Water gas .... do....	4,266,889	3,956,699	227,673
Oil gas .... do....	14,090	14,090	4,245
	4,427,406	4,089,096	241,699
Light oil and derived products:			
Coal gas .... do....	10,717,423	10,912,216	805,697
Water gas .... do....	2,905,700	3,142,425	271,168
Coke-oven gas .... do....	109,709,915	81,227,914	18,860,682
	123,333,038	95,282,555	19,937,547
Naphthalene (crude and refined):			
Coal gas .... pounds..	4,559,775	1,483,993	58,037
Water gas .... do....	134,433	275,900	5,400
Oil gas .... do....	400	400	12
Coke-oven gas .... do....	14,168,089	14,448,762	487,974
	18,862,697	16,209,055	551,423
Miscellaneous by-products:			
Coal and water gas	....	....	428,324
Coke-oven gas	....	....	1,284,981
	....	....	1,713,305
Total value of sales of gas and by-products:			
Coal-gas, water-gas and oil-gas plants	....	....	297,952,173
By-product coke ovens excluding coke	....	....	94,941,768
	....	....	392,893,941

[a] Sales of coke from by-product ovens not comparable, as 90 per cent of the production is used by the operator. The total value of the coke produced, including estimates for coke consumed in associated iron furnaces but not sold, was for 1920, $313,028,732.
[b] In addition, lampblack used for briquets, 74,474,000 pounds in 1920.

TABLE 59.—*Salient figures of the manufactured gas industry in 1920.*

Gas produced (M cubic feet):	
Coal gas	47,378,501
Water gas	220,078,821
Oil gas	22,269,815
Coke-oven gas	476,485,744
	766,212,881
Gas sold (M cubic feet):	
Coal gas	42,948,127
Water gas	200,490,272
Oil gas	19,041,777
Coke-oven gas	230,415,919
	492,896,095
Average price per M cubic feet of gas sold:	
Coal gas	$1.16
Water gas	1.05
Oil gas	.99
Coke-oven gas	.14
Average percentage of gas unaccounted for at all plants (coal, water, and oil gas)	9.2
Annual per capita consumption of artificial gas, including coke-oven gas (cubic feet)	4,632
Number of active gas plants:	
Coal gas	213
Water gas	445
Oil gas	78
Coke-oven gas	68
Coal and water gas	155
Coal and oil gas	1
Water and oil gas	0
	960
Average sales of gas per plant per annum (M cubic feet):	
Coal gas	116,390
Water gas	334,150
Oil gas	241,035
Coke-oven gas	3,388,469
Fuels used in gas manufacture:	
Bituminous coal (net tons):	
Coal and water gas	4,761,538
Coke ovens	44,204,996
Anthracite (gross tons)	1,620,730
Oil (gallons)	923,263,457
Average yield of coal gas per ton of coal carbonized (M cubic feet)	10.1
Solid fuel used per M cubic feet of water gas produced, average (pounds)	32.1
Oil used per M cubic feet of water gas produced, average (gallons)	3.4
Oil used per M cubic feet of oil gas produced, average (gallons)	8.1
Coke sold by coal-gas plants:	
Quantity (net tons)	1,378,537
Average price per ton	$8.44
Average yield of coke per ton of coal carbonized in coal-gas plants (per cent)	66.7
Tar produced (gallons):	
Coal gas	51,264,956
Water gas and oil gas	116,073,907
Coke-oven gas	360,664,124
	528,002,987
Average yield of coal-gas tar per ton of coal carbonized (gallons)	10.9
Average yield of water-gas tar per gallon of oil consumed (gallons)	0.154
Ammonia (sulphate equivalent) produced (pounds):	
Coal gas	57,970,606
Coke oven	938,925,522
	996,896,128
Crude light oil produced (gallons):	
Coal gas	10,717,423
Water gas	2,905,700
Oil gas	0
Coke-oven gas	109,709,915
	123,333,038
Retort carbon produced at coal-gas, water-gas, and coke-oven gas plants (pounds)	1,069,466
Lampblack produced at oil-gas plants (pounds)	203,281,411
Drip and holder oils produced at coal-gas, water-gas, and oil-gas plants (gallons)	4,427,406
Naphthalene produced at coal-gas, water-gas, and coke-oven gas plants, crude and refined (pounds)	18,862,697

TABLE 59.—*Salient figures of the manufactured gas industry in 1920*—Continued.

Value of products of the coal-gas, water-gas, and oil-gas industry:	
Gas sold	$278,830,123
By-products sold	19,122,050
	297,952,173
Value of products of the by-product coke industry:	
Coke	313,028,732
Gas sold	32,234,318
Other by-products sold	62,707,450
	407,970,500
Total value of products of manufactured gas industries sold, exclusive of by-product coke	392,893,941

MANUFACTURED GAS AND BY-PRODUCTS.

By R. S. McBride.

GENERAL DISCUSSION.

SUMMARY OF DATA FOR 1920.

Data are now available for the first time since the end of the World War to show the output of manufactured gas and by-products in the United States during a full calendar year, and it is now possible, therefore, to determine the trend of development in the industry in the period just before, during, and just after the war.

The conditions in the gas industry were greatly disturbed in 1920, largely because of the difficulty in procuring fuel. The coal and railway strikes in the early part of the year were especially notable in affecting the industry adversely, but despite the difficulty of procuring fuels and their very great increase in price due to the strikes, the industry made some marked advances.

The year was one of increased output, increased local development, and increased efficiency. Table 1 shows the more important data regarding production and sales of gas and other products. A comparison of the figures for 1918 and 1920 shows the large magnitude of the changes that took place. The industry has almost reached total annual sales of 500,000,000,000 cubic feet of gas, and the income from these sales has for the first time exceeded $300,-000,000. Table 2 gives other salient figures from the industry for the two years, which show in many other particulars the marked recent changes. The great increase in the price of gas, the marked increase in the average sales of gas per plant per year, and the increase in average sales per capita are especially notable. These and other important developments within the industry are discussed in detail in this report.

Table 1.—*Summary of output of gas and by-products from manufactured-gas plants in the United States, 1918 and 1920.*

Product.	1918			1920		
	Production.	Sales.		Production.	Sales.	
		Quantity.	Value.		Quantity.	Value.
Gas:	*M.*	*M.*		*M.*	*M.*	
Coal gas	48,486,546	42,659,487	$42,846,964	47,378,501	42,948,127	$49,933,179
Water gas	193,046,980	175,597,423	155,426,672	220,078,821	200,490,272	210,043,126
Oil gas	19,871,797	16,684,157	15,757,487	22,269,815	19,041,777	18,853,818
Coke-oven gas	385,035,154	158,358,479	13,699,515	476,485,744	230,415,919	32,234,318
	646,440,477	393,299,546	227,730,638	766,212,881	492,896,095	311,064,441

TABLE 1.—*Summary of output of gas and by-products from manufactured-gas plants in the United States, 1918 and 1920*—Continued.

Product.	1918			1920		
	Production.	Sales.		Production.	Sales.	
		Quantity.	Value.		Quantity.	Value.
Coke:	*Net tons.*	*Net tons.*		*Net tons.*	*Net tons.*	
Coal gas	3,180,535	1,813,740	$13,963,232	3,137,332	1,378,537	$11,638,525
Coke-oven	25,997,580	(*a*)	(*a*)	30,833,951	(*a*)	(*a*)
	29,178,115			33,971,283		
Tar:	*Gallons.*	*Gallons.*		*Gallons.*	*Gallons.*	
Coal gas	52,694,826	47,727,839	1,863,580	51,264,956	46,604,133	2,010,186
Water gas	100,268,434	54,733,478	1,789,898	114,410,107	58,907,980	2,100,838
Oil gas	716,722	550,006	15,967	1,663,800	330,750	8,550
Coke-oven gas	263,299,470	200,233,002	6,364,972	360,664,124	174,363,696	6,378,040
	416,979,452	303,244,325	10,034,417	528,002,987	280,206,559	10,497,614
Ammonia (sulphate equivalent)	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	
Coal gas	59,348,144	56,900,464	1,453,070	57,970,606	55,350,961	1,252,726
Coke-oven gas	697,308,770	669,287,568	26,442,951	938,925,522	874,321,063	35,695,433
	756,656,914	726,188,032	27,896,021	996,896,128	929,672,024	36,948,159
Crude light oil and derived products:	*Gallons.*	*Gallons.*		*Gallons.*	*Gallons.*	
Coal gas	5,729,629	2,032,883	1,457,972	10,717,423	10,912,216	805,697
Water gas	11,909,702	4,613,751	3,830,392	2,905,700	3,142,425	271,168
Coal and water gas	4,230,908	2,229,535	1,220,138	(*b*)	(*b*)	(*b*)
Oil gas	21,494	20,376	4,274			
Coke-oven gas	87,222,450	59,564,376	25,688,446	109,709,915	81,227,914	18,860,682
	109,114,183	68,460,921	32,201,222	123,333,038	95,282,555	19,937,547
Drip or holder oils:	*Gallons.*	*Gallons.*		*Gallons.*	*Gallons.*	
Coal gas	179,614	176,289	42,949	146,427	118,307	9,781
Water gas	3,484,165	3,430,232	455,949	4,266,889	3,956,699	227,673
Oil gas				14,090	14,090	4,245
	3,663,779	3,606,521	498,898	4,427,406	4,089,096	241,699
Naphthalene (crude and refined):	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	
Coal gas	429,798	392,997	10,675	4,559,775	1,483,993	58,037
Water gas	539,884	503,083	3,607	134,433	275,900	5,400
Oil gas				400	400	12
Coke-oven gas	16,087,498	15,890,447	650,229	14,168,089	14,448,762	487,974
	17,057,180	16,786,527	664,511	18,862,697	16,209,055	551,423
Retort carbon:	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	
Coal gas	2,202,853	2,014,961	13,275	1,025,466	783,985	5,739
Water gas	521,748	501,723	2,230			
Coke-oven gas	1,310,020	1,310,020	2,732	44,000	44,000	340
	4,034,621	3,826,704	18,237	1,069,466	827,985	6,079
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	
Lampblack: Oil gas	262,022,000	*c*35,355,000	95,211	203,281,411	*c*71,292,159	295,149
Miscellaneous by-products:						
Coal and water gas			25,826			428,324
Coke-oven			1,753,613			*d* 1,284,981
			1,779,439			1,713,305
Total value of sales of gas and by-products:						
Coal-gas, water-gas, and oil-gas plants			240,279,368			297,952,173
By-product coke ovens, excluding coke			74,602,458			*d*94,941,768
			314,881,826			392,893,941

a Sales of coke from by-product ovens not comparable, as 90 per cent of the production is used by the operator. The total value of the coke produced including estimates for coke consumed in associated iron furnaces, but not sold, was for 1918, $193,018,785, and for 1920, $313,028,732.
b Figures given separately above.
c In addition, lampblack used for briquets, 80,124,000 pounds in 1918, and 74,474,000 pounds in 1920.
d Includes in 1920 value of coke breeze ($1,249,004). Value of breeze for 1918 not ascertained, but bulk of sales included in coke sales.

Table 2.—*Salient figures of the manufactured gas industry, 1918 and 1920.*

	1918	1920
Gas produced (M):		
Coal gas	48,486,546	47,378,501
Water gas	193,046,980	220,078,821
Oil gas	19,871,797	22,269,815
Coke-oven gas	385,035,154	476,485,744
	646,440,477	766,212,881
Gas sold (M):		
Coal gas	42,659,487	42,948,127
Water gas	175,597,423	200,490,272
Oil gas	16,684,157	19,041,777
Coke-oven gas	158,358,479	230,415,919
	393,299,546	492,896,095
Average price per M of gas sold:		
Coal gas	$1.00	$1.16
Water gas	.89	1.05
Oil gas	.94	.99
Coke-oven gas	.09	.14
Average percentage of gas unaccounted for at all plants (coal, water, and oil gas).	12.7	9.2
Annual per capita consumption of manufactured gas, including coke-oven gas (cubic feet)	3,683	4,632
Number of active gas plants:		
Coal gas	250	213
Water gas	431	445
Oil gas	81	78
Coke-oven gas	60	68
Coal and water gas	150	155
Coal and oil gas	3	1
Water and oil gas	3	....
	[a] 1,134	[a] 1,116
Average sales of gas per plant per annum (M):		
Coal gas	105,855	116,390
Water gas	300,681	334,150
Oil gas	191,772	241,035
Coke-oven gas	2,639,308	3,388,469
Fuels used in gas manufacture:		
Bituminous coal (net tons)—		
Coal and water gas	5,031,614	4,761,538
Coke ovens	36,867,721	44,204,996
Anthracite (gross tons)	1,730,029	1,620,730
Oil (gallons)	841,928,218	923,263,457
Average yield of coal gas per ton of coal carbonized (M)	9.8	10.1
Solid fuel used per M of water gas produced, average (pounds)	35.8	32.1
Oil used per M of water gas produced, average (gallons)	3.6	3.4
Oil used per M of oil gas produced, average (gallons)	7.8	8.1
Coke sold, by coal-gas plants:		
Quantity (net tons)	1,813,740	1,378,537
Average price per ton	$7.70	$8.44
Average yield of coke per ton of coal carbonized in coal-gas plants (percent)	64.0	66.7
Tar produced (gallons):		
Coal gas	52,694,826	51,264,956
Water gas and oil gas	100,985,156	116,073,907
Coke-oven gas	263,299,470	360,664,124
	416,979,452	528,002,987
Average yield of coal-gas tar per ton of coal carbonized (gallons)	10.6	10.9
Average yield of water-gas tar per gallon of oil consumed (gallons)	0.146	0.154
Ammonia (sulphate equivalent) produced (pounds):		
Coal gas	59,348,144	57,970,606
Coke oven	697,308,770	938,925,522
	756,656,914	996,896,128
Crude light oil produced (gallons):		
Coal gas	5,729,629	10,717,423
Water gas	11,909,702	2,905,700
Coal and water gas	4,230,908	([b])
Oil gas	21,494	....
Coke-oven gas	87,222,450	109,709,915
	109,114,183	123,333,038

[a] For information in greater detail see Table 8, p. 451.
[b] Figures given separately for 1920.

TABLE 2.—*Salient figures of the manufactured gas industry, 1918 and 1920*—Continued.

	1918	1920
Retort carbon produced at coal-gas, water-gas, and coke-oven gas plants (pounds)	4,034,621	1,069,466
Lampblack produced at oil-gas plants (pounds)	262,022,000	203,281,411
Drip and holder oils produced at coal-gas, water-gas and oil-gas plants (gallons)	3,663,779	4,427,406
Naphthalene produced at coal-gas, water-gas, and coke-oven gas plants, crude and refined (pounds)	17,057,180	18,862,697
Value of products of the coal-gas, water-gas, and oil-gas industry:		
Gas sold	$214,031,123	$278,830,123
By-products sold	26,248,245	19,122,050
	240,279,368	297,952,173
Value of products of the by-product coke industry:		
Coke	$193,018,785	$313,028,732
Gas sold	13,699,515	32,234,318
Other by-products sold	60,902,943	62,707,450
	267,621,243	407,970,500
Total value of sales of products of manufactured-gas industries, excluding by-product coke	$314,881,826	$392,893,941

MUNICIPAL GAS SUPPLY AN ENGINEERING AND CHEMICAL-RESOURCE PROBLEM.

Municipal fuel supply is one of the greatest problems of modern urban life; it is the last link in the chain which connects the user of heat, light, and power with the natural resources that supply fuel and energy. Gas and electricity, companion agencies in this service, are of constantly increasing importance. The public-utility aspects of these agencies are usually most conspicuous for rates and the quality of service rendered are most in the public eye. However, these public-service industries are also of great economic significance, especially the gas industry, which furnishes not only gas as a source of heat, light, and power, but also the by-products of the manufacture of gas—coke, tar, ammonia, light oils, retort carbon, and lampblack—which are resources of great importance as raw materials for the chemical industry. It is this economic significance and the industrial application of these products that lend particular importance to the following discussion.

SCOPE OF THIS REPORT.

This report attempts to give all the basic data not only for manufactured gas but also for the by-products of its manufacture. These by-products are really mineral resources for they represent raw materials for chemical industry only partly manufactured in the processing of the coal.

The data that have been supplied by the gas companies of the country are summarized in the form in which they are submitted; these data have also been analyzed in the effort to show average and extreme conditions of operation for various types and sizes of gas plants. Thus the industry can hope to find many standards of operating practice or operating efficiency by which to judge the general performance of the industry, and each operator will find a basis for comparison of his own results with those obtained by other operators of similar plants.

The report deals with manufactured gas made by coal gas, carbureted water-gas, and oil-gas processes and with mixtures of these gases. In parts of the report are included, for the sake of comparison, data for natural-gas and coke-oven operations. However, in general, coke-oven gas is not discussed here, as there is a full report on this subject in another chapter of this volume.[1]

Practically the entire output of coal-gas, water-gas, and oil-gas plants goes into public-utility municipal supplies. However, the total for these kinds of gas does not completely represent the public-utility gas service in the United States, as a considerable quantity of coke-oven gas is so used. In this report only incidental reference can be made to the public-utility aspects of the matter.

It should be borne in mind that the prices of gas sold for public-utility supply are much higher than those usually charged for the gas sold by coke-oven companies for the sale of coke-oven gas is usually a wholesale transaction. The higher price of the city supply represents, however, more than a charge for the gas itself, because the companies that supply public-utility service distribute their product over wide areas and maintain many facilities that contribute to the service of their customers but that are not essential in the supply of fuel gas from coke ovens to large industrial consumers or to the gas companies themselves. These companies in fact often purchase coke-oven gas for distribution and resale as a public-utility supply.

This report does not include any discussion of producer, blast-furnace, acetylene, Pintsch, or other industrial gases, which seldom form an important part of the municipal gas supply.

The summaries of data for gas and by-products are given on several bases and thus permit consideration by product, by State, or other subdivision of the country, by class of company, or otherwise, as may seem most significant and feasible. The effort has been made not only to serve the gas industry and those interested in public-utility gas supply, but also to furnish data for an intelligent study both of coal by-products as furnished by gas companies and of the general fuel-engineering facts of greatest importance connected therewith.

UNITS OF MEASUREMENT.

The standard commercial unit for measuring gas in the United States is 1,000 cubic feet, represented in this report by the abbreviation M. The coal used in gas manufacture is usually reported in tons—anthracite in gross tons of 2,240 pounds, bituminous coal in net tons of 2,000 pounds. Statistics of coke in this report are also expressed in net tons.

ACKNOWLEDGMENTS.

The author makes grateful acknowledgment of the painstaking work and cooperation of Mrs. Helen L. Bennit, of the United States Geological Survey, who has been responsible for the collection and analysis of the statistical data upon which this report is based. The cooperation and assistance of F. G. Tryon, also of the United

[1] McBride, R. S., and Tryon, F. G., Coke and by-products: U. S. Geol. Survey Mineral Resources, 1920, pt. 2, pp. 361–437, 1922.

States Geological Survey, under whose general direction all these studies have been made, are also gratefully acknowledged.

MAGNITUDE AND DEVELOPMENT OF THE GAS INDUSTRY.

PRODUCTION AND SALES OF GAS.

The manufactured gas produced and sold in 1915, 1918, and 1920 can well be contrasted for a comparison of pre-war, wartime, and post-war activity in the industry. These data are given in Table 3 for each kind of manufactured gas and also for natural gas. They show clearly the important trends in the industry.

TABLE 3.—*Manufactured and natural gas produced and sold in 1915, 1918, and 1920, by kinds.*

[Value for coke-oven gas is at point of production; that for coal, water, and oil gas and for natural gas is at point of ultimate consumption.]

Kind.	Year.	Production (M.)	Sales.		Unaccounted for (M).
			M.	Value.	
Coal	1915	47,638,905	43,747,432	$40,257,108	3,891,473
	1918	48,486,546	42,659,487	42,846,964	5,827,059
	1920	47,378,501	42,948,127	49,933,179	4,091,350
Water	1915	136,333,318	124,129,569	112,281,956	12,203,749
	1918	193,046,980	175,597,423	155,426,672	17,449,557
	1920	220,078,821	200,490,272	210,043,126	19,478,776
Oil	1915	16,035,105	13,971,333	12,668,169	2,063,772
	1918	19,871,797	16,684,157	15,757,487	3,187,640
	1920	22,269,815	19,041,777	18,853,818	3,008,805
Coke-oven	1915	213,667,614	84,355,914	8,624,899	6,139,827
	1918	385,035,154	158,358,479	13,699,515	15,800,363
	1920	476,485,744	230,415,919	32,234,318	10,367,966
Total manufactured	1915	413,674,942	266,204,248	173,832,132	24,298,821
	1918	646,440,477	393,299,546	227,730,638	42,264,619
	1920	766,212,881	492,896,095	311,064,441	36,946,897
Natural gas	1915	628,578,842	628,578,842	101,312,381	....
	1918	721,000,959	721,000,959	153,553,560	....
	1920	860,540,000	[a] 798,210,000	[a] 197,660,000	[b] 62,330,000
Grand total	1915	1,042,253,784	894,783,090	275,144,513	....
	1918	1,367,441,436	1,114,300,505	381,284,198	....
	1920	1,626,752,881	1,291,106,095	508,724,441	99,276.897

[a] These figures have become available since preliminary data in summary of mineral production, Part I of Mineral Resources for 1920, went to press.
[b] Wasted at wells.

The production of coal gas has been maintained on substantially the same basis for a considerable number of years. In fact, coal-gas sales barely held their own in 1920 as compared with 1918. Oil-gas and water-gas sales increased markedly during that interval, the output of each in 1920 being approximately one-seventh greater than during 1918. Sales of coke-oven gas in 1920 were 50 per cent greater than in 1918. In the aggregate the sales of manufactured gas were almost exactly 100,000,000,000 cubic feet greater in 1920 than in 1918.

Table 4 affords similar comparisons over a longer period. From that table and from the curves of figure 22 it is to be seen that the tendency to increase or to maintain sales of the different kinds of gas did not change materially during the interval from 1918 to 1920, as compared with the preceding three years. However, the continuance of these trends has somewhat displaced the several kinds of gas in relation to one another. The rapid increase in sales of coke-oven gas is a most conspicuous item. These sales in 1920 were almost equal to the sales of all other kinds of manufactured gas put together. Of the sales of coke-oven gas recorded here, only about one-fourth went into public-utility distribution, but the remainder was used industrially or incidentally in connection with the operation of coke-oven plants (not for heating the ovens) and thus is comparable with the industrial applications of gas from other sources of supply. Undoubtedly the most important factor in producing this very great increase in sales of coke-oven gas was the completion of numerous plants that were contracted for during the war in order to make available adequate supplies of ammonia and toluol. Many of these

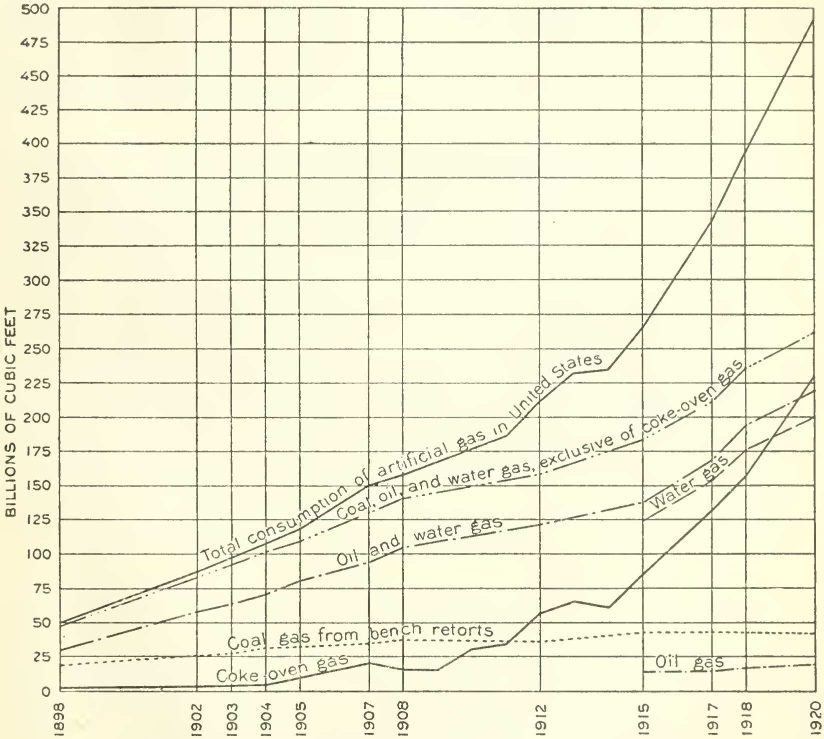

FIGURE 22.—Manufactured gas sold in the United States, 1898–1920.

plants operated a full year for the first time in 1920. Thus, their influence on the production and sales of gas was then first noticed.

The material increase in production and sales of water-gas is also in particular a result of war-time factors. The costs of installing water-gas plants are much less per unit of productive capacity than those of plants for coke-oven gas or coal gas. Moreover, water-gas equipment can be installed in a very short time, and it has material advantages over other gas-making equipment during periods of labor shortage or widely fluctuating demand. All these factors combined increased the number and capacity of water-gas plants operating during the war period, and, despite the high cost of oil, these plants have continued to make large quantities of gas each succeeding year.

The increase in production and sales of oil gas during recent years has been continuous but in general less than the increase in water gas. The manufacture of oil gas is not commercially practicable except in the West and Southwest, where petroleum is available at a low price compared with the price of coal or coke in the same communities. However, the increase in demand for gas in those parts of the country has not been so great as in the regions of greater industrial concentration. Moreover, the cost of petroleum, even in the far West, has increased by large percentages during and since the war. Hence the economic advantage of the oil-gas system even in that territory is somewhat less marked than before. Furthermore, natural gas has been developed to some extent in the far West to replace manufactured gas. In that particular the Western States have differed materially from most of the rest of the United States, for with few exceptions in the territory east of the Rocky Mountains the tendency has been to replace waning supplies of natural gas with manufactured gas.

In 1920 the total production of manufactured gas nearly equaled the total sales of natural gas, for the first time in many years. Because of the fact that much of the manufactured gas made at coke-oven plants is used in the manufacture of coke, the sales of manufactured gas have not yet equaled the sales of natural gas. But the present rate of increase in the sales of manufactured gas is so much greater than the rate of increase in the sales of natural gas that the manufactured gas will probably overtake the natural gas within a few years. During the last five years the sale of natural gas has increased only 27 per cent, whereas in the same period the sale of manufactured gas has increased 85 per cent. If these same percentages should continue for the next five years, the sales of the two kinds of gas would be almost the same at the end of the period.

TABLE 4.—*Manufactured gas sold in the United States, by kinds, 1898–1920.*

Year.	Coal gas.		Water gas.		Oil gas.	
	M.	Value.	M.	Value.	M.	Value.
1898	18,431,201	$21,502,295	[a] 30,418,987	([b])	[a] 497,016	([b])
1902	25,069,000	[c] 29,342,881	([b])	([b])	([b])	([b])
1903	25,670,000	[c] 30,315,776	([b])	([b])	([b])	([b])
1904	30,109,449	[c] 32,090,998	([b])	([b])	([b])	([b])
1905	30,722,279	[c] 32,937,456	[d] 77,412,025	[d] $78,072,500	([d])	([d])
1907	34,302,956	33,331,465	[d] 94,634,620	[d] 90,173,112	([d])	([d])
1908	37,355,886	34,670,418	[d] 103,347,497	[d] 96,343,221	([d])	([d])
1912	35,202,124	32,031,367	[d] 122,697,796	[d] 111,600,841	([d])	([d])
1915	43,747,432	40,257,108	124,129,569	112,281,956	13,971,333	$12,668,169
1917	42,927,728	38,324,113	153,457,318	131,876,065	14,739,508	13,470,911
1918	42,659,487	42,846,964	175,597,423	155,426,672	16,684,157	15,757,487
1920	42,948,127	49,933,179	200,490,272	210,043,126	19,041,777	18,853,818

[a] Figures of production.
[b] Statistics not available.
[c] Value of coke-oven gas included with coal gas.
[d] Figures for oil gas included with water gas.

TABLE 4.—*Manufactured gas sold in the United States, by kinds, 1898-1920*—Continued.

Year.	Coke-oven gas.[a]		Total.	
	M.	Value.	M.	Value.
1898	3,620,673	(b)	52,967,877	....
1902	4,010,074	(c)	29,079,074	$29,342,881
1903	5,379,462	(c)	31,049,462	30,315,776
1904	4,705,542	(c)	34,814,991	32,090,998
1905	9,731,936	(c)	117,866,240	111,009,956
1907	20,516,731	$3,130,839	149,454,307	126,635,416
1908	16,205,925	2,557,483	156,909,308	133,571,122
1912	54,491,248	4,650,517	212,391,168	148,282,725
1915	84,355,914	8,624,899	266,204,248	173,832,132
1917	131,026,575	11,360,335	342,151,129	195,031,424
1918	158,358,479	13,699,515	393,299,546	227,730,638
1920	230,415,919	32,234,318	492,896,095	311,064,441

[a] Includes only surplus gas sold.
[b] Statistics not available.
[c] Value of coke-oven gas included with coal gas.

As a further indication of the magnitude of the manufactured-gas industry, Table 5 gives a number of interesting estimates regarding the number of communities, the population, and other characteristics of a territory supplied with manufactured gas. These data have been prepared by the American Gas Association.

TABLE 5.—*Scope of distribution of manufactured gas.*[2]

Number of cities, towns, and villages served (estimated)		4,600
Number of meters:		
Prepayment	1,268,496	
Ordinary	7,708,729	
		8,977,225
Number of consumers		8,837,270
Miles of gas mains		68,450
Meters per mile of main		131
Number of active services		6,082,475
Population served		45,997,000

The figures of value in Table 4 represent the sums paid to public utility companies by the users of gas except that the value of coke-oven gas is that received by the coke-oven operator for sales in wholesale quantity at the coke works. The gas unaccounted for listed in the last column of Table 3 represents, except in the case of coke-oven gas, only the unavoidable losses due to leakage during distribution, to error in meters, and to changes in volume from condensation of vapors. The quantity of coke-oven gas listed as unaccounted for is that actually wasted. The coke-oven gas sold is in general measured or estimated at the works, and hence there are no distribution losses to be accounted for. The wastage represents the quantity of gas for which there is no market or readily available application at an accessible point near the works in which it is produced. The price of gas and the gas unaccounted for are discussed more fully later in this report.

[2] Compiled by the American Gas Association from data published in Brown's Directory of American gas companies.

PRODUCTION AND SALES, BY STATES.

Table 6 shows for 1918 and 1920 the number of plants producing gas, production, sales, and gas unaccounted for in each of the States separately where three or more plants were operating. It has been necessary to combine a few States into groups in order to avoid disclosure of returns from one or two plants.

TABLE 6.—*Manufactured gas produced and sold in the United States in 1918 and 1920, by States.*

[Including coke-oven gas.]

State.	Number of plants producing.	Gas produced (M).	Gas sold.			Unaccounted for (M).
			M.	Value.		
				Total.	Average.	
1918.						
Alabama	21	45,687,951	16,444,475	$1,796,335	$0.11	1,896,889
Arizona	8	478,366	295,038	480,684	1.63	183,328
Arkansas, Louisiana, and Oklahoma	6	122,824	104,698	141,751	1.35	18,126
California	54	16,779,097	14,105,255	13,242,140	.94	2,673,842
Colorado	14	5,722,217	3,525,678	1,632,508	.46	586,138
Connecticut	28	6,808,327	6,195,291	6,659,453	1.07	613,036
Delaware	6	860,452	754,370	804,137	1.07	106,082
District of Columbia and Maryland	16	19,291,102	11,764,858	7,534,289	.64	578,101
Florida	16	1,115,097	977,666	1,340,210	1.37	137,431
Georgia	18	2,170,943	1,951,304	2,050,297	1.05	219,639
Idaho	3	92,657	78,433	129,124	1.65	14,224
Illinois	84	66,553,065	41,611,240	23,729,695	.57	3,092,855
Indiana	53	58,912,920	30,780,904	5,885,540	.19	3,196,358
Iowa	68	4,250,715	3,909,402	4,243,626	1.09	341,313
Kansas	8	140,542	123,980	164,957	1.33	16,562
Kentucky	10	8,211,016	4,279,853	202,914	.05	37,564
Maine	12	791,949	702,593	902,647	1.28	89,356
Massachusetts	70	25,385,944	20,377,687	17,875,542	.88	1,624,257
Michigan	78	25,526,416	15,854,146	9,338,332	.59	1,269,099
Minnesota	25	14,020,752	8,578,614	3,557,029	.41	224,384
Mississippi	9	270,414	210,249	265,326	1.26	60,165
Missouri	25	11,844,529	8,732,546	6,782,666	.78	1,186,021
Montana	7	253,482	215,090	346,435	1.65	38,392
Nebraska	18	1,716,718	1,573,251	1,931,888	1.23	143,467
Nevada	4	66,669	55,383	100,887	1.82	11,286
New Hampshire	13	813,626	735,556	951,616	1.29	78,070
New Jersey	36	24,157,945	18,692,369	13,995,166	.75	1,855,225
New Mexico and Wyoming	4	70,021	60,112	88,116	1.47	9,909
New York	97	92,898,494	73,143,190	57,235,865	.78	6,395,186
North Carolina	22	795,197	672,065	949,267	1.41	123,132
North Dakota	6	236,098	174,354	314,578	1.80	61,744
Ohio	29	78,364,690	37,071,480	2,597,138	.07	5,612,435
Oregon	10	2,512,260	2,200,382	1,901,879	.86	311,878
Pennsylvania	94	87,485,018	40,005,978	20,675,457	.52	7,352,301
Rhode Island	7	3,102,283	2,972,695	3,134,701	1.05	129,588
South Carolina	10	662,282	584,075	754,469	1.29	78,207
South Dakota	10	306,990	271,884	420,614	1.55	35,106
Tennessee	10	2,190,841	1,578,819	1,169,727	.74	232,701
Texas	24	2,645,694	2,262,819	2,529,242	1.12	382,875
Utah	4	552,550	500,403	493,680	.99	52,147
Vermont	10	295,525	263,656	358,517	1.36	31,869
Virginia	22	2,583,339	2,329,338	2,271,133	.98	254,001
Washington	16	2,596,459	2,312,713	2,370,192	1.02	283,746
West Virginia	6	9,029,198	4,387,080	374,344	.09	5,627
Wisconsin	43	18,067,803	9,878,574	4,006,525	.40	620,957
	1,134	646,440,477	393,299,546	227,730,638	.58	42,264,619
1920.						
Alabama	18	53,012,968	22,501,364	2,906,670	.13	3,086,653
Arizona	9	467,721	401,000	707,570	1.76	64,858
California	55	18,701,226	16,039,094	15,889,262	.99	2,470,908
Colorado	15	10,792,008	6,745,614	2,783,706	.41	510,709
Connecticut	26	7,496,965	6,979,380	8,699,015	1.24	481,370

TABLE 6.—*Manufactured gas produced and sold in the United States in 1918 and 1920, by States*—Continued.

State.	Number of plants producing.	Gas produced (M).	Gas sold.			Unaccounted for (M).
			M.	Value.		
				Total.	Average.	
1920—Continued.						
Delaware	5	996,157	875,453	$1,289,323	$1.47	121,704
District of Columbia and Maryland	15	19,274,427	15,418,175	9,010,568	.58	686,169
Florida	16	1,284,892	1,106,960	1,867,042	1.68	171,890
Georgia	19	2,805,534	2,433,329	3,101,481	1.27	353,460
Idaho	3	117,594	97,893	185,948	1.90	19,082
Illinois	84	67,056,687	45,408,517	34,932,497	.77	3,527,147
Indiana	57	75,128,832	40,352,830	10,613,189	.26	2,536,687
Iowa	57	4,516,033	4,196,588	5,746,997	1.37	304,378
Kansas	8	182,594	154,301	251,293	1.63	71,683
Kentucky	10	7,593,234	3,386,040	394,698	.12	32,995
Louisiana	5	2,385,189	1,957,688	2,560,775	1.30	415,161
Maine	9	902,668	761,058	1,136,135	1.49	134,418
Massachusetts	66	26,338,001	21,686,474	24,450,554	1.13	1,028,983
Michigan	80	31,964,301	20,433,174	13,139,143	.64	1,241,687
Minnesota	27	13,294,551	8,426,583	5,411,715	.64	210,563
Mississippi	7	231,579	191,167	303,674	1.59	41,086
Missouri	26	10,796,594	8,528,028	7,694,288	.90	535,023
Montana	7	296,775	257,082	415,990	1.62	39,401
Nebraska	20	2,787,954	2,661,423	3,343,712	1.26	120,468
New Hampshire	13	939,741	854,542	1,346,297	1.58	80,997
New Jersey	36	27,924,604	24,648,308	22,028,838	.89	2,206,818
New York	97	98,517,671	77,518,626	65,891,275	.85	6,152,971
North Carolina	25	1,087,813	951,111	1,617,893	1.70	187,987
North Dakota	6	273,395	234,979	494,944	2.11	37,619
Ohio	27	86,389,429	44,879,579	4,613,096	.10	2,716,329
Oregon	7	3,374,929	2,823,354	2,452,364	.87	526,019
Pennsylvania	93	147,726,076	82,424,358	30,480,854	.37	4,862,765
Rhode Island	7	3,469,136	2,905,765	3,810,511	1.31	111,479
South Carolina	8	834,873	708,554	984,430	1.39	58,651
South Dakota	10	380,736	355,494	586,616	1.65	23,840
Tennessee	13	3,671,925	2,350,615	1,986,757	.84	143,479
Texas	20	3,329,011	2,934,228	3,440,921	1.17	382,867
Utah	5	631,656	560,760	632,558	1.13	67,583
Vermont	10	325,478	301,923	530,534	1.76	21,814
Virginia	21	2,952,061	2,645,832	3,087,881	1.17	297,189
Washington	16	2,846,922	2,545,467	3,580,181	1.41	279,744
West Virginia	6	6,576,509	3,503,932	361,064	.10	116,143
Wisconsin	43	16,294,242	8,544,609	5,933,812	.69	430,140
Arkansas, Oklahoma and New Mexico	5	111,298	96,092	180,929	1.88	15,031
Nevada and Wyoming	4	130,892	108,752	187,441	1.72	20,949
	1,116	766,212,881	492,896,095	311,064,441	.63	36,946,897

Table 7 gives the number of companies distributing manufactured gas during 1920, by States, as estimated by the engineers of the American Gas Association. The number of distributing companies is of course not usually the same as the number of manufacturing plants, for several plants may supply a single distributing system, or several distributing companies may be supplied from a single manufacturing plant. In general, however, there are a few more distributing companies in each State than there are manufacturing plants.

TABLE 7.—*Number of companies distributing manufactured gas in 1920, by States.*[3]

[Estimated by American Gas Association.]

Alabama	12	Maine	13	Oregon	11
Arizona	10	Maryland	13	Pennsylvania	81
Arkansas	1	Massachusetts	60	Rhode Island	8
California	56	Michigan	53	South Carolina	8
Colorado	10	Minnesota	23	South Dakota	9
Connecticut	25	Mississippi	8	Tennessee	8
Delaware	6	Missouri	24	Texas	16
District of Columbia	2	Montana	4	Utah	3
Florida	15	Nebraska	18	Vermont	9
Georgia	16	Nevada	2	Virginia	15
Hawaii	2	New Hampshire	11	Washington	12
Idaho	3	New Jersey	36	West Virginia	3
Illinois	66	New Mexico	2	Wisconsin	38
Indiana	42	New York	92	Wyoming	2
Iowa	56	North Carolina	20		
Kansas	6	North Dakota	5		966
Kentucky	9	Ohio	17		
Louisiana	4	Oklahoma	1		

KINDS OF GAS PRODUCED AND SOLD.

As shown in Table 8, the number of coal-gas plants operating (not in conjunction with water-gas plants) has been still further decreased during the last few years, but the total number of plants that had some coal-gas equipment has not decreased so greatly as the number of plants where only coal-gas equipment was used. This is the result of the installation of water-gas equipment in connection with coal-gas apparatus. The water-gas plants so installed provide for a minimum investment for the necessary new plant capacity; they also afford greater flexibility in operation and the minimum of difficulty from inadequate labor supply.

It is also evident from Table 8 that the number of oil-gas plants is continually decreasing. However, it appears that this is the result of the distribution from fewer large plants rather than of the discontinuance of the use of oil gas. In the Western States, where oil gas is more commonly supplied than elsewhere, long-distance, high-pressure transmission of gas has been accomplished to a much greater degree than in any other part of the United States. This has undoubtedly been the largest factor in producing a decrease in the number of plants while the quantity of gas produced and sold was increasing.

The number of by-product coke-oven plants increased by nearly 50 per cent between 1915 and 1918, and by 13 per cent more between 1918 and 1920. Many new installations were also made at old plants, greatly increasing their capacity, and thus the number of coke-oven plants indicated for 1920 is by no means indicative of the great increase in the number of ovens operated.

[3] Includes 46 municipal plants supplying manufactured gas to the public.

TABLE 8.—*Manufactured gas plants in the United States, 1915, 1918, and 1920.*

	1915	1918	1920
Coal-gas plants (only)	271	250	213
Coal-gas plants operated with water-gas plants	123	150	155
Coal-gas plants operated with oil-gas plants	2	3	1
	396	403	369
Water-gas plants (only)	430	431	445
Water-gas plants operated with coal-gas plants	123	150	155
Water-gas plants operated with oil-gas plants		3	
	553	584	600
Oil-gas plants (only)	91	81	78
Oil-gas plants operated with coal-gas plants	2	3	1
Oil-gas plants operated with water-gas plants		3	
	93	87	79
By-product coke-oven plants	41	60	68

In Tables 9 to 12 are given further details for each kind of gas, by States, for 1918 and 1920. This summary affords a detailed comparison of local conditions in any State between the two years and a more detailed analysis for each of the several kinds of gas with respect to the geographic distribution of the industry. In several States the number of companies reporting production was less than three, and in order to avoid disclosing individual operations such States are combined in geographic groups.

TABLE 9.—*Coal gas produced and sold in the United States in 1918 and 1920, by States.*

State.	Number of plants producing.	Gas produced (M).	Gas sold. M.	Gas sold. Value. Total.	Gas sold. Value. Average.	Gas unaccounted for. M.	Gas unaccounted for. Percentage of total produced.
1918.							
Alabama	11	781,437	636,710	$661,820	$1.04	144,727	19
Arkansas, Louisiana, and Oklahoma	3	74,523	63,453	81,363	1.28	11,070	15
California, New Mexico, and Wyoming	4	59,780	52,692	74,985	1.42	7,088	12
Colorado	7	1,655,731	1,458,430	1,227,938	.84	197,301	12
Connecticut	6	1,381,215	1,285,782	1,354,690	1.05	95,433	7
Delaware, Vermont, and West Virginia	6	110,610	97,879	140,596	1.44	12,731	12
District of Columbia and Maryland	5	98,342	81,204	118,785	1.46	17,138	17
Florida and South Carolina	5	419,429	355,770	462,228	1.30	63,659	15
Georgia	11	847,714	746,015	790,926	1.06	101,699	12
Idaho	3	92,657	78,433	129,124	1.65	14,224	15
Illinois	37	2,660,186	2,286,734	2,392,038	1.05	373,452	14
Indiana	27	1,668,828	1,431,337	1,429,624	1.00	237,491	14
Iowa	15	775,991	699,860	770,741	1.10	76,131	10
Kansas, Nebraska, and South Dakota	5	79,562	67,746	96,171	1.42	11,816	15
Kentucky	8	139,063	115,456	133,171	1.15	23,607	17
Maine	7	379,057	325,353	431,431	1.33	53,704	14
Massachusetts	31	5,749,292	5,388,115	5,640,203	1.05	361,177	6
Michigan	52	6,985,722	6,345,491	5,763,127	.91	640,231	9
Minnesota	8	1,054,690	984,043	918,606	.93	70,647	7
Mississippi	7	191,749	148,740	180,606	1.21	43,009	22
Missouri	8	4,758,170	4,068,189	3,006,193	.74	689,981	15
Montana	4	156,304	125,754	215,480	1.71	30,550	20

TABLE 9.—*Coal gas produced and sold in the United States in 1918 and 1920, by States*—Continued.

State.	Number of plants producing.	Gas produced (M).	Gas sold.			Gas unaccounted for.	
			M.	Value.		M.	Percentage of total produced.
				Total.	Average.		
1918—Continued.							
New Hampshire	3	141,428	127,371	$185,860	$1.46	14,057	10
New Jersey	4	262,345	227,942	249,295	1.09	34,403	13
New York	32	7,937,874	6,752,097	7,183,094	1.06	1,185,777	15
North Carolina	9	510,282	430,246	595,268	1.38	80,036	16
North Dakota	3	208,987	149,120	273,107	1.83	59,867	29
Ohio	9	303,441	248,893	288,207	1.16	54,548	18
Oregon	3	41,231	36,477	63,460	1.74	4,754	12
Pennsylvania	13	2,141,931	1,844,865	1,904,048	1.03	297,066	14
Rhode Island	3	639,315	613,340	643,016	1.05	25,975	4
Tennessee	6	593,354	509,967	453,913	.89	83,387	14
Texas	4	200,658	185,363	230,371	1.24	15,295	8
Utah	3	459,780	418,408	414,534	.99	41,372	8
Virginia	12	1,039,234	939,277	947,868	1.01	99,957	10
Washington	9	1,051,184	920,395	1,149,296	1.25	130,789	12
Wisconsin	20	2,835,450	2,412,540	2,245,781	.93	422,910	15
	403	48,486,546	42,659,487	42,846,964	1.00	5,827,059	12
1920.							
Alabama	7	562,659	490,444	681,941	1.39	71,348	13
California, New Mexico, and Wyoming	4	97,592	85,725	138,490	1.62	10,676	11
Colorado	7	1,610,401	1,376,701	1,409,859	1.02	229,433	14
Connecticut	5	2,063,911	1,956,217	2,402,240	1.23	93,534	5
Delaware and West Virginia	2	39,685	33,834	58,373	1.72	4,786	12
Florida and South Carolina	3	387,889	330,353	540,054	1.63	56,502	15
Georgia	11	819,743	711,666	932,518	1.31	106,892	13
Idaho	3	117,594	97,893	185,948	1.90	19,082	16
Illinois	33	2,379,376	2,106,398	2,502,380	1.19	256,305	11
Indiana	26	1,483,919	1,309,553	1,725,405	1.32	164,975	11
Iowa	7	299,473	263,685	414,122	1.57	33,826	11
Kansas	3	97,358	82,963	125,249	1.51	13,744	14
Kentucky	8	168,107	145,277	193,641	1.33	20,444	12
Louisiana and Oklahoma	2	40,756	31,637	55,804	1.76	8,798	22
Maine	4	523,973	431,078	633,485	1.47	87,640	17
Maryland	5	116,352	100,990	186,541	1.85	14,906	13
Massachusetts	26	4,922,576	4,579,204	6,108,269	1.33	322,331	7
Michigan	53	7,260,014	6,606,076	7,532,730	1.14	647,792	9
Minnesota	8	1,064,893	986,933	1,251,463	1.27	74,103	7
Mississippi	6	170,696	140,370	231,952	1.65	31,449	18
Missouri	10	2,942,855	2,747,799	2,327,062	.85	191,239	6
Montana	4	170,418	139,263	225,335	1.62	30,894	18
Nebraska and South Dakota	2	25,391	22,660	40,167	1.77	2,671	11
New Hampshire	3	151,186	138,151	225,920	1.64	11,371	8
New Jersey	5	312,354	276,383	389,767	1.41	33,558	11
New York	32	8,970,457	8,553,691	8,114,379	.95	408,863	5
North Carolina	9	589,972	514,817	838,292	1.63	74,002	13
North Dakota	3	238,916	201,378	424,892	2.11	36,776	15
Ohio	8	313,860	250,679	381,355	1.52	45,300	14
Oregon	3	53,096	47,312	86,419	1.83	5,560	10
Pennsylvania	12	2,646,819	2,322,669	2,592,780	1.12	311,408	12
Rhode Island and Vermont	4	434,874	404,090	527,782	1.31	29,278	7
Tennessee	7	638,584	344,681	628,926	1.82	105,819	17
Texas	3	186,202	168,480	230,559	1.37	16,869	9
Utah	3	492,572	437,125	494,949	1.13	53,106	11
Virginia	10	674,442	605,664	678,361	1.12	66,462	10
Washington	9	973,690	840,243	1,262,432	1.50	125,249	13
Wisconsin	19	3,335,846	3,066,045	3,153,338	1.03	274,359	8
	369	47,378,501	42,948,127	49,933,179	1.16	4,091,350	9

TABLE 10.—*Water gas produced and sold in the United States in 1918 and 1920, by States.*

State.	Number of plants producing.	Gas produced (M).	Gas sold.			Gas unaccounted for.	
			M.	Value.		M.	Percentage of total produced.
				Total.	Average.		
1918.							
Alabama	5	594,357	486,396	$482,210	$0.99	107,961	18
Arkansas, Louisiana, Mississippi, and Oklahoma	5	126,966	102,754	145,108	1.41	24,212	25
Colorado	6	478,211	477,104	396,619	.83	1,107	....
Connecticut	22	5,427,112	4,909,509	5,304,763	1.08	517,603	10
Delaware	4	851,126	745,359	793,121	1.06	105,767	12
District of Columbia and Maryland	10	10,055,419	9,494,456	7,210,551	.76	560,963	6
Florida	14	806,195	716,248	1,013,635	1.42	89,947	11
Georgia	7	1,323,229	1,205,289	1,259,371	1.05	117,940	9
Illinois	43	28,383,751	26,049,756	20,227,700	.78	2,333,995	8
Indiana	20	3,120,642	2,611,282	2,247,604	.86	509,360	16
Iowa	52	3,471,837	3,207,294	3,470,082	1.08	264,543	8
Kansas	6	90,887	79,880	106,210	1.33	11,007	12
Kentucky and West Virginia	3	80,395	63,467	95,171	1.50	16,928	21
Maine	5	412,892	377,240	471,216	1.25	35,652	9
Massachusetts	38	12,868,652	12,160,284	11,482,855	.94	708,368	6
Michigan	21	4,144,305	3,896,968	3,033,475	.78	247,337	6
Minnesota	13	2,536,877	2,491,264	2,032,058	.82	45,613	2
Missouri	15	3,122,493	2,626,461	2,309,476	.88	496,032	16
Montana, Oregon, and Utah	5	219,063	198,185	244,926	1.24	20,878	10
Nebraska	17	1,708,077	1,565,551	1,920,269	1.23	142,526	8
New Hampshire	8	660,723	597,801	746,978	1.25	62,922	10
New Jersey	30	15,064,627	13,243,805	12,811,536	.97	1,820,822	12
New York	61	66,968,260	61,758,851	49,529,817	.80	5,209,409	8
North Carolina	13	284,915	241,819	353,999	1.46	43,096	15
North Dakota	3	27,111	25,234	41,471	1.64	1,877	7
Ohio	6	207,352	175,257	191,602	1.09	32,095	16
Pennsylvania	70	18,842,972	16,124,817	16,938,479	1.05	2,718,155	14
Rhode Island	4	2,462,968	2,359,355	2,491,685	1.06	103,613	4
South Carolina	7	551,755	489,723	618,816	1.26	62,032	11
South Dakota	8	285,724	255,938	394,809	1.54	29,786	10
Tennessee	3	921,362	772,048	676,217	.88	149,314	16
Texas	16	2,388,464	2,028,781	2,236,995	1.10	359,683	15
Vermont	8	220,182	198,073	259,456	1.31	22,109	10
Virginia	10	1,544,105	1,390,061	1,323,265	.95	154,044	10
Washington	6	1,078,385	953,093	1,074,914	1.13	125,292	12
Wisconsin	20	1,715,589	1,518,020	1,490,213	.98	197,569	12
	584	193,046,980	175,597,423	155,426,672	.89	17,449,557	9
1920.							
Alabama	4	697,392	679,250	659,126	.98	16,107	2
Arkansas, Mississippi, and Oklahoma	3	110,276	92,716	148,006	1.60	17,471	16
California, Oregon, and Utah	4	517,648	432,043	514,591	1.19	84,686	16
Colorado	6	1,053,242	892,144	857,590	.96	142,831	14
Connecticut	21	5,433,054	5,023,163	6,296,775	1.25	387,836	7
Delaware	3	980,157	860,953	1,259,073	1.46	120,204	12
District of Columbia and Maryland	9	9,510,682	8,814,815	7,857,036	.89	671,263	7
Florida	14	954,592	824,960	1,400,042	1.70	124,590	13
Georgia	8	1,985,791	1,721,663	2,168,963	1.26	246,568	12
Illinois	44	31,972,717	29,508,769	30,250,219	1.03	2,423,676	8
Indiana	25	4,276,380	3,906,127	3,988,919	1.02	359,178	8
Iowa	50	4,216,560	3,932,903	5,332,875	1.36	270,552	6
Kansas	5	85,236	71,338	126,044	1.77	57,939	68
Kentucky and West Virginia	3	98,351	80,352	145,470	1.81	16,688	17
Louisiana	3	2,345,989	1,925,263	2,506,175	1.30	408,571	17
Maine	5	378,695	329,980	502,650	1.52	46,778	12
Massachusetts	39	15,105,312	14,343,454	17,116,223	1.19	706,652	5
Michigan	24	5,046,409	4,637,156	4,426,420	.95	403,532	8
Minnesota	16	3,111,981	3,010,115	3,404,615	1.13	79,937	3
Missouri	14	4,290,749	3,935,881	3,894,568	.99	343,780	8
Montana	3	126,357	117,819	190,655	1.62	8,507	7
Nebraska	19	2,773,563	2,648,763	3,323,045	1.25	118,797	4
New Hampshire	8	776,482	707,295	1,098,750	1.55	66,972	9
New Jersey	29	17,106,661	14,887,165	18,249,692	1.23	2,173,260	13
New York	61	70,763,140	64,865,249	57,191,012	.88	5,744,108	8

TABLE 10.—*Water gas produced and sold in the United States in 1918 and 1920, by States*—Continued.

State.	Number of plants producing.	Gas produced (M).	Gas sold.			Gas unaccounted for.	
			M.	Value. Total.	Value. Average.	M.	Percentage of total produced.
1920—Continued.							
North Carolina	16	497,841	436,294	$779,601	$1.79	113,985	23
North Dakota	3	34,479	33,601	70,052	2.08	843	2
Ohio	7	181,941	158,138	196,671	1.24	22,045	12
Pennsylvania	67	22,234,551	19,555,702	21,596,745	1.10	3,219,807	14
Rhode Island	4	1,204,584	1,111,815	1,432,208	1.29	88,131	7
South Carolina	7	777,284	660,201	911,376	1.38	49,449	7
South Dakota	9	369,736	345,494	567,116	1.64	22,840	6
Tennessee	5	1,263,814	1,070,807	1,287,161	1.20	37,660	3
Texas	16	3,132,809	2,756,748	3,192,362	1.16	364,998	12
Vermont	8	246,414	229,578	407,078	1.77	15,884	6
Virginia	11	2,277,619	2,040,168	2,409,520	1.18	230,727	10
Washington	6	1,457,676	1,312,358	1,810,859	1.38	131,805	9
Wisconsin	21	2,682,657	2,530,032	2,473,843	.98	140,119	5
	600	220,078,821	200,490,272	210,043,126	1.05	19,478,776	9

TABLE 11.—*Oil gas produced and sold in the United States in 1918 and 1920, by States.*

State.	Number of plants producing.	Gas produced (M).	Gas sold.			Gas unaccounted for.	
			M.	Value. Total.	Value. Average.	M.	Percentage of total produced.
1918.							
Arizona	8	478,366	295,038	$480,684	$1.63	183,328	38
California	53	16,777,938	14,104,207	13,238,733	.94	2,673,731	16
Iowa, Minnesota, Missouri, and Wisconsin	4	14,026	12,651	22,411	1.77	1,375	10
Michigan	3	1,805	1,423	2,071	1.46	382	21
Nevada	4	66,669	55,383	100,887	1.82	11,286	17
New Hampshire, Ohio, and Pennsylvania	4	23,107	21,261	30,693	1.44	1,846	8
New Mexico and Texas	5	67,972	57,143	78,414	1.37	10,829	16
Oregon	6	2,441,914	2,137,051	1,803,594	.84	304,863	13
	87	19,871,797	16,684,157	15,757,487	.94	3,187,640	16
1920.							
Arizona	9	467,721	401,000	707,570	1.76	64,858	14
California	53	18,361,210	15,764,652	15,573,947	.99	2,404,847	13
Colorado, Nevada, New Mexico, and Texas	5	100,689	84,389	167,841	1.99	15,879	16
Delaware, New Hampshire, and Pennsylvania	4	29,283	25,096	54,627	2.18	3,864	13
Illinois, Louisiana, Missouri, and Wisconsin	5	28,267	25,182	48,041	1.91	3,046	11
Oregon	3	3,282,645	2,741,458	2,301,792	.84	516,311	16
	79	22,269,815	19,041,777	18,853,818	.99	3,008,805	14

TABLE 12.—*Coke-oven gas produced and sold in the United States in 1918 and 1920, by States.*

State.	Number of plants producing.	Gas produced (M).	Gas used in process (M).	Gas sold.			Gas wasted (M).
				M.	Value.		
					Total.	Average.	
1918.							
Alabama	5	44,312,157	27,346,587	15,321,369	$652,305	$0.04	1,644,201
Colorado	1	3,588,275	1,610,401	1,590,144	(a)	(a)	387,730
Illinois	4	35,509,128	21,848,970	13,274,750	1,109,957	.08	385,408
Indiana	6	54,123,450	24,935,658	26,738,285	2,208,312	.08	2,449,507
Kentucky	1	8,021,323	3,893,599	4,127,724	18,875	.05	....
Maryland	1	9,137,341	6,948,143	2,189,198	(a)	(a)	....
Massachusetts	1	6,768,000	3,384,000	2,829,288	(a)	(a)	554,712
Minnesota	3	10,428,585	5,217,764	5,102,957	605,915	.12	107,864
New Jersey	2	8,830,973	3,610,351	5,220,622	(a)	(a)	....
New York	4	17,992,360	13,360,118	4,632,242	522,954	.11	....
Ohio	13	77,844,890	35,680,775	36,638,953	2,109,790	.06	5,525,162
Pennsylvania	10	66,497,490	40,126,614	22,033,796	1,828,554	.08	4,337,080
Tennessee	1	676,125	379,321	296,804	39,597	.13	....
Washington	1	466,890	....	439,225	145,982	.33	27,665
West Virginia	2	8,973,492	4,636,491	4,337,001	299,522	.07	....
Michigan, Missouri, and Wisconsin	5	31,864,675	17,897,520	13,586,121	[b] 4,157,752	[b] .16	381,034
	60	385,035,154	210,876,312	158,358,479	13,699,515	.09	15,800,363
1920.							
Alabama	7	51,752,917	27,422,049	21,331,670	1,565,603	.07	2,999,198
Colorado	1	8,122,365	3,513,151	4,470,986	(a)	(a)	138,228
Illinois	5	32,692,774	18,064,052	13,783,152	2,162,467	.16	845,570
Indiana	6	69,368,533	32,218,849	35,137,150	4,898,865	.14	2,012,534
Kentucky	1	7,365,332	4,171,288	3,194,044	124,762	.04	....
Maryland	1	9,647,393	3,145,023	6,502,370	(a)	(a)	....
Massachusetts	1	6,310,113	3,546,297	2,763,816	(a)	(a)	....
Michigan	3	19,657,878	10,277,573	9,189,942	1,179,993	.13	190,363
Minnesota	3	9,117,677	4,631,619	4,429,535	755,637	.17	56,523
New Jersey	2	10,505,589	1,020,829	9,484,760	(a)	(a)	....
New York	4	18,784,074	14,684,388	4,099,686	585,884	.14	....
Ohio	12	85,893,628	38,773,882	44,470,762	4,035,070	.09	2,648,984
Pennsylvania	13	122,840,496	60,967,169	60,541,987	6,282,329	.10	1,331,340
Tennessee	1	1,769,527	834,400	935,127	70,670	.08	....
Washington	1	415,556	....	392,866	506,890	1.29	22,690
West Virginia	3	6,501,268	2,954,583	3,438,965	239,766	.07	107,720
Missouri, Rhode Island, and Wisconsin	4	15,740,624	9,476,707	6,249,101	[b] 9,826,382	[b] .33	14,816
	68	476,485,744	235,701,859	230,415,919	32,234,318	.14	10,367,966

[a] Included in combined States.
[b] Includes also output of States shown as "(a)" above.

CAPACITY OF GAS PLANTS.

The number of gas plants has not materially changed during recent years, but the total production and sales of gas have been increasing each year. It is obvious, therefore, that the average sales per plant must have increased. This fact is brought out strikingly in Table 13, which shows the number of plants and the average sales per plant for each kind of gas during the period 1898 to 1920. These data are shown graphically also in figure 23.

TABLE 13.—*Number and average sales per plant for each kind of gas, 1898–1920.*

Year.	Coke-oven gas.		Coal gas.		Water gas.		Oil gas.		Total.	
	Plants.	Average sales. (M).	Plants.	Average sales (M).	Plants.	Average sales (M).	Plants.	Average sales (M).	Plants.	Average sales (M).
1898	(a)	(a)	433	42,566	(a)	(a)	(a)	(a)	....	....
1902	(a)	(a)	522	48,024	(a)	(a)	(a)	(a)	....	....
1903	(a)	(a)	514	49,942	(a)	(a)	(a)	(a)	....	....
1904	(a)	(a)	514	58,579	(a)	(a)	(a)	(a)	....	....
1905	(a)	(a)	508	60,477	b 477	b 162,289	(b)	(b)	....	....
1907	(a)	(a)	493	69,580	b 520	b 181,990	(b)	(b)	....	....
1908	(a)	(a)	482	77,502	b 552	b 187,224	(b)	(b)	....	....
1912	29	1,879,009	424	83,024	b 604	b 203,142	(b)	(b)	1,057	200,938
1915	41	2,057,461	396	110,473	552	224,872	93	150,229	1,082	246,030
1917	55	2,382,302	402	106,785	579	265,039	86	171,390	1,122	304,948
1918	60	2,639,308	403	105,855	584	300,681	87	191,772	1,134	346,825
1920	68	3,388,469	369	116,390	600	334,150	79	241,035	1,116	441,663

a Statistics not available.
b Figures for oil gas included with water gas.

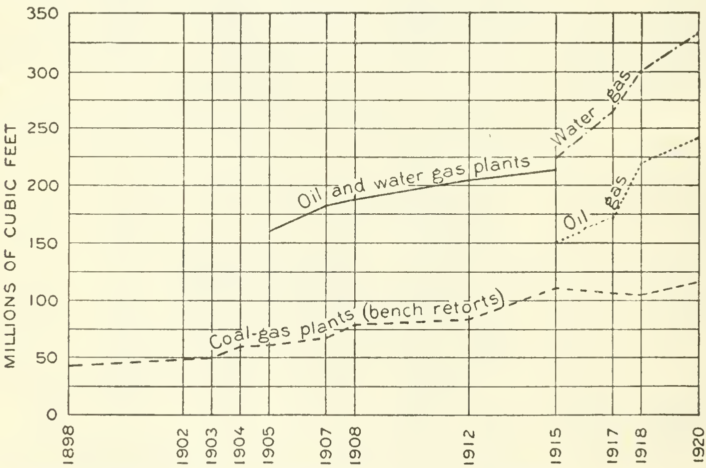

FIGURE 23.—Manufactured gas sold per plant in the United States, 1898–1920.

The data and the curve in figure 23 show a marked increase in sales of water gas per plant during recent years. This has resulted not only from the increasing number of water-gas machines but also from increasing capacity per machine. Similarly, in oil-gas plants the output increased still further in 1920 as compared with 1918, but not at so great a percentage rate as during the previous period. The sales per plant by coal-gas plants in 1920 were a trifle greater than during any previous year for which data are available. But the increase is by no means so conspicuous for coal-gas plants as for oil-gas or water-gas plants.

The sales per plant by coke-oven gas plants are of course not strictly comparable with the sales per plant by other manufactured-gas works, but they are included in Table 13 for convenience of comparison. In 1920 they were more than 10 times as great as the sales per plant by water-gas plants and 30 times as great as the sales per plant by coal-gas plants. The large operating units used in the coke-oven industry and the tendency to increase largely the number of ovens per plant have brought about great increases in sales per plant during recent years. In the eight years from 1912 to 1920 the sales per plant have nearly doubled.

Similarly, the war-time demand for increased capacity with minimum extra investment undoubtedly lay at the root of the increasing output from water-gas plants. To some extent these two factors will probably continue, but it is unlikely that the rate of increase in output per plant will be anything like as great during the next few years as during the period from 1915 to 1920.

In considering the sales of coke-oven gas it should be understood, of course, that only the gas sold or used otherwise than for coking operations is included. If the total gas produced per plant were shown, the contrast between coke-oven gas and other types of gas would be even more striking than appears in Table 13.

GAS USED BY THE MANUFACTURER.

One of the reasons why the sale of gas is always less than the quantity of gas produced is that the gas works themselves are large consumers of gas. In general, separate account is kept of the quantity so used by the producer, and in the returns for 1920 separate entry was made of this item.

Table 14 summarizes the quantity of gas used by the manufacturer. In general terms, a gas company can be expected to use between 0.1 and 2 per cent of the gas it manufactures. Only in very small coal-gas companies is there any evidence of the use of more than 2 per cent, and the larger companies of this type almost invariably use less than 1 per cent of their product. A few of the larger water-gas plants estimated that more than 2 per cent was consumed in their own operations, but it is quite as likely that such estimates were rather generous and that this greater quantity of gas was not actually so employed. The gas so used is not generally metered separately, and hence it is not strange that errors in estimating will often occur.

In Table 14 and in similar tables throughout this report all the plants supplying coal, water, or oil gas are grouped according to their sales, as follows: Class A, plants selling less than 20,000 M cubic feet of gas a year; B, 20,000 to 50,000 M; C, 50,000 to 100,000 M; D, 100,000 to 200,000 M; E, 200,000 to 500,000 M; F, 500,000 to 1,000,000 M; G, 1,000,000 M or more.

TABLE 14.—*Number of plants using different percentages of gas in 1920, by size of plant.*

Coal-gas plants.

	A. 1-20,000 M.	B. 20,000-50,000 M.	C. 50,000-100,000 M.	D. 100,000-200,000 M.	E. 200,000-500,000 M.	F. 500,000-1,000,000 M.	G. 1,000,000 M. or more.	Total.
Total sales of gas by coal-gas plants........M..	1,419,852	3,934,443	3,433,883	4,342,237	9,259,920	6,127,324	14,430,468	42,948,127
Number of plants using gas [a].......	61	84	40	21	24	8	6	244
Percentage of gas used by company:								
Minimum......	0.2	0.03	0.03	0.07	0.4	0.2	0.2	0.03
Maximum......	15.3	3.1	16.8	1.7	1.0	.8	.4	16.8
Average [b]......	1.3	.8	.5	.6	.4	.5	.3	.77

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.
[b] Exclusive of all plants using less than 0.1 or more than 3.0 per cent.

TABLE 14.—*Number of plants using different percentages of gas in 1920, by size of plant*—Continued.

Coal-gas plants—Continued.

	A. 1–20,000 M.	B. 20,000–50,000 M.	C. 50,000–100,000 M.	D. 100,000–200,000 M.	E. 200,000–500,000 M.	F. 500,000–1,000,000 M.	G. 1,000,000 M. or more.	Total.
Number of plants using—								
Less than 0.1 per cent		1	2	1				4
0.1–0.4 per cent	10	26	25	10	17	3	6	97
0.5–0.9 per cent	12	34	5	5	6	5		67
1.0–1.4 per cent	7	12	4	3	1			27
1.5–1.9 per cent	13	6	4	2				25
2.0–2.4 per cent	3	1						4
2.5–2.9 per cent	3	2						5
3.0 or more per cent	13	2						15

Oil-gas plants.

	A.	B.	C.	D.	E.	F.	G.	Total.
Total sales of gas by oil-gas plants, M.	387,130	536,722	524,266	406,920	1,780,127	1,632,252	13,774,360	19,041,777
Number of plants using gas [a]	15	12	4	2	6	1	3	43
Per centage of gas used by company:								
Minimum	0.03	0.3	0.4	1.0	0.1	11.5	0.3	.03
Maximum	2.7	3.0	2.9	1.4	1.1	11.5	.76	11.5
Average [b]	1.0	1.1	1.4	1.2	.5	11.5	.45	1.22
Number of plants using—								
Less than 0.1 per cent								
0.1–0.4 per cent	4	2	1		2		2	11
0.5–0.9 per cent	5	2	1		3		1	12
1.0–1.4 per cent	2	6		2	1			11
1.5–1.9 per cent	3	1	1					5
2.0–2.4 per cent								
2.5–2.9 per cent	1		1					2
3.0 or more per cent		1				1		2

Water-gas plants.

	A.	B.	C.	D.	E.	F.	G.	Total.
Total sales of gas by water-gas plants, M.	2,120,753	4,370,234	4,901,467	7,694,304	16,982,423	26,307,425	138,113,666	200,490,272
Number of plants using gas [a]	81	80	44	45	43	32	28	353
Percentage of gas used by company:								
Minimum	0.1	0.1	0.07	0.01	0.1	0.05	0.1	0.01
Maximum	11.0	3.9	2.7	1.6	5.6	1.0	.8	11.0
Average [b]	.8	.7	.6	.4	.5	.4	.3	.6
Number of plants using—								
Less than 0.1 per cent			2	1		1	1	5
0.1–0.4 per cent	29	28	16	30	25	23	23	174
0.5–0.9 per cent	20	31	19	10	12	7	3	102
1.0–1.4 per cent	13	10	4	3	4	1		35
1.5–1.9 per cent	5	5	2	1	1			14
2.0–2.4 per cent	1	4						5
2.5–2.9 per cent	5		1					6
3.0 or more per cent	8	2			1		1	12

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.
[b] Exclusive of all plants using less than 0.1 or more than 3.0 per cent.

The one large oil-gas plant reporting that it used more than 11 per cent of its product was employing this gas in a special process, which involved the "reforming" of natural gas in special oil-gas machines. This process requires prior mixing of the natural gas with some finished oil gas, and it is the oil gas so employed that has been included in this 11 per cent. In general oil-gas companies, like coal-gas and water-gas companies, consume not more than 2 per cent of their own product.

GAS UNACCOUNTED FOR.

In the manufacture and distribution of gas there are leakages and uses of gas which are not accurately measurable and which amount to a considerable percentage of the total gas produced. The difference between production and sales—except gas used by the manufacturer—is here considered as a whole and called "unaccounted for." This includes the decrease in volume due to change in temperature, the actual leakage during distribution, and the net losses, if any, due to inaccuracy of meters. Tables 9 to 13 indicate the quantity of gas unaccounted for, by kinds of gas and by States. The magnitude of this loss measured in percentages of the quantities shown in Table 4 is rather appalling, but only a small part of it is unavoidable.

To show in what classes of companies the percentage of gas unaccounted for is largest, a comparsion of percentages according to the size of the plant is presented in Table 15.

TABLE 15.—*Number of coal, water, and oil gas plants reporting different percentages of gas unaccounted for, 1918 and 1920, by size of plant.*

	A. 1–20,000 M.		B. 20,000–50,000 M.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M).	4,377,073	3,927,735	8,245,525	8,841,399
Number of plants reporting gas unaccounted for [a]	430	299	257	259
Percentage reported:				
Minimum	0.4	0.2	2.5	0.2
Maximum	52.0	40.0	46.5	36.7
Average	13.3	10.8	13.7	12.0
Number of plants reporting:				
Less than 5 per cent	45	45	16	29
5–9.9 per cent	136	80	72	65
10–14.9 per cent	101	81	68	81
15–19.9 per cent	68	42	60	52
20–24.9 per cent	42	22	23	21
25 per cent or more	38	29	18	11

	C. 50,000–100,000 M.		D. 100,000–200,000 M.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M).	9,340,761	8,859,616	10,616,777	12,443,461
Number of plants reporting gas unaccounted for [a]	134	125	74	87
Percentage reported:				
Minimum	0.4	1.4	2.0	1.9
Maximum	40.7	45.4	26.2	31.7
Average	12.3	10.9	12.2	10.2
Number of plants reporting:				
Less than 5 per cent	8	13	2	8
5–9.9 per cent	49	44	27	41
10–14.9 per cent	39	41	23	23
15–19.9 per cent	22	15	12	10
20–24.9 per cent	9	8	8	4
25 per cent or more	7	4	2	1

a Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

TABLE 15.—*Number of coal, water, and oil gas plants reporting different percentages of gas unaccounted for, 1918 and 1920, by size of plant*—Continued.

	E. 200,000–500,000 M.		F. 500,000–1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M).	27,395,047	28,022,470	20,171,972	34,067,001
Number of plants reporting gas unaccounted for [a]	83	86	30	49
Percentage reported:				
Minimum	1.2	1.2	2.6	1.0
Maximum	29.0	23.1	38.9	24.5
Average	10.8	10.2	10.6	9.3
Number of plants reporting:				
Less than 5 per cent	9	16	4	14
5–9.9 per cent	27	27	11	13
10–14.9 per cent	32	30	10	14
15–19.9 per cent	9	10	2	7
20–24.9 per cent	4	3	2	1
25 per cent or more	2	....	1	....

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M).	154,793,912	166,318,494	234,941,067	262,480,176
Number of plants reporting gas unaccounted for [a]	40	43	1,048	948
Percentage reported:				
Minimum	1.1	1.7	0.4	0.2
Maximum	24.2	17.4	52.0	45.4
Average	9.9	8.6	12.7	10.8
Number of plants reporting:				
Less than 5 per cent	10	9	94	134
5–9.9 per cent	11	18	333	288
10–14.9 per cent	13	12	286	282
15–19.9 per cent	4	4	177	140
20–24.9 per cent	2	....	90	59
25 per cent or more	....	....	68	45

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

Table 15 shows that very few plants can claim to have less than 5 per cent of their gas unaccounted for. The greater number report such losses to be between 5 and 15 per cent of the production. Most of the plants that report large percentages of gas unaccounted for are those making less than 50,000,000 cubic feet of gas a year, although there are a considerable number of the medium-sized plants that find it impracticable to keep the gas unaccounted for below 15 per cent.

A comparison of results for 1918 and 1920 is significant in a few particulars. Almost 2 per cent less of the total production was unaccounted for in 1920 than in 1918. This lower percentage has resulted largely because of the great decrease in the number of companies with unaccounted for percentages above 15 per cent.

No definite conclusions regarding the gas unaccounted for in any particular locality can be reached without careful consideration of local conditions—the length of the distribution system relative to the quantity of gas sold, the age and condition of the distribution system, and many other factors of engineering significance. The loss of over 30,000,000,000 cubic feet of gas during distribution can be better understood by remembering that this gas was handled through many thousands of miles of distributing system for the supply of many millions of buildings. The unavoidable leakages and other losses that do not represent actual waste should be reduced to the lowest practicable figure. That some progress has been made to this end is evident from the lower average percentage of loss in 1920 than in 1918. However, there is a limit below which it is impracticable to go in this endeavor, for it usually costs more to keep the losses below 7 or 8 per cent of the total gas distributed than the gas saved is worth. Under these conditions the gas companies can not be expected to undertake measures of economy that would make the average much below these figures.

UTILIZATION OF GAS.

In previous years it has been customary for the Geological Survey to ask companies to report their estimates of the quantity of gas sold by them for illumination, domestic fuel, and industrial fuel; but it has become more and more evident in recent years that such estimates were at best only crude approximations. Practically all the gas sold for these several purposes is distributed together, and only under exceptional conditions are two separate distributing systems or two separate sets of meters used for gas burned for different purposes. Because of these facts the Survey is no longer undertaking to summarize the sales of gas according to the use made of it.

In most municipalities the sales of gas have been increasing more rapidly than the population. This fact is most strikingly brought out by the figures in the first column of Table 16, which show that the sales of gas per person in the United States have been more than doubled in the last eight years. This has resulted in part from an extension of gas-distribution systems, both farther into the suburbs and into communities not previously supplied with gas, but the larger factor has been the many new applications of gas made possible by more efficient appliances and more vigorous selling effort in the larger cities of the country. Between 1918 and 1920 there was the surprising increase in the sales per capita of 950 cubic feet, resulting in total sales per person in the entire United States of 4,632 cubic feet in 1920. It is not possible to report the sales per capita of the population in territory actually supplied with gas. If that were done, the figures would of course be larger than those here shown. The rate of growth, however, would be none the less striking on that basis than on the basis here used. The curve shown in figure 24 gives a graphic presentation of these same facts.

TABLE 16.—*Per capita consumption and average price of gas, 1898–1920.*

Year.	Per capita consumption in the United States.	Average price per M.				
		Coke-oven gas.	Coal gas.	Water gas.	Oil gas.	Total average.
	Cubic feet.					
1898	726	...	$1.17	...	...	...
1902	1,098	$1.01		...	...	...
1903	1,192	.98		...	...	...
1904	1,330	.92		...	...	...
1905	1,402	.81		$1.01		$0.94
1907	1,712	$0.15	.97	.95		.85
1908	1,764	.16	.93	.93		.85
1912	2,226	.09	.91	.91		.70
1915	2,648	.10	.92	$0.90	$0.91	.65
1917	3,254	.09	.89	.86	.91	.57
1918	3,683	.09	1.00	.89	.94	.58
1920	4,632	.14	1.16	1.05	.99	.63

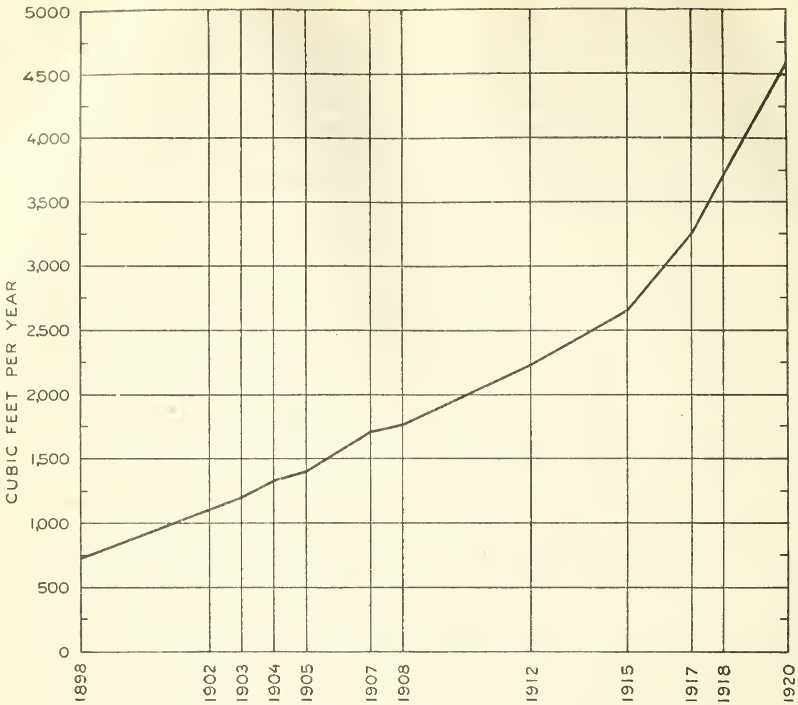

FIGURE 24.—Manufactured gas sold per capita in the United States, 1898–1920.

PRICE OF GAS.

In Tables 6, 9, 10, 11, and 12 are given data, by States, for the average price of gas sold. These figures show surprising variations from 4 cents per M for coke-oven gas in Kentucky to $2.11 per M for coal gas in North Dakota. Obviously, the 4-cent price is the income at the coke oven, and the high price of coal gas mentioned is the charge to consumers. Therefore the two are not comparable. Such comparisons should consider only coal gas, water gas, and oil gas, the prices recorded for which are those charged to ultimate users.

Table 16 gives the average prices per M for each of the several kinds of gas for a number of years. Before the World War the price of coke-oven gas had tended to decrease in comparison with prices realized in 1907 and 1908, but owing to the influence of high fuel costs, during and since the war the average price per M in 1920 represents an advance of 55 per cent over that realized by coke-oven operators in 1918. With other gases costing from 50 to 200 per cent more per M than coke-oven gas, even at the highest prices realized in any year recorded, it is not to be expected that the price of coke-oven gas will materially decrease in the near future.

Through the influence of public regulation the average price of coal gas, water gas, and oil gas tended to decrease steadily from 1898 to 1917. Early in the war period, however, the cost of fuel increased so much that public-utility companies were compelled to seek relief through higher prices for gas, and as a result slight increases were recorded in the average price of both water gas and oil gas for 1918 and a larger increase in that of coal gas. But the full influence of price increases was not felt until later, as shown by the fact that averages for 1920 are higher than those for 1918 by sums greater than the difference between the averages for 1917 and 1918. For both coal gas and water gas the average increase in price from 1918 to 1920 was 16 cents; for oil gas and coke-oven gas it was 5 cents.

As coke-oven gas is a by-product rather than a principal product it is not surprising that the increase in price of this gas was much less than that recorded for coal gas or water gas. That the increase in price of oil gas was also relatively small is probably explained by the fact that there was no such relative increase in the price of petroleum in the far Western States during this interval as was experienced in the price of gas oil in the Eastern States. Therefore the increase in prices of oil gas was less than was found necessary for water gas, which is made by a somewhat similar process.

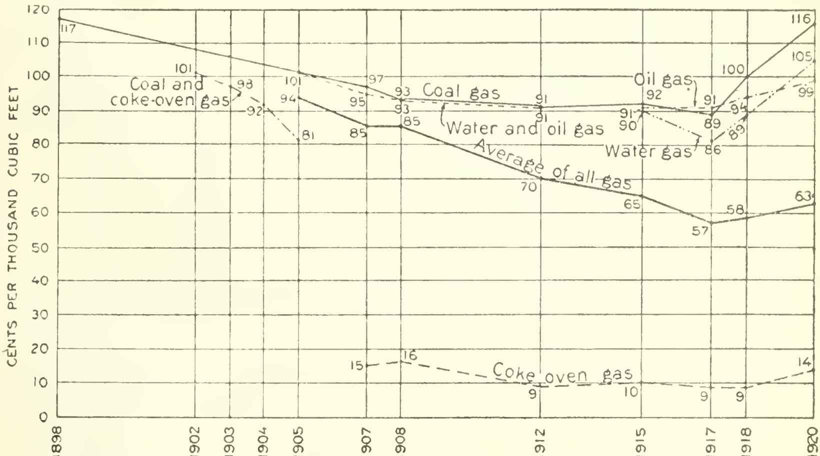

FIGURE 25.—Average price of manufactured gas sold in the United States, 1898–1920.

The average price data discussed above are presented graphically in figure 25, which shows clearly the abrupt change in the price curves that occurred during 1917 and 1918, when for the first time in many years there was a distinct tendency for these prices to increase.

In considering the price of gas it is especially important to keep in mind the size of the plant. Most small plants incur costs materially greater per M of gas sold than the large plants. To bring out the extent to which this difference affects price, Table 17 has been prepared. From this table it is evident that the increases in price of gas have been distributed over plants of all sizes, for there is a general tendency shown by the figures of 1920 for a larger number of plants in each of the higher price groups. As in 1918, for which a similar analysis of the data was made, the average price realized per M decreased materially as the size of the company increased.

In using the data in these tabulations one should not assume that the price of gas in any community should be approximately a certain amount simply because other companies of the same size and apparently working under similar conditions charge that amount. Local conditions, such as the cost of fuel, the number of customers, the number of miles of mains, and other factors, affect the proper average price fully as much as the kind of gas and the size of the undertaking. This fact is well illustrated by the wide range of prices within each of the several size groups recorded in Table 17.

TABLE 17.—*Number of coal, water, and oil gas plants reporting different average prices of gas in 1918 and 1920 by size of plant.*

	A. 1-20,000 M.		B. 20,000-50,000 M.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M)	4,377,073	3,927,735	8,245,525	8,841,399
Total number of plants reporting price [a]	442	377	257	281
Price per M cubic feet:				
Minimum	$0.48	$0.94	$0.71	$0.80
Maximum	5.56	5.94	2.37	2.94
Average	1.48	1.70	1.32	1.73
Number of plants selling gas at—				
Less than $0.60 per M cubic feet	1	2		
$0.60-$0.69				
$0.70-$0.79	3		2	
$0.80-$0.89	3	1	4	3
$0.90-$0.99	18	2	9	2
$1.00-$1.09	22	8	24	5
$1.10-$1.19	20	8	40	8
$1.20-$1.29	47	9	46	14
$1.30-$1.39	56	17	38	21
$1.40-$1.49	72	27	32	35
$1.50-$1.74	133	99	53	94
$1.75-$1.99	47	90	6	77
$2.00-$2.49	15	92	3	19
$2.50-$2.99	3	15		3
$3.00 or more	2	7		

	C. 50,000-100,000 M.		D. 100,000-200,000 M.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M)	9,340,761	8,859,616	10,616,777	12,443,461
Total number of plants reporting price [a]	134	133	75	98
Price per M cubic feet:				
Minimum	$0.71	$0.65	$0.55	$0.62
Maximum	1.92	2.34	2.39	2.45
Average	1.22	1.45	1.11	1.30
Number of plants selling gas at—				
Less than $0.60 per M cubic feet			1	
$0.60-$0.69		1		1
$0.70-$0.79	1		2	1
$0.80-$0.89	8		7	4
$0.90-$0.99	13	3	10	5
$1.00-$1.09	22	3	18	10
$1.10-$1.19	24	16	16	9
$1.20-$1.29	23	13	13	12
$1.30-$1.39	16	27	3	19
$1.40-$1.49	15	16	3	18
$1.50-$1.74	11	37	1	14
$1.75-$1.99	1	13		2
$2.00-$2.49		4	1	2
$2.50-$2.99				
$3.00 or more				1

a Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

Table 17.—*Number of coal, water, and oil gas plants reporting different average prices of gas in 1918 and 1920, by size of plant*—Continued.

	E. 200,000–500,000 M.		F. 500,000–1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M)	27,395,047	28,022,470	20,171,972	34,067,001
Total number of plants reporting price [a]	86	105	32	61
Price per M cubic feet:				
Minimum	$0.66	$0.66	$0.69	$0.56
Maximum	1.55	4.66	1.27	1.72
Average	1.03	1.23	.97	1.12
Number of plants selling gas at—				
Less than $0.60 per M cubic feet				3
$0.60–$0.69	2	2	1	2
$0.70–$0.79	3	3	2	4
$0.80–$0.89	9	5	4	3
$0.90–$0.99	26	6	11	4
$1.00–$1.09	21	7	10	7
$1.10–$1.19	12	19	4	10
$1.20–$1.29	6	20		17
$1.30–$1.39	5	13		5
$1.40–$1.49	1	17		5
$1.50–$1.74	1	11		1
$1.75–$1.99				
$2.00–$2.49				
$2.50–$2.99				
$3.00 or more		2		

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by all coal, water, and oil gas plants (M)	154,793,912	166,318,494	234,941,067	262,480,176
Total number of plants reporting price [a]	42	58	1,068	1,113
Price per M cubic feet:				
Minimum	$0.62	$0.45	$0.48	$0.45
Maximum	1.14	1.32	5.56	5.94
Average	.84	1.03	1.31	1.53
Number of plants selling gas at—				
Less than $0.60 per M cubic feet		4	2	9
$0.60–$0.69	6	6	9	12
$0.70–$0.79	9	9	22	17
$0.80–$0.89	12	11	47	27
$0.90–$0.99	9	6	96	28
$1.00–$1.09	5	11	122	51
$1.10–$1.19	1	5	117	75
$1.20–$1.29		5	135	90
$1.30–$1.39		1	118	103
$1.40–$1.49			123	118
$1.50–$1.74			199	256
$1.75–$1.99			54	182
$2.00–$2.49			19	117
$2.50–$2.99			3	18
$3.00 or more			2	10

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

MATERIALS USED IN GAS MANUFACTURE.

BITUMINOUS COAL.

In the manufacture of coal gas practically no other fuel is used except bituminous coal. A very few companies scattered throughout the country use also a small quantity of cannel coal and benzol, gasoline, or other oil for enriching this gas. In Table 18 are shown the quantities of fuel used in the manufacture of coal gas in 1915, 1918, and 1920. The quantity of coal shown for 1920 is slightly less than for 1918 but substantially the same as for 1915. The quantity of cannel coal used in 1920 was almost negligible, amounting to barely 72 tons. The oil consumption, which reached a minimum in 1917, when only 106,000 gallons was employed as an enricher, has increased somewhat since that year, being nearly 400,000 gallons in 1920. In general it appears that companies using oil as an enricher are virtually making a small quantity of oil gas in coal-gas retorts. Strictly speaking, therefore, what is being produced from the oil is not an enricher but a separate kind of gas. Nevertheless, in general the oil gas so made is of higher heating value per cubic foot than the coal gas with which it is mixed. Hence it is proper to speak of the oil as an enricher.

TABLE 18.—*Fuels used in the manufacture of coal gas in 1915, 1918, and 1920, by States.*

State.	1915		1918		1920	
	Bituminous coal (net tons).	Oil (gallons).	Bituminous coal (net tons).	Oil (gallons).	Bituminous coal (net tons).	Oil (gallons).
Alabama	74,551	300	80,477		54,889	150
Colorado	101,540		130,634		120,802	
Connecticut	a 152,925	b 376,671	132,305		197,642	
Georgia	73,786	100	87,531		86,036	1,250
Idaho	6,930		8,256		9,917	9,416
Illinois	208,671	51,235	297,605		246,556	2,600
Indiana	150,587		178,648		152,959	
Iowa	60,555		80,675		31,322	1,930
Kentucky	14,111		14,272		16,553	
Maine	36,093		38,079		40,071	
Massachusetts	a 559,044	b 347,173	a 571,970		a 482,196	
Michigan	629,492	3,334	733,853	50	753,041	
Minnesota	84,164		104,232		101,079	240
Mississippi	12,596		19,095		17,380	
Missouri	a 383,361	100	596,988	255,473	269,927	93,798
Montana	8,951		14,065		15,651	
New Hampshire	14,914		15,603		15,941	
New Jersey	a 99,968		24,072		27,883	
New York	a 828,974	b 362,337	a 726,439	27,883	a 915,840	127,239
North Carolina	38,173		50,215		58,189	
Ohio	95,572		35,902		33,254	
Oregon	3,387		3,928		5,114	
Pennsylvania	231,160	6,266	a 214,009		254,222	161,811
Rhode Island	112,802		64,552		32,954	
Tennessee	62,162	b 156,219	61,897		69,783	
Utah	35,002		38,629		39,589	
Virginia	90,801		114,672		73,300	
Washington	119,438	600	98,287		104,514	
Wisconsin	a 237,293		305,918		343,960	
Northeastern States: Delaware, District of Columbia, Maryland, and Vermont	47,276		20,368		21,297	
Southeastern States: Florida, South Carolina, and West Virginia	28,704	10,143	43,708	8,059	40,424	
Northwestern States: Kansas, Nebraska, North Dakota, South Dakota, and Wyoming	22,155		29,065		39,211	
Southwestern and Western States: Arkansas, California, Louisiana, New Mexico, Oklahoma, and Texas	19,964		30,723		22,704	
	c 4,645,102	d 1,314,478	c 4,966,672	291,465	c 4,694,200	398,434

a Includes a small quantity of cannel coal.
b Includes a small quantity of benzol.
c Includes 307 tons of cannel coal in 1915; 927 tons in 1918; and 72 tons in 1920.
d Includes 53,805 gallons of benzol in 1915.

COAL-GAS YIELDS.

The average yield of coal gas per ton of coal carbonized was 9.7 M in 1920, or 0.2 M per ton greater than in 1918. This gain in average yield was accomplished despite considerable difficulties in obtaining the kind of coal best suited to coal-gas manufacture. It was probably made possible largely by the fact that the quality of coal even from less desirable sources had been improved by greater care in mining and preparation at the mine, as well as by the fact that gas-plant labor was generally more efficient and careful during 1920 than during 1918, when because of war conditions inexperienced men were frequently employed and numerous problems in management of labor could not be satisfactorily solved.

The increase in average yield seems to be generally distributed over all sizes of companies, as shown in Table 19. The average yield for companies of classes A, C, D, F, and G, increased by 0.2 M per ton of coal carbonized. It happens that the average yield for the other classes did not change during this two-year period. Apparently the increase in average for all plants resulted from a decrease in the number of plants reporting very low yields rather than from an increase in the number obtaining exceptionally high yields. In any event only half as many plants reported yields less than 8 M per ton in 1920 as in 1918.

That the yield of gas per ton of coal depends upon the size of the plant is again well demonstrated by the averages for the various groups shown in Table 19. It is evident that only the larger plants can be expected consistently to maintain yields of gas greater than 10 M per ton. Most of the maximum yields recorded for smaller companies appear to be only estimates, for many of these smaller plants do not have facilities for accurate measurement of the gas which they produce. In general, therefore, it is safe to conclude that a small plant will seldom make more than 10 M per ton.

On the other hand, with respect to the minimum yield, some of the smaller plants make only 3 or 4 M per ton. For any plant producing 50,000,000 cubic feet or more a year, such a yield would be inexcusable. The lowest yield recorded for any such plant in 1920 was 7.9 M per ton. It would seem that even the smaller companies could be expected to maintain at least 6 M per ton as the minimum, and in fact, 7 or 8 M is not at all difficult, if real care is exercised, even though the skill of the management and the plant labor is only moderate. In this connection it should be realized that the difference in wages or salaries of only $1,000 a year, for example, means a difference in cost of 10 cents per M for a plant making 10,000,000 cubic feet of gas a year. In other words, better management or better labor in the plant, which is essential to success in medium-sized works, may be out of the question for the small plant solely because it costs a trifle more per year.

TABLE 19.—*Number of plants reporting different average yields of coal gas per ton of coal carbonized, 1918 and 1920, by size of plant.*

	A. 1-20,000 M.		B. 20,000-50,000 M.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants.....M..	1,501,169	1,419,852	4,057,995	3,934,443
Number of plants reporting yield [a]	135	103	126	118
Gas produced per ton of coal, in M:				
Minimum	4.1	3.4	6.9	4.0
Maximum	13.1	12.6	13.4	13.7
Average	9.0	9.2	9.8	9.8
Number of plants producing—				
Less than 7 M per ton	16	9	1	1
7-7.99 M	13	8	8	4
8-8.99 M	29	19	19	13
9-9.99 M	34	36	45	41
10 M or more	43	31	53	59

[a] Exclusive in 1920 of a small number of plants for which reports were incomplete or otherwise defective.

TABLE 19.—*Number of plants reporting different average yields of coal gas per ton of coal carbonized, 1918 and 1920, by size of plant*—Continued.

	C. 50,000-100,000 M.		D. 100,000-200,000 M.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants.....M..	4,664,570	3,433,883	4,182,702	4,342,237
Number of plants reporting yield [a]	68	52	30	32
Gas produced per ton of coal, in M:				
Minimum	7.2	7.9	6.7	8.7
Maximum	10.6	14.3	13.0	13.4
Average	9.8	10.0	9.8	10.0
Number of plants producing—				
Less than 7 M per ton	....	....	1	....
7-7.99 M	3	1	....	....
8-8.99 M	8	3	3	2
9-9.99 M	23	18	12	11
10 M or more	34	30	14	19

	E. 200,000-500,000 M.		F. 500,000-1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants.....M..	9,180,896	9,259,920	5,046,679	6,127,324
Number of plants reporting yield [a]	29	28	8	10
Gas produced per ton of coal, in M:				
Minimum	7.7	8.6	8.9	9.2
Maximum	12.3	13.8	10.7	11.6
Average	9.9	9.9	10.0	10.2
Number of plants producing—				
Less than 7 M per ton	....	....	....	....
7-7.99 M	1	....	....	....
8-8.99 M	4	5	1	....
9-9.99 M	10	9	2	5
10 M or more	14	14	5	5

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants.....M..	14,025,476	14,430,468	42,659,487	42,948,127
Number of plants reporting yield [a]	7	7	403	350
Gas produced per ton of coal, in M:				
Minimum	7.9	9.5	4.1	3.4
Maximum	12.0	11.6	13.4	14.3
Average	10.2	10.4	9.5	9.7
Number of plants producing—				
Less than 7 M per ton	....	....	18	10
7-7.99 M	1	....	26	13
8-8.99 M	....	....	64	42
9-9.99 M	2	3	128	123
10 M or more	4	4	167	162

[a] Exclusive in 1920 of a small number of plants for which reports were incomplete or otherwise defective.

FUELS USED FOR WATER GAS.

Until very recent years only anthracite or coke has been used as the solid fuel for the manufacture of water gas. However, during the World War period the shortage of coke and anthracite gave an added impetus to the use of bituminous coal in the manufacture of water gas. In both 1918 and 1920 approximately 65,000 tons of bituminous coal was so used. But anthracite and coke still form the principal solid fuels for making water gas, as is shown by the fact that more than 1,600,000 tons of each was so used in 1920. These data are given in Table 20.

The choice between anthracite and coke for making water gas is largely a question of the relative price of the two fuels. There are slight differences in convenience of operation and capacity of gas-making equipment, but the major factor in determining choice is almost always one of relative cost. In 1915 about 40 per cent more coke was used than anthracite. In 1918 nearly 35 per cent more anthracite was used than coke. In 1920 about 10 per cent more anthracite was used than coke.

As the coke from by-product ovens becomes more widely available it will doubtless prove to be a large factor in making water gas. As combination coal-gas and water-gas plants or coke-oven and water-gas plants develop, it is certain that the coke made in one department will more and more be used as a gas-making material in the other. In fact, one of the prominent engineering problems of to-day is the question of the most economical and efficient method for complete gasification of bituminous coal—that is, for the combination of coal-gas and water-gas methods, so that there will be no solid fuel by-products from the processing of the coal.

The quantity of oil used for water-gas manufacture has continued to increase during recent years. In 1920 the total consumption of oil was nearly 750,000,000 gallons. That this increase has been general is shown by the figures for the several States given separately in Table 20.

TABLE 20.—*Fuels used in the manufacture of water gas in 1915, 1918, and 1920, by States.*

State.	1915			1918				1920			
	Anthracite (gross tons).	Coke (net tons).	Oil (gallons).	Bituminous (net tons).	Anthracite (gross tons).	Coke (net tons).	Oil (gallons).	Bituminous (net tons).	Anthracite (gross tons).	Coke (net tons).	Oil (gallons).
Alabama		3, 644	594, 608			9, 705	2, 104, 691			15, 490	2, 505, 278
California, Oregon, and Utah		a 18, 642	4, 413, 712			b 2, 393	b 412, 170			12, 279	2, 076, 408
Colorado	684	7, 401	1, 464, 962	1, 056		8, 648	1, 655, 866	1, 305		16, 430	2, 831, 436
Connecticut	30, 955	17, 923	11, 472, 308	1, 899	74, 419	15, 921	17, 339, 470	2, 126	59, 783	31, 938	16, 407, 856
Delaware	9, 111	167	1, 921, 820		13, 676	107	3, 043, 389		14, 352	70	3, 222, 377
District of Columbia and Maryland	78, 730	10, 772	22, 087, 021	1, 644	155, 225	2	33, 708, 231		145, 283	1, 818	32, 103, 224
Florida	2, 326	8, 042	1, 911, 404		1, 890	15, 763	2, 784, 231		22	20, 015	3, 093, 663
Georgia		12, 219	3, 023, 750		317	24, 016	4, 555, 326	1, 762	34	34, 565	8, 214, 212
Illinois	240	344, 103	96, 025, 978	20, 523	130, 560	401, 032	111, 055, 073	45, 667	90, 836	27, 950	97, 482, 213
Indiana		25, 220	5, 528, 244	390		55, 029	8, 727, 779	1, 848	557	75, 378	2, 000, 203
Iowa	773	49, 304	10, 532, 611	581	1, 224	62, 367	12, 094, 127	6, 082	525	75, 263	4, 021, 340
Kansas	108	1, 128	225, 806	476	10	1, 700	381, 096			1, 771	320, 747
Kentucky and West Virginia		3, 105	550, 621		426	1, 624	274, 807		1, 051	1, 138	294, 409
Louisiana, Mississippi, Arkansas, and Oklahoma		28, 643	5, 677, 306			2, 940	482, 143	532	1, 131	41, 335	8, 737, 628
Maine	1, 481	2, 457	806, 525		3, 418	3, 488	1, 304, 940	540	3, 942	2, 396	1, 182, 114
Massachusetts	14, 227	129, 732	27, 615, 751	1, 012	84, 616	163, 412	38, 008, 338	30	56, 519	224, 720	43, 237, 453
Michigan	161	31, 589	6, 091, 913	36	280	71, 216	14, 214, 189	27		97, 456	19, 022, 094
Minnesota		54, 717	13, 783, 252		2, 561	42, 045	9, 846, 634			53, 082	11, 891, 262
Missouri		45, 043	10, 613, 569	2, 479		54, 492	10, 941, 320	1, 135	1, 584	72, 107	14, 339, 032
Montana		1, 339	253, 029			1, 806	291, 384	1, 250		1, 919	328, 416
Nebraska		20, 325	5, 069, 992	198	138	28, 557	6, 045, 747			43, 735	9, 877, 354
New Hampshire	3, 643	5, 449	1, 805, 937		5, 095	7, 793	2, 150, 960		6, 316	9, 593	2, 455, 743
New Jersey	111, 214	73, 991	43, 869, 583	5, 954	226, 839	23, 796	55, 965, 463	74	207, 846	52, 496	58, 167, 237
New York	523, 559	171, 798	202, 151, 388	14, 167	773, 443	172, 385	241, 597, 588	71	799, 093	317, 504	274, 700, 825
North Carolina	428	2, 636	526, 500		782	5, 709	1, 042, 607			10, 227	1, 707, 244
North Dakota		513	77, 446			628	61, 181		268	499	103, 268
Ohio		6, 717	1, 316, 661			4, 860	891, 960	179		4, 380	605, 888
Pennsylvania	44, 269	149, 976	51, 816, 505	4, 644	228, 629	98, 220	68, 498, 622	355	217, 755	160, 361	78, 585, 925
Rhode Island	3, 807	4, 893	1, 833, 813	400	18, 431	23, 707	8, 423, 113		1, 962	25, 966	4, 242, 291
South Carolina		6, 498	1, 477, 531		217	9, 738	1, 890, 497			13, 262	2, 481, 375
South Dakota	300	4, 498	867, 816	249	88	5, 432	976, 856			7, 976	1, 241, 441
Tennessee		8, 350	1, 985, 375	5, 840		11, 576	2, 679, 859			24, 917	4, 428, 736
Texas	818	25, 625	5, 561, 573		1, 413	41, 288	7, 792, 680	304		51, 779	9, 214, 790
Vermont	3, 213	152	657, 161		4, 850	140	775, 730		5, 333	100	908, 617
Virginia	118	12, 905	3, 894, 876		577	27, 292	6, 153, 424	532	6, 007	32, 572	8, 234, 304
Washington		14, 538	2, 887, 055			22, 989	4, 387, 643			35, 225	5, 195, 400
Wisconsin	354	14, 172	2, 844, 561	3, 394	905	29, 907	4, 864, 829	3, 591	531	51, 343	7, 857, 693
	830, 519	1, 318, 226	553, 237, 963	64, 942	1, 730, 029	1, 451, 723	687, 423, 963	67, 410	1, 620, 730	1, 649, 055	743, 319, 496

a Includes 5,200 tons of lampblack.

b Oregon and Utah only.

FUEL EFFICIENCY IN WATER-GAS PLANTS.

More significant than the question of total quantities of fuel used for making water gas are the figures for solid fuel used per M of water gas produced; 35.8 pounds of solid fuel was required in 1918 and 32.1 pounds in 1920. Thus in a two-year interval there was a 10 per cent increase in efficiency in water-gas manufacture, judged by the solid fuel consumed per M. This increase in efficiency was probably the result of both better fuel and increased skill and efficiency in plant operation.

Not only was there an increase in efficiency in solid fuel, but also a decrease in quantity of oil used per M of water gas produced in 1920, as compared with 1918. In the earlier year 3.6 gallons of oil was used per M; 3.4 gallons sufficed in 1920.

Very often the quantity of oil used per M is determined solely by the heating-value requirements fixed by local authorities. Thus, for each 0.1 gallon of oil used per M made, the heating value increases by approximately 8 British thermal units per cubic foot. Consequently whenever the local authorities permit a reduction of the standard of gas quality the quantity of oil used may be reduced correspondingly. However, with the lowering of heating value and the decrease in quantity of oil used per M, there is usually a slight increase in the quantity of solid fuel required per M. It is therefore particularly gratifying to find that in 1920 the decrease in oil consumption per M was accompanied by a simultaneous decrease in solid fuel used per M. Evidently it was not simply a change in the quality of gas but an improvement in plant efficiency that brought about these changes in general averages.

The relation of plant efficiency to size of plant is shown by Tables 21 and 22. As in the analysis for 1918, it is seen that the larger plants are able to gain much higher efficiency in the use of solid fuel in water-gas manufacture. The averages in Table 21 differ from those for the country as a whole because of the fact that about 35 water-gas plants did not report in sufficient detail to permit accurate separate estimates of their solid-fuel efficiency. The general statement above made is based upon results for the country as a whole, obtained by dividing the total solid-fuel consumption by the total water gas produced. Although the figures thus obtained differ materially from the averages in Table 21, yet the ratio between 1918 and 1920 is substantially the same, showing marked improvement in plant conditions.

A similar relation exists between the data of Table 22 and the general data above disclosed. However, there is no such difference in the quantities of oil used per M of gas manfactured in small plants and in large plants as in the quantities of solid fuel so used. In groups of every size the average lies between 3.3 and 3.6 gallons per M of carbureted water gas made, and it is identical for the smallest group and for the largest. Thus this is still further evidence that it is a question of choice on the part of the management, and not primarily of skill, which determines the consumption of water-gas oil.

TABLE 21.—*Number of plants using different quantities of solid fuel per M of carbureted water gas manufactured in 1918, and 1920, by size of plant.*

	A. 1–20,000 M.		B. 20,000–50,000 M.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants.....M..	2,479,767	2,120,753	3,690,017	4,370,234
Number of plants reporting sales [a]	256	194	116	131
Pounds of fuel used per M of gas produced:				
Minimum	17	15	19	24
Maximum	161	160	84	88
Average	63	58	48	47
Number of plants using—				
Less than 30 pounds per M	6	3	4	1
30–34 pounds	7	10	4	10
35–39 pounds	7	16	14	21
40–44 pounds	36	16	26	30
45–49 pounds	30	20	21	25
50–54 pounds	30	20	16	13
55–59 pounds	17	19	14	16
60–69 pounds	42	45	13	12
70–89 pounds	47	28	4	3
90–119 pounds	27	12	....	....
120 pounds or more	7	5	....	....

	C. 50,000–100,000 M.		D. 100,000–200,000 M.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants.....M..	4,037,795	4,901,467	5,956,703	7,694,304
Number of plants reporting sales [a]	58	64	42	53
Pounds of fuel used per M of gas produced:				
Minimum	29	24	22	26
Maximum	141	82	63	73
Average	44	43	40	41
Number of plants using—				
Less than 30 pounds per M	1	3	4	2
30–34 pounds	8	7	7	9
35–39 pounds	16	15	13	20
40–44 pounds	15	17	8	11
45–49 pounds	6	6	5	5
50–54 pounds	7	10	3	2
55–59 pounds	2	3	....	....
60–69 pounds	1	2	2	2
70–89 pounds	1	1	....	2
90–119 pounds	....	....	....	....
120 pounds or more	1	....	....	....

	E. 200,000–500,000 M.		F. 500,000–1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants.....M..	16,862,175	16,982,423	15,125,293	26 307,425
Number of plants reporting sales [a]	52	52	24	37
Pounds of fuel used per M of gas produced:				
Minimum	29	23	28	30
Maximum	56	50	50	61
Average	37	38	37	37
Number of plants using—				
Less than 30 pounds per M	2	1	1	....
30–34 pounds	14	17	9	16
35–39 pounds	22	14	8	12
40–44 pounds	11	13	4	6
45–49 pounds	2	6	1	2
50–54 pounds	....	1	1	....
55–59 pounds	1	....	....	....
60–69 pounds	....	....	....	1
70–89 pounds	....	....	....	....
90–119 pounds	....	....	....	....
120 pounds or more	....	....	....	....

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

TABLE 21.—*Number of plants using different quantities of solid fuel per M of carbureted water gas manufactured in 1918 and 1920, by size of plant*—Continued.

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants .... M..	127,445,673	138,113,666	175,597,423	200,490,272
Number of plants reporting sales [a]	31	32	579	563
Pounds of fuel used per M of gas produced:				
Minimum	26	27	17	15
Maximum	49	45	161	160
Average	35	35	51	47
Number of plants using—				
Less than 30 pounds per M	6	2	24	12
30–34 pounds	11	14	60	83
35–39 pounds	9	12	89	110
40–44 pounds	4	3	104	96
45–49 pounds	1	1	66	65
50–54 pounds	....	....	57	46
55–59 pounds	....	....	34	38
60–69 pounds	....	....	58	62
70–89 pounds	....	....	52	34
90–119 pounds	....	....	27	12
120 pounds or more	....	....	8	5

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

TABLE 22.—*Number of plants using different quantities of oil for manufacture of carbureted water gas in 1918 and 1920, by size of plant.*

	A. 1–20,000 M.		B. 20,000–50,000 M.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants .... M..	2,479,767	2,120,753	3,690,017	4,370,234
Number of plants reporting oil used [a]	258	191	116	131
Gallons of oil used per M of gas produced:				
Minimum	1.6	0.4	2.0	1.8
Maximum	9.7	10.0	5.7	6.0
Average	4.0	3.6	3.5	3.5
Number of plants using—				
Less than 2 gallons of oil per M of gas	2	3	....	1
2.0–2.9 gallons	20	27	10	18
3.0–3.4 gallons	52	46	44	40
3.5–3.9 gallons	66	32	40	39
4.0–4.4 gallons	62	37	15	22
4.5–4.9 gallons	24	21	4	4
5.0 gallons or more	32	25	3	7

	C. 50,000–100,000 M.		D. 100,000–200,000 M.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants .... M..	4,037,795	4,901,467	5,956,703	7,694,304
Number of plants reporting oil used [a]	58	65	42	53
Gallons of oil used per M of gas produced:				
Minimum	2.7	2.1	2.4	2.4
Maximum	4.9	4.3	4.8	4.5
Average	3.5	3.4	3.4	3.3
Number of plants using—				
Less than 2 gallons of oil per M of gas	....	....	....	....
2.0–2.9 gallons	8	9	5	11
3.0–3.4 gallons	26	26	21	27
3.5–3.9 gallons	13	20	13	14
4.0–4.4 gallons	9	10	2	....
4.5–4.9 gallons	2	....	1	1
5.0 gallons or more	....	....	....	....

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

TABLE 22.—*Number of plants using different quantities of oil for manufacture of carbureted water gas in 1918 and 1920, by size of plant*—Continued.

	E. 200,000-500,000 M.		F. 500,000-1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants M..	16,862,175	16,982,423	15,125,293	26,307,425
Number of plants reporting oil used [a]	52	52	24	37
Gallons of oil used per M of gas produced:				
Minimum	1.9	0.3	1.9	2.0
Maximum	8.7	4.7	4.0	4.0
Average	3.5	3.3	3.3	3.3
Number of plants using—				
Less than 2 gallons of oil per M of gas	1	2	1	....
2.0-2.9 gallons	7	14	4	8
3.0-3.4 gallons	22	21	10	15
3.5-3.9 gallons	11	10	8	13
4.0-4.4 gallons	8	4	1	1
4.5-4.9 gallons	2	1	....	....
5.0 gallons or more	1	....	....	....

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by water-gas plants M..	127,445,673	138,113,666	175,597,423	200,490,272
Number of plants reporting oil used [a]	31	32	581	561
Gallons of oil used per M of gas produced:				
Minimum	2.8	2.5	1.6	0.3
Maximum	4.5	4.7	9.7	10.0
Average	3.6	3.6	3.7	3.4
Number of plants using—				
Less than 2 gallons of oil per M of gas	....	....	4	6
2.0-2.9 gallons	4	5	58	92
3.0-3.4 gallons	8	10	183	185
3.5-3.9 gallons	15	9	166	137
4.0-4.4 gallons	3	4	100	78
4.5-4.9 gallons	1	4	34	31
5.0 gallons or more	....	....	36	32

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

OIL USED FOR OIL-GAS MANUFACTURE.

More oil was used in the manufacture of oil gas in 1920 than in any previous year. The quantities so employed are shown by States in Table 23. The quantity of oil gas made in 1920 was also the largest on record. However, the average consumption of oil per M, in the country as a whole, increased slightly, being 8.1 gallons per M in 1920 and 7.8 gallons in 1918.

It is possible to determine individually the ratio of oil gas for only 72 plants out of the total number of oil-gas plants reporting. These plants show a wide range of consumption of oil—from 2 to 24.7 gallons per M of oil gas manufactured. The average for this group was 10 gallons per M, which is identical with the average recorded for companies giving detailed reports in 1918.

In view of the conflicting evidence on this question, it is difficult to interpret the general oil-gas situation. The results for the entire country, estimated as accurately as possible, and the results for these 72 individual plants for which full data have been furnished show slightly different tendencies. As a matter of fact, it is likely that there has not been any very great change in consumption of oil per M of gas made, except in certain localities where the quality of the gas produced has also been changed. As might be expected from such a process, less oil is used per M in the larger plants than in the smaller plants. In this particular the experience of 1920 simply confirms the data obtained for operations in 1918.

TABLE 23.—*Oil used in the production of oil gas in 1912, 1915, 1918, and 1920, by States, in gallons.*

State.	1912	1915	1918	1920
Arizona	2,816,776	1,825,764	3,425,801	4,468,428
California	[a] 128,311,597	118,400,146	127,601,352	146,859,425
Nevada	315,260	503,133	649,266	645,877
Oregon and Washington	14,269,051	[b] 14,263,719	[b] 21,496,159	27,049,202
Texas	251,200	231,700	523,868	(c)
Northeastern group [d]	118,100	831,700	149,200	325,467
South Central group [e]	728,568	189,308	177,062	404,825
North Central group [f]	925,800	157,250	190,082	190,737
	147,736,352	136,402,720	154,212,790	179,943,961

[a] Includes oil used for a small quantity of water gas.
[b] Oregon only.
[c] Included with South Central group.
[d] Includes in 1912, New York and Pennsylvania; in 1915, Connecticut, Massachusetts, and New Hampshire; in 1918, New Hampshire and Pennsylvania; and in 1920, Delaware, New Hampshire, and Pennsylvania.
[e] Includes in 1912, Louisiana, New Mexico, and Oklahoma; in 1915, Louisiana, Missouri, and New Mexico; in 1918, Missouri and New Mexico; and in 1920, Colorado, Louisiana, New Mexico, and Texas.
[f] Includes in 1912, Illinois, Iowa, Michigan, Minnesota, Ohio, South Dakota, and Wisconsin; in 1915, Illinois, Michigan, Minnesota, Ohio, and Wisconsin; in 1918, Iowa, Michigan, Minnesota, Ohio, and Wisconsin; in 1920, Illinois, Missouri, and Wisconsin.

TABLE 24.—*Number of plants using different quantities of oil per M of oil gas manufactured in 1918 and 1920, by size of plant.*

	A. 1-20,000 M.		B. 20,000-50,000 M.	
	1918	1920	1918	1920
Total sales of gas by oil-gas plants ... M.	396,137	387,130	497,513	536,722
Number of plants reporting [a]	48	36	16	16
Gallons of oil used per M of gas produced:				
Minimum	4.5	2.0	8.9	8.8
Maximum	15.9	24.7	12.5	12.5
Average	10.5	10.2	10.3	10.2
Number of plants using—				
Less than 6 gallons of oil per M of gas	2	2		
6-7.9 gallons	3			
8-8.9 gallons	2		1	1
9-9.9 gallons	8	4	5	7
10-10.9 gallons	15	20	7	4
11-11.9 gallons	8	3	2	3
12-14.9 gallons	9	5	1	1
15 gallons or more	1	2		

	C. 50,000-100,000 M.		D. 100,000-200,000 M.	
	1918	1920	1918	1920
Total sales of gas by oil-gas plants ... M.	638,396	524,266	477,372	406,920
Number of plants reporting [a]	9	7	3	3
Gallons of oil used per M of gas produced:				
Minimum	8.1	8.9	8.0	7.1
Maximum	15.8	11.8	11.0	9.1
Average	10.5	10.0	9.0	8.3
Number of plants using—				
6-7.9 gallons				1
8-8.9 gallons	3	1	2	1
9-9.9 gallons	1	2		1
10-10.9 gallons	2	2		
11-11.9 gallons	1	2	1	
12-14.9 gallons	1			
15 gallons or more	1			

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

TABLE 24.—*Number of plants using different quantities of oil per M of oil gas manufactured in 1918 and 1920, by size of plant*—Continued.

	E. 200,000-500,000 M.		F. 500,000-1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by oil-gas plants.....M..	1,351,976	1,780,127	.....	1,632,252
Number of plants reporting [a]	5	6	.....	1
Gallons of oil used per M of gas produced:				
Minimum	4.4	7.5	.....	.....
Maximum	8.6	9.2	.....	.....
Average	7.2	8.6	.....	8.9
Number of plants using—				
Less than 6 gallons of oil per M of gas	1	.....	.....	.....
6-7.9 gallons	2	1	.....	.....
8-8.9 gallons	2	3	.....	1
9-9.9 gallons	.....	2	.....	.....

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by oil-gas plants.....M..	13,322,763	13,774,360	16,684,157	19,041,777
Number of plants reporting [a]	5	3	86	72
Gallons of oil used per M of gas produced:				
Minimum	7.0	7.0	4.4	2.0
Maximum	8.8	8.2	15.9	24.7
Average	7.6	7.8	10.0	10.0
Number of plants using—				
Less than 6 gallons of oil per M of gas	.....	.....	3	2
6-7.9 gallons	4	1	9	3
8-8.9 gallons	1	2	11	9
9-9.9 gallons	.....	.....	14	16
10-10.9 gallons	.....	.....	24	26
11-11.9 gallons	.....	.....	12	8
12-14.9 gallons	.....	.....	11	6
15 gallons or more	.....	.....	2	2

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

BY-PRODUCTS OF GAS MANUFACTURE.

All modern processes of manufacturing gas yield by-products, and in many processes the value of the by-product is as great as the value of the gas itself. The manufacture of coal gas is not commercially feasible unless the by-products are produced efficiently and can be marketed under favorable conditions. The relative value of the several by-products can be seen in the general summary of data (Table 1), which shows that coke, coal-gas tar, water-gas tar, ammonia, and other by-products reach total values in the millions of dollars. Even the output of retort carbon and lampblack must be measured in hundreds of thousands of dollars, although these are minor by-products in practically all gas works.

In fixing prices for manufactured gas the first element to determine is the "net holder cost" of the gas, which represents the total expenditure for producing operations, less the income from the sales of by-products, divided by the output of gas. In other words, it represents the net operating expense of the plant considered only as a gas-manufacturing establishment. To this net holder cost, which may be very small, must be added, of course, the proper charges for taxes, depreciation, amortization, and interest upon the plant investment, to ascertain the actual total cost for supplying the gas at the works; and the expenses of distribution, commercial department, and management, as well as the interest upon the distribution system, must be added in calculating the total proper charge for the gas supplied to the customer. Although the holder cost may be small, especially in a coal-gas plant, the capital charges resulting from a large investment in such plants are very considerable. If it were not possible to obtain the income from by-products to offset the operating expense in whole or in part, the sum of the operating expense and of this group of capital charges would make the gas prohibitively high.

The principal by-products of gas works are coke, tar, ammonia (in one or more forms), retort carbon and lampblack, light oils, and naphthalene. All kinds of gas plants produce tar, but coke and ammonia are produced only in coal-gas plants. Retort carbon and lampblack and also light oils may be recovered at works of almost any type. Only relatively few plants, however, recover the retort carbon, light oils, and naphthalene in salable quantities; hence they are all minor products for the country as a whole.

COKE.

The production and sales of coke manufactured at coal-gas plants in the United States during 1915, 1918, and 1920 are shown in Table 25. These data are presented by States as far as is possible without revealing individual operations.

Although the total quantity of coke produced at coal-gas plants is considerable, yet it is only 10 per cent of that produced at by-product coke-oven plants. The coke produced at coal-gas works is quite different in character from that made in the by-product or beehive ovens. It is softer and more friable and hence unsuited to metallurgical use.

Less than half of the coke produced at gas works in 1920 was sold. The remainder was used for heating the coal-gas retorts, for water-gas manufacture, and for raising steam under boilers at the works. That sold was in general employed as domestic fuel, in water-gas manufacture by other companies, or for miscellaneous industrial uses. Practically none of it was consumed in any way as a metallurgical fuel.

TABLE 25.—*Coke produced and sold from coal-gas plants in 1915, 1918, and 1920.*

State.	Number of plants producing.[a]	Production (net tons).	Sales.		
			Net tons.	Value.	
				Total.	Average.
1915.					
Alabama	....	45,315	29,552	$96,806	$3.28
California, Montana, New Mexico, and Wyoming	....	5,630	4,377	32,998	7.54
Colorado	....	63,618	53,659	145,900	2.72
Connecticut	....	90,327	36,552	142,927	3.91
Delaware, Florida, South Carolina, and West Virginia	....	19,414	9,421	37,678	4.00
District of Columbia and Maryland	....	23,170	11,121	50,338	4.53
Georgia	....	45,880	24,007	91,998	3.83
Idaho	....	4,226	3,179	18,820	5.92
Illinois	....	155,226	115,326	438,389	3.80
Indiana	....	97,386	47,933	179,624	3.75
Iowa	....	34,525	23,426	128,448	5.48

[a] Figures for 1915 not available.

TABLE 25.—*Coke produced and sold from coal-gas plants in 1915, 1918, and 1920*—Continued.

State.	Number of plants producing.	Production (net tons).	Sales.		
			Net tons.	Value.	
				Total.	Average.
1915—Continued.					
Kansas, North Dakota, and South Dakota	....	11,519	7,609	$47,927	$6.30
Kentucky	....	6,944	2,446	6,437	2.63
Louisiana, Oklahoma, and Texas	....	11,307	5,834	29,510	5.06
Maine	....	16,771	10,894	62,972	5.78
Massachusetts	....	334,686	175,226	857,726	4.89
Michigan	....	416,901	286,505	1,319,637	4.61
Minnesota	....	52,835	8,004	47,660	5.95
Mississippi	....	6,117	4,615	15,615	3.38
Missouri	....	243,617	84,932	325,325	3.83
New Hampshire	....	8,764	5,977	30,331	5.07
New Jersey	....	62,877	10,728	42,147	3.93
New York	....	543,406	283,284	1,077,573	3.80
North Carolina	....	52,005	11,981	52,290	4.36
Ohio	....	60,104	48,442	199,222	4.11
Oregon	....	1,999	1,250	6,115	4.89
Pennsylvania	....	150,464	125,283	653,223	5.21
Rhode Island and Vermont	....	22,111	8,111	34,273	4.23
Tennessee	....	39,153	26,742	73,500	2.75
Utah	....	21,651	11,580	55,074	4.76
Virginia	....	51,432	23,012	97,995	4.26
Washington	....	81,045	36,746	191,345	5.21
Wisconsin	....	160,501	124,798	608,554	4.88
	....	2,940,926	1,662,552	7,198,377	4.33
1918.					
Alabama	11	49,172	23,415	134,832	5.76
Arkansas, Louisiana, and Oklahoma	3	5,101	3,486	22,070	6.33
California, New Mexico, and Wyoming	3	2,859	1,529	4,869	2.53
Colorado	7	93,617	48,882	306,114	6.26
Connecticut	6	91,480	35,215	393,915	11.19
Delaware and West Virginia	3	1,665	1,014	6,536	6.45
Florida and South Carolina	3	26,045	18,147	130,165	7.17
Georgia	11	53,772	13,780	87,626	6.36
Idaho	3	4,966	2,234	12,008	5.38
Illinois	37	177,915	133,050	1,057,253	7.95
Indiana	27	114,706	87,005	599,801	6.89
Iowa	15	49,924	26,003	229,754	8.84
Kansas, Nebraska, and South Dakota	5	4,547	2,493	18,424	7.39
Kentucky	8	8,396	5,940	31,936	5.38
Maine	7	21,671	9,189	71,085	7.74
Maryland	5	6,902	3,894	21,298	5.47
Massachusetts	31	390,073	165,011	1,066,674	6.46
Michigan	52	469,558	337,184	2,543,271	7.54
Minnesota	8	67,450	17,157	147,132	8.58
Mississippi	7	10,026	7,519	44,610	5.93
Missouri	7	357,973	324,679	3,165,464	9.75
Montana	4	8,139	3,159	24,664	7.81
New Hampshire	3	9,087	6,048	57,557	9.57
New Jersey	4	15,528	10,226	57,982	5.62
New York	30	502,223	172,395	1,063,879	6.17
North Carolina	9	33,169	19,287	133,873	6.94
North Dakota	3	12,377	8,040	61,715	7.68
Ohio	8	19,335	13,234	97,605	7.38
Oregon	3	2,416	961	6,541	6.80
Pennsylvania	13	113,191	99,196	625,931	6.31
Rhode Island and Vermont	5	46,345	14,887	117,792	7.91
Tennessee	6	41,934	22,439	126,482	5.64
Texas	4	10,914	3,685	26,701	7.25
Utah	3	23,241	7,416	40,165	5.42
Virginia	12	70,547	13,207	72,867	5.52
Washington	9	58,389	13,927	85,828	6.16
Wisconsin	19	205,882	138,807	1,268,813	9.14
	394	3,180,535	1,813,740	13,963,232	7.70
1920.					
Alabama	5	32,866	22,433	160,570	7.16
California and Wyoming	3	2,621	1,263	8,727	6.91
Colorado	7	83,656	47,321	326,303	6.90
Connecticut	5	126,881	58,336	653,556	11.20
Delaware and West Virginia	2	2,595	1,582	8,965	5.67

TABLE 25.—*Coke produced and sold from coal-gas plants in 1915, 1918, and 1920*—Continued.

State.	Number of plants producing.	Production (net tons).	Sales.		
			Net tons.	Value.	
				Total.	Average.
1920—Continued.					
Florida and South Carolina	3	22,048	8,500	$82,410	$9.69
Georgia	11	55,695	14,535	158,575	10.91
Idaho	3	6,450	2,973	16,132	5.43
Illinois	33	149,622	89,674	825,160	9.20
Indiana	25	100,932	70,982	578,680	8.15
Iowa	7	20,297	11,958	104,315	8.72
Kansas	3	5,533	1,985	15,509	7.81
Kentucky	8	9,537	6,257	53,972	8.63
Louisiana, New Mexico, and Oklahoma	3	4,325	1,224	10,331	8.44
Maine	4	24,802	19,135	147,286	7.70
Maryland	5	6,174	3,306	22,318	6.75
Massachusetts	25	340,012	126,422	960,882	7.60
Michigan	54	496,765	235,295	2,132,161	9.06
Minnesota	8	66,468	14,429	147,550	10.23
Mississippi	6	10,515	7,800	56,508	7.24
Missouri	10	184,811	94,619	768,834	8.13
Montana	3	7,622	3,172	23,295	7.34
Nebraska and South Dakota	2	1,520	574	5,740	10.00
New Hampshire	3	9,022	6,771	45,808	6.77
New Jersey	4	16,725	8,332	57,757	6.93
New York	29	641,482	223,052	1,645,877	7.38
North Carolina	9	37,348	18,805	131,785	7.01
North Dakota	3	14,919	9,260	97,359	10.51
Ohio	8	19,468	13,187	95,471	7.24
Oregon	3	2,700	1,263	10,394	8.23
Pennsylvania	12	171,885	25,368	200,061	7.89
Rhode Island and Vermont	4	28,707	13,159	108,194	8.22
Tennessee	7	45,681	27,257	261,951	9.61
Texas	3	10,617	1,592	14,013	8.80
Utah	3	24,898	9,289	67,105	7.22
Virginia	9	45,655	12,933	66,524	5.14
Washington	8	63,540	20,605	127,870	6.21
Wisconsin	19	242,938	143,889	1,440,577	10.01
	359	3,137,332	1,378,537	11,638,525	8.44

A considerable portion of the coke made from the coal carbonized for coal-gas manufacture is employed for heating the retorts in which the carbonization takes place. In Table 26 are given by groups of plants the minimum, maximum, and average quantities of coke so used. In the larger plants from 200 to 350 pounds of coke is required per ton of coal carbonized, but the smaller plants use much more. However, some of the smaller companies only estimate the quantity of coke employed in this way, and the returns to the Geological Survey indicate that the operators of many of these plants have very little appreciation of the magnitude of their consumption of coke. In general, it is safe to say that those reporting less than 200 pounds have done so through error in estimate. For the sake of completeness of record, however, all the companies, even those reporting very small quantities, have been included in the tabulation. In general, the average shows the tendency to use more coke per ton of coal in the smaller plants, most of which used from 350 to 450 pounds of coke per ton of coal treated.

TABLE 26.—*Number of coal-gas plants using different quantities of coke in heating retorts, 1920, by size of plant.*

	A. 1-20,000 M.	B. 20,000-50,000 M.	C. 50,000-100,000 M.	D. 100,000-200,000 M.	E. 200,000-500,000 M.	F. 500,000-1,000,000 M.	G. 1,000,000 M or more.	Total.
Total sales of gas by coal-gas plants..M..	1,419,852	3,934,443	3,433,883	4,342,237	9,259,920	6,127,324	14,430,468	42,948,127
Number of plants using coke for heating retorts..........	74	96	41	27	26	8	7	279
Pounds of coke used:								
Minimum........	69	82	19	272	19	41	196	19
Maximum.......	1,500	817	719	611	732	376	358	1,500
Average..........	485	139	400	357	361	223	276	422
Number of plants using—								
Less than 200 pounds per ton of coal carbonized	5	1	1	....	3	2	1	14
200-299 .pounds..	4	7	5	8	6	2	4	36
300-399 .pounds..	15	30	17	14	12	4	2	94
400-499 .pounds..	18	32	12	3	3	....	....	68
500-599 .pounds..	11	15	4	1	1	....	....	32
600-699 .pounds..	13	5	1	1	....	....	....	19
700-799 .pounds..	2	5	1	....	1	....	....	9
800 pounds or more...........	6	1	....	....	....	....	....	7

Only about 40 per cent of the coke made by coal-gas works was sold in 1920, whereas 60 per cent was sold in 1918, and more than 50 per cent in 1915. It is probable that the difficulty in procuring adequate supplies of high-grade gas-making fuel was the cause of this lower percentage sold during 1920.

In Table 25 are shown the total value and the average price per ton received for the coke sold, by States. The average prices are summarized also in Table 27, by price groups. The average price received for gas-works coke in 1920 was 74 cents per ton higher than in 1918. However, the maximum price in 1920 was less than in 1918, despite the fact that severe shortages of fuel were experienced in many districts of the country. It is now an unusual company which receives an average of less than $4 per ton for the gas-works coke that it sells, and by far the greater number of the companies receive more than $7. The price is, in general, governed by the local price of anthracite in the same community. Coke does not command a price equal to anthracite, but generally sells at retail for $1 or $2 per ton less. When the margin in favor of coke is greater than this there is a distinct tendency to increase the use of coke as a domestic fuel, for which purpose it is well adapted if proper apparatus and method of burning are employed.

TABLE 27.—*Number of coal-gas plants receiving different average prices for coke sold in 1918 and 1920.*

	1918	1920
Total sales of gas by coal-gas plants..........M..	42,659,487	42,948,127
Number of plants selling coke [a]..........	377	317
Average price per ton of coke sold:		
Minimum..........	$2.75	$1.00
Maximum..........	19.13	15.17
Average..........	7.25	8.59

[a] Excludes a small number of plants for which reports were incomplete or otherwise defective.

TABLE 27.—*Number of coal-gas plants receiving different average prices for coke sold in 1918 and 1920*—Continued.

	1918	1920
Number of plants receiving—		
Less than $3.00 a ton	6	4
$3.00-$3.99	7	3
$4.00-$4.99	28	14
$5.00-$5.99	53	23
$6.00-$6.99	79	39
$7.00-$7.99	80	48
$8.00-$8.99	68	49
$9.00-$9.99	25	42
$10.00-$10.99	13	43
$11.00-$11.99	5	21
$12.00 or more	13	31

The yield of coke obtained in coal-gas plants is summarized by size of company and by efficiency groups in Table 28. The average yield of coke per ton of coal carbonized was slightly greater in 1920 than in 1918, as might be expected from the general tendency to higher plant efficiency in the post-war period. The increase in plant efficiency seems to have been quite general throughout the industry, for almost all the groups show a slightly higher average in 1920. Only two groups reported slightly lower average efficiencies in 1920 than in 1918. This is probably due to abnormal returns for one or two companies in these small groups, for where there are only 8 or 10 companies in any particular group the influence of changing practice in a single one of them would affect appreciably the average of all. As in 1918, the returns for 1920 show a greater yield of coke in the larger plants than in the smaller plants. Furthermore, if it were possible to classify according to size of company the coke available for sale, the difference between large and small plants would be even greater because in the small plants much larger percentages of the coke are needed for bench fuel to heat the retorts than is necessary in the well-managed larger establishments.

The tendency toward increasing use of coke as domestic fuel and in industrial heating would encourage the production of coal gas under normal circumstances, because the price obtainable for coke and the certainty of a regular and profitable market for it are primary considerations in the installation of coal-gas plants. However, this tendency to use more coke which has been evident during recent years was overshadowed in 1920 by the greater difficulty of obtaining adequate gas-works fuel. There was also but little tendency to add expensive gas-making equipment during that year, as the public utilities found that such installations could be made only at prohibitive cost, considering both the expense of construction and the cost of money with which to finance extensions. As a result little new coal-gas equipment was put into operation during 1920, and the small increase in capacity made did not operate to increase the total coke output materially, because in many plants coal-gas equipment was idle and water-gas equipment was used instead, in order that the minimum production cost for gas could be attained.

TABLE 23.—*Number of coal-gas plants recovering different percentage yields of coke from coal carbonized in 1918 and 1920, by size of plant.*

	A. 1–20,000 M.		B. 20,000–50,000 M.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants........M..	1,501,169	1,419,852	4,057,995	3,934,443
Number of plants producing coke [a]	124	93	124	116
Percentage yield of coke from coal:				
Minimum	18.5	14.0	24.3	32.3
Maximum	[b] 91.7	[b] 88.5	81.4	76.7
Average	58.6	58.8	60.4	61.8
Number of plants recovering—				
Less than 30 per cent	1	4	1	....
30–39.9 per cent	9	1	3	2
40–44.9 per cent	3	5	3	2
45–49.9 per cent	7	5	6	5
50–54.9 per cent	14	13	8	8
55–59.9 per cent	25	20	17	19
60–64.9 per cent	32	22	37	38
65–69.9 per cent	21	13	36	32
70–74.9 per cent	6	2	8	7
75–79.9 per cent	3	4	3	3
80 per cent or more	3	4	2	....

	C. 50,000–100,000 M.		D. 100,000–200,000 M.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants........M..	4,664,570	3,433,883	4,182,702	4,342,237
Number of plants producing coke [a]	68	51	30	32
Percentage yield of coke from coal:				
Minimum	37.0	43.0	49.5	54.8
Maximum	76.8	80.1	[b] 93.5	80.4
Average	63.8	62.9	65.5	67.2
Number of plants recovering—				
Less than 30 per cent	....	....	....	....
30–39.9 per cent	1	....	....	....
40–44.9 per cent	1	1	....	....
45–49.9 per cent	1	1	1	....
50–54.9 per cent	5	3	1	1
55–59.9 per cent	6	8	2	1
60–64.9 per cent	26	15	8	7
65–69.9 per cent	19	16	13	13
70–74.9 per cent	8	4	2	7
75–79.9 per cent	1	2	1	2
80 per cent or more	....	1	2	1

	E. 200,000–500,000 M.		F. 500,000–1,000,000 M.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants........M..	9,180,896	9,259,920	5,046,679	6,127,324
Number of plants producing coke [a]	29	28	8	10
Percentage yield of coke from coal:				
Minimum	50.7	47.1	65.0	54.1
Maximum	[b] 86.3	85.6	74.3	74.7
Average	64.8	66.6	68.8	66.3
Number of plants recovering—				
Less than 30 per cent	....	....	....	....
30–39.9 per cent	....	....	....	....
40–44.9 per cent	....	....	....	....
45–49.9 per cent	....	1	....	....
50–54.9 per cent	3	1	....	1
55–59.9 per cent	3	1	....	1
60–64.9 per cent	8	3	....	1
65–69.9 per cent	11	13	5	5
70–74.9 per cent	3	5	3	2
75–79.9 per cent	....	3	....	....
80 per cent or more	1	1	....	....

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.
[b] Improbable, but so reported.

TABLE 28.—*Number of coal-gas plants recovering different percentage yields of coke from coal carbonized in 1918 and 1920, by size of plant*—Continued.

	G. 1,000,000 M or more.		Total.	
	1918	1920	1918	1920
Total sales of gas by coal-gas plants......M..	14,025,476	14,430,468	42,659,487	42,948,127
Number of plants producing coke [a]	7	7	390	337
Percentage yield of coke from coal:				
Minimum	49.8	65.4	18.5	14.0
Maximum	75.0	76.9	[b] 93.5	88.5
Average	66.3	70.2	61.2	62.4
Number of plants recovering—				
Less than 30 per cent	....	....	2	4
30-39.9 per cent	....	....	13	3
40-44.9 per cent	....	....	7	8
45-49.9 per cent	1	....	16	12
50-54.9 per cent	....	....	31	27
55-59.9 per cent	....	....	53	50
60-64.9 per cent	2	....	113	86
65-69.9 per cent	1	3	106	95
70-74.9 per cent	2	3	32	30
75-79.9 per cent	1	1	9	15
80 per cent or more	....	....	8	7

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.
[b] Improbable, but so reported.

TAR FROM COAL-GAS PLANTS.

The production of tar at coal-gas plants in 1920 amounted to 51,000,000 gallons, or less than one-seventh the production from coke-oven operations in the same year. In fact, the output of coal-gas tar was slightly lower in 1920 than in either 1915 or 1918, in each of which approximately 53,000,000 gallons was made.

The quantity of tar produced and sold is summarized, by States, for the coal-gas plants operated in 1920 in Table 29. In a few States totals of tar used as fuel under boilers are also reported. As in previous years about 90 per cent of the coal tar produced in 1920 was sold. About 6 per cent is reported as used for fuel under boilers, and the remaining 4 per cent is unaccounted for in the returns to the Geological Survey. However, the increase of tar in stock or the use of tar as fuel not reported to the Survey would account for the difference.

TABLE 29.—*Tar produced and sold from coal-gas plants in 1920, by States.*

State.	Number of plants producing.	Production (gallons).	Sales.			Used as fuel under boilers (gallons).
			Gallons.	Value.		
				Total.	Average.	
Alabama	5	498,684	495,485	$21,522	$0.05	100
Colorado	7	1,409,512	1,148,898	63,435	.06	281,216
Connecticut	5	2,390,453	1,766,797	116,203	.07	....
Georgia	10	985,196	923,831	51,032	.06	34,918
Idaho	3	109,933	112,233	4,932	.04	....
Illinois	33	2,509,742	2,636,098	109,960	.04	....
Indiana	25	1,595,178	1,468,258	66,161	.05	....
Iowa	6	337,162	266,341	10,912	.04	....
Kansas	3	81,565	56,472	3,772	.07	....
Kentucky	7	138,572	131,852	9,842	.07	....
Maine	4	502,707	481,436	25,593	.05	....
Maryland	5	117,533	122,383	8,197	.07	....

TABLE 29.—*Tar produced and sold from coal-gas plants in 1920, by States*—Continued.

State.	Number of plants producing.	Production (gallons).	Sales.			Used as fuel under boilers (gallons).
			Gallons.	Value.		
				Total.	Average.	
Massachusetts	25	5,411,227	4,551,932	$177,746	$0.04	719,394
Michigan	53	8,048,886	7,826,227	211,311	.03	34,516
Minnesota	8	1,243,379	1,117,874	49,034	.04	16,280
Mississippi	6	157,290	120,201	5,176	.04	....
Missouri	8	2,522,372	2,888,107	142,729	.05	14,593
Montana	3	142,630	56,468	5,147	.09	....
New Hampshire	3	185,296	187,846	8,649	.05	....
New Jersey	4	307,255	324,854	16,942	.05	....
New York	30	10,390,824	10,183,277	485,825	.05	174
North Carolina	7	488,295	382,961	12,756	.03	....
North Dakota	3	290,976	273,043	8,472	.03	....
Ohio	8	334,470	360,737	16,503	.05	....
Oregon	3	27,955	15,732	919	.06	....
Pennsylvania	10	3,020,891	720,176	30,469	.04	2,083,932
Tennessee	7	671,575	728,440	28,190	.04	....
Texas	3	168,210	206,545	14,098	.07	....
Utah	3	454,584	406,823	19,669	.05	....
Virginia	8	681,872	754,678	26,265	.03	....
Washington	8	1,024,519	1,030,216	50,240	.05	....
Wisconsin	19	4,000,063	4,036,262	167,531	.04	....
Delaware and West Virginia	2	44,284	49,562	2,904	.06	....
Florida and South Carolina	3	361,200	249,000	11,261	.04	....
Louisiana, Oklahoma, and New Mexico	3	75,852	71,772	4,258	.06	....
Nebraska, South Dakota, and Wyoming	3	55,847	34,884	1,339	.04	....
Rhode Island and Vermont	3	478,967	416,432	21,192	.05	....
	344	51,264,956	46,604,133	2,010,186	.043	3,185,123

The tar made is refined at very few of the gas works. Tar refining is in general a separate industry, practiced by companies that purchase tar in large quantities from a considerable number of gas works. The value of the tar sold varies considerably throughout the country. The average price realized by some gas works is only 1 or 2 cents per gallon, but much higher prices are obtained at a considerable number of plants, as shown by the summary of Table 30. In general, tar can be used instead of other boiler fuel to advantage if the gas works can not get at least 4 or 5 cents per gallon for it. Some operators say that tar is worth as many cents per gallon for fuel as coal costs in dollars per ton. Thus, if the boiler coal costs $5 per ton delivered to the boiler plant of the company, the tar is worth 5 cents per gallon as a substitute for this coal. However, it is evident from Tables 29 and 30 that most coal-gas companies do not reason in this way, as obviously a large quantity of the tar sold was marketed for less than would correspond to this ratio to the coal prices current in 1920.

Analysis of the price realized by gas works in accordance with the size of the plant fails to reveal any particular relation between the price of the tar and the size of the company. This fact was brought out in the report on operations in 1918 and seems to be confirmed by the data for 1920. Therefore, the figures in Table 30 are summarized for the industry as a whole, not according to the size of the companies reporting.

TABLE 30.—*Number of coal-gas plants receiving different average prices for coal tar sold in 1918 and 1920.*

	1918	1920
Total sales of gas by coal-gas plants.....M..	42,659,487	42,948,127
Number of plants selling tar [a]	379	316
Average prices per gallon of tar sold:		
Minimum	$0.015	$0.01
Maximum	.195	.35
Average	.044	.049
Number of plants receiving—		
1-1.9 cents per gallon	4	2
2-2.9 cents	28	9
3-3.9 cents	165	67
4-4.9 cents	89	89
5-5.9 cents	32	67
6-7.9 cents	31	44
8-9.9 cents	8	17
10 cents or more	22	21

[a] Excludes a small number of plants for which reports were incomplete or otherwise defective.

The yield of coal-gas tar per ton of coal consumed is given according to efficiency groups in Table 31. In general, the recovery of tar in very small works is considerably lower than in larger plants, but for all of the companies making more than 20,000,000 cubic feet of gas annually the average does not seem to be affected materially by the size of the company. Hence the data are summarized in Table 31 for the industry as a whole.

The irregularities in the reports of the production of tar are probably due in some measure to the difficulty of estimating the quantities of tar in stock at various times. A stock of tar representing the production of weeks or even months may be on hand at the beginning or end of a year, and some error in estimating this stock may make an apparent discrepancy in the reports of average production for the previous and the subsequent periods. This condition probably accounts for many reports of less than 7 or more than 12 gallons of tar per ton of coal consumed. The yield of tar varies more with the kind of coal, the process of treatment, and the care in collection than it does with the size of the plant.

TABLE 31.—*Number of plants recovering different yields of coal-gas tar per ton of coal consumed in 1918 and 1920.*

	1918	1920
Total sales of gas by coal-gas plants.....M..	42,659,487	42,948,127
Number of plants producing tar [a]	383	329
Gallons of tar per ton of coal consumed:		
Minimum	2.0	1.0
Maximum	26.3	17.9
Average	10.6	10.3
Number of plants recovering—		
Less than 5 gallons per ton	7	5
5-5.9 gallons	7	5
6-6.9 gallons	12	4
7-7.9 gallons	18	8
8-8.9 gallons	33	29
9-9.9 gallons	48	32
10-10.9 gallons	102	78
11-11.9 gallons	67	65
12 gallons or more	89	103

[a] Exclusive of a small number of plants for which reports were incomplete or otherwise defective.

TAR FROM WATER-GAS AND OIL-GAS PLANTS.

In the manufacture of water gas and oil gas, some of the oil used is not completely broken up into gas. The portion not "cracked" appears in the crude gas as vapor or fine tar fog. This is removed from the gas by condensing and washing it to form what is variously known as "oil tar," "gas tar," "water-gas tar," or "oil-gas tar." This tar differs materially in composition and properties from coal-gas tar, and its uses in industry are correspondingly different.

In Table 32 are shown, by States, the production, sales, and uses of the tar produced at water-gas plants in 1920. Of the total production, 114,000,000 gallons, approximately half is sold and half is used as boiler fuel. Like that of coal-gas tar, the value of water-gas tar for fuel depends upon the local cost of coal which the tar may replace. Despite the fact that water-gas tar is usually regarded as worth 5 or 6 cents per gallon for boiler fuel, most of the tar sold from water-gas plants returns to the producer a lower average price than that.

In this connection it is interesting to compare the average price obtained for the various kinds of tar. In 1920 an average of 4.3 cents per gallon was received for coal-gas tar, whereas oil-gas tar brought only 2.6 cents per gallon, by-product coke-oven tar 3.7 cents, and water-gas tar 3.6 cents.

TABLE 32.—*Tar produced and sold from water-gas plants in 1920, by States.*

State.	Number of plants producing.	Production (gallons).	Sales.			Used as fuel under boilers (gallons).
			Gallons.	Value.		
				Total.	Average.	
Alabama	4	353,852	344,852	$13,029	$0.04	....
Colorado	3	220,578	64,184	3,239	.05	142,460
Connecticut	14	1,795,935	454,660	21,817	.05	902,124
District of Columbia and Maryland	6	5,789,648	2,269,106	126,040	.06	3,500,517
Florida	6	226,998	172,716	9,336	.05	87,616
Georgia	6	920,895	460,200	28,844	.06	261,057
Illinois	26	15,453,586	12,014,340	309,212	.03	3,734,342
Indiana	13	1,011,458	798,711	32,876	.04	....
Iowa	23	1,574,055	1,331,083	60,075	.05	28,549
Massachusetts	25	5,792,304	2,546,297	173,258	.07	2,850,071
Michigan	14	2,119,659	2,004,925	44,288	.02	189,208
Minnesota	6	1,639,817	1,839,148	85,534	.05	201,642
Missouri	5	1,455,410	1,305,663	65,663	.05	17,803
Montana	3	32,200	33,124	1,982	.06	....
Nebraska	8	1,611,510	1,498,058	50,820	.03	6,409
New Hampshire	3	178,187	151,310	8,031	.05	26,877
New Jersey	16	7,201,024	6,593,440	233,384	.04	1,206,919
New York	37	43,691,477	10,560,697	472,757	.04	33,649,251
North Carolina	6	83,590	44,190	1,956	.04	6,400
Pennsylvania	36	15,984,607	10,115,265	197,855	.02	6,818,739
South Carolina	5	248,450	169,100	7,407	.04	....
South Dakota	4	25,000	1,377	138	.10	123
Texas	12	1,234,289	56,958	2,775	.05	484,585
Virginia	8	500,811	149,974	7,532	.05	444,664
Washington	5	1,049,126	1,087,736	48,348	.04	350
Wisconsin	8	971,869	1,044,386	29,325	.03	13,550
California and Utah	2	277,299	23,006	791	.03	244,879
Delaware, Ohio, and West Virginia	5	751,937	....	....	....	708,828
Kansas, Louisiana, and North Dakota	4	1,178,408	828,060	26,883	.03	369,800
Kentucky and Tennessee	3	356,095	440,984	12,504	.03	....
Maine, Rhode Island, and Vermont	5	680,033	504,430	25,139	.05	569,966
	321	114,410,107	58,907,980	2,100,838	.036	56,466,729

The yield of tar in water-gas plants is figured in terms of recovery of tar per gallon of oil used in carbureting the gas. In general, the industry expects to get a volume of tar about equal to one-sixth the volume of oil used. The average is a little less than this, for in many smaller plants the recovery of tar is far from complete. The range of yields and the range in prices obtained for this tar are shown in Table 33. In Table 34 are given corresponding figures for the tar produced and sold from oil-gas plants. The production of tar in 1920 at such plants was more than double that in 1918, but was less than half the production reported in 1915. The average yield, however, is probably not very different from that in either of the two previous years. As formerly, only a small part of the total production was sold, the remainder being used as boiler fuel. In 1920 these sales were made at the very low average price of 2.6 cents per gallon, the lowest average price received for many years.

TABLE 33.—*Yield of tar from water-gas plants and average prices obtained in 1918 and 1920.*

	1918	1920
Number of plants reporting production of tar [a]	277	300
Recovery per gallon of oil consumed (gallons):		
Minimum	0.01	0.002
Maximum	.35	.913
Average	.115	.121
Number of plants reporting sales of tar [a]	224	224
Average price obtained per gallon:		
Minimum	$0.01	$0.02
Maximum	.15	.16
Average	.038	.045

[a] Excludes a small number of plants for which reports were incomplete or otherwise defective.

TABLE 34.—*Tar produced and sold from oil-gas plants in 1915, 1918, and 1920.*

	1915	1918	1920
Number of plants reporting production	21	9	21
Production ... gallons	3,665,176	716,722	1,663,800
Yield (gallons of tar per gallon of oil used):			
Maximum [a]	....	0.084	0.476
Average	....	.021	.027
Sales:			
Quantity ... gallons	64,433	550,006	330,750
Value—			
Total	$4,268	$15,967	$8,550
Average ... cents	6.6	2.9	2.6
Used as fuel under boilers ... gallons	([b])	([b])	994,436

[a] The reports range from zero to the maximum.
[b] Statistics not available.

RETORT CARBON AND LAMPBLACK.

In the manufacture of coal gas a certain quantity of carbon is deposited in the form known as retort carbon. This material forms in the outlet of the retort or standpipe, from which it is removed periodically. In many plants the material is mixed with the coke and not separately reported, as it it only a small percentage of the total solid material left behind after the treatment of the coal. In some plants the retort carbon is saved separately and sold as such. In Table 35 are recorded the number of plants reporting sales of retort carbon and the total production and sales. The average value of this retort carbon has usually been about half a cent a pound, but in 1920 it was 0.73 cent a pound. This increase was probably due, in part at least, to the fact that the quantities produced and sold that year were materially less than formerly.

TABLE 35.—*Retort carbon produced and sold from manufactured-gas plants in 1915, 1917, 1918, and 1920.*

	Number of plants reporting production.	Production (pounds).	Sales.		
			Pounds.	Value.	
				Total.	Average (cent).
1915.					
Coal-gas and water-gas plants	47	8,166,000	1,722,000	$9,873	0.57
1917.					
Coal-gas and water-gas plants	47	10,600,000	2,640,000	14,800	.56
1918.					
Coal-gas plants	90	2,202,853	2,014,961	13,275	.66
Water-gas plants	6	521,748	501,723	2,230	.44
Coke-oven plants	4	1,310,020	1,310,020	2,732	.21
	100	4,034,621	3,826,704	18,237	.48
1920.					
Coal-gas plants	40	1,025,466	783,985	5,739	.73
Coke-oven plants	1	44,000	44,000	340	.77
	41	1,069,466	827,985	6,079	.73

In the manufacture of oil gas the cracking of the oil produces not only gaseous material, but also some lampblack, which is carried out of the generator with the crude gas and removed in wash boxes, together with some of the tar. In Table 36 are shown the data for production, use, and sales of this material in 1915, 1918, and 1920. The number of plants reporting lampblack production was slightly less in 1920 than in 1918, and the production reported was also materially lower than 1918 but higher than in previous years. As formerly, a considerable portion of the total production is used for making lampblack briquets. About one-third of the total was so employed in 1920; the sales of lampblack account for another third, and the remainder was presumably used for fuel in the oil-gas works. It is notable that the average price obtained per pound of lampblack sold was higher in 1920 than in any other recent year.

TABLE 36.—*Lampblack produced and sold from oil-gas plants in 1915, 1918, and 1920.*

	1915	1918	1920
Number of plants reporting production	21	29	24
Production ... pounds	100,090,000	262,022,000	203,281,411
Used for lampblack briquets ... do	....	80,124,000	74,474,000
Sales:			
Quantity ... do	52,918,000	35,355,000	71,292,159
Value—			
Total	$174,659	$95,211	$295,149
Average ... cent	0.33	0.27	0.41

In the territory where oil gas is made—that is, the far West and the Southwest—all forms of high-grade solid fuel are rare or very expensive, hence lampblack briquets afford a valuable substitute for anthracite or coke. To some extent also lampblack enters the chemical industries for further manufacture into various carbon products, but its large content of tar makes it less valuable for such uses than it might otherwise be. The presence of this tar, however, makes it well adapted to briquetting.

Two distinct views as to lampblack are held by oil-gas manufacturers. One group undertakes to make as large a quantity of lampblack as possible, regarding it as a valuable by-product, which returns more to the producer than it costs. The second group undertakes to reduce the yield of lampblack to the lowest possible point, regarding it as only a nuisance. Many local conditions affect both the cost of production and the value of this product, and it is not practicable to generalize as to the merits of the claims of these two groups or to prophesy any tendency within the industry toward greater or lesser production of lampblack.

AMMONIA.

The production of ammonium sulphate, ammonia liquor, or ammonia in any other forms is an economic necessity in any plant making considerable quantities of coal gas. However, in some of the very small plants the ammonia, although removed from the gas by washing with water, is allowed to run to waste in the sewer. Only about 100 plants recover appreciable quantities of the ammonia that is formed in the gas during the carbonization of the coal. The production and sales of this ammonia are figured on the basis of the equivalent ammonium sulphate which could be formed from it. The data are given in Table 37.

The total production of ammonium sulphate or equivalent at coal-gas works in 1920 was practically 58,000,000 pounds. During the same year 940,000,000 pounds of ammonium sulphate or equivalent was produced in coke-oven plants. In other words, the coal-gas works of the country produced less than one-sixteenth as much ammonia or ammonium compounds as the coke ovens.

Practically all the ammonia produced at coal-gas works is sold in the form of ammonia liquor, but for purposes of tabulation all of this liquor is calculated in terms of equivalent sulphate. This is necessary because the strength of the liquor marketed varies widely and it is not feasible to make any report on the basis of gallons or of the average strength of the liquor sold.

Table 37 shows that the average value of the sales per pound of ammonium sulphate varies widely. This is partly the result of difference in local conditions, but also the result of the difference in concentration of the ammonia in the liquor marketed. Obviously in a weak liquor the ammonia is not worth as much per unit as if it were in a concentrated form.

TABLE 37.—*Ammonium sulphate equivalent produced and sold from coal-gas plants in 1920.*

State.	Number of plants producing.	Production (pounds).	Sales.		
			Pounds.	Value.	
				Total.	Average.
Connecticut	5	2,529,176	2,509,812	$111,583	$0.04
Illinois	11	3,005,354	2,955,772	63,323	.02
Indiana	5	490,044	380,060	11,454	.03
Massachusetts	15	6,078,710	5,624,734	111,029	.02
Michigan	16	9,184,924	8,894,208	208,813	.02
New York	11	17,891,562	17,520,237	322,362	.02
Ohio	3	47,384	35,844	842	.02
Pennsylvania	4	2,260,175	1,859,566	46,553	.03
Tennessee	3	657,656	652,796	8,386	.01
Washington	4	1,309,128	1,323,264	26,429	.02
Wisconsin	7	4,567,012	4,489,084	131,511	.03
Alabama and Mississippi	3	488,308	454,944	8,440	.02
Colorado and Utah	4	1,406,292	1,375,540	24,753	.02
Florida and Georgia	3	1,192,508	1,227,480	40,245	.03
Iowa and Missouri	3	5,222,356	4,565,764	101,098	.02
Maine, New Hampshire, and Rhode Island	2	834,072	789,572	17,692	.02
Minnesota and North Dakota	3	643,121	630,104	16,652	.03
North Carolina and Virginia	3	162,824	62,180	1,561	.03
	105	57,970,606	55,350,961	1,252,726	.023

The average price realized for ammonium sulphate or its equivalent sold as ammonia liquor is summarized in Table 38, from which it is evident that the average is not very different for small or for large companies. There are, however, wide variations in the average price obtained within several of the size groups, but the price for ammonia is in general between 2 and 4 cents per pound of ammonium sulphate equivalent without regard to the part of the country, the size of the company, or the condition in which the ammonia was when sold. From the individual returns it is not evident why in one or two cases so very much higher prices were obtained for ammonia than have been had elsewhere. It may be that these figures have been reported erroneously through misunderstanding, but for completeness of summary they are included just as given by the operators.

TABLE 38.—*Number of coal-gas plants receiving different average prices for ammonium sulphate or equivalent sold in 1920, by size of plant.*

	A. 1-20,000 M.	B. 20,000-50,000 M.	C. 50,000-100,000 M.	D. 100,000-200,000 M.	E. 200,000-500,000 M.	F. 500,000-1,000,000 M.	G. 1,000,000 M. or more.	Total.
Total sales of gas by coal-gas plants..M..	1,419,852	3,934,443	3,433,883	4,342,237	9,259,920	6,127,324	14,430,468	42,948,127
Number of plants selling ammonia	1	9	20	21	28	9	7	95
Average price per pound of ammonia sold:								
Minimum	$0.033	$0.02	$0.01	$0.01	$0.01	$0.01	$0.02	$0.01
Maximum	.033	.04	.03	.03	.05	.07	.04	.07
Average	.033	.026	.019	.020	.028	.031	.024	.024
Number of plants receiving—								
1-1.9 cents per pound			5	4	2	2	1	14
2-2.9 cents		5	12	12	12	2	3	46
3-3.9 cents	1	3	3	5	7	4	2	25
4-4.9 cents		1			6		1	8
5-5.9 cents					1			1
6-6.9 cents								
7-9 cents						1		1
10 cents or more								

The figures for production and sales in 1920 differ little from the corresponding figures for 1918. In 1918 there were more plants reporting production, slightly greater production, and slightly greater total and average value of sales than in 1920.

The efficiency of coal-gas plant operation with respect to the yield of ammonium sulphate per ton of coal consumed is given in Table 39, from which it is evident that there is a wide range in the quantity of ammonia recovered per ton of coal. This results partly from difference in local plant conditions, partly from difference in the quality of coal, but perhaps more than anything else from the difference in completeness of recovery in the liquor marketed. Although at many plants most of the ammonia is removed from the gas, much of it is not ultimately recovered in a form that can be reported as production, as it is so diluted that the preparation of it for market is not feasible. In the analysis of plant efficiency in 1918 it was shown that there was great difference in efficiency according to size of plant.

The larger plants of course recover larger percentages of the ammonia present and also have better control of coal-carbonizing conditions, so that more ammonia is formed than is usual under the less efficient methods of operation that are more likely to exist at small works.

The general average recovery of ammonium sulphate per ton in 1920 was not radically different from that in 1918, nor does there seem to be any radical difference in distribution of plants in the various efficiency groups. The completeness of recovery depends so much upon local conditions, such as the availability of adequate cold water for washing the gas and adequate washing capacity, that marked changes from year to year in this particular are not to be expected.

TABLE 39.—*Number of coal-gas plants recovering different yields of ammonium sulpnate per ton of coal consumed in 1918 and 1920.*

	1918	1920
Total sales of gas by coal-gas plants.....M..	42,659,487	42,948,127
Number of plants reporting production of ammonia	133	105
Ammonium sulphate per ton of coal (pounds):		
Minimum	0.2	0.2
Maximum	30.4	28.1
Average	10.2	10.1
Number of plants recovering—		
Less than 2 pounds per ton	6	4
2–3.9 pounds	10	12
4–5.9 pounds	20	15
6–7.9 pounds	18	12
8–9.9 pounds	14	8
10–14.9 pounds	37	28
15–19.9 pounds	19	19
20–24.9 pounds	7	6
25 pounds or more	2	1

DRIP OR HOLDER OILS.

When the gas manufactured by any ordinary process is washed and purified, ready for distribution, it still contains certain oil vapors that tend to condense from the gas upon exposure to lower temperatures. The oil that thus condenses is known as "holder oil" or "drip oil," from the fact that it collects in the gas holder or in the drips placed at the lowest points in the main system under the city streets. This oil contains many of the same constituents as the crude light oil, and it derives its value from this fact.

In 1920, recovery of drip or holder oils was reported by 71 plants having a total production of 4,427,000 gallons of this material. The sales were about 90 per cent of the production and were made at the average price of 6 cents per gallon. This average price obtained for the drip or holder oil is much lower than in 1918, when an average of 13.3 cents per gallon was received at the plants. This lower price resulted from the fact that all the light oils, which are the more valuable constitutents of the drip oil, now command a much lower market price than during the war period. As in previous years, this average price obtained for drip oil corresponds closely with the average market price for crude light oil. The wide variation in average price in different States results from different local conditions with respect to the use of the material. At most plants there are no facilities available for refining the material to readily usable form, and hence the price there is low, but in a number of plants the conditions are particularly favorable for the use of the material, and this accounts for the higher average price obtained in a few States.

TABLE 40.—*Drip and holder oils produced and sold from gas plants in the United States in 1920.*

State.	Number of plants producing.	Production (gallons).	Sales.		
			Gallons.	Value.	
				Total.	Average.
Connecticut	3	34,209	8,529	$564	$0.07
Illinois	4	248,131	85,589	4,191	.05
Iowa	7	29,888	22,968	1,584	.07
Massachusetts	6	36,401	34,527	3,288	.10
Minnesota	3	82,090	48,941	5,181	.10
Missouri	3	35,171	30,352	2,178	.07
Nebraska	5	73,452	67,686	3,018	.04
New Jersey	10	576,948	756,455	57,676	.08
New York	13	1,869,683	1,785,189	110,686	.06
Washington	4	43,594	43,839	4,345	.10
California, Oregon, and South Dakota	4	14,760	14,760	4,312	.29
Delaware, Maryland, and Rhode Island	3	167,837	167,837	12,188	.07
Georgia and North Carolina	3	26,480	22,830	2,192	.10
Ohio and Pennsylvania	3	1,008,762	999,594	30,296	.03
	71	4,427,406	4,089,096	241,699	.06

LIGHT OIL AND DERIVED PRODUCTS.

During the period of the World War the plants producing light oils became numerous, and in 1918 there were 41 plants that reported the production of light oil or its derivatives. In that year the total production of crude light oil was almost 22,000,000 gallons, of which about one-fifth was toluol. In fact, it was the demand for toluol which occasioned the recovery of light oil at gas works.

After the war the demand for toluol, benzol, and solvent naphtha or xylol decreased rapidly, and most of the gas works where light oil and its products had been produced in 1918 found it no longer profitable to continue the operation of that branch of their business. In consequence in 1920 only eight companies reported the production of such materials. One of them is a coal-gas works; four make both coal gas and water gas; and three make water gas only. The total production of crude light oil in 1920 was 13,600,000 gallons. The sales were in fact a trifle greater than the production, some material sold being drawn from stocks. The aggregate value of the sales was only about $1,000,000, less than one-sixth the value of the sales of these materials in 1918.

Not only did the total value of sales decrease, but also the average value per gallon of the material sold. In 1918 a large number of the sales were made up of refined products such as benzol, toluol, and solvent naphtha or xylol. But in 1920 none of the gas works reporting indicated that their sales included any of these refined materials. Two companies reported sales in the form of motor fuel, approximately half of which was benzol and half gasoline, and six companies reported sales as crude light oil. Naturally, the average price per gallon of these lower-grade materials was only about one-tenth of the high price commanded during the war by the higher-grade refined products.

In connection with this change in gas-works practice with respect to the recovery of light oil it should be borne in mind that many of the light-oil plants operating during the war period at gas works were owned by the United States Government and were operated for it by the gas companies at whose works these plants were installed. So far as information is available, it appears that all these plants have been completely dismantled, and those which remain are exclusively those which were erected by gas companies as part of their own equipment. Even some of the light-oil plants thus erected privately in gas works have been removed because of the small market demand or low price for the products which they were able to manufacture.

TABLE 41.—*Light oils and derived products produced and sold from gas plants in the United States in 1918 and 1920.*

Kind of gas.	Number of plants producing.	Production of crude (gallons).	Sales of crude and all products.		
			Gallons.	Value.	Average price.
1918.					
Coal gas	7	5,729,629	2,032,883	$1,457,972	$0.717
Water gas	26	11,909,702	4,613,751	3,830,392	.830
Coal gas and water gas mixed	5	4,230,908	2,229,535	1,220,138	.547
Oil gas	3	21,494	20,376	4,274	.210
	41	21,891,733	8,896,545	6,512,776	.732
1920.[a]					
Coal gas	5	10,717,423	10,912,216	805,697	.074
Water gas	7	2,905,700	3,142,425	271,168	.086
	12	13,623,123	14,054,641	1,076,865	.077

[a] Production in four mixed water and coal-gas plants has been divided to show separately as accurately as possible production by kind of gas.

NAPHTHALENE AND MISCELLANEOUS PRODUCTS.

The production and sales of naphthalene made at various kinds of gas plants are given in Table 42. This material was recovered in somewhat fewer works in 1920 than in 1918, but still in many more than in 1915. The production was slightly greater but the sales substantially the same as in the last war year. The value of the naphthalene sold was distinctly less than in 1918 but more than ten times as great as in 1915. The average price per pound obtained by the producers was only 3.4 cents, which is 15 per cent less than the average in 1918 and a trifle less than half the average in 1915.

TABLE 42 —*Naphthalene produced and sold from gas plants and coke-oven plants in the United States in 1915, 1918, and 1920.*

	1915 [a]	1918	1920
Number of plants reporting:			
Coal gas—			
Crude	4	6	3
Refined		1	1
Water gas—			
Crude	....	2	1
Refined		....	....
Coke-oven gas—			
Crude	6	24	24
Refined		9	5
Oil gas—			
Crude	....	....	1
Refined	....	....	....
	10	42	35
Production (pounds): [b]			
Coal gas—			
Crude	....	424,679	2,981,236
Refined	....	5,119	1,578,539
Water gas—			
Crude	....	539,884	134,433
Refined	....	....	....
Coke-oven gas—			
Crude	....	10 614,799	11,246,807
Refined	....	5,472,699	2,921,282
Oil gas—			
Crude	....	....	400
Refined	....	....	....
	....	17,057,180	18,862,697
Sales (pounds):			
Coal gas—			
Crude	222,925	387,878	177,550
Refined		5,119	1,306,443
Water gas—			
Crude	....	503,083	275,900
Refined		....	....
Coke-oven gas—			
Crude	465,865	10,403,758	11,507,703
Refined		5,486,689	2,941,059
Oil gas—			
Crude	....	....	400
Refined	....	....	....
	688,790	16,786,527	16,209,055
Value of sales:			
Coal gas—			
Crude	$3,565	$10,200	$1,033
Refined		475	57,004
Water gas—			
Crude	....	3,607	5,400
Refined		....	....
Coke-oven gas—			
Crude	46,959	287,581	307,999
Refined		362,648	179,975
Oil gas—			
Crude	....	....	12
Refined	....	....	....
	50,524	664,511	551,423
Average price per pound (cents):			
Coal gas—			
Crude	1.6	2.6	0.6
Refined		9.3	4.4
Water gas—			
Crude	....	.7	2.0
Refined		....	....
Coke-oven gas—			
Crude	10.0	2.8	2.7
Refined		6.6	6.1
Oil gas—			
Crude	....	....	3.0
Refined	....	....	....
	7.3	4.0	3.4

[a] Data on naphthalene were not asked for specifically in 1915, hence the figures shown may not cover the entire output of the country.
[b] Figures of production were not asked for until 1918.

About a dozen gas plants reported the production and sale of miscellaneous products, such as spent oxide, coke breeze, cinders, cyanogen, cyanogen press cake, sulphuric acid, and copperas. The quantities of most of these materials are small, and the values are almost negligible in comparison with the values of the other principal by-products. However, they have all been totaled, so far as reported, and amount to $30 from water-gas plants and $428,294 from coal-gas plants. Of course these amounts do not represent the total income from miscellaneous products disposed of, for undoubtedly there are many plants that have not reported these incidental transactions.

Three plants, all coal-gas plants, reported the production and sales of cyanogen or cyanogen cake. It is possible, therefore, to report this item separately from the other miscellaneous products. About 3,600,000 pounds of cyanogen cake was reported as produced, and substantially the same quantity as sold. The value of this material sold at these three plants, together with the estimated value of a small quantity sold at a fourth plant, was $315,097. The concentration of cyanogen in the product sold was not reported, hence the unit value can not be properly computed from the above data.

RELATION TO BY-PRODUCT COKE INDUSTRY.

As pointed out in various sections of this report, the products of the gas works and by-product coke ovens are identical or very similar. In connection with the discussion of several of the important by-products a comparison has been made between the quantities of these materials made at gas works and the quantities available from the by-product coke-oven plants. For convenience of comparison between the industries as a whole Table 43 gives a summary of the more important statistics with respect to the coke industry in 1919 and 1920. From these data a comparison of the magnitude of the industries can readily be made.

TABLE 43.—*Salient figures of the coke industry in 1919 and 1920.*

	1919	1920
New ovens completed and put in operation:		
Beehive	(a)	....
By-product	(a)	757
	(a)	757
Ovens dismantled:		
Beehive	2,779	6,706
By-product	68	300
	2,847	7,006
Ovens in existence Dec. 31.:		
Beehive	82,560	75,298
By-product	10,379	10,881
	92,939	86,179
Daily coke capacity of ovens in existence Dec. 31:		
Beehive ... net tons	(a)	196,065
By-product ... do	(a)	117,319
	(a)	313,384
Ovens in course of construction Dec. 31:		
Beehive	164	332
By-product	877	396
	1,041	728

a Statistics not available.

TABLE 43.—*Salient figures of the coke industry in 1919 and 1920*—Continued.

	1919	1920
Coal charged into ovens:		
Beehive .... net tons..	29,730,499	31,985,836
By-product .... do....	35,857,419	44,204,996
	65,587,918	76,190,832
Average value of coal charged into ovens:		
Beehive	$2.17	$3.14
By-product	3.96	5.40
	3.14	4.44
Coke produced:		
Beehive .... net tons..	19,042,936	20,511,092
By-product .... do....	25,137,621	30,833,951
	44,180,557	51,345,043
Average yield of coke from coal:		
Beehive .... per cent..	64.1	64.1
By-product .... do....	70.1	69.9
	67.4	67.3
Screenings and breeze produced:		
Beehive .... net tons..	63,865	245,977
By-product .... do....	1,848,547	2,460,835
	1,912,412	2,706,812
Furnace coke sold:		
Beehive .... do....	14,574,264	13,128,237
By-product .... do....	4,677,497	4,054,964
	19,251,761	17,183,201
Foundry coke sold:		
Beehive .... do....	1,349,483	1,807,256
By-product .... do....	1,480,516	1,715,982
	2,829,999	3,523,238
Domestic and other coke sold:		
Beehive .... do....	[b] 143,930	192,142
By-product .... do....	[b] 2,885,270	2,361,737
	[b] 3,029,200	2,553,879
Screenings and breeze sold:		
Beehive .... do....	([b])	44,040
By-product .... do....	([b])	563,019
	([b])	607,059
Average value of furnace coke sold:		
Beehive	$4.94	$8.30
By-product	6.63	10.57
	5.35	8.83
Average value of foundry coke sold:		
Beehive	$6.20	$9.52
By-product	8.69	13.80
	7.50	11.60
Average value of domestic and other coke sold:		
Beehive	[b] $5.39	$8.04
By-product	[b] 5.41	8.93
	[b] 5.41	8.86
Average value of screenings and breeze sold:		
Beehive	([b])	$3.82
By-product	([b])	2.22
	([b])	2.33
Coke used by producer:		
Beehive .... net tons..	3,023,828	3,204,884
By-product .... do....	17,767,066	22,848,461
	20,790,894	26,053,345

[b] Screenings and breeze included with domestic and other coke.

TABLE 43.—*Salient figures of the coke industry in 1919 and 1920*—Continued.

	1919	1920
Screenings and breeze used by producer:		
Beehive ... net tons..	(a)	59,171
By-product ... do....	(a)	1,692,186
	(a)	1,751,357
By-products obtained from by-product ovens.		
Tar produced ... gallons..	288,901,739	360,664,124
Sold:		
Quantity ... do....	217,707,157	174,363,696
Value ...	$6,918,549	$6,378,040
Used as fuel under boilers ... gallons..	(a)	23,947,848
Used in open-hearth or other affiliated plants ... do....	(a)	167,855,300
Average yield per ton of coal coked ... do....	8.1	8.2
Ammonia produced (sulphate equivalent) ... pounds..	746,446,383	938,925,522
Sold (sulphate equivalent):		
Quantity ... do....	764,079,749	874,321,063
Value ...	$26,751,694	$35,695,433
Average yield per ton of coal coked ... pounds..	20.8	21.4
Gas produced ... M cubic feet..	415,655,098	476,485,744
Used in heating ovens ... do....	212,221,693	235,701,859
Used under boilers or other coke-plant equipment ... do....	(a)	25,430,288
Used in steel or other affiliated plant ... do....	(a)	151,764,807
Distributed through city mains ... do....	49,464,601	53,220,824
Wasted ... do....	10,609,311	10,367,966
Value of gas sold or used (exclusive of that used for heating ovens) ...	$16,650,195	$32,234,318
Average yield per ton of coal coked ... M cubic feet..	11.6	10.8
Crude light oil produced ... gallons..	92,473,409	109,709,915
Sold:		
Quantity ... do....	...	1,067,045
Value ...	...	$126,158
Refined on premises ... gallons..	...	106,564,417
Average yield per ton of coal coked ... do....	2.7	2.7
Crude benzol produced ... do....	c 44,060,970	8,747,572
Sold:		
Quantity ... do....	c 44,673,554	1,510,420
Value ...	c $7,860,093	$401,296
Refined benzol produced ... gallons..	17,006,532	16,977,556
Sold:		
Quantity ... do....	18,403,909	15,720,356
Value ...	$3,783,552	$4,096,527
Motor fuel produced ... gallons..	(c)	57,645,462
Sold:		
Quantity ... do....	(c)	55,764,265
Value ...	(c)	$12,644,931
Crude toluol produced ... gallons..	...	287,142
Refined toluol produced ... do....	1,160,136	2,710,649
Sold:		
Quantity ... do....	1,353,827	2,470,364
Value ...	$355,990	$740,722
Solvent naphtha produced ... gallons..	3,920,489	5,678,525
Sold:		
Quantity ... do....	3,625,978	4,695,464
Value ...	$552,853	$851,048
Crude naphthalene produced ... pounds..	3,579,998	11,246,807
Sold:		
Quantity ... do....	4,038,455	11,507,703
Value ...	$82,244	$307,999
Refined naphthalene produced ... pounds..	2,763,271	2,921,282
Sold:		
Quantity ... do....	2,663,585	2,941,059
Value ...	$109,120	$179,975

a Statistics not available. c Motor fuel included with crude benzol.

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DEPARTMENT OF THE INTERIOR
Albert B. Fall, Secretary

UNITED STATES GEOLOGICAL SURVEY
George Otis Smith, Director

COKE PRODUCED IN THE UNITED STATES, 1880-1920

(Net tons.)

Year.	Alabama.	Colorado.	Georgia.	Illinois.	Indiana.	Kansas.	Kentucky.	Maryland.	Massachusetts.	Michigan.	Minnesota.	Missouri.	Montana.	New Jersey.	New Mexico.	New York.	Ohio.	Oklahoma (Indian Territory).	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Utah.	Virginia.	Washington.	West Virginia.	Wisconsin.	Wyoming.	Other States.	Total.	Year.
1880	60,781	25,568	38,041	12,700	......	3,070	4,250	......	......	......	......	......	......			......	100,596	1,546	2,821,384	......	130,609	......	1,000	......	......	138,755	......	......	......	3,338,300	1880
1881	109,033	48,587	41,376	14,800	......	5,670	4,370	......	......	......	......	......	......	......	......	......	119,469	1,768	3,437,708	......	143,853	......	......	......	......	187,126	......	......	......	4,113,760	1881
1882	152,940	102,105	46,602	11,100	......	6,080	4,070	......	......	......	......	......	......	......	1,000	......	103,722	2,025	3,945,034	......	187,695	......	250	......	......	230,398	......	......	......	4,793,321	1882
1883	217,531	133,997	67,012	13,400	......	8,430	5,025	......	......	......	......	......	......	......	3,905	......	87,834	2,573	4,438,461	......	203,691	......	......	25,340	......	257,519	......	......	......	5,464,721	1883
1884	244,009	115,719	79,268	13,095	......	7,190	2,223	......	......	......	......	......	75	......	18,282	......	62,709	1,912	3,822,128	......	219,723	......	......	63,600	400	223,472	......	......	......	4,873,805	1884
1885	301,180	131,960	70,669	10,350	......	8,050	2,704	......	......	......	......	......	175	......	17,940	......	39,416	3,584	3,991,805	......	218,842	......	......	49,139	311	260,571	......	......	......	5,106,696	1885
1886	375,054	142,797	82,680	8,103	6,124	12,493	4,528	......	......	......	......	......	......	......	10,236	......	34,932	6,351	5,406,597	......	368,139	......	......	122,352	825	261,158	......	......	......	6,845,369	1886
1887	325,020	170,698	79,241	9,198	17,658	14,950	14,565	......	......	......	......	2,970	7,200	......	13,710	......	93,004	10,060	5,832,849	......	396,979	......	......	166,947	14,625	412,031	......	......	......	7,611,705	1887
1888	508,511	179,682	83,721	7,410	11,956	14,831	23,150	......	......	......	......	2,600	12,000	......	8,510	......	67,194	7,502	6,545,779	......	385,693	......	......	149,199	......	531,762	500	......	......	8,540,030	1888
1889	1,030,510	187,638	91,727	11,583	8,301	13,910	13,021	......	......	......	......	5,275	14,043	......	3,460	......	75,124	6,639	7,659,055	......	359,710	......	761	116,528	3,841	607,880	16,016	......	......	10,258,022	1889
1890	1,072,942	245,756	102,233	5,000	6,013	12,311	12,343	......	......	......	......	6,136	14,427	......	2,050	......	74,633	6,639	8,560,245	......	348,728	......	8,528	165,847	5,837	833,377	24,976	......	......	11,508,021	1890
1891	1,282,496	277,074	103,057	5,200	3,798	14,174	33,777	......	......	......	......	6,672	29,009	......	2,309	......	38,718	9,464	6,954,846	......	364,318	......	7,919	167,516	6,000	1,009,051	34,387	2,682	......	10,352,688	1891
1892	1,501,571	[a] 373,229	81,807	3,170	3,207	9,132	36,123	......	......	......	......	7,299	34,557	......	......	......	51,818	3,569	8,327,612	......	354,096	......	(a)	117,912	7,177	1,034,750	33,800	......	......	12,010,829	1892
1893	1,168,085	[a] 362,986	90,726	2,209	5,724	8,565	48,619	......	......	......	......	5,905	29,945	......	5,803	12,850	22,436	7,135	6,229,051	......	265,777	......	(a)	125,092	6,731	1,062,076	14,958	2,916	......	9,477,580	1893
1894	923,817	[a] 317,196	93,029	2,200	6,551	8,439	29,748	......	......	......	......	2,250	17,388	......	6,529	16,500	32,640	3,051	6,063,777	......	292,646	......	(a)	180,691	5,245	1,193,933	4,250	1,352	......	9,203,632	1894
1895	1,444,339	[a] 310,357	60,212	2,250	4,804	5,287	25,460	......	......	......	......	2,028	25,337	......	11,663	18,521	29,050	5,175	9,404,215	......	396,790	286	(a)	244,738	15,129	1,285,206	4,972	4,895	......	13,333,714	1895
1896	1,479,437	[a] 363,760	53,673	2,600	4,353	4,785	27,107	......	......	......	......	2,500	60,078	......	21,228	(b)	80,868	21,021	[c] 7,356,502	......	339,202	......	(a)	268,081	25,949	1,649,755	5,332	19,542	......	11,788,773	1896
1897	1,413,017	[a] 342,653	33,000	1,549	2,901	6,181	32,117	......	......	......	......	2,593	67,849	......	1,438	(b)	95,087	30,364	[c] 8,966,924	......	368,769	394	(a)	354,067	26,189	1,472,666	17,216	24,007	......	13,288,984	1897
1898	1,663,020	[a] 174,808	49,529	2,325	1,825	4,180	22,212	......	......	......	......	740	52,009	......	6,980	(b)	85,535	34,110	[e] 10,715,302	......	391,545	......	(a)	531,161	30,197	1,925,071	35,280	18,350	......	16,047,209	1898
1899	1,787,809	[a] 530,424	50,907	[d] 2,370	(d)	11,476	81,095	......	(b)	......	......	2,860	56,376	......	44,131	(b)	83,878	24,339	[e] 13,577,870	......	435,308	......	(a)	618,707	30,372	2,278,577	33,137	15,630	......	19,668,569	1899
1900	2,110,837	[a] 648,755	73,928	(f)	(f)	5,948	95,532	......	(f)	(f)	......	2,087	54,731	......	44,774	(f)	72,116	38,141	13,357,295	......	475,432	......	(a)	685,156	33,387	2,358,499	(f)	(f)	506,730	20,533,348	1900
1901	2,148,911	[a] 671,303	51,550	(f)	(f)	7,138	100,285	......	(f)	(f)	......	4,749	57,004	......	41,643	(f)	108,774	37,374	14,355,917	......	401,017	......	(a)	907,130	49,197	2,283,700	(f)	(f)	561,191	21,795,883	1901
1902	2,552,246	[a] 1,003,393	82,064	(f)	(f)	20,902	126,879	......	(f)	(f)	......	5,780	53,463	......	23,298	(f)	116,099	49,441	16,497,910	......	560,008	......	(a)	1,124,572	40,305	2,516,505	(f)	(f)	598,869	25,401,730	1902
1903	2,693,497	[a] 1,053,810	85,516	(f)	(f)	11,191	115,362	(f)	(f)	(f)	......	1,839	45,107	(f)	11,059	(f)	143,913	19,818	15,650,932	......	516,875	......	(a)	1,176,439	45,623	2,707,818	(f)	(f)	932,128	25,274,281	1903
1904	2,310,219	[a] 789,060	75,812	4,139	(f)	9,460	64,112	(f)	(f)	(f)	(f)	2,446	41,497	(f)	58,259	(f)	109,284	44,808	14,861,061	......	379,240	......	(a)	1,101,716	45,132	2,283,086	(f)	(f)	1,451,172	23,661,106	1904
1905	2,576,986	[a] 1,378,824	70,593	10,307	......	4,425	79,487	(f)	(f)	(f)	(f)	1,580	31,482	(f)	89,638	(f)	277,130	54,781	20,573,736	......	468,092	......	(a)	1,499,181	53,137	3,400,593	(f)	(f)	1,660,857	32,231,129	1905
1906	3,034,501	[a] 1,455,905	70,280	268,693	......	1,698	74,061	(f)	(f)	(f)	(f)	......	38,182	(f)	147,747	(f)	293,994	49,782	23,060,511	......	483,428	......	(a)	1,577,659	45,612	3,713,514	(f)	(f)	2,085,617	36,401,217	1906
1907	3,021,794	[a] 1,421,579	74,934	372,697	......	6,274	67,068	332,253	166,458	(f)	(f)	......	40,714	256,057	265,125	385,178	270,634	19,089	26,513,214	......	467,499	......	(a)	1,515,289	52,028	4,112,896	(f)	......	1,088,493	40,779,564	1907
1908	2,362,666	[a] 982,291	39,422	362,182	(f)	2,497	37,827	270,016	453,883	(f)	(f)	......	(f)	248,893	271,565	473,569	159,578	2,911	15,511,634	......	214,528	......	(a)	1,162,051	38,889	2,637,123	(f)	......	798,060	26,033,518	1908
1909	3,085,824	[a] 1,251,805	46,385	,276,956	(f)	......	16,371	315,587	444,349	(f)	(f)	......	(f)	261,460	373,967	523,551	222,711	(f)	21,905,525	......	261,808	......	(a)	1,347,478	42,981	3,913,918	(f)	......	961,359	39,315,065	1909
1910	3,249,027	[a] 1,346,211	43,814	,514,501	(f)	(f)	53,857	335,373	450,001	(f)	(f)	......	(f)	250,153	401,616	652,459	282,315	(f)	26,315,607	......	322,756	......	(a)	1,193,655	59,337	3,803,850	(f)	......	1,131,245	41,708,810	1910
1911	2,761,521	[a] 1,177,023	37,553	1,610,212	(f)	(f)	66,099	343,451	477,561	(f)	(f)	......	(f)	255,334	381,927	686,172	311,382	......	21,923,935	......	330,418	......	(a)	910,111	40,180	2,291,049	(f)	......	1,917,258	35,551,489	1911
1912	2,975,489	972,911	43,158	1,764,944	2,616,339	(f)	191,555	304,715	511,596	(f)	(f)	......	......	304,715	413,906	791,618	388,669	......	27,438,693	......	370,076	......	(f)	967,947	49,260	2,465,986	(f)	......	1,408,992	43,983,599	1912
1913	3,323,661	879,461	42,747	1,859,553	2,727,025	......	317,084	236,423	531,384	(f)	(f)	......	......	255,792	467,945	758,186	351,846	......	28,753,441	......	364,578	......	(f)	1,303,603	76,221	2,472,752	(f)	......	1,577,522	46,299,530	1913
1914	3,084,149	666,083	24,517	1,425,168	2,276,652	......	443,959	87,852	540,631	(f)	(f)	......	......	255,283	362,572	457,370	521,638	......	20,258,393	......	264,127	......	(f)	780,984	81,923	1,427,962	(f)	......	1,593,651	34,555,914	1914
1915	4,071,811	670,938	20,039	1,686,998	2,768,099	......	526,097	313,283	504,438	(f)	127,847	(f)	......	269,448	389,411	684,461	681,658	......	25,622,862	......	256,973	......	(f)	629,807	136,552	1,391,146	(f)	......	1,825,982	41,581,150	1915
1916	4,298,417	1,053,553	47,127	2,320,400	3,489,660	......	802,526	489,982	563,048	(f)	431,319	(f)	......	240,766	502,812	775,014	1,803,268	......	31,279,695	......	382,175	......	(g)	1,242,332	[g] 531,653	2,521,309	(f)	......	1,785,529	54,533,585	1916
1917	4,892,589	1,112,449	39,589	2,259,833	3,540,718	......	863,071	518,810	595,113	(f)	490,272	(f)	......	423,301	577,679	993,181	3,691,302	......	27,912,025	......	411,326	......	(g)	1,304,230	[g] 497,533	3,319,761	(f)	......	2,100,983	55,606,828	1917
1918	4,352,172	989,447	22,018	2,285,610	3,898,215	......	818,785	474,368	556,397	(f)	781,065	(f)	......	682,148	597,072	1,069,587	5,365,243	(f)	26,723,645	......	427,106	......	(f)	1,234,256	123,788	3,320,006	(f)	......	2,754,414	56,478,372	1918
1919	3,380,771	613,753	18,149	1,703,903	3,702,180	......	691,969	356,237	393,331	808,729	586,094	(f)	......	788,465	260,162	751,067	5,484,660	(f)	20,501,831	(f)	260,915	......	(f)	930,516	62,546	1,413,932	(f)	......	1,474,347	44,180,557	1919
1920	4,013,894	789,499	16,523	2,136,793	4,553,697	......	739,577	682,132	488,089	1,393,445	674,801	(f)	......	725,571	(f)	1,040,192	5,704,810	......	23,638,739	(f)	304,768	......	(f)	1,027,788	59,395	1,828,336	(f)	......	1,533,057	51,345,043	1920

[a] Utah included with Colorado. [b] Included with Pennsylvania. [c] Includes New York. [d] Indiana included with Illinois. [e] Includes Massachusetts and New York. [f] Included with other States having less than three producers. [g] Utah included with Washington.

Division of Mineral Resources.

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