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U. S. DEPARTMENT OF COMMERCE
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BUREAU OF MINES
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CONTENTS

FLUORSPAR AND CRYOLITE[1]

By Hubert W. Davis

CONTENTS

FLUORSPAR

Fluorspar (or fluorite) is a compound of calcium and fluorine and consists chemically of 51.1 per cent of calcium and 48.9 per cent of fluorine. It has a specific gravity of 3.2, is brittle, has a hardness of 4, can be scratched easily with a knife, weighs about 200 pounds per cubic foot, and has a melting point of 1,650° F. Fluorspar crystallizes in the isometric system and is often found in cubical crystals. It is a mineral of many colors, ranging according to purity from a clear, colorless, or slightly bluish glasslike substance through various hues of purple, green, yellow, pink, lavender, and brown. Most fluorspar contains silica or calcite, or both, and usually some iron oxide and alumina. Other more or less common associated minerals are barite, galena, and sphalerite.

In common with the industries (except the manufacture of fruit jars) on which it is dependent, the fluorspar industry in 1931 suffered from the extreme curtailment in general business activities which prevailed in the United States. In consequence, the year was one of decreased production, declining prices, and smaller earnings.

Shipments of fluorspar were 42,365 short tons less than in 1930 and 71,312 tons below the average for the 5-year period 1926 to 1930. Imports were 44,194 tons less than in 1930 and 42,014 tons below the average from 1926 to 1930. The average price per ton of fluorspar sold to steel plants by domestic producers was $1.97 less than in 1930 and $2.12 below the average for the preceding five years. Consumption of fluorspar in the United States was 44,200 tons less than in 1930 and 82,000 tons below the average for the preceding five years. Stocks of fluorspar at consumers' plants were 22,800 tons less than in 1930 and 10,600 tons below the average from 1926 to 1930.

[1] Work on manuscript completed March, 1932.

PRODUCTION AND SHIPMENTS

In 1931 fluorspar was produced at 48 mines or prospects, which yielded an equivalent of about 55,000 short tons of merchantable fluorspar. In 1930, 65 mines or prospects were worked, yielding about 130,000 tons of merchantable fluorspar.

Shipments of fluorspar to each of the industries in which the mineral is used except the glass industry decreased in 1931. Domestic producers shipped 48 per cent less fluorspar to steel plants and 49 per cent less fluorspar to foundries than in 1930. In the ceramic industries shipments of fluorspar to manufacturers of enamel and cement decreased 9 and 59 per cent, respectively. However, shipments to manufacturers of glass—chiefly makers of fruit jars—increased 67 per cent, because of the demand for fruit jars and fruit-jar liners to be used in canning the abundant fruit crop. Shipments of acid-grade fluorspar from domestic mines were 55 per cent less than in 1930 and were equivalent to only about 37 per cent of the total fluorspar consumed in the United States in 1931 in the manufacture of hydrofluoric acid, whereas shipments of domestic acid-grade fluorspar in 1930 were equivalent to about 78 per cent of the total.

Shipments of fluorspar from domestic mines aggregated 53,484 short tons, valued at $931,275, a decrease of 44 per cent in quantity and 47 per cent in total value as compared with 1930. The general average value for all grades was $17.41 a ton, 81 cents less than the 1930 average. The value recorded for domestic fluorspar is the price paid f. o. b. mine shipping point by the consumer and excludes the cost of containers. The general average value per ton of the fluorspar shipped to steel plants from the Illinois-Kentucky district was $14.23 and from the Colorado-New Mexico district, $12.16. The average value of the fluorspar shipped to steel plants from Nevada mines was slightly more than that for the Illinois-Kentucky district. This difference in average values represents chiefly economic factors in marketing rather than differences in quality of fluorspar from these three districts.

All the fluorspar shipped from Nevada went to steel plants on the Pacific coast; the greater part of that from Colorado was shipped to Pueblo, Colo.; and most of the product from New Mexico went to mid-west steel plants, although a little went to plants on the Pacific coast. Shipments of fluorspar from domestic mines to consumers on the Pacific coast amounted to 477 short tons and importations of fluorspar at Pacific coast ports of entry amounted to 787 tons, indicating purchases of 1,264 tons by Pacific coast consumers.

The table that follows presents such details of the shipments of fluorspar for 1928 to 1931, by States, as may be published without revealing, except by permission, data supplied by individual producers.

Fluorspar shipped from mines in the United States, 1928–1931

State	Gravel			Lump			Ground			Total		
	Short tons	Value		Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1928												
Illinois	56,555	$876,819	$15.50	4,066	$161,603	$26.12	5,263	$368,417	$29.99	65.884	$1,154,983	$17.53
Kentucky	62,528	1,212,760	19.40	1,428			5,791			69,747	1,426,766	20.46
New Mexico	961	36,955	12.58	399			1,229			2,589	74,805	15.40
Colorado	1,562			253						1,815		
Nevada	415			40						455		
	122,021	2,126,534	17.43	6,186	161,603	26.12	12,283	368,417	29.99	140,490	2,656,554	18.91
1929												
Illinois	59,101	1,046,748	17.71	2,926	201,725	24.23	4,982	358,147	32.38	67,009	1,284,834	19.17
Kentucky	60,393	1,087,593	18.01	4,356			6,078			70.827	1,390,603	19.63
Colorado	4,508	96,913	12.82	300						4,808	56,607	11.77
New Mexico	2,295			143						2,438	59,082	15.57
Nevada	757			600						1,357		
	127,054	2,231,254	17.56	8,325	201,725	24.23	11,060	358,147	32.38	146,439	2,791,126	19.06
1930												
Illinois	38,702	680,211	17.58	2,107	98,672	23.05	3,325	216,979	33.52	44,134	836,473	18.95
Kentucky	34,129	608,313	17.82	1,903			3,149			39,181	763,370	19.48
Colorado	9,198	142,468	11.62	50						9,248	101,758	11.00
New Mexico	2,188			124						2,312	45,042	13.71
Nevada	877			97						974		
	85,094	1,430,992	16.82	4,281	98,672	23.05	6,474	216,979	33.52	95,849	1,746,643	18.22
1931												
Illinois	23,632	341,534	14.45	1,098	32,715	19.98	3,342	230,156	31.29	28,072	468,386	16.69
Kentucky	19,000	303,648	15.98	497			3,959			23,462	437,642	18.65
New Mexico	972	17,301	13.06				54			1,026	19,326	13.60
Nevada	353			42						395		
Colorado	500	5,533	11.07	29	388	13.38				529	5,921	11.19
	44,463	668,016	15.02	1,666	33,103	19.87	7,355	230,156	31.29	53,484	931,275	17.41

HISTORY OF PRODUCTION

The accompanying table presents statistics of the production of fluorspar by States, beginning with 1880. The record of production before 1880 was not obtained and the statistics for Kentucky and Colorado are incomplete for certain years after 1880, so that more fluorspar has been mined than the table shows. The unrecorded output must be small, however, as the advantages of fluorspar over limestone as a flux in basic open-hearth steel plants have been generally recognized only since about 1899. Before that time fluorspar was used mainly in the preparation of hydrofluoric acid and in the manufacture of opalescent glass; consequently, the demand was small.

The production of fluorspar by years for 1880 to 1904, a brief discussion of the history of mining in the different States, and estimates of unrecorded output in early years are given in Mineral Resources, 1925, Part II, pages 9 to 14.

Fluorspar produced [1] in the United States, 1880–1931, by States

Year	Arizona		Colorado		Illinois		Kentucky		Nevada		New Hampshire		New Mexico		Tennessee		Utah		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1880–1904	654	$6,593			169,870	$1,037,399	134,186	$740,467							400	$3,400					305,110	$1,787,859
1905			1,156	$8,200	33,275	220,206	22,694	132,362							260	1,720					57,385	362,488
1906			300	1,800	28,268	160,623	11,868	79,802							360	1,800					40,796	244,025
1907			3,300	11,400	25,128	141,971	21,058	133,971													49,436	287,342
1908	34	252	701	4,266	31,727	172,838	6,323	48,642													38,785	225,998
1909	30	435	350	2,100	41,852	232,251	7,800	53,233					710	$3,728							50,742	291,747
1910			268	1,608	47,302	277,764	17,003	124,574					4,854	26,250							69,427	430,196
1911			721	4,226	68,817	481,635	12,403	96,574			800	$6,400	4,307	22,612							87,048	611,447
1912			1,639	9,834	103,937	695,467	10,473	61,186			300	1,500	196	1,176							116,545	769,163
1913	100	800	4,432	26,592	85,854	550,815	19,622	113,903			200	1,200	5,372	42,976							115,580	736,286
1914			1,978	12,992	73,811	426,063	19,077	128,986			250	2,000									95,116	570,041
1915			247	1,482	116,340	624,040	19,219	129,873			650	5,200	485	3,880							136,941	764,475
1916	199	2,587	8,669	42,457	126,369	746,150	19,698	123,596			800	7,864									155,735	922,654
1917	135	1,080	17,104	196,633	156,676	1,373,333	43,639	697,566			1,274	19,110									218,828	2,287,722
1918	364	5,537	38,475	416,780	132,798	2,887,099	87,604	2,069,185			1,059	21,243	3,437	64,348			20	$465	60	$824	263,817	5,465,481
1919	45	450	9,687	150,739	92,729	2,430,361	32,386	883,171	400	$5,600	531	12,826	2,346	37,643			166	4,784			138,290	3,525,574
1920	181	3,264	12,852	251,308	120,299	3,096,767	46,091	1,246,942	532	8,672	202	4,040	6,353	101,460			268	6,094			186,778	4,718,547
1921			3,143	39,907	12,477	315,767	15,266	294,513			567	13,721	3,507	60,186							34,960	724,094
1922			2,309	20,169	83,855	1,493,188	52,484	970,059			690	15,353	2,180	30,992			78	1,404			141,596	2,531,165
1923			6,044	59,710	65,045	1,443,490	45,441	945,402			142	3,160	4,328	50,861			188	3,196			121,188	2,505,819
1924			12,301	135,411	62,067	1,288,310	47,847	988,940					2,580	35,178			184	3,292			124,979	2,451,131
1925			11,776	153,707	54,428	1,024,516	44,826	833,794					2,639	40,325							113,669	2,052,342
1926			10,440	[2] 161,269	53,734	1,012,879	62,494	1,167,129					1,989	(2)							128,657	2,341,277
1927			6,432	[2] 130,481	46,006	863,909	57,495	1,040,338					2,613	(2)							112,546	2,034,728
1928			1,815	[2] 74,805	65,884	1,154,983	69,747	1,426,766	455	(2)			2,589	(2)							140,490	2,656,554
1929			4,808	56,607	67,009	1,284,834	70,827	1,390,603	1,357	(3)			2,438	[3] 59,082							146,439	2,791,126
1930			9,248	101,758	44,134	836,473	39,181	763,370	974	(3)			2,312	[3] 45,042							95,849	1,746,643
1931			529	5,921	28,072	468,386	23,462	437,642	395	(3)			1,026	[3] 19,326							53,484	931,275
	1,742	20,998	170,724	[2] 2,082,162	2,037,763	26,741,517	1,060,214	17,122,589	4,113	[2,3] 14,272	7,465	113,617	56,261	[2,3] 645,065	1,020	6,920	904	19,235	60	824	3,340,266	46,767,199

[1] Beginning with 1906 figures represent shipments from mines.
[2] Value for New Mexico for 1926, 1927, and 1928 and for Nevada for 1928 included with Colorado.
[3] Value for Nevada for 1929, 1930, and 1931 included with New Mexico.

SHIPMENTS, BY USES

The two tables that follow show the relative dependence of the fluorspar industry upon the different industries in which fluorspar is used. The predominance of the steel industry as a purchaser of fluorspar is evident. The high value of fluorspar for hydrofluoric acid, glass, and enamel is due to the high quality demanded.

Fluorspar shipped from mines in the United States, 1930 and 1931, by uses

Use	1930				1931			
	Percentage	Short tons	Value		Percentage	Short tons	Value	
			Total	Average			Total	Average
Steel	80.17	76,837	$1,239,679	$16.13	74.48	39,832	$563,842	$14.16
Foundry	2.30	2,209	41,281	18.69	2.10	1,123	18,075	16.10
Glass	3.30	3,158	103,947	32.92	9.87	5,279	162,292	30.74
Enamel and vitrolite	2.28	2,188	73,549	33.61	3.73	1,996	65,458	32.79
Hydrofluoric acid and derivatives	10.26	9,834	260,130	26.45	8.20	4,386	108,136	24.65
Miscellaneous	1.40	1,342	21,897	16.32	1.04	557	7,873	14.13
	99.71	95,568	1,740,483	18.21	99.42	53,173	925,676	17.41
Exported	.29	281	6,160	21.92	.58	311	5,599	18.00
	100.00	95,849	1,746,643	18.22	100.00	53,484	931,275	17.41

Fluorspar shipped from mines in the United States, 1922–1931, by uses

Year	Steel		Foundry		Glass		Enamel and vitrolite	
	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value
1922	122,403	$16.24	2,998	$19.02	[1] 8,904	[1] $36.29	(1)	(1)
1923	96,713	18.23	3,748	21.20	[1] 10,768	[1] 36.17	(1)	(1)
1924	104,349	17.72	7,138	22.35	6,094	35.16	3,471	$34.85
1925	91,760	16.16	6,275	19.31	6,767	31.23	3,237	31.22
1926	105,614	16.51	6,212	19.55	7,507	32.01	3,410	33.27
1927	93,196	16.35	4,533	18.69	5,968	30.91	3,813	31.44
1928	108,064	15.19	3,694	17.93	6,499	30.14	4,713	30.23
1929	118,904	17.08	3,498	19.93	5,742	31.98	3,879	32.39
1930	76,837	16.13	2,209	18.69	3,158	32.92	2,188	33.61
1931	39,832	14.16	1,123	16.10	5,279	30.74	1,996	32.79

Year	Hydrofluoric acid and derivatives		Miscellaneous		Exported		Total	
	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value
1922	4,782	$24.81	213	$18.02	2,296	$17.84	141,596	$17.88
1923	6,976	30.19	1,839	20.85	1,144	22.13	121,188	20.68
1924	3,150	28.39	160	21.13	617	23.48	124,979	19.61
1925	4,455	25.60	120	39.00	1,055	16.66	113,669	18.06
1926	3,410	23.20	372	21.47	2,132	16.38	128,657	18.20
1927	3,748	26.24	903	17.59	385	19.50	112,546	18.08
1928	15,946	36.69	1,176	16.23	398	16.55	140,490	18.91
1929	12,906	27.45	1,004	14.96	506	22.97	146,439	19.06
1930	9,834	26.45	1,342	16.32	281	21.92	95,849	18.22
1931	4,386	24.65	557	14.13	311	18.00	53,484	17.41

[1] Shipments for enamel and vitrolite included with shipments for glass.

QUOTED PRICES

The following table shows the quoted prices on domestic fluxing gravel fluorspar at mines in the Illinois-Kentucky district and in Colorado and on imported fluorspar at seaboard in 1931, also the quoted prices on domestic foundry lump and ground fluorspar. These prices are for carload lots. Prices quoted for smaller lots are generally somewhat higher than prices for large tonnages sold on contracts.

Quoted prices per short ton of fluorspar in the United States in 1931 [1]

Month	Illinois-Kentucky (f. o. b. mines)			Colorado (f. o. b. mines)	Imported (at seaboard, duty paid)
	Fluxing gravel (not less than 85 per cent CaF_2 and not over 5 per cent SiO_2)	Foundry lump (not less than 85 per cent CaF_2 and not over 5 per cent SiO_2)	Ground (bulk) (95 to 98 per cent CaF_2 and not over 2½ per cent SiO_2)	Fluxing gravel (82 per cent CaF_2 and not over 5 per cent SiO_2)	Fluxing gravel (not less than 85 per cent CaF_2 and not over 5 per cent SiO_2)
January	$16	$18	$32.50	$12.75	[2] $17.40
February	16	18	32.50	12.75	[2] 17.00-17.40
March	15	17	32.50	12.75	[2] 17.00-17.40
April	15	17	32.50	12.75	[2] 17.00
May	15	17	32.50	12.75	[2] 17.00
June	13-15	17	32.50	12.75	16.50
July	13	15	30.00	12.75	16.50
August	13	15	30.00	12.75	16.50
September	13	15	30.00	12.75	16.50
October	13	15	30.00	10.00	16.50
November	13	15	30.00	10.00	16.50
December	13	15-17	30.00	10.00	16.50

[1] Engineering and Mining Journal, vols. 131 and 132, 1931.
[2] Steel, vol. 88, 1931.

INDUSTRY IN 1931, BY STATES

COLORADO

Shipments of fluorspar from Colorado mines amounted to 529 short tons, compared with 9,248 tons in 1930. All the fluorspar shipped in 1931 went to metallurgical plants.

The chief production in Colorado was from the Wagon Wheel Gap mine 1¼ miles southwest of Wagon Wheel Gap in Mineral County. This mine, however, was operated only 10 days; it produced 317 tons which, with 145 tons stocked at the mine, was shipped to the company's steel plant at Pueblo, Colo.

Only one carload of fluorspar was reported shipped during 1931 from mines in the Jamestown district, Boulder County.

A carload of fluorspar mined in 1930 was shipped during 1931 from the Gilpin prospect near Longview, Jefferson County, to the steel works at Pueblo, Colo.; it averaged 93.06 per cent CaF_2 and 1.69 per cent SiO_2.

In the Chaffee County field, where considerable prospecting and development work was under way during 1929 and 1930, only one carload of fluorspar was shipped in 1931. This fluorspar, produced at a property near Brown Canon, Colo., was hauled to Salida, the shipping point, and sent to a mid-western steel plant.

Shippers of fluorspar from Colorado in 1931

Colorado Fuel & Iron Co	Denver, Colo.
Lehman Fluorspar Co	Salida, Colo.
McMahon, P. S	South Platte, Colo.

ILLINOIS

Approximately 57,800 short tons of fluorspar-bearing rock, equivalent to about 32,000 tons of merchantable fluorspar, was mined at 13 mines or prospects in Illinois. The quantity of fluorspar of Illinois origin milled aggregated approximately 63,800 tons, from which about 33,000 tons of merchantable fluorspar was recovered—a loss of 30,800 tons in milling and a ratio of 1.933:1. Shipments from Illinois to consumers amounted to 28,072 short tons, a decrease of 36 per cent from 1930; of this total, 13,840 tons were moved to their destination by the Ohio River. The fluorspar shipped from Illinois in 1930 and 1931 was reported distributed among the various industries as follows:

Distribution among the various industries of fluorspar from Illinois, 1930 and 1931, in short tons

Industry	1930	1931
Steel	37,156	22,397
Foundry	1,448	723
Glass	1,315	2,149
Enamel	1,265	1,174
Hydrofluoric acid	2,718	1,463
Miscellaneous	163	147
	44,065	28,053
Exported	69	19
	44,134	28,072

The Daisy mine on the Daisy-Blue Diggings veins, one-half mile north of Rosiclare, Hardin County, was again the largest producer of fluorspar in Illinois. The output of this mine was supplemented by some production from the Eureka Nos. 1 & 2 and Eureka No. 4 mines on the north extension of the Rosiclare vein. These mines are served by the Rosiclare mill eight-tenths mile south of the Daisy mine; the ore is milled into products suitable for use in the metallurgical, ceramic, and chemical industries. The mines and mill were operated on a 4-day week schedule until August 1, 1931, when operations were suspended on account of unsatisfactory business conditions.

The output of crude ore from the Daisy mine was 24,748 short tons—35 per cent less than in 1930—and from the Eureka group 5,795 tons—33 per cent less than in 1930. The Rosiclare mill treated 40 per cent less crude ore than in 1930; the grade of crude ore treated was virtually the same in both years. Of the total shipments from the Rosiclare mill in 1931, 68 per cent went to metallurgical, 29 per cent to ceramic, and 3 per cent to chemical industries. Most of the product from the Rosiclare mill was shipped by rail to destination; however, a river loading station to provide for shipment of fluorspar by the Ohio River serves the Rosiclare mill, and 46 per cent of the shipments in 1931 were by barges.

The Hillside mine on the eastern extension of the Rosiclare vein was worked on a greatly reduced scale. The quantity of crude ore milled—21,287 short tons—was only 20 per cent less than in 1930, due to the milling of some low-grade ore previously mined. Thus, the ore treated was of much lower grade than in 1930, so that the quantity of finished product recovered decreased 30 per cent. Shipments from the mine were chiefly gravel fluorspar to steel plants, but some fluorspar was shipped to foundries. This mine is served by a river loading station, and barges on the Ohio River handled about one-fifth of the shipments.

The Illinois mines of the Franklin Fluorspar Co., which were closed in September, 1930, remained inactive throughout 1931; however, the flotation mill of this company was operated in 1931 but on a greatly reduced scale. A total of 9,111 short tons of fluorspar-bearing materials was treated in the mill, from which was recovered 3,106 tons of No. 1 concentrates suitable for use in the manufacture of hydrofluoric acid. Most of the fluorspar-bearing materials treated in the mill in 1931 originated in Kentucky, and the concentrates recovered from such materials have been credited to Kentucky in the statistics. The shipments from this mill consisted chiefly of No. 1 concentrates, but some No. 2 concentrates were shipped for use in the manufacture of cement.

At the Victory mine in Hardin County 6 miles northwest of Cave in Rock the production of crude ore yielded 4,741 short tons of fluorspar in 1931, about one-fifth less than in 1930. All the fluorspar shipped was of gravel size and of metallurgical grade. This mine is served by a unique river loading station, and practically all the shipments were made by barges on the Ohio River. A single roll crusher for reducing the size of the finished product was added to the mill equipment during 1931.

At the Spar Mountain mine 5 miles northwest of Cave in Rock operations were greatly curtailed, the production of crude ore amounting to only 4,176 short tons in 1931, a decrease of 84 per cent from 1930. The tonnage shipped was three-fourths less than in 1930; all was of fluxing grade. This mine is also served by a river loading station, and all shipments were made by barges on the Ohio River. Discovery of a large new ore body in the course of development work during the year was reported. From time to time this mine yields some clear fluorspar suitable for optical instruments; none of this material was sold in 1931, but 1,440 pounds were sold in 1930.

At the Crystal mine near Cave in Rock development work was continued, in the course of which 700 short tons of fluorspar was mined and shipped. The shipments consisted of 600 tons of gravel fluorspar to steel plants and 100 tons of lump fluorspar to foundries. A mill of 100 tons capacity, comprising double steel log and trommel washers and other essential accessory equipment, was completed during 1931. The fluorspar at this property occurs in a blanket formation, as at the Spar Mountain and Victory mines.

Another ore body was found during development work in 1931 northeast of that previously discovered. According to Arthur J. Lay, manager, this is proving to be a strictly acid-spar mine, 15,000 tons having been definitely blocked out, with reasonable anticipation of 10,000 tons more if it repeats the history of other mines in this structure.

The Mid-West No. 2 mine in Pope County near Eichorn was opened by a 150-foot shaft. Short drifts were run at this level, a washer and a picking belt were installed, some fluorspar was mined, and a carload of lump fluorspar was shipped to a foundry. The Mid-West No. 1 mine (also known locally as the Baker mine) in Hardin County was inactive during the year.

Production of fluorspar at the Empire-Knight and Douglas mines in Pope County near Eichorn amounted to 1,600 short tons of crude ore which yielded 487 tons of gravel fluorspar of metallurgical grade and 469 tons of lump fluorspar chiefly of acid grade.

Fluorspar was also mined in Illinois in 1931 at the Dimick, Iron Hill, and Rose prospects in Hardin County near Rosiclare. The total output from the prospects was 80 short tons.

A list of the producers of fluorspar in Illinois in 1931, with their post-office addresses, follows.

Producers of fluorspar in Illinois in 1931

Benzon Fluorspar Co	Cave in Rock, Ill.
Bozarth, Elmer	Elizabethtown, Ill.
Crystal Fluorspar Co. (Inc.)	Do.
Franklin Fluorspar Co	Pittsburgh, Pa.
Gipson, Mark	Elizabethtown, Ill.
Hillside Fluor Spar Mines	Chicago, Ill.
Knight, Knight & Clark	Rosiclare, Ill.
Mid-West Fluorspar Co	Golconda, Ill.
Rosiclare Lead & Fluorspar Mining Co	Rosiclare, Ill.
Victory Fluorspar Mining Co	Elizabethtown, Ill.
Yandell, Milton	Marion, Ky.

KENTUCKY

Fluorspar-bearing rock equivalent to approximately 20,000 short tons of merchantable fluorspar was mined at 27 mines or prospects in Kentucky; shipments of fluorspar from Kentucky to consumers amounted to 23,462 short tons, a decrease of 40 per cent from 1930. The shipments of fluorspar from Kentucky in 1930 and 1931 were distributed among the industries as follows:

Distribution among the various industries of fluorspar from Kentucky, 1930 and 1931, in short tons

Industry	1930	1931
Steel	27, 321	15, 568
Foundry	587	371
Glass	1, 843	3, 100
Enamel	923	798
Hydrofluoric acid	7, 116	2, 923
Portland cement	954	388
Miscellaneous	225	22
	38, 969	23, 170
Exported	212	292
	39, 181	23, 462

Caldwell County.—The chief production of fluorspar in Caldwell County was made by the S. L. Crook Corporation, which has several mines 3 to 10 miles from Crider; however, only one shaft was worked about two months.

The Walker mine 3 miles north of Crider and the Eureka mine 3½ miles from Crider were also worked on a small scale in 1931.

Crittenden County.—The Kentucky mines and mill of the Franklin Fluorspar Co. were inactive during 1931. This company, however, shipped from stock piles 341 short tons of fluorspar to consuming industries and 5,258 tons to its flotation mill at Rosiclare, Ill.

The Watson mine 7 miles southwest of Marion was worked about six months, producing 3,784 short tons of crude fluorspar, or 17 per cent less than was mined in 1930. Sales by this company, including fluorspar purchased from other producers, were 14 per cent greater than in 1930. Of the fluorspar sold in 1931, 84 per cent was fluxing grade, 3 per cent acid grade, and 13 per cent grinding grade.

The Lucile mine (a short distance south of the railroad station at Marion) produced about 3,858 short tons of crude ore, which yielded 1,929 tons of merchantable fluorspar, all of metallurgical grade. The ore from the Lucile mine is prepared for the market in the adjacent Kentucky mill.

The mines and mill of the Lafayette Fluorspar Co. near Mexico, Ky., were worked until July, 1931, when operations were suspended. The production of crude ore at these mines in 1931 was only about one-third of the output in 1930. At Tabb No. 1 mine a pump station, a sump, and a loading pocket at the 400-foot level and a skip pit in the shaft below the 400-foot level were completed during the year. Development in the vein at this level had progressed about 200 feet when mining was suspended. The mine, however, is being kept unwatered.

The Kentucky Fluor Spar Co., which has a mill a short distance south of the station at Marion, shipped 6,161 short tons of fluorspar in 1931, compared with 2,756 tons in 1930. Of the sales, metallurgical grades comprised 30 per cent, ground ceramic grades 68 per cent, and acid grade 2 per cent. The sales of ceramic-grade fluorspar were 127 per cent more than in 1930. This company does not operate any mines but buys part or all of the output of many local mines and prospects. In 1931 the company obtained its supply chiefly from the Nancy Hanks, Watson, Crittenden Springs, Lucile, Peyton, Walker, Pepper Box, Davenport, and Hodge mines in Kentucky and from the Empire-Knight and Douglas mines in Illinois.

The Davenport mine 8 miles from Marion produced about 3,000 short tons of crude ore, compared with 1,100 tons in 1930. The output of this mine is log washed, and some is treated further in the Holly mill. In 1931 about 2,300 tons was so treated and yielded 1,767 tons.

The Pepper Box mine 9 miles from Marion yielded 858 short tons of log-washed fluorspar, compared with 1,108 tons in 1930.

At the properties of the Pope Mining Co. about 300 short tons of crude ore was produced from two shafts 5 and 6 miles, respectively, from Marion; the Two Brothers mine and mill 10 miles southwest of Marion were leased to McMaster & Hunter, who are overhauling the mill, which consists of jigs, screens, tables, and other necessary equipment.

Fluorspar was mined during 1931 at many other mines and prospects in Crittenden County in quantities ranging from a few tons to 600 tons. Such properties include the Hodge, K. K., White, Reiter, Edwards, Gill, Crystal, Miller, Summers, Crittenden Springs, Blue & Marble, Pogue, Krausee, and Commodore.

Fluorspar suitable for optical purposes has occasionally been found in mines in western Kentucky. In 1931 the Mineral Products Co., Marion, Ky., sold 2,750 pieces of optical fluorite, recovered from material purchased from the Franklin Fluorspar Co.

A laboratory has been opened at Marion, Ky., by V. C. McDonald. This laboratory should be of much aid to the many small operators in the western Kentucky field whose volume of business is too small to warrant the steady employment of a chemist.

Livingston County.—In Livingston County four mines or prospects were worked; they produced about 5,300 short tons of ore, compared with 19,000 tons produced by six mines or prospects in 1930.

The chief producer in the county was the Nancy Hanks mine 1½ miles southeast of Salem and 13 miles southwest of Marion, which produced 4,115 tons, compared with 1,139 tons in 1930. Of the 1931 production, 2,985 tons was sold to the Kentucky mill at Marion and 1,130 tons was stocked at the mine.

The Guill mine 1½ miles north of Salem produced about 600 short tons of ore, from which 450 tons of log-washed fluorspar was recovered, compared with 2,434 tons mined and 1,825 tons recovered in 1930. The fluorspar in this mine was reported exhausted during 1931.

The Peyton mine near Salem produced and sold about 500 tons. A small quantity was produced at the Riley prospect also near Salem.

The Klondike mine 7 miles northeast of Smithland, the chief producer of fluorspar in Livingston County since 1928, was inactive during 1931; however, shipments of 661 short tons were made from stock pile during the year.

The list that follows contains the names and addresses of the chief operators of fluorspar mines or mills in Kentucky in 1931.

Operators of chief fluorspar mines or mills in Kentucky in 1931

Crider, Hobart	Mexico, Ky.
Crook Corporation, S. L.	Princeton, Ky.
Eagle Fluor Spar Co	Salem, Ky.
Franklin Fluorspar Co	Pittsburgh, Pa.
Fredonia Fluorspar Co	Princeton, Ky.
Gugenheim Mining Co	Marion, Ky.
Haynes Fluorspar Co	Do.
Henry & Frazer	Do.
Hughes, Rush	Do.
Kentucky Fluor Spar Co	Do.
K. K. Mining Co	Do.
Klondike Fluorspar Corporation	Youngstown, Ohio.
Lafayette Fluorspar Co	Duluth, Minn.
McMaster & Hunter	Mexico, Ky.
National Fluorspar Co	Marion, Ky.
Pope Mining Co	Louisville, Ky.
Republic Fluorspar Corporation	Cleveland, Ohio.
Wallace Fluorspar Co	Sturgis, Ky.

NEVADA

Shipments of fluorspar from Nevada amounted to 395 short tons, compared with 974 tons in 1930. All the fluorspar from Nevada was shipped to steel plants in California.

The chief producing mine in Nevada is the Daisy mine 4½ miles southeast of Beatty in Nye County; it shipped 353 short tons, compared with 877 tons in 1930. During 1931 it was reported that additional ore was developed, that methods of handling the ore were improved, and that a concentrating plant with a capacity of 10 tons per 8 hours was completed.

The Baxter mine 5½ miles from Broken Hills in Mineral County shipped 42 short tons of fluorspar averaging 95 per cent CaF_2 and 3½ per cent SiO_2 in 1931, compared with 97 tons in 1930.

Producers of fluorspar in Nevada in 1931

Baxter, V. S	Broken Hills, Nev.
Crowell, J. Irving, jr	Beatty, Nev.

NEW MEXICO

Shipments of fluorspar from New Mexico amounted to 1,026 short tons as compared with 2,312 tons in 1930. Of the 1931 total, 972 tons were for use in steel plants and 54 tons for use in the ceramic industry.

In 1931, as in many other years, the greater part of the fluorspar mined in New Mexico was obtained near Las Cruces, Dona Ana County. This ore was prepared for the market in the Tortugas mill near Mesilla Park.

The Alamo mine near Derry in Sierra County made its initial shipment of fluorspar in 1931. The product shipped consisted of gravel and ground fluorspar and some clear material for use in optical instruments. The work at this mine in 1931 was devoted chiefly to the development of ore and to the building of a mill for the production of ceramic-grade fluorspar. The mill consists of decrepitation, screening, grinding, and other necessary equipment. The product of the mill is hauled about 17½ miles to Hatch, the shipping point.

At the Cox prospect in Sierra County 15 miles from Cutter considerable development work on the ore body and road improvements were reported.

A carload of ground fluorspar was shipped in 1931 by the Fluorspar Mines of America, Hot Springs, N. Mex. This fluorspar was produced in 1928 at the Hot Springs mine, 4½ miles southwest of Hot Springs, Sierra County.

Producers of fluorspar in New Mexico in 1931

Alamo Fluorspar Mills	Derry, N. Mex.
Hayner & Manasse	Las Cruces, N. Mex

STOCKS AT MINES OR SHIPPING POINTS

According to the reports of producers the total quantity of fluorspar in stock at mines or shipping points at the close of 1931 was 105,727 short tons, a decrease of 2 per cent from 1930. These stocks consisted of 43,186 tons of crude fluorspar (calculated to be equivalent to 21,000 tons of ready-to-ship fluorspar) and of 62,541 tons of ready-to-ship fluorspar. As the quantity of fluorspar in stock piles must be partly estimated the mine reports vary from year to year, preventing absolute balance between the quantity mined and that shipped and in stock.

Certain stocks of fluorspar reported as on hand in Arizona and New Mexico at the close of 1930, but which are now noncommercial on account of low quality or lack of market or both, have been disregarded in compiling the following table.

Stocks of fluorspar at mines or shipping points in the United States, 1930 and 1931, by States, in short tons

State	1930			1931		
	Crude [1]	Ready-to-ship	Total	Crude [1]	Ready-to-ship	Total
Colorado	205	40	245	235	40	275
Illinois	7,624	32,632	40,256	8,943	37,135	46,078
Kentucky	43,412	23,499	66,911	33,552	25,344	58,896
Nevada	175		175	408		408
New Mexico	(2)	[2] 30	[2] 30		22	22
Texas	48		48	48		48
	[2] 51,464	[2] 56,201	[2] 107,665	43,186	62,541	105,727

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.
[2] Revised figures.

IMPORTS AND EXPORTS [2]

The total imports of fluorspar into the United States in 1931 amounted to 20,709 short tons, valued [3] at $211,435, the smallest since 1921 and a decrease of 68 per cent in quantity and 61 per cent in total value from 1930. The value assigned to the foreign fluorspar averaged $10.21 a ton. The cost to consumers in the United States includes, in addition, the duty, loading charges at the docks, ocean freight, insurance, and consular fee, and freight from docks to manufacturers' plants.

The imports were equivalent to 39 per cent of the total shipments of domestic fluorspar in 1931 as compared with 68 per cent in 1930.

As the next table shows, a striking change was recorded in the relative distribution of imported fluorspar in 1931. Whereas in former years the steel industry has been the chief purchaser of foreign fluorspar, having taken four-fifths of the total in 1930, it accounted for only two-fifths of the total in 1931. This change is probably attributable both to the depressed condition in the steel industry and to the revised tariff on fluorspar effective June 18, 1930. The reported imports of ground fluorspar, which increased

[2] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce; those on exports supplied by the producers. No exports of fluorspar recorded by the Bureau of Foreign and Domestic Commerce.

[3] "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States, as defined in section 402 of the tariff act of 1922."

about 7 per cent, accounted for about 19 per cent of the total as compared with 6 per cent in 1930. The reported imports of acid-grade fluorspar, which increased about 80 per cent, accounted for 32 per cent of the total as compared with 6 per cent in 1930.

According to reports by importers to the Bureau of Mines the selling price at tidewater, duty paid, of the imported fluorspar sold to steel manufacturers averaged $16.99 a short ton in 1931; the selling price at tidewater, duty paid, of imported ground fluorspar sold to manufacturers of glass and enamel ranged from $29 to $32.50 a short ton and averaged $32.47; the selling price of lump fluorspar sold for use in making hydrofluoric acid ranged from $25 to $27 a short ton and averaged $25.77.

The following table was compiled chiefly from data courteously furnished the Bureau of Mines by importers; it shows the distribution of the fluorspar imported into the United States in 1930 and 1931.

Distribution of fluorspar imported into the United States, 1930 and 1931

[Distribution partly estimated by Bureau of Mines]

Industry	1930			1931		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	51,758	$906,622	$17.52	8,340	$141,657	$16.99
Foundry	955	17,429	18.25	96	1,681	17.51
Glass	2,981	102,746	34.47	2,963	95,563	32.25
Enamel	647	23,976	37.06	919	30,469	33.15
Hydrofluoric acid	3,643	100,600	27.61	6,556	168,962	25.77
Cement	56	1,114	19.89	300	5,289	17.63
	60,040	1,152,487	19.20	19,174	443,621	23.14
Undistributed	2,969	(1)	(1)	295	(1)	(1)
Unsold	1,894			1,240		
	64,903			20,709		

[1] Data not available.

Germany was again the chief source of imported fluorspar, supplying 6,491 short tons, compared with 23,797 tons in 1930, a decrease of 73 per cent; of the total, 2,501 tons contained less and 3,990 tons more than 97 per cent of calcium fluoride. In view of the data furnished the Bureau of Mines by importers it is apparent that a considerable quantity of the ground fluorspar sold to the ceramic trade is included in the 3,990 tons containing more than 97 per cent of calcium fluoride. Similarly, some ground fluorspar that was sold to the ceramic trade is included in the 2,501 tons containing less than 97 per cent of calcium fluoride.

Imports of fluorspar from France amounted to 4,462 short tons, compared with 23,313 tons in 1930, a decrease of 81 per cent; of the total, 3,808 tons contained less and 654 tons more than 97 per cent of calcium fluoride. A small quantity of ground fluorspar from France was sold to manufacturers of glass and enamel in 1931.

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Imports from Africa amounted to 3,672 short tons, compared with 2,712 tons in 1930, an increase of 35 per cent. All the fluorspar from this source contained more than 97 per cent of calcium fluoride; it was sold for use in the manufacture of hydrofluoric acid.

Imports from Spain amounted to 4,068 short tons, compared with 6,784 tons in 1930, a decrease of 40 per cent, and consisted of 3,970 tons containing less and 98 tons containing more than 97 per cent of calcium fluoride. A small quantity of ground fluorspar from Spain was sold to the ceramic trade in 1931.

Imports from Italy amounted to 1,523 short tons, compared with 1,802 tons in 1930, a decrease of 15 per cent. All the fluorspar imported from this source in 1931 was ground and sold for use in the glass industry.

The United Kingdom, which (except in 1921) was the chief source of imported fluorspar until 1927 and which has supplied probably three-fifths of all the fluorspar imported into the United States, made no shipments to the United States in 1931.

Other sources of imported fluorspar in 1931 were Belgium, Canada, and China. The fluorspar imported from Belgium probably originated in Germany, and that credited to Canada was probably mined in Europe. The imports from China, amounting to 202 short tons, consisted of 112 tons containing less and 90 tons containing more than 97 per cent of calcium fluoride.

The rate of duty on fluorspar that contains not more than 97 per cent of calcium fluoride is $8.40 per long ton ($7.50 per short ton); and the rate of duty on fluorspar containing more than 97 per cent of calcium fluoride is $5.60 per long ton ($5 per short ton).

The distances domestic fluorspar must be transported by rail from mines to steel plants in the Lehigh and Susquehanna Valleys of Pennsylvania are much greater than the distances that foreign fluorspar must be moved from the ports of entry to these plants, so that comparatively little domestic fluorspar is sold to steel plants in this district. As the value of fluorspar depends mainly upon its purity, however, comparison of American with foreign fluorspar should be made not merely on the basis of price per ton but on quality as well.

Fluorspar imported into the United States, 1930 and 1931, by countries

[General imports]

Country	1930		1931	
	Short tons	Value	Short tons	Value
Belgium			11	$170
Canada			280	2,313
China	739	$7,957	202	1,811
France	23,313	184,238	4,462	33,646
Germany	23,797	189,587	6,491	77,067
Italy	1,802	17,198	1,523	24,267
Spain	6,784	53,612	4,068	31,786
Union of South Africa	2,712	31,069	3,672	40,375
United Kingdom	5,756	60,995		
	64,903	544,656	20,709	211,435

Fluorspar imported into the United States in 1931, by countries and districts

[General imports]

Country	District	Containing more than 97 per cent of calcium fluoride		Containing not more than 97 per cent of calcium fluoride	
		Short tons	Value	Short tons	Value
Belgium	Philadelphia			11	$170
Canada	Buffalo			280	2,313
China	New York	15	$320		
	Philadelphia	75	835		
	Washington			112	656
		90	1,155	112	656
France	Maryland	219	3,183	1,568	13,660
	Philadelphia	435	3,980	2,240	12,823
		654	7,163	3,808	26,483
Germany	Los Angeles	56	1,248		
	Maryland	1,211	21,243	1,092	10,239
	New York	16	257		
	Philadelphia	2,707	37,227	790	2,510
	San Francisco			224	816
	Washington			395	3,527
		3,990	59,975	2,501	17,092
Italy	Maryland			221	2,311
	Philadelphia			1,302	21,956
				1,523	24,267
Spain	Maryland	45	777	1,735	14,387
	New York			628	5,135
	Philadelphia	53	826	1,607	10,661
		98	1,603	3,970	30,183
Union of South Africa	New York	854	10,862		
	Philadelphia	2,818	29,513		
		3,672	40,375		
		8,504	110,271	12,205	101,164

Fluorspar imported into the United States, 1922–1931, by countries

[General imports]

Year	Africa		Canada		France		Germany		Italy	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1922	486	$8,415	2,877	$32,679			5,804	$49,196		
1923	10,380	157,625	(1)	5			8,580	67,595	268	$2,471
1924	11,125	147,977	213	3,216	232	$2,782	6,834	69,357	1,585	14,804
1925	7,906	108,647			2,537	20,887	11,680	103,845	4,278	32,208
1926	8,506	136,502	1,109	10,310	11,163	90,737	20,465	171,769	1,379	15,434
1927	7,069	90,966	560	4,250	11,711	86,279	31,829	230,821	449	5,969
1928	2,661	36,471			15,072	141,434	17,601	150,872	1,033	9,600
1929	6,387	75,856			16,850	159,059	16,488	140,860	1,258	10,528
1930	2,712	31,069			23,313	184,238	23,797	189,587	1,802	17,198
1931	3,672	40,375	280	2,313	4,462	33,646	6,491	77,067	1,523	24,267

[1] Quantity not recorded.

Fluorspar imported into the United States, 1922–1931, by countries—Continued

[General imports]

Year	Spain		United Kingdom		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1922			23,836	$206,950	105	$1,948	33,108	$299,188
1923			22,862	202,548	136	2,075	42,226	432,319
1924			29,365	298,391	1,689	19,115	51,043	555,642
1925			21,635	195,229	664	8,031	48,700	468,847
1926	2,948	$33,915	29,407	281,735	694	6,835	75,671	747,237
1927	978	3,650	18,449	168,840	470	4,410	71,515	595,185
1928	680	5,178	9,360	56,585	776	8,560	47,183	408,700
1929	7,168	52,039	4,828	30,580	1,366	12,053	54,345	480,975
1930	6,784	53,612	5,756	60,995	739	7,957	64,903	544,656
1931	4,068	31,786			213	1,981	20,709	211,435

Producers of fluorspar reported exports amounting to 311 short tons, valued at $5,599, or $18 a ton, compared with 281 tons, valued at $6,160, or $21.92 a ton, in 1930. All the fluorspar exported in 1930 and 1931 went to Canada.

Fluorspar reported by producers as exported from the United States, 1922–1931

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1922	2,296	$40,966	$17.84	1927	385	$7,507	$19.50
1923	1,144	25,312	22.13	1928	398	6,586	16.55
1924	617	14,489	23.48	1929	506	11,621	22.97
1925	1,055	17,574	16.66	1930	281	6,160	21.92
1926	2,132	34,915	16.38	1931	311	5,599	18.00

USES

The uses and specifications for fluorspar are discussed in greater detail in Mineral Resources, 1926, Part II, pages 30 to 34.

Metallurgical industries.—Fluorspar has many uses, but the most important is in the manufacture of steel by the basic open-hearth process. It is also used in the manufacture of alloy steel and ferro-alloys by the electric-furnace process and in some foundry and other metallurgical operations.

Ceramic industries.—Considerable quantities of fluorspar are used in the glass industry, chiefly for the manufacture of opal or opaque and colored glass; as an ingredient in enamels for various purposes; and in the manufacture of cement.

Chemical industries.—Fluorspar is the basic material in the manufacture of hydrofluoric acid. It is also said to be used to facilitate the fusion and contact of ingredients in the manufacture of calcium carbide and cyanamid.

Optical fluorspar.—A very small quantity of clear fluorspar crystals is used for optical purposes; fluorspar is useful in correcting the color and spherical aberration errors in lenses, especially those of microscopes and small telescopes.

CONSUMPTION—STOCKS AT CONSUMERS' PLANTS

Figures on the consumption of fluorspar in 1930 and 1931 and on stocks at consumers' plants at the close of these years are given in the following table. Although these figures do not include data from all consumers, it is believed that they do not fall far short of the total for the United States. Thus, in 1931 the figures for the basic open-hearth steel industry, the chief consumer of fluorspar, include actual figures from the 59 companies that make 99.68 per cent of the total basic open-hearth steel and estimates for the other 2 companies. Consumption by all electric steel and ferro-alloy manufacturers who are known to use fluorspar is represented. The smaller foundries, some of which use a little fluorspar, are not all represented, so that data on consumption and stocks for this industry are somewhat incomplete. The figures for fluorspar used in hydrofluoric acid for 1931 represent actual figures for six companies and an estimate for one company. The consumption and stocks for the glass and enamel industries represent 103 companies and are believed to be practically complete, as these companies include all the larger and probably most of the smaller consumers.

Fluorspar consumed and in stock in the United States, 1930 and 1931, by industries, in short tons

Industry	1930		1931	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	109,000	89,000	66,200	67,600
Electric furnace steel	3,600	1,000	3,100	900
Foundry	1,600	800	1,000	600
Ferro-alloys	1,100	300	300	200
Hydrofluoric acid and derivatives	12,600	15,000	12,000	14,000
Enamel and vitrolite	4,000	600	3,000	700
Glass	4,300	1,000	7,100	1,000
Miscellaneous	2,000	600	1,300	500
	138,200	108,300	94,000	85,500

The average quantity of fluorspar used by individual plants per ton of basic open-hearth steel made varies widely, usually ranging from 1 to 50 pounds. In general, the average is 5 to 8 pounds—a very small proportion of the furnace charge. The next table shows over a period of five years the variation in average consumption of fluorspar per ton of basic open-hearth steel in certain plants that make about 88 per cent of the total.

Average consumption of fluorspar per ton of steel, 1927–1931, in pounds

1927	1928	1929	1930	1931	1927	1928	1929	1930	1931
13.315	12.211	14.727	16.931	16.111	4.487	6.156	5.822	6.276	6.219
7.074	6.761	6.043	6.559	5.781	11.509	10.766	10.470	10.651	7.784
6.100	5.640	4.825	4.768	4.613	10.033	6.953	5.569	5.311	2.437
7.067	6.253	6.674	6.544	2.431	12.850	12.261	11.510	9.720	5.774
4.862	4.181	3.815	2.545	4.867	4.842	5.272	6.589	6.118	5.822
8.572	8.204	7.215	5.661	5.856	4.822	5.988	7.880	6.606	3.791
4.561	5.875	6.237	5.555	4.978	7.219	6.906	6.622	7.087	7.049
6.320	7.648	7.344	7.705	6.590					

The table that follows shows the relation of the consumption of fluorspar to the production of basic open-hearth steel for the five years from 1927 to 1931 and the stocks of fluorspar at such plants at the close of each of these years. The small but steady downward trend in the general average consumption of fluorspar per ton of steel made is shown. During this period the general average consumption of fluorspar has dropped from 7.4 pounds in 1927 to 6 pounds in 1931.

Consumption and stocks of fluorspar at basic open-hearth steel plants, 1927–1931

	1927	1928	1929	1930	1931
Production of basic open-hearth steel ....long tons..	37,144,268	43,200,483	47,232,419	34,268,316	22,130,398
Consumption of fluorspar in basic open-hearth steel production.......short tons..	138,000	152,000	155,600	109,000	66,200
Consumption of fluorspar per ton of steel made..........pounds..	7.4	7.0	6.6	6.3	6.0
Stocks of fluorspar on hand at steel plants at end of year..........short tons..	85,000	76,000	70,700	89,000	67,600

CONSUMERS

A directory of consumers of fluorspar in the United States, classified according to the industries in which the mineral is used and each industry arranged alphabetically by States and by location of consuming plants, was published by the Bureau of Mines, October 19, 1931. A copy of this directory may be obtained on application to the Director, Bureau of Mines, Washington, D. C.

FLUORSPAR IN FOREIGN COUNTRIES

CANADA [4]

The production of fluorspar in Canada in 1931 was 40 short tons, valued at $620; it came from a deposit near Madoc, Ontario. The production in 1930 was 80 tons, valued at $1,240, also mined near Madoc, Ontario.

Imports of fluorspar into Canada in 1931 amounted to 3,215 short tons, valued at $31,257, compared with 12,652 tons, valued at $160,995, in 1930.

SOUTH AFRICA

According to Moorhead,[5]

It has been reported that a deposit of 99 per cent fluorspar has been opened up in South-West Africa in the Kalkfontein district about 50 miles from the railway. According to a stockbroker in Johannesburg, the owner of the deposit has this week entered into a contract for the delivery of a trial order of 500 tons, the price, it is understood, being 57s. 6d. ($13.99) per long ton on a 98 per cent basis f. o. r. docks Cape Town, the purchase price being payable at Cape Town on delivery. The railage from Kalkfontein to Cape Town is estimated at

[4] Dominion Bureau of Statistics, Preliminary Report of the Mineral Production of Canada during the Calendar Year 1931: Ottawa, 1932, p. 25.

[5] Moorhead, M. K., American consul general, Johannesburg, South Africa, Production of Fluorspar in South Africa: Ms. Rept., Oct. 23, 1931.

22s. 6d. ($5.47) per ton and road transport (donkey wagons) is estimated to cost 15s. ($3.65) per ton.

The deposit is apparently in fissure formation and is of considerable extent. The owner is reported to be in a position to enter into new contracts. He is believed to be short of capital, and with an investment of about $10,000 it would be possible to increase the output, according to the stockbroker.

Some additional notes on the fluorspar deposits of South Africa are given in the chapter of this series for 1930.

WORLD PRODUCTION

The following table was compiled by the Bureau of Mines from official sources as far as possible.

World production of fluorspar, 1927–1931, by countries, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Argentina [2]	24			(3)	(3)
Australia:					
New South Wales			96	205	(3)
Queensland	1,050	1,143	602	763	(3)
Canada			16,211	73	36
China	3,436	(3)	(3)	(3)	(3)
Chosen		950	1,470	2,297	(3)
France	44,210	46,650	52,968	(3)	(3)
Germany: [4]					
Bavaria	51,001	48,552	50,797	48,063	(3)
Prussia	36,607	37,365	37,717	30,272	(3)
Saxony	22,027	16,422	18,491	11,871	(3)
Great Britain	40,362	47,614	42,432	30,266	(3)
Italy	5,577	4,520	5,740	6,655	5,850
Russia [5]	840	5,551	(3)	(3)	(3)
South-West Africa	995	872	565		(3)
Spain	757	2,082	13,478	11,076	(3)
Union of South Africa	7,582	5,582	2,715	1,520	(3)
United States	102,099	127,450	132,847	86,952	48,520

[1] In addition to the countries listed, Norway reports exports of domestic fluorspar as follows: 1927, ½ ton; 1929, 2 tons.
[2] Railroad shipments.
[3] Data not available.
[4] In addition to the German States listed, fluorspar is produced in Baden and Thuringia, but data of output are not available.
[5] Year ended Sept. 30.

CRYOLITE

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. The greater part of the product is shipped to Copenhagen; the remainder is exported to the United States, from which country some is reexported to Canada. Most of the cryolite shipped to the United States is used in the metallurgy of aluminum and in making opaque glass.

According to the Bureau of Foreign and Domestic Commerce, the United States imported 7,908 long tons of cryolite, valued at $580,621, in 1931, compared with 8,315 tons, valued at $695,794, in 1930.

POTASH[1]

By A. T. Coons

CONTENTS

PRODUCTION AND SALES

The total production of potassium salts in 1931 was 133,920 short tons, containing the equivalent of 63,880 short tons of potash (K_2O), an increase of 26.6 per cent in the quantity of salts produced and of 4 per cent in their potash (K_2O) equivalent. The average content calculated as potash (K_2O) in the salts produced was 47.7 per cent in 1931, compared with 57.9 per cent in 1930. The considerable increase in total production with the smaller increase in potash (K_2O) equivalent was due to the inclusion of lower grade material from a recently opened deposit of potassium salts at Carlsbad, N. Mex., in the figures for the first time.

Sales of potassium salts (133,430 short tons) were 36 per cent more, and the potash (K_2O) equivalent (63,770 tons) of the material sold was 12.6 per cent more than in 1930. The total sales in 1931 were only slightly less than the total production. The total value ($3,086,955) of the potassium salts sold was 3 per cent more than in 1930. The value per unit (20 pounds of K_2O) was 48.4 cents in 1931, compared with 52.7 cents in 1930 and 51.9 cents in 1929.

Stocks of salts and their equivalent as potash (K_2O) remaining in producers' hands were somewhat less at the end of 1931 than at the end of 1930. One more plant reported production, two more reported sales, and two less reported stocks on hand in 1931 than in 1930.

Tables of sales by States and by sources are omitted to avoid disclosing individual production. A summary of production, sales, and producers' stocks of potassium salts in the United States for the past 10 years is given in the following table:

[1] Work on manuscript completed April, 1932.

Potassium salts produced, sold, and in stock in the United States, 1922–1931

Year	Production			Sales				Stocks		
	Number of plants	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Number of plants	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Number of plants	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1922	12	25,176	11,714	16	22,028	11,313	$463,512	16	30,100	11,653
1923	12	39,029	20,215	11	35,164	19,281	784,671	14	34,794	12,363
1924	12	43,734	22,903	9	37,492	21,880	842,618	11	32,389	10,770
1925	9	51,565	25,448	7	52,823	25,802	1,204,024	7	[1] 30,919	10,276
1926	7	46,324	23,366	6	51,369	25,060	1,083,064	4	[2] 26,000	[2] 9,000
1927	9	76,819	43,510	5	94,722	49,500	2,448,146	8	7,250	2,500
1928	9	104,129	59,910	5	105,208	60,370	3,029,422	7	6,260	2,100
1929	5	107,820	61,590	4	101,370	57,540	2,988,448	5	12,650	6,200
1930	5	105,810	61,270	4	98,280	56,610	2,986,157	5	20,550	11,000
1931	6	133,920	63,880	6	133,430	63,770	3,086,955	3	20,000	10,500

[1] Of this quantity, 212 tons were lost by leaching, etc. [2] Estimate.

PRODUCING LOCALITIES

In 1931 the potassium salts produced were from natural brines, from the waste from molasses distillation, from sylvinite, from alunite, and from incinerated cotton bolls. The American Potash & Chemical Corporation (233 Broadway, New York, N. Y., and Trona, Calif.), the chief American producer of potassium salts, also recovered borax and other natural sodium salts as coproducts at its plant at Trona (Searles Lake), San Bernardino County, Calif. Its output of potassium salts was less in 1931 than in 1930, and somewhat more was marketed than was produced. The product (muriate) sold by this company has a higher equivalent of potash (K_2O) than that of any other company, and the percentage in 1931 (61.09) was lower than in 1930 (61.54). In 1931, for the first time, the potash-bearing mineral deposits known to exist in New Mexico and Texas and explored widely since the World War, both through private and Government activities, entered the markets of the United States as an important factor. The United States Potash Co. (Inc.) (342 Madison Avenue, New York, N. Y., and Carlsbad, N. Mex.) shipped sylvinite mined 20 miles east of Carlsbad in Eddy County, N. Mex. The potassium salts shipped by this company averaged 25.9 per cent of potash (K_2O).

The plant of the United States Industrial Chemical Co. (110 East Forty-second Street, New York, N. Y.) at Baltimore, Md., was another important producer of potassium salts in 1931. Two grades of salts are made by this company. One grade, known as vegetable ash (the ash obtained by incineration of the waste from molasses distillation) averaged 35.28 per cent of potash (K_2O) in 1931; the other potash material, known as sulphate-muriate (the dust collected from the fumes of combustion during the incineration), averaged 53.45 per cent of potash (K_2O). The company's total sales were slightly lower than its production. Alunite was mined at Sulphur, Humboldt County, Nev., and shipped to the American Development Co., Berkeley, Calif., where it was crushed and marketed as fertilizer material. A small quantity of alunite was also mined at Marysvale, Piute County, Utah, by the Al-Ke-Mee Fertilizer & Manufacturing Co. Cotton-boll or cottonseed-hull ashes containing about 25 per cent of water-soluble potash (K_2O) were sold by the F. W. Brodé Corporation (119 Madison Avenue, Memphis, Tenn.) in 1931, chiefly in the New England States, as fertilizer in tobacco cultivation. Such ashes have been sold at irregular intervals for several years. They are produced in the Cotton Belt States and come into the distributors' hands in small lots from various localities. As there is no means for allocating this material according to producing plants, the distributor is given credit for the entire production and sales. Experimental work was continued by the Bureau of Mines and the Department of Agriculture on the recovery of potassium salts suitable for fertilizer from polyhalite found in Texas and New Mexico, from leucite or wyomingite found in Wyoming, and from greensand marl found in New Jersey. The results of the foregoing investigations and of others carried on by the United States Bureau of Mines, the United States Geological Survey, and other Government bureaus in Texas, New Mexico, and other potash-bearing localities are issued in separate publications and are not reviewed in this report.

IMPORTS AND EXPORTS[3]

Imports of potash materials are shown in the following tables. The materials are classified as salts used chiefly in the fertilizer industry and as those used chiefly in the chemical industries. The former class, which includes kainite, manure salts, muriate, sulphate, and wood ashes, accounted for 92 per cent of the gross imports in 1931, compared with 95 per cent in 1930. The total quantity of potassium salts imported in 1931 decreased 41 per cent compared with 1930. Salts used chiefly for fertilizer decreased 43 per cent in gross weight and 40 per cent in their approximate equivalent as potash (K_2O). It is noticeable that the higher grade salts (muriate and sulphate) showed less decrease (34 per cent) than the low-grade cheaper salts (kainite and manure salts), which decreased about 51 per cent.

Potassium salts used chiefly in the chemical industries increased 6 per cent in gross weight and 3 per cent in approximate equivalent as potash (K_2O). Imports of crude sodium nitrate (saltpeter) increased 13 per cent in 1931 compared with 1930. The total value of the potassium salts imported decreased 33 per cent, fertilizer material decreased 39 per cent in value, and salts destined chiefly for the chemical industries 7 per cent.

The potash (K_2O) equivalents of the different salts in 1931, as shown in the following table, are calculated on the same estimated percentages that have been used since 1928.

[3] Unless otherwise stated, figures on quantity and value of imports and exports were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Potash materials imported for consumption in the United States, 1930 and 1931

Material	Approximate equivalent as potash (K_2O) (per cent)	1930				1931			
		Short tons	Approximate equivalent as potash (K_2O)		Value	Short tons	Approximate equivalent as potash (K_2O)		Value
			Short tons	Per cent of total			Short tons	Per cent of total	
Used chiefly in fertilizers:									
Kainite	14.0	125,454	18,000	5.3	$979,487	61,750	8,650	4.0	$502,671
Manure salts	24.0	405,215	97,000	28.3	5,048,302	200,600	48,140	22.4	2,573,397
Muriate (chloride)	52.0	306,047	159,000	46.4	9,929,801	202,204	105,150	49.0	6,517,606
Sulphate	50.0	96,608	48,000	14.0	3,947,479	63,663	31,830	14.8	2,628,316
Other potash fertilizer material [1]	60.0	613	370	.1	4,728	547	330	.2	3,743
		933,937	322,370	94.1	19,909,797	528,764	194,100	90.4	12,225,733
Used chiefly in chemical industries:									
Bicarbonate	46.0	87	40	5.9	9,876	184	85	9.6	20,334
Bitartrate (argols)	20.0	9,109	1,822		1,862,220	9,657	1,931		1,604,875
Bitartrate (cream of tartar)	25.0	22	6		8,051	42	11		16,398
Bromide	39.6	32	13		16,439	29	11		18,983
Carbonate, crude	61.0								
Carbonate, crude or black salts	50.0	9,121	5,564		848,214	7,583	4,626		664,059
Carbonate, refined	67.0								
Caustic	80.0	4,661	3,729		492,981	4,315	3,452		451,605
Chlorate and perchlorate	36.0	6,454	2,323		470,745	6,960	2,506		495,542
Chromate and bichromate	40.0	(2)	(2)		347	2	1		769
Citrate	43.0	(3)	(3)		(3)	5	2		2,429
Cyanide	70.0	45	32		31,908	47	33		34,219
Ferricyanide (red prussiate)	42.0	85	36		45,302	59	25		28,265
Ferrocyanide (yellow prussiate)	44.0	10	4		2,667	7	3		1,941
Iodide	28.0	(4)	(4)		85	[4] 1	(4)		3,830
Nitrate (saltpeter), crude	40.0	14,335	5,734		620,146	16,250	6,500		646,269
Nitrate (saltpeter), refined	46.0	1,465	674		113,813	3,059	1,407		237,791
Permanganate	29.0	91	26		16,284	96	28		15,882
Rochelle salt	22.0	5	1		1,709	13	3		3,281
All other	50.0	160	80		48,670	122	61		28,277
		45,682	20,084	5.9	4,589,457	48,431	20,685	9.6	4,274,749
Grand total		979,619	342,454	100.0	24,499,254	577,195	214,785	100.0	16,500,482

[1] Chiefly wood ashes from Canada.
[2] Quantity of bichromate imported was 1,043 pounds; approximate equivalent as K_2O is 417 pounds.
[3] None imported June 18 to Dec. 31, 1930; not separately classified prior to change in tariff.
[4] In 1930 quantity of iodide imported was 16 pounds; approximate equivalent as K_2O is 4.5 pounds. In 1931 quantity of iodide imported was 1,305 pounds; approximate equivalent as K_2O is 365 pounds.

The present classification of fertilizer salts of potassium, as reported by the Bureau of Foreign and Domestic Commerce, does not provide for the individual grades of the different salts, nor is the potash-magnesia sulphate given separately. The National Fertilizer Association, through the importers of potassium salts, has compiled figures of the imports of these salts by the grades of the individual salts, as shown in the following table:

Imports of potash materials for 1930 and 1931, according to the records of importers, in short tons[1]

	Muriate	Sulphate	Potash-magnesia sulphate	Manure salts, 30 per cent	High-grade kainite, 20 per cent	Kainite	Total
1930							
United States	280,156	73,185	12,341	130,026	295,276	92,115	883,099
Puerto Rico	6,100	5,360	625				12,085
Hawaiian Islands	3,742	4,648					8,390
Total	289,998	83,193	12,966	130,026	295,276	92,115	903,574
1931							
United States	170,338	53,331	7,714	65,708	139,652	48,684	485,427
Puerto Rico	9,488	4,250	183				13,921
Hawaiian Islands	9,419	6,160					15,579
Total	189,245	63,741	7,897	65,708	139,652	48,684	514,927

[1] The National Fertilizer Association (Inc.), Exports and Imports: The N. F. A. Service Letter, vol. 6, letter 49, Mar. 2, 1932.

Although the figures in the foregoing table do not agree exactly in totals with the imports as shown by the Bureau of Foreign and Domestic Commerce, they indicate the segregation of the individual grades.

In 1913, when the entire supply was imported, the United States imported the equivalent of 272,457 short tons of potash (K_2O); in 1931 the imports were 214,785 tons of potash (K_2O), or 21 per cent less than in 1913 and 37 per cent less than in 1930. The imports for 1913 have been exceeded only three times since that year—in 1928, 1929, and 1930. In 1931 the imports of potash (K_2O) were about three and one-third times the production in the United States; in 1930 they were about five and one-half times the production.

Approximate equivalent as potash (K_2O) of potash-bearing materials imported for consumption in the United States, 1922–1931, in short tons

1922	201,415	1927	244,155
1923	209,950	1928	330,493
1924	200,365	1929	324,638
1925	258,217	1930	342,454
1926	266,280	1931	214,785

The following table indicates the amount of potash-bearing materials imported in 1931 and the countries from which last shipment was made. Nearly all of the crude salts and much the larger part of the refined salts imported originated in Germany and France.

Potash materials imported into the United States in 1931, in short tons

[General imports. The figures in parentheses in the column headings indicate in per cent the approximate equivalent as potash (K_2O)]

Country	Muriate (chloride) (52)	Sulphate (50)	Manure salts (24)	Kainite (14)	Bitartrate: Argols or wine lees (20)	Bitartrate: Cream of tartar (25)	Caustic (80)
Africa: Algeria and Tunisia					1,588		
Argentina					821		
Austria							
Belgium	23,869	4,493	19,849	5,905			
Canada	291				2		
Chile					240		
China							
Cuba	100						
Czechoslovakia	56						1
Denmark							
France			3,720		3,450		
Germany	108,634	51,705	106,708	38,981		5	4,166
Greece					108		
Hong Kong							
India, British				218			
Italy			548		2,017	23	
Japan							
Netherlands	43,853	7,465	65,637	16,622	96		28
Portugal					771		
Spain	25,400		4,497		564		
Sweden							120
Switzerland						6	
United Kingdom				242		13	
	202,203	63,663	200,959	61,968	9,657	47	4,315
Approximate equivalent as potash (K_2O)	105,150	31,830	48,230	8,680	1,931	12	3,452

Country	Carbonate (61)	Cyanide (70)	Nitrate (salt-peter), crude (40)	Chlorate and perchlorate (36)	All other (50)	Total: Short tons	Total: Value
Africa: Algeria and Tunisia						1,588	$262,096
Argentina						821	142,889
Austria					23	23	8,144
Belgium			85			54,201	1,238,231
Canada	11		448		(1)	752	41,174
Chile			9,262			9,502	352,183
China	(1)					(1)	33
Cuba						100	4,350
Czechoslovakia	805				18	880	72,337
Denmark	28					28	2,323
France			82	39	6	7,297	654,910
Germany	6,298	47	7,493	5,754	3,383	333,174	9,501,140
Greece						108	14,291
Hong Kong	1					1	145
India, British						218	1,863
Italy						2,588	381,336
Japan					28	28	6,033
Netherlands	408				48	134,157	2,639,054
Portugal						771	106,916
Spain						30,461	962,014
Sweden	5			379		504	70,864
Switzerland				36	6	48	7,632
United Kingdom	27				22	304	21,010
	7,583	47	17,370	6,208	3,534	577,554	16,490,968
Approximate equivalent as potash (K_2O)	4,626	33	6,948	2,235	1,767	214,894	----------

[1] Less han 1 ton.

Potassium salts (not fertilizer) exported from the United States, 1922-1931

Year	Short tons	Value	Year	Short tons	Value
1922	6,238	$780,996	1927	1,965	$487,726
1923	3,997	505,837	1928	2,619	609,018
1924	1,923	301,036	1929	1,523	583,668
1925	2,155	398,740	1930	1,256	498,774
1926	1,679	319,201	1931	1,158	370,935

The above figures represent a decrease of 8 per cent in quantity and 26 per cent in value of exports of potassium compounds not classed as fertilizer in 1931 compared with 1930.

In 1929, for the first time, exports of potash fertilizer material (15,532 short tons, valued at $582,690) were published separately from those of other fertilizer materials. In 1931 further separation of export figures was made, the muriate (KCl) being separated from other salts. The increase in exports of potassium fertilizer compounds in 1931 over 1930 amounted to 90 per cent in quantity and 97 per cent in value. The total exports in 1930 and 1931 and the receiving countries are shown in the following table:

Potash fertilizer material exported from the United States, 1930 and 1931, by destinations

Destination	1930		1931					
			Chloride or muriate		Other potash fertilizer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Barbados	1	$38						
Canada	3,478	121,357	5,417	$194,116	774	$23,386	6,191	$217,502
Colombia	2	279			13	659	13	659
Dominican Republic	1	70	1	22	3	159	4	181
Guatemala					7	641	7	641
Haiti					4	198	4	198
Honduras	11	564	1	40			1	40
Japan	12,858	483,818	25,872	1,034,406	336	11,872	26,208	1,046,278
Mexico	12	923			19	916	19	916
Newfoundland and Labrador	672	36,000						
Nicaragua	7	318						
Venezuela					2	136	2	136
West Indies ("Other British")					11	558	11	558
	17,042	643,367	31,291	1,228,584	1,169	38,525	32,460	1,267,109

The potash (K_2O) content of these salts is not known, but on account of the large amount of muriate the content is estimated as averaging 45 to 60 per cent. More than 80 per cent of the shipments are made from Pacific coast customs ports.

CONSUMPTION

The calculated total consumption of potash materials in the United States in 1931, as indicated by imports plus sales of domestic products minus exports of potash fertilizer material (exports for other purposes being negligible), was 678,165 short tons of material equivalent to approximately 262,000 tons of K_2O, a decrease of 33 per cent from the 390,000 tons of K_2O consumed in 1930. About 92 per cent of the total supply of potash (K_2O) in 1931 was used in the manufacture of fertilizers.

MARKET CONDITIONS

On account of the generally unsatisfactory business conditions that have prevailed since 1929, the demand for fertilizer material has been unusually light, and the total consumption of potash fertilizer material in 1931 was about 38 per cent less in gross weight and 35 per cent less in calculated potash (K_2O) equivalent than in 1929.

As cotton, tobacco, and "truck" are the chief potash-consuming crops, the States east of the Mississippi River and south of the Ohio River and Mason and Dixon's line are the chief users of potash, although in the Northeastern States potash is used for growing tobacco as well as for potatoes and other vegetables.

PRICES

The prices of foreign potassium salts remained unchanged throughout 1931, although prices for both bulk and bagged salts in certain grades were omitted from the May 1 and November 2 statement issued by the N. V. Potash Export My. (Inc.), American sales agents for the French and German potash syndicates. The prices were guaranteed against reduction until April 30, 1932.

The prices prevailing from 1925 to 1931, as reported by the N. V. Potash Export My. (Inc.), are given in the following table:

Quoted prices of different grades of potassium salts, 1925–1931

[Per ton of 2,000 pounds, c. i. f. Atlantic and Gulf ports]

		Oct. 1, 1925, to Nov. 30, 1926	Dec. 1, 1926, to Apr. 30, 1929	May 1, 1929, to Feb. 24, 1930	Feb. 25, 1930, to Dec. 31, 1931
Sulphate, 90 to 95 per cent K_2SO_4	in bags	$45.85	$47.30	$47.75	$48.25
	in bulk	44.60	45.70	46.15	[1] 46.65
Muriate, 80 to 85 per cent KCl	in bags	34.90	36.40	36.75	37.15
	in bulk	33.65	34.80	35.15	35.55
Potash-magnesia sulphate (double manure salts), 48 to 53 per cent K_2SO_4	in bags	26.35	27.25	27.50	27.80
	in bulk	25.10	25.65	25.90	[1] 26.20
Manure salts, 30 per cent K_2O	in bags	20.00	21.75	21.95	[1] 22.15
	in bulk	18.00	18.75	18.95	19.15
Kainite, 20 per cent K_2O	in bags	13.35	15.40	15.50	[1] 15.65
	in bulk	11.35	12.40	12.50	12.65
Kainite, 14 to 16 per cent K_2O	in bags	10.50	12.50	12.60	[1] 12.70
	in bulk	8.50	9.50	9.60	9.70
Kainite, 12.4 per cent K_2O	in bags	10.00	12.00	12.10	----------
	in bulk	8.00	9.00	9.10	----------

[1] Price not quoted after May 1, 1931.

Until May 1 the discounts from the sales prices offered by the importing company in 1931 were the same as in 1930. The discounts offered beginning May 1, 1931, were as follows: On orders placed prior to June 1 for prompt shipment, 11 per cent; prior to June 1 for shipment in equal monthly quantities June to September, inclusive, 10 per cent; prior to July 1 for July shipment, 7 per cent; prior to August 1 for August shipment, 6 per cent; prior to September 1 for September shipment, 5 per cent; prior to October 1 for shipment in equal monthly quantities October to December, inclusive, 4 per cent; prior to October 1 for October shipment, 4 per cent; prior to November 1 for November shipment, 3 per cent; prior to December 1 for December shipment, 2 per cent. Bagged salts are sold on foreign weights, tares, and analyses and bulk salts on American weights and foreign analyses.

SUMMARY OF WORLD PRODUCTION

The following table, compiled by L. M. Jones, of the Bureau of Mines, lists the countries that in the past five years have produced potassium salts and gives the available figures for their production of crude salts and K_2O equivalent. The list of countries differs somewhat from that in the table of imports, because in the latter table some of the countries from which the imports came were not themselves producers but received their supply from other countries. Both tables, however, show clearly the predominance of Germany and Alsace as producers of potash.

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World production of potash minerals and equivalent K_2O, 1927–1931, in metric tons

Country and mineral [1]	1927		1928		1929		1930		1931	
	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O	Output	Equivalent K_2O
Australia: Western Australia, alunite	------	------	------	------	39	3	------	------	(2)	(2)
Chile, perchlorate of potash [3]	101	(2)	297	(2)	1,259	(2)	2,409	(2)	(2)	(2)
Chosen, alunite	3,639	(2)	13,798	(2)	10,812	(2)	11,708	(2)	(2)	(2)
Ethiopia, crude potassium salts	1,600	800	1,300	650	(2)	(2)	(2)	(2)	(2)	(2)
France (Alsace), crude potassium salts	2,321,757	[4] 370,901	2,580,196	[4] 406,640	3,124,816	[4] 492,097	3,138,783	[4] 506,488	2,197,481	[4] 368,870
Germany, crude potassium salts:										
Carnallite [5]	1,773,195	171,208	2,057,760	200,488	2,317,940	222,506	1,867,548	179,087	(2)	(2)
Kainite, sylvinite, and hartsalz	9,298,346	1,346,829	10,431,310	1,490,640	10,998,278	1,565,269	10,094,703	1,429,427	(2)	(2)
India (British), nitrate of potash [6]	6,900	3,000	4,800	2,000	4,900	2,000	4,100	1,600	(2)	(2)
Italy:										
Alunite	800	90	185	19	105	11	825	83	(2)	(2)
Leucite rock	29,000	2,300	39,200	3,200	37,727	(2)	41,200	(2)	(2)	(2)
Palestine, crude potassium salts [7]	------	------	------	------	------	------	6,000	1,200	(2)	(2)
Poland, crude potassium salts:										
Kainite	127,772	12,772	146,692	14,669	137,858	14,062	100,783	10,209	59,120	7,165
Sylvinite	148,340	31,053	194,964	40,942	220,770	49,673	204,826	45,021	202,199	45,576
Russia: [8]										
Alum stone	1,364	(2)	1,131	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Alunite clays	3,065	(2)	1,812	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Carbonate of potash [9]	3,784	(2)	6,057	(2)	6,980	(2)	(2)	(2)	(2)	(2)
Spain:										
Alunite	(2)	(2)	826	(2)	1,599	(2)	3,864	(2)	(2)	(2)
Crude potassium salts	172,356	17,236	243,233	24,323	243,949	24,395	286,436	28,644	(2)	(2)
Potassic earth	950	(2)	850	(2)	850	(2)	900	(2)	(2)	(2)
United States, crude potassium salts	69,689	39,471	94,464	54,349	97,812	55,873	95,989	55,583	121,490	57,951

[1] In addition to the countries listed, Queensland produced 6 tons of alunite in 1927, but working expenses equaled returns and operations were discontinued.
[2] Data not available.
[3] Produced at nitrate plants from caliche.
[4] Figures relate to merchantable products.
[5] Includes some natural kieserite.
[6] Estimated production (Imperial Institute, London).
[7] Extracted from waters of the Dead Sea.
[8] Year ended Sept. 30.
[9] Made from sunflower ash.

CARBON BLACK [1]

By G. R. Hopkins and H. Backus [2]

CONTENTS

ILLUSTRATIONS

SUMMARY

The history of the carbon-black industry in 1931 was one of declining production and uniform demand, but materially lower prices. The total output amounted to 280,907,000 pounds, which was 26 per cent below 1930 and represented the first annual decrease since 1925. (See fig. 1.) This material decline resulted chiefly from the curtailment in operations made necessary by stock accumulations in preceding years. In general, the demand for carbon black in 1931 fulfilled, even surpassed, expectations. Sales to rubber companies showed a small increase over 1930, even though the output of casings declined 7 per cent. Sales to ink and paint companies fell off materially, but these decreases were more than offset by increased exports. Stocks of carbon black held at the plants, which assumed burdensome proportions in 1929 and 1930, increased about 20,000,000 pounds in 1931. This is not discouraging, when it is considered that most of the increase probably occurred in January and February and that the addition to stocks in 1930 was more than six times as great as in 1931. The average yield of carbon black reached a new high level in 1931, a reflection of the increased importance of retort blacks. The center of the industry became more firmly established in Texas, as the output of that State was 75 per cent of the Nation's total in 1931, compared with 72 per cent in 1930.

There are two general methods of producing carbon black, the "contact" method whereby the black is deposited on a relatively cold metallic surface and the "furnace" method by means of which the gas is cracked in a brick-lined retort. The contact method may be further divided into the channel, roller, and disk processes, depending upon the shape of the contact surface. Of these three, the channel process is by far the most important, as it gives the highest yield and a product which has satisfactory characteristics in most

[1] Work on manuscript completed May, 1932.

[2] Figures on exports and imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

uses. The roller process is used principally in the manufacture of blacks used in "long" or free-flowing inks. Retort black, usually called thermatomic black after the name of the principal manufacturer, is grayish; hence, the chief and perhaps the only use is as a reinforcing agent in rubber goods. Retort black varies considerably from channel black in physical and chemical qualities, although the differences are not so great but what there is considerable competition between the two in the rubber industry. In this competitive struggle the principal asset of retort black is the high yield—about 10 pounds per thousand cubic feet—which compensates the manufacturer for any deficiency in quality.

The production of channel blacks in 1931 totaled 255,322,000 pounds (27 per cent less than in 1930). The output of all the other types of black, including retort black, in 1931 amounted to 25,585,000

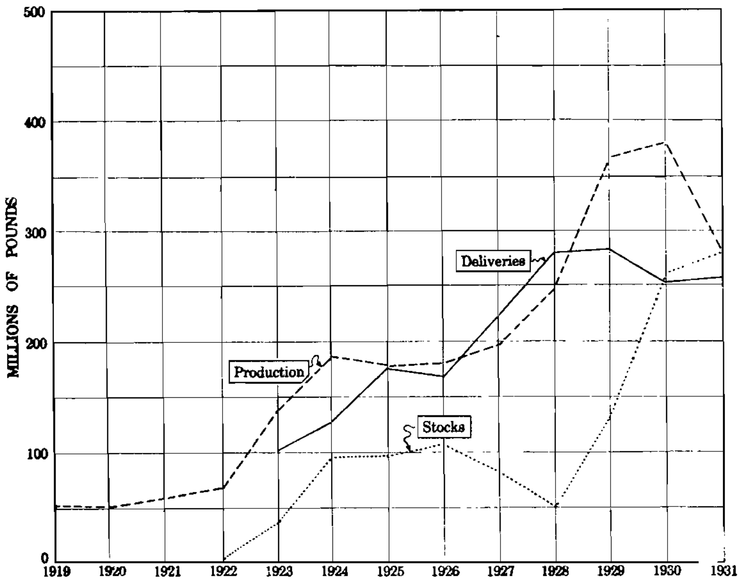

FIGURE 1.—Carbon-black production, stocks, and deliveries, 1919–1931

pounds, a decline of 14 per cent from 1930. As the percentage decrease for channel black was the greater, it follows that its relative importance declined in 1931.

The utilization of natural gas at carbon-black plants constitutes one of the major items in the total consumption of gas. In 1931 the estimated quantity of natural gas burned totaled 195,396,000,000 cubic feet, a decline of 27 per cent from 1930, 12 per cent of the total amount utilized, and equivalent to nearly half of the quantity used for domestic and commercial purposes.

The average yield of carbon black has fluctuated in recent years, but the general trend has been upward. In 1931 the average yield was 1.44 pounds per thousand cubic feet, a new high record, but only 0.01 pound above the yield in 1930. The small increase in yield in 1931 was probably due to a gain in the relative proportion of high-yield or retort blacks, rather than to an improvement in the technique of manufacturing contact blacks.

The Texas Panhandle and the Monroe-Richland gas fields are usually referred to as "dry" gas areas. The term "dry" gas is used relatively to show the distinction from "wet" gas from oil wells. Actually most of the gas from these two fields contains enough of the heavier hydrocarbons to make the extraction of natural gasoline commercially feasible, hence most of the natural gas burned for carbon black consists of residue gas from natural-gasoline plants. It is estimated that 89 per cent of the total gas consumed in the manufacture of carbon black in 1931 was residue gas, compared with 88 per cent in 1930.

In 1931, as in 1930, losses of carbon black incurred in handling at the plants increased materially. The total so lost in 1931, including samples given away, amounted to 1,716,000 pounds, equivalent to only 0.6 per cent of the total output.

Although carbon black is generally considered indispensable in the manufacture of rubber goods and inks, it meets considerable competition from lampblack, bone black, acetylene black, and manufactured-gas black in all the principal uses and from zinc oxide in rubber. Each of these products has its own peculiar properties and certain uses in which it excels. For example, lampblack is generally considered to be the best tinting agent for gray paints, whereas bone black is superior in plate inks and in quick-drying paints. Acetylene black is largely used in tires, where toughness has paramount importance. However, the use of acetylene black is restricted by the relatively small output and high price. Black made from manufactured gas is considered equal or superior to carbon back in most uses, but the relatively high price of the gas practically prohibits the manufacture of this type of black. Zinc oxide competes with carbon black in the manufacture of dark rubber goods, although the qualities that each imparts to the rubber mix do not entirely overlap and some of both are usually used. In light-colored rubber, zinc oxide has a clear field over carbon black as a reinforcing agent; however, the output of white and red rubber goods is relatively small.

Statistics of lampblack and bone black are compiled every 2 years by the Bureau of the Census. The latest figures available (1929) indicate an annual output of 10,000,000 pounds of lampblack and 50,000,000 pounds of bone black. Statistics of zinc oxide are compiled annually by the Bureau of Mines; the 1931 figures of sales indicate the production of about 200,000,000 pounds in that year. According to trade journals, the average spot prices per pound for these three competitive products in 1931 were 10 cents for lampblack, 5 cents for bone black, and 6 cents for zinc oxide—all considerably higher than average carbon-black prices.

Summary of statistics of carbon black made from natural gas in the United States, 1927–1931

	1927	1928	1929	1930	1931
Number of producers reporting	33	31	35	33	26
Number of plants	61	65	71	69	58
Quantity produced:					
By States—					
Kentucky ... pounds	5,669,000	484,000			
Louisiana ... do	124,188,000	136,320,000	127,345,000	96,729,000	57,485,000
Texas ... do	56,396,000	100,828,000	228,183,000	271,749,000	210,878,000
West Virginia ... do	2,796,000	697,000	578,000	(1)	
Wyoming ... do	6,294,000	(1)	(1)	(1)	(1)
Other States ... do	3,086,000	10,461,000	10,336,000	11,464,000	12,544,000
Total ... do	198,429,000	248,790,000	366,442,000	379,942,000	280,907,000
By processes—					
Channel process ... do	167,357,000	220,532,000	327,552,000	350,254,000	255,322,000
Other processes [2] ... do	31,072,000	28,258,000	38,890,000	29,688,000	25,585,000
Stocks held by producers Dec. 31 ... do	82,831,000	50,240,000	132,203,000	259,245,000	280,010,000
Losses ... do	546,000	802,000	673,000	1,361,000	1,716,000
Quantity sold:					
Domestic—					
To rubber companies ... do	(3)	140,938,000	138,474,000	128,572,000	134,315,000
To ink companies ... do	(3)	27,223,000	27,350,000	19,220,000	15,184,000
To paint companies ... do	(3)	20,040,000	17,257,000	11,922,000	6,760,000
For miscellaneous purposes ... do	(3)	14,475,000	8,896,000	7,565,000	5,453,000
Total ... do	168,999,000	202,676,000	191,977,000	167,279,000	161,712,000
Export ... do	54,431,000	77,903,000	91,829,000	84,260,000	96,714,000
Total ... do	223,430,000	280,579,000	283,806,000	251,539,000	258,426,000
Value (at plants) of carbon black produced:					
Total ... dollars	10,955,000	13,782,000	18,720,000	14,852,000	8,621,000
Average per pound ... cents	5.52	5.54	5.11	3.91	3.07
Estimated quantity of natural gas used ... M cubic feet	144,087,000	175,137,000	261,107,000	266,625,000	195,396,000
Average yield per M cubic feet ... pounds	1.38	1.42	1.40	1.43	1.44

[1] Included under "Other States."
[2] 1927–1930: Disk, Lewis, roller, "special," and thermatomic; 1931: Disk, roller, "special," and thermatomic.
[3] Figures not available.

PRODUCTION BY STATES AND DISTRICTS

Although the output of carbon black in the Texas Panhandle declined 57,298,000 pounds (22 per cent) in 1931, the decrease in total production in the other districts was proportionately greater; hence, the relative importance of the Panhandle increased. In 1930, 67 per cent of the total output was produced in the Panhandle; in 1931, the proportion rose to 70 per cent. The production in Texas, exclusive of the Panhandle—that is, in the Breckenridge district, composed of Eastland and Stephens Counties—declined in 1931, but the decrease was relatively less than in 1930. Louisiana, which showed its first material decline as a carbon-black producer in 1930, showed an even larger decline in 1931. (See fig. 2.) The total output of the State in 1931, all from plants in the Monroe-Richland gas field, amounted to 57,485,000 pounds (41 per cent below 1930). The output in Montana declined substantially, but the combined total from the other producing States (Oklahoma, Utah, and Wyoming) in 1931 was 16 per cent above the total from the other producing States (Oklahoma, Utah, West Virginia, and Wyoming) in 1930. Owing to the closing of the only active plant in West Virginia at the end of 1930 the number of producing States declined from seven in 1930 to six in 1931. It is noteworthy that the West Virginia plant was the last operated east of the Mississippi.

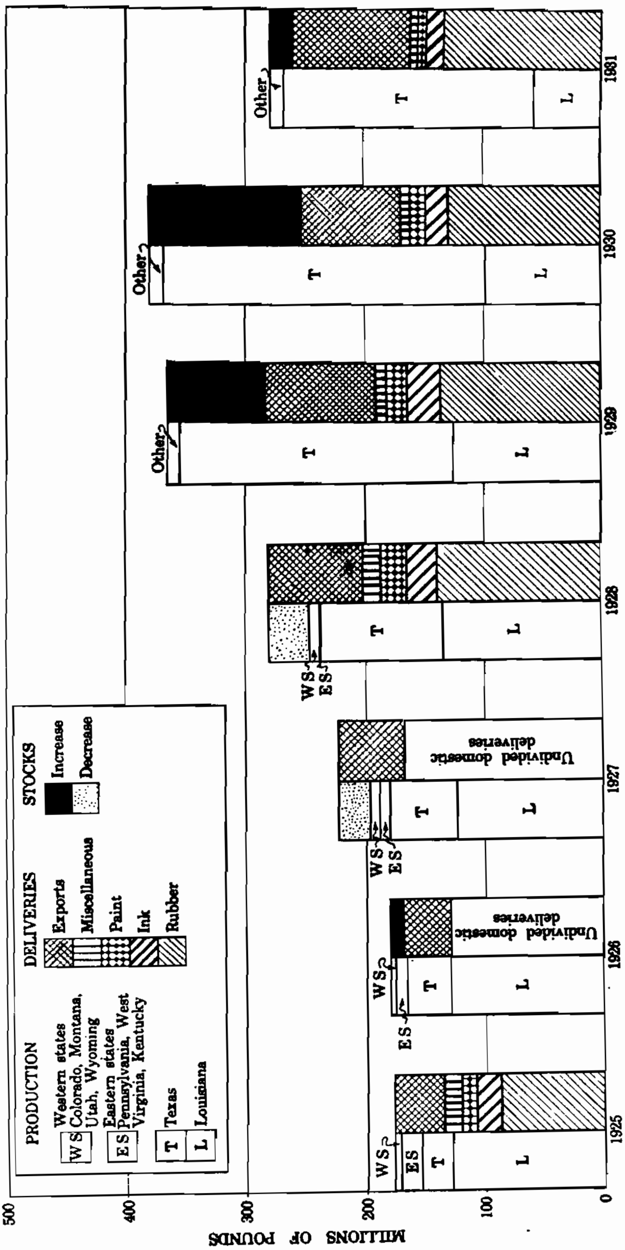

FIGURE 2.—Production and consumption of carbon black, 1925–1931

Carbon black produced from natural gas in the United States, 1930 and 1931, by States and by major producing districts

State and district	Producers reporting	Number of plants	Production: Pounds	Production: Value at plant: Total	Production: Value at plant: Average (cents)	Estimated quantity of natural gas used (M cubic feet)	Average yield per M cubic feet (pounds)
1930							
Louisiana: Monroe-Richland district (Morehouse, Ouachita, Richland, and Union Parishes)	19	32	96,729,000	$3,900,000	4.03	85,226,000	1.13
Montana	1	1	842,000	34,000	4.04	684,000	1.23
Oklahoma	1	1	(1)	(1)	(1)	(1)	(1)
Texas:							
Breckenridge district (Eastland and Stephens Counties)	6	7	16,905,000	689,000	4.08	8,314,000	2.03
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties)	13	25	254,844,000	9,770,000	3.83	168,104,000	1.52
Total Texas	[2] 15	32	271,749,000	10,459,000	3.85	176,418,000	1.54
Utah	1	1	575,000	23,000	4.00	392,000	1.47
West Virginia	1	1	(1)	(1)	(1)	(1)	(1)
Wyoming	1	1	(1)	(1)	(1)	(1)	(1)
Undistributed [3]			10,047,000	436,000	4.34	3,905,000	2.57
Total United States	[2] 33	69	379,942,000	14,852,000	3.91	266,625,000	1.43
1931							
Louisiana: Monroe-Richland district (Morehouse, Ouachita, and Richland Parishes)	12	23	57,485,000	1,806,000	3.14	52,204,000	1.10
Montana	1	1	181,000	5,000	2.76	206,000	.88
Oklahoma	1	1	(1)	(1)	(1)	(1)	(1)
Texas:							
Breckenridge district (Eastland and Stephens Counties)	5	6	13,332,000	474,000	3.56	6,175,000	2.16
Panhandle district (Carson, Gray, Hutchinson, and Wheeler Counties)	14	25	197,546,000	5,965,000	3.02	129,478,000	1.53
Total Texas	[2] 14	31	210,878,000	6,439,000	3.05	135,653,000	1.55
Utah	1	1	(1)	(1)	(1)	(1)	(1)
Wyoming	1	1	(1)	(1)	(1)	(1)	(1)
Undistributed [3]			12,363,000	371,000	3.00	7,333,000	1.69
Total United States	[2] 26	58	280,907,000	8,621,000	3.07	195,396,000	1.44

[1] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[2] In counting the total number of producers, a producer operating in more than 1 State, district, or county is counted only once.
[3] 1930: Oklahoma, West Virginia, and Wyoming; 1931: Oklahoma, Utah, and Wyoming.

CONSUMPTION

The total distribution of carbon black in 1931 amounted to 258,426,000 pounds, an increase of 6,887,000 pounds (3 per cent) over that in 1930. Of the total in 1931, 161,712,000 pounds (63 per cent) represented sales by the producers to brokers or directly to domestic consumers, whereas 96,714,000 pounds (37 per cent) represented total sales to foreign countries. No data are available as to the ultimate disposition of exports of carbon black, but fairly reliable information was obtained as to domestic sales. Of the total domestic deliveries, 134,315,000 pounds (83 per cent) were consigned to rubber companies, 15,184,000 pounds (10 per cent) to ink companies, and 6,760,000 pounds (4 per cent) to paint companies, leaving 5,453,000 pounds (3 per cent) used in miscellaneous products. In comparison with 1930 these data represent an increase in the relative proportion sold to rubber companies at the expense of consignments to all the other three classes.

The use of carbon black as a filler and pigment in rubber goods, particularly in tires, has been the dominating factor in the industry since this particular use was developed in 1915. Sales of carbon black to rubber companies increased steadily from 1920 to 1928 and declined in both 1929 and 1930 but showed a rather unexpected gain in 1931, when they amounted to 134,315,000 pounds, or nearly 6,000,000 pounds above the total in 1930.

Because of the close relationship between the carbon-black and rubber industries it may be helpful to cite the following data, relative to rubber consumption, supplied by E. G. Holt, chief, rubber division, Bureau of Foreign and Domestic Commerce.

According to Holt, the total consumption of crude and reclaimed rubber in 1931 amounted to 473,000 long tons, a decline of 56,500 tons (11 per cent) from 1930. Owing to the severe drop in prices the consumption of crude rubber was better maintained than that of reclaimed rubber, a favorable development for the carbon-black industry, as more black is used in crude rubber than in reclaimed rubber. The output of casings in 1931 amounted to approximately 49,500,000, compared with about 53,000,000 in 1930, a decline of 7 per cent.

It has been suggested that the increase in sales of carbon black to rubber companies, in the face of a decrease in use of crude rubber in 1931, was due to the desire of the rubber manufacturers to take advantage of the low prices; in other words, that a considerable part of their purchases was stored. No data are available as to stocks of carbon black held elsewhere than at the plants, but it was frequently stated in the trade journals in 1931 that most of the rubber manufacturers were pursuing a "hand-to-mouth" policy in their purchases of carbon black and that the average stock carried was only about a 5-day supply. In view of this, it appears probable that the increase in demand for carbon black by rubber companies in 1931 was due to an increase in the amount used in the average tire.

The second most important use of carbon black is in inks, of which newsprint ink is by far the most important. The sale of carbon black to ink companies varies directly with the consumption of newsprint paper. According to N. S. Meese, assistant chief, paper division, Bureau of Foreign and Domestic Commerce, the downward trend in the output of newsprint was continued in 1931, when the total was at least 10 per cent below 1930; in addition, there was a material decline in advertising, due to depressed conditions and to the competition of radio broadcasting.

Sales of carbon black to ink companies declined from 19,220,000 pounds in 1930 to 15,184,000 pounds in 1931, or 21 per cent. The fact that this decrease exceeded the decline in output of newsprint paper was probably due to a much larger decrease in advertising.

The third most important use of carbon black is as a pigment in paints, varnishes, and enamels. This particular use has declined rapidly in importance in recent years; for example, total sales in 1931

(6,760,000 pounds) were only about one-third what they were in 1928. Statistics as to the output of black paints, varnishes, and enamels in 1931 are not yet available, but there is little doubt that a material decline was registered in that year. This decline was occasioned largely by the recession in activity in the automobile industry and by a tendency to use brighter colors on the new cars.

In addition to the use in rubber goods, ink, and paint, carbon black is used as a filler and as a coloring and reinforcing agent in a number of articles, such as shoe and stove polishes, artificial stone and tile, phonograph records, typewriter ribbons, crayons, carbon paper, linoleum, and artificial leather, and as a component of liquid-oxygen explosives. Data as to the consumption of carbon black in the manufacture of each of these commodities are not available, but the total for these and other miscellaneous articles amounted to 5,453,000 pounds in 1931, compared with 7,565,000 pounds in 1930. This decrease probably was due to depressed conditions in the manufacturing industries, although the fact that the 1931 total was only 38 per cent of that in 1928 would indicate the replacement of carbon black by other agents in the miscellaneous uses.

NUMBER AND CAPACITY OF PLANTS

The unsatisfactory economic conditions experienced by the carbon-black industry in 1931 were reflected in material declines in the number of operators and in the number of plants. The number of operators declined to 26 and the number of plants to 58. These data represent the smallest number of operators and plants since just before the rapid expansion of the industry in 1923; however, they fail to measure completely the extent of the curtailment in operations in 1931, as there were 9 plants that operated part of the year and then closed, but are included in the total of 58. The 9 plants closed in 1931 included 4 in Louisiana, 3 inTexas, and 1 each in Montana and Utah. The plants that closed in Montana and Utah were the only active ones in those States, indicating further concentration of the industry in Texas in 1932.

The total daily capacity of the plants operated during 1931 amounted to 1,366,975 pounds, compared with 1,481,175 pounds for those operated during 1930. This undoubtedly represents the first time in recent years in which a decline in operating capacity has been recorded. The average daily output of carbon black during the closing days of 1931 probably did not exceed 700,000 pounds, from which the deduction can be made that the plants were then operating at about 50 per cent of their capacity.

Number and daily capacity of carbon-black plants operated in the United States, 1930 and 1931, by counties or parishes

State	County or parish	Number of plants 1930	Number of plants 1931	Total daily capacity (pounds) 1930	Total daily capacity (pounds) 1931
Louisiana	Morehouse	8	8	103,900	101,900
	Ouachita	21	13	331,925	271,425
	Richland	2	2	26,000	26,000
	Union	1	(1)	19,500	(1)
		32	23	481,325	399,325
Montana	Stillwater	1	1	5,000	5,000
Oklahoma	Beckham		1		(2)
	Seminole	1	(1)	(2)	(1)
		1	1	(2)	(2)
Texas	Carson	2	2	86,800	86,800
	Eastland	2	1	12,250	(3)
	Gray	8	9	301,400	308,400
	Hutchinson	12	11	450,500	435,500
	Stephens	5	5	67,400	[3] 50,450
	Wheeler	3	3	24,000	24,000
		32	31	942,350	905,150
Utah	Grand	1	1	5,500	(2)
West Virginia	Logan	1	(1)	(2)	(1)
Wyoming	Niobrara	1	1	(2)	(2)
Undistributed [4]				47,000	57,500
United States		69	58	1,481,175	1,366,975

[1] Closed before Jan. 1, 1931.
[2] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[3] Eastland County included with Stephens County.
[4] 1930: Oklahoma, West Virginia, and Wyoming; 1931: Oklahoma, Utah, and Wyoming.

PRODUCERS

Carbon-black producers of the United States, as of January 1, 1932

State and company	County	Nearest town	Process
Louisiana:			
Century Carbon Co., 365 East Illinois Street, Chicago, Ill.	Ouachita	Swartz	Channel.
	Richland	Archibald	Do.
J. Smylie Herkness, route No. 2, Bastrop, La.	Morehouse	Bastrop	Do.
J. M. Huber Co. of Louisiana (Inc.), 460 West Thirty-fourth Street, New York, N. Y.	Ouachita	Swartz	Do.
Imperial Oil & Gas Products Co., 1104 Union Bank Building, Pittsburgh, Pa.	do	Sterlington	Do.
Peerless Carbon Black Co., 3003 Grant Building, Pittsburgh, Pa.	do	Bourland	"Special."
	do	Guthrie	Do.
Southern Carbon Co., 45 East Forty-second Street, New York, N. Y.	Morehouse	Perryville	Channel.
	do	Spyker	Do.
	Ouachita	Fairbanks	Do.
	do	Fowler	Do.
	do	Swartz	Do.
Texas-Louisiana Producing & Carbon Co., post-office box 181, Monroe, La.	do	Not reported	Do.
Thermatomic Carbon Co., 230 Park Avenue, New York, N. Y.	do	Sterlington	Thermatomic.
United Carbon Co., post-office box 1475, Charleston, W. Va.	Morehouse	Bastrop	Channel.
	Ouachita	Cargas	Do.
	do	Phillips	Do.
	do	Swartz	Do.
United Gas Public Service Co., Monroe, La.	Morehouse	Bastrop	Do.
Oklahoma: Oklahoma Carbon Industries (Inc.), Sayre, Okla.	Beckham	Sayre	Do.

Carbon-black producers of the United States, as of January 1, 1932—Continued

State and company	County	Nearest town	Process
Texas.			
Cabot Carbon Co., 940 Old South Building, Boston, Mass.	Gray	Pampa	Channel.
	Hutchinson	Stinnett	Do.
Cabot Co., 940 Old South Building, Boston, Mass.	Carson	Skellytown	Channel and roller.
Coltexo Corporation, 45 East Forty-second Street, New York, N. Y.	Gray	Lefors	Channel.
	Stephens	Parks	Do.
Crescent Carbon Co., Point Pleasant, W. Va.	Hutchinson	Borger	Do.
Eastern Carbon Black Co. (United Carbon Co., owner), post-office box 1475, Charleston, W. Va.	do	Borger (2 plants)	Do.
	do	Borger	Channel and disk.
General Atlas Chemical Co., 60 Wall Street, New York, N. Y.	Gray	Pampa	"Special."
J. M. Huber Co. of Louisiana (Inc.), 460 West Thirty-fourth Street, New York, N. Y.	Hutchinson	Borger	Channel.
Kosmos Carbon Co. (United Carbon Co., owner), post-office box 1475, Charleston, W. Va.	do	do	Do.
Magnolia Petroleum Co., Dallas, Tex.	Gray	Pampa	Do.
	Wheeler	Lela	Do.
Palmer Carbon Co., 80 East Jackson Boulevard, Chicago, Ill.	Hutchinson	Borger	Do.
Panhandle Carbon Co., Slattery Building, Shreveport, La.	do	do	Do.
Peerless Carbon Black Co., 3003 Grant Building, Pittsburgh, Pa.	Eastland	Pioneer	"Special."
	Gray	Pampa	Do.
Texas Carbon Industries (Inc.), post-office box 55, Breckenridge, Tex.	Stephens	Breckenridge (2 plants).	Channel.
Texas Elf Carbon Co., 940 Old South Building, Boston, Mass.	Gray	Pampa	Do.
	Stephens	Eliasville	Do.
Western Carbon Co., 45 East Forty-second Street, New York, N. Y.	Gray	Kings Mill	Do.
	do	Lefors	Do.
	do	Pampa	Do.
	Hutchinson	Borger	Do.
	Wheeler	Lela	Do.
	do	Magic City	Do.
Wyoming: J. M. Huber Co. of Louisiana (Inc.), 460 West Thirty-fourth Street, New York, N. Y.	Niobrara	Manville	Do.

PRICES AND VALUES

The average value of carbon black at the plants in 1931 was 3.07 cents per pound, the lowest recorded and a decline of 0.84 cent per pound from the average value in 1930. The greater part of the domestic consignments of carbon black in 1931 sold for 3.0 cents per pound, the price established by practically all the major companies in February. Shipments of carbon black to rubber manufacturers accelerated following a decline of half a cent in the posted price in both January and February, so that in April they were reported to have exceeded the production for the first time in many months. This increase in demand made the carbon-black producers optimistic of higher prices, but reduced sales of tires in the latter half of the year and the top-heavy stocks of carbon black prevented this hope from being realized. As a matter of fact, prices showed a tendency to weaken late in the year, and considerable so-called distress product was sold for less than 3 cents per pound. However, nearly all the new contracts covering the requirements for 1932 were based on a 3-cent price, as the rubber manufacturers realized that the chance was greater for an increase in price than for a decrease.

The total value at the plants of the carbon black produced in 1931 amounted to $8,621,000, compared with $14,852,000 in 1930 and with the peak value of $18.720,000 in 1929.

Quoted prices of various grades of carbon black, 1930 and 1931, in cents per pound

[Oil, Paint and Drug Reporter]

Date	Lithoink qualities (bags)	Standard rubber, ink, and paint qualities (bags, cases)	Works, Louisiana (bags)	Works, Texas (bags)
1930				
Jan. 6	22.0	10.5	6.1	6.0
Jan. 13			5.85	5.75
Jan. 20			5.6	5.5
Feb. 24		9.5	5.1	5.0
June 30		8.0	4.6	4.5
Oct. 6		7.5	4.1	4.0
1931				
Jan. 12		7.0	3.6	3.5
Feb. 9			3.1	3.0

FOREIGN TRADE

Exports of carbon black reached a new high level in 1931, when they amounted to 96,714,000 pounds, an increase of 15 per cent over 1930. In view of the fact that exports of carbon black declined in 1930 and that foreign trade generally was lower in 1931, the establishment of a new record by the carbon-black industry in 1931 represents an important achievement. The total value of exports of carbon black declined, although the average realization per pound continued to be considerably higher than the average domestic price. The United States continued to be the only country that produces contact black in commercial quantities, although the recent construction of a plant in Japan has been reported. Imports of carbon black from Canada in 1931 totaled 21,602 pounds, valued at $2,168. An investigation of similar imports in 1930 indicated that the shipments consisted entirely of manufactured-gas black and acetylene black, and it is believed that the same held true in 1931.

The United Kingdom continued to be the leading carbon-black customer and was again followed in order by France, Germany, and Canada. Exports of carbon black to the United Kingdom rose from 24,017,974 pounds in 1930 to 32,279,788 pounds in 1931, an increase of 34 per cent. Exports to France and Germany were also higher, but the total to Canada again declined. Exports to Japan, the customer ranking fifth, increased 43 per cent in 1931, the largest relative increase recorded by any of the important carbon-black consuming nations.

Carbon black exported from the United States, 1929–1931, by countries

Country	1929		1930		1931	
	Pounds	Value	Pounds	Value	Pounds	Value
Australia	5, 705, 833	$510, 526	2, 630, 771	$184, 283	1, 915, 738	$97, 890
Belgium	2, 260, 152	196, 946	2, 644, 502	174, 676	2, 896, 126	139, 952
Canada	13, 890, 749	975, 002	11, 757, 174	601, 134	9, 825, 346	352, 236
China	1, 049, 680	97, 417	995, 423	70, 614	1, 047, 870	58, 320
France	16, 698, 430	1, 708, 131	16, 438, 685	1, 179, 074	18, 039, 671	1, 005, 411
Germany	14, 049, 753	1, 363, 124	12, 369, 542	902, 712	14, 414, 348	771, 243
Italy	2, 544, 267	239, 907	2, 485, 113	210, 034	2, 808, 707	165, 458
Japan	5, 113, 956	469, 511	4, 402, 010	299, 254	6, 313, 937	327, 366
Netherlands	2, 006, 238	188, 991	1, 896, 430	138, 249	1, 583, 015	86, 051
United Kingdom	23, 273, 769	2, 068, 911	24, 017, 974	1, 695, 203	32, 279, 788	1, 763, 180
Other	5, 236, 388	452, 371	4, 622, 823	334, 225	5, 589, 570	311, 731
	91, 829, 215	8, 270, 837	84, 260, 447	5, 789, 458	96, 714, 116	5, 078, 838

CARBON-BLACK ASSOCIATION

The carbon-black industry, like most important industries, maintains a trade association to promote the welfare of its members and to collect and distribute statistics. This association, known as the National Gas Products Association, maintains an office at 90 Wall Street, New York City. The present officers are Godfrey L. Cabot, president; Oscar Nelson, vice president; H. W. Huber, vice president; G. A. Williams, treasurer; Reid L. Carr, secretary; A. F. Kitchel, assistant secretary; and C. H. Rohrbach, statistical secretary.

SALT, BROMINE, AND CALCIUM CHLORIDE[1]

By A. T. Coons

CONTENTS

SALT

PRODUCTION

Salt produced for sale or use by operators of salt mines, wells, and ponds in the United States in 1931 amounted to 7,358,070 short tons, valued at $21,541,012—a decrease of 8.6 per cent in quantity and 14 per cent in value in comparison with 1930. This is the smallest recorded production since 1924 but is only 14 per cent less than the record production of 8,543,560 tons in 1929. The output of evaporated salt in 1931 (2,203,690 tons, valued at $14,177,116) represented 30 per cent of the total quantity of salt produced and showed a decrease of 7 per cent in quantity and 14 per cent in value compared with 1930. The salt content (3,300,210 tons) of the brine produced and used by producers in the manufacture of chemicals represented 45 per cent of the total salt produced and showed a decrease of 11 per cent in quantity. Rock salt produced (1,854,170 tons, valued at $5,735,207) represented 25 per cent of the total output and showed a decrease of 6 per cent in quantity and 10 per cent in value. The average value of all salt was $2.93 a short ton in 1931 (8 cents less than in 1930); that of evaporated salt, including pressed blocks from evaporated salt, was $6.43 (58 cents less than in 1930); and that of rock salt was $3.09 (14 cents less than in 1930).

Seventy-four plants reported operations in 1931 as compared with 77 in 1930 and 104 in 1920.

Salt sold or used by producers in the United States, 1922–1931

Year	Short tons				Value [a]	
	Manufactured (evaporated)	In brine	Rock salt	Total	Total	Average
1922	2,276,683	2,569,042	1,947,124	6,792,849	$27,464,838	$4.04
1923	2,239,872	2,787,239	2,103,602	7,130,713	27,795,941	3.90
1924	2,224,555	2,513,853	2,064,707	6,803,115	25,747,048	3.78
1925	2,235,170	2,819,690	2,342,640	7,397,500	26,162,361	3.54
1926	2,198,060	3,037,820	2,135,720	7,371,600	25,055,012	3.40
1927	2,263,030	3,161,800	2,143,860	7,568,690	24,817,962	3.28
1928	2,430,050	3,426,870	2,217,780	8,074,700	26,772,568	3.32
1929	2,546,390	3,884,160	2,113,010	8,543,560	27,334,695	3.20
1930	2,358,610	3,718,460	1,977,370	8,054,440	25,009,480	3.11
1931	2,203,690	3,300,210	1,854,170	7,358,070	21,541,012	2.93

[a] The values are f.o.b. mine or refinery and do not include cost of cooperage or containers.

[1] Work on manuscript completed May, 1932.

Michigan continued to be the leading salt-producing State, followed by New York, Ohio, Kansas, Louisiana, and California, in the order named. Michigan continued also to rank first as a producer of evaporated salt; it was followed in 1931 by New York, Ohio, California, and Kansas. New York leads in output of rock salt, followed by Louisiana, Kansas, and Michigan; and Ohio, Michigan, New York, and Virginia produce large quantities of brine from which various chemical products are manufactured.

Salt sold or used by producers in the United States, 1929–1931, by States

State	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
California	410, 300	$2, 432, 329	350, 370	$2, 080, 133	334, 900	$2, 000, 567
Kansas	840, 370	3, 761, 984	759, 800	3, 148, 728	691, 160	3, 003, 756
Louisiana	525, 840	2, 277, 366	535, 250	2, 164, 365	529, 280	1, 962, 690
Michigan	2, 650, 220	8, 343, 607	2, 558, 290	7, 884, 072	2, 053, 980	5, 760, 001
New York	2, 194, 590	6, 470, 051	2, 009, 280	5, 837, 103	1, 788, 940	5, 293, 470
Ohio	1, 449, 360	3, 199, 903	1, 311, 440	3, 015, 206	1, 398, 000	2, 526, 952
Puerto Rico	(1)	(1)	(1)	(1)	11, 560	19, 878
Texas	(1)	(1)	(1)	(1)	103, 040	468, 562
Utah	84, 940	202, 676	85, 240	188, 983	74, 010	159, 778
West Virginia	20, 290	153, 477	28, 670	184, 327	35, 480	218, 762
Undistributed [2]	367, 650	493, 302	416, 100	506, 563	337, 720	126, 596
	8, 543, 560	27, 334, 695	8, 054, 440	25, 009, 480	7, 358, 070	21, 541, 012

[1] Included under "Undistributed."
[2] 1929 and 1930, Nevada, New Mexico, Oklahoma, Puerto Rico, Texas, and Virginia; 1931, Nevada, New Mexico, Oklahoma, and Virginia.

Salt is used for so large a variety of purposes that satisfactory figures of quantities used annually for even the most common uses have never been compiled. It has been found possible, however, to show salt production by methods of manufacture, as in the following table.

Salt sold or used by producers in the United States, 1930 and 1931, by methods of manufacture

Method of manufacture	1930		1931	
	Short tons	Value	Short tons	Value
Evaporated in open pans or grainers	707, 330	$6, 355, 341	589, 130	$4, 540, 095
Evaporated in vacuum pans [1]	1, 163, 630	7, 875, 537	1, 158, 190	7, 504, 399
Solar evaporated	353, 080	1, 234, 621	326, 500	1, 148, 970
Pressed blocks from evaporated salt	134, 570	1, 079, 372	129, 870	983, 652
Rock	1, 935, 220	6, 157, 422	1, 819, 700	5, 542, 281
Pressed blocks from rock salt	42, 150	234, 353	34, 470	192, 926
Salt in brine (sold or used as such)	3, 718, 460	2, 072, 834	3, 300, 210	1, 628, 689
	8, 054, 440	25, 009, 480	7, 358, 070	21, 541, 012

[1] Including salt manufactured by the spray system of cooling in 1931.

New York, Louisiana, Kansas, and Michigan together produced about 95 per cent of the rock salt mined in 1931, compared with 98 per cent in 1930. Texas showed production of rock salt in 1931 for the first time. Other States producing rock salt were California, Utah, and Nevada.

Rock salt sold by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	1, 947, 124	$7, 489, 644	1927	2, 143, 860	$6, 376, 355
1923	2, 103, 602	7, 843, 419	1928	2, 217, 780	6, 923, 827
1924	2, 064, 707	7, 501, 419	1929	2, 113, 010	7, 127, 681
1925	2, 342, 640	7, 444, 799	1930	1, 977, 370	6, 391, 775
1926	2, 135, 720	7, 234, 757	1931	1, 854, 170	5, 735, 207

Evaporated salt sold or used by producers in the United States, 1930 and 1931, by States

State	1930		1931	
	Short tons	Value	Short tons	Value
California	329, 430	$1, 990, 397	310, 360	$1, 912, 090
Kansas	286, 960	2, 016, 541	270, 630	1, 977, 097
Michigan	944, 200	6, 544, 793	787, 040	4, 408, 451
New York	330, 500	3, 225, 003	350, 440	3, 126, 179
Ohio	301, 400	2, 005, 163	319, 450	2, 016, 032
West Virginia	28, 670	184, 327	35, 480	218, 762
Undistributed [1]	137, 450	578, 647	130, 290	518, 505
	2, 358, 610	16, 544, 871	2, 203, 690	14, 177, 116

[1] 1930, Louisiana, Nevada, New Mexico, Oklahoma, Puerto Rico, Texas, and Utah; 1931, Nevada, New Mexico, Oklahoma, Puerto Rico, Texas, and Utah.

The production of pressed blocks from both evaporated salt and rock salt, as reported by the original producers of the salt and shown in the following table, does not represent the entire pressed-block industry, as some firms that do not produce salt make pressed blocks from salt bought in the open market. Pressed blocks from evaporated salt are made chiefly by salt producers in Kansas and Michigan but are also produced in Texas, Utah, Ohio, California, and Oklahoma. Pressed blocks from rock salt are made chiefly by salt producers in Kansas and Louisiana, and small amounts are made in Texas and Utah.

Pressed-salt blocks sold by original producers of the salt in the United States, 1922–1931

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1922	134, 089	$1, 309, 255	38, 593	$245, 174	172, 682	$1, 554, 429
1923	128, 073	1, 263, 246	38, 043	281, 302	166, 116	1, 544, 548
1924	135, 720	1, 059, 484	36, 624	263, 260	172, 344	1, 322, 744
1925	135, 480	1, 069, 685	35, 730	206, 818	171, 210	1, 276, 503
1926	125, 670	1, 038, 292	28, 870	196, 414	154, 540	1, 234, 706
1927	150, 140	1, 251, 022	34, 420	230, 048	184, 560	1, 481, 070
1928	145, 720	1, 205, 794	34, 930	293, 626	180, 650	1, 499, 420
1929	172, 120	1, 392, 427	40, 920	331, 397	213, 040	1, 723, 824
1930	134, 570	1, 079, 372	42, 150	234, 353	176, 720	1, 313, 725
1931	129, 870	983, 652	34, 470	192, 926	164, 340	1, 176, 578

IMPORTS AND EXPORTS [2]

Imports of salt for consumption in the United States in 1931—33,216 short tons, valued at $84,511—decreased 39 per cent in quantity and 41 per cent in value as compared with 1930. This is the smallest importation of salt recorded.

Exports of salt amounted to 98,710 short tons, valued at $775,490, an increase of 40 per cent in quantity and 8 per cent in value over 1930.

Salt imported for consumption in the United States, 1922–1931

Year	Used for curing fish		In bags, barrels, and other packages		In bulk		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1922	2,252	$5,549	22,140	$211,169	89,530	$305,620	113,922	$522,338
1923	16,472	46,260	19,713	194,710	52,565	142,288	88,750	383,258
1924	27,096	61,581	13,330	148,060	48,512	114,451	88,938	324,092
1925	17,976	51,332	8,997	137,580	58,815	127,915	85,788	316,827
1926	24,310	50,915	4,698	87,441	26,956	63,887	55,964	202,243
1927	25,048	55,054	3,725	70,182	16,195	42,439	44,968	167,675
1928	14,710	34,777	3,605	52,877	24,541	61,905	42,856	149,559
1929	8,812	23,258	4,385	48,353	23,253	60,105	36,450	131,716
1930	25,176	49,212	5,811	45,682	23,034	49,059	54,021	143,953
1931	16,354	27,042	1,465	21,343	15,397	36,126	33,216	84,511

Salt imported into the United States, 1928–1931, by countries

[General imports]

Country	1928		1929		1930		1931	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America:								
Canada	1,332,557	$5,470	2,051,172	$7,697	4,694,546	$13,524	5,403,269	$8,883
Mexico	4,743,659	12,940	990,000	1,485	----------	--------	57,663	194
West Indies—								
British—								
Jamaica	23,137,510	25,914	23,550,823	28,806	33,590,912	38,555	21,410,090	21,260
Other British	15,911,627	18,107	16,971,389	22,837	5,114,460	6,460	3,831,810	4,051
French	125,200	377	----------	--------	----------	--------	----------	--------
Netherland	1,497,655	2,362	2,444,416	4,186	4,200,478	6,546	7,171,842	9,027
Europe:								
France	----------	--------	79	20	88	35	----------	--------
Germany	2,909,598	11,403	4,110,616	12,457	2,570,185	9,922	2,935,842	10,711
Greece	11,108	121	----------	--------	----------	--------	----------	--------
Netherlands	828	75	----------	--------	56,000	338	----------	--------
Spain	28,560,000	28,578	34,955,200	36,606	54,185,600	43,798	24,040,000	15,477
United Kingdom	5,819,163	44,344	6,438,636	37,570	4,117,704	26,366	2,176,200	13,656
Africa:								
Algeria and Tunisia	----------	--------	----------	--------	----------	--------	1,104	23
Portuguese	----------	--------	163,000	99	----------	--------	----------	--------
	84,048,905	149,691	91,675,331	151,763	108,529,973	145,544	67,027,820	83,282

Salt exported from the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	134,989	$1,429,172	1927	153,832	$1,329,980
1923	125,529	1,211,226	1928	145,396	1,185,682
1924	144,945	1,288,376	1929	109,222	1,008,842
1925	155,079	1,219,935	1930	70,478	715,575
1926	158,908	1,277,790	1931	98,710	775,490

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Salt exported from the United States, 1928–1931, by countries

Country	1928		1929		1930		1931	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America:								
Bermudas	100,460	$1,935	104,832	$1,285	183,366	$2,214	147,328	$1,751
British Honduras	865,495	4,965	717,898	5,224	812,883	5,859	535,100	3,672
Canada	223,256,071	736,007	172,298,827	570,921	100,194,835	348,758	122,696,712	404,490
Central American States—								
Costa Rica	161,749	1,912	323,709	3,187	81,998	1,368	84,355	1,727
Guatemala	603,386	5,135	1,147,823	8,482	323,652	2,723	267,692	2,290
Honduras	3,706,772	24,516	2,046,741	17,632	2,639,429	21,351	2,235,288	16,882
Nicaragua	998,931	10,298	749,505	11,672	710,926	8,299	751,434	8,842
Panama	1,631,501	12,862	1,577,504	15,340	1,779,321	15,635	1,352,007	12,137
Salvador	548	19	886	29	2,284	120	3,043	82
Mexico	11,785,593	110,712	9,066,490	99,606	9,611,239	94,460	6,014,537	48,688
Miquelon, Langley, etc.	2,558	75	2,976	108	-----	-----	1,880	69
Newfoundland and Labrador	48,925	511	639,010	3,253	494,490	2,462	356,472	2,895
West Indies—								
British—								
Jamaica	172	12	2,400	72	6,107	191	1,195	14
Trinidad and Tobago	-----	-----	1,400	19	4,480	57	-----	-----
Other British	8,534	366	14,068	558	13,549	398	20,221	319
Cuba	40,217,746	168,484	20,703,211	138,955	16,648,042	104,524	39,414,601	180,280
Dominican Republic	27,886	818	69,705	1,649	61,183	1,289	55,850	1,174
French	600,000	900	-----	-----	643,860	1,863	-----	-----
Haiti	12,235	398	7,328	250	10,730	384	5,897	208
Netherland	15,815	241	129,304	1,724	115,589	829	97,158	700
Virgin Islands of the United States	812,000	742	629,732	2,557	1,000	34	565	15
South America:								
Argentina	133,761	1,785	5,428	216	4,303	101	24,139	760
Bolivia	-----	-----	-----	-----	720	28	-----	-----
Brazil	-----	-----	17,444	1,152	5,501	332	4,820	260
Chile	4,700	163	4,800	186	13,858	876	8,738	678
Colombia	68,596	1,225	62,850	1,304	267,484	2,526	85,462	916
Ecuador	2,393	79	1,164	109	804	58	628	29
Guiana—								
British	-----	-----	-----	-----	200	3	-----	-----
Surinam	-----	-----	192	4	2,000	14	-----	-----
Paraguay	2,400	90	600	15	84	4	2,940	102
Peru	-----	-----	550	55	340	4	610	57
Venezuela	30,000	176	52,610	446	5,045	72	-----	-----
Europe:								
Azores and Madeira Islands	-----	-----	-----	-----	-----	-----	10,300	6
Denmark	3,185	166	600	40	7,215	277	975	38
Finland	-----	-----	-----	-----	3,900	135	-----	-----
France	10,060	81	14,136	221	16,940	322	-----	-----
Germany	92,215	800	-----	-----	-----	-----	399	20
Greece	-----	-----	-----	-----	-----	-----	80	2
Iceland and Faroe Islands	-----	-----	12,544	892	-----	-----	-----	-----
Irish Free State	-----	-----	1,000	38	878	31	-----	-----
Italy	-----	-----	124	3	-----	-----	-----	-----
Netherlands	10,342	39	7,609	82	5,298	40	11,653	60
Norway	-----	-----	-----	-----	1,339	61	2,488	97
Portugal	-----	-----	1,000	26	-----	-----	-----	-----
Spain	-----	-----	-----	-----	4,601	232	-----	-----
Sweden	-----	-----	-----	-----	79,985	2,984	28,752	1,046
United Kingdom	467,542	3,271	130,984	1,002	55,116	806	182,771	1,495
Asia:								
Ceylon	2,024	185	3,202	237	1,140	124	1,740	198
China	151,991	7,852	228,980	3,245	26,483	1,474	59,049	2,913
East Indies—								
British—								
India	6,045	780	5,398	450	4,732	377	1,645	174
Malaya	3,208	199	2,051	152	988	100	552	43
Netherland—								
Java and Madura	16,684	699	22,972	1,066	25,684	1,154	20,676	802
Other Netherland	2,492	79	6,168	364	6,016	280	656	37
Hong Kong	61,306	2,423	46,200	2,625	47,184	1,956	58,349	2,421
Indo-China, French	3,944	197	5,512	308	4,936	240	396	42
Iraq	208	10	-----	-----	-----	-----	-----	-----
Japan	398,046	3,860	827,643	6,981	502,432	3,994	19,864,850	33,993
Kwantung	5,400	407	7,606	326	12,370	487	26,640	961
Persia	-----	-----	864	41	-----	-----	-----	-----

Salt exported from the United States, 1928–1931, by countries—Continued

Country	1928		1929		1930		1931	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Asia—Continued.								
Philippine Islands	313, 293	$9, 742	388, 567	$8, 650	365, 433	$8, 956	388, 784	$7, 706
Siam	4, 382	400	3, 160	246	3, 424	271	3, 056	224
Soviet Russia	170, 000	1, 242	150, 300	1, 207				
Syria			16, 000	525	10, 920	358	22, 472	784
Africa:								
British—								
East			120	4				
Nigeria					120	14		
South (Union of)			480	20	5, 367	204	1, 170	45
Liberia	2, 259	38						
Morocco	3, 280	44						
Portuguese—								
Mozambique							60	5
Other Portuguese							150	11
Oceania:								
British—								
Australia	3, 135, 376	56, 281	5, 651, 398	84, 039	3, 386, 980	50, 515	1, 587, 155	20, 825
New Zealand	403, 462	6, 947	203, 507	5, 554	1, 415, 217	19, 135	618, 845	7, 957
Other British	32, 665	637	84, 808	1, 389	42, 572	588	14, 848	294
French	394, 862	4, 877	238, 247	3, 099	279, 729	3, 624	342, 484	4, 254
	290, 792, 498	1, 185, 682	218, 443, 167	1, 008, 849	140, 956, 301	715, 575	197, 419, 667	775, 490

SHIPMENTS

For several years requests have been made of the Bureau of Mines for a statement showing the shipments of salt into the various States. For 1931, for the first time, an attempt was made to obtain such information from producers. A few of the operators did not find it possible to furnish this information, as their records did not show shipments by States. However, data were obtained for 94 per cent of the total quantity of rock salt and for 80 per cent of the evaporated salt shipped, with the results indicated in the following table. No account was taken in this survey of reshipment beyond the original point of destination indicated at the time the salt left the producing plant.

Distribution (shipments) of evaporated and rock salt in the United States in 1931, by States, in short tons

Destination	Evaporated	Rock	Destination	Evaporated	Rock
Alabama	7, 995	28, 725	Nevada	2, 689	585
Arizona	6, 428	3, 018	New Hampshire	1, 689	15, 400
Arkansas	8, 295	19, 950	New Jersey	26, 265	74, 514
California	198, 447	15, 121	New Mexico	5, 424	3, 995
Colorado	25, 348	11, 059	New York	130, 778	258, 766
Connecticut	6, 517	6, 205	North Carolina	20, 811	41, 075
Delaware	2, 325	61, 938	North Dakota	8, 109	1, 239
District of Columbia	2, 993	2, 657	Ohio	85, 024	51, 892
Florida	3, 969	22, 371	Oklahoma	20, 099	16, 688
Georgia	10, 074	34, 659	Oregon	24, 326	270
Idaho	12, 783	733	Pennsylvania	64, 019	91, 163
Illinois	191, 540	151, 676	Rhode Island	4, 685	6, 568
Indiana	52, 859	53, 136	South Carolina	7, 415	10, 062
Iowa	56, 752	59, 383	South Dakota	12, 501	9, 730
Kansas	37, 115	92, 817	Tennessee	23, 524	30, 828
Kentucky	24, 545	16, 195	Texas	46, 980	115, 932
Louisiana	2, 182	36, 397	Utah	12, 050	1, 298
Maine	4, 033	14, 558	Vermont	2, 773	1, 203
Maryland	13, 396	18, 782	Virginia	27, 637	13, 948
Massachusetts	35, 334	31, 097	Washington	50, 525	438
Michigan	140, 140	31, 762	West Virginia	39, 527	19, 705
Minnesota	66, 890	54, 423	Wisconsin	74, 923	33, 451
Mississippi	2, 914	28, 597	Wyoming	6, 472	2, 525
Missouri	54, 360	53, 995	Other [1]	49, 211	43, 518
Montana	13, 985	1, 014			
Nebraska	34, 072	44, 608	Total shipments reported	1, 762, 747	1, 739, 669
			Total sales	2, 203, 690	1, 854, 170

[1] Includes shipments to Alaska and to Canada, Japan, Central America, Cuba, Hawaii, Australia, and other countries outside the United States.

WORLD PRODUCTION

World production of salt, 1926–1930, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1926	1927	1928	1929	1930
North America:					
Canada	235,938	245,756	273,525	299,518	242,787
Cuba	(2)	411	2,359	14,515	24,947
Guatemala	4,805	46	(2)	(2)	7,915
Mexico [3]	67,000	67,000	67,000	67,000	67,000
Panama	1,280	1,149	835	(2)	366
United States—					
Rock salt	1,937,482	1,944,867	2,011,926	1,916,880	1,793,831
Other salt	4,749,886	4,921,297	5,313,281	5,833,666	5,512,996
West Indies—					
British—					
Bahamas [4]	7,476	1,923	725	813	3,048
Grenada (Windward Islands) [4]	56	(2)	37	70	(2)
Leeward Islands [4]	614	1,214	1,586	1,310	1,541
Turks and Caicos Islands [4]	54,824	28,371	50,846	62,135	42,208
Netherland [4]	10,159	8,218	9,778	4,677	4,820
South America:					
Argentina [5]	96,655	153,213	167,617	197,799	144,593
Chile	34,903	71,549	34,746	37,422	39,623
Colombia [3]	29,000	29,000	29,000	29,000	29,000
Ecuador—					
Rock salt	8,587	628	333	69	126
Other salt		16,100	10,051	17,377	24,433
Peru	30,114	29,997	32,669	30,000	30,000
Venezuela	23,865	20,803	26,228	25,443	20,722
Europe:					
Albania	5,596	6,600	5,283	(2)	(2)
Austria—					
Rock salt	3,227	2,675	1,607	3,041	1,063
Other salt	141,914	145,405	152,212	175,442	156,559
Bulgaria—					
Rock salt	1,284	3,982	4,108	3,653	1,704
Other salt	14,000	30,980	42,709	25,194	(2)
Czechoslovakia	98,105	122,202	154,243	166,361	177,693
France—					
Rock salt and salt from springs	1,643,360	1,518,000	1,707,506	1,746,076	1,702,031
Other salt	467,610	432,500	407,768	443,685	(2)
Germany—					
Rock salt	1,965,847	2,268,807	2,399,669	2,541,489	2,455,605
Other salt	479,547	533,984	509,663	501,024	501,258
Greece	89,726	104,378	[3] 100,000	[3] 100,000	[3] 100,000
Italy—					
Rock salt	67,610	66,850	67,187	63,039	73,093
Other salt	698,642	984,124	836,201	847,410	776,663
Malta	(2)	(2)	587	482	587
Netherlands—Rock salt	34,505	40,596	41,858	[6] 45,247	[6] 50,067
Poland	457,503	498,435	548,377	569,488	534,260
Portugal [4]	49,404	49,552	46,777	15,317	27,236
Rumania—					
Rock salt	344,062	328,028	340,212	318,802	306,932
Other salt	-----------	3	2,567	2,698	2,155
Russia [7]	1,685,717	2,216,136	2,548,106	(2)	(2)
Spain—					
Rock salt	118,581	110,839	146,147	164,837	164,532
Other salt	978,688	868,381	836,912	914,639	872,966
Switzerland	77,267	78,262	79,982	86,476	80,830
United Kingdom—					
Great Britain—					
Rock salt	35,152	22,809	24,254	28,786	21,377
Other salt	1,708,864	1,985,250	1,938,575	1,962,024	2,066,386
Ireland, Northern—					
Rock salt	6,191	7,262	7,598	7,954	4,048
Other salt	4,960	(2)	7,130	7,093	8,938
Yugoslavia	52,260	54,765	52,128	44,564	54,636
Asia:					
Ceylon	16,218	26,080	44,275	25,482	9,686
China (including Kwantung)	[3] 3,600,000	[8] 2,067,269	[3] 2,000,000	[3] 2,000,000	[3] 2,000,000
Chosen	(2)	(2)	134,516	138,000	(2)
Cyprus [3]	3,000	3,000	3,000	3,000	3,000
India—					
British (including Aden)—					
Rock salt	149,025	173,489	157,846	181,164	178,283
Other salt	1,516,026	1,464,328	1,381,824	1,555,367	1,560,532
Portuguese [3]	12,000	12,000	12,000	12,000	12,000
Indo-China [4]	20,456	27,701	35,816	25,636	42,471
Iraq [9]	5,015	5,791	6,251	7,803	8,919

See footnotes at end of table.

World production of salt, 1926-1930, in metric tons—Continued

Country	1926	1927	1928	1929	1930
Asia—Continued.					
Japan—					
Japan proper [10]	614,134	619,138	637,888	644,151	628,682
Taiwan	135,232	113,400	134,515	164,357	163,217
Netherland East Indies	407,607	264,197	253,162	486,907	313,579
Palestine—					
Rock salt			1,654	2,508	1,395
Other salt	6,279	7,014	(2)	5,233	6,102
Philippine Islands	24,075	66,669	71,475	46,876	40,572
Russia [7]	166,886	209,830	257,635	(2)	(2)
Siam	125,670	115,356	119,332	[11] 177,070	[11] 181,003
Syria [3]	10,000	10,000	10,000	10,000	10,000
Turkey [3]	100,000	100,000	100,000	100,000	100,000
Africa:					
Algeria	43,216	36,936	10,975	15,305	58,443
Belgian Congo [3]	80	80	80	80	80
Egypt [4]	180,241	222,535	167,874	149,023	154,852
Eritrea	65,000	68,000	75,700	115,000	123,083
Ethiopia—Rock salt	(2)	25,000	20,000	10,000	10,000
Libia (Italian Africa)—					
Cyrenaica			[3] 10,000	[3] 10,000	[3] 10,000
Tripolitania [3]	20,000	20,000	20,000	20,000	20,000
Mauritania	4,500	4,300	4,000	[3] 4,000	[3] 4,000
Mauritius [3]	1,500	1,500	1,500	1,500	1,500
Morocco, French	1,200	3,600	8,000	8,000	(2)
Nigeria [3]	400	400	400	400	400
Portuguese West Africa (Angola) [3]	9,000	9,000	9,000	9,000	9,000
Somaliland—					
British [3]	15,000	15,000	15,000	15,000	15,000
French	[3] 15,000	18,444	39,000	38,972	25,369
Italian			1,656	4,347	77,970
South-West Africa—Rock salt	363	343	146	334	511
Sudan, Anglo-Egyptian	9,342	9,872	12,481	14,951	14,308
Tanganyika Territory	3,155	4,852	5,134	7,387	6,356
Tunisia	132,080	144,788	114,045	120,165	120,345
Uganda	1,743	2,049	2,067	2,280	1,779
Union of South Africa [12]	80,517	80,416	83,735	88,857	89,338
Oceania:					
Australia—					
North Australia					120
South Australia	92,563	80,559	72,574	77,684	59,709
Victoria	[3] 40,000	36,503	52,181	(2)	(2)
Western Australia [3]	8,000	8,000	8,000	8,000	8,000

[1] In addition to the countries listed salt is produced in Arabia, Bolivia, Brazil, Gold Coast, Kenya Colony, Madagascar, and Southern Rhodesia, but figures of production are not available.
[2] Data not available.
[3] Estimated annual production.
[4] Exports.
[5] Railway shipments.
[6] Sales.
[7] Year ended Sept. 30.
[8] Figures of production as published by the Geological Survey of China, Peiping.
[9] Salt issued by the Government for sale.
[10] Year ended Mar. 31 of year following that stated. The figures do not include output from salt beds which, though situated on Government beach lands, have no fixed areas.
[11] Year ended Mar. 31 of year following that stated.
[12] Year ended June 30.

LOCALITIES PRODUCING SALT IN THE UNITED STATES IN 1931

The salt deposits in the United States that furnish salt for commercial purposes are, with the exception of small deposits used for local supply, confined to definite regions in the northeastern, south central, and western parts of the country. Michigan, New York, and Ohio, included in the first group, furnished 71 per cent of the total salt sold or used by producers in 1931 compared with 73 per cent in 1930. Kansas and Louisiana, in the central belt of States, are the next largest producers, and California is chief among the Western States.

The salt is marketed as evaporated salt and as rock salt. Salt brine is drawn from wells by several chemical manufacturers, and the salt content is used by them in their manufacturing processes. Bittern water, or the residue from some of the salt works, is sold to chemical manufacturers for further treatment and for the recovery of bromine and calcium chloride.

The companies reporting in 1931, the location of their plants, and the nature of the salt sold or used by them, as reported to the Bureau of Mines, are given by States on the following pages to supply information often requested regarding the operation of salt properties.

CALIFORNIA

In California salt is obtained from sea water, from salt springs, lakes, etc., and rock salt. The greater part of the production is from the solar evaporation of sea water, especially along the shores of San Francisco Bay in Alameda and San Mateo Counties. Reports were received in 1931 from the following:

Alameda County:
- Alvarado and Mount Eden (Oliver plant)—Leslie-California Salt Co. (address, 149 California Street, San Francisco); evaporated salt (open pans or grainers, solar, vacuum pans), pressed blocks from evaporated salt.
- Newark—Arden Salt Co. (address, Standard Oil Building, San Francisco); solar evaporation.
- ——— Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (solar, vacuum pans), pressed blocks from evaporated salt. Salt for refining produced by Arden Salt Co.

Inyo County: Keeler (Saline Valley)—Sierra Salt Corporation (address, 512 South Alameda Street, Los Angeles); solar evaporation. Plant idle in 1931; sales from stock.

Kern County: Saltdale (Ceneda)—Consolidated Salt Co. of California (address, Long Beach). On a playa known as Cane Lake; solar evaporation.

Los Angeles County: Long Beach (Anaheim Road)—Long Beach Salt Co.; solar evaporation.

Modoc County: Cedarville—Surprise Valley Salt Works; solar evaporation.

Monterey County: Moss Landing—Monterey Bay Salt Co.; solar evaporation.

San Bernardino County:
- Amboy (Saltus)—California Rock Salt Co. (address, 2465 Hunter Street Los Angeles); rock salt, also calcium chloride from Amboy playa.
- ——— Saline Products (Inc.) (address, 2000 Santa Fe Avenue, Los Angeles); rock salt, also calcium chloride.

San Diego County: San Diego (south end of San Diego Bay)—Western Salt Co.; solar evaporation.

San Mateo County:
- Leslie—Leslie-California Salt Co. (address, 149 California Street, San Francisco); evaporated salt (solar, vacuum pans), pressed blocks from evaporated salt.
- Redwood City—Stauffer Chemical Co. (address, 636 California Street, San Francisco); solar evaporation.

A considerable quantity of bitterns or waste water from the salt plants is used by chemical plants in the manufacture of magnesium chloride, other magnesium salts, and insulating material. Iodine is extracted from brine obtained from oil wells.

KANSAS

In 1931 Kansas again ranked fourth among the salt-producing States. The salt sold in the State is rock salt and evaporated salt made from brines obtained from solution of rock salt. The companies reporting in 1931 were as follows:

Ellsworth County:
- Kanopolis—Crystal Salt Co. (address, Equitable Building, Denver, Colo.); rock salt.
- ——— Independent Salt Co. (address, 33 South Clark Street, Chicago, Ill.); rock salt.

Harper County: Anthony—Western Ice & Utilities Co. (Anthony Salt Co.); evaporated salt (open pans or grainers), pressed blocks from evaporated salt.

Reno County:
- Hutchinson—The Barton Salt Co.; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
- ——— The Carey Salt Co. (east plant); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
- ——— ——— (rock salt mine); rock salt, pressed blocks from rock salt.
- ——— Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Rice County:
- Lyons—American Salt Corporation (address, La Salle Building, Kansas City, Mo.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.
- ——— Diamond Crystal Salt Co. (address, 250 Park Avenue, New York, N. Y.); evaporated salt (vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt.

LOUISIANA

Louisiana in 1931 again ranked fifth in quantity of salt produced. Only rock salt was produced in 1931. The firms reporting in 1931 were:

Iberia Parish:
- Avery Island—Avery Rock Salt Mining Co. (address, Scranton, Pa.); rock salt.
- Jefferson Island—Jefferson Island Salt Mining Co. (Inc.) (address, Columbia Building, Louisville, Ky.); rock salt, pressed blocks from rock salt.
- Weeks Island—Myles Salt Co. (Ltd.) (address, 1007 Camp Street, New Orleans); rock salt, pressed blocks from rock salt.

Winn Parish: Winnfield—The Carey Salt Co. (address, Hutchinson, Kans.). Plant under construction; no commercial output.

MICHIGAN

Michigan in 1931 again ranked first among the salt-producing States. The output is obtained from both rock salt and natural brine. In 1931 reports were received from the following companies:

Manistee County: Manistee—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.) (successor to Ruggles & Rademaker Co.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt, also bromine.

——— Manistee Salt Works; plant under construction.

Mason County: Ludington—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Midland County: Midland—The Dow Chemical Co.; evaporated salt (vacuum pans), also bromine, magnesium chloride, and calcium chloride.

Saginaw County:
- Carrollton—Mershon, Eddy, Parker Co. (address, Saginaw); evaporated salt (open pans or grainers).
- ——— Saginaw Salt Products Co. (address, Saginaw); evaporated salt (open pans or grainers).
- Saginaw—Strable Lumber & Salt Co.; evaporated salt (open pans or grainers).

St. Clair County:
Port Huron—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
St. Clair—Diamond Crystal Salt Co. (address, 250 Park Avenue, New York, N. Y.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

Wayne County:
Delray—The Solvay Process Co. (address, Syracuse, N. Y.); brine for the manufacture of chemicals.
Detroit—Detroit Rock Salt Co. (address, Scranton, Pa.); rock salt.
Ecorse—Worcester Salt Co. (address, 71 Murray Street, New York, N. Y.) evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt. Plant dismantled after May, 1931.
Wyandotte—Michigan Alkali Co.; brine for the manufacture of chemicals.
——— Pennsylvania Salt Manufacturing Co. (address, Widener Building, Philadelphia, Pa.); evaporated salt (open pans or grainers), brine for the manufacture of chemicals.

NEVADA

In 1931 the Virgin River Salt Co. produced small quantities of rock salt at St. Thomas, Clark County, and the Nevada Pure Salt Co. produced solar salt at Fallon, Churchill County.

NEW MEXICO

Production of salt in 1931 was reported in Catron County, by Frank A. Hubbell Co., Albuquerque.

NEW YORK

New York in 1931 again ranked second among the salt-producing States. Both evaporated and rock salt are supplied by producers, but the entire product is from rock salt. Brine for evaporated salt is obtained by dissolving the rock salt with water that is allowed to flow into the beds and is pumped out when saturated.. The producing companies in 1931 were as follows:

Livingston County:
Cuylerville (Halite) and Retsof—Retsof Mining Co. (address, Scranton, Pa.); rock salt. Cuylerville plant idle in 1931.
Piffard—Worcester Salt Co. (address, 71 Murray Street, New York); evaporated salt (open pans or grainers, vacuum pans).

Onondaga County: Solvay and Tully—The Solvay Process Co. (address, Syracuse); evaporated salt (vacuum pans), brine for the manufacture of chemicals and refined salt as a by-product.

Schuyler County:
Watkins Glen—International Salt Co. (address, Scranton, Pa.); evaporated salt (open pans or grainers, vacuum pans).
——— The Watkins Salt Co.; evaporated salt (open pans or grainers, vacuum pans).

Tompkins County:
Ludlowville—International Salt Co. (address, Scranton, Pa.); evaporated salt (open pans or grainers, vacuum pans).
Myers—Cayuga Rock Salt Co. (Inc.); rock salt.

Wyoming County: Silver Springs—Worcester Salt Co. (address, 71 Murray Street, New York); evaporated salt (open pans or grainers, vacuum pans).

OHIO

Ohio in 1931 again ranked third in production of salt. The larger part of the output is used in the form of brine for the manufacture of chemicals.

Cuyahoga County: Cleveland—The Union Salt Co.; evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Lake County: Painesville—Diamond Alkali Co. (address, 436 Seventh Avenue, Pittsburgh, Pa.); evaporated salt (vacuum pans), brine for the manufacture of chemicals.
Meigs County:
  Minersville—Pomeroy Salt Corporation (address, Pomeroy); evaporated salt (open pans or grainers), also bromine and calcium chloride.
  Pomeroy—The Excelsior Salt Works (Inc.); evaporated salt (open pans or grainers), also bromine and calcium chloride.
Summit County:
  Barberton—Pittsburgh Plate Glass Co. (Columbia chemical plant); brine for the manufacture of chemicals.
  Kenmore—The Colonial Salt Co. (address, Akron); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.
Wayne County: Rittman—The Ohio Salt Co. (address, Wadsworth); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt.

OKLAHOMA

In 1931 the greater part of the salt output in Oklahoma was from salt water obtained from brine wells. Such water, after undergoing treatment for concentration and for removal of corrosive magnesium compounds, is used to cool vapors in oil refining, and while hot is passed through a spray into the air where, upon cooling, the salt crystallizes and may be collected. Salt was obtained in this manner in Oklahoma from 1926 to 1928, inclusive. The present operations, which started in 1931, are carried on at West Tulsa, Tulsa County, by the Texaco Salt Products Co. Calcium chloride is also obtained during the process, and it is stated that bromine, iodine, and potassium and magnesium salts may be also recovered. Other salt is taken from playas and lagoons in the State and used locally as cattle salt. In 1931 Y. L. Stockman reported sales of such salt from near Vinson, Harmon County.

PUERTO RICO

In 1931 three plants reported production, as follows:

Cabo Rojo—F. Carrera & Hno. (address, Mayaguez); solar evaporation.
Guanica—José Couto Miniño (address, Ensenada); solar evaporation.
Lajas—Miguel Antonio Ramirez Dominguez (address, San German); solar evaporation.

TEXAS

Salt was produced in Texas in 1931 as follows:

Anderson County: Palestine—Palestine Salt & Coal Co.; evaporated salt (open pans or grainers), pressed blocks from evaporated salt.
Harris County: Hockley—Houston Salt Co. (address, Houston); rock salt.
Van Zandt County: Grand Saline—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); evaporated salt (open pans or grainers, vacuum pans), pressed blocks from evaporated salt, rock salt, pressed blocks from rock salt. Rock salt mine opened in 1931.

Salt formed by the evaporation of the waters of playas and lagoons is also used locally by cattlemen but there is no record of the quantity so used.

UTAH

Production of salt in Utah in 1931 was reported by the following companies:

Salt Lake County: Saltair—Royal Crystal Salt Co. (address, 133 Regent Street, Salt Lake City); solar evaporation, pressed blocks from evaporated salt.
Sanpete County: Axtell—Royal Crystal Salt Co. (address 133 Regent Street, Salt Lake City); rock salt.
Sevier County:
Redmond—Great Western Salt Co.; rock salt, pressed blocks from rock salt.
——— Poulson Bros.; rock salt.
Tooele County: Burmester—Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.); solar evaporation, pressed blocks from evaporated salt.

VIRGINIA

Salt brine is produced in Virginia at Saltville, Smyth County, by the Mathieson Alkali Works (Inc.) for the manufacture of chemicals.

WEST VIRGINIA

The salt made in West Virginia is all obtained from natural brines. In 1931 the operators were as follows:

Kanawha County:
Malden—J. Q. Dickinson & Co.; evaporated salt (open pans or grainers), also bromine and calcium chloride.
South Charleston—Westvaco Chlorine Products (Inc.); brine used in the manufacture of chlorine; bromine manufactured from bittern of this plant by J. Q. Dickinson & Co., Malden.
Mason County:
Hartford—Liverpool Salt & Coal Co.; evaporated salt (open pans or grainers), also bromine; calcium chloride manufactured from bittern of this plant by American Calcium Chloride Works, Hartford.
Mason—Ohio River Salt Corporation; evaporated salt (open pans or grainers), also bromine and calcium chloride.

BROMINE

The figures for bromine production as given in this report comprise the quantity of bromine recovered by the producers from natural brines and the bromine content of bitterns used by producers in the manufacture of bromine compounds. The larger part of the bromine output as reported is not sold as bromine but as potassium and sodium bromide, as ethylene dibromide, and as other bromine compounds. In 1931 the bromine produced amounted to 8,935,330 pounds, valued at $1,854,650, an increase of 5.6 per cent in quantity but a decrease of 12 per cent in value from 1930. The production of bromine in the United States was augmented greatly in 1924 by the demand for ethylene dibromide for use in the manufacture of high-powered gasoline. In 1925 and 1926 demand for bromine fell off on account of temporary restrictions placed upon the manufacture of such gasoline, but since that time the output of bromine has increased steadily. The decrease in unit value has been due in part to improvements in methods of manufacture and to general business conditions. Imports of ethylene dibromide, all of which came from Germany, increased notably in 1930 but decreased 48 per cent in quantity in 1931.

The plants operated in 1931 were those of the California Chemical Corporation (address, 111 Sutter Street, San Francisco), Chula Vista, Calif.; Morton Salt Co. (address, 208 West Washington Street, Chicago, Ill.) (successor to Ruggles & Rademaker Co.), Manistee, Mich.; The Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corporation (address, Pomeroy, Ohio), Minersville, Ohio; The Excelsior Salt Works (Inc.), Pomeroy, Ohio; J. Q. Dickinson & Co., Malden, W. Va.; Liverpool Salt & Coal Co., Hartford, W. Va.; and Ohio River Salt Corporation, Mason, W. Va. So far as the Bureau of Mines is informed no bromine was produced directly from sea water in 1931.

Bromine and bromine in compounds sold or used by producers in the United States, 1922–1931

Year	Pounds	Value	Year	Pounds	Value
1922	1,005,174	$150,668	1927	1,756,310	$564,689
1923	842,352	146,176	1928	2,164,000	649,475
1924	2,033,804	594,685	1929	6,414,620	1,759,325
1925	1,566,120	488,406	1930	8,462,800	2,109,974
1926	1,245,760	426,837	1931	8,935,330	1,854,650

The figures for the value of bromine, as reported to the Bureau of Mines by the producers, represent the value of the bromine f. o. b. plant or shipping point. The average unit value for 1931 was 21 cents a pound, compared with 25 cents in 1930, 27 cents in 1929, 30 cents in 1928, and 32 cents in 1927. The wholesale price per pound of bulk bromine quoted in the New York market from 1926 to February, 1931, was, according to Chemical and Metallurgical Engineering, 45 to 47 cents a pound; the price quoted from March, 1931, to the end of the year was 36 to 38 cents a pound.

Bromine and bromine compounds imported for consumption in the United States, 1927–1931

Product	1927		1928		1929		1930		1931	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Bromine					17,573	$5,804	1,123	$347	25	$24
Ammonium bromide	(1)	(1)	(1)	(1)	(1)	(1)	[2] 7,717	[2] 2,209	220	63
Potassium bromide	20,813	$7,075	23,231	$7,918	28,310	9,834	64,399	16,439	58,411	18,983
Sodium bromide	1,102	370			110	51	20,774	4,991		
Ethylene dibromide	465,048 (with other bromine compounds)	144,167 (with other bromine compounds)	283,205	86,966	443,004	104,917	3,023,484	648,455	1,570,840	358,082
Other bromine compounds			27,730	2,857	643	572	21,594	13,378	43,636	23,053

[1] Not separately recorded prior to tariff of June 18, 1930.
[2] June 18 to December 31. Not separately recorded prior to change in tariff.

CALCIUM CHLORIDE

The calcium chloride reported in the following table is an original constituent of the natural brine produced in connection with the extraction of salt or salt and bromine from mineral raw materials only. A further large output of calcium chloride made by manufacturing processes used in chemical industries is not reported. The calcium chloride reported includes an output of mixed calcium and magnesium chlorides and other salts. The output of calcium chloride from natural brines, which increased steadily from 1921 to 1930, decreased 26 per cent in quantity and 24 per cent in value in 1931. Production in 1931 was reported as 86,156 short tons, valued at $1,687,166. The use of calcium chloride in chemical preparations for prevention of dust in treatment of highways and in coal and coke in storage, for refrigeration, and for fire-prevention purposes has been the chief factor in the increased demand for this product.

The calcium chloride reported for 1931 in the following table was produced by the California Rock Salt Co. (address, 2465 Hunter Street, Los Angeles), Saltus, Calif.; Saline Products (Inc.) (address, 2000 Santa Fe Avenue, Los Angeles), Amboy, Calif.; The Dow Chemical Co., Midland, Mich.; Pomeroy Salt Corporation (address, Pomeroy, Ohio), Minersville, Ohio; The Excelsior Salt Works (Inc.), Pomeroy, Ohio; Texaco Salt Products Co., West Tulsa, Okla.; J. Q. Dickinson & Co., Malden, W. Va.; American Calcium Chloride Works (using bittern from the Liverpool Salt & Coal Co.), Hartford, W. Va.; and Ohio River Salt Corporation, Mason, W. Va.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	33,067	$571,326	1927	95,721	$1,947,797
1923	44,961	663,384	1928	102,090	1,995,603
1924	58,791	1,164,848	1929	114,240	2,097,061
1925	67,870	1,386,639	1930	116,160	2,207,800
1926	82,340	1,710,405	1931	86,156	1,687,166

Imports of calcium chloride were not separately recorded by the Bureau of Foreign and Domestic Commerce prior to September 22, 1922. The following table shows the available figures for imports:

Calcium chloride imported for consumption in the United States, September 22, 1922, to December 31, 1931

Year	Short tons	Value	Year	Short tons	Value
1922 (Sept. 22 to Dec. 31)	740	$8,563	1927	6,514	$85,456
1923	3,232	48,527	1928	9,253	100,223
1924	3,996	54,542	1929	8,236	113,573
1925	2,253	37,121	1930	6,641	95,921
1926	7,372	96,742	1931	4,916	74,546

Exports of calcium chloride were not separately recorded until 1929, when 15,425 short tons, valued at $362,658, were exported. Exports in 1930 amounted to 21,350 tons, valued at $513,577, and in 1931 to 24,351 tons, valued at $566,573.

IODINE

Very little naturally occurring iodine has been produced in the United States. During the war a small quantity of iodine was produced from kelp at plants on the Pacific coast, but these are no longer in operation. During recent years extensive experimental work has been done on processes for the extraction of iodine from brines and oil-well waters. The iodine obtained has been sold commercially, but the character of the industry is at present largely experimental. The General Salt Co., Long Beach, Calif., and The Dow Chemical Co., Midland, Mich., are the companies most interested in domestic iodine production.

The present supply of iodine in the United States is imported chiefly from Chile, where it is obtained as a by-product of the nitrate plants. Practically all the iodine enters the United States in crude form, with occasional small shipments of resublimed material. The crude iodine enters free of duty. The resublimed product is subject to a duty of 10 cents a pound under the tariff act of 1930; prior to June, 1930, the duty was 20 cents a pound.

Iodine imported for consumption in the United States, 1922–1931

Year	Crude		Resublimed		Year	Crude		Resublimed	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
1922	352,557	$1,024,609			1927	926,492	$2,900,574		
1923	273,338	883,361	24	$45	1928	720,766	2,429,076	3	$15
1924	(1)	(1)	(1)	(1)	1929	627,162	2,249,266		
1925	246,474	889,860	1	6	1930	493,587	1,797,754		
1926	711,291	2,272,343			1931	278,713	998,079		

[1] Figures for 1924 not recorded by Bureau of Foreign and Domestic Commerce.

FUEL BRIQUETS[1]

By W. H. Young, F. G. Tryon, and J. M. Corse

CONTENTS

PRODUCTION

In 1931 the production of fuel briquets declined to the lowest level since 1924. According to reports courteously furnished the Bureau of Mines by the operators of briquetting plants, the total output in 1931 was 698,316 net tons, valued at $5,260,585, a decrease of 32.1 per cent in tonnage and 34.5 per cent in value from 1930. (See Table 1.) The sharp decline in both production and value of briquets in 1931, as compared with 1930, was due partly to the general business depression and partly to the intense competition in the domestic fuel market.

Table 1.—*Fuel briquets produced in the United States, 1930 and 1931*

	Production			Value		
	1930	1931	Decrease	1930	1931	Decrease
	Net tons	*Net tons*	*Per cent*			*Per cent*
Eastern States	300, 609	243, 402	19. 0	$1, 817, 791	$1, 405, 292	22. 7
Central States	641, 171	381, 443	40. 5	5, 214, 376	3, 094, 787	40. 6
Pacific Coast States	87, 085	73, 471	15. 6	996, 569	760, 506	23. 7
	1, 028, 865	698, 316	32. 1	8, 028, 736	5, 260, 585	34. 5

In 1931 the Pacific Coast States showed the smallest proportional decrease in production of briquets. Their output was 73,471 tons, or 15.6 per cent less than in 1930. The Eastern States reported a decrease of 19 per cent. Production in the Central States amounted to 381,443 tons, a decrease of 40.5 per cent from 1930.

In 1931 Wisconsin accounted for almost half the total output. Its four plants and the three plants active in Pennsylvania produced more than 60 per cent of the total tonnage of the country.

[1] Work on manuscript completed April, 1932.

Although the expansion of the industry for a number of years was particularly notable in the Central States, these States suffered the most severe decline in 1931. The abnormally warm weather in the Central States accounted partly for this decline. Figure 3 shows the trend of production during the last 17 years.

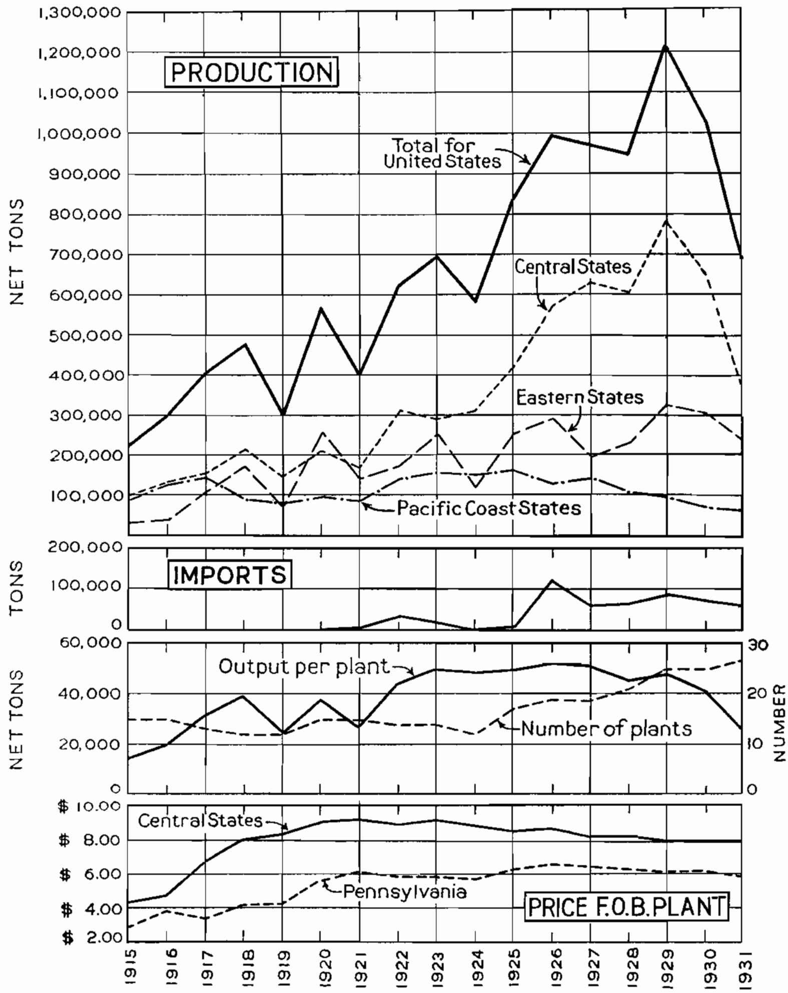

FIGURE 3.—Production and imports of fuel briquets, number of plants in operation, and average prices received f. o. b. plants, 1915-1931

The progress of the industry since 1907, the date of the first statistical survey covering fuel briquets, is recorded in Table 2.

TABLE 2.—*Statistical trends of the fuel briquet industry, 1907–1931*

Year or yearly average	Production of briquets: Eastern States (thousands of net tons)	Production of briquets: Central States (thousands of net tons)	Production of briquets: Pacific Coast States (thousands of net tons)	Production of briquets: Total (thousands of net tons)	Imports (thousands of net tons)	Consumption (thousands of net tons)	Value of product, thousands of dollars	Number of plants in operation	Average output per plant, tons	Average value per ton f. o. b. plant: Pennsylvania	Average value per ton f. o. b. plant: Central States
YEARLY AVERAGE											
1907–1909	(1)	(1)	(1)	99	(2)	99	345	12	8,691	(1)	(1)
1912–1915	76	90	53	219	(2)	219	1,037	17	13,179	$2.68	$4.62
1916–1920	129	172	107	408	(2)	408	2,763	13	30,640	4.17	7.48
1921–1925	188	299	140	627	12	639	5,418	14	43,672	6.04	9.07
1926–1930	268	648	115	1,031	84	1,115	8,354	22	47,646	6.42	8.36
YEAR											
1922	170	305	144	619	35	654	5,445	14	44,245	5.93	9.02
1923	252	290	155	697	20	717	5,899	14	49,772	5.95	9.35
1924	121	308	151	580	(3)	580	4,987	12	48,373	5.82	9.00
1925	254	422	163	839	7	846	7,128	17	49,375	6.35	8.72
1926	289	575	131	995	124	1,119	8,533	19	52,386	6.74	8.86
1927	197	629	144	970	61	1,031	7,985	19	51,077	6.52	8.30
1928	229	605	113	947	71	1,018	7,706	21	45,115	6.38	8.38
1929	325	788	99	1,212	89	1,301	9,515	25	48,497	6.22	8.13
1930	301	641	87	1,029	73	1,102	8,029	25	41,155	6.22	8.13
1931	243	382	73	698	61	759	5,261	27	25,864	5.90	8.11

1 Not available before 1912.
2 No record of imports is available before 1919, but the quantity imported prior to that time was negligible.
3 Less than 500 tons.

MONTHLY PRODUCTION

The production of 102,602 tons of briquets in January, 1931, was the outstanding feature of the year; this was the only month in which more than 100,000 tons were produced, in striking contrast with the production of 175,503 tons in January, 1930, the peak month for that year.

The seasonal character of househeating makes the production of briquets highly seasonal. Activity, therefore, is curtailed and at many plants discontinued during the early spring and summer. In 1931, July marked the lowest ebb of output; January, May, and the last four months of the year were the periods of greatest production. (See Table 3.)

TABLE 3.—*Monthly production of fuel briquets in the United States, 1929–1931, in net tons*

Month	1929	1930	1931	Month	1929	1930	1931
January	159,768	175,503	102,602	August	57,439	53,446	41,943
February	139,540	86,645	57,764	September	96,948	73,325	60,552
March	44,266	48,858	40,537	October	145,156	145,260	76,723
April	42,952	24,865	32,590	November	157,086	105,556	68,104
May	112,418	110,544	82,777	December	175,960	127,861	70,092
June	44,582	38,776	34,905				
July	36,300	38,226	29,727		1,212,415	1,028,865	698,316

PRODUCERS' STOCKS OF FINISHED BRIQUETS

For 1931, as for earlier years, the Bureau of Mines requested information regarding the quantity of finished briquets on hand in producers' yards. The replies show that on January 1, 1931, producers had on hand 15,843 tons, compared with 25,901 tons at the end of the year, indicating a net increase of 10,058 tons in stocks.

Producers' stocks of finished briquets increased in 1931 as compared with earlier years. (See Table 4.) Stocks for any previous date of record were never more than 1.9 per cent of the total output for the respective years; however, stocks on October 1, 1931, were 4.2 per cent of the total production in 1931. The slack demand for briquets doubtless explains partly the increase in stocks during 1931.

TABLE 4.—*Producers' stocks of finished briquets in 1931, in net tons*

Jan. 1, 1931	15, 843	Oct. 1, 1931	29, 438
July 1, 1931	26, 178	Jan. 1, 1932	25, 901

VALUE

The total value of the briquets manufactured during 1931 was $5,260,585, a decrease of $2,768,151 (34.5 per cent), compared with 1930. The average value per net ton, f. o. b. plant, was $7.53, compared with $7.80 in 1930 and $7.85 in 1929. The drop in the average value per ton is partly a reflection of lower price trends for almost all solid fuels and is due partly to the fact that the proportion of the total output from the relatively low-priced product of the Eastern States was higher in 1931 than in 1930.

The sales realizations obtained on briquets in the scattered producing centers in a given year show considerable variation. The figure on average value per ton for the entire industry therefore has doubtful significance because of the different conditions under which briquets are manufactured in certain sections of the country. Among the factors that influence the value per ton at any plant, the most important are probably the cost of raw materials and the prices of competing fuels. Hence, the trend of prices from year to year is indicated best by the average value in particular localities, as shown in the last two columns of Table 2.

For the Eastern States the average value per ton f. o. b. plant in 1931 was $5.77, compared with $6.05 in 1930. The average for Pennsylvania was $5.90, the lowest figure since 1924. In the eastern part of the country materials suitable for the manufacture of briquets are available at relatively low cost, and competition with other fuels is especially keen. The average value per ton for the Pacific Coast States was $10.35, a decrease of $1.09 from 1930. The average value of the product of the Central States was $8.11, the lowest average since 1917.

These figures do not indicate the prices paid by consumers. Some of the plants are far from the markets where their product is consumed, and to the value at the plant must be added the cost of transportation and the margin of the wholesaler or the retailer, sometimes both.

PRINCIPAL EXPENSES AND VALUE ADDED BY MANUFACTURE

By far the largest item of expense in the manufacture of briquets is the cost of raw materials. A special study covering 1927 indicated that the average cost of raw materials for 16 briquetting plants throughout the country, which produced 93 per cent of the total output, was $5.09 per ton, as compared with expenditures of 17 cents per ton for salaries, 47 cents for wages, and 26 cents for purchased electric power and fuel used for power. The average value of the product in 1927 was $7.86 per ton, and the difference of $1.87 between this figure and the total of principal expenses represented the value added by the processes of manufacture. Further details of this analysis are given on page 4 of the report of this series for 1928.

DISTRIBUTION

In its questionnaire for 1931 the Bureau of Mines requested, as for 1930, information on the tonnage of briquets shipped to each State. It should be noted that the commercial sales were slightly lower than the total output, as changes in producers' stocks were taken into account.

The tonnage produced in 1931 was distributed widely, briquets being shipped into no less than 38 States, the District of Columbia, Alaska, and Canada. This distribution indicates a notable broadening of markets compared with 1928. (See Fuel Briquets in 1928, fig. 1, p. 5.) Although a considerable proportion of the output at most briquetting operations entered markets outside the States of manufacture, four small plants, with a combined production of 1.5 per cent of the total sales, disposed of their output entirely within the States of origin.

Although the consumption of briquets in 1931, as in 1930, was concentrated in the Central, Eastern, and Pacific Coast States, all of the principal consuming States registered sharp declines in 1931 compared with 1930. (See Fuel Briquets in 1930, fig. 2, p. 6, for a map of consumption of fuel briquets by States.) Table 5 gives the tonnage consumed in each State in 1930 and 1931.

TABLE 5.—*Fuel briquets of domestic manufacture consumed in the United States and exported, 1930 and 1931, in net tons*

	1930	1931
Consumed in—		
Alaska		547
Arizona		194
Arkansas	[1] 100	
California	908	9,711
Colorado		400
Connecticut	559	343
Delaware	1,042	926
District of Columbia		46
Florida	[1] 200	204
Georgia	[1] 100	49
Idaho		33
Illinois	13,246	7,918
Indiana	5,422	3,502
Iowa	40,857	23,843
Kansas	20,074	10,033
Kentucky	[1] 200	
Louisiana	[1] 723	600
Maine	4,872	3,449
Maryland	8,750	6,391
Massachusetts	99,320	85,362
Michigan	21,032	11,650
Minnesota	291,775	200,583
Missouri	6,940	4,271
Nebraska	27,818	16,975
Consumed in—Continued.		
New Hampshire	4,604	4,446
New Jersey	24,797	4,814
New York	6,793	5,066
North Carolina	2,365	2,819
North Dakota	98,129	52,288
Ohio	19,639	7,727
Oklahoma	1,581	473
Oregon	48,282	34,801
Pennsylvania	14,075	11,120
Rhode Island	6,202	9,884
South Carolina	211	499
South Dakota	68,367	39,490
Texas	1,771	2,000
Vermont	125	111
Virginia	18,171	17,573
Washington	36,714	20,992
West Virginia	465	398
Wisconsin	120,171	77,907
Miscellaneous		1,735
Exported to—		
Canada	12,265	7,085
Cuba	[1] 200	
	1,028,865	688,258

[1] Partly estimated.

WEIGHT AND SHAPE OF BRIQUETS

In 1931 the Bureau of Mines for the second time asked the producers to give information on the weight, size, and shape of briquets. The results of the inquiry appear in Table 6. Little change was registered in the weight and shape of briquets in 1931, compared with 1930. By far the greater percentage of briquets produced was of the smaller sizes. Briquets weighing less than 3 ounces accounted for 75.7 per cent of the production in 1931—the same proportion of the total as in 1930. In 1931 only 15.9 per cent of the production of briquets weighed 3 and under 5 ounces, whereas 18.5 per cent was in this group in 1930. Thus, 91.6 per cent of the briquets in 1931 weighed less than 5 ounces. Three plants produced briquets weighing 5 to 16 ounces. One plant manufactured the large brick-shaped briquets in two different sizes, one weighing 4 and the other 8 pounds, the type so popular in Europe. However, all the briquets weighing more than 5 ounces accounted for only 8.4 per cent of the total production.

The pillow-shaped briquet continued to be most popular. Of the 27 plants producing, 15 made pillow-shaped briquets, 4 cylindrical briquets, 5 ovoid, 1 pyramid, and 1 brick-shaped; one plant produced both pillow-shaped and cylindrical briquets.

TABLE 6.—*Classification of briquet plants by prevailing weight of briquets manufactured, 1930 and 1931*

Weight of briquet	Number of plants		Per cent of production		Weight of briquet	Number of plants		Per cent of production	
	1930	1931	1930	1931		1930	1931	1930	1931
Less than 2 ounces	2	4	75.7	75.7	5 and under 6	1	1	5.8	8.4
2 and under 3	12	13			6 and under 10	1	1		
3 and under 4	1	3	18.5	15.9	10 and under 16	1	([1])		
4 and under 5	5	4			48 ounces and over (brick-shaped)	2	1		
						25	27	100.0	100.0

[1] Part of the production of one plant in 1931 was in the classification "10 and under 16 ounces."

NUMBER OF PLANTS IN OPERATION

Twenty-seven plants, two more than in 1930, reported production of briquets on a commercial scale in 1931. In the 25 years from 1907 to 1931 the number of plants has more than doubled. Average production per plant in 1931 was 25,864 tons, a decrease of 15,291 tons from 1930 and the lowest since 1919.

Although the number of plants has increased, the industry has not escaped failures. From 1907 to 1931, 50 briquetting plants were abandoned, indicating that the costs of production and the possibilities of markets should be weighed carefully before a new plant is constructed. As the record of the industry shows, a number of companies are firmly established.

The increase in the number of briquetting operations and the average output per plant over an extended period are indicated in Table 2, page 63.

Table 7 gives list of the 27 plants active in 1931. One plant active in 1930 produced no briquets in 1931, but three new ones began commercial operation during the year—the California Fuel & Utilities (Inc.), Dominguez, Calif.; the Acme Smokeless Fuel Co., Salida, Colo.; and the Pittsburgh & Ashland Coal & Dock Co., Ashland, Wis.

TABLE 7.—*Briquetting plants operated in the United States in 1931*

State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used, as reported by producer
Eastern States:				
Massachusetts	American Briquet Co., 1505 Philadelphia Bank Building, Philadelphia, Pa.	Charlestown	1929	Anthracite.
Do	Salem Briquette Co., Salem, Mass.	Salem	1927	Do.
New Jersey	Anthracite Manufacturing Co., 500 Brunswick Avenue, Trenton, N. J.	Trenton	1918	Do.
Do	Navicoal Corporation, 1421 Chestnut Street, Philadelphia, Pa.	Keasbey	1925	Anthracite and bituminous slack.
Pennsylvania	American Briquet Co., 1505 Philadelphia Bank Building, Philadelphia, Pa.	Lykens	1920	Anthracite.
Do	Henriette Coal Mining Co., 15 Moore Street, New York, N. Y.	Dunlo	1929	Bituminous slack.
Do	Philadelphia & Reading Coal & Iron Co., Twelfth and Market Streets, Philadelphia, Pa.	North Manheim Township.	1927	Anthracite.
Virginia	Virginia Fuel Corporation, P. O. Box 505, Norfolk, Va.	Portlock	1923	Anthracite and bituminous slack.
West Virginia	Berwind Fuel Co. of West Virginia, 122 South Michigan Avenue, Chicago, Ill.	Berwind	1929	Bituminous slack.
Do	Coal Distillation Co. of West Virginia, 712 Park Building, Pittsburgh, Pa.	Moundsville	1927	Semicoke.[1]
Do	Winding Gulf Collieries, P. O. Box 30, Bluefield, W. Va.	Davy	1930	Bituminous slack.
Central States:				
Colorado	Acme Smokeless Fuel Co., 212 Davidson Building, Bay City, Mich.	Salida	1931	Anthracite culm and bituminous slack.
Iowa	Glen Smith Fuel Co., Patterson Building, Omaha, Nebr.	Council Bluffs	1930	Bituminous slack and petroleum coke.
Missouri	Standard Briquet Fuel Co., 818 Security Building, St. Louis, Mo.	Kansas City	1909	Arkansas anthracite and semianthracite slack.
North Dakota	Lehigh Briquetting Co., Fargo, N. Dak.	Lehigh	1929	Semicoke.[1]
Oklahoma	Lincoln Power Co., 141 West Jackson Street, Chicago, Ill.	Howe	1929	Bituminous slack.
Texas	Magnolia Petroleum Co., P. O. Box 798, Beaumont, Tex.	Beaumont	1930	Petroleum coke.
Wisconsin	Berwind Fuel Co., 122 South Michigan Avenue, Chicago, Ill.	Superior	1912	Semibituminous slack.
Do	Pittsburgh & Ashland Coal & Dock Co., 1011 Foshay Building, Minneapolis, Minn.	Ashland	1931	Bituminous slack.
Do	Stott Briquet Co., First National Bank Building, St. Paul, Minn.	Superior	1909	Anthracite fines and bituminous slack.
Do	United Coal & Dock Co., 102 West Wells Street, Milwaukee, Wis.	Milwaukee	1928	Bituminous slack.
Pacific Coast States:				
California	California Fuel & Utilities (Inc.), Box 735, Compton, Calif.	Dominguez	1931	Petroleum coke.
Do	San Diego Gas & Electric Corporation, Sixth and E Streets, San Diego, Calif.	San Diego	1925	Carbon (petroleum residue) from oil gas.
Oregon	Portland Gas & Coke Co., 206 Sixth Street, Portland, Oreg.	Portland	1913	Do.
Washington	Pacific Coast Coal Co., Smith Tower, Seattle, Wash.	Renton	1914	Coking bituminous slack and free-burning slack.
Do	Paramount Briquet Co., 1721 Northlake Place, Seattle, Wash.	Seattle	1929	Bituminous slack.
Do	Wilkeson Coal & Coke Co., Wilkeson, Wash.	Fairfax	1926	Do.

[1] The residue of low-temperature carbonization of bituminous coal or lignite.

CAPACITY OF PLANTS

As more than half of the plants worked 14 to 24 hours during the busy season, the measurement of capacity on an hourly basis affords a good indication of potential output. In 1931 three plants had a capacity of less than 5 tons per hour, and the two largest had a capacity exceeding 75 tons; also, four plants had an hourly capacity of more than 50 tons. (See Table 8.)

TABLE 8.—*Classification of briquet plants, by hourly capacity in 1931*

Capacity per hour	Number of plants	Capacity per hour	Number of plants
Less than 5 net tons	3	50 and less than 75	2
5 and less than 10	6	75 net tons and over	2
10 and less than 25	8		
25 and less than 50	6		27

A further conception of the prevailing size of the briquetting operations may be obtained by grouping them according to their total production in 1931. As Table 9 shows, 5 plants produced less than 2,000 tons during the year, 6 produced 10,000 to 25,000 tons, 6 produced 25,000 to 100,000, and only 2 produced 100,000 to 200,000 tons.

TABLE 9.—*Classification of briquet plants, by size of output, 1929–1931*

Output	Number of plants		
	1929	1930	1931
Less than 2,000 net tons	7	5	5
2,000 and less than 5,000	3	1	3
5,000 and less than 10,000	2	5	5
10,000 and less than 25,000	5	6	6
25,000 and less than 100,000	4	5	6
100,000 and less than 200,000	2	1	2
200,000 net tons and over	2	2	-------
	25	25	27

HOURS OPERATED PER DAY

The sharp seasonal demand for briquets is met by rapidly expanded production rather than from accumulations of producers' stocks. Hence, during the busy season, many plants work two or even three shifts a day. Fourteen plants, producing 86 per cent of the total output in 1931, reported that they operated 14 or more hours a day. The 13 plants working 8 to 12 hours a day contributed only 14 per cent of the total production. (See Table 10.)

TABLE 10.—*Classification of briquet plants, by number of hours operated per day during busy season, 1929 and 1931*

Hours per day	Number of plants		Production, net tons	
	1929	1931	1929	1931
14 to 24 hours	13	14	1,113,690	600,431
8 to 12 hours	12	13	98,725	97,885
	25	27	1,212,415	698,316

RAW FUELS

A total of 671,178 net tons of raw fuel of all kinds was briquetted in 1931; 36 per cent of this amount was anthracite and semianthracite, 54 per cent semibituminous and bituminous coal, and 10 per cent semicoke, oil-gas residue, or petroleum coke. (See Table 11.)

Eight plants reported that from a small portion to all of the raw coal used was washed either by the colliery operator or the briquet manufacturer.

TABLE 11.—*Raw fuels used in making briquets in the United States, 1926–1931, in net tons*

Fuel	1926	1927	1928	1929	1930	1931
Anthracite culm and fine sizes and semianthracite	426,064	359,438	376,257	408,967	368,294	243,888
Semibituminous, bituminous, and subbituminous slack	480,684	521,318	512,806	[1] 711,459	[1] 569,057	[1] 360,226
Semicoke, oil-gas residue, and petroleum coke	64,387	70,052	51,743	67,513	67,014	67,064
	971,135	950,808	940,806	1,187,939	1,004,365	671,178

[1] Includes no subbituminous coal.

In 1931 anthracite fines were used as raw material at 10 operations, either alone or in combination with other coal. Bituminous coal alone was employed at 9 plants. Table 12 shows the character of the raw fuel used by the 27 active plants.

TABLE 12.—*Classification of briquet plants, by kinds of raw fuel used in 1931*

Kind of raw fuel used	Number of plants
Anthracite fines	5
Mixture of anthracite or semianthracite fines and bituminous or semibituminous slack	5
Bituminous slack	9
Semibituminous fines	1
Semicoke (low-temperature coke or char)	2
Carbon residue from the manufacture of oil gas	2
Petroleum coke	2
Mixture of petroleum coke and bituminous slack	1
	27

BINDERS AND RECARBONIZATION

Asphaltic pitch is the binder used most often in the manufacture of briquets, and it was employed either alone or in combination by 23 out of the 27 plants active in 1931. Of the producers, 18 used asphaltic pitch exclusively; 1, asphalt and lignite pitch; 1, aspholeum; 1, coal-tar pitch; 1, oil-tar pitch; 2, starch, asphalt, and water; 1, sulphite liquor; and 1, mixed pitches. One of the plants briquetting the carbon residue from the manufacture of oil gas required no binder.

The percentage of binder to raw fuel, by weight, ranged from less than 5 to 9 or more per cent. The proportion used most was 5 or 6 per cent. (See Table 13.)

TABLE 13.—*Classification of briquet plants, by percentage of binder used in 1931*

Binder used	Number of plants
Using no binder (carbon residue)	1
Using—	
Less than 5 per cent binder	3
5 and less than 7 per cent	17
7 and less than 9 per cent	3
9 per cent and over	3
	27

Three of the producers using a binder, whose total output was 24,698 tons, reported that they recarbonized the briquets coming from the presses to drive off smoke from the binder. Two other producers reported that they partly recarbonized the briquets.

FOREIGN TRADE IN BRIQUETS

Imports of fuel briquets in 1931 were 60,950 net tons, a decrease of 12,468 tons (17 per cent) from 1930. (See Tables 2 and 14.) Before 1922 the quantity of briquets imported was negligible. The anthracite shortages of 1922–23 and 1925–26, however, accelerated the introduction of the European product into the New England market. Although supplies of anthracite have been abundant from 1927 to 1931, the volume of briquet imports has persisted at a high level compared with the period before 1926. In 1931 the imports were equivalent to 8.7 per cent of the domestic production.

According to the customs records, 58,166 tons (95.4 per cent of the total imported in 1931) were discharged at or in the vicinity of Boston; 2,477 tons were imported into Maine and New Hampshire. Very small tonnages also were imported into New York and Philadelphia.

Of the total imports 52,087 tons (85.5 per cent) came from Germany, 8,833 tons from Belgium, 29 tons from France, and 1 ton from the Netherlands.

TABLE 14.—*Briquets and other composition coals for fuels imported for consumption in the United States, 1926–1931* [1]

Year	Net tons	Value	Year	Net tons	Value
1926	123, 593	$736, 804	1929	89, 458	$458, 517
1927	60, 601	314, 435	1930	73, 418	399, 146
1928	71, 485	353, 168	1931	60, 950	325, 189

[1] Compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Table 15 shows that the volume of imports from month to month during the year exhibits much the same seasonal trend that production normally follows.

TABLE 15.—*Fuel briquets imported into the United States, 1929–1931, by months, in net tons*

[General imports]

Month	1929	1930	1931	Month	1929	1930	1931
January	12,902	22,146	6,712	August	3		2,466
February	14,123	8,780	7,311	September	6,720	4,706	4,738
March	8,415	560	3,360	October	45	3,136	3,475
April	13,071	6,053	5,519	November	8,099	6,953	8,959
May	8,731			December	17,335	21,077	15,135
June	10	7	3,275				
July	4				89,458	73,418	60,950

WORLD PRODUCTION

The world production of briquetted fuel is now about 50,000,000 metric tons a year. Germany is by far the largest producer and usually accounts for more than three-fourths of the world total. France and Belgium are the second and third largest producers. At present the United States contributes approximately 2 per cent of the world supply. The briquetting industry has attained its greatest development in countries where a large part of the available fuel is of low grade and where market conditions warrant its conversion from the raw state to briquets.

TABLE 16.—*World production of fuel briquets, 1927–1931, in metric tons*

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Algeria	83,338	33,767	101,552	96,812	(2)
Austria			420		(2)
Belgium	1,688,970	1,959,130	2,018,110	1,875,210	1,850,330
Czechoslovakia:					
Coal	160,254	214,613	270,294	239,080	285,781
Lignite	211,770	241,174	256,111	180,718	211,784
France	5,551,200	5,885,616	6,670,000	6,810,000	(2)
Germany: [3]					
Coal	5,554,980	5,375,842	6,059,195	4,691,028	4,682,527
Lignite	36,489,901	40,157,264	42,136,834	33,999,210	32,434,290
Saar	285				1,178
Great Britain	1,502,053	1,151,270	1,394,898	1,149,114	883,498
Greece	86				(2)
Hungary: Coal, Lignite	42,553	56,165	82,289	101,009	(2)
Indo-China	119,700	103,518	113,225	144,000	134,000
Italy			6,716	2,002	2,450
Netherlands:					
Coal	662,210	785,829	958,186	945,939	(2)
Lignite	69,111	69,091	54,498	48,868	(2)
Netherland East Indies	112,543	82,629	64,099	52,292	17,418
Poland	252,779	264,362	354,783	234,123	300,999
Spain	803,127	846,645	921,906	929,736	(2)
United States	880,389	859,483	1,099,879	933,366	633,498
Venezuela	2,297	1,232	1,691	524	(2)
Yugoslavia	(4)	27,582	51,477	32,413	(2)
	54,217,546	58,115,212	62,616,163	52,465,444	(2)

[1] In addition to the countries listed briquets are produced in Australia, Canada, and New Caledonia, but data of output are not available.
[2] Data not available.
[3] Exclusive of the Saar.
[4] Estimate included in total.

FULLER'S EARTH [1]

By PAUL HATMAKER and JEFFERSON MIDDLETON [2]

CONTENTS

STATISTICAL SUMMARY

Summary of statistics for fuller's earth in the United States, 1930 and 1931

	1930	1931	Per cent change
Sold or used by producers:			
Short tons	335,644	288,400	−14.1
Value	$4,326,705	$3,055,570	−29.4
Per ton	$12.89	$10.59	−17.8
Distribution of domestic production by uses:			
Bleaching, clarifying, decolorizing, or filtering—			
Mineral oils—			
Short tons	326,087	272,177	−16.5
Per cent of total	97.1	94.4	
Vegetable oils and animal fats—			
Short tons	8,350	14,133	+69.3
Per cent of total	2.5	4.9	
Miscellaneous uses—			
Short tons	1,207	2,090	+73.2
Per cent of total	.4	.7	
Imports:			
Unwrought or unmanufactured—			
Short tons	386	136	−64.8
Value	$5,805	$1,534	−73.6
Wrought or manufactured—			
Short tons	6,849	3,877	−43.4
Value	$150,715	$47,430	−68.5
Total imports—			
Short tons	7,235	4,013	−44.5
Value	$156,520	$48,964	−68.7
Exports:			
Short tons	14,237	8,368	−41.2
Value	$161,128	$77,945	−51.6

[1] Work on manuscript completed June, 1932.
[2] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce; those on exports supplied by the producers. No exports of fuller's earth recorded by the Bureau of Foreign and Domestic Commerce.

INTRODUCTION

The production of fuller's earth has practically tripled in quantity and doubled in value since 1921, due largely to the demand for filtering and bleaching earths in petroleum refining. In 1931 domestic production was 288,400 short tons, valued at $3,055,570, or $10.59 a ton at the mines. Of this quantity 94.4 per cent was used in beneficiating mineral oils. The quantity of fuller's earth produced from domestic mines in 1931 decreased 14 per cent and the value 29 per cent as compared with 1930.

The rapid growth of the fuller's earth industry and its comparatively strong position when many nonmetallic industries are suffering from the effects of world conditions have tended to attract capital to new enterprises in this field. Because the Bureau of Mines receives many inquiries concerning various phases of production and markets, information is incorporated in this chapter that, it is hoped, will prove interesting to prospective as well as present operators.

In this regard it is well to point out that the open market for fuller's earth is much smaller than production statistics indicate, a condition that warrants most careful consideration in connection with the projected exploitation of any new deposit. Many oil-refining companies own deposits of fuller's earth and are not in the market for material from other sources. To maintain production schedules, such companies or those controlled by oil refiners may at times even produce a surplus, which is offered to other refineries in competition with material from independent producers.

Even where refining companies do not supply themselves with fuller's earth but rely on independent sources the market is not invaded readily by unfamiliar material. Both clay and petroleum vary widely in chemical composition and physical properties. Consequently refinery technique not only is complex but also depends largely upon the source of the crude oil and the products desired. Establishing a market for fuller's earth from a new deposit is therefore a question of first learning the properties and subsequent behavior of the particular earth and then finding an oil which demands just such peculiarities. No deposit is likely to produce an earth eminently suitable for the entire petroleum industry, and the market of a deposit may be confined to one particular grade of oil from a single field.

The demand for fuller's earth is also affected by overproduction of oil from new fields and decline of output from depleted pools. In some years the crude oils may come from sources yielding darker material, thus requiring increased tonnages of fuller's earth for their bleaching. In other years production may consist of lighter-colored oils which require correspondingly less bleaching. The manufacturing process likewise is a factor perhaps as important as the character of the oil itself. Lubricating oils taken from a vacuum still are much lighter in color than those distilled from a shell still in which some cracking is likely to occur. Acid treatment removes much of this coloring matter, but not to such an extent that the filters do not also have to remove considerable coloring matter.

The Bureau of Mines lists the oil-producing districts of the United States as follows: Appalachian; Lima-northeast Indiana-Michigan; Illinois and southwest Indiana; Mid-Continent; Gulf coast; Rocky Mountain; and California. The Mid-Continent district includes north Louisiana and Arkansas, west Texas, southeast New Mexico, Oklahoma, Kansas, north Texas, and east Texas. Crude oils from these regions may have different bases and may vary in the quantity and kind of impurities present (113).[3] For example, the Appalachian district, which includes New York, Pennsylvania, Kentucky, central and eastern Ohio, West Virginia, and Tennessee, produces a light oil with a paraffin base. It is virtually free from sulphur and yields little or no asphalt. Certain fields in other districts yield oils varying in sulphur content and base. Refining problems therefore differ throughout the country and change somewhat from year to year, depending upon the current grade of crude oils and the market demands for the various products.

Changes in oil-refining technique also have great interest to producers of fuller's earth. Both the percolation process and the contact method of oil filtration are described briefly in another section. There appears to be an appreciable trend among refiners toward adoption of the contact process, but it is by no means unanimous. Producers of fuller's earth necessarily will watch this trend closely because more general use of contact filtration will mean a lessened demand for granular fuller's earth and an increased market for finely ground material.

With the trend toward the contact process is a related trend toward the use of acid-treated clays rather than natural fuller's earth. The relationship does not seem to be parallel, however, as many new plants employing the contact method also use natural fuller's earth similar to that formerly employed in the percolation process, except that it is finely ground. Some refiners report that adoption of contact filtration has included adoption of highly activated clays. Choice here seems to be purely a question of refining cost.

Moreover, a number of factors appear to be hindering the more widespread adoption of the contact process. Plant changes involve scrapping old equipment and spending money for replacements; also, many operators doubt the efficiency of the contact method for certain oils. Some operators in Pennsylvania, for example, report that the contact method is not so well adapted to Pennsylvania oils as the percolation process.

On the other hand, the following advantages are claimed for the contact method: (*a*) Lower initial plant cost, (*b*) better cost control of filtration, (*c*) more flexible plant operation, (*d*) better color control, (*e*) use of finely ground clay, which gives a greater bleaching efficiency per pound of clay, (*f*) ability to neutralize sour or acid-treated oils with fine fuller's earth without a caustic wash, and (*g*) decrease in emulsion troubles.

These general considerations are pertinent to the development of new deposits of filtering clays. Equally important, however, are more specific data regarding fuller's earth itself and the technologic and economic aspects of its production.

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[3] Figures in parentheses appearing throughout the text refer to the bibliography at the end of the paper.

ACKNOWLEDGMENT

Cooperation from the companies listed as buyers and producers in furnishing certain data for this chapter is gratefully acknowledged. Thanks are due especially to the Continental Oil Co., Silica Products Co., Oliver United Filters (Inc.), Sinclair Refining Co., Solvents Extraction Corporation, and Houston Chemical Co., through whose courtesy considerable information was obtained.

GENERAL DESCRIPTION

DEFINITION

Fuller's earth may be defined as a natural claylike mineral substance having a high capacity for decolorizing oils and fats. The term is somewhat loosely applied to such material possessing certain definite bleaching properties in its natural state. "Fuller's earth" is a commercial name rather than a mineralogical designation, so called from the early use of such earth by fullers to remove grease from wool. Chemically, fuller's earth consists of complex hydrous aluminum silicates with varying amounts of iron oxide, magnesia, lime, and alkalies; usually its chemical composition has little to do with classification, which is based upon its efficiency in use. Fuller's earth is differentiated from other somewhat similar clays and earths only because of its superior affinity for oils and grease and for basic coloring matter.

Chemical analyses may have some value, however, in indicating the ratio of silica to alumina in fuller's earth, which is usually higher than in other clays, being 5 or 6 to 1 for good grades (26). Inactive materials (constituents other than silica and alumina), such as lime and iron-bearing minerals, may be determined by analyses. Such determinations have value because the percentage of inactive materials should be low.

PHYSICAL PROPERTIES

Fuller's earth ranges in color from almost white to shades of buff, brown, green, olive, or blue. It is an earthy material, usually indurated or more or less hardened, exhibiting a conchoidal fracture. Most earths are brittle and feel unctuous or greasy. They are nonplastic to semiplastic, unless finely ground, and may or may not disintegrate in water. The small individual particles (commonly less than 0.07 mm in diameter) can not always be identified mineralogically under the microscope, even with high magnification.

The true specific gravity of fuller's earth is about that of ordinary clay, or 2 to 2.6; however, the apparent specific gravity of many earths is much less owing to the relatively large percentage of pore space. Prepared and graded earth, according to one consumer, weighs 34 to 36 pounds per cubic foot. Most earths show an acid reaction with litmus, due to an affinity of the earth for basic coloring matter rather than to the presence of any acid. Fuller's earth is quite hygroscopic; that is, it readily absorbs moisture from the air.

The commercial value of fuller's earth depends chiefly upon its ability to filter oils and fats readily and to absorb and remove impurities and basic coloring matter. Some oils also may be neutralized by filtering with fuller's earth, which under certain conditions removes the acid by absorption. Investigators do not know definitely why some earths possess such qualities whereas others do not. The action has been explained as due to colloidal properties of the minute particles, to mechanical and electrical action, and to selective adsorption; however, these explanatory theories mean little or nothing to one unskilled in physical chemistry, and the fact remains that it is impossible to predict the adsorptive value of a material from chemical analyses alone. The important point to bear in mind is that the action of fuller's earth depends upon various factors, such as character of deposit, degree of fineness, and inherent physical qualities of the earth itself, all of which are difficult if not impossible to evaluate except by experiment. Proper preparation is also important, of course, but while a good material may be spoiled (in the original roast, for example) a poor material can not be transformed into a good product by ordinary preparatory treatment.

CHEMICAL ANALYSES

Chemical analyses of fuller's earth are not reliable criteria of its possible commercial value. Material from different sources seldom has similar composition; the following range has been noted from a study of a number of chemical analyses.

Chemical composition of fuller's earth

	Per cent
Silica (SiO_2)	44–68
Alumina (Al_2O_3)	5–23
Ferric oxide (Fe_2O_3)	1.26–14.8
Lime (CaO)	.82–7
Magnesia (MgO)	.86–3.5
Alkalies (K_2O and Na_2O)	.8–2.5
Sulphur trioxide (SO_3)	0–0.31
Water (combined) (H_2O)	3.56–11.9
Moisture (uncombined)	6.41–13.73

REQUIREMENTS AND TESTS

The commercial utility of any fuller's earth can be determined only by exhaustive tests in the contemplated use, either in the laboratory or in commercial practice; however, certain fundamental requirements may be set forth.

For filtering mineral oils, fuller's earth must (*a*) possess adequate bleaching qualities, (*b*) be of proper particle size (depending upon the kind and grade of oil and the method of filtration), (*c*) not absorb too great a quantity of the oil, and (*d*) ordinarily lend itself to revivification so that it may be used repeatedly. For filtering waxes, another requirement is that it should not impart an "earthy" odor. Such specifications, of course, are very general. Refinery practice varies with the kind of oil treated; and factors such as temperature, viscosity, plant equipment, and refining technique may affect considerably the grade and kind of fuller's earth desired. The kind and type of earth burner available for revivifying the earth may likewise affect to a considerable degree the choice of earths that a given refiner may use.

The requirements for earth used in treating edible oils are somewhat similar. For such purposes fuller's earth must (*a*) bleach well, (*b*) allow easy filtering without formation of an impervious filter cake, (*c*) not retain or absorb an undue quantity of the oil, (*d*) not impart a taste to the oil, and (*e*) not cause the oil left in the cake to oxidize rapidly enough for spontaneous combustion either in the presses or in the waste piles.

Laboratory tests may entail a complete chemical and physical analysis, including the determination of moisture, particle size, oil retention, and decolorizing properties. Bleaching qualities are determined by filtering unbleached lubricating oil or other material through the sample undergoing test and comparing the results with the same liquids filtered through standard English fuller's earth, using Lovibond glasses for checking color. The free fatty acid content of the vegetable oil may also be determined before and after the test to ascertain if the earth increases the free fatty acid in the oil. Liability to spontaneous combustion is gaged, and the ease of filtration is also measured.

Further tests may include experiments to calculate the best heat treatment for developing the maximum qualities of the earth. The most efficient particle size for the particular earth in question must also be learned. Clay amenable to acid treatment requires tests to determine the kind and extent of such processing. Preliminary laboratory results, when comparing favorably with those on standard earths, may indicate that the material has commercial possibilities. In this event, further work may be warranted, with additional tests under different conditions of moisture content, particle size, and other variable factors. Finally, the material may be given a trial factory or plant test.

Unless such investigative work is done carefully the results may be inconclusive or misleading. Samples for such tests should be representative of the deposit and should be typical of the material that could be furnished in quantity under practical mining conditions; otherwise the results have little value. It is also advisable to make separate tests of material from different horizons in the deposit and from different points in the same horizon. Such complete tests, of course, would not be necessary or warranted unless the deposit is to be exploited commercially and unless a preliminary test indicated that further investigations were justified.

It is not a function of the Bureau of Mines to make laboratory tests of fuller's earth (or other ores or minerals) either for private individuals or corporations; however, the following commercial laboratories are equipped to conduct such investigations:

California:
- Smith-Emery Co., 920 Santee Street, Los Angeles.

Georgia:
- Dr. Poole Maynard, Atlanta.
- The Dumas Laboratory, 10½ Auburn Avenue, Atlanta.

Massachusetts:
- Arthur D. Little (Inc.), Cambridge.

Missouri:
- Kansas City Testing Laboratory (Inc.), 700 Baltimore Avenue, Kansas City.

Pennsylvania:
- Pittsburgh Testing Laboratory, Stevenson and Locust Streets, Pittsburgh.

Texas:
The Fort Worth Laboratories, P. O. Box 1008, Fort Worth.
Houston Laboratories, 1206½ Preston Avenue, Houston.

USES

Only fuller's earth that has passed rigid tests successfully is used commercially. The following table shows the distribution, by uses, of the domestic output of fuller's earth from 1927 to 1931, inclusive, as reported by producers. Such data are not available prior to 1927.

Fuller's earth sold or used by producers in the United States, 1927–1931, by uses

Year	Bleaching, clarifying, decolorizing, or filtering—				Miscellaneous uses		Total (short tons)
	Mineral oils		Vegetable oils and animal fats				
	Short tons	Percentage of total	Short tons	Percentage of total	Short tons	Percentage of total	
1927	243,009	91.9	15,363	5.8	6,106	2.3	264,478
1928	258,645	90.1	24,288	8.5	4,079	1.4	287,012
1929	301,607	95.4	10,685	3.4	3,691	1.2	315,983
1930	326,087	97.1	8,350	2.5	1,207	.4	335,644
1931	272,177	94.4	14,133	4.9	2,090	.7	288,400

MINERAL OILS

Fuller's earth entering the petroleum industry, which in 1931 was 94.4 per cent of the domestic output, is used in bleaching, clarifying, decolorizing, or filtering lubricating, cylinder, and special oils; it is used also for treating gasoline, kerosene, petrolatum, paraffin wax, and ceresin.

Oil may be decolorized and in some cases neutralized either by the percolation method or the contact method of filtration (5). The percolation process consists essentially of allowing the oil to percolate, with or without heat or pressure, through a column of suitably prepared fuller's earth placed in tall cylindrical tanks. These vertical filters may range from 6 to 10 feet in diameter and from 15 to 30 feet in height. The quantity of fuller's earth used during one charge may be 40 or more tons for the larger filters. The bottom of each filter commonly is provided with a canvas-covered perforated drainage plate. Some filters, however, are equipped with a special filter head and screen.

After the filter is charged with earth, the oil is pumped into it under a pressure of 5 to 6 pounds. At some of the older plants the oil is filtered by gravity, but newer installations commonly use a pressure feed. Many operators allow the filter to soak 12 to 24 hours at first to prevent the earth bed from channeling during subsequent filtering. The pressure is then increased to about 15 pounds, which insures a steady flow.

The first oil to pass through the earth is very light in color, but the oil which follows gradually becomes darker. When the oil coming from the filter is too dark to blend satisfactorily with that previously drawn the filter inlet is shut off and air pressure is applied to remove the excess oil in the filter. Light naphtha is pumped through the earth, and this is followed by steam to displace the naphtha. The filter is then dumped, and a fresh charge of fuller's earth is added.

Granular fuller's earth generally is used in the percolation process, the sizes ranging from minus 15 to plus 90 mesh. The different grades are designated as 15/30, 30/60, 40/60, 60/80, and 60/90, depending upon the maximum and minimum grain size. One consumer reports that of his 15/30-mesh material, 3 per cent is coarser than 15 mesh, 89 per cent is between 15 and 30 mesh, and 8 per cent is finer than 30 mesh. The 40/60 grade (or through 40 on 60 mesh) is used extensively with oils of fairly high viscosity. More viscous oils require coarser earths, and thinner oils can be treated successfully with finer sizes. Although the finer sizes are more efficient (owing to the greater surface area), the degree of fineness that can be used successfully is limited by mechanical difficulties such as resistance to flow.

The contact process of oil filtering consists of agitating finely divided clay and oil at the proper temperature and subsequently filtering the mixture through filter presses. The agitation must be thorough and may be carried on at temperatures ranging from 350° to 600° F. The mix is then cooled to perhaps 200° to 300° F. and filtered. If the oil is too viscous to filter easily, naphtha may be added as a thinning agent.

The filter-press cake is blown out with air or steam and rinsed with naphtha to dissolve the retained oil. The cake is then blown dry and removed.

Either natural fuller's earth or acid-treated clay is used in the contact process. Some earths are prepared by grinding so that 85 to 95 per cent passes 200 mesh. One producer reports that his product is ground so that 97.50 per cent passes 100 mesh and 76.60 per cent passes 200 mesh. One consumer reports that material designated as 100/up mesh may contain 5 per cent coarser than 100 mesh, 42 per cent between 100 and 200 mesh, and 55 per cent finer than 200 mesh.

Although fuller's earth finds its greatest utilization in purifying lubricating oils, it is used also to benefit other products, especially waxes. Kerosene may be treated by the contact process which has been described. In processing gasolines and other light distillates by the Gray vapor-phase system the vapors are passed through a chamber containing fuller's earth. The earth is regenerated as in lubricating-oil practice.

EDIBLE OILS

During recent years only 2.5 to 8.5 per cent of the total production of fuller's earth has been used in the treatment of vegetable oils and animal fats.

Edible oils are usually given a preliminary hot-alkali treatment to remove fatty acids and to convert the coloring matter to basic form. From 0.5 to 10 per cent of fuller's earth is introduced; the mixture is thoroughly stirred or agitated for 10 to 45 minutes, filtered through pressure filters, and deodorized. Moisture, either in the oil or in the earth, is detrimental. Steam, hot water, or air is used afterward to displace the oil left in the filter cake, which is thrown away. Caution must be observed in the use of compressed air with oil-soaked fuller's earth, as compressed air increases the risk of spontaneous combustion.

Vegetable oils bleached by fuller's earth include castor, coconut, cottonseed, linseed, mustard seed, olive, palm nut, peanut, poppy seed, rape, and soybean. Such animal products as beeswax, bone oil, fish oil, fish stearine, lard, skin glue, seal oil, tallow, and whale oil are also beneficiated.

The leaching process is used for some animal and vegetable fats, but agitation and filtering are said to be preferred owing to better control. Some processes include a second bleaching using a mixture of fuller's earth and carbon black.

The finer sizes of fuller's earth are used for filtering edible oils, the maximum size usually being 90 or 100 mesh.

MISCELLANEOUS

The tonnage of fuller's earth for miscellaneous uses during the past five years has ranged from 0.4 to 2.3 per cent of the total production. Relatively small quantities are used as a filler, as a binder, and for fulling cloth. Some may be used in the manufacture of pigments for printing wall paper, for detecting certain coloring matters in some food products, as a substitute for talcum powder, in medicine as a poultice, and as an antidote for alkaloid poisons. A suggested use is in deliming hides in the manufacture of leather. It is reported that fuller's earth cake from oil mills can be used in the manufacture of hand soaps, for waterproofing concrete, and in asphalt preparations (15). Ladoo (57) states that fuller's earth has been used as a ceramic binder for abrasive wheels, and finely pulverized material is employed to spread or level the color in certain types of dyeing. Fuller's earth has been used as the base of various beauty clays, soaps, and other cosmetics. In India it is reported to have been used as a cleansing medium for garments and to constitute the principal ingredient of various "edible" earths which are sold in bazaars.

REVIVIFICATION

Much larger quantities of fuller's earth would be required in the oil-refining industry were it not for the fact that such clays are used over and over again. Through constant use, however, fuller's earth gradually loses its bleaching and adsorptive qualities.

Because of the relatively large quantities required for the beneficiation of mineral oils, development of revivification processes has effected great economies to oil refiners. The technique has developed to such a point, it is claimed, that earth in more modern filtering plants can be reused in different operations as many as 30 times before being discarded.

Revivification is essentially a roasting process. When fuller's earth begins to lose its effectiveness the oil is shut off and the filter drained, washed with naphtha, and steamed to remove as much of the oil as possible. The fuller's earth is then roasted at a moderate temperature, usually from 700° to 1,200° F., depending somewhat upon the nature of the earth. After the earth is roasted and cooled it is ready for reuse. At a modern plant in the Middle West regeneration is carried on in a Wedge multiple-hearth-type furnace, which insures close temperature control and high efficiency (17).

Although fuller's earth, before being used, may be roasted at 600° to 700° F., later burnings for reuse usually require a higher temperature. The purpose of the initial burn is to remove water and volatile matter, and at 700° F. there is no danger of glazing the pores of the earth by incipient fusion. In subsequent burns, however, carried on at higher temperatures, much caution must be exercised to prevent any agglomeration or sintering action.

It is good practice to conduct subsequent burns at a slower rate than the initial roast. For the second burn the temperature is usually held between 1,050° and 1,100° F. and should never be allowed to exceed a degree which gives a deep cherry red color. Subsequent burns are held between 1,100° and 1,200° F. Usually the heavier the oil the higher the temperature required for roasting, but any heat above 1,200° F. may cause serious loss in the absorptive power of the earth.

Reactivation is greatest in fuller's earth used in the percolation process of filtration and in relatively costly acid-treated clays used in the contact method. Cheaper natural earths used in contact work are seldom revivified, and little or no material used in the edible-oil industry is ever reused.

ACID-TREATED EARTHS

The potential demand for fuller's earth is also affected by various acid-treated earths or clays that have been placed upon the market in recent years.

Certain earths, such as some bentonites and related clays, having in their natural state little if any bleaching power, may be rendered highly active by an acid treatment which varies in detail with the different earths. Acid-treated earths are used in the contact method of oil filtration, which has been described.

Acid treatment consists essentially of digesting the sun-dried crushed clay with sulphuric or hydrochloric acid. After the reaction is complete the clay is washed repeatedly with water until the wash solution shows practically no acid content. The clay is then dried and pulverized. A process describing an acid treatment of clays is the subject of United States Patent 1408655 granted to Charles Wolcott Stratford, March 7, 1922.

The art of chemically treating clays to render them highly active in bleaching power was developed first in Germany. Burghardt (12) has recently described the acid-treating process as applied to clays in Bavaria. The method is outlined in the following paragraphs.

The clay occurs in beds covered with an overburden from 6½ to 65 feet thick. The color of the earth ranges from green and yellow to gray. A typical analysis indicates the following composition.

Chemical composition of Bavarian filtering clay

	Per cent
Silica (SiO_2)	53.9
Alumina (Al_2O_3)	16.3
Ferric oxide (Fe_2O_3)	3.8
Lime (CaO)	.9
Magnesia (MgO)	.8
Alkalies and undetermined	.8
Loss on ignition (combined) (H_2O)	11.4
Moisture	12.1
	100.0

Five steps are necessary in the activating process: (*a*) Preparing the slime, (*b*) treatment with acid, (*c*) filtering, (*d*) drying, and (*e*) milling.

The slime is prepared by adding water to the moist raw clay. The mixture is thoroughly agitated in a specially constructed agitator capable of breaking down the clay lumps. When sufficiently mixed, the slime is pumped through a scalping screen to remove coarse foreign material and passed to the reaction kettle.

Either sulphuric or hydrochloric acid may be used, but the latter is commonly preferred. The acid is carefully measured into the reaction kettle, which is built of pine and lined with acid-proof rubber. Steam pressure is then applied. The mixture is boiled two to three hours at about 105° C. The quantity of acid used varies according to operating conditions. The ratio is usually about 1 pound of hydrochloric acid (19° to 21° B.) to 1 pound of finished clay.

From the acid chamber the sludge is pumped into the filter press and filtered. The cake is washed with clean water for about six hours to remove the acid. The clean cakes are then conveyed to a drier.

Drying is done in a rotary kiln, using coke for fuel. From the drier the earth passes through a high-speed hammer mill where it is pulverized until 85 to 90 per cent passes a 180-mesh screen.

Preparation of acid-treated clays in the United States began about 1922. The domestic clays so processed occur chiefly in the Western or Southwestern States. The material is commonly classed as of the order of bentonite. The process of acid treatment in the United States is substantially the same as in Bavaria, except that domestic producers have used sulphuric instead of hydrochloric acid. The strength of the acid varies according to the type of clay. At one plant 20 to 22 per cent sulphuric acid is used in the proportion of one-half pound of acid to 1 pound of clay. At this plant digestion of the raw clay is carried on at a temperature slightly above 200° F.

According to another method the clay is dried at 230° F., ground to an impalpable powder, digested with 96 per cent sulphuric acid for several hours, drained, and washed with clean water. About 9 parts of acid by weight are used to 20 parts of clay (27).

It is reported that 1 ton of clay properly activated with acid is as effective for bleaching purposes as 3 tons of natural fuller's earth. Because of the cost of acid treatment and the loss of material during such processing the price of domestic activated earths is considerably higher than for natural filtering earths.

The finished product is consumed chiefly in animal, vegetable, and mineral oil refineries.

Thus material dissimilar in origin and natural properties becomes ultimately a strong bidder for at least part of the market dominated by fuller's earth.

ORIGIN AND OCCURRENCE

The relation of origin, occurrence, and ultimate commercial applicability of fuller's earth is obscure. There seems to be no satisfactory explanation as to why bleaching and adsorptive properties are given to certain deposits of earths and clays, whereas others are not so endowed, although conditions of origin appear similar.

Many deposits of fuller's earth are sedimentary, some perhaps having been laid down in rather shallow marine seas. In Massachusetts, however, a deposit of glacial silt is classified as fuller's earth. The Arkansas deposits have resulted from alteration of basaltic dikes and occur in vein formations. With the exception of the Arkansas deposits, commercial beds of fuller's earth in the United States occur in much the same manner as common clay.

In some deposits distinct stratification is quite common, many of the layers being thinly intercalated with sand. In other deposits, however, bedding is not developed to any great extent, the material having a concretionary or nodular structure and a conchoidal fracture. Jointing is fairly well developed. Commercial sedimentary deposits may have as much as 50 feet of overburden consisting of clay, silt, soil, loess, sand, gravel, or bowlders.

DISTRIBUTION OF DEPOSITS

UNITED STATES

The relative location of fuller's earth deposits is an important factor in their successful development, because eminently satisfactory material is not widely distributed and sources are not always in the most advantageous positions as regards proximity to markets. Georgia, Florida, and Illinois, in order of importance, were the leading producing States in 1931, although production was reported from Texas, Nevada, Utah, Colorado, California, Massachusetts, and Idaho. The more important occurrences are briefly as follows:

Alabama.—Deposits of fuller's earth occur in Choctaw, Clarke, De Kalb, and Monroe Counties, but no production has been reported since 1924.

Arizona.—Small amounts of fuller's earth were reported in 1927 and 1928 from Maricopa and Yavapai Counties.

Arkansas.—Fuller's earth occurs chiefly near Klondyke and Fairplay in Saline County. An undeveloped deposit has been reported at Forrest City, St. Francis County. No production has been reported by this State since 1922.

California.—Important deposits of bentonitic clay occur along the Amargosa River in Inyo County. Other deposits of similar material occur in San Diego, San Bernardino, Solano, Calaveras, Kern, Kings, and Monterey Counties. Small quantities of fuller's earth were reported from Inyo and San Bernardino Counties in 1931.

Colorado.—Fuller's earth from a deposit near Akron, Washington County, was used for bleaching vegetable oils, but no production has been reported since 1914. Production is reported from Mineral County.

Florida.—All the 1931 Florida production came from near Quincy, Gadsden County, and from Marion County. Deposits also occur along the west coast (south portion) near Ellenton, Manatee County, and in Hernando County. In the southern part of the State the deposits are near the shore and may extend below sea level. Those in northwestern Florida are at higher elevations and consequently have drainage, except where they occur in old stream beds.

Georgia.—Fuller's earth occurs in Decatur, Twiggs, Baldwin, Houston, Jefferson, Randolph, Screven, Washington, and Wilkinson Counties. Fuller's earth also has been reported from many other counties of the State, including Bibb, Columbia, Colquitt, Stewart, Ware, Grady, and Pulaski. The deposits of the central Georgia district are in a different geological formation from the Florida occurrences, being on comparatively high ground and quite dry. Present production comes from Decatur, Stewart, Twiggs, and Wilkinson Counties.

Idaho.—A small production of fuller's earth was reported in 1931 from a deposit in Idaho County near Kamiah.

Illinois.—Extensive deposits occur near Olmsted, Pulaski County. A somewhat similar clay has been found in Massac, Alexander, and Union Counties, but these occurrences so far have not been developed.

Massachusetts.—Fuller's earth is produced near Lancaster, Worcester County, and in Norfolk County.

Nevada.—Production of fuller's earth has been reported from Nye and Esmeralda Counties.

Texas.—Walker and Grimes Counties are the chief producing localities at present. Deposits of fuller's earth also occur about 16 miles from San Antonio, Bexar County; near Somerville, Burleson County; at Westpoint, Fayette County; and at (or near) Benton, Washington County.

Utah.—Fuller's earth is being produced near Aurora, Sevier County.

Miscellaneous.—Deposits of fuller's earth are reported near Salters Depot (Williamsburg County), at Summerville (Dorchester County), and near Sumter (Sumter County), S. C.; in Clarke, Lauderdale, Newton, Franklin, Smith, and Winston Counties, Miss.; in Silver Bow County, Mont.; in King William, New Kent, and Mecklenburg Counties, Va.; and in Richmond, Gaston, and Madison Counties, N. C. Occurrences of fuller's earth have been reported in Minnesota, Missouri, Nebraska, New Mexico, New York, Pennsylvania, South Dakota, Washington, and Wyoming.

FOREIGN

Although foreign deposits of fuller's earth do not compete seriously with domestic producers, it is of interest to mention the principal occurrences.

Great Britain.—England is second in importance as a producing country; in fact, the United States and England are the largest producers of fuller's earth in the world. Deposits have been worked for many years near Reigate and at Nutfield in Surrey, near Bath in Somerset, in Bedfordshire, and in North Wales.

India.—A small production of fuller's earth has come from the Central Provinces.

Australia.—A deposit of fuller's earth occurs at Wingen, New South Wales.

Germany.—Deposits of fuller's earth occur in Bavaria. Much of this material is given a preliminary acid treatment by digesting the earth in large boilers with hot hydrochloric or sulphuric acid. It is then washed, dried, and ground. It is reported that the annual consumption in Germany for treating oils is 40,000 tons.

PRODUCTION METHODS

Successful marketing of fuller's earth by producers and its worth in ultimate use depend largely upon efficient mining and milling technique. The procedure may appear to be quite simple, but much attention must be given to efficient mining practice and to correct preparation of the material for use.

MINING

The mining of flat-lying deposits of fuller's earth is comparatively simple, planned primarily to conform with local conditions of the deposit and volume of production desired.

The first step is to remove the overburden, which may range in depth from a few inches to 50 or more feet. This stripping can be accomplished by power shovels, teams, and scrapers, or hand methods. Such material, of course, must be removed far enough from the pit to avoid interference with subsequent mining activities. At some operations it may be feasible to dump the overburden into the part of the pit from which the fuller's earth already has been removed. Blasting may be necessary, depending upon the kind of material overlying the deposit. At some operations stripping is done in two stages. The bulk of the overburden is removed; but a thin layer, a foot or so in thickness, is left to protect the fuller's earth from weathering. The removal of this cover becomes practically the first step in the actual mining procedure.

Again, local conditions largely govern the methods employed to remove the fuller's earth stratum. In some deposits the material is blasted with dynamite, picked up with steam shovels, and conveyed to the mill in dump cars served by steam locomotives. At other operations the fuller's earth can be dislodged simply by prying the material with bars and shooting it with comparatively light charges of explosive. The earth can be loaded by hand into small narrow-gage mine cars, which may be hand trammed to the mill or pulled from the pit by cable and inclined track. At some deposits the fuller's earth occurs in layers possessing different characteristics and qualities, often separated by thin strata of sand or other foreign material. Under these conditions the mining scheme must be modified, and it may be advisable to remove only one particular stratum. Such a decision naturally affects the general mining plan.

The fuller's earth deposits in Arkansas, which occur in the form of weathered dikes 4 or 5 feet thick and dip from 45° to 90°, have been mined by underground methods consisting of a system of overhand stopes.

Fuller's earth has high absorptive qualities, and care must be taken to keep the pits or mines well drained to minimize the amount of water which subsequently must be driven off by artificial drying. Obviously it is more economical to send material to the mill as dry as possible, both from the standpoint of fuel conservation and ease of primary crushing.

Care must also be taken to avoid contamination of the fuller's earth with either the overburden or the underlying stratum. The amount of attention necessary depends somewhat upon the character of the deposits. Clean material can be recovered more readily from deposits lying directly above a comparatively hard substance, such as sandstone, than from those lying between beds of soft clay.

MILLING

The preparation of fuller's earth for market is essentially a process of removing excess moisture and reducing the material to the most efficient size for eventual use. Coarse sizes (16 to 60 mesh) are commonly demanded by petroleum refiners, whereas manufacturers of edible oils use stock ranging from 60 to 300 mesh, depending upon the nature of the earth and its reaction to their particular materials during manufacturing processes. Recently some petroleum refiners have been demanding the finer sizes for use in contact filtration.

No arbitrary mill flow sheet can be given which will apply to all deposits. In fact, the actual preparation of marketable fuller's earth does or should depend upon the physical characteristics of the particular earth in question and its behavior in the uses contemplated.

At some plants the first milling operation consists in air drying the crude clay for two or three days in well-ventilated sheds. This preliminary treatment not only facilitates crushing but also reduces the cost of more drastic drying later.

At other plants, however, the raw material from the mine is sent direct to the primary crushing unit. For this operation roll crushers, often with corrugated or toothed surfaces, are commonly employed. By experimenting and selecting the most efficient methods some of the larger companies have worked out their own designs for these primary crushers. The maximum size of material coming from the primary crushing unit is usually 1 inch, but it may be 2 inches at some plants, where a secondary crushing unit reduces the material to minus 1 inch.

Generally the material is passed from the crushing units to rotary oil-fired driers for further removal of moisture. Such driers are of various types and sizes, depending upon the requirements of the plant. The fuller's earth, while drying, which takes ordinarily from 12 to 20 minutes, is repeatedly lifted, mixed, and dropped to facilitate the removal of vapor and volatile gases.

This initial roasting of the earth may be done at a temperature of about 600° to 700° F. Close control is necessary because certain earths have optimum bleaching powers partly dependent, at least, upon a definite moisture content. Specific practice must be worked out for each particular earth.

At some plants the hot earth from the driers is conveyed to well-ventilated cylindrical cooling tanks before further reduction. In other mills the material goes direct to a secondary roll system, where it is further reduced in size and screened. It may be necessary to do this secondary crushing in several stages to avoid too large a percentage of fines. Oversize from the screens may be returned for further reduction. Care must be exercised in heating and drying the fuller's earth because some material loses its bleaching and adsorptive properties if the temperature is kept too high. This applies more particularly to earths used for treating edible oils.

Final sizing is done either with screens of various types fitted with wire mesh or by bolting through Swiss silk. Gyratory sifters using silk screens are sometimes used. The material then is ready to be stored in bulk or to be bagged. Burlap sacks of 135 pounds capacity are used and usually are filled to the required weight by special automatic machinery. Shipments are made in bulk and in bags.

At the plant of the Attapulgus Clay Co., Attapulgus, Ga., steam shovels in the pit load the clay into 5-cubic yard side-dump cars, which are hauled by small steam locomotives over a 36-inch-gage track to the mill (55). The fuller's earth is dumped into a 3,000-ton lattice-sided drying shed, where air-drying continues for two or three days. Electric traveling cranes handle the clay to distributors which discharge onto belt conveyors, the material passing to the primary crushing system. Specially designed roller crushers reduce the earth to a maximum size of 1 inch.

Kiln-type oil-fired rotary driers drive off volatile matter and reduce excess moisture from 40 to 50 per cent to a maximum of 20 per cent, the clay being lifted and dropped through the hot gases while passing through the drier. This process takes about 20 minutes. Bucket-type chain-drag conveyors carry the drier discharge to "hot-rock" cooling tanks, which are large well-ventilated vertical steel cylinders. The material is then mechanically fed to a ½-inch-mesh electric vibrating Hum-mer screen. Oversize is reduced in a high-speed roller mill and joins the undersize to a belt conveyor equipped with a magnetic head pulley.

Succeeding milling operations consist of screening the clay through Hum-mer screens, further reducing it by means of corrugated rolls, and sizing it by sifters equipped with handmade Swiss silk. The process requires rigid control to minimize the percentage of fines. A maximum of granular sizes is desired and is obtained by gradual reduction and frequent sifting of the particles. The finished product is stored according to size and grade in separate bins of 75 tons capacity.

Shipment is made in bags and in bulk. High quality burlap bags of 135 pounds capacity are filled by means of an autometer scale. Grain-type freight cars are loaded to a capacity of 25 to 35 tons. Paper-lined bulk cars are loaded by machinery. False doors are also provided inside the car.

MARKET DATA

PRODUCTION STATISTICS

The growth and present extent of the fuller's earth market can be appraised by examination of production statistics, but this knowledge affords little help to those interested in new deposits, because data are not available as to the proportion of domestic shipments derived from deposits owned or controlled by oil-refining companies. The ratio, however, is undoubtedly large. Domestic consumption comes almost entirely from sources of supply in the United States, nearly 99 per cent of the apparent consumption of 284,000 tons in 1931 having been derived from domestic deposits.

It is of interest to note that the number of producing companies in the field is relatively small. This fact might seem at first to indicate that the industry was not crowded and that great opportunities existed for new enterprises. Such a conclusion does not necessarily follow. In 1910, 17 operators reported a total production of 32,822 tons of fuller's earth, or an average output of 1,931 tons. In 1930, 15 operators contributed to the total production of 335,644 tons for that year, or an average output of 22,376 tons per operator. In 1931, 22 operators reported to the bureau a production of 288,400 short tons, or an average of 13,109 tons. However, a number of these reported only a very small production, some of which may have been mined to fill trial orders. Apparently the trend in market supply has been toward strengthening established units, with little opportunity for, and no tendency toward, a great number of small independent enterprises. Quantity production of a specialized product depends for its sales success upon inherent qualities skillfully enhanced and controlled by scientific preparation for use and upon access to markets. The small operator can not accomplish this if he is handicapped by an inferior earth or has limited experience and capital.

The following table gives the number of producing companies, quantity of fuller's earth produced, and its value at the mines from 1900 to 1931. Production by States (other than Texas) can not be published without disclosing confidential data.

Fuller's earth sold or used by producers in the United States, 1900–1931

Year	Operators reporting sales	Short tons	Value at mines		Year	Operators reporting sales	Short tons	Value at mines	
			Total	Average				Total	Average
1900	(1)	9,698	$67,535	$6.96	1916	10	67,822	$706,951	$10.42
1901	(1)	14,112	96,835	6.86	1917	11	72,567	772,087	10.64
1902	(1)	11,492	98,144	8.54	1918	14	84,468	1,146,354	13.57
1903	(1)	20,693	190,277	9.20	1919	10	106,145	1,998,829	18.83
1904	(1)	29,480	168,500	5.72	1920	12	128,487	2,506,189	19.51
1905	(1)	25,178	214,497	8.52	1921	12	105,609	1,973,848	18.69
1906	(1)	32,040	265,400	8.28	1922	15	138,944	2,289,719	16.48
1907	(1)	32,851	291,773	8.88	1923	15	149,134	2,247,523	15.07
1908	(1)	29,714	278,367	9.37	1924	13	177,994	2,632,342	14.79
1909	15	33,486	301,604	9.01	1925	14	206,574	2,923,965	14.15
1910	17	32,822	293,709	8.95	1926	14	234,152	3,356,482	14.33
1911	13	40,697	383,124	9.41	1927	16	264,478	3,767,038	14.24
1912	13	32,715	305,522	9.34	1928	17	287,012	3,895,991	13.57
1913	10	38,594	369,750	9.58	1929	17	315,983	4,309,723	13.64
1914	14	40,981	403,646	9.85	1930	15	335,644	4,326,705	12.89
1915	12	47,901	489,219	10.21	1931	22	288,400	3,055,570	10.59

[1] Figures not available.

Texas reported 35,540 short tons, valued at $350,809, or $9.87 a ton, in 1931, compared with 45,503 short tons, valued at $443,477, or $9.75 a ton, in 1930, a decrease of 22 per cent in output and 21 per cent in value.

Florida and Georgia together in 1931 reported 175,139 tons, or 61 per cent of the output, valued at $1,890,649, or 62 per cent of the total value, compared with 228,070 tons, valued at $3,235,842, in 1930, a decrease of 23 per cent in quantity and 42 per cent in value.

IMPORTS

The quantity of fuller's earth imported into the United States is relatively small compared with domestic production, having been less than 1.5 per cent in 1931. Imports, therefore, are no longer a vital factor in the domestic situation, although at one time they constituted the entire domestic supply.

Imports were increasing prior to the World War and reached a maximum in 1914; since then the general trend has been downward, as shown in the following table. The quantity imported in 1931 was less than one-sixth of that imported in 1914. In 1931 wrought or manufactured earth constituted nearly 97 per cent of the total quantity and value of fuller's earth imported.

Fuller's earth imported for consumption in the United States, 1900–1931 [1]

Year	Unwrought or unmanufactured		Wrought or manufactured		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1900	2,723	$14,750	6,431	$50,047	9,154	$64,797
1901	3,266	17,230	8,792	63,467	12,058	80,697
1902	4,239	26,635	10,895	75,945	15,134	102,580
1903	4,260	28,339	12,840	92,332	17,100	120,671
1904	1,975	9,546	8,247	64,460	10,222	74,006
1905	1,705	12,798	12,858	93,199	14,563	105,997
1906	2,905	20,129	11,920	88,566	14,825	108,695
1907	2,490	16,833	13,916	105,388	16,406	122,221
1908	2,363	16,242	9,803	77,171	12,166	93,413
1909	1,802	12,492	10,950	88,659	12,752	101,151
1910	2,160	14,399	14,427	118,146	16,587	132,545
1911	1,881	10,877	16,343	132,717	18,224	143,594
1912	1,970	11,619	17,139	133,718	19,109	145,337
1913	1,916	12,344	16,712	133,657	18,628	146,001
1914	1,468	9,283	23,509	185,800	24,977	195,083
1915	850	5,176	18,591	147,317	19,441	152,493
1916	1,132	7,742	15,669	131,922	16,801	139,664
1917	1,441	11,718	15,553	164,699	16,994	176,417
1918	1,085	12,636	15,837	213,599	16,922	226,235
1919	373	4,301	13,500	185,410	13,873	189,711
1920	1,518	19,793	17,497	202,100	19,015	221,893
1921	483	6,172	9,261	113,243	9,744	119,415
1922	607	7,413	9,962	128,282	10,569	135,695
1923	642	8,252	7,905	105,692	8,547	113,944
1924	296	3,385	7,006	89,103	7,302	92,488
1925	215	2,619	7,800	108,676	8,015	111,295
1926	158	2,290	8,940	121,384	9,098	123,674
1927	550	5,679	7,030	103,602	7,580	109,281
1928	354	6,710	7,239	125,293	7,593	132,003
1929	608	11,583	7,694	140,849	8,302	152,432
1930	386	5,805	6,849	150,715	7,235	156,520
1931	136	1,534	3,877	47,430	4,013	48,964

[1] Compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

TARIFF

Under paragraph 207 of the tariff act of 1930 provision is made for duties on natural fuller's earth and activated earths as follows:

> * * * Fuller's earth, unwrought and unmanufactured, $1.50 per [long] ton; wrought or manufactured, $3.25 per [long] ton; clays or earths artificially activated with acid or other material, one-fourth of 1 cent per pound and 30 per centum ad valorem; * * *.

The provision for activated earths was new, but the above rates for fuller's earth are the same as those under the act of 1922. Under the act of 1913 fuller's earth was dutiable as follows: Unwrought and unmanufactured, 75 cents per long ton; wrought or manufactured, $1.50 per long ton.

MARKET PRICES

The following market prices of fuller's earth, as quoted in trade journals, indicate mainly the value of current sales and do not necessarily represent the actual market price. Price concessions in accordance with existing conditions doubtless are made where large tonnages are involved, the contract price being a matter of direct negotiation between the buyer and the seller or being settled by intercompany arrangement.

Quotations given here are per ton f. o. b. mines and are compiled from the Engineering and Mining Journal.

Average quoted prices of fuller's earth per ton, f. o. b. mines, 1922–1931

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	First quarter of 1932
Florida or Georgia, 15–30 mesh	$18.50	$17.00	$16.54	$16.50	$16.50	$16.50	$16.50	$16.50	$16.50	$15.83	$14.83
Florida, 16–60 mesh		18.25	18.00	18.00		18.00	17.56	17.00	17.00	(1)	(1)
Florida or Georgia, 30–60 mesh	19.37	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	16.92	15.67
Florida, 60–90 mesh	[2] 16.66	14.25	14.04	14.33	15.00	14.75	14.00	14.00	14.00	(1)	(1)
Florida or Georgia, 100 mesh up	12.40	8.125	7.50	8.00	8.00	8.00	7.75	7.00	7.00	7.00	7.00
Georgia or Florida, 200 mesh up									10.00	10.00	10.00
Colorado, various fineness to minus 90 mesh									18.00	18.00	18.00
Powdered, import duty paid		(1)	(1)	24.00	24.00	24.20	24.50	24.50	24.58	25.00	(1)

[1] Not quoted.
[2] 60 to 100 mesh.

FOREIGN TRADE

Domestic operators as a whole can not consider foreign markets as an outlet for much of their production; however, relatively small tonnages have been shipped to a number of countries.

Official foreign commerce records of the United States do not show exports of fuller's earth. Since 1923, however, exports have been reported directly to the Bureau of Mines by the operators, and these data are summarized in the following table. The countries to which this material has been shipped include Argentina, Belgium, Canada, Canary Islands, Cuba, Denmark, France, Germany, Great Britain, Greece, India, Ireland, Mexico, Netherlands, Peru, Poland, Rumania, Russia, Scotland, and Sweden. In 1931 six operators exported a total of 8,368 short tons of fuller's earth. This tonnage represents a decrease of 41 per cent compared with 1930. The following table shows such exports from 1923 to 1931.

Fuller's earth exported from the United States, 1923–1931, as reported by producers

Year	Operators reporting exports	Short tons	Value	Year	Operators reporting exports	Short tons	Value
1923	5	3,700	(1)	1928	8	16,494	$198,374
1924	5	6,319	$97,691	1929	7	21,264	258,408
1925	5	6,195	91,975	1930	7	14,237	161,128
1926	5	6,650	105,641	1931	6	8,368	77,945
1927	6	12,287	191,835				

[1] Figures not available.

PRODUCERS

The following operators have reported production of fuller's earth to the Bureau of Mines in recent years.

California:
- Inyo County—Olancha Mineral Products Co. (Ltd.), 714 South Hill Street, Los Angeles.
- San Bernardino County—Hill Bros. Chemical Co., 2159 Bay Street, Los Angeles.

Colorado:
- Mineral County—Peerless Clay & Mineral Co., 53 West Jackson Boulevard, Chicago, Ill.

Florida:
- Gadsden County—
  - Floridin Co., 220 Liberty Street, Warren, Pa.
  - Fuller's Earth Co., 10616 Euclid Avenue, Cleveland, Ohio.
- Marion County—Superior Earth Co. (Inc.), Ocala.

Georgia:
- Decatur County—Attapulgus Clay Co., 260 South Broad Street, Philadelphia, Pa.
- Stewart County—Columbia Chemical Corporation, 25 Broad Street, New York, N. Y.
- Twiggs County—General Reduction Co. (Inc.), Macon.
- Wilkinson County—Hall-Stevens Products Co., McIntyre.

Idaho:
- Idaho County—Acilis Corporation, 3080 Andover Street, Seattle, Wash.

Illinois:
- Pulaski County—
  - Sinclair Refining Co., 45 Nassau Street, New York, N. Y.
  - Standard Oil Co. (Indiana), 910 South Michigan Avenue, Chicago.

Massachusetts:
- Norfolk County—Stoughton Earth Co., 161 Devonshire Street, Boston.
- Worcester County—R. M. Farnsworth Estate, Lancaster.

Nevada:
- Esmeralda County—U. S. Diatom Co., 800 Santa Fe Avenue, Los Angeles, Calif.
- Nye County—
  - Coen Co. (Inc.), 428 Story Building, Los Angeles, Calif.
  - Filtering Clay Products (Ltd.), 811 West Seventh Street, Los Angeles, Calif.

Texas:
- Bexar County—Standard Fuller's Earth Co. (Inc.), Box 56, South San Antonio. (Also in Grimes County.)
- Fayette County—Crown Central Petroleum Corporation, First National Bank Building, Houston.
- Gonzales County—Coen Co. (Inc.), 428 Story Building, Los Angeles, Calif.
- Walker County—
  - Continental Oil Co. of Delaware, Ponca City, Okla.
  - The Texas Co., Houston.

Utah:
- Sevier County—Western Clay & Metals Co., 576 Chamber of Commerce Building, Los Angeles, Calif.

CONSUMERS

The more important consumers of fuller's earth are among the oil-refining companies listed in United States Bureau of Mines Information Circular 6485, Petroleum Refineries in the United States, January 1, 1931. This directory is issued annually and may be obtained from the United States Bureau of Mines, Washington, D. C., as long as copies are available for distribution.

In the following (incomplete) list are included certain mineral and edible oil-refining companies, as well as some dealers and brokers who normally are in the market for various filtering and decolorizing earths and clays.

Possible purchasers of fuller's earth

Arkansas:
- Eldorado—Lion Oil Refining Co.

California:
- Los Angeles—
  - Braun Corporation, 363 New High Street.
  - General Petroleum Corporation of California.
  - Richfield Oil Co. of California.
  - Union Oil Co. of California.
- San Francisco—
  - Associated Oil Co. of California.
  - Standard Oil Co. of California.

Georgia:
- Atlanta—International Vegetable Oil Co.

Illinois:
- Chicago—
  - Armour & Co., Union Stock Yards.
  - Cudahy Packing Co., 111 West Monroe Street.
  - Dabrol Products Corporation.
  - Pure Oil Co.
  - Standard Oil Co. (Indiana), 910 South Michigan Avenue.
  - Swift & Co.
  - Wilson & Co.
- Lawrenceville—Indian Refining Co.

Iowa:
- East Omaha—Mona Motor Oil Co.

Kansas:
- Coffeyville—National Refining Co.
- Neodesha—Standard Oil Co. of Kansas.

Louisiana:
- Baton Rouge—Standard Oil Co. of Louisiana.

Massachusetts:
- Boston—Cities Service Refining Co.
- Cambridge—Lever Bros. Co.

Missouri:
- St. Louis—Shell Petroleum Corporation.

Montana:
- Billings—Big Horn Oil & Refining Co.

New York:
- Long Island City—Triplex Oil Refining Co. (Inc.), 37–80 Review Avenue.
- New York—
  - Cheseborough Manufacturing Co.
  - Corn Products Refining Co., 17 Battery Place.
  - Charles B. Chrystal Co. (Inc.), 11 Cliff Street.
  - Gold Dust Corporation, 44 Beaver Street.
  - Hammil & Gillespie (Inc.), 225 Broadway.
  - J. L. Hopkins & Co., 135 William Street.
  - Industrial Chemical Sales Co. (Inc.), 230 Park Avenue.
  - Pomeroy & Fischer (Inc.), 95 Madison Avenue.
  - L. A. Salomon & Bro., 216 Pearl Street.
  - Sinclair Refining Co., 45 Nassau Street.
  - Standard Oil Co. of New Jersey, 26 Broadway.
  - Standard Oil Co. of New York, 26 Broadway.
  - Tide Water Oil Co., 17 Battery Place.
  - Vacuum Oil Co. (Inc.), 61 Broadway.

Ohio:
- Cincinnati—
  - National Sales Corporation, 31 East Thirteenth Street.
  - Procter & Gamble Co.
- Cleveland—Standard Oil Co. of Ohio.

Oklahoma:
- Cyril—Anderson-Prichard Oil Corporation.
- Duncan—Rock Island Refining Co.
- Ponca City—Continental Oil Co.
- Tulsa—
  - Barnsdall Refineries (Inc.), P. O. Box 2091.
  - Empire Oil & Refining Co.
  - Marathon Oil Co.
- West Tulsa—Mid-Continent Petroleum Corporation.

Pennsylvania:
- Bradford—
  - Bradford Oil Refining Co.
  - Kendall Refining Co.
- Clarendon—Pure Penn Refining Co.
- Marcus Hook—Sun Oil Co.
- Oil City—
  - The Pennzoil Co.
  - Quaker State Oil Refining Co

Pennsylvania—Continued.
- Philadelphia—
  - The Atlantic Refining Co.
  - The Harshaw Chemical Co., Jackson and Swanson Streets.
  - C. F. Simmons Sons Co.
  - Chas. A. Wagner & Co. (Inc.), 811 Callowhill Street.
- Pittsburgh—
  - Gulf Refining Co., Frick Building Annex.
  - Waverly Oil Works Co., Fifty-fourth Street.
- Warren—
  - Conewango Refining Co.
  - Pennsylvania Oil Products Refining Co.

Texas:
- Beaumont—Magnolia Petroleum Co.
- Houston—
  - Crown Central Petroleum Corporation of Texas.
  - Humble Oil & Refining Co.
  - The Texas Co.
- Seguin—Seguin Cotton Oil Co.

Utah:
- Salt Lake City—Utah Oil Refining Co.

West Virginia:
- Charleston—Elk Refining Co.

Wyoming:
- Casper—The Midwest Refining Co.
- Parco—Producers & Refiners Corporation.

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TALC AND SOAPSTONE [1]

By OLIVER BOWLES and B. H. STODDARD [2]

CONTENTS

INTRODUCTION

Talc and soapstone are included in a single chapter because talc is present in varying amounts in all true soapstones, being the constituent that gives them their characteristic soapy feel. There is, too, some similarity in the uses of the two minerals. A small amount of massive talc (steatite) is shaped into insulators, crayons, and other forms comparable with soapstone products, and a limited tonnage of soapstone is pulverized and sold for the same uses as low-grade ground talc. Aside from these activities, which use a very small fraction of the total output, the two industries are, however, quite diverse. About 95 per cent of all talc mined is sold in pulverized form, whereas at least an equal percentage of all soapstone is marketed as slabs, blocks, or other structural products. Soapstone production is therefore part of the dimension-stone industry. In view of this diversity in quarry and mill processes and in use of products, talc and soapstone are considered separately in this chapter.

TALC

GENERAL CONDITIONS

The talc industry declined in 1931, although its downward trend was less pronounced than in 1930. From the high output of 1929 a decrease of 18 per cent in quantity and 20 per cent in value was recorded in 1930, and a further decline of 9 per cent in quantity and 12 per cent in value was recorded for 1931 as compared with 1930. The total quantity sold, as reported by 25 producers, was the lowest recorded since 1921. Competition was sharp between the lower grades of ground talc and ground soapstone, which have the same uses

[1] Work on manuscript completed June, 1932.
[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

in the rubber and roofing industries. Prices suffered some recession and efforts were made to maintain profits by reducing operating costs. No new companies entered the field in 1931; and three of the active producers in 1930, one each in California, Nevada, and Virginia, did not report any production of talc in 1931.

Reduced demand and lower prices were reflected in a drop of 9 per cent in volume and 18 per cent in value of imports, as compared with 1930. The value of imports in 1931 was the lowest since 1924.

COMPOSITION AND PROPERTIES

Pure talc contains 31.7 per cent of magnesia (MgO), 63.5 per cent of silica (SiO_2), and 4.8 per cent of water (H_2O). Its chemical composition is expressed by the formula $H_2Mg_3(SiO_3)_4$. Talc mined or quarried in the United States usually contains small quantities of clay, iron oxide, silica, calcite, and dolomite, together with sodium and potassium compounds.

A soapy feel and a softness which permits it to be scratched easily with the finger nail are its most characteristic physical properties. The texture of talc from various localities varies considerably; it occurs in fine granular, flaky, and occasionally fibrous form. Talc has superior properties of resisting and retaining heat, is very resistant to the action of all ordinary acids and alkalies, and when pure has high dielectric strength. It ranges in color from pure white to various shades of gray, green, and yellow and is colloidal when finely ground.

A related mineral, pyrophyllite, differs from talc in composition only by the replacement of magnesium with aluminum. It closely resembles talc in color, luster, and feel and is employed as a substitute for it in many products. Therefore, the production of pyrophyllite in the United States is included with that of talc.

ORIGIN AND OCCURRENCE

Talc is generally regarded as a secondary mineral resulting from the alteration of primary magnesian minerals such as pyroxenes and amphiboles. If alteration has not been complete, some of the original magnesian rocks or minerals may be present as impurities. Talc occurs in commercial quantities only in areas of highly crystalline schists, gneisses, and other regional metamorphic rocks. Deposits in New York and North Carolina are associated with limestone and have been derived from the alteration of tremolite schist in the limestone. Many talc deposits are in the form of irregular, more or less lenticular bodies. Commercial operations are confined chiefly to the Appalachian Mountain areas of the Atlantic States and to the mountainous belt near the Pacific coast, notably in California and Washington.

USES

The uses of talc are determined largely by its physical properties. Thus, its colloidal nature and its high retention make it valuable as a paper filler. It is useful also as a filler in paint and other products. Its soapy feel and absence of grit render it peculiarly adaptable to the manufacture of toilet powders and cosmetics. Talc is employed commercially in a great many ways, but because of inherent differences in physical and chemical properties material from all deposits can not be applied equally to all uses.

Ground talc is used extensively as a filler in paper, paint, rubber, textiles, and various other products. It is also employed for foundry facings, lubricants, and various toilet preparations, such as talcum powder; in ceramics and glass making; as a polishing agent for peanuts and rice; as an insecticide; and as an insulating material for underground conduits. Large quantities of low-grade talc are used in the manufacture of composition roofing, both as surface material to increase weather-resisting qualities and as a nonadhesive coating to prevent sticking. It is also used in rubber factories to prevent rubber compounds from adhering to hot rollers. Off-color talc is consumed in increasing amounts for rock-dusting coal mines.

Because of their electrical resistance and remarkable property of hardening under heat treatment certain massive talcs free from iron oxide or grit and without cracks or cleavage planes are used for manufacture of the so-called "lava" products. The material, which is easily carved in its natural soft state, is fashioned into innumerable electrical fittings, such as bushings, blocks, tubes, disks, or threaded cores. The articles are then heated to about 1,100° C., such calcination having the peculiar effect of rendering the product hard enough to cut glass; yet the expansion, contraction, and distortion resulting from heating and subsequent cooling are so minute that the shapes, sizes, and even the accuracy of the milling remain unimpaired. The purer forms of massive talc are employed chiefly for electrical insulation. Massive talc is also used in the manufacture of crayons, pencils, and French chalk (tailor's chalk).

About 96 per cent of the total talc output in 1931 was sold in pulverized form. From information supplied by producers it has been possible to classify 96 per cent of the ground talc sold according to uses, as follows:

Ground talc sold to various industries in the United States in 1931

	Per cent of total		Per cent of total
Paint	48	Foundry facing	1
Paper	16	Ceramics	1
Roofing	11	Miscellaneous [3]	9
Rubber	11		
Toilet preparations	3		100

PRODUCTION

The total quantity of talc sold by producers in the United States in 1931 was 163,752 short tons, valued at $1,852,472. As compared with 1930, these figures represent decreases of 9 per cent in quantity and 12 per cent in value. The output comprised 6,673 short tons of crude talc, valued at $47,382; 181 short tons of sawed and manufactured talc, valued at $51,740; and 156,898 short tons of ground talc, valued at $1,753,350. Of the total sales, New York supplied 84,977 tons, valued at $1,059,790, as compared with 93,216 tons, valued at $1,192,604, in 1930, a decrease of 9 per cent in quantity and 11 per cent in value; Vermont supplied 38,424 tons, valued at $318,322, as compared with 45,881 tons, valued at $399,548, in 1930, a decrease of 16 per cent in quantity and 20 per cent in value; and California

[3] Includes talc used for waterproofing concrete and in pharmaceutical products, plastic cement, tiling, wall plaster, wire insulation, textiles, stove linings, lubricants, cleansing preparations, and cork.

supplied 11,605 tons, valued at $180,582, as compared with 14,993 tons, valued at $219,246, in 1930, a decrease of 23 per cent in quantity and 18 per cent in value. The talc industry of North Carolina with a production of 15,283 tons, valued at $170,250, has made noteworthy progress. Figures for 1930 are not available for publication, but the 1931 production exceeded that of 1929 by 62 per cent in quantity and 109 per cent in value. New York produced 52 per cent of quantity and 57 per cent of value of all the talc mined in the United States in 1931. Ninety-two per cent of the total quantity and 93 per cent of the total value were produced by New York, Vermont, North Carolina, and California combined. The remainder of the output came from Georgia, Maryland, New Jersey, Pennsylvania, Virginia, and Wisconsin.

Sales of talc and soapstone by producers over a series of years are shown in the following table:

Talc and soapstone sold by producers in the United States, 1922–1931, by classes

Year	Crude		Sawed and manufactured: Talc		Sawed and manufactured: Soapstone		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1922	4,981	$22,582	654	$86,333	22,700	$712,144	170,349	$2,038,838	198,684	$2,859,897
1923	5,706	50,125	682	114,772	22,857	932,098	167,447	1,915,258	196,692	3,012,253
1924	5,710	22,247	846	109,405	25,630	1,288,885	171,635	2,095,019	203,821	3,515,556
1925 [1]	5,684	24,533	895	107,691	(2)	(2)	175,677	1,879,569	182,256	2,011,793
1926 [1]	5,988	26,723	1,528	130,253	(2)	(2)	174,052	1,954,018	181,568	2,110,994
1927 [1]	5,706	25,365	1,494	111,650	(2)	(2)	185,116	2,097,709	192,316	2,234,724
1928 [1]	6,360	48,031	936	70,394	(2)	(2)	195,680	2,419,569	202,976	2,537,994
1929 [1]	11,228	87,820	473	140,928	(2)	(2)	208,082	2,399,914	219,783	2,628,662
1930 [1]	4,972	48,913	385	90,370	(2)	(2)	174,028	1,969,055	179,385	2,108,338
1931 [1]	6,673	47,382	181	51,740	(2)	(2)	156,898	1,753,350	163,752	1,852,472

[1] Figures represent talc only. [2] Bureau of Mines not at liberty to publish figures for soapstone.

Talc sold by producers in the United States, 1929–1931, by classes

Form in which sold	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Rough (crude)	11,228	$87,820	4,972	$48,913	6,673	$47,382
Sawed and manufactured [1]	473	140,928	385	90,370	181	51,740
Ground [2]	208,082	2,399,914	174,028	1,969,055	156,898	1,753,350
	219,783	2,628,662	179,385	2,108,338	163,752	1,852,472

[1] For slate pencils and metal-worker's crayons and for blanks used in making acetylene burners and other objects.
[2] For filler in paper, paint, and rubber goods, and for toilet powder, foundry facings, textiles, lubricators, electric insulation, pharmaceutical products, waterproofing, concrete, etc.

REVIEW BY STATES

The following table gives the quantity and value of the talc sold by producers in the various States in the last three years.

Talc sold by producers in the United States, 1929–1931, by States

State	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
California	17,620	$256,977	14,993	$219,246	11,605	$180,582
Georgia	4,989	146,025	(1)	(1)	(1)	(1)
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Nevada			50	600		
New Jersey and Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
New York	109,543	1,439,272	93,216	1,192,604	84,977	1,059,790
North Carolina	9,439	81,306	(1)	(1)	15,283	170,250
Vermont	60,469	546,658	45,881	399,548	38,424	318,322
Virginia	5,185	47,646	(1)	(1)	(1)	(1)
Wisconsin	4,350	14,238	1,078	3,499	3,583	11,646
Undistributed	8,188	96,540	24,167	292,841	9,880	111,882
	219,783	2,628,662	179,385	2,108,338	163,752	1,852,472

1 Included under "Undistributed."

California.—The quantity of talc sold in California in 1931 (11,605 tons) was the smallest since 1921. The value, likewise, was lower than for any other year since 1921. Production decreased 23 per cent in quantity and 18 per cent in value compared with 1930. The output, which was all ground before being sold, brought an average price of $15.56 a ton, compared with $14.62 in 1930. Ninety per cent of the total sold was high-grade talc from Inyo and San Bernardino Counties. The Pacific Coast Talc Co., 2149 Bay Street, Los Angeles, reported new uses for its material, notably the use of crystalline talc as an admixture in concrete and in the ceramic industry.

Georgia.—In 1931 two producers in Georgia, the Cohutta Talc Co. and the Georgia Talc Co., furnished the entire output of the State. The total sales, consisting of talc crayons and ground talc, increased in quantity but decreased in value as compared with 1930. The average price of talc crayons ($278 a ton) increased as compared with 1930, while the average price of ground talc was $6.49 a ton as compared with $6.51 in 1930.

Maryland.—The marketed production of talc in Maryland was contributed by two producers—the Harford Talc Co., of Baltimore, and Herbert I. Oursler, Marriottsville. The production of the Harford Talc Co., which is of refractory grade, is utilized in the manufacure of lava tips for gas burners, of electrical insulators, and of heat-resisting parts. The product of the Oursler property near Henryton, Carroll County, is an impure talc schist used principally for foundry facings.

New Jersey and Pennsylvania.—The Rock Products Co. operated, as usual, its property at Phillipsburg, N. J. The product—talc dust—was sold in crude form. Operations in Pennsylvania were conducted at the Fox quarry near Easton by C. K. Williams & Co. This region, which is limited to the vicinity of Easton, produces talc that is associated with serpentine; hence, the trade name "verdolite." The rock is ground and used largely in the manufacture of paint, plaster, paper, soap, and rubber goods.

New York.—Three companies supplied the entire output of talc in New York in 1931; it was all ground to a powder before being sold. Total sales decreased 9 per cent in quantity and 11 per cent in value as compared with 1930. New York, as usual, outranked all other States, contributing 52 per cent of the total sales for the year. The fibrous variety of talc of the Gouverneur district was mined by the International Pulp Co., 41 Park Row, New York City, and the W. H. Loomis Talc Corporation, 173 East Main Street, Gouverneur; and the nonfibrous variety of Natural Bridge was mined by the Carbola Chemical Co. (Inc.), Natural Bridge.

North Carolina.—The marketed output of North Carolina consisted of talc and pyrophyllite. Pyrophyllite, a hydrous silicate of aluminum, has physical properties similar to those of talc and therefore has many of the same uses as talc. The increases in both quantity and value of the output of North Carolina in 1931 are attributed largely to the increased sales of pyrophyllite in the State.

Vermont.—In 1931 sales of talc in Vermont, which decreased 16 per cent in quantity and 20 per cent in value, consisted almost entirely of ground talc and had an average value of $8.28 a ton, as compared with $8.71 a ton in 1930. Vermont ranked second, as usual, in production of talc in the United States in 1931. A large increase in production, however, was reported by the Vermont Mineral Products (Inc.) at Chester, whose property 2½ miles from Chester in Windsor County was formerly operated by the American Soapstone Finish Co.; the increase is attributed to the fact that the company's trade was not fully established in 1930, the first year of operations.

Virginia.—Sales of talc in Virginia were reported, as usual, by the Blue Ridge Talc Co., Henry, and the Bull Run Talc & Soapstone Co., Clifton Station. The production was obtained from Franklin and Fairfax Counties. Decreases in both quantity and value were reported, as compared with 1930. The output was sold as crude and ground talc and was used chiefly for foundry facings. Soapstone produced in Nelson County is discussed on page 109.

Wisconsin.—The American Talc Co., Plymouth, the only producer of talc in Wisconsin, reported sales of talc amounting to more than three times the quantity and value of those reported in 1930. The product was sold in crude form for grinding to a mid-western dealer.

LIST OF PRODUCERS

Producers of talc and soapstone in the United States in 1931

Producer	Material	Product	Location of mine
CALIFORNIA			
W. S. McLean, 1919 San Bruno Avenue, San Francisco.	Soapstone	Ground	Butte County.
Pacific Coast Talc Co., 2149 Bay Street, Los Angeles.	Talc	do	7 miles north of Silver Lake station, San Bernardino County.
Sierra Talc Co., 428 Union League Building, Los Angeles.	do	do	Near Darwin, Inyo County.
Western Talc & Magnesite Co., 1901 East Slauson Avenue, Los Angeles.	do	do	Tecopa, Inyo County.
John L. Witney (Inc.), Jamestown.	Soapstone	do	Near Jamestown, Tuolumne County.
GEORGIA			
Cohutta Talc Co., Dalton	Talc	Crayons, ground.	Chatsworth, Murray County.
Georgia Talc Co., Asheville, N. C.	do	do	Foot of Cohutta Mountain, 3¼ miles southeast of Chatsworth, Murray County.
MARYLAND			
Harford Talc Co., 1516 Continental Building, Baltimore.	Talc, massive steatite, or "lava" grade.	Rough	Near Dublin, Harford County.
Herbert I. Oursler, Marriottsville	Talc schist	do	Near Henryton, Carroll County.

Producers of talc and soapstone in the United States in 1931—Continued

Producer	Material	Product	Location of mine
NEW JERSEY			
Rock Products Co., 403 Trust Building, Easton, Pa.	Talc and serpentine.	Rough	Above Marble Hill, on Delaware River near Phillipsburg, Warren County.
NEW YORK			
Carbola Chemical Co. (Inc.), Natural Bridge.	Talc	Ground	1¼ miles from Natural Bridge, Lewis County.
International Pulp Co., 41 Park Row, New York.	do	do	Talcville, St. Lawrence County.
W. H. Loomis Talc Corporation, 173 East Main Street, Gouverneur.	do	do	Fowler, St. Lawrence County.
NORTH CAROLINA			
Nantahala Co., Andrews	do	Rough, blanks, crayons.	Hewitt, Swain County.
Notla Talc Co., Murphy	do	Rough, crayons, ground.	Near Murphy, Cherokee County.
Craig L. Rudisell Talc Co., Marshall.	do	Crayons	Near Marshall, Madison County.
Standard Mineral Co. (Inc.), Hemp	Pyrophyllite	Ground	2½ miles from Hemp, Moore County.
PENNSYLVANIA			
C. K. Williams & Co., 640 North Thirteenth Street, Easton.	Talc and serpentine.	do	Near Easton, Northampton County.
VERMONT			
American Soapstone Finish Co. (Inc.), Chester.	Talc	do	2½ miles northwest from Chester, Windsor County.
Eastern Magnesia Talc Co. (Inc.), Burlington.	do	Crayons, ground	Johnson, Lamoille County, and Waterbury, Washington County.
Vermont Mineral Products (Inc.), Chester.	do	Ground	Near Chester, Windsor County.
Vermont Talc Co., Chester	do	do	Windham, Windham County.
VIRGINIA			
Blue Ridge Talc Co. (Inc.), Henry	do	Rough, ground	Near Henry Station, Franklin County.
Bull Run Talc & Soapstone Co. (Inc.), Clifton Station.	do	Ground	3 miles north of Clifton, Fairfax County.
Virginia Alberene Corporation, 153 West Twenty-third Street, New York, N. Y.	Soapstone	Furnace blocks, special products, ground.	Schuyler, Nelson County.
WISCONSIN			
American Talc Co., Plymouth	Talc	Rough	Milladore, Wood County.

PRICES

Prices of talc depend on the quality and the fineness of grinding. The average price in the rough as the talc came from the mine in 1931, for the United States as a whole, was $7.10 a short ton. Some of it sold as low as $3.25 a ton, while other material sold as high as $30 a ton. Talc sawed and manufactured into crayons, pencils, and similar products sold at an average of $286 a ton. Vermont talc, graded 99 per cent through 200 mesh, was quoted at $8 to $8.50 a ton throughout the year. Similarly, Virginia 325-mesh talc was quoted regularly at $8.75 to $10.50, but Virginia 200-mesh material, with a minimum quotation of $6 a ton for the first half of 1931, dropped to a minimum of $4.60 from August to December. New York double air-floated short-fiber 200-mesh talc maintained a price of $13.75 a ton and 325-mesh material a price of $14.75; both of these quotations were the same as in 1930. The New Jersey product, designated ground soapstone, was quoted regularly at $10 to $12 a ton. Georgia talcs were not regularly quoted. The average foreign market value per short ton of all Italian talc imported into the United States in 1931 was $26.93, as compared with $27.04 in 1930. Imports of Canadian talc averaged $9.93 and those of French talc $11.79 a ton. The corresponding figures in 1930 were $11.35 and $11.55, respectively. It is evident, therefore, that talc from European sources suffered less price decline than either the domestic or Canadian products; French talc, in fact, shows a small increase in unit value.

NOTEWORTHY TRENDS AND DEVELOPMENTS

According to press reports the Moss Chemical Co. is installing a new electrochemical process at Chatsworth, Ga. It is claimed that with the new equipment, Georgia talc may be refined so that it will compare favorably with the finest of the imported Italian product. Another press notice relates that the Labbe Manufacturing Co., of Denver, Colo., is developing a talc deposit near Wheatland, Wyo. A novel use, not heretofore noted, is planned for a part of the product of this mine, namely, the manufacture of a powder for dance floors—an air-separated product between 85 and 110 mesh. Production during 1932 is expected.

The Notla Talc Co., operating 6 miles west of Murphy, N. C., is enlarging its plant to take care of increasing business.

As reported in the Talc and Soapstone chapter for 1930, it has been claimed that definite advantages result from adding to concrete a small percentage of the fibrous talc from Gouverneur, N. Y. Some of the advantages are increased plasticity, imperviousness to water, acid resistance, and strength. Crystalline talc apparently has similar advantages. According to Wicks,[4] laboratory tests and experience indicate definite improvement in the structural qualities and appearance of concrete in which crystalline talc has been used as an admixture. Increasing quantities of talc are being consumed in both concrete and mortar.

Increased sales of pyrophyllite in North Carolina contributed largely to the increased output of the State. Crude and ground talc also increased in quantity and value, but the output of talc crayons in the State decreased.

The marketed production of talc in Wisconsin, reported by one producer, was more than three times the quantity and value of the output in 1930.

Until recent years Russia has been an importer of talc; but production is increasing in the Ural district to such an extent that domestic needs are supplied, and a surplus is available for export. Exports of 515 metric tons in 1928 and 808 tons in 1929 have been reported.

A deposit of high-grade talc has been developed by the Mineralia Co. 12 kilometers from the town of Hunedoara, Rumania. About 80 tons have been mined, and according to report it compares favorably with Italian and American talc. Present mine capacity is 10 tons of selected mineral a day, and the principal markets are Rumania and Germany. The company needs capital for further development.

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[4] Wicks, Frank B., Crystalline Talc As an Admixture in Concrete: Proc. Am. Soc. Testing Materials, vol. 31, pt. 2, 1931 pp. 534–548.

IMPORTS AND EXPORTS

Talc imported for consumption in the United States, 1922–1931

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1922	248	$9,850	18,196	$367,528	18,444	$377,378
1923	560	20,653	19,405	402,238	19,965	422,891
1924	313	4,847	17,496	337,508	17,809	342,355
1925	121	6,547	20,872	443,985	20,993	450,532
1926	199	16,366	23,642	523,716	23,841	540,082
1927	377	27,326	24,817	523,056	25,194	550,382
1928	459	33,276	26,590	546,639	27,049	579,915
1929	1,228	74,840	29,949	596,789	31,177	671,629
1930	722	28,306	25,057	501,516	25,779	529,822
1931	146	7,755	23,335	425,927	23,481	433,682

[1] Prior to Sept. 22, 1922, the classification was "Talc, steatite, and French chalk—cut, ground, or washed."

France, Italy, and Canada are the chief sources of foreign talc. Total imports for consumption in 1931, as in 1930, were equivalent to 14 per cent of total domestic sales. Italian talc is of high quality and is particularly well adapted for the manufacture of cosmetics. Both ground talc and the massive variety known as French chalk (tailor's chalk) are imported from France.

Of the total (23,481 tons) imported for consumption in the United States in 1931, 146 tons, valued at $7,755, was crude material.

Talc, steatite or soapstone, and French chalk, crude, manufactured, or ground, imported into the United States, 1930 and 1931, by countries

[General imports]

Country	1930		1931	
	Short tons	Value	Short tons	Value
Africa:				
British—				
Union of South Africa	123	$2,971	99	$3,071
Other British South Africa	1	20		
Portuguese—Mozambique	22	419		
Austria	149	4,438	34	994
Canada	7,580	86,012	6,829	67,817
China	350	63,231	326	50,447
Cuba			29	1,435
Czechoslovakia	(1)	70		
France	7,785	89,886	8,020	94,556
Germany	30	1,992	29	1,406
Hong Kong	(1)	101	(1)	98
India (British)	447	22,484	(1)	166
Italy	8,557	231,378	7,707	207,542
Japan	162	5,634	394	8,450
Kwantung	1	26		
Soviet Russia in Europe	(1)	94	20	162
Spain	1	40	4	160
United Kingdom	4	278	57	494
	25,212	509,074	23,548	436,798

[1] Less than 1 ton.

Exports of "talcum and other toilet powders" in 1922 amounted to 1,821 short tons, valued at $1,397,542; in 1923, 1,907 tons, valued at $1,671,588; in 1924, 1,614 tons, valued at $1,688,211; in 1925, 1,734 tons, valued at $1,882,196; in 1926, 1,645 tons, valued at $1,726,933;

in 1927, 1,627 tons, valued at $1,621,068; and in 1928, 1,568 tons, valued at $1,605,630. Exports of "powders—talcum, face, compact, bath, and other toilet powders" in 1929 were valued at $1,592,301; quantity not recorded. In 1930 exports of talcum powder (in bulk) amounted to 956,050 pounds, valued at $36,410; exports of "powders—talcum (in packages), face, and compact toilet powders" were valued at $1,447,928; quantity not recorded. In 1931 exports of "powders—talcum, face, and compact" were valued at $1,244,525; quantity not recorded.

TARIFF

The import duties on talc and steatite or soapstone, as fixed by the tariff act which became effective June 18, 1930, are described as follows:

Talc, steatite or soapstone, and French chalk, crude and unground, one-fourth of 1 cent per pound; ground, washed, powdered, or pulverized (except toilet preparations), 35 per centum ad valorem; cut or sawed, or in blanks, crayons, cubes, disks, or other forms, 1 cent per pound; manufactures (except toilet preparations), of which talc, steatite or soapstone, or French chalk is the component material of chief value, wholly or partly finished, and not specially provided for, if not decorated, 35 per centum ad valorem; if decorated, 45 per centum ad valorem.

WORLD PRODUCTION

The following table gives the world production of talc and soapstone, 1927–1931, in so far as figures are available.

World production of talc and soapstone, 1927–1931, by countries, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Australia:					
New South Wales	488	674	555	280	230
South Australia	629	641	776	811	817
Tasmania		33	23	14	15
Austria (exports)	17,135	19,755	19,603	18,530	(2)
Canada	14,988	14,567	[3] 14,069	[3] 10,742	[3] 10,710
China [4]	23,000	(2)	(2)	(2)	(2)
Finland	1,050	4,725	2,848	2,800	(2)
France	75,600	89,500	105,560	(2)	(2)
Germany (Bavaria)	6,381	7,872	6,805	5,794	4,208
Great Britain		164	29	188	163
Greece	213	30	150	256	(2)
India (British)	5,134	5,628	7,333	6,967	(2)
Italy	32,940	33,030	40,810	38,131	38,620
Japan [5]	60,000	(2)	(2)	(2)	(2)
Morocco, French (exports)	2	535	610	(2)	(2)
Norway	7,607	7,822	8,332	7,690	(2)
Rumania	1,138	2,164	1,077	3,353	(2)
Russia [6]	2,118	5,568	(2)	(2)	(2)
Spain	3,843	5,302	5,164	5,438	6,585
Sweden	3,475	4,876	7,026	5,117	(2)
Union of South Africa (Transvaal)	307	541	464	380	336
United States [7]	174,465	184,136	199,383	162,734	148,553
Uruguay (exports)	36	985	786	1,463	1,789

[1] In addition to the countries listed, Argentina, Brazil, and Guatemala produce a small quantity of talc. No data of production are available for Argentina and Brazil. Rail and river shipments in Argentina for 1928 were reported as 440 kilograms. Guatemala reports a production of 193 tons in 1927.
[2] Data not available.
[3] Exclusive of soapstone for which value only is given.
[4] Talc only. Estimated production (China, Geological Survey Special Report).
[5] Includes agalmatolite.
[6] Year ended Sept. 30.
[7] Figures represent talc only. Bureau of Mines not at liberty to publish figures for soapstone.

Estimating the production of France at about 100,000 tons and Japan, China, and Russia at about 88,000 tons, world production in 1930 was divided about as follows: United States, 36 per cent; France, 22; Japan, China, and Russia, 19; Italy, 8; Germany and Austria, 5; Canada, 3; and other countries 7.

SOAPSTONE

DEFINITION

The term "soapstone" in its original sense apparently was synonymous with steatite (massive talc). More properly, however, the term includes all dark-gray to greenish talcose massive rocks that have a soapy feel and that, with few exceptions, are soft enough to be carved easily with a knife. While all true soapstone contains talc the percentage present is extremely variable, ranging from less than 10 to 80 or more per cent. Other constituents are actinolite, chlorite, and calcite, with smaller amounts of mica, tremolite, pyrite, quartz, and iron oxide. Soapstone therefore is generally a rock rather than a mineral.

USES

The uses of soapstone are intimately related to its physical properties. Its notable resistance to acids and heat has led to one very important use in paper manufacture, namely, the lining of smelting furnaces of sulphate (kraft) pulp mills, a use that consumes about 40 per cent of the total output. For this purpose compact, massive material, free from cracks, flaws, or schistosity and containing no pyrite, calcite, or dolomite, is desired. The chemical inertness of soapstone has led to its wide use for laboratory equipment, including table tops, sinks, drain boards, gutters, fume hoods, shelving, floors, and tanks. Similar use of the stone is made in chemical and dye works and in photographic and blue-print laboratories.

Its easy workability, light color, and resistance to weathering or water action fit soapstone admirably for many structural uses, such as laundry tubs, aquariums, wainscoting, mantels, baseboard, stair treads, tiles, and spandrels. The structural uses are becoming increasingly important, but the major applications are quite different from those of many years ago. In early days more than half the soapstone quarried was used in the manufacture of laundry tubs and kitchen sinks, whereas only about 10 per cent of the total volume is now consumed in this way. On the other hand, increased amounts are used for spandrels, floor tile, stair treads, and other building uses.

Some soapstones have high dielectric strength and are used for switchboards and other electrical purposes. On account of its ability to resist and to retain heat soapstone is employed for griddles, foot warmers, fireless-cooker stones, fireplaces, hearths, and furnace linings. Pulverized waste material is employed in the roofing industry, as an admixture in concrete, as a filler, and for dusting coal mines.

PRODUCTION CENTERS

The principal soapstone deposits in the United States, which now supply practically the entire output, form a large belt extending through Nelson, Albemarle, and Orange Counties, Va. Present operations are conducted by the Virginia Alberene Corporation at Schuyler, Nelson County. The deposits near that place consist of irregular or lens-like dikes bordered with mica schist and peridotite and are regarded as alteration products of basic igneous rock. Many openings have been made, averaging about 100 by 120 feet in size and 100 to 200 feet in depth. Very large, well-equipped mills are maintained where blocks are sawed into slabs and fabricated into a great variety of products.

Soapstone has been produced in Vermont, Maryland, North Carolina, Rhode Island, and California, but no recent production has been noted. A deposit near Robertson, Quebec, Canada, was first utilized in 1922, and an industry of some magnitude has been developed. Production in 1925 amounted to 750 tons; in 1926, 995 tons; and in 1927, 1,411 tons. Tonnage for recent years is not given, but the value of block soapstone produced in 1929 was $47,986 and in 1930, $50,168. This material is used in Canadian kraft-paper mills and is supplemented by imports from Virginia.

Soapstone is quarried at Gudbrandsdal, Norway, for structural purposes. Deposits are reported in other countries; but foreign production, except as mentioned above, is confined to local uses. A large part of the world demand for slab soapstone is met by exports from the United States.

CONDITIONS IN THE INDUSTRY

From the discussion of uses already given it is evident that the building trades consume a major part of the soapstone output. The notable stagnation in building that has characterized the past two years has caused recession in sales of all structural products, and soapstone has shared in this general decline. As it is used in office buildings and other large structures more extensively than in residences, contracts for Federal, State, and privately owned buildings of large size in New York, Washington, and other eastern cities have created a market of some magnitude, although sales are far below those of normal years. Recovery may not be expected until the construction industries resume more normal activity.

During recent years so large a part of the production of soapstone has been in the hands of a single company that figures can not be published without revealing individual statistics. Production a number of years ago is shown in the table on page 102.

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ABRASIVE MATERIALS [1]

By Paul Hatmaker and A. E. Davis [2]

CONTENTS

INTRODUCTION

Industrial utilization of abrasive materials ranges from the cutting of the hardest metals and rocks with diamonds to the polishing of rice and peanuts with talc.

Abrasive materials are of two kinds, natural and artificial. Natural abrasives include emery and garnet, used in the manufacture of coated abrasive papers, and diamonds, used in saws to cut stone and in core drills; the term is properly applied to any mineral employed for cutting, grinding, or polishing which requires no other preparation than shaping, sizing, separation from impurities, or bonding into suitable forms. Artificial abrasives are synthetic compounds, mostly products of the electric furnace.

A great variety of natural mineral products is used either wholly or partly as abrasives; to group these under one heading is desirable, although many of the commodities so listed have other and perhaps more important utilization. As far as possible, statistics are confined to that part of the production used as abrasives. For example, figures for abrasive sandstone (such as grindstones, pulpstones, and whetstones), comprising only a small part of the sandstone industry, are easily segregated from the greater quantity used in the building industries. On the other hand, as it is impossible to make a separation by uses with diatomite and tripoli, the entire production is included in the figures for abrasives. Certain other minerals, such as quartz and feldspar, are considered in the Mineral Resources chapters entitled "Silica" and "Feldspar," because the extent to which they are used as abrasives is limited and the figures can not be determined with reasonable accuracy.

This report deals particularly with natural abrasives. Their production includes a number of widely scattered dissimilar enter-

[1] Work on manuscript completed June, 1932.

[2] Figures on production compiled by Miss A. T. Coons and Miss A. E. Davis, of the Bureau of Mines. Data on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

prises engaged in placing various products on the market. Not many of these enterprises would be considered large if compared with other mining industries, but individually as well as collectively they are important elements in the industrial life of the Nation. They supply not only tools for grinding, polishing, and other abrasive operations but also ingredients of cleansing compounds, without which the wood, leather, glass, metal-working, and other industries, as well as many householders, would be put to great expense and inconvenience.

Artificial abrasives are finding very wide use as substitutes for natural abrasives. Therefore, they are considered briefly in this report for purposes of comparison and because of their strong influence on the marketing of the natural products.

In addition to these, sand used for grinding and polishing is also considered briefly in this report, although complete figures appear in the Mineral Resources chapter on Sand and Gravel.

NATURAL ABRASIVES

Under the head of natural abrasives in this report are included millstones and related quarry products, such as chasers, dragstones, and paving stone for chaser mills; grindstones and pulpstones; oilstones and other whetstones, hones, scythestones, and rubbing stones; corundum and emery; abrasive garnet; tripoli; diatomite (diatomaceous earth); pumice and pumicite; and pebbles for grinding and lining for tube mills. In 1931 these natural abrasives were produced in 25 States as follows:

Arizona	Pumice.
Arkansas	Oilstones and tripoli.
California	Diatomite, grinding pebbles, pumice, and pumicite.
Idaho	Diatomite.
Illinois	Grindstones and tripoli.
Indiana	Rubbing stones and whetstones.
Kansas	Pumicite.
Michigan	Grindstones.
Minnesota	Grinding pebbles and tube-mill lining.
Missouri	Tripoli.
Nebraska	Pumicite.
Nevada	Diatomite.
New Hampshire	Garnet.
New York	Diatomite, emery, garnet, and millstones.
North Carolina	Millstones.
Ohio	Grindstones, pulpstones, rubbing stones, scythestones, and whetstones.
Oklahoma	Pumicite and tripoli.
Oregon	Diatomite.
Pennsylvania	Rottenstone.
South Dakota	Pumicite.
Tennessee	Tripoli.
Vermont	Scythestones.
Virginia	Millstones.
Washington	Diatomite and pulpstones.
West Virginia	Grindstones and pulpstones.

MILLSTONES

The value of the millstones or burrstones and related quarry products—chasers, dragstones, and pavers—sold by producers in the United States in 1931 was $5,330, a decrease of nearly 70 per cent compared with the value in 1930. Most of the reports for 1931 by millstone producers were returned with the laconic statement "no business" or "no orders."

American millstones have been for the most part made of quartz sandstone and conglomerate. During the past 10 years Ulster County, N. Y., has been the principal source of production, the largest number of producers having reported from that region. Montgomery County, Va., has also been an important source. Millstones are also made of granite, particularly in New Hampshire and North Carolina. The production recorded in Mineral Resources includes only the stones made for other than purely local use. Doubtless a large number of stones have been made in many unrecorded localities as local use has required, and they have been made of other rocks than those specified, particularly in the mountain sections of the Southern States.

The millstone-manufacturing industry was formerly much larger than it is now. About 1880 the total value of the stones produced and sold in the United States was around $200,000 annually. Production has declined since the late eighties and during the last 11 years has been less than $50,000 worth of stones annually. The decline is due in part to the fact that the manufacture of millstones is a handicraft in which, as in many others in the United States, the old master craftsmen, who are gradually disappearing, are not being replaced. In part, also, the change is due to new processes in the grain, paint, and mineral milling industries in which the old-style burrstones and chaser mills are being supplanted by grinding equipment of an entirely different type.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1922–1931

Year	New York		Other States [1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1922	12	$17,025	4	$3,828	16	$20,853
1923	17	14,344	4	7,885	21	22,229
1924	17	18,215	5	11,910	22	30,125
1925	13	14,063	5	8,427	18	22,490
1926	12	23,629	7	22,308	19	45,937
1927	12	26,015	5	9,423	17	35,438
1928	14	26,224	6	16,662	20	42,886
1929	11	18,147	5	13,260	16	31,407
1930	7	6,577	5	11,125	12	17,702
1931	6	2,030	2	3,300	8	5,330

[1] 1922: Alabama, North Carolina, and Virginia; 1923: Maine, Minnesota, North Carolina, and Virginia; 1924–1928 and 1930: New Hampshire, North Carolina, and Virginia; 1929 and 1931: North Carolina and Virginia.

GRINDSTONES AND PULPSTONES

The total output of grindstones and pulpstones in the United States in 1931 was 8,724 short tons, valued at $342,149, a decrease of 53 per cent in quantity and 56 per cent in value compared with 1930.

Grindstones and pulpstones are made chiefly from sandstone quarried in northeastern Ohio, western West Virginia, and eastern Michigan, and in Pierce County, Wash. In 1930 and 1931 grindstones were also made from sandstone quarried in Illinois; these stones were shaped by the company using the stones and were not marketed.

The tonnage of grindstones produced has gradually declined, undoubtedly because of the substitution of manufactured abrasive wheels for the natural stones. Segmental pulpstones, which are constructed of artificial abrasives and attached to a core of concrete or metal, are finding increasing use as substitutes for natural pulpstones. The manufacture of artificial grindstones from crushed sandstone, sand, and cement, shaped in molds of desired size, is also being considered.

An interesting article entitled "Producing Pulpstone on a Large Scale," describing the operations of the Smallwood Stone Co., appeared in the Explosives Engineer, volume 10, February, 1932, pages 63–65. A comparison is made of the size of pulpstones demanded by groundwood mills. Stones used in 1904 to grind 24-inch wood were commonly 54 inches in diameter and 27 inches thick, but now stones up to 67 inches in diameter and 54 inches thick are used to grind 48-inch wood. One thousand four hundred horsepower are required to operate a stone of this size.

The following 10-year table reveals the extent of the industry's decline.

Grindstones and pulpstones sold by producers in the United States, 1922–1931

Year	Grindstones		Pulpstones		
	Short tons	Value	Pieces	Short tons	Value
1922	21,367	$574,900	[1] 1,619	[1] 5,157	[1] $445,286
1923	37,384	1,008,899	2,533	9,186	680,416
1924	28,991	852,260	2,660	9,193	814,409
1925	28,970	864,637	2,530	8,370	841,302
1926	28,669	875,240	2,804	9,670	997,994
1927	23,222	633,207	2,707	8,709	921,543
1928	24,222	606,408	2,461	9,016	902,429
1929	21,071	617,618	1,834	6,665	623,928
1930	14,559	423,835	1,176	4,141	346,736
1931	6,994	221,272	482	1,730	120,877

[1] Exclusive of sales in Washington prior to 1923.

The companies producing grindstones and pulpstones for commercial purposes in the United States in 1931, with the locations of the deposits from which the stone was obtained, were as follows:

MICHIGAN

Huron County: Grind Stone City—The Cleveland Quarries Co. (address, Cleveland, Ohio); grindstones.

OHIO

Cuyahoga County: Berea—The Cleveland Quarries Co. (address, Cleveland); grindstones.

Holmes County:
- Glenmont—The Briar Hill Stone Co.; grindstones.
- Killbuck—Mount Pisbia Stone Co. (address, Elyria); grindstones.

Jefferson County: Empire—Smallwood Stone Co. (address, Union Trust Building, Cleveland); pulpstones.

Lorain County:
- Amherst—The Cleveland Quarries Co. (address, Cleveland); grindstones.
- Columbia Station—Columbia Stone Co.; grindstones.
- Kipton—The Nicholl Stone Co. (address, Lorain); grindstones.

Washington County:
- Constitution—The Constitution Stone Co.; grindstones.
- Marietta—
  - The Cleveland Quarries Co. (address, Cleveland); grindstones.
  - The Hall Grindstone Co.; grindstones.
  - Ohio Valley Stone Co.; grindstones.

WASHINGTON

Pierce County: Wilkeson—Walker Cut Stone Co. (address, Tacoma); pulpstones.

WEST VIRGINIA

Jackson County: Ravenswood—The Constitution Stone Co. (address, Constitution, Ohio); grindstones.
Monongalia County:
Fairmont (near)—The Smallwood-Low Stone Co. (address, Fairmont); pulpstones.
Morgantown—The West Virginia Pulpstone Corporation (address, Builders Exchange Building, Cleveland, Ohio); pulpstones.
Opekiska—
The General Stone Co. (address, Amherst, Ohio); pulpstones.
Smallwood Stone Co. (address, Union Trust Building, Cleveland, Ohio); pulpstones.
Uffington—Uffington Stone Co.; pulpstones.

OILSTONES AND OTHER WHETSTONES, SCYTHESTONES, RUBBING STONES, AND SIMILAR PRODUCTS

Natural stone or quarry products used as abrasive material include, besides the millstones, grindstones, and pulpstones considered above, oilstones and other whetstones, hones, rubbing stones, and scythestones. These are cut or otherwise shaped, usually in small pieces, in a great variety of forms for the special uses indicated by their names. Oilstones are produced in the United States from novaculite quarried in Arkansas; other whetstones chiefly from sandstone quarried in Indiana and Ohio; scythestones from sandstone quarried in Ohio and from schist quarried in Vermont; and rubbing stones from sandstone quarried in Indiana and Ohio.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	1,016	$197,450	1927	1,048	$233,545
1923	1,223	231,812	1928	956	228,245
1924	1,056	258,943	1929	838	212,017
1925	970	272,224	1930	651	137,184
1926	1,680	223,359	1931	370	81,951

The manufacturers of oilstones and other whetstones, scythestones, and rubbing stones from natural stone in 1931 and the sources of their raw materials were as follows:

The American Rubbing Stone Co., Cincinnati, Ohio: Rubbing stones; manufactured from sandstone quarried at Floyds Knobs, Floyd County, Ind.
The Bracher Co., Belleville, Newark, N. J.: Oilstones and whetstones; manufactured from stone obtained near Hot Springs, Garland County, Ark.
J. A. Chaillaux, West Baden, Ind.: Scythestones; manufactured from sandstone quarried at McDermott, Scioto County, Ohio. Stone also sold to other companies for the manufacture of whetstones.
The Cleveland Quarries Co., Cleveland, Ohio: Scythestones, lathe stones, and holystones; manufactured from stone obtained at Berea, Cuyahoga County, and Amherst, Lorain County, Ohio.
Garland Whetstone & Realty Co., Hot Springs, Ark.: Produces rough stone, in Garland County, for oilstones, some of which is shipped abroad and some sold to manufacturers in this country.
Lewis Whetstone Co., W. E. Lewis, Hot Springs, Ark.: Produces rough stone, in Garland County, for oilstones, most of which is shipped to Germany.

Pike Manufacturing Co., Pike, N. H.:
- Oilstones; manufactured from novaculite obtained from quarries near Hot Springs, Garland County, Ark.
- Whetstones; manufactured from sandstone obtained from quarries near West Baden, Orange County, Ind., and McDermott, Scioto County, Ohio.
- Scythestones; manufactured from schist quarried at Barton, Orleans County, Vt.

CORUNDUM AND EMERY

Corundum, the natural aluminum oxide (Al_2O_3), is a mineral exceeded in hardness only by the diamond. The purest form of corundum has excellent abrasive qualities. In the past it has been used extensively as an abrasive but recently has been supplanted almost entirely by the artificial aluminum oxide abrasives. Production in the United States was reported for 1906 and a number of preceding years and again in 1917 and 1918, but no production has been reported since 1918.

Emery is simply a mixture of corundum and magnetite. The best varieties consist of 50 to 60 per cent of corundum and 40 to 50 per cent of magnetite; the more impure varieties contain various amounts of spinel, hematite, and other minerals; the corundum is the important abrading agent. Emery is used principally in the metal trades where, however, it is being replaced by artificial abrasives to a great extent. The best foreign emery is obtained from the Greek island Naxos. Greece and Turkey are the chief sources of foreign supply.

Emery sold or used by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	1,468	$17,511	1927	506	$5,855
1923	2,286	29,478	1928	1,341	16,787
1924	2,195	19,756	1929	924	10,722
1925	769	5,907	1930	555	5,996
1926	386	3,641	1931	512	5,557

The companies reporting sales of emery in the United States in 1931, with the locations of the deposits from which the material was obtained, were as follows:

NEW YORK

Westchester County:
- Peekskill (near)—
  - Keystone Emery Mills (address, 4329 Paul Street, Frankford, Philadelphia, Pa.).
  - Smith & Ellis (address, Peekskill).

GARNET

Garnet is a complex silicate mineral or, more properly, a group of minerals varying somewhat in composition and properties. The iron-aluminum garnet almandite is the one most commonly used as an abrasive. Garnet is somewhat harder than quartz, and the nature of its fracture is such that the broken particles have enough flat surfaces to permit firm attachment to a paper backing and at the same time expose very efficient cutting edges. About 90 per cent of the garnet mined is used for the manufacture of abrasive papers and cloths which have a higher cutting efficiency than sandpaper. Powdered garnet is used for grinding purposes, particularly for the grinding of plate glass.

The chief production of garnet in the United States is from Warren County, N. Y. Merrimack County, N. H., has been second in importance in recent years. The garnet of the former locality occurs as crystals scattered throughout a granite gneiss and constitutes 4 to 8 per cent of the rock. The rock is quarried by open-pit methods and passed through crushers and rolls, and the garnet is separated from the waste rock by jigs and tables.

In 1931 the sales of abrasive garnet by producers in the United States amounted to 2,946 short tons, valued at $193,015. The average value of garnet mined in 1931 was about $66 a ton, as compared with $63 in 1930, $73 in 1929, and $69 in 1928.

Abrasive garnet sold or used by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	7,054	$566,879	1927	6,939	$573,525
1923	9,006	688,437	1928	6,617	459,307
1924	8,290	674,176	1929	5,961	435,420
1925	8,429	712,853	1930	5,003	314,129
1926	6,397	523,875	1931	2,946	193,015

The companies producing garnet in the United States in 1931, with the locations of the deposits from which the garnet was obtained, were as follows:

NEW HAMPSHIRE

Merrimack County:
- Danbury—Ford Motor Co. (address, Dearborn, Mich.).
- South Danbury—Garnet Products Co.

NEW YORK

Warren County:
- North Creek—Barton Mines Corporation.
- Riparius (Johnsburg)—Warren County Garnet Mills (address, 149 Orange Street, Newark, N. J.).

TRIPOLI

Tripoli is an extremely fine-grained porous form of silica of the chalcedony variety. Some authorities believe that it was formed by decomposition of siliceous limestones, but others question this mode of origin. Its most important abrasive use is as a constituent of buffing compounds. It is also used in metal pastes and polishes and in rubs and polishes for paint and lacquer finishes. It is a constituent of various scrubbing and scouring powders and soaps and is said to have superior qualities for cleaning tile floors, woodwork, and kitchen appliances.

Rottenstone is a material related to tripoli but is somewhat more earthy and less siliceous. It is usually regarded as residual matter from the natural decomposition of argillaceous rocks or of impure limestone. It is produced in Lycoming County, Pa., and it is imported from Europe. In Europe it is mined in Derbyshire (England), in Wales, and in Belgium and is used more extensively there than in America. In England it is used as one of the abrasive bases in pastes and liquid metal polishes. In America it is used as a mild abrasive in wood and metal finishing, as, for example, in the scouring of metal surfaces prior to plating. Pennsylvania "rottenstone" is also reported as used in the manufacture of phonograph records.

The value of tripoli (including Pennsylvania "rottenstone") sold in 1931, as reported by producers, was $310,131. This value corresponds approximately to 27,000 short tons of material, of which about one-fourth was sold in the form of crude quarry products. Most of the production, however, was sold in ground or otherwise prepared form by the producers at values ranging from $8 to $23 a ton.

The chief sources of production in 1931, as in previous years, were a small area lying in Newton County, Mo., and Ottawa County, Okla., and the Alexander-Union County area in southern Illinois; an appreciable output was also reported from Arkansas, and a smaller output was reported from Tennessee. The output of rottenstone in Lycoming County, Pa., is also included in the figures here presented.

Tripoli from the Missouri-Oklahoma district is used extensively for abrasive purposes, in scouring and polishing powders, and in polishing compositions and pastes. An important use is for foundry partings.

A promising new market outlet is being developed in concrete construction. Properly prepared tripoli used as an admixture is said to give greater workability and to decrease laitance of the mix, as well as to insure a higher degree of water-tightness, added strength, decreased shrinkage, diminished efflorescence, and greater durability of the final concrete.

The market for filter blocks of natural stone has declined during recent years because of gradual improvements in municipal water systems and invasion of the market by synthetic stone. However, tripoli is still so used in many smaller isolated communities. Other uses are as a filler in hard rubber and substitute compositions and as a pouncing powder for tracing cloth. Tripoli has been suggested for use as a washing powder for laundries and as a dry-cleaning agent, but merchandising difficulties appear to hinder extensive development of these markets.

The Illinois product is generally known simply as "silica," and although employed to some extent as an abrasive for metal polishes, in soaps, and in cleansers it is very largely used in paint and fillers, in making glass, in the body and enamel of ceramic wares, and for facing foundry molds.

It is not possible to determine the amounts of tripoli used as abrasive material and otherwise or to obtain from the producers uniform reports on the quantity and value of the crude or rough quarried material, as they sell much of the product originally in some manufactured or prepared form. Statistics reported in this chapter and in earlier chapters of Mineral Resources on tripoli therefore do not permit satisfactory comparison between years or between producing States.

An attempt was made in 1931 to collect information on the quantity and value of tripoli sold or used during the year by the producers for the various purposes, similar to that collected for the first time and reported on for pumice, but only three producers supplied the detailed information. Some of the producers stated that they were unable to furnish such information as separate records were not kept, while others reported that they sold through jobbers and had no way of knowing what the material was used for.

In the following table the value for the total output of crude tripoli is in part arbitrarily assigned, as a large part of the output is not sold crude but in ground or other prepared form by the original producers.

The values given "as sold" are the total realizations as reported by producers and include receipts from sales of both crude and ground or otherwise finished material.

Tripoli (including Pennsylvania "rottenstone") sold or used by producers in the United States, 1922–1931

Year	Illinois			Other States [1]			Total		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Crude (estimated)	As sold (crude and finished)		Crude (estimated)	As sold (crude and finished)		Crude (estimated)	As sold (crude and finished)
1922	18, 747	$54, 741	$194, 371	11, 458	$50, 568	$122, 357	30, 205	$105, 309	$316, 728
1923	11, 522	31, 230	117, 201	15, 560	30, 960	265, 556	27, 082	62, 190	382, 757
1924	13, 466	23, 566	116, 188	15, 010	31, 971	273, 221	28, 476	55, 537	389, 409
1925	11, 809	27, 480	143, 859	17, 579	31, 290	291, 027	29, 388	58, 770	434, 886
1926	11, 948	29, 870	192, 483	19, 421	35, 152	331, 126	31, 369	65, 022	523, 609
1927	(2)	(2)	(2)	(2)	(2)	(2)	26, 099	66, 452	447, 068
1928	(2)	(2)	(2)	(2)	(2)	(2)	34, 043	73, 689	555, 576
1929	12, 889	27, 597	139, 557	25, 122	46, 878	406, 101	38, 011	74, 475	545, 658
1930	9, 954	22, 813	116, 307	22, 485	48, 977	391, 198	32, 439	71, 790	507, 505
1931	12, 651	27, 170	87, 481	14, 031	29, 078	222, 650	26, 682	56, 248	310, 131

[1] 1922–23: Missouri, Oklahoma, and Pennsylvania; 1924–1928: Missouri, Oklahoma, Pennsylvania, and Tennessee; 1929 and 1931: Arkansas, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1930: Arkansas, Georgia, Missouri, Oklahoma, Pennsylvania, and Tennessee.
[2] Bureau of Mines not at liberty to publish figures.

The companies reporting production and sales of tripoli (including Pennsylvania "rottenstone") in the United States in 1931, with the locations of the deposits from which the material was obtained, were as follows:

ARKANSAS

Benton County: Rogers—Corona Silica (Inc.).

ILLINOIS

Alexander County:
- Delta—Geo. S. Mepham & Co. (address, East St. Louis).
- Elco—International Silica Co. (address, Cairo).
- Olive Branch—Olive Branch Mineral Products Co.
- Tamms (near)—American Minerals Corporation (address, 206 Bank Street, Burlington, Vt.).

Union County:
- Millcreek—
  - C. H. Hileman (address, R. D. 1, Box 65, Jonesboro).
  - Miller & Allen (address, Elco).

MISSOURI

Newton County:
- Racine—Independent Gravel Co. (address, 220½ West Fourth Street, Joplin).
- Seneca—American Tripoli Co.

OKLAHOMA

Ottawa County:
- Peoria (near)—The Tri-State Quarries Co. (Inc.) (address, Junction City, Kans.).
- Seneca, Mo. (near)—American Tripoli Co. (address, Seneca, Mo.).

PENNSYLVANIA

Lycoming County: Antes Fort—Penn Keystone Co.

TENNESSEE

Bradley County: Cleveland (near)—American Minerals Corporation (address, 206 Bank Street, Burlington, Vt.).

The tripoli properties worked by the American Minerals Corporation in 1930 near Rome and La Fayette, Ga., were reported as abandoned in 1931.

The majority of the producers reported decreases in the unit value of their material sold, ranging from $3.70 to 50 cents less per ton compared with 1930; only one company reported an advance in the selling price of its product.

One producer reported shipments to Canada of material used as a filler; another reported exports to Belgium, England, France, Germany, Italy, Japan, and Sweden, mostly for polishes.

DIATOMITE

Diatomite (known also as diatomaceous earth, infusorial earth, and kieselguhr) is a fine-grained hydrous or opaline fossil form of silica. Deposits consist chiefly of the skeletal remains of minute water plants known as diatoms. These plants secrete silica from the water in which they live; their skeletons accumulate, eventually becoming more or less consolidated. Deposits may be either of marine or fresh water origin. The organic structure of the particles is plainly visible by using a microscope of high magnification, affording a definite and simple means of identification. Diatomite can thus be distinguished from tripoli, which shows no organic structure.

The economic importance of diatomite depends mainly upon its unusual physical properties—fineness and uniformity of texture, light weight, high porosity, and relative chemical inertness. Dry lump material weighs about 28 pounds a cubic foot. Dry, loose powder usually ranges in weight from 7 to 16 pounds a cubic foot, depending upon the character of material and type of deposit. Diatomite can absorb one and one-half to two times its weight of water. Because of its organic structure and high porosity diatomite contains innumerable small chambers, the character of which is extremely important for many uses.

The chief uses of diatomite are nonabrasive in character, being mainly as a filtering and clarifying agent, an insulating medium, a filler, an admixture in concrete, and an absorbent. As an insulator it may be used as cut or sawed brick or as prepared brick. As a filtering agent it is used widely in refining sugar. As an admixture to concrete it is said to give added plasticity and to retard segregation of the mix when hauled by truck or other means. During the past few years diatomite has been used to an increasing extent as a filler in the manufacture of battery boxes. The quantity used for this purpose in 1929, for example, is conservatively estimated at 15,000 tons. Material for this market outlet must be very low in acid-soluble substances, iron, manganese, and other foreign material.

To a limited extent diatomite is used as an abrasive for polishing metals, glass, furniture, and enamel and in cosmetics. Its value as a polishing agent depends upon hardness, fineness, uniformity of grain size, and the character of the individual diatoms. Certain fresh-water varieties are said to have superior cutting qualities, because many such particles are relatively smaller, harder, or sharper. Diatomite has value as a cleanser not only because of its abrasive qualities but also because of its ability readily to absorb grease, coloring matter, and other impurities.

As with many other nonmetallic minerals markets for diatomite are changing constantly; certain new uses are being developed while others are being abandoned. In addition to the use of diatomite as a filler in asphalt or hard-rubber and composition goods a promising field for the future is in connection with the manufacture of lightweight building material. Considerable success has been achieved in Europe in the development of lightweight building units using diatomite, lime, and sawdust as essential ingredients. These products are being used successfully for partitions and flooring slabs for office buildings and other structures. Advantages that are claimed for such products are: (1) A saving in dead load resulting in greater economy; (2) efficient heat and sound insulating qualities; (3) a saving in cost of construction because such units can be sawed and nailed easily; and (4) fire-resistant qualities.

In 1931, as usual, the chief source of production of diatomite was California; sales were also reported from Oregon, Washington, Nevada, New York, and Idaho.

Diatomite sold or used by producers in the United States, 1922–1931 [1]

Year	Short tons	Value	Year	Short tons	Value
1922	44,761	$386,669	1925	73,030	$922,281
1923	65,833	699,406	1926	[2] 87,126	[2] 1,081,564
1924	63,163	693,917	1927–1931	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures for years beginning 1927.
[2] Partly estimated.

The companies reporting production and sales of diatomite in the United States in 1931, with the locations of the deposits from which the diatomite was obtained, were as follows:

CALIFORNIA

Fresno County: Mendota—Mineral Products Manufacturing Co. (address, 1735 Ventura Avenue, Fresno).
Los Angeles County:
Walteria—
Dicalite Co. (address, 756 South Broadway, Los Angeles).
Floatstone Industries (Ltd.) (address, 124 West Fourth Street, Los Angeles).
Monterey County: Bradley (near)—Pacatome (Ltd.) (address, 814 Kohl Building, San Francisco).
Santa Barbara County:
Lompoc—
Celite Corporation.
National Silica Products Co. (address, 1201 Bryant Street, Palo Alto).

IDAHO

Gooding County: Gooding—George H. Chaffin (address, 216 East Fourth South, Provo, Utah).
Idaho County: Kamiah—Pacific Coast Silica Corporation (address, 3080 Andover Street, Seattle, Wash.).

NEVADA

Mineral County: Mount Montgomery—U. S. Diatom Co. (address, 800 Santa Fe Avenue, Los Angeles, Calif.).
Nye County: Mina—Superdent Co. (address, Box 794, Reno).
Storey County: Virginia City—The Electro-Silicon Co. (address, 22 Cliff Street, New York, N. Y.).

NEW YORK

Herkimer County: Ohio—Adirondack Diatomaceous Earth Co. (address, Herkimer).

OREGON

Deschutes County: Terrebonne—Atomite Corporation (address, 1021 Pacific Building, Portland).
Malheur County: Harper—Pacific Coast Diatom Co.

WASHINGTON

Grant County: Quincy—E. J. Webley.
Kittitas County:
- Kittitas—Kittitas Diatomite Co. (address, Ellensburg).
- Roza—Washington Silica & Fire Clay Co. (address, 3205 Hewitt Avenue, Everett).

The Paraffine Cos. (Inc.), 475 Brannan Street, San Francisco, Calif., has diatomite property at Lompoc, Calif., but reported that it did not mine any of the material in 1931 except a very small quantity for experimental purposes. The Tri-o-lite Products Co., Carlin, Nev., which has been a steady producer for a number of years, did not operate its diatomite deposits in Elco County, Nev., in 1931. The mines of the American Diatom Co. near Oak Grove, Westmoreland County, Va. (address, 618 Witherspoon Building, Philadelphia, Pa.), were not operated in 1931; they were active in 1930.

PUMICE AND PUMICITE

Pumice and pumicite are among the few domestic mineral products of which an increased quantity was produced in 1931, as compared with preceding years. In fact, the 68,819 short tons sold or used by producers in 1931 is the largest quantity so far recorded, exceeding by 1,806 tons that reported in 1929, the next highest year. The total value of the output, however, was $338,586 in 1931, as compared with $353,064 in 1929.

Pumice and pumicite are siliceous volcanic substances quite similar in chemical composition but somewhat different in manner of formation and mode of occurrence. Pumice usually occurs near active or extinct volcanoes in solid coherent masses; some deposits, however, are fragmental in character. The color is generally white to light gray. Pumice is formed by sudden expansion of included gases in molten lava, followed by relatively quick cooling. It thus contains innumerable vesicules or chambers separated by thin glasslike walls. Pumicite, known also as volcanic ash and volcanic dust, is composed of small, sharp, angular, or platy particles of volcanic glass spumed from volcanoes during periods of violent eruptions and subsequently transported and deposited by air currents.

Lump pumice is used as an abrasive for polishing various metals; for rubbing down wood surfaces in the manufacture of high-grade furniture, such as pianos, phonographs, and radios; to a limited extent in the automobile industry; and for working, cleaning, and polishing stone and glass. Fine lump pumice is used as a toilet article. Ground pumice is used in the electroplating industry; in tumbling barrels; in cleansing, scouring, and polishing compounds; in dental preparations; and as an abrasive in rubber erasers. Pumice is used in construction as a lightweight concrete aggregate, in the manufacture of bricks and other building units, as building blocks having fireproof and earthquake-proof qualities, and as an ingredient in acoustic plasters. It is also used as a heat and sound insulating medium.

In Japan pumice is reported to be used in the pottery industry and in Armenia as a raw material in the manufacture of green bottle glass, the alkali present effecting economies in the use of soda and sulphates.

Pumicite is used in making cleansing and scouring compounds, abrasive hand soaps, and, to a limited extent, metal polishes. It is used in construction as an admixture in concrete, as an absorbent for oiled-road surfaces, and to a lesser extent as an insulating material for packing steam and water pipes, lagging boilers, lining cold-storage rooms, in filter cells, and as a filler or absorbent in paints, sweeping compounds, and fertilizers.

Production of pumice and pumicite in the United States in 1931 was reported from Yuma County, Ariz.; from Fresno, Imperial, Inyo, Kern, Mono, San Bernardino, and San Luis Obispo Counties, Calif.; from Grant, Meade, and Norton Counties, Kans.; from Frontier and Furnas Counties, Nebr.; from Beaver County, Okla.; and from Tripp County, S. Dak. In California the output was partly lump pumice. Kansas and Nebraska produced only pumicite or volcanic ash.

As a result of a questionnaire sent to the producers, asking for a separation of their sales according to uses, the Bureau of Mines is able for the first time to present statistics on the quantity and value of pumice and pumicite sold by producers according to uses. Eleven producers reported a total of 54,934 short tons (80 per cent of the total shipments), valued at $207,792 ($3.78 a ton), sold for cleaning and scouring compounds and hand soap; three reported a total of 895 tons (1 per cent of the total shipments), valued at $12,863 ($14.37 a ton), sold for "other abrasive uses"; seven reported a total of 9,242 short tons (13 per cent), valued at $66,376 ($7.18 a ton), sold for concrete admixture and concrete aggregate; and three producers reported a total of 3,088 short tons (5 per cent), valued at $48,720 ($15.78 a ton), sold for acoustic plaster; the remainder (660 short tons, or 1 per cent, valued at $2,835, or $4.30 a ton) was sold for miscellaneous uses. Owing to the fact that less than three producers reported material sold for "concrete aggregate," the sales for that use may not be reported separately but are combined with concrete admixture in the foregoing figures.

Most of the producers reported lower selling prices for their material in 1931 than in 1930, although two producers reported slightly increased value per ton. The mines of W. A. T. Agard (address, 2022 Woolsey Street, Berkeley, Calif.), near Klamath Falls, Klamath County, Oreg., were reported as having produced 1 or 2 tons in 1931 for samples but in the spring of 1932 expected to start sizing and grinding for acoustic plasters, for soaps and abrasive purposes, and for concrete aggregate. The Mid-Co. Products Co. (address, Kansas City, Mo.), with deposits at Meade, Kans., Edison, Nebr., and Gate, Okla., reported that the highway department of Kansas has been quite successful in spreading crude pumice as an absorbent on oiled roads.

An interesting article was published on the manufacture of "Pumitile" concrete [3] by the Jourdan Concrete Pipe Co., Fresno, Calif., which utilizes pebble pumice and pumicite obtained from deposits in the vicinity of Friant and about 18 miles northeast of Fresno, Fresno County, Calif.

Pumice and pumicite sold or used by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	45,262	$175,600	1927	53,298	$221,481
1923	56,575	214,169	1928	57,430	278,516
1924	43,651	190,253	1929	67,013	353,064
1925	40,380	179,020	1930	56,843	336,099
1926	53,887	208,504	1931	68,819	338,586

The companies reporting production and sales of pumice and pumicite in the United States in 1931, with the locations of the deposits from which the pumice and pumicite were obtained, were as follows:

ARIZONA

Yuma County: Bouse—Yuma Products Manufacturing Co. (address, 3648 Humboldt Street, Denver, Colo.).

CALIFORNIA

Fresno County:
- Friant (near)—
  - Earlonite Mining Co. (address, Box 474, Selma).
  - The McKenzie Estate (address, Griffith-McKenzie Building, Fresno).

Imperial County:
- Calipatria (near)—Kalite Co. (Ltd.) (address, 90 South Oak Knoll Avenue, Pasadena).
- Niland—Mineral Milling Co. (successors to Flynt Silica & Spar Co.) (address 1081 Richmond Street, Los Angeles).

Inyo County:
- Little Lake—Victorville Lime Rock Co. (address, 2149 Bay Street, Los Angeles).
- Shoshone—
  - Chas. Brown.
  - R. W. Glendenning (address, 1134 Western Pacific Building, Los Angeles).

Kern County: Saltdale—Cudahy Packing Co. (address, 111 West Monroe Street, Chicago, Ill.).

Mono County: Laws (near)—California Quarries Corporation (address, 1300 Quinby Building, Los Angeles).

San Bernardino County: Barstow—Hill Brothers Chemical Co. (address, 2159 Bay Street, Los Angeles).

San Luis Obispo County: Paso Robles (near)—Golden State Cleaner Mine (M. L. Francis) (address, Creston, R. F. D.).

KANSAS

Grant County: Satanta (near)—H. H. Zimmerman (address, Belle Plaine).

Meade County:
- Fowler—
  - Cudahy Packing Co. (address, 111 West Monroe Street, Chicago, Ill.).
  - The Pumicite Co. (address, 4025 Clara Avenue, St. Louis, Mo.).
- Meade—Mid-Co. Products Co. (address, Kansas City, Mo.).

Norton County: Calvert—The Davidson Pumice Co. (address, Norton).

[3] Scott, W. A., California Products Manufacturer Uses Pumice as Aggregates: Rock Products, vol. 35, April, 1932, pp. 68–69.

NEBRASKA

Frontier County: Eustis—La Rue Axtell Pumice Co.
Furnas County: Edison—Mid-Co. Products Co. (address, Kansas City, Mo.).

OKLAHOMA

Beaver County: Gate (near)—Mid-Co. Products Co. (address, Kansas City, Mo.).

SOUTH DAKOTA

Tripp County: Winner—Klenit Corporation.

PEBBLES FOR GRINDING AND FLINT LINING FOR TUBE MILLS

The commercial production of pebbles used for grinding minerals, ores, cement, and for other purposes, together with the output of quartzite blocks for use as tube-mill liners, includes, so far as known to the Bureau of Mines, only the output of beach pebbles in southern California and of cut cubes and cut liners made of quartzite in Minnesota. The figures in the following table appear to cover the entire commercial output, but doubtless there was unrecorded additional production for local or own use by other companies than those reporting.

Pebbles for grinding and flint lining for tube mills sold or used by producers in the United States, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922	3,159	$30,798	1927	3,342	$46,856
1923	4,551	51,795	1928	6,288	89,321
1924	2,532	37,429	1929	4,630	66,178
1925	3,831	50,147	1930	3,480	50,816
1926	6,219	85,146	1931	2,024	26,211

ABRASIVE DIAMONDS

Abrasive diamonds, or industrial diamonds as they are commonly called, are of two types—the black diamond, or carbonado, and bort. The black diamond is the hardest substance known, the claim being made that it is 3 per cent harder than the gem diamond. It is lacking in cleavage, is opaque, and resembles a piece of lava or coal. Black diamonds are found chiefly and almost exclusively in the State of Bahia in the interior of Brazil. The second variety (bort) consists of cull stones from the gem-diamond industry, most of which are obtained from South Africa. Unlike the black diamond, bort has a distinct cleavage. Although the diamond is extremely hard it is also brittle and is easily shattered if subjected to a sudden shock or blow.

Industrial diamonds are widely used in drill bits for rock drilling and boring. The usual procedure is to set 6 to 10 diamonds in the lower face of a hollow cylinder of soft annealed steel. By rotation the bit cuts out a cylindrical core of rock. Black diamonds are still employed chiefly for this work, although bort bits having as many as 56 small diamonds set in the cutting face are cheaper and are coming into more and more extensive use.

Diamonds cut more quickly, are more durable, and can finish material with greater precision than steel; diamond tools, therefore, are especially adapted for the production of large numbers of pieces of exact and uniform sizes. Diamond saws are used extensively for sawing rock, such as marble and limestone. The diamonds are mounted in detachable steel sockets at regular intervals around the rim of circular saws or along the edge of specially constructed drag and gang saws. The individual teeth are made by casting a special steel alloy around the diamonds, which are suspended in the molds by wires. Bort diamonds set and held in special tools are used widely for truing abrasive wheels, for cutting or machining hard rubber, rubber composition, paper rolls, bakelite, fiber, papier-mâché, ivory, graphite, mica, brass, bronze, aluminum, and other metals, and also for grinding cylinder walls. Perforated diamonds are used as dies through which to draw fine wire to accurate and uniform cross section. Although this use has decreased somewhat because of the substitution of special alloys small diamond dies are still widely used, especially in connection with the radio industry. Small diamonds are used in many kinds of glaziers' tools. Fragments of bort are pulverized into diamond dust, which is used for cutting and polishing precious stones, as an abrasive for drilling diamonds to make diamond dies, and in sawing porcelain and similarly hard materials.

Continued depressed world trade during 1931 had its effect upon the diamond industry, production the world over being severely curtailed.

Relatively few diamonds have been produced in the United States. During 1930, however, the Arkansas Diamond Corporation, Little Rock, Ark., recovered a number of gem and bort stones in the course of exploration work upon its holdings.

Imports of diamonds are shown on pages 127 and 128. It will be noted that the value of dust and bort imported has decreased from $271,382 in 1926 to $20,292 in 1931. Imports of uncut diamonds for use by glaziers, engravers, and miners reached a maximum value of $4,067,674 in 1929 but decreased in 1931 to $2,400,879.

ABRASIVE SAND

Abrasive sand is used extensively in sawing and rubbing stone, such as granite, limestone, marble, slate, and soapstone. Both gang saws and wire saws employ sand as a cutting medium. Such sand generally needs little preparation except screening to remove oversize particles, sticks, and other rubbish; consequently, it is a relatively low-priced commodity. In gang saws thin strips of steel held in suitable frames pass back and forth on the stone block while a stream of water and sand is constantly fed into the cuts. With the wire saw the principle is the same, except that a long endless traveling wire is used instead of steel bands. The surface of sawed stone slabs may be smoothed and trued by holding the blocks stationary on revolving circular tables or rubbing-beds, which are covered with a film of sand and water. "Chats" (tailings from the Joplin (Mo.) lead-zinc district) are used to some extent in the Indiana limestone district as a substitute for sand. The particles, being mostly ground chert, are very angular and sharp and produce a surface desirable for certain types of work.

Abrasive sand is used widely for removing surface inequalities in crude-rolled plate glass before later grinding and polishing processes. Two or three tons of sand are required to grind 1 ton of plate glass.

Carefully graded sand used for the second stage of grinding and for beveling glass has been displaced largely by artificial abrasives.

Sand propelled by compressed air has a terrific abrading action and is so used to remove inequalities from rough castings, to clean paint from old surfaces, to clean or renovate stone and brickwork, to cut glass, to prepare the surfaces of metal for electroplating or enameling, and to carve and engrave designs and inscriptions on monuments.

The production of abrasive sand was 607, 589 short tons, valued at $1,105,213 in 1931, as compared with 1,115,915 tons, valued at $1,613,022, in 1930. Statistics for earlier years appear in the various Mineral Resources chapters on Sand and Gravel. Most, if not all, of such material is silica sand derived from weathered sandstone or won from deposits of sand and gravel in beaches, rivers, or glacial drift. Much of it is by-product material from the production of glass, molding, building, and paving sands. Abrasive sand does not include pulverized quartz or other forms of silica reduced by intensive grinding.

MISCELLANEOUS ABRASIVE MATERIALS

River silt is used to a limited extent in cleansing powders and in the manufacture of bath bricks. Clays are used as mild abrasives in some polishes and cleansing soaps. Highly burned clays are sometimes ground to dust and used in metal polish. Talc is used for polishing peanuts and rice. Very pure high-grade lime is used for polishing surgical instruments and cutlery. Chalk is used as a mild abrasive for polishing plated ware. Feldspar is used in some window-cleaning compounds; as it is softer than quartz it is less liable to scratch glass than compounds containing some form of free silica.

IMPORTS AND EXPORTS

The following tables show the value of abrasive materials imported for consumption in the United States, 1926–1931; the quantity and value of abrasive materials imported for consumption in the United States, 1930 and 1931, by kinds; and the value of domestic abrasive materials exported from the United States, 1926–1931.

Value of abrasive materials imported for consumption in the United States, 1926–1931

Material	1926	1927	1928	1929	1930	1931
Millstones and burrstones	$6, 266	$12, 726	$6, 354	$6, 564	$7, 050	$2, 435
Grindstones	120, 335	134, 804	114, 874	119, 264	66, 677	39, 171
Hones, oilstones, and whetstones	63, 152	67, 368	45, 303	48, 207	40, 612	24, 881
Emery and corundum	616, 700	264, 613	272, 533	494, 174	329, 752	151, 501
Garnet	----------	----------	115	----------	----------	149
Diatomaceous earth, tripoli, and rottenstone [1]	14, 544	15, 403	21, 883	23, 183	46, 478	53, 581
Pumice	129, 449	124, 074	159, 430	143, 944	94, 387	77, 168
Diamond:						
Dust and bort	271, 382	62, 045	31, 222	89, 363	90, 945	20, 292
Glaziers' and engravers', unset, and miners'	1, 939, 735	2, 148, 275	2, 756, 895	4, 067, 674	2, 756, 630	2, 400, 879
Flint, flints, and flint stones, unground	120, 078	93, 658	144, 313	127, 457	62, 463	54, 623

[1] Beginning June 18, 1930, classification reads "Tripoli and rottenstone."

Abrasive materials imported for consumption in the United States, 1930 and 1931, by kinds

Kind	1930		1931	
	Quantity	Value	Quantity	Value
Millstones and burrstones:				
Rough or unmanufactured ....short tons..	73	$4,974	15	$1,332
Bound up into millstones ....do....	21	2,076	15	1,103
Grindstones, finished or unfinished ....do....	857	66,677	640	39,171
Hones, oilstones, and whetstones ....do....	170	40,612	93	24,881
Emery:				
Ore ....do....	4,252	64,217	2,355	34,187
Grains, ground, pulverized, or refined ....pounds..	(1)	(1)	(1)	(1)
Paper and cloth of emery or corundum ....do....	(2)	27,278	(2)	33,910
Wheels, files, and other manufactures of which emery or corundum is the material of chief value ....pounds..	71,694	38,476	73,186	40,001
Corundum (see also "Emery"):				
Ore ....short tons..	3,017	160,559	716	37,039
Grains, ground, pulverized, or refined ....pounds..	[1] 598,788	[1] 39,222	[1] 125,933	[1] 6,364
Garnet in grains or ground, pulverized, etc ....short tons..	....	....	2	149
Diatomaceous earth, tripoli, and rottenstone [3] ....do....	5,441	46,478	4,088	53,581
Pumice:				
Crude or unmanufactured ....do....	6,507	64,326	6,548	59,152
Manufactures of, or of which pumice is the component material of chief value ....short tons..	(4)	30,061	(4)	18,016
Diamond:				
Bort ....carats..	5,119	86,036	1,075	17,849
Dust ....pounds..	(4)	4,909	(4)	2,443
Glaziers' and engravers', unset, and miners' ....carats..	145,862	2,756,630	224,970	2,400,879
Flint, flints, and flint stones, unground ....short tons..	6,856	62,463	6,291	54,623
	....	3,494,994	....	2,824,680

[1] Emery included with corundum; not separately classified.
[2] 5,143 reams in 1930 and 6,389 reams in 1931; weight not recorded.
[3] Beginning June 18, 1930, classification reads "Tripoli and rottenstone."
[4] Quantity not recorded.

Value of domestic abrasive materials exported from the United States, 1926–1931

Material	1926	1927	1928	1929	1930	1931
Grindstones	$629,748	$578,113	$560,975	$391,239	$246,512	$104,602
Abrasive wheels, emery and other	248,631	240,027	254,493	286,360	203,371	115,076
All other natural abrasives, hones, whetstones, etc	323,447	419,088	453,055	423,363	361,055	232,196

ARTIFICIAL ABRASIVES

Artificial abrasives fall chiefly into three main groups: (1) Metallic abrasives, such as crushed steel, steel shot, and steel wool; (2) silicon carbide abrasives, such as carborundum, crystolon, and carbolon; and (3) aluminum oxide abrasives, such as alundum, aloxite, exolon, and lionite. The metallic abrasives are used chiefly in loose form as cutting agents in sawing or drilling rock and other hard materials. A very important use of the silicon carbide and the aluminum oxide abrasives is in the manufacture of bonded abrasive wheels. The abrasive grains graded into uniform sizes are bonded together into wheels of varying degrees of coarseness and hardness. A fusible clay is used as the bonding material in vitrified grinding wheels. Sodium silicate, shellac, rubber, and bakelite are also employed as bonding materials. Much progress has been made in recent years in the development of highly efficient abrasive wheels, which are being used more and more as substitutes for natural abrasive products, such as emery wheels, grindstones, and pulpstones.

An artificial abrasive consisting of tin oxide or a mixture of tin oxide and oxalic acid has been termed "putty powder." It is used for polishing marble and granite. Rouge and crocus, both of which are forms of ferric oxide, are employed to produce a high luster—the former on precious metals and the latter on tin and cutlery. Rouge is used also for final polishing of plate glass. Chromium oxide, manganese dioxide, and magnesia have limited use as abrasives.

The table that follows gives the production of silicon carbide, aluminum oxide, and steel shot or crushed steel grains. These materials compete with the natural abrasives used as grains—for example, emery, corundum, and garnet. The figures represent the total output of crude materials or first product of the manufacturing plants, not all of which is used as abrasive material; in fact, a large but undetermined part of the silicon carbide and aluminum oxide output is not so used. The total output is shown here without separation of the products according to the uses to which they are put, because it is thought that the proportion used as abrasive material has not fluctuated so widely in recent years as to destroy the value of these figures for comparison with the statistics of natural abrasives.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1922–1931

Year	Silicon carbide		Aluminum oxide		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1922	16,233	$2,022,613	31,898	$3,246,714	5,804	$421,148	53,935	$5,690,475
1923	21,149	2,786,929	51,391	5,378,926	8,229	612,140	80,769	8,777,995
1924	17,792	2,161,498	33,708	3,482,577	8,597	569,665	60,097	6,213,740
1925	24,112	2,493,756	53,253	4,714,562	11,165	780,612	88,530	7,988,930
1926	17,026	1,702,037	43,967	4,106,699	12,610	942,429	73,603	6,751,165
1927	26,289	2,603,571	50,973	4,516,637	13,364	839,683	90,626	7,959,891
1928	22,162	2,286,518	59,103	5,640,901	18,466	904,629	99,731	8,832,048
1929	30,309	3,060,401	72,614	6,471,373	23,789	1,289,922	126,712	10,821,696
1930	22,008	2,047,188	46,465	4,067,148	16,428	977,037	84,901	7,091,373
1931	8,193	967,840	25,070	2,336,586	11,105	613,683	44,368	3,918,109

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SULPHUR AND PYRITES [1]

By Robert H. Ridgway [2]

CONTENTS

SUMMARY

The economic crisis which has caused exceptional contraction in the consumption of nearly all industrial products was reflected in the sulphur market in 1931. Although production receded from the record total of the preceding year the decline in consumption was so pronounced that stocks continued to accumulate in the principal producing countries. The search for substitutes for sulphur and for methods of eliminating sulphur and sulphuric acid in chemical manufacture continued, but it is believed that the effect of this on the curtailment in consumption of sulphur has been slight. However, in times of stress, the necessity of effecting economies through cheaper raw materials is accelerated. Plants are relieved of the pressure of production, thus making available equipment and personnel for experimental purposes. By-products and waste material present unsolved problems to which attention is being turned.

The world market for sulphur is controlled by contract between the Sicilian Sulphur Consortium and the American exporters. The agreement, which dates from 1923, is in existence now in its original form, and the quota allocated to either party has never been changed. The contract provides for annual adjustments of all outstanding matters, and such annual adjustments have been made regularly in the past. At the last meeting, held to adjust outstanding matters of the fiscal year 1930–31, it was found that the Sicilians had exceeded their quota by approximately 50,000 tons. In view of existing trade conditions and other matters the Sulphur Export Corporation consented to waive any claim to make up this tonnage without prejudice to any of its rights under the contract.

[1] Work on manuscript completed May, 1932.

[2] Figures on domestic production compiled by A. W. Mitchell and those on imports and exports compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

Although American production decreased 17 per cent the United States continued to be by far the major factor in the world production of sulphur in 1931. Italy, the second largest producing country, retained approximately the level of production reached in 1930, while estimates for Japan indicate that production declined slightly. These three countries produce about 98 per cent of the world's sulphur—the United States contributing 83 per cent, Italy 13 per cent, and Japan 2 per cent.

Spain continued to be the most important factor in the world's pyrites industry, while the production of Norway, which usually ranks second, dropped sharply due to labor disturbances during part of the year. Increased production of pyrites was noted in Canada, among the smaller producing countries. Processes for the recovery of the sulphur content of pyrites, as sulphurous gases or as elemental sulphur, are being developed in the hope of utilizing more completely the sulphur and iron contained in pyrites.

In the United States the consumption of both sulphur and pyrites was curtailed because industrial activity declined. The production and imports of pyrites held up well. In the sulphur industry the year was characterized by high production, decreased shipments, increased stocks, and a steadily maintained price.

A statistical summary of the industry in the United States follows: Compared with 1930, the production of sulphur decreased 17 per cent. Shipments of sulphur totaled 1,376,526 long tons (31 per cent less than 1930). Exports of crude sulphur in 1931 decreased to 407,586 tons, a quantity equivalent to about 43 per cent of shipments to domestic consumers. No imports of "sulphur and sulphur ore" were recorded for 1931. The production of pyrites amounted to 330,848 tons (a decrease of 5 per cent from 1930); total imports were 352,066 (a decrease of 4 per cent). Exports of pyrites amounted to 26,604 tons. The production of by-product sulphuric acid was 862,729 short tons of 60° B., compared with 1,188,316 tons in 1930.

SULPHUR

DOMESTIC PRODUCTION

The production of sulphur in the United States in 1931 amounted to 2,128,930 long tons, a decrease of 430,051 tons (17 per cent) from the record output of 2,558,981 tons in 1930. The decrease was caused by curtailed production by two of the principal producers. Shipments also decreased, from 1,989,917 tons, valued at $35,800,000, in 1930, to 1,376,526 tons, valued at $24,800,000, in 1931, a decline of 31 per cent in both quantity and value; they were the smallest recorded since 1922. The substantial decrease in shipments was due to lessened demand from both domestic and foreign consumers, the percentage decrease from 1930 being about the same in both cases.

The high rate of production and declining shipments in 1931 increased producers' stocks at the mines from 2,497,000 long tons at the beginning of the year to 3,250,000 tons on December 31, 1931, a net gain of 753,000 tons. The stocks were approximately 250,000 tons higher than the previous record stocks on hand at the mines at the end of 1923.

The average quoted price for sulphur as reported by the trade journals was unchanged at $18 a ton f. o. b. mines throughout the year. Open prices were $1 to $3 a ton higher, and prices for sulphur exported were given as $22 a ton f. a. s. Atlantic ports.

The following table shows the progress of American sulphur production from 1912 to 1931:

Sulphur produced and shipped in the United States, 1912–1931

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1912	787, 735	305, 390	$5, 289, 000	1922	1, 830, 942	1, 343, 624	$22, 000, 000
1913	491, 080	319, 333	5, 617, 000	1923	2, 036, 097	1, 618, 841	26, 000, 000
1914	417, 690	341, 985	6, 214, 000	1924	1, 220, 561	1, 537, 345	25, 000, 000
1915	520, 582	293, 803	4, 959, 000	1925	1, 409, 262	1, 858, 003	29, 000, 000
1916	649, 683	766, 835	12, 246, 000	1926	1, 890, 027	2, 072, 657	37, 300, 000
1917	1, 134, 412	1, 120, 378	23, 987, 000	1927	2, 111, 618	2, 072, 109	38, 300, 000
1918	1, 353, 525	1, 266, 709	27, 868, 000	1928	1, 981, 873	2, 082, 924	37, 500, 000
1919	1, 190, 575	678, 257	10, 252, 000	1929	2, 362, 389	2, 437, 238	43, 800, 000
1920	1, 255, 249	1, 517, 625	30, 000, 000	1930	2, 558, 981	1, 989, 917	35, 800, 000
1921	1, 879, 150	954, 344	17, 000, 000	1931	2, 128, 930	1, 376, 526	24, 800, 000

All of the sulphur reported herein as produced in the United States in 1931 came from Texas. One Colorado producer reported the mining in 1931 of a quantity of sulphur ore containing 45 per cent sulphur. This material, however, is not included in the sulphur production figures for the United States.

The sulphur mines operating in the United States in 1931 are listed in the following table:

Sulphur mines operating in the United States in 1931

Operating company	Name of mine	Location of mine
Texas Gulf Sulphur Co.	Long Point Dome	Long Point, Fort Bend County, Tex.
Do.	Big Hill Dome	Gulf, Matagorda County, Tex.
Do.	Boling Dome	Newgulf, Wharton County, Tex.
Freeport Sulphur Co.	Bryan Mound	Freeport, Brazoria County, Tex.
Do.	Hoskins Mound	Do.
Duval Texas Sulphur Co.	Palangana Dome	Benavides, Duval County, Tex.

TEXAS

The progressive curtailment of sulphur production in Texas in 1931 is evident in the following table, which shows the production in 1930 and 1931 on a quarterly basis. The table is taken from a report issued by the Texas State comptroller's office.

Sulphur produced in Texas, 1930 and 1931, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
1930					
Texas Gulf Sulphur Co.	386, 254	490, 930	404, 284	455, 584	1, 737, 052
Freeport Sulphur Co.	187, 845	209, 790	173, 120	211, 825	782, 580
Duval Texas Sulphur Co.	6, 429	11, 246	10, 180	10, 710	38, 565
	580, 528	711, 966	587, 584	678, 119	2, 558, 197
1931					
Texas Gulf Sulphur Co.	403, 685	374, 049	305, 376	214, 527	1, 297, 637
Freeport Sulphur Co.	234, 105	223, 620	225, 780	113, 165	796, 670
Duval Texas Sulphur Co.	11, 805	11, 061	8, 075	4, 346	35, 287
	649, 595	608, 730	539, 231	332, 038	2, 129, 594

On September 1 an increase of 20 cents per long ton in the severance tax levied by the Texas State Legislature became effective. The former tax law, which became effective in 1930, placed a tax of 55 cents per ton on sulphur mined in the State. Previously the tax had been 2 per cent on gross receipts of the sulphur producers.

Texas Gulf Sulphur Co.—Production was continued at the three plants of this company during 1931, although no shipments were made from Long Point Dome. The Texas Court of Civil Appeals has handed down a decision affirming a previous decision of the lower courts in favor of the Texas Gulf Sulphur Co. with regard to certain leases on Boling Dome.

The company is seeking by further exploration to expand its producing sources. During the year it purchased the sulphur rights on a large leased acreage in Jefferson County, where a number of test wells will be drilled.

Exploration was also carried on at Moss Bluff near Liberty, Tex., and in other parts of the Gulf coast region.

Freeport Sulphur Co.—The Freeport Sulphur Co. produced sulphur at Bryan Mound and at Hoskins Mound in 1931. The production in 1931 by this company amounted to 796,670 long tons, an increase of 14,090 tons over that of 1930. Prospecting operations on a dome at Black Bayou in Cameron Parish, La., were concluded in 1931, and the property was released. Vinton Dome, in Calcasieu Parish, La., was optioned and prospected during 1931 and was also released. Evidently commercial quantities of sulphur were not found on either of these properties.

Duval Texas Sulphur Co.—During 1931 production at Palangana Dome by the Duval Texas Sulphur Co. was at about the same rate as in 1930, although there was considerable curtailment during the fourth quarter.

LOUISIANA

Prospecting continued at the Jefferson Island Salt Dome in Iberia Parish 8 miles southwest of New Iberia. The Jefferson Lake Oil Co., which has a State lease on the property, made the discovery in 1929; the sulphur occurs in the cap rock of the dome beneath the bed of Lake Peigneur. Late in the year the Jefferson Lake Oil Co. began construction of a plant which will mine sulphur by the Frasch process and is to have a minimum annual capacity of 100,000 tons. The property lies near the New Iberia-Abbeville branch of the Southern Pacific Railroad, to which it is being connected by a spur. The dome has been previously prospected by the American Cyanamid Co., but the extent of the reserves is not known. However, it is understood that more than 25 wells have been drilled in outlining the deposit.

The States Production (Inc.), a subsidiary of E. I. du Pont de Nemours & Co., leased the Chacahoula Salt Dome about 6 miles from Thibodaux, La Fourche Parish, where prospecting for sulphur is proceeding. This dome had been previously tested by the Texas Gulf Sulphur Co. and the Union Sulphur Co.

The Freeport Sulphur Co. prospected on domes in Calcasieu Parish and Cameron Parish (see under Texas).

MISSISSIPPI

The Hercules Sulphur Exploration Syndicate continued tests for sulphur in the Gulf coast region of the State during the year.

NEVADA

No production of sulphur was reported from Nevada during 1931, but a small shipment was made from the property which is now controlled by the Sierra Sulphur Corporation (Ltd.).

UTAH

No production of sulphur was reported from Utah in 1931. The properties of the Utah Sulphur Industries at Sulphurdale, Utah, are expected to resume operations in 1932. During the past year the mines have been leased to interests who were developing a new process for retorting the sulphur. It was reported during the year that the process was not successful and that the leases were given up.

COLORADO

A small quantity of sulphur-bearing material was produced by the P. T. & S. Chemical Co. near Austin, Delta County. The material, which contains 45 per cent sulphur, is dug from opencuts by hand methods and is sold to the farmers in the vicinity as a fertilizer.

NEW MEXICO

During the year the Union Sulphur Co. obtained options on large acreages in Chaves and Eddy Counties, N. Mex., as the result of a sulphur discovery in an artesian well near Artesia, N. Mex. Three test wells were driven in the area of the discovery, and drilling was subsequently abandoned.

BY-PRODUCT SULPHUR

A large quantity of sulphur is recovered each year as a by-product from copper and zinc mining operations and from the manufacture of fuel gas. This sulphur is largely recovered in the form of sulphuric acid and is not included in the sulphur-production figures for the United States.

Concentration of some copper and zinc ores yields, in addition to copper and zinc concentrates, a pyrites concentrate which is an important source of sulphur. The production of this commodity is discussed under the pyrites section of this report. In the smelting of copper and zinc concentrates the sulphur content is driven off in the form of sulphur dioxide gas, which is used in the manufacture of sulphuric acid at many smelters. Approximately 220,000 tons of sulphur have been recovered annually during the past five years.

During the past several years processes for the recovery of sulphur from a slurry that results from the purification of manufactured fuel gases have been developed in the United States. The slurry contains very finely divided sulphur, which may be recovered by steam distillation, or the slurry itself may be used directly as an insecticide after washing to remove certain objectionable chemicals. A canvass of the various producers of slurry indicates an annual production of 2,500 long tons of sulphur in this type of material. Only part of the material is marketed; the remainder accumulates in dumps at various plants. Before the advent of natural gas in northern California several thousand tons of this by-product sulphur were produced and used for agricultural purposes.

Figures for the production of sulphuric acid as a by-product at smelting plants during the last five years follow. The table gives the output at both copper and zinc plants and constitutes practically all of the by-product acid produced in the United States. At many plants in the zinc industry, the SO_2 content of the gas from the roasters is raised by burning sulphur; the acid reported in the following table, however, is only that made from the sulphur content of the sulphide ores. The figures also include the sulphuric acid made from the pyrites concentrates in Tennessee and Wisconsin.

By-product sulphuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1927–1931, in short tons

	1927	1928	1929	1930	1931
Copper plants	[1] 469, 561	603, 100	633, 438	651, 702	436, 111
Zinc plants	588, 544	558, 537	627, 018	536, 614	426, 618
	[1] 1, 058, 105	1, 161, 637	1, 260, 456	1, 188, 316	862, 729

[1] Revised figures.

IMPORTS AND EXPORTS

The imports of sulphur into the United States reached a peak of nearly 189,000 long tons in 1903. With the rapid increase in American production, however, imports have declined and since 1917 have been of little consequence. No imports of "sulphur or sulphur ore" were reported for 1931.

The export business in American sulphur was started in 1904, when a cargo of 3,000 long tons was shipped from Louisiana. Since then the exports have increased and in 1929 reached a record figure of 855,183 tons. Exports of sulphur in 1931 declined and amounted to 407,586 tons, compared with 593,312 in 1930, a decrease of 31 per cent.

The following table shows the crude sulphur imported into and exported from the United States from 1912 to 1931:

Crude sulphur imported into and exported from the United States, 1912–1931

Year	Imports for consumption		Exports		Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1912	26, 885	$494, 778	57, 736	$1, 076, 414	1922	[1] 167	$6, 453	485, 664	$7, 095, 628
1913	15, 122	286, 209	89, 221	1, 599, 761	1923	[2] 465	21, 535	472, 525	7, 105, 260
1914	23, 610	398, 984	98, 163	1, 807, 324	1924	[2] 1, 005	40, 293	482, 114	7, 792, 854
1915	24, 647	405, 990	37, 312	724, 679	1925	[2] 100	4, 411	629, 401	11, 000, 235
1916	21, 289	358, 416	128, 755	2, 505, 857	1926	[2] 48	1, 052	576, 966	10, 918, 394
1917	973	20, 176	152, 736	3, 500, 819	1927	[2] 3, 384	34, 487	789, 274	16, 254, 227
1918	55	1, 692	131, 092	3, 626, 638	1928	[2] 4, 787	21, 320	685, 051	14, 345, 075
1919	77	1, 997	224, 712	6, 325, 552	1929	[2] 1, 163	6, 616	855, 183	17, 628, 813
1920	44	1, 722	477, 450	8, 994, 350	1930	[2] 29	1, 523	593, 312	12, 416, 233
1921	4	226	285, 762	4, 524, 768	1931			407, 586	8, 837, 268

[1] Composed of 130 tons of "crude sulphur," imported Jan. 1 to Sept. 21, and 37 tons of "sulphur and sulphur ore," imported Sept. 22 to Dec. 31.
[2] Classified as "sulphur and sulphur ore."

In addition to brimstone or crude sulphur the United States exports treated products, such as crushed, ground, refined, and sublimed sulphur and flowers of sulphur. Exports of these commodities in 1931 were 27,197,699 pounds, valued at $431,785, a decrease of 8,672,660 pounds (24 per cent) from the total in 1930. The average value in 1931 was 1.59 cents a pound or about $36 per long ton.

Exports to all countries that receive important quantities of American crude sulphur, with the exception of those to France, decreased substantially. The most notable decrease among the large consumers occurred in shipments to Australia, which were only 21,362 long tons in 1931, compared with 65,036 tons in 1930 (a decrease of 67 per cent). During the quinquennial period 1926 to 1930 Australia has received on an average more than 87,000 tons of American crude sulphur annually. Exports to France in 1931 showed an increase of 31 per cent over those of 1930. Canada was again the best customer for American crude sulphur, taking 111,958 tons (27 per cent of the total exports) in 1931, compared with 166,943 tons in 1930; Germany was again second with 82,218 tons (20 per cent), compared with 120,569 tons in 1930; France regained third place with 73,457 tons (18 per cent), compared with 56,190 tons in 1930; the United Kingdom was fourth with 23,635 tons (6 per cent of the total), compared with 28,683 in 1930. These four countries received 71 per cent of the total exports of American crude sulphur in 1931.

In 1931, Canada was the largest importer of American treated sulphur, taking 6,736,212 pounds (25 per cent of the total), and supplanted Germany, which ranked second with 4,440,834 pounds (16 per cent). The United Kingdom, Mexico, Australia, Greece, and Uruguay followed in order, each requiring over 1,000,000 pounds in 1931.

The following table shows the exports of crude sulphur and treated sulphur from the United States in 1931 by countries of destination:

Sulphur exported from the United States in 1931, by destinations

Destination	Sulphur or brimstone		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Pounds	Value
North America:				
Canada	111,958	$2,026,789	6,736,212	$128,879
Central America	152	4,734	307,895	6,825
Mexico	4,995	108,674	1,784,521	39,059
Newfoundland and Labrador	5,507	104,646	2,360	96
West Indies and Bermudas	9,040	198,880	159,757	4,467
	131,652	2,443,723	8,990,745	179,326
South America:				
Argentina	6,750	144,250	133,070	2,324
Brazil	295	5,608	877,644	11,382
Colombia			225,569	5,728
Uruguay			1,334,415	17,416
Other			229,059	4,060
	7,045	149,858	2,799,757	40,910
Europe:				
Belgium	4,606	109,903	457,215	6,004
Finland	2,859	54,339	22,500	306
France	73,457	1,729,240	231,350	4,237
Germany	82,218	1,945,833	4,440,834	53,468
Netherlands	20,524	482,982	403,238	4,939
Spain	6,004	138,866		
United Kingdom	23,635	519,971	3,736,136	48,233
Other	708	13,488	2,249,361	30,041
	214,011	4,994,622	11,540,634	147,228
Asia	2,235	62,704	1,354,184	21,538

Sulphur exported from the United States in 1931, by destinations—Continued

Destination	Sulphur or brimstone		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Pounds	Value
Africa:				
Algeria and Tunisia	8,188	$186,770		
Canary Islands			90	$5
Liberia			4,000	80
Mozambique	1,500	42,000	55,000	823
Union of South Africa	4,500	99,000	529,550	8,443
Other			13,523	203
	14,188	327,770	602,163	9,554
Oceania:				
Australia	21,362	479,203	1,700,829	27,929
New Zealand	17,093	379,388	209,387	5,300
	38,455	858,591	1,910,216	33,229
	407,586	8,837,268	27,197,699	431,785

CONSUMPTION

APPARENT CONSUMPTION OF PRIMARY SULPHUR

Agriculture and almost every other industrial activity depend to a certain extent upon sulphur as an essential raw material. Owing to this widely diversified use a decline in the consumption of sulphur in 1931 in line with the conditions of general business was inevitable. The market was slow throughout the year. Shipments to domestic consumers in 1931 declined in about the same proportion as shipments to foreign consumers; in 1930 the percentage decline in exports greatly exceeded that in domestic shipments. As sulphur is sold on long-term contracts consumers' stocks may have varied; however, no figures for consumers' stocks are available.

The trend of sulphur consumption in the United States for the last quinquennial period is shown in the following table, in which it is assumed that stocks in consumers' hands are small and constant:

Apparent consumption of sulphur in the United States, 1927–1931, in long tons

	1927	1928	1929	1930	1931
Shipments	2,072,109	2,082,924	2,437,238	1,989,917	1,376,526
Imports	3,384	4,787	1,163	29	
	2,075,493	2,087,711	2,438,401	1,989,946	1,376,526
Exports (crude)	789,274	685,051	855,183	593,312	407,586
Exports (refined)	14,026	19,882	17,663	16,014	12,142
	803,300	704,933	872,846	609,326	419,728
Apparent consumption	1,272,193	1,382,778	1,565,555	1,380,620	956,798

CONSUMPTION, BY USES

The consumption of sulphur in the various domestic industries has been estimated as follows for the last 5-year period by Chemical and Metallurgical Engineering:

Sulphur consumed in the United States, 1927–1931, by uses, in long tons

Use	1927	1928	1929	1930	1931
Heavy chemicals	490,000	520,000	560,000	471,000	327,000
Fertilizer and insecticides	300,000	345,000	415,000	418,000	254,000
Pulp and paper	260,000	250,000	265,000	235,000	178,000
Explosives	65,000	60,000	67,000	48,000	39,000
Dyes and coal-tar products	40,000	42,000	47,000	41,000	39,000
Rubber	35,000	40,000	43,000	31,000	23,000
Electrochemicals	20,000	21,000	23,000	20,000	16,000
Fine chemicals	13,000	14,000	15,000	13,000	12,000
Paint and varnish	5,000	5,000	5,000	4,500	4,000
Food products	3,000	5,000	5,000	4,500	4,700
Miscellaneous	119,000	124,000	136,700	110,600	72,000
	1,350,000	1,426,000	1,581,700	1,396,600	968,700

SULPHURIC ACID

The production of sulphuric acid, the chief use of sulphur in the United States, decreased materially in 1931, due largely to the very large drop in the consumption of acid for fertilizers. The following table, which shows the consumption of sulphuric acid by industries from 1927 to 1931, is based largely on estimates by Chemical and Metallurgical Engineering. The figures on acid consumed in the fertilizer industry are those given by the Bureau of the Census.

Sulphuric acid (expressed as 50° B.) consumed in the United States, 1927–1931, by industries, in short tons [1]

Industry	1927	1928	1929	1930	1931
Fertilizer [2]	2,137,000	2,474,000	2,446,000	2,477,000	1,352,000
Petroleum refining	1,250,000	1,350,000	1,570,000	1,420,000	1,220,000
Chemicals	725,000	745,000	890,000	820,000	760,000
Coal products	732,000	740,000	935,000	800,000	550,000
Iron and steel	685,000	670,000	800,000	660,000	480,000
Other metallurgical	600,000	570,000	675,000	560,000	410,000
Paints and pigments	210,000	205,000	225,000	200,000	180,000
Explosives	183,000	170,000	195,000	177,000	175,000
Rayon	----------	105,000	150,000	145,000	145,000
Textiles	135,000	78,000	90,000	78,000	81,000
Miscellaneous	280,000	292,000	390,000	330,000	181,000
	6,937,000	7,399,000	8,366,000	7,667,000	5,534,000

[1] Figures, except those for the fertilizer industry, from Chem. and Met. Eng., January, 1932, p. 42, and from earlier annual review issues.
[2] Bureau of the Census, Department of Commerce.

WORLD PRODUCTION

The world production of sulphur in 1931 is estimated at 2,570,000 long tons, a decline of 430,000 tons from the all-time record production of the preceding year. The principal producers in order of their importance are the United States, Italy (including Sicily), Japan, Chile, and Spain, with the United States contributing 83 per cent of the total production. The following table shows the production of sulphur in the principal producing countries during the last decade:

Production of sulphur in the principal producing countries, 1922–1931, in long tons

Year	United States (sulphur)	Italy		Japan		Chile (sulphur)	Spain (sulphur)
		Sulphur	Ore	Sulphur	Ore		
1922	1,830,942	164,696	22,347	34,095	41,424	12,057	13,028
1923	2,036,097	252,293	9,316	36,825	35,749	11,200	8,382
1924	1,220,561	290,241	21,948	46,133	50,892	9,611	9,388
1925	1,409,262	259,428	26,821	46,962	42,620	8,929	7,859
1926	1,890,027	267,107	33,088	47,020	46,545	8,787	9,351
1927	2,111,618	300,888	23,487	60,371	16,505	12,303	10,065
1928	1,981,873	291,430	31,051	68,956	13,109	15,423	10,199
1929	2,362,389	318,722	21,149	64,430	14,849	16,043	11,715
1930	2,558,981	345,026	19,409	61,375	14,392	18,184	11,557
1931	2,128,930	348,132	19,502	[1] 60,000	(2)	[1] 14,000	[1] 10,000

[1] Estimated. [2] Data not available.

ITALY

The production of sulphur in Italy in 1931 amounted to 348,132 tons, a slight increase over that in 1930, which was the largest production since 1915; the production from Sicily was estimated at 248,132 tons, while the mines on the Continent contributed 100,000 tons. Besides the production of crude sulphur listed above, which contains 2 to 11 per cent impurities, Italy also produces ground crude ore, which is used for agricultural purposes. In 1931 Italy produced 19,502 long tons of this ground ore, compared with 19,409 tons in 1930.

During the year 1931 Italian sulphur producers were faced with the problem of overproduction pending the outcome of negotiations between the Sicilian Sulphur Consortium and the American producers regarding exports into the world markets. The contract between the Sicilian Sulphur Consortium and the American Exporters, which dates from 1923, is still in effect in its original form, and no change of quota has been allocated to either party. The contract provides for annual adjustments of all outstanding matters, and such annual adjustments have been made regularly in the past. During the 1930–31 season Sicily exported 50,000 tons in excess of its quota. In view of the existing trade conditions and other matters the Sulphur Export Corporation consented to waive any claim to make up this tonnage without prejudice to any of its rights under the contract. The output of continental Italy (largely the Montecatini interests) is not included in the agreement. The Italian producers, however, are pressing [3] for a larger quota because of increased output in Sicily and on the Continent. Awaiting the possible conclusion of new agreement between the Sulphur Consortium and the American producers, the Montecatini has adjusted its output to sales, resulting in no accumulation of stocks on the Continent, while stocks of sulphur in Sicily at the end of the year totaled 150,000 tons.

Sicily.—Sicily, the chief source of sulphur besides the United States, produced 245,354 long tons of sulphur during the fiscal year ended July 31, 1931, an increase of 2,298 tons over the preceding fiscal year. During the last fiscal year 25 new mines were opened, while 24 old mines closed down, making the total of producing mines 201. One cause of increased production in Sicily was that the licenses of many of the mines expire in the near future, and because of the laws of 1927 many of them will not be renewed.

[3] Montecatini, Rapports et Bilan: Milan, vol. 44, 1932, pp. 12–13.

The sulphur ores mined in Sicily contain 20 to 24 per cent sulphur, which is extracted from the ore either in burning heaps (calcaroni) or in Gill chamber furnaces. In 1928 ores treated in the calcaroni yielded 13.66 per cent sulphur, while that treated in the Gill furnaces yielded 14.42 per cent. Other figures indicate a recovery of 152.8 kilograms per ton of ore for the 4-year period 1924 to 1927. The following table shows the quantity and quality of the sulphur produced by the mines in the various districts of Sicily in the fiscal year ended July 31, 1931:

Sulphur produced in Sicily in the fiscal year ended July 31, 1931, by districts, in long tons

District	Best seconds	Best thirds unmixed	Best thirds	Good thirds	Current thirds	Dark inferior	Total
Catania	5,111	7,407	33,736	19,519	3,808		69,581
Porto Empedocle	2,979	707	18,049	31,759	15,679	1,427	70,600
Licata	25,373	28,599	21,970	22,026	1,845	29	99,842
Termini	346	1,014	3,314	614	43		5,331
	33,809	37,727	77,069	73,918	21,375	1,456	245,354

Although the Sicilian mines are operated largely by inferior hand methods they will in a short time be able to adopt all mechanical benefits mining technique can offer. A large, modern central power station at Porto Empedocle, with an initial power of 5,000 kilowatts and with necessary transmission lines and distributing network, is scheduled for completion during 1932.

The consortium which controls the supply of raw sulphur in Sicily has not renewed its agreement with Forza (the sulphur-refining company), and it is understood that the consortium will refine and sell refined sulphur for its own account. In the past the Sicilian sulphur industry has been divided into two branches, the extracting industry, which produces raw sulphur, and the refining industry, which refines this raw material. The refining industry has always been the more prosperous of the two, due to the low price for raw sulphur paid the extractive industry.

Recently there has been developed in Sicily a new process for refining sulphur. A refining still is installed in the Gill furnace and uses the surplus heat derived from the melting of the sulphur in the furnace.

Continental Italy.—The production of sulphur in continental Italy, which has been estimated at 100,000 long tons in 1931, has been increasing during the past few years. The output comes mainly from the Marches and Romagna, but a small production also comes from the mines in Avellino and Catanzaro Provinces. The deposits on the Continent are said to be inferior to those of Sicily, their thickness rarely exceeding 10 meters compared with 20 to 31 meters in Sicily. The continental mines are worked with more modern methods, extraction being almost entirely by mechanical means and some of the shafts being equipped with electric hoists. These advantages favor lower production costs for the continental producers despite the higher wages paid as compared with those of Sicily. In 1929 the average wage paid to underground workers of all kinds in central Italy (Marches and Romagna) was 17.59 lire per day and 14.24 lire to workers above ground. The general average is 16.45 lire compared with 13.15 lire in Sicily. It is contended in certain quarters, however, that the advantages of mechanization are not enough to offset the difference in wages. Gill furnaces are used for extracting sulphur from the ore. According to official figures, during the 4-year period 1924 to 1927 the yield in crude sulphur averaged 165.1 kilograms per ton of ore in central Italy, as compared with 152.8 kilograms per ton of ore in Sicily.

The Montecatini Co., the principal continental producer, does its own refining at Bellisio, Pesaro, and Cesena, which are favorably located in respect to the mines.

The exports of sulphur from Italy decreased only slightly in 1931, thus holding the high level gained by increases in 1929 and 1930. A table showing the quantity and destination of the consignments in 1929, 1930, and 1931 follows:

Sulphur exported from Italy, 1929–1931, by destinations, in long tons

Destination	1929	1930	1931	Destination	1929	1930	1931
Europe:				Africa:			
Austria	13,627	12,436	9,292	Algeria	4,331	98	522
Belgium	2,901	3,518	3,436	British South Africa	637	4,200	6,522
Finland	5,860	8,369	20,872	Egypt	1,545	1,986	1,612
France	34,776	33,520	35,359	Tunisia	1,720	3,797	887
Germany	4,919	8,064	22,186	Asia:			
Great Britain	37,218	42,111	30,562	British India	13,879	16,218	11,723
Greece	8,418	8,586	11,767	Netherland East Indies			
Hungary	584	1,138	225		15,032	12,255	10,162
Netherlands	123	697	1,660	Turkey in Asia	2,982	1,861	1,238
Portugal	7,784	8,814	6,949	South America:			
Rumania	1,601	2,557	626	Argentina	6,295	4,356	5,607
Spain	3,134	7,942	5,679	Brazil	1,207	1,589	1,382
Sweden	17,433	14,045	11,373	Uruguay	1,439	1,238	320
Switzerland	1,176	1,761	2,595	Australia	448	13,948	254
Turkey in Europe	308	212	527	Other countries	9,988	9,868	7,605
Union of Socialist Soviet Republics	16,846	11,106	21,920		218,259	237,994	236,734
Yugoslavia	2,048	1,704	3,872				

JAPAN

The production of sulphur in the Japanese Empire during the fiscal year ended July 31, 1931, was 55,082 metric tons, as compared with 71,230 tons in the preceding fiscal year. Most of the Japanese sulphur comes from Hokkaido and is used in Japan, but small amounts go to near-by China and Hong Kong. Early in 1931 a cargo of 5,000 tons was shipped to New Zealand, where the bulk of the sulphur imports had previously been shipments from the United States.

CHILE

The production of sulphur in Chile is estimated at 14,000 tons in 1931, largely from Tacna and Antofagasta. Enormous deposits of sulphur occur at high altitudes in the volcanic regions of Chile, but their development is retarded by the rigors of climate and hardships when working at altitudes of 5,000 meters. The mines along the Antofagasta-Bolivian Railway are worked by Bolivian laborers using pick-and-shovel methods, and the refining is done with yareta for fuel.

The closing of some of the nitrate plants in the Provinces of Antofagasta and Tarapaca has caused a large decrease in the demand for sulphur. This industry, which formerly consumed about 10,000 tons of sulphur, is now taking only about 1,500 tons, while the normal annual consumption of 3,000 tons for agriculture is now about 1,000 tons. Exports to Argentina and Europe have provided other outlets. The shipment to Europe was probably made possible by the drop in value of the pound sterling, and it is not expected that under normal conditions Chilean sulphur can compete in world markets. In December a bill was sent to the Chilean Congress proposing the payment of 100 pesos per metric ton on exports of refined sulphur at least 90 per cent pure and 30 pesos per metric ton on exports of sulphur ore.

The Cia-Azufrera y Minera del Pacifico, a subsidiary of a British firm, the Tigon Mining & Finance Corporation (Ltd.), is planning to install modern machinery and increase production to about 2,000 tons per month, or more than double the present output. The firm operates sulphur mines on Mounts Tacora and Chupiquina adjacent to the Arica-La Paz Railway in the extreme northern part of Chile. The ore is mined as rough lumps containing 60 to 80 per cent sulphur, which is refined to 99½ per cent purity. The cost of refining and transporting the sulphur is about $5 per ton (United States currency). Ocean freight rates are about $5 from Arica to Buenos Aires and $4 from Antofagasta to New York or Europe. Because of the excess stocks of sulphur which have accumulated, production by the Tigon interests was temporarily suspended during the latter part of 1931.

SPAIN

Spain's output of sulphur, which is estimated at 10,000 long tons in 1931, is insufficient for its own requirements. The bulk of the sulphur mined in Spain comes from Teruel, Murcia, and Albacete Provinces. In 1930 the average sulphur content of the ore mined in Albacete was 14 per cent, in Murcia 19 per cent, and in Teruel 20 per cent. Smaller amounts of sulphur came from Almeria, where the Tigon Mining & Finance Corporation (Ltd.) is improving its method of extracting sulphur from the ores. In 1931 the company discontinued experimental work on furnaces it has been developing and installed improved Gill furnaces similar to those in use in Italy. These proved satisfactory, and at the end of the year five 4-unit refining furnaces were in operation, giving an approximate rate of production of 1,700 tons per annum. The ore mined in Almeria in 1930 averaged about 6 per cent sulphur.

OTHER COUNTRIES

Small quantities of sulphur are produced in New Zealand, Russia, China, Netherland East Indies, and Southern Rhodesia, and elsewhere in regions of volcanic activity either active or extinct.

A suitable method has been developed [4] for the extraction of sulphur from the Kara-Kum deposits in Turkmenistan, where there are reported to be several million tons of sulphur. The process consists of heating an aqueous suspension of the sulphur-containing soil with superheated steam in closed vessels above 120° C., with separation of the molten sulphur. The first small plant worked

[4] Industrial and Engineering Chemistry (News Edition), Desert of Kara-Kum Supplies Soviet Union with Large Quantities of Sulphur: Vol. 10, No. 5, Mar. 10, 1932, p. 53.

satisfactorily, and a larger plant has been built, which is now working regularly. Transportation under desert conditions presents a serious obstacle to development of the deposits. Previously there has been only a very minor production of sulphur in the Union of Socialist Soviet Republics from the small Crimean deposits.

It was reported [5] during the year that the Kechiborlu sulphur works erected during the war, which have been idle for some time, had resumed operations. The deposits, 16 kilometers southeast of Dinier, Turkey, a town on the Egedir extension of the Smyrna-Aidin Railway, will be operated by the Société Générale de Mines et Métallurgie.

Deposits of sulphur were reported [6] to have been found in the region of Palmyra, Syria.

Discovery of a surface deposit of sulphur near the Rio Grande River in Mexico opposite Candelaria, Tex., was reported [7] during the year. According to reports the deposit is almost pure sulphur. Barrera [8] has described the sulphur deposits of Mexico.

PYRITES

DOMESTIC PRODUCTION

The production of pyrites (ores and concentrates) amounted to 330,848 long tons in 1931, a decrease of only 5 per cent from the production of 347,512 tons in 1930. The above figures include the pyrite and pyrrhotite concentrates from copper operations in Tennessee and pyrite concentrates from zinc operations in New York and Wisconsin. Figures prior to 1928 in the reports of this series do not include the concentrates from copper operations in Tennessee or zinc operations in Wisconsin. The following table gives the production of pyrites (ore and concentrates) in the United States during the past 20 years:

Pyrites produced in the United States, 1912–1931

Year	Long tons	Value	Year	Long tons	Value
1912	350,928	$1,334,259	1922 [1]	169,043	$671,241
1913	341,338	1,286,084	1923 [1]	181,628	661,000
1914	336,662	1,283,346	1924 [1]	160,096	645,262
1915	394,124	1,674,933	1925 [1]	170,081	650,448
1916	439,132	2,038,002	1926 [1]	166,559	616,668
1917	482,662	2,593,035	1927 [1]	215,786	804,006
1918	464,494	2,644,515	1928 [1]	312,815	1,081,758
1919	420,647	2,558,172	1929 [1]	333,465	1,250,141
1920	310,777	1,596,961	1930 [1]	347,512	1,028,680
1921	157,118	711,432	1931 [1]	330,848	974,820

[1] Figures for 1928 to 1931, inclusive, include by-product pyrites from zinc operations in Wisconsin and New York and pyrite and pyrrhotite concentrates from copper operations in Tennessee. Similar output for Wisconsin and Tennessee in earlier years (1922 to 1927) was not included in the statistics. The production of pyrite and pyrrhotite concentrates in Tennessee began in 1925.

The production of by-product pyrites from zinc operations in Wisconsin and of pyrite and pyrrhotite concentrates from copper operations in Tennessee, 1922 to 1927, not included in the preceding table, was as follows:

[5] Metal Bulletin (London), No. 1623, Sept. 8, 1931, p. 16.
[6] World Trade Notes, vol. 5, No. 51, Dec. 21, 1931, p. 1.
[7] Engineering and Mining Journal, Find Surface Sulphur Deposit Near Rio Grande, Mexico: Vol. 132, No. 1, July 13, 1931, p. 35.
[8] Barrera, Tomas, Estudio Monografico del Azufre: Bol. Minero, vol. 31, No. 1, January, 1931, pp. 2–13.

	Long tons		Long tons
1922	3, 808	1925	23, 561
1923	9, 007	1926	60, 374
1924	7, 818	1927	87, 040

Of the total production in 1931 only 88,468 long tons were lump and the remainder fines, the bulk of the latter being in the form of flotation concentrates. The sulphur content of the pyrites produced was 36.7 per cent (121,503 tons of sulphur), compared with 35.7 per cent (124,226 tons) in 1930.

The quantity of pyrites (ore or concentrates) sold or consumed by the producing companies totaled 330,145 tons, compared with 350,177 tons in 1930. In 1931 only 49,922 tons were sold, of which more than half was exported. The prices of pyrites quoted by the trade journals are those for imported pyrites and are given in cents per long-ton unit of sulphur c. i. f. Atlantic ports. At the beginning of the year the price was quoted at 13 cents per unit. In March the quotation dropped to 12 cents, where it remained steady for the rest of the year.

In 1931, as in 1930, pyrites was produced in California, New York, Tennessee, Virginia, and Wisconsin. Pyrites was also produced in 1931 from coal-mining operations in Illinois. Tennessee was again by far the largest producing State, the output coming from the mines of the Tennessee Copper Co. and from the Ducktown Chemical & Iron Co. in the Ducktown Basin, Polk County.

TENNESSEE

The Tennessee Copper Co., a subsidiary of the Tennessee Corporation, operated the Burra Burra, Eureka, and Polk County Mines in 1931. The Burra Burra is much the largest operation and is the chief source of ore smelted and treated in the company's copper smelter and acid plant at Copperhill, while the Eureka Mine is operated irregularly and produces a much smaller tonnage of high-sulphur ore, the rate of output depending upon the demand for sulphur in acid making. The Polk County Mine, which has been idle since 1920, was recently unwatered, and production was resumed in 1931. The methods of mining at these properties have been described by McNaughton.[9] The pyrite and pyrrhotite are recovered in the mill by selective flotation; the mill also makes copper and zinc concentrates. The pyrite and pyrrhotite concentrates are roasted at the smelter, and the SO_2 gas evolved is mixed with gases from the copper blast furnace and converter and conducted to the chamber acid plants where it is converted into sulphuric acid. The Tennessee Corporation has curtailed operations at its acid plant pending betterment of the fertilizer market, which is the chief outlet for the acid.

The Ducktown Chemical & Iron Co. operates the Mary and the Isabella Mines, but the only pyrites produced comes from the mill at the Isabella Mine, where pyrite concentrates and pyrrhotite concentrates are made by selective flotation. In the operation of the mill the chalcopyrite is floated off first, then the pyrite, and last the pyrrhotite. Iron concentrates (magnetic) of a third type are made with a Dings magnetic separator. The three types of iron concentrates are then mixed and sent to the roasters. Kegler has described the method of mining.[10]

[9] McNaughton, C. H., Mining Methods of the Tennessee Copper Co., Ducktown, Tenn.: Inf. Circ. 6149, Bureau of Mines, 1929, pp. 1–17.

[10] Kegler, V. L., Mining Methods of the Ducktown Chemical & Iron Co., M r Mine, Isabella, Tenn.: Inf. Circ. 6397, Bureau of Mines, 1931, pp. 1–9.

The pyrites mined in Tennessee does not enter the market, as both companies use all of their product in the manufacture of sulphuric acid. The sinter from the roasting operations is recovered and shipped to the iron blast furnaces in the Birmingham district. The sinter averages 64.51 per cent iron, 0.12 per cent manganese, and 0.007 per cent phosphorus.

VIRGINIA

The only pyrites produced in Virginia in 1931 came from the Gossan Mine at Cliffview, Carroll County. The mine, which produces both lump and fines, was operated by the General Chemical Co. The ore is mined by opencut and underground methods and is used for the manufacture of sulphuric acid at the company plant, Pulaski, Va.

CALIFORNIA

The companies producing pyrites in California in 1931 were the Leona Chemical Co. (Ltd.) in Alameda County and The Mountain Copper Co. (Ltd.) in Shasta County.

The Leona Heights Mine, operated by the Leona Chemical Co. (Ltd.) is located within the municipal limits of Oakland, Alameda County, and has a continuous record of production since 1912. A new section of the mine was opened by an adit in 1926; all ore is now coming from this section, which is 25 feet thick and underlies 60 to 80 feet of overburden. The pyrites averages about 47 per cent sulphur; it carries $1 to $2 per ton in gold and approximately 1 per cent copper; the metal values are recovered by leaching. The sulphur content is used by the Stauffer Chemical Co. in the manufacture of sulphuric acid.

The production by The Mountain Copper Co. (Ltd.) came from the Hornet Mine in Shasta County, where a fines concentrate averaging about 50 per cent sulphur is being produced.

NEW YORK

During 1931 the St. Joseph Lead Co. produced 26,604 long tons of pyrite concentrates at its Balmat Mine. The pyrite was produced as a flotation concentrate in the treatment of ore in which zinc is the principal value.

Mining at the Balmat Mine is chiefly by open stopes with pillars, with some production from shrinkage stopes. Knaebel[11] has described the mining methods at the near-by Edwards Mine, of the same company, which are similar to those used at the Balmat.

The Balmat ore is in general a massive mixture of zinc and iron sulphides, with some galena, and a nonmetallic gangue of silicate minerals, dolomite, and quartz. The average mineralogical composition of the ore is about as follows:

	Per cent		Per cent
Pyrite	24	Quartz	9
Sphalerite	20	Dolomite	8
Galena	2	Chlorite	5
Magnetite and hematite	5	Talc	3
Allanite	1	Serpentine	1
Garnet	.5	Miscellaneous	2.5
Tremolite and diopside	19		

[11] Knaebel, John B., Mining Practice at the Edwards Mine of the St. Joseph Lead Co., St. Lawrence County, N. Y.: Inf. Circ. 6586, Bureau of Mines, 1932, pp. 1–25.

During 1930 the average dry assay of the ore was 12.29 per cent zinc, 1.66 per cent lead, and 12.93 per cent iron. The valuable constituents are recovered in an all-flotation mill, which was designed to handle 500 tons of ore per day and has been operating virtually at capacity since May, 1930. During the latter part of 1931 about 570 tons of ore were milled daily. Three kinds of concentrates are made by selective flotation in the order named: Lead, zinc, and pyrite. The primary heads to the pyrite circuit consist of the zinc scavenger tails. During 1931, when the mill was treating slightly more than 500 tons per day, the pyrite averaged about 52 per cent sulphur, with a recovery of about 66.2 per cent. The mill has been described by Knaebel.[12]

WISCONSIN

The only company reporting pyrites production in Wisconsin in 1931 was the National Zinc Separating Co., which operated its roasting and magnetic separating plant at reduced capacities. The company makes a pyrites concentrate at its magnetic separation plant at Cuba City from raw zinc concentrates obtained from several mines in the Platteville district. The ore is mined by the system used in southeast Missouri and Joplin and contains principally sphalerite, pyrite, and galena. The zinc-pyrite concentrates are brought together at the roasting plant. A preliminary roast renders the iron sulphides magnetic, and after the calcines are cooled magnetic concentrates are made with a rotating magnetic disk and then given a dead roast to remove the sulphur. The gases from the preliminary and dead roasts are used in the manufacture of sulphuric acid.

During the year a detailed study was made of the possibility of substituting differential flotation for roasting and magnetic separation. The plan is to ship mine concentrates to an all-flotation mill where lead concentrates, zinc concentrates, and pyrites concentrates will be made. The lead and zinc concentrates would be shipped to the smelters. The pyrites concentrates would be roasted and sulphuric acid made from the gases. The resultant iron oxide calcine would be shipped to the blast furnaces in the Chicago district if the zinc content can be kept low enough. Flotation treatment is expected to increase recoveries and produce higher grade concentrates, but the development is awaiting an improvement in the zinc market.

IMPORTS AND EXPORTS

The "general" imports of pyrites amounted to 352,066 long tons in 1931, compared with 368,114 tons in 1930, a decrease of 4 per cent. The "imports for consumption," however, held up remarkably well, amounting to 352,066 tons in 1931, compared with 354,543 tons in 1930.

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[12] Knaebel, John B., Milling Methods at the Balmat Mill of the St. Joseph Lead Co., Balmat, St. Lawrence County, New York: Inf. Circ. 6574, Bureau of Mines, 1932, pp. 1–28.

The trend of imports of pyrites from 1912 to 1931 is shown in the following table:

Pyrite or sulphide of iron, containing more than 25 per cent sulphur, imported for consumption in the United States, 1912–1931

Year	Long tons	Value	Year	Long tons	Value
1912	970, 785	$3, 841, 683	1922	279, 445	$1, 199, 076
1913	850, 592	3, 611, 137	1923	263, 695	1, 254, 389
1914	1, 026, 617	4, 797, 326	1924	246, 737	598, 544
1915	964, 634	4, 817, 977	1925	276, 385	773, 925
1916	1, 244, 662	6, 728, 318	1926	366, 151	856, 981
1917	967, 340	5, 981, 457	1927	250, 794	647, 512
1918	496, 792	2, 741, 676	1928	457, 123	1, 135, 463
1919	388, 973	2, 176, 565	1929	514, 336	1, 507, 648
1920	332, 606	1, 660, 832	1930	354, 543	1, 009, 081
1921	216, 229	818, 852	1931	352, 066	1, 496, 197

Of the total pyrites imported in 1931 Spain furnished 327,771 long tons (93 per cent) and Canada 24,245 tons (7 per cent). The countries from which pyrites has been imported since 1927 are shown in the following table:

Pyrite or sulphide of iron, containing more than 25 per cent sulphur, imported into the United States, 1927–1931, by sources

[General imports]

Country	1927		1928		1929		1930		1931	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	9, 203	$30, 992	56, 956	$192, 864	68, 243	$240, 411	42, 117	$145, 645	24, 245	$109, 440
Norway			7, 468	15, 611						
Soviet Russia in Europe							5	20	50	300
Spain	241, 591	616, 520	393, 840	932, 261	446, 093	1, 267, 237	325, 992	891, 352	327, 771	1, 386, 457
	250, 794	647, 512	458, 264	1, 140, 736	514, 336	1, 507, 648	368, 114	1, 037, 017	352, 066	1, 496, 197

Despite the exceptional decline in the consumption of most commodities imports of pyrites from Spain increased slightly in 1931. Such imports constitute the major part of the American trade in this commodity, owing to the large, cheaply mined deposits of pyrites of unusual grade near the coast of Spain (Huelva district) and to the comparatively low ocean-transportation rates between Huelva and the Atlantic seaboard of the United States. The following table shows typical analyses of imported Spanish pyrites, which is marketed on the eastern seaboard:

Typical analyses of Spanish pyrites imported into the United States, in per cent[1]

	Lump	Fines	Washed
Copper	1.75- 2.00	1.75- 2.00	0.30 - 0.45
Lead	.94	1.10	.50 - .80
Bismuth	.14	.017	.005 - .01
Arsenic	.45	.47	.25 - .35
Antimony	.055	.062	.010 - .020
Sulphur	47.47	46.43	48.50 -50.00
Phosphorus	.007	.008	.007 - .010
Iron	40.41	39.27	42.0 -43.50
Alumina	1.69	1.25	.10 - .20
Zinc	1.31	1.37	.35 - .55
Manganese	.041	.60	.01 - .02
Nickel and cobalt	.122	.134	.13 - .132
Lime	.324	.370	.20 - .30
Magnesia	.115	.130	.10 - .15
Siliceous residue	3.59	4.90	2.50 - 4.00
Silver	.0047	.0050	.004 - .005
Gold	.00007	.00007	.00007- .00007

[1] Hearings before a subcommittee of the Committee on Finance, United States Senate, Seventy-First Congress, 1929, p. 663.

Imports from Canada decreased 42 per cent in 1931, following a 38 per cent decrease in 1930. This was due to the cessation of shipments from British Columbia into the bay region of San Francisco, Calif. The following table shows the customs districts into which pyrites has been imported during the last five years:

Pyrite or sulphide of iron, containing more than 25 per cent sulphur, imported into the United States, 1927–1931, by customs districts

Customs district	1927	1928	1929	1930	1931
Buffalo	174	120	413	90	114
Chicago		28			
Georgia	3,650	5,915		5,554	5,628
Maine and New Hampshire			25,751		
Maryland	74,827	140,090	182,249	175,611	125,559
Massachusetts		14,907			
New York	25,895	70,231	54,331	42,145	55,225
Philadelphia	120,309	153,644	166,056	87,178	128,650
San Francisco	7,488	50,147	52,514	7,990	
South Carolina	8,980	11,792	5,696	7,322	5,053
Vermont	1,280	6,554	17,326	19,591	24,131
Virginia	7,930	4,729	10,000	8,187	7,706
Washington	261	107		14,446	
	250,794	458,264	514,336	368,114	352,066

Considering the recoverable sulphur content of imported pyrites as 45 per cent, the quantity of sulphur available in imported pyrites was 158,400 long tons.

Exports of pyrites are not separately classified by the Bureau of Foreign and Domestic Commerce. A producing company reports that during 1931, 26,604 tons were exported to Canada. This figure exceeds the imports of pyrites from Canada to the United States.

WORLD PRODUCTION

The following table shows the world production of pyrites and the quantity of sulphur it is supposed to replace in the market. Most of the figures are taken from the official sources of the countries concerned, supplemented by information taken from the publications of the Imperial Institute and other reliable sources.

World production of pyrites (including cupreous pyrites), 1927–1931, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Algeria:					
Gross weight	12,918	13,825	16,804	16,628	21,325
Sulphur content	6,071	6,498	7,730	7,483	(2)
Australia (Tasmania):					
Gross weight					515
Sulphur content					(2)
Austria:					
Gross weight	19,328	10,000			(2)
Sulphur content	3,153	2,000			(2)
Canada:					
Gross weight	46,142	62,447	70,087	48,619	57,418
Sulphur content	22,887	[3] 35,007	[3] 39,949	25,163	28,822
Cyprus: [4]					
Gross weight	211,462	243,913	295,772	242,316	202,993
Sulphur content	105,731	121,956	147,886	121,158	101,496
Czechoslovakia:					
Gross weight	23,300	23,626	23,005	21,669	(2)
Sulphur content	9,203	9,332	9,087	8,559	(2)
France:					
Gross weight	200,400	198,454	198,705	197,658	192,730
Sulphur content	94,380	91,670	90,099	(2)	(2)
Germany:					
Gross weight	350,430	342,179	351,909	289,741	(2)
Sulphur content	149,531	145,866	149,983	124,123	(2)
Greece:					
Gross weight	100,050	94,270	134,399	177,808	(2)
Sulphur content	48,884	45,360	64,434	85,403	(2)
Hungary:					
Gross weight	3,666	4,222	1,023	1,069	(2)
Sulphur content	(2)	(2)	(2)	(2)	(2)
India, British:					
Gross weight			299		(2)
Sulphur content			(2)		(2)
Italy:					
Gross weight	625,338	558,390	664,543	717,270	645,759
Sulphur content	286,227	256,683	305,847	314,790	(2)
Japan:					
Gross weight	506,089	593,972	618,743	561,400	(2)
Sulphur content	(2)	(2)	(2)	(2)	(2)
Norway:					
Gross weight	617,044	738,535	739,597	730,951	(2)
Sulphur content	266,855	321,630	323,844	324,102	(2)
Poland:					
Gross weight	24,596	10,668	9,410	11,046	3,591
Sulphur content	(2)	(2)	(2)	4,860	1,580
Portugal:					
Gross weight	301,035	242,122	384,350	400,224	(2)
Sulphur content	(2)	(2)	(2)	(2)	(2)
Rumania:					
Gross weight	25,514	23,715	23,851	24,264	(2)
Sulphur content	(2)	(2)	(2)	(2)	(2)
Russia: [5]					
Gross weight	225,318	152,041	(2)	241,718	(2)
Sulphur content	(2)	(2)	(2)	(2)	(2)
Spain:					
Gross weight	3,610,694	3,624,819	3,867,250	3,416,465	2,593,933
Sulphur content	1,609,776	1,439,747	1,496,756	1,517,789	(2)
Sweden:					
Gross weight	69,239	19,996	72,055	60,441	57,610
Sulphur content	32,126	12,394	32,082	27,733	(2)
Union of South Africa:					
Gross weight	2,254	3,754	4,116	3,603	3,768
Sulphur content	(2)	(2)	(2)	(2)	(2)
United Kingdom:					
Gross weight	4,968	4,440	4,441	5,585	2,011
Sulphur content	(2)	(2)	(2)	(2)	(2)
United States:					
Gross weight	[6] 219,249	317,836	338,817	353,090	336,158
Sulphur content	84,909	115,124	122,303	126,220	123,453
Yugoslavia:					
Gross weight	57,003	64,273	61,153	50,345	29,495
Sulphur content	(2)	(2)	(2)	(2)	(2)

[1] In addition to the countries listed, Chosen reports production as follows: 1928, 60 kilograms; 1929, 60 kilograms; 1930, 50 kilograms. Belgium also reports production, but figures are not shown separately.
[2] Data not available.
[3] Includes estimated quantity of sulphur in smelter gases used for acid making.
[4] Exports.
[5] Year ended Sept. 30.
[6] Exclusive of by-product pyrites from zinc operations in Wisconsin and of pyrite and pyrrhotite concentrates from copper operations in Tennessee.

SPAIN

The production of pyrites in Spain in 1931 is reported as 2,593,933 metric tons, the outputs from the two leading producers, the Rio Tinto Co. and the Tharsis Co., having been on a curtailed basis throughout the year. Exports [13] of pyrites through the port of Huelva, Spain, amounted to 1,894,855 tons in 1931, compared with 2,563,598 in 1930. The entire exports of pyrites from the Rio Tinto, Tharsis, and Pyrites de Huelva Mines pass through this port.

Although under favorable conditions Spain consumes about 300,000 tons of pyrites per year in the superphosphate industry the bulk of its output is exported for use in various chemical outlets, via sulphuric acid.

NORWAY

Pyrites is one of the most important items in the mineral production of Norway. The output in 1931 is estimated at about 365,000 metric tons, compared with 730,951 tons in 1930. Apart from the general depression, the drastic decline in production was the result perhaps of the largest labor dispute Norway has ever known. The dispute continued from March to the end of September, when it was settled by an agreement which is to continue to April 1, 1934. Production, however, exceeded shipments, resulting in the building of stocks and in curtailed operations. One of the larger mines was closed down while other properties have been reducing the number of employees and days worked per week. The greater part of the output normally goes to Germany, and the collapse of the German market has restricted exports.

During the last decade the Orkla Grubeaktiebolag has been studying the problem of extracting sulphur from pyrites because of the low prices for pyrites during the postwar years. In 1927 the company erected a 40-ton-per-day plant at the Lökken Mine, and the process can now be reckoned to extract 85 to 90 per cent of the sulphur and copper content of the ore at an economical cost. Late in 1931 a much larger plant was erected on the Orkdal Fjord, at Thamshavn, which will treat 200,000 tons of pyrites annually for an output of 75,000 tons of sulphur. The sulphur produced has been of high quality, containing 0.01 per cent ash and no traces of oil. It has been tried in many of the sulphite cellulose works and found very satisfactory, and 200 tons have already been reported shipped for domestic consumption.

Strict secrecy has been observed regarding all the details of the process; but the main reaction is supposed [14] to be carried out in four continuously working furnaces, where the sulphur is decomposed from the pyrites by the combined action of heat, oxidation with oxygen from air, and reduction with carbon. The reactions of the gases are stimulated by being passed over a catalyst of iron or aluminum oxide at a temperature of from 350° to 400° C.

It is expected that the new plant will be able to furnish a large share of the Scandinavian sulphur requirements.

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[13] Echo des Mines et de la Métallurgie, Expéditions de Pyrites de Huelva en 1931: Sixtieth Year, No. 3092, Feb. 10, 1932, p. 115.

[14] Industrial and Engineering Chemistry (News Edition), Norwegian Plant Makes Sulphur from Pyrite: Vol. 10, No. 5, Mar. 10, 1932, p. 53.

ITALY

According to official figures the production of pyrites in Italy in 1931 amounted to 645,759 metric tons, compared with 717,270 tons in 1930, a decrease of 71,511 tons. The Montecatini is the most important factor in the pyrites field, producing more than three-fourths of the Italian output. Some of the pyrites is exported; but Italy also has an import trade, largely from Spain and Cyprus. This import and export trade is made possible because of varying costs of transportation from mines to various plants. The recovery of the pyrites sinter, which is used as an ore of iron, is important in evaluating the pyrites industry of Italy. The production of the sinter exceeds domestic demands and finds a market in European steel centers. A good grade of pyrites, such as the Italian pyrites from Maremma, yields a sinter containing 60 to 62 per cent iron, very little silica, and virtually no impurities. Such material is sold f. o. b. steel plant in the Ruhr for 16 to 18 shillings per ton.

CANADA

Production of pyrites in Canada, as measured by shipments, was 57,418 metric tons in 1931, compared with 48,619 tons in 1930, an increase of 18 per cent. The pyrites shipped in 1931 contained slightly in excess of 50 per cent sulphur, whereas that shipped in 1930 averaged nearly 52 per cent. Increased output was noted in 1931 for British Columbia and Quebec, while Ontario reported no production in 1931. Production in British Columbia increased from 25,886 metric tons in 1930 to 30,975 tons in 1931. The pyrites from British Columbia comes from the Britannia mill, where pyrites concentrates are produced in the treatment of ores for the extraction of copper. The analysis of the pyrites concentrates produced at Britannia in 1931 follows:

Sulphur	per cent	50. 24	Insoluble	per cent	3. 90
Iron	do	44. 65	Undetermined	do	. 795
Copper	do	. 32	Gold	ounce	. 015
Zinc	do	. 08	Silver	do	. 35
Arsenic	do	. 15			

The pyrites output in Quebec was produced by the Consolidated Copper & Sulphur Co. from the Eustis Mine near Sherbrooke, where pyrites is produced as a flotation concentrate in the treatment of ore in which copper is the principal value. The pyrites concentrate from the Eustis Mine, which has the following analysis,[15] is exported to the United States for acid fabrication:

	Per cent		Per cent
S	50. 0	As	0. 03
Fe	43. 0	Pb	. 008
SiO_2	2. 5	Cl	. 002
CaO	. 02	Se	Trace.

Late in 1931 the Aldermac Mines (Ltd.) began producing pyrites at its properties about 10 miles west of Noranda in Boischatel Township, northwestern Quebec. A large tonnage of material averaging about 2 to 2.5 per cent copper and about 70 per cent pyrites has been developed. The ore bodies are a mixture of chalcopyrite, pyrite, pyrrhotite, and a little sphalerite, with pyrite predominating. A con-

[15] Freeman, Horace, Pyrites in Canada: Pulp and Paper Mag., vol. 32, No. 6, Feb. 11, 1932, p. 168.

centrator of 500 tons daily capacity, which is expected to produce about 300 tons per day of pyrites concentrates averaging 50 per cent sulphur, was erected during 1931. A copper concentrate, which is to be shipped to the near-by Noranda smelter, will also be made. The success of the venture depends upon finding a market for the pyrites concentrates, which are particularly adapted to the recently developed Freeman flash-roasting process for producing sulphur dioxide in sulphite cellulose manufacture. Two flash-roasting furnaces have been installed by the St. Lawrence Corporation at its plants in Three Rivers, Quebec, and it is understood that they are giving satisfactory service. At the present time virtually all of the sulphur requirements of Canada are met by imports of native sulphur from Texas. Imports have averaged over 160,000 tons during the last five years, most of which have been used in the sulphite-pulp industry. Should the new flash roasting of pyrites prove adaptable to the manufacture of sulphite pulp, a large potential market for pyrites will be made available.

YUGOSLAVIA

The production of pyrites in Yugoslavia has averaged more than 50,000 metric tons during the last 5-year period. The only producer of importance is the Belgian Maiden-Peh copper mine. The ore, although low in copper, has a high sulphur content.

During the year a method of producing a high-grade pyrites concentrate (48 to 50 per cent sulphur) was developed by the Trepca Mines (Ltd.) at its properties near the town of Kosovska Mitrovica. Tests were carried out both by table concentration and flotation methods, the latter proving more satisfactory. A few hundred tons of pyrites concentrates assaying over 48 per cent sulphur were produced for market development. During December, 1931, the mill treated 28,426 tons of ore in which lead and zinc were the principal values. At the end of September the ore reserves were given as 2,100,000 tons.

PORTUGAL

The figures for the production of pyrites in Portugal for 1931 are not available, but exports declined from 399,119 tons [16] in 1930 to 200,817 tons in 1931. Most of the production of pyrites is exported. The principal producing area is along the southeastern boundary, on an extension of the Spanish pyrites belt. The largest producing mine is the San Domingos in the Beja district, Alemtejo Province.

UNION OF SOUTH AFRICA

There is a small regular annual production of pyrites from the treatment of gold sands in the Union of South Africa. In 1931, 3,768 tons of pyrites were produced.

SULPHURIC ACID PLANTS IN THE UNITED STATES

Due to the importance of sulphuric acid in the consumption of sulphur raw materials, there follows a list of the sulphuric acid plants in the United States in 1931. The list, which shows the location, type of plant, and the source of sulphur, is based largely on information furnished by E. J. Sawbridge, of the Ozark Chemical Co.

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[16] Mining Journal (London), Portugal: Vol. 176, No. 5040, Mar. 26, 1932, pp. 200 and 201.

Sulphuric acid plants in the United States in 1931

Company	Location	Type of plant	Source of sulphur
ALABAMA			
The American Agricultural Chemical Co.	Montgomery	Chamber	Brimstone.
E. I. du Pont de Nemours & Co. (Inc.).	Mineral Springs	Contact	Do.
Home Guano Co	Dothan	Chamber	Do.
Standard Chemical Co	Troy	do	Do.
Steel Cities Chemical Co. (Virginia-Carolina Chemical Corporation).	Exum (Birmingham)	do	Do.
Virginia-Carolina Chemical Corporation.	Dothan	do	Do.
Do	Mobile	do	Do.
ARIZONA			
Apache Powder Co. (Inc.)	Douglas	Contact	Copper ores.
Calumet and Arizona Mining Co. (Phelps Dodge Corporation after Sept. 30).	do	Chamber	Do.
ARKANSAS			
Southern Acid & Sulphur Co. (Inc.)	North Little Rock	do	Brimstone.
CALIFORNIA			
Dominguez Chemical Co. (Stauffer Chemical Co.).	Dominguez (Los Angeles).	Contact	Do.
General Chemical Co	Bay Point	do	Pyrites.
Do	El Segundo	do	Brimstone.
Hercules Powder Co	Hercules	do	Do.
The Mountain Copper Co. (Ltd.)	Martinez	Chamber	Pyrites.
Stauffer Chemical Co. (Consolidated Chemical Industries (Inc.)).	Vernon (Los Angeles).	Contact	Brimstone.
Do	Stege	do	Brimstone and pyrites.
Do	San Francisco	Chamber	Brimstone.
COLORADO			
E. I. du Pont de Nemours & Co. (Inc.).	Louviers	Contact	Do.
General Chemical Co	Denver	do	Do.
CONNECTICUT			
The Kalbfleisch Corporation (American Cyanamid Co.).	Waterbury	Chamber	Do.
The Naugatuck Chemical Co	Naugatuck	do	Do.
FLORIDA			
The American Agricultural Chemical Co.	Pensacola	do	Do.
Armour Fertilizer Works	Jacksonville	do	Do.
U. S. Phosphoric Products Corporation.	East Tampa	Contact	Do.
Wilson & Toomer Fertilizer Co	Jacksonville	Chamber	Do.
GEORGIA			
The American Agricultural Chemical Co.	Savannah	do	Do.
Armour Fertilizer Works	Albany	do	Do.
Armour Fertilizer Works (two plants).	Atlanta	do	Do.
Armour Fertilizer Works	Columbus	do	Do.
Blackshear Manufacturing Co	Blackshear	do	Do.
Cotton States Fertilizer Co	Macon	do	Do.
Empire State Chemical Co	Athens	do	Do.
Georgia Fertilizer Co	Valdosta	do	Do.
International Agricultural Corporation.	Columbus	do	Do.
Pelham Phosphate Co	Pelham	do	Do.
Reliance Fertilizer Co	Savannah	do	Pyrites.
F. S. Royster Guano Co	Macon	do	Brimstone.
Southern Fertilizer & Chemical Co	Savannah	do	Do.
Southern States Phosphate & Fertilizer Co.	do	do	Do.
Virginia-Carolina Chemical Corporation.	Rome	do	Do.
Do	Savannah	do	Do.
Do	Augusta	do	Do.

Sulphuric acid plants in the United States in 1931—Continued

Company	Location	Type of plant	Source of sulphur
ILLINOIS			
American Zinc, Lead & Smelting Co.	East St. Louis	Chamber	Brimstone, zinc ores.
Do	Hillsboro	do	Zinc ores.
Armour Fertilizer Works	Chicago Heights	do	Brimstone.
Central Chemical Co	Calumet City (Chicago).	do	Do.
The Eagle-Picher Lead Co	Hillsboro	Contact	Zinc ores, brimstone.
General Chemical Co	Hegewisch (Chicago)	do	Brimstone.
Do	East St. Louis	do	Do.
Hegeler Zinc Co	Danville	Chamber	Zinc ores.
Illinois Zinc Co	Peru	do	Brimstone, zinc ores.
Matthiessen & Hegeler Zinc Co	La Salle	do	Brimstone, zinc ores, coal brasses.
Monsanto Chemical Works (see also Merrimac Chemical Co. (Inc.)).	East St. Louis (Monsanto).	Chamber, contact	Brimstone, zinc ores.
The New Jersey Zinc Co	Depue	Contact	Zinc ores.
INDIANA			
The Grasselli Chemical Co. (Inc.) (Du Pont Co.).	East Chicago, Ind	Chamber, contact	Zinc ores, brimstone.
Standard Oil Co. of Indiana	Whiting, Ind. (Chicago).	Contact	Brimstone.
Stauffer Chemical Co. of Indiana	East Hammond, Ind. (Chicago).	do	Do.
KENTUCKY			
The Grasselli Chemical Co. (Inc.) (Du Pont Co.).	Wurtland	do	Do.
LOUISIANA			
Armour Fertilizer Works	New Orleans	Chamber	Do.
Louisiana Chemical Co. (Inc.) (Consolidated Chemical Industries (Inc.)) (see also Texas Chemical Co.).	Baton Rouge	Contact	Do.
Southern Acid & Sulphur Co. (Inc.)	Bossier City	do	Do.
Swift & Co	Harvey (New Orleans).	Chamber	Do.
Virginia-Carolina Chemical Corporation.	Shreveport	do	Do.
MARYLAND			
The American Agricultural Chemical Co.	Baltimore	do	Do.
Baugh Chemical Co	do	Chamber (2)	Pyrites.
The Davison Chemical Co	do	Chamber, contact	Do.
Naval Powder Factory (United States Government).	Indian Head	Contact	Brimstone.
Rasin-Monumental Co. (Virginia-Carolina Chemical Corporation).	Fairfield (Baltimore)	Chamber	Do.
F. S. Royster Guano Co	Baltimore	do	Brimstone, pyrites.
Standard Wholesale Phosphate & Acid Works (Inc.).	do	Chamber (2), contact (3).	Brimstone.
MASSACHUSETTS			
The American Agricultural Chemical Co.	North Weymouth	Chamber	Do.
Lowell Fertilizer Co. (Consolidated Rendering Co.).	Lowell	do	Do.
Merrimac Chemical Co. (Inc.) (Monsanto Chemical Co.).	Everett	Chamber, contact	Brimstone, pyrites.
MICHIGAN			
The American Agricultural Chemical Co.	Detroit	Chamber	Brimstone.
Detroit Chemical Works	do	Contact	Do.
The Grasselli Chemical Co. (Inc.) (Du Pont Co.).	Ecorse (Detroit)	do	Do.
MISSISSIPPI			
Davison-Gulfport Fertilizer Co. (The Davison Chemical Co.).	Gulfport	Chamber	Do.
International Agricultural Corporation.	Tupelo	do	Do.
Jackson Fertilizer Co	Jackson	do	Do.
Meridian Fertilizer Factory	Meridian	do	Do.
Do	Hattiesburg	do	Do.

Sulphuric acid plants in the United States in 1931—Continued

Company	Location	Type of plant	Source of sulphur
MISSOURI			
Atlas Powder Co	Atlas	Contact	Brimstone.
MONTANA			
Anaconda Copper Mining Co	Anaconda	Chamber	Copper ores.
NEW JERSEY			
The American Agricultural Chemical Co.	Carteret	do	Brimstone.
American Cyanamid Co. (see also The Calco Chemical Co. (Inc.) and The Kalbfleisch Corporation).	Warners	Chamber, contact	Do.
Armour Fertilizer Works	Carteret	Chamber	Do.
Atlas Powder Co	Hopatcong	Contact	Do.
The Calco Chemical Co. (Inc.) (American Cyanamid Co.) (see also The Kalbfleisch Corporation).	Bound Brook	do	Do.
E. I. du Pont de Nemours & Co. (Inc.).	Deepwater Point-Pennsgrove.	do	Do.
General Chemical Co	Edgewater	Chamber, contact	Pyrites, brimstone.
The Grasselli Chemical Co. (Inc.) (Du Pont Co.).	Paulsboro	Chamber	Brimstone.
Do	Newark	do	Do.
Do	Grasselli	Chamber, contact	Do.
Hercules Powder Co	Kenvil	Contact	Do.
The Kalbfleisch Corporation (American Cyanamid Co.) (see also The Calco Chemical Co. (Inc.)).	Elizabeth	Chamber	Do.
Mutual Chemical Co. of America	Jersey City	do	Do.
Standard Oil Co. of New Jersey	Bayonne	do	Do.
NEW YORK			
The American Agricultural Chemical Co.	Buffalo	do	Do.
Eastman Kodak Co	Rochester	Contact	Do.
General Chemical Co	Buffalo	do	Do.
NORTH CAROLINA			
Acme Manufacturing Co	Wilmington	do	Do.
The American Agricultural Chemical Co.	do	Chamber	Do.
Armour Fertilizer Works	Greensboro	do	Do.
Do	Navassa (Wilmington).	do	Do.
Merchants Phosphate Fertilizer Co.	Charlotte	do	Do.
Swift & Co	Wilmington	do	Do.
Virginia-Carolina Chemical Corporation.	Durham	do	Do.
Do	Wadesboro	do	Do.
Do	Wilmington	do	Do.
Do	Selma	do	Do.
Do	Charlotte	do	Do.
OHIO			
The American Agricultural Chemical Co.	Cleveland	do	Do.
Farmers Fertilizer Co	Columbus	do	By-product gas from adjacent zinc roasters.
Jarecki Chemical Co. (Armour Fertilizer Works).	Sandusky	do	Brimstone.
General Chemical Co	Willow (Cleveland)	Chamber, contact	Do.
The Grasselli Chemical Co. (Inc.) (Du Pont Co.).	Canton	Chamber	Brimstone, zinc ores.
Do	Niles	do	Do.
Do	Cleveland	Chamber, contact	Do.
Do	Lockland	Chamber	Do.
Do	Toledo	Contact	Brimstone.
The Smith Agricultural Chemical Co.	Columbus	Chamber	Do.
Virginia-Carolina Chemical Corporation.	Cincinnati	do	Do.
OKLAHOMA			
National Zinc Co. (Inc.)	Bartlesville	Contact	Brimstone, zinc ores.
Ozark Chemical Co	Tulsa	do	Brimstone.

Sulphuric acid plants in the United States in 1931—Continued

Company	Location	Type of plant	Source of sulphur
PENNSYLVANIA			
American Sheet & Tin Plate Co. (United States Steel Corporation).	Vandergrift	Chamber	Brimstone.
American Steel & Wire Co. (United States Steel Corporation).	Donora	do	Zinc ores, brimstone.
American Zinc & Chemical Co. (The American Metal Co. (Ltd.)).	Langeloth	do	Do.
Atlas Powder Co	Reynolds	Contact	Brimstone.
Chas. Lennig & Co. (Inc.)	Philadelphia	Chamber	Do.
Daugherty & Son Refining Co	Petrolia	Contact	Do.
General Chemical Co	Marcus Hook	do	Brimstone, pyrites.
Do	Newell	do	Brimstone.
The Grasselli Chemical Co. (Inc.) (Du Pont Co.).	Newcastle	Chamber	Brimstone, zinc ores.
Do	Philadelphia	Chamber, contact	Brimstone.
The Kalbfleisch Corporation (American Cyanamid Co.).	Erie	Chamber	Do.
The New Jersey Zinc Co	Palmerton	Contact	Zinc ores.
Pennsylvania Salt Manufacturing Co.	Philadelphia	Chamber, contact	Brimstone.
Do	Natrona	do	Do.
St. Joseph Lead Co	Josephtown	Contact	Zinc ores, brimstone.
Trojan Powder Co	Allentown	do	Brimstone.
York Chemical Co	York	Chamber	Do.
RHODE ISLAND			
Rumford Chemical Works	Rumford	Contact	Do.
SOUTH CAROLINA			
The American Agricultural Chemical Co.	Columbia	Chamber	Do.
Do	Charleston	do	Do.
Anderson Fertilizer Co. (Inc.)	Anderson	do	Do.
Etiwan Fertilizer Co	Charleston	do	Do.
Maybank Fertilizer Co	do	do	Pyrites.
Merchants Phosphate & Fertilizer Co.	do	do	Brimstone.
Planters Fertilizer & Phosphate Co	do	do	Do.
Read Phosphate Co. (The Davison Chemical Co.).	do	do	Do.
Virginia-Carolina Chemical Corporation.	do	do	Do.
Do	Blacksburg	do	Do.
Do	Greenville	do	Do.
TENNESSEE			
Armour Fertilizer Works (Tennessee Chemical Co.).	Nashville	do	Do.
Ducktown Chemical & Iron Co	Isabella	Chamber, contact	Ores.
Read Phosphate Co. (The Davison Chemical Co.).	Nashville	Chamber	Brimstone.
Tennessee Corporation	Copper Hill	Chamber, concentrator.	Ores.
Victor Chemical Works	Nashville	Chamber	Brimstone.
Virginia-Carolina Chemical Corporation.	Memphis	do	Do.
TEXAS			
Armour Fertilizer Works	Houston	do	Do.
Gulf Refining Co. (Gulf Oil Corporation of Pennsylvania).	Port Arthur	Contact	Do.
Southern Acid & Sulphur Co. (Inc.)	do	do	Do.
Do	Chaison (Beaumont)	do	Do.
Texas Chemical Co. (Consolidated Chemical Industries (Inc.)) (see also Louisiana Chemical Co. (Inc.)).	Houston	do	Do.
Do	Fort Worth	do	Do.
United Chemical Co	Dallas	Chamber	Do.
UTAH			
American Smelting & Refining Co. (Garfield Chemical Manufacturing Corporation).	Garfield	do	Ores.

Sulphuric acid plants in the United States in 1931—Continued

Company	Location	Type of plant	Source of sulphur
VIRGINIA			
The American Agricultural Chemical Co.	Alexandria	Chamber	Brimstone.
General Chemical Co.	Pulaski	Contact	Pyrites.
Richmond Guano Co.	Richmond	Chamber	Brimstone.
Roberston Chemical Corporation	Norfolk	do	Do.
F. S. Royster Guano Co.	do	do	Pyrites, brimstone.
Vanadium Corporation of America	Piney River	Contact	Brimstone.
Virginia-Carolina Chemical Corporation.	Richmond	Chamber	Do.
Do	Lynchburg	do	Do.
Do	Pinners Point (Portsmouth).	do	Do.
WASHINGTON			
E. I. du Pont de Nemours & Co. (Inc.).	Du Pont (Fort Lewis)	Contact	Do.
WEST VIRGINIA			
Carbide & Carbon Chemicals Corporation (Union Carbide & Carbon Corporation).	South Charleston	do	Do.
United Zinc Smelting Corporation	Moundsville	Chamber	Brimstone, zinc ores.
WISCONSIN			
E. I. du Pont de Nemours & Co. (Inc.).	Barksdale	Contact	Brimstone.
National Zinc Separating Co. (The Youngstown Sheet & Tube Co.).	Cuba City	do	Zinc ores.
WYOMING			
Standard Oil Co. of Indiana	Casper	do	Brimstone.

SILICA[1]

By E. R. PHILLIPS[2]

CONTENTS

INTRODUCTION

Silica (SiO_2) occurs in deposits of commercial importance in many different forms, such as vein quartz, as a constituent of pegmatites, as sand, sandstone, quartzite, or flint, as tripoli, and as diatomite or diatomaceous earth. In some forms, such as rose, smoky, and amethystine quartz, it has value as a gem. This chapter deals with silica of all kinds except gem quartz, silica sand or sandstone used for making glass, and silica used in the form of sand, gravel, and crushed material for building, for concrete and mortar, for foundry and furnace work, and for cutting and grinding stone. Such material as is not included here is either gem material or sand, is commercially so designated, and is therefore considered in other chapters of Mineral Resources. Tripoli and diatomite were, in the past, largely consumed as abrasives and are considered in the chapter on Abrasive Materials; however, both are finding increasing markets for other than abrasive purposes. As it is impossible to separate the figures to show the quantities used for other purposes, the figures given here for tripoli are duplicated in the abrasives chapter.

For a comprehensive discussion of the occurrence, mining or quarrying, methods of preparation, and uses of the various forms of silica the reader is referred to a report by W. M. Weigel, Technology and Uses of Silica and Sand, Bulletin 266, Bureau of Mines, 1927, which may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 40 cents a copy.

PRODUCTION

The production of quartz (crude, crushed, and ground) from pegmatite dikes, from veins, and from quartzite decreased 40 per cent in quantity and 43 per cent in value in 1931, compared with 1930. Ground sand and sandstone decreased 24 per cent in both quantity and value.

[1] Work on manuscript completed July, 1932.
[2] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Silica sold or used by producers in the United States for pottery, paints, fillers, polishers, abrasives, and other uses, 1929–1931

Material	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Quartz (vein quartz, pegmatite, and quartzite)	20,981	$205,759	13,156	$121,289	7,851	$69,103
Sand and sandstone[1]	302,139	2,039,144	241,947	1,566,815	183,880	1,196,425
Tripoli (including rottenstone) (ground and otherwise prepared)	38,011	545,658	32,439	507,505	26,682	310,131
Diatomite	(2)	(2)	(2)	(2)	(2)	(2)
	(2)	(2)	(2)	(2)	(2)	(2)

[1] Includes only finely ground material. Figures probably incomplete.
[2] Bureau of Mines not at liberty to publish figures for diatomite.

QUARTZ

The States that reported production of quartz (from pegmatite dikes, from veins, and from quartzite) in 1931 were Arizona, California, Maryland, New Hampshire, New York, North Carolina, Ohio, and Wisconsin. The total quantity of crude, crushed, and ground quartz sold or used by producers in 1931 was 7,851 short tons, valued at $69,103. This output consisted of 3,107 tons of crude quartz, valued at $12,628; 1,353 tons of crushed quartz, valued at $6,580; and 3,391 tons of ground quartz, valued at $49,895.

Some of the crude quartz included in the foregoing figures was purchased by grinders in Arizona, New Jersey, New York, and Tennessee, who reported an additional production of 2,974 tons of ground quartz, valued at $36,206. This output of ground quartz, with the 3,391 tons reported by grinders who produced their own crude material, made a total of 6,365 tons of ground quartz, valued at $86,101.

Average values f. o. b. mines for the crude quartz reported by individual producers ranged from $2.40 to $7.50 a short ton, with an average sales value of $4.06 for the total quantity of crude quartz reported for the country. Average values f. o. b. plant for the crushed quartz ranged from $3.50 to $10, with an average sales value of $4.86 a ton for the total output.

Average values for the ground quartz reported by the individual producers ranged from $5.50 to $30 a ton, with an average sales value of $13.53 a ton for all ground quartz covered in this report.

The total production of quartz—crude, crushed, and ground—including that manufactured from purchased crude by the grinders represented the output of 16 producers with 19 plants.

Some imported vein quartz, not included in these figures, was crushed and fused for use in the manufacture of fused-quartz products.

Some of the uses of the quartz are given by the producers as follows: Tile and other ceramic products, flux in steel foundries, roofing, base in paints, cleansers, sandpaper, refractories and abrasives, packing acid towers and filters, pulp burrs, matches, and fused-quartz lenses.

Quartz sold or used by producers in the United States, 1927–1931

Year	Crude [1]		Ground [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	18,504	$124,021	3,640	$70,019	22,144	$194,040
1928	15,363	79,229	6,835	130,104	22,198	209,333
1929	13,104	59,257	7,877	146,502	20,981	205,759
1930	7,362	32,531	5,794	88,758	13,156	121,289
1931	4,460	19,208	3,391	49,895	7,851	69,103

[1] Includes some crushed quartz.
[2] To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

Quartz (crude, crushed, and ground [1]) sold or used by producers in the United States, 1929–1931, by States

State	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
California	5,573	$58,807	[2] 2,895	[2] $22,762	1,553	$16,654
Maryland	3,670	8,875	[2] 1,584	[2] 4,123	444	4,928
Massachusetts	(3)	(3)	765	5,500		
Nevada	346	2,358				
New Hampshire	(3)	(3)	132	396	(3)	(3)
North Carolina	2,493	28,709	2,981	23,838	1,807	11,460
Undistributed [4]	8,899	107,010	4,799	64,670	[2] 4,047	[2] 36,061
	20,981	205,759	13,156	121,289	7,851	69,103

[1] To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Partly estimated.
[3] Included under "Undistributed."
[4] 1929: Maine, Massachusetts, New Hampshire, New York, Virginia, Washington, and Wisconsin; 1930: Maine, New York, Washington, and Wisconsin; 1931: Arizona, New Hampshire, New York, Ohio, and Wisconsin.

Following is a list of manufacturers of ground quartz.

American Encaustic Tiling Co. (Ltd.), 2030 East Fifty-second Street, Los Angeles, Calif.
Behr-Manning Corporation, Troy, N. Y.
Charlotte Chemical Laboratories (Inc.), Charlotte, N. C.
Consolidated Feldspar Corporation, Trenton, N. J.
Eureka Flint & Spar Co., Trenton, N. J.
Harford Talc Co., Baltimore, Md.
Mineral Milling Co., 1081 Richmond Street, Los Angeles, Calif.
Minnesota Mining & Manufacturing Co., St. Paul, Minn.
H. P. Scheel Eversharp Pulp-Burr Co., 520 North G Street, Tacoma, Wash.
Spicky Polish Corporation, 1401 Third Street, San Francisco, Calif.
Standard Flint & Spar Corporation, Trenton, N. J.

Following is a list of producers of "crushed" quartz.

Consolidated Feldspar Corporation, Trenton, N. J.
Day Quartz Co., Sykesville, Md.
Ohio Quartz Products Co., Jackson, Ohio.
Spicky Polish Corporation, 1401 Third Street, San Francisco, Calif.

Following is a list of some producers and sellers of crude quartz who have produced in recent years or who will produce when market offers.

Apex Engineering Co., 609 Rookery Building, Spokane, Wash.
Apex Quartz Co. (Inc.), St. Clair, Mo.
Gottlieb Baer, Marriottsville, Md.
Canaan Feldspar Co., Fairlee, Vt.

P. Carmean, Le Grand, Calif.
Carolina Minerals Co., Spruce Pine, N. C.
Charlotte Chemical Laboratories (Inc.), Charlotte, N. C.
Consolidated Feldspar Corporation, Trenton, N. J.
Crystal Quartz Co., 1289 Sunset Boulevard, Los Angeles, Calif.
J. W. Cummings Feldspar Co., Bath, Me.
Day Quartz Co., Sykesville, Md.
Eureka Flint & Spar Co., Trenton, N. J.
F. B. Fortner, Spruce Pine, N. C.
Golding-Keene Co., Keene, N. H.
C. L. Graber, 15701 Detroit Avenue, Lakewood, Ohio.
L. I. Green, Owings Mills, Md.
John T. Hanley, R. F. D., West Rumney, N. H.
Oscar Lauger, Escondido, Calif.
Maine Feldspar Co., Brunswick, Me.
Minnesota Mining & Manufacturing Co., St. Paul, Minn.
Northwest Mineral Products Co., Tacoma, Wash.
W. H. O'Dell, Randallstown, Md.
J. R. Oursler, Marriottsville, Md.
Perris Mining Co., Perris, Calif.
Anthony Pesente, Woodbury, Conn.
J. C. Pitman, Penland, N. C.
Wm. Retallick, Roxbury Station, Conn.
H. T. A. Rhodewalt, Nottingham, Pa.
C. L. Roesbery, Yermo, Calif.
H. P. Scheel Eversharp Pulp-Burr Co., 520 North G Street, Tacoma, Wash.
Galen Sparks, Spruce Pine, N. C.
Spicky Polish Corporation, 1401 Third Street, San Francisco, Calif.
N. M. Sweetser, 4235 Monroe Street, Los Angeles, Calif.
Trenton Flint & Spar Co., Marion Street, Trenton, N. J.
John Wallen, Marriottsville, Md.
Geo. W. Wheatley, Moneta, Va.
Whitehall Co. (Inc.), 17 Battery Place, New York, N. Y.
W. M. Yox, Reisterstown, Md.

GROUND SAND AND SANDSTONE

Ground sand and sandstone amounting to 183,880 short tons, valued at $1,196,425, were sold or used in 1931 by producers in California, Delaware, Illinois, Missouri, New Jersey, Ohio, Pennsylvania, West Virginia, and Wisconsin. The average values of the output of the individual producers ranged from $3.04 to $18.80 a short ton, with an average sales value for the total output of $6.51 a ton. There is a great variation in the purity, fineness, and perfection of sizing of the ground sand and sandstone produced, which results in a wide range of average values for the output of the individual operators.

The following producers reported ground sand or sandstone in 1931:

Cape Henlopen Sand Co., Drawer 496, Lewes, Del.
Central Silica Co., Glass Rock, Ohio.
Del Monte Properties Co., 401 Crocker Building, San Francisco, Calif.
Eureka Flint & Spar Co., Trenton, N. J.
Michigan Quartz Silica Co., Milwaukee, Wis.
National Pulverizing Co., Millville, N. J.
National Silica Co., Oregon, Ill.
National Silica Works, Berkeley Springs. W. Va.
Ottawa Silica Co., Ottawa, Ill.
Pennsylvania Glass Sand Co. (grinds in New Jersey, Pennsylvania, and West Virginia), Lewistown, Pa.
Pioneer Silica Products Co., Pacific, Mo.
Potters Mining & Milling Co., East Liverpool, Ohio.
Standard Flint & Spar Corporation, Trenton, N. J.
Standard Silica Co., 120 South La Salle Street, Chicago, Ill.
Wedron Silica Co., First National Bank Building, Chicago, Ill.
White Rock Silica Co., 21 North Curtis Street, Chicago, Ill.

Ground sand and sandstone sold or used by producers in the United States, 1927–1931 [1]

Year	Short tons	Value	Year	Short tons	Value
1927	275,737	$1,897,303	1930	241,947	$1,566,815
1928	280,402	1,966,296	1931	183,880	1,196,425
1929	302,139	2,039,144			

[1] Includes only finely ground material. Figures probably incomplete.

Ground sand and sandstone sold or used by producers in the United States, 1930 and 1931, by States [1]

	1930		1931	
	Short tons	Value	Short tons	Value
Illinois and Missouri	74,198	$453,310	58,311	$349,560
New Jersey	77,813	315.984	48,257	194,116
Ohio	(2)	(2)	18,633	146,922
Undistributed [3]	89,936	797,521	58,679	505,827
	241,947	1,566,815	183,880	1,196,425

[1] Includes only finely ground material. Figures probably incomplete.
[2] Included under "Undistributed."
[3] 1930: California, Ohio, Pennsylvania, West Virginia, and Wisconsin; 1931: California, Delaware, Pennsylvania, West Virginia, and Wisconsin.

IMPORTS

Data on imports of silica materials are found in the records of the Bureau of Foreign and Domestic Commerce under the classifications "silica, crude," "silica, for use as pigment," "silica, n. s. p. f.," and "flint, flints, and flint stones, unground."

No imports of crude silica have been recorded since 1927, when 12 short tons, valued at $175, were reported as received from the Philippine Islands. Imports of silica for use as pigment were not separately recorded until 1927, when they amounted to 22 short tons, valued at $535; none have been recorded since 1927. Imports of "silica, n. s. p. f.," have been recorded as follows: 1931, 174 short tons, valued at $2,639; 1930 (June 18 to December 31), 63 tons, valued at $1,141; not separately recorded prior to change in tariff.

The imports of "flint, flints, and flint stones, unground," are flint pebbles for grinding mills and for other uses indicated in this report; imports totaled 6,291 short tons, valued at $54,623, in 1931, compared with 6,856 tons, valued at $62,463, in 1930, a decrease of 8 per cent in quantity and 13 per cent in value.

Imports of "flint, flints, and flint stones, unground," from Denmark in 1931 were 46 per cent of the total quantity imported; from France, 34 per cent; and from Germany, 14 per cent. The remainder (6 per cent) came from Belgium and the United Kingdom.

The values assigned imports considered in the following tables are those upon which the import duties in the United States are levied and represent the foreign market value (or the export value, if higher) plus cost of containers and all expenses incident to placing merchandise ready for shipment to the United States, including export tax, if any.

"Flint, flints, and flint stones, unground," imported for consumption in the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	15,191	$93,658	1930	6,856	$62,463
1928	15,719	144,313	1931	6,291	54,623
1929	14,097	127,457			

"Flint, flints, and flint stones, unground," imported into the United States, 1929–1931, by countries

[General imports]

Country	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	11	$129				
Belgium	1,436	25,378	644	$10,458	356	$4,364
Denmark	3,365	34,160	2,958	30,670	2,877	24,481
France	9,157	66,327	3,183	20,406	2,180	13,108
Germany	78	1,192	58	704	871	12,568
Japan			1	30		
United Kingdom			12	195	7	102
	14,047	127,186	6,856	62,463	6,291	54,623

SLATE [1]

By Oliver Bowles and A. T. Coons

CONTENTS

CONDITIONS IN THE INDUSTRY

Slate sold by producers in the United States in 1931 was valued at $5,498,336, a decrease of 30.5 per cent from the value for 1930. The quantity of slate sold in 1931, approximately 368,420 short tons, decreased 20.5 per cent from 1930. More than 97 per cent of the slate produced is used in some form of construction, and the pronounced recession in building is definitely reflected in decreased demand for slate. The value of the output in 1931 is the smallest since 1918. The quantity is smaller than that in any year beginning 1919, when total quantity was first recorded.

Sales of roofing slate in 1931 amounted to 277,700 squares, valued at $2,364,861, a decrease of 18 per cent in quantity and 30 per cent in value compared with 1930. The average value per square was $8.52 in 1931, $9.88 in 1930, $10.65 in 1929, and $11.20 in 1928.

Total sales of mill stock in 1931 amounted to 5,794,380 square feet, valued at $1,754,054, a decrease of 27 per cent in quantity and 36 per cent in value from 1930. Decreases by uses are as follows: Electrical, 47 per cent in quantity and 53 per cent in value; structural and sanitary, 34 per cent in quantity and 35 per cent in value; blackboards and bulletin boards, 24 per cent in quantity and 31 per cent in value; billiard-table tops, 23 per cent in quantity and 16 per cent in value; and school slates—mostly exported—12 per cent in quantity and 16 per cent in value. Slate for walk ways, flagstones, crosswalks, stepping-stones, and similar uses decreased 14 per cent in quantity and 34 per cent in value from 1930. Slate sold for vaults and covers was the only product that increased in output.

Sales of crushed slate in the form of granules and slate flour amounted to 229,980 short tons, valued at $1,312,517, in 1931, a decrease of 21 per cent in quantity and 23 per cent in value compared with 1930. The slate flour included in this total amounted to 31,530 tons, valued at $129,833, compared with 34,630 tons, valued at $146,116, in 1930. The total average value of crushed slate was $5.71 in 1931 and $5.85 in 1930. Other stone—"greenstone" (an altered

[1] Work on manuscript completed June, 1932.

diabase), "red rock," etc.—crushed into granules and sold in 1931 amounted to 87,960 short tons, valued at $546,320, as shown in the chapter of this series on Stone. Crushed slate in the form of granules used as surfacing material in manufactured roofing began competing with squares of solid slate about 1913 as one of the cheaper roofing substitutes. The largest output was in 1924; production has decreased gradually, and the output in 1931 was the lowest since 1919. At present, except for local work, solid squares of roofing slate are used chiefly in higher-priced dwellings, whereas the manufactured material using granules as facing is employed in all classes of building construction. Available figures regarding granule production from 1927 to 1931 are given in the table on page 171.

In 1931, 120 slate-quarrying companies—2 more than in 1930—reported sales. In New York and Vermont many small quarries are worked intermittently on a small scale for roofing slate. The product of these quarries generally is sold with that of some of the larger quarries, and much of it consists of "freak" or odd-colored slate of unusual size or thickness for use in special work.

As slate from many of the small producers is sold by the larger producing companies the possibility of duplicating returns must be considered in the compilation of operators' reports. In the preparation of this report special care has been taken to avoid such duplication.

COMPOSITION, ORIGIN, AND OCCURRENCE OF SLATE

All commercial slate has originated from clay beds that have been subjected to intense pressure and heat. Such metamorphic agencies have converted the clay into a dense, fine-grained rock having a pronounced cleavage that permits it to be split readily into thin, smooth sheets. Although derived from clay, high-grade slates are not to be regarded as clay rocks, for they may contain only 2 or 3 per cent of clay, metamorphic processes having changed nearly all of it into mica, chlorite, quartz, and other minerals. The mica and chlorite consist of minute tabular crystals having their flat surfaces in one plane, thus giving slate the remarkable splitting property that is its most characteristic feature.

Although rocks commonly termed "slate"—as, for example, the "bone" or slate associated with coal—are of common occurrence, slate of commercial quality appears only in relatively few localities (see p. 173).

PHYSICAL PROPERTIES

Slate is an extremely fine-grained, dense rock of very low porosity and is very strong, as it consists largely of overlapping flakes consolidated under great pressure. Colors vary considerably, those in Virginia, Pennsylvania, Maryland, and Maine ranging from light gray to blue black. The slates of New York and Vermont are chiefly red, green, purple, or variegated. Some slates retain their color many years, whereas others change after exposure to the weather, although such a color change may not indicate deterioration. The color assumed on aging may, in fact, be more attractive than the original.

Clear slate free from veins or iron-bearing minerals and low in carbon possesses high electrical resistance.

The essential constituents of slate are stable and enduring silicate minerals; therefore, high-grade slate is notably resistant to weathering and will endure a great many years without noticeable deterioration. Slate of medium grades will serve in exposed places for 25 to 50 years, and the highest grades will far outlive most structures on which they are placed. Some American slates are still in excellent condition after exposure on roofs for nearly 200 years. In Europe slate roofs placed on buildings 800 to 1,200 years ago are still in service.

STRUCTURAL FEATURES OF SLATE

Slates were originally bedded deposits of varying composition. Intense metamorphism has so folded and tilted the beds that they now lie at angles ranging from vertical to horizontal. Slates of high quality alternate with inferior beds, and on this account quarrying is often a complex problem. Commercial slate beds, known locally as veins, differ from each other in color and texture, and definite names have been assigned to them. Characteristic features of some slates, notably those of Pennsylvania, are known as ribbons, which are dark bands crossing the slate surfaces. Ribbons represent variations in the original materials as they were laid down in successive beds. They mar the appearance of slate for certain uses, and some contain minerals that are less enduring than the clear stock.

The most noteworthy structural characteristic of slate, as mentioned previously, is its cleavage. Slates usually possess a second direction of splitting—less pronounced than the slaty cleavage—known as sculp or grain; it is usually vertical and approximately at right angles to the slaty cleavage. The third direction, in which there is no tendency to split, is known as the hard way. Processes of both quarrying and manufacture are governed considerably by the directions of slaty cleavage and grain.

USES

The uses of slate depend upon its physical properties. The ease with which it could be manufactured into thin, weather-resisting slabs led to its early use for roofing, and for many years it was employed almost exclusively for that purpose. Slate is now fabricated into many other products. That which is shaped into blocks or slabs of various sizes and shapes is classed under the general term "mill stock."

Mill products are of numerous kinds. Blackboards, bulletin boards, and school slates constitute one important branch. In the construction industries slate is widely used as steps, risers, baseboards, floor tile, mantels, window sills, lavatory slabs, wainscoting, and hearths. Various accessories include billiard and other table tops, sinks, laundry tubs, refrigerator shelves, greenhouse shelves, and flower boxes. The strength, endurance, and elasticity of slate adapt it remarkably well for grave vaults and for partitions and shelves in mausoleums. Slate of high electrical resistance and easy workability is used for switchboards, panels, and other types of electrical insulation.

Slate has been used to an increasing extent during recent years for ornamental flagging and walk ways. As it is available in a variety of colors and may be patterned in many ways it is possible to construct porch floors or other flagged areas that vie in beauty with the most ornate rugs; and they have the added value of being fireproof, waterproof, and capable of withstanding continuous wear. Flagging may be used for interior floors, for paving yards, porches, courts, and flat roofs, or for ornamental walk ways. Two main styles are in general use. The "regular" style consists of rectangular flags of various sizes and colors fitted together with close joints; the "irregular" is made of random shapes and sizes that are necessarily less closely fitted and require well-cemented joints. Rough slates are also used for stepping-stones and as building stone. As flagging and rough building stones have a low-cost freight classification they may command a wide market area.

Various surface finishes are obtained by the so-called marbleizing process of repeated painting and baking. A more recent form of surface finish, known as Struco, consists of spraying or printing the surface with a volatile lacquer. Very beautiful designs are possible for application to various forms of structural products, as well as to novelties such as clocks, inkwells, and paper weights.

Slate crushed to granular form is employed very widely in the manufacture of slate-surfaced composition roofing. Red, green, and blue-black or gray granules are manufactured from slates having these natural colors. Experiments are being conducted in artificial coloring for granules to provide material for the highly colored roofs demanded by many architects and home builders. The chief problem is to procure a fast color that will neither wash out nor fade. Slate in pulverized form, known as slate flour, is used as a filler in paints, road asphalt-surface mixtures, roofing mastic, and various other products.

RECENT TRENDS

Although a decrease of 30 per cent in the value of production in each of two successive years has led to a degree of discouragement among operators, they are, nevertheless, alert to any improvements that will place the industry on a more favorable basis when business conditions improve. Slate is confronted with difficult marketing problems because of the competition it must meet in practically every field of use. For every use of slate some other material may be substituted. This keen competition has led operators to seek means of improving their position.

Two definite lines of inquiry have been followed. The first has to do with improving quarrying and milling conditions and reducing waste to such an extent that production costs are reduced, the industry thereby being in a better position to face price competition. The introduction of wire saws in quarries is an important step in this direction, for it has reduced quarry costs and materially lowered the percentage of waste. Milling methods likewise have been improved by the use of better saws and by the introduction of drum sanders and sand-recovery equipment. Steps have been taken to introduce the use of wire saws in slate mills.

The second line of inquiry has as its object improvement in the quality of products sold, for the industry realizes that satisfaction to customers is the most effective advertising. With this object in view much study has been devoted to the properties of slate in their relation to use. The National Slate Association and Committee D–16 of the American Society for Testing Materials are sponsoring better classification and more adequate specifications. The United States Bureau of Standards, Lafayette College, Lehigh University, Rensselaer Polytechnic Institute, and Pennsylvania State College have collaborated in exhaustive studies of properties and methods of tests. Northwestern University is accumulating interesting data on the acid and alkali resistance of slate. The Greater Pennsylvania Council is planning further technical studies of Pennsylvania slates. It is believed that information obtained from these various sources will enable slate producers to classify their materials more accurately and to direct each type to the use for which it is best adapted.

Some progress has been made in widening the market areas in which slate may be sold profitably. Owing to recent reductions in rail-water rates, increasing quantities of slate are reaching Pacific coast points by way of the Panama Canal.

For three years the Federal Specifications Board has devoted much study to the preparation of a roofing-slate specification for Government use. Tests have been developed which it is believed will sufficiently indicate enduring qualities to permit definite and reliable classification into three main groups. Conferences have been held, and criticisms from the industry have been invited. The purpose is to establish a specification that will insure a good quality of slate of any desired grade with a minimum of inconvenience or hardship to producers. Slate research in Great Britain has been directed along similar lines. Slates have been classed in three groups—excellent, good, and inferior—on the basis of their behavior in sulphuric acid.

No more important problem faces the industry than that of sales. Centralization of sales effort in well-organized agencies would doubtless tend to cultivate wider market demands. With this end in view a definite movement is on foot to establish larger and fewer marketing agencies in Vermont, Maine, and Pennsylvania.

Although various efforts are being directed toward improving and stabilizing the slate industry little immediate benefit is to be noted, because the effects are overshadowed by a general and pronounced recession in sales brought about by conditions over which the slate producer has no control. The industry, however, has faith in the future and believes that these movements are laying the foundation for improved technique, better products, and a sounder basis of competition. Such fundamental studies should therefore bear fruit when more normal conditions reappear.

PRODUCTION

The following tables show sales of slate, by uses, from 1927 to 1931. The total quantity and value given for each use are the totals of the reports of the quarrymen (not the selling agents), and the value is that f. o. b. quarry or nearest point of shipment. It should be borne in mind that some of the mill stock may ultimately be used for purposes other than those reported by the quarrymen.

Slate sold by producers in the United States, 1927–1931, by uses

[Value is at point of shipment]

Year	Roofing slate		Mill stock		Other uses [1] (value)	Total	
	Squares (100 square feet)	Value	Square feet	Value		Short tons (approximate)	Value
1927	468, 560	$4, 949, 940	9, 287, 680	$3, 519, 386	$2, 911, 410	692, 040	$11, 380, 736
1928	483, 280	5, 411, 332	9, 220, 170	3, 408, 304	2, 652, 655	646, 360	11, 472, 291
1929	462, 120	4, 920, 766	9, 936, 480	3, 702, 145	2, 622, 267	670, 070	11, 245, 178
1930	340, 140	3, 359, 939	7, 917, 220	2, 755, 530	1, 796, 149	463, 610	7, 911, 618
1931	277, 700	2, 364, 861	5, 794, 380	1, 754, 054	1, 379, 421	368, 420	5, 498, 336

[1] Chiefly slate granules.

In approximating the tonnage for the various slate products given in the table that follows, a specific gravity of 2.75 has been used as the basis of calculation, and thicknesses used range from three-sixteenths inch to 2 inches to correspond to the averages for the several products. Calculations are made on the individual lots reported by each producer. The thickness of individual roofing slates sold—especially in New York and Vermont—has increased greatly in the last few years, owing to the demand for better roofs and for architectural effects. The weight of a square of slate as reported by the quarrymen ranged from 670 to 2,000 pounds.

Roofing slate, mill stock,[1] and slate granules (including slate "flour") sold by producers in the United States, 1930 and 1931, by uses

Use	1930		1931	
	Quantity	Value	Quantity	Value
Roofing .... squares	340, 140	$3, 359, 939	277, 700	$2, 364, 861
Approximate equivalent in short tons	127, 080		103, 210	
Electrical .... square feet	928, 760	711, 578	492, 640	333, 032
Approximate equivalent in short tons	7, 690		4, 000	
Structural and sanitary .... square feet	2, 498, 340	960, 190	1, 648, 200	622, 699
Approximate equivalent in short tons	19, 190		13, 820	
Grave vaults and covers .... square feet	350, 440	85, 047	392, 180	92, 830
Approximate equivalent in short tons	3, 290		3, 610	
Blackboards and bulletin boards .... square feet	3, 092, 880	921, 735	2, 357, 070	640, 593
Approximate equivalent in short tons	7, 830		6, 230	
Billiard-table tops .... square feet	143, 440	57, 750	110, 730	48, 663
Approximate equivalent in short tons	1, 270		980	
School slates .... pieces	1, 688, 540	19, 230	1, 483, 600	16, 237
Approximate equivalent in square feet	903, 360		793, 560	
Approximate equivalent in short tons	850		800	
Flagstones, walk ways, etc .... square feet	895, 230	100, 732	765, 620	66, 904
Approximate equivalent in short tons	6, 710		5, 790	
Granules and "flour" .... short tons	289, 700	1, 695, 417	229, 980	1, 312, 517
Total (quantities approximate, in short tons)	463, 610	7, 911, 618	368, 420	5, 498, 336

[1] Mill stock sold, including school slates, was as follows: 1930, 7,917,220 square feet, valued at $2,755,530; 1931, 5,794,380 square feet valued at $1,754,054.

Slate sold by producers in the United States in 1931, by States and uses

State	Operators	Roofing		Mill stock		Other uses (value) [1]	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	1					(2)	(2)
California	4					$45,661	$45,661
Georgia	2	(2)	(2)			(2)	(2)
Maine	3	5,060	$54,373	269,660	$203,246		257,619
Maryland	2	(2)	(2)			(2)	(2)
New York	19	4,060	51,023	15,260	8,298	266,155	325,476
Pennsylvania	37	183,600	1,254,080	5,122,080	1,296,701	240,971	2,791,752
Vermont	47	66,870	793,047	387,380	245,809	469,662	1,508,518
Virginia	5	15,740	185,638			(2)	(2)
Undistributed [3]		2,370	26,700			356,972	569,310
Total, 1931	120	277,700	2,364,861	5,794,380	1,754,054	1,379,421	5,498,336
Total, 1930	118	340,140	3,359,939	7,917,220	2,755,530	1,796,149	7,911,618

[1] For details see table of general sales on p. 170 and table on p. 176 for Pennsylvania.
[2] Included under "Undistributed."
[3] Includes output of States entered as (2) above.

Crushed slate (granules and flour) sold by producers in the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	459,760	$2,775,962	1930	289,700	$1,695,417
1928	413,980	2,468,471	1931	229,980	1,312,517
1929	428,940	2,497,743			

IMPORTS AND EXPORTS[2]

The value of the slate imported for consumption in the United States in 1931 decreased 3 per cent compared with 1930 but was 51 per cent less than in 1929. Exports shown are for roofing slate only, except for information obtained by the Bureau of Mines from shippers and given in the table on page 173. In 1931 exports of roofing slate decreased 21 per cent in quantity and 30 per cent in value from 1930 and 60 per cent in quantity and 63 per cent in value from 1929.

The imports and exports of slate for a series of years are shown in the following tables.

Value of slate imported for consumption in the United States, 1927–1931

1927	$78,909	1930	$48,065
1928	44,778	1931	46,581
1929	95,073		

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce, except as otherwise indicated.

Slate imported into the United States, 1930 and 1931, by countries and uses [1]

[General imports]

Country	1930 (total value)	1931					
		Not manufactured		Manufactured			Total value
				Roofing		Other uses (value)	
		Cubic feet	Value	Square feet	Value		
Belgium	$307						
China	4						
Czechoslovakia	445					$1,986	$1,986
Denmark						100	100
France	6,274			4,000	$405		405
Germany						2,463	2,463
Hong Kong	29						
Italy	28,040			69,873	2,884	33,539	36,423
Japan	199					75	75
Norway	5,612	3,562	$1,088	21,500	850	1,892	3,830
Portugal	1,804						
Spain	858						
United Kingdom	3,255					572	572
	46,827	3,562	1,088	95,373	4,139	40,627	45,854

[1] Not separately classified by uses prior to June 18, 1930.

Roofing slate exported from the United States, 1927–1931

Year	Number of squares	Value	Year	Number of squares	Value
1927	6,798	$80,171	1930	5,278	$64,343
1928	12,236	119,187	1931	4,174	45,020
1929	10,376	121,367			

Roofing slate exported from the United States, 1929–1931, by countries

Country	1929		1930		1931	
	Number of squares	Value	Number of squares	Value	Number of squares	Value
Australia			137	$1,000		
Canada	8,277	$102,053	4,010	54,069	3,405	$37,816
Colombia	36	174				
Mexico	77	352	79	475		
New Zealand	148	2,318	256	2,175	262	1,795
Panama	5	25	7	53	50	1,166
Philippine Islands			60	899		
United Kingdom	1,372	11,470	605	4,362	300	2,341
West Indies:						
British—						
Bermudas	5	25				
Trinidad and Tobago	196	1,767	66	648	66	562
Other	49	250				
Cuba	20	134	47	479		
Dominican Republic			2	30		
Haiti	191	2,799			91	1,340
Netherland			9	153		
	10,376	121,367	5,278	64,343	4,174	45,020

The following figures for exports of slate other than roofing slate were collected by the Bureau of Mines from shippers of the products named.

Slate other than roofing exported from the United States, 1929–1931, by uses

Use	1929		1930		1931	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates.....cases [1]	19,570	$108,135	16,280	$95,935	11,470	$57,746
Electrical slate.....square feet	16,720	18,037	18,830	20,406	6,950	4,026
Blackboards.....do	188,720	74,610	177,760	59,810	183,130	62,883
Billiard tables.....do	20,150	34,455	15,760	9,802	25,730	12,480
Structural.....do	18,390	15,882	12,670	5,280	20,360	6,930
Slate granules and "flour".....short tons	14,250	84,185	27,540	162,000	13,880	79,000
	----------	335,304	----------	353,233	----------	223,065

[1] Cases weigh 130 to 165 pounds each; average is 135 pounds.

Of the slate reported in this table exports increased for blackboard, billiard-table, and structural slate and decreased notably for electrical slate, school slates, and slate granules. About 94 per cent of the blackboard slate was shipped to Canada, with small amounts to Panama and Peru; Canada and Mexico received the material for billiard-table tops; and 90 per cent of the structural slate went to Canada and the remainder to the Philippine Islands. The largest shipments of school slates went to India, Netherland East Indies, and Canada; however, considerable amounts went to Australia, New Zealand, and the Netherlands, with smaller shipments to Mexico, South America, Central America, Canal Zone, Africa, and other countries. Nearly 80 per cent of the electrical slate, chiefly as switchboards and panels, was shipped to Canada, the remainder going in small lots to different South American countries, Russia, India, Philippine Islands, Canal Zone, Panama, and Puerto Rico. The granules were shipped chiefly to Canada, and small lots went to England and Germany.

REVIEW BY DISTRICTS

The active slate-producing districts of the United States are the Monson district of Maine; the New York-Vermont district, including Washington County, N. Y., and Rutland County, Vt.; the Lehigh district, including Lehigh and Northampton Counties, Pa.; the Peach Bottom district, including York County, Pa., and Harford County, Md.; and the Buckingham County (Arvonia) and Albemarle County districts of Virginia. These districts produce roofing slate and mill stock; some of them also produce roofing granules and slate flour. Roofing granules and flour were also produced in California, and granules and a small quantity of roofing slate in Georgia in 1931. A little slate was taken out in Arkansas.

Maine.—Slate produced in the Maine district is sold chiefly for electrical work, with lesser amounts for roofing and for structural purposes. The quantity of roofing slate sold in 1931 decreased slightly compared with 1930, but the value increased; sales of structural and electrical slate decreased. The producing companies in 1931 were The Monson Maine Slate Co. (address, Monson, Me.), the Portland-

Monson Slate Co. (address, 25 Central Wharf, Portland, Me.), and the Rising & Nelson Slate Co. (address, West Pawlet, Vt.), each with quarries at Monson.

New York-Vermont.—The New York slate district adjoins that of Vermont, so it is sometimes difficult to determine from the reports of the producers to which State the product should be credited. These two States produce all of the colored slates used for roofing. Red slate is the chief product of the New York quarries; they also produce, with those of Vermont, various green, purple, variegated, mottled, and "freak" slates in demand for roofs.

The output of the New York quarries is for granules (red), roofing slate, mill stock, and slabs for walk ways, flagging, etc. The principal producers of granules are the Advance Industrial Supply Co. (address, 111 West Washington Boulevard, Chicago, Ill.) and the J. B. Preston Co. (Inc.) (address, 122 East Forty-second Street, New York City), Granville; the Staso Milling Co. (address, 332 South Michigan Avenue, Chicago, Ill.), Hampton; and the Sheldon Slate Products Co., Middle Granville. The Advance Industrial Supply Co. and the Sheldon Slate Products Co. also produced roofing slate. Other roofing-slate producers in New York are Paramount Slate Co., John Ritchie, and A. K. Schubert, Granville; William Darius, Jones & Hopkins (address, Whitehall), Montvert Slate Co., and McGrath Bros., Middle Granville; Penrhyn Hill Slate Co. and Wold & Cullen, Truthville; and others who operate quarries intermittently and sell their product through dealers or other quarry operators. The chief producers of flagging, walk ways, etc., are Jones & Hopkins and the Sheldon Slate Products Co., with addresses as given above. There was an increase of 9 per cent in the number of squares of roofing slate reported by the New York quarries in 1931, compared with 1930, but a decrease of 6 per cent in value. The quantity and value of structural slate increased, but the amount of slate sold for flagging and for granules decreased.

The Vermont quarries produce roofing slate, mill stock, granules, and slate for walks, etc. The colors are combinations of green and purple and are generally classed as green, unfading green, unfading mottled green and purple, weathering green (sea green), purple, variegated, and "freak." There are also black and gray varieties. Most of the granules manufactured are green. Much of the roofing slate produced in Vermont, as in New York, is quarried and shaped by owners of small quarries that are worked at irregular intervals. This slate is generally of unusual color and specially sized and is sold through operators of large quarries or through dealers. On account of the variety of colored slates found in this district much of the roofing slate commands a high price. Roofing slate reported sold in Vermont in 1931 decreased 38 per cent in quantity and 45 per cent in value as compared with 1930. Mill stock used in structural and sanitary work, for electrical purposes, and for billiard-table tops is also produced in Vermont. There was a decrease in 1931 of 44 per cent in quantity and 35 per cent in value in mill stock for these purposes as compared with 1930.

Roofing and mill slate is produced in Vermont chiefly by the following firms, many small producers being omitted.

Castleton: The John Jones Slate Co.; mill stock.
Castleton and Poultney: The Penrhyn Slate Co. of Vermont (address, Hydeville); roofing, mill stock.
Fair Haven:
- S. Allen's Sons; roofing, mill stock.
- C. R. Beach; roofing.
- Harvey Bush Slate Co.; roofing.
- Durick, Keenan & Co. (Inc.); mill stock.
- Fair Haven Marble & Marbleized Slate Co.; roofing, mill stock.
- Hydeville Slate Works (address, Hydeville); mill stock.
- W. H. Pelkey; roofing, mill stock.
- Sbardella & Pedro Bros. Slate Co. (address, Poultney); roofing.

Pawlet:
- O'Brien Bros. Slate Co. (Inc.) (address, Granville, N. Y.); roofing.
- Owen W. Owens & Sons (Inc.) (address, Granville, N. Y.); roofing.
- Roberts, Jones & Williams (address, Granville, N. Y.); roofing.
- H. G. Williams Slate Co. (address, Granville, N. Y.); roofing.

Pawlet, Poultney, and Rupert: F. C. Sheldon Slate Co. (address, Granville, N. Y.); roofing.
Pawlet and Wells: Norton Bros. (address, Granville, N. Y.); roofing.
Poultney:
- The Auld & Conger Co. (address, 1920 East Seventy-fifth Street, Cleveland, Ohio); Bush quarries; roofing. Quarries not operated in 1931; sales made from stock.
- Berdew Slate Co. (Inc.); roofing.
- Cambrian Slate Co. (address, Granville, N. Y.); roofing.
- El Nido Slate Co.; roofing.
- The John D. Emack Co. (address, 1700 Sansom Street, Philadelphia, Pa.); roofing.
- Mahar Bros. Slate Co. (Inc.) (address, Fair Haven); roofing, mill stock.
- Mammoth Slate Co.; roofing, mill stock.
- Montvert Slate Co.; roofing.
- New England Slate Co.; roofing.
- A. Panda Slate Co. (address, Granville, N. Y.); roofing.
- Red Morris Slate Co.; roofing.
- United Slate Co.; roofing.

Poultney and West Pawlet: Rising & Nelson Slate Co. (address, West Pawlet); roofing.
Wells:
- Evergreen Slate Co. (address, Granville, N. Y.); roofing.
- Wm. Morris & Son (address, Granville, N. Y.); roofing.
- O. L. Williams & Son (address, Granville, N. Y.); roofing.

West Pawlet:
- Edwards Bros.; roofing.
- Jones & Roberts; roofing.
- Patrick Kehoe; roofing.
- Griffith T. Roberts Estate; roofing.

Nearly all the firms in Vermont that produce mill stock also sell slabs for flagstones, stepping-stones, etc. Vermont produces the greater part of this class of slate. Slate granules and slate flour are produced at Castleton by the Staso Milling Co. (address, 332 South Michigan Avenue, Chicago, Ill.).

Maryland-Pennsylvania.—Production in the Peach Bottom district in Maryland and Pennsylvania was confined to roofing slate and granules in Harford County, Md., and granules in York County, Pa.

Slate for roofing was quarried in Maryland in 1931 at Cardiff, Harford County, by the Peach Bottom Slate Co. of Harford County (address, Delta, Pa.). The Staso Milling Co. (address, 332 South Michigan Avenue, Chicago, Ill.) operates a plant for the production of slate granules and flour at Whiteford, Harford County.

The granules from York County, Pa., were produced by The Funkhouser Co. (address, Hagerstown, Md.), near Delta.

Pennsylvania is the largest producer of slate (exclusive of slate granules) in the United States and produces a greater variety of slate products than any other State, although Maine and Vermont both outrank it in the output of electrical slate. The total value of slate sold in Pennsylvania by producers was 23 per cent less in 1931 than in 1930. Roofing slate decreased 6 per cent in quantity and 15 per cent in value in 1931 as compared with 1930, and total mill stock (5,122,080 square feet, valued at $1,296,701) decreased 23 per cent in quantity and 32 per cent in value.

Sales of slate by producers in Pennsylvania, by counties and uses, in 1931 were as follows:

Slate sold by producers in Pennsylvania in 1931, by counties and uses

County	Operators	Roofing slate		Mill stock [1]			
				Structural and sanitary [2]		Electrical	
		Squares (100 square feet)	Value	Square feet	Value	Square feet	Value
Lehigh	10	22,930	$127,629	67,410	$23,179	77,010	$31,950
Northampton and York [3]	27	160,670	1,126,451	1,704,350	526,826	18,120	12,470
Total, 1931	37	183,600	1,254,080	1,771,760	550,005	95,130	44,420
Total, 1930	36	194,700	1,470,669	2,358,150	822,391	180,470	99,577

County	Mill stock—Continued				Other (value) [4]	Total value
	Blackboards and bulletin boards		School slates			
	Square feet	Value	Square feet	Value		
Lehigh	682,370	$134,540	793,560	$16,237	$396	$333,931
Northampton and York [3]	1,674,700	506,053			286,021	2,457,821
Total, 1931	2,357,070	640,593	793,560	16,237	286,417	2,791,752
Total, 1930	3,092,880	921,735	903,360	19,230	300,656	3,634,258

[1] Exclusive of billiard-table material, value for which is included under "Other."
[2] Includes slate for grave covers and vaults.
[3] York County produced roofing granules and "flour" only.
[4] In 1930 includes 140,190 square feet of billiard-table material, valued at $55,819; in 1931 includes 104,560 square feet of billiard-table material, valued at $45,446.

The principal slate-quarry operators in Pennsylvania and the classes of slate produced by them are as follows:

The Lehigh district, which includes Lehigh and Northampton Counties, now produces all the roofing slate and all the mill stock sold in the State.

Lehigh County: All the slate companies operating in Lehigh County produce both roofing and mill stock. The quarries are in the vicinity of Emerald, Slatedale, and Slatington. The producing companies in 1931 and their addresses were as follows: J. P. Kern Slate Co., Royal Blue Slate Co., and Shenton Slate Co., Slatedale; American Slate Quarries, Blue Mountain Slate Manufacturing Co., Blue Ridge Quarries (Inc.), Cambridge Slate Co., Manhattan Slate Co., Pennsylvania Slate Blackboard Co., and Slatington Slate Co., Slatington.

Northampton County: The quarry operators in Northampton County and their product in 1931 were as follows:

Bangor:
- Bangor Ideal Slate Mining Co.; roofing.
- Bangor Quarry Co. (address, 1920 East Seventy-fifth Street, Cleveland, Ohio); Bangor Union quarry; roofing, mill stock. Shipments from stock.
- Bangorvein Slate Co.; Bangor Peerless quarry; roofing, mill stock.
- Columbia Bangor Slate Co.; roofing.
- North Bangor Slate Co.; roofing, mill stock.
- Old Bangor Slate Co.; roofing.
- Slate Products Co. (Inc.); roofing, mill stock.

Berlinsville: Amalgamated Slate Quarries Co. (address, Easton); Genuine Washington quarries; roofing, mill stock.

Chapman Quarries: Chapman Slate Co. (address, Bethlehem); roofing.

Edelman: The Hard-Vein Slate Co. (address, Easton); roofing.

Nazareth: Edelman Standard Hard-Vein Slate Co. (address Edelman); roofing.

Pen Argyl:
- Albion Vein Slate Co. (address, Bangor); roofing.
- Belmont Slate Co. (address, Bangor); roofing, mill stock.
- Diamond Slate Co. (Inc.); mill stock.
- Doney Slate Co. (Inc.); roofing, mill stock.
- Jackson-Bangor Slate Co.; roofing, mill stock.
- Keenan Structural Slate Co.; Albion quarry; roofing, mill stock.
- Parsons Bros. Slate Co.; roofing, mill stock.
- Parsons Manufacturing Co.; slate "flour."
- Stephens-Jackson Co.; Courtney quarry; roofing, mill stock.
- D. Stoddard & Son (address, Bangor); Albion Vein quarry; mill stock.

West Bangor: Bangor Fidelity Slate Co. (address, Bangor); roofing, mill stock.

Windgap:
- Bolger-Heller Slate Co.; roofing, mill stock.
- Colonial Slate Co. (address, Bangor); roofing, mill stock.
- Imperial Slate Blackboard Co.; roofing, mill stock.
- Phoenix Slate Co.; roofing, mill stock.

Virginia.—Slate was quarried in Virginia in 1931 by the following companies.

Albemarle County: Monticello—Monticello Slate Corporation (address, care of Williams-Arvonia Slate Corporation, Richmond); roofing.

Albemarle and Buckingham Counties: Esmont and Dutch Gap—Blue Ridge Slate Corporation (address, Charlottesville); Flint Arrow and Dutch Gap quarries; roofing, granules.

Buckingham County:
- Arvonia—
  - Arvonia-Buckingham Slate Co. (Inc.) (address, Richmond); roofing.
  - Williams Slate Co. (Inc.); Big Quarry; roofing.
- Ore Bank—Le Sueur-Richmond Slate Corporation; roofing.

Other States.—A small amount of slate used for flagging or walk ways was taken from the slate deposits near Norman, Montgomery County, Ark., operated by Ouachita Quarries of Little Rock. It was stated that this slate would also be marketed as crushed granules in 1931.

In 1931 The Pacific Minerals Co. (Ltd.) (address, Richmond) operated the Chili Bar slate quarry at Placerville, Eldorado County, Calif., for slate granules. The Union Flagstone Co. (address, San Mateo) quarried slate for flagstone in Mariposa County, near Le Grand; and John L. Witney (Inc.), Jamestown, and W. S. McLean, San Francisco, quarried slate in Tuolumne County for roofing granules.

Slate granules (green) and ground slate for use as a fertilizer filler were produced at Fair Mount, Ga., in 1931, by The Funkhouser Co. (address, Hagerstown, Md.), and roofing slate was produced by the H. G. Williams Slate Co. (address, Granville, N. Y.).

FEELDSPAR [1]

By H. H. Hughes and Jefferson Middleton

CONTENTS

STATISTICAL SUMMARY

Summary of statistics for feldspar in the United States, 1930 and 1931

	1930	1931
Crude feldspar sold or used by producers:		
Quantity ... long tons	171,788	147,119
Value ... dollars	1,066,636	861,059
Average value per long ton ... do	6.21	5.85
Ground feldspar sold by merchant mills:		
Quantity ... short tons	181,541	143,924
Value ... dollars	2,450,915	1,853,393
Domestic—		
Quantity ... short tons	167,380	132,542
Value ... dollars	2,167,352	1,630,917
Average value per short ton ... do	12.95	12.30
Canadian—		
Quantity ... short tons	14,161	11,382
Value ... dollars	283,563	222,476
Average value per short ton ... do	20.02	19.55
Feldspar imported for consumption:		
Crude—		
Quantity ... long tons	21,006	10,719
Value ... dollars	167,157	95,096
Ground—		
Quantity ... short tons	57	79
Value ... dollars	586	1,500

INTRODUCTION

Further decreases in tonnage and value of both crude and ground spar characterized the feldspar industry in 1931. Production of crude amounted to only 147,119 long tons, a decline of more than 14 per cent from 1930. The average value of crude spar was $5.85 a long ton, the lowest since 1919 and $1.80 (24 per cent) lower than the peak in 1926.

Although decreases were common in all the important older producing States, crude spar production suffered the greatest loss in

[1] Work on manuscript completed July, 1932.

New England, where the decline, compared with 1930, was 48 per cent in quantity and 59 per cent in value. Maine bore the brunt of these declines with a decrease of 55 per cent in tonnage and 60 per cent in value.

The quantity of ground feldspar marketed by merchant mills in 1931 was nearly 21 per cent less than in 1930 and was smaller than in any year since 1922; the value of the product was the smallest recorded since the canvass of merchant grinding mills was inaugurated in 1922. The average value of domestic ground spar continued to decline; it reached $12.30 a short ton, the lowest value ever recorded and 27 per cent below the 1924 high level of $16.84.

Feldspar is the name given to a group of rock-forming silicate minerals, several varieties being used widely in the manufacture of glass, pottery, enamel ware, and other ceramic products. United States Bureau of Mines Information Circular 6381, Feldspar, contains detailed information regarding the occurrence, properties, and uses of the material. Until the edition is exhausted, copies of this paper may be procured free from the Section of Publications, U. S. Bureau of Mines, Washington, D. C.

SPECIFICATIONS AND TESTS

The principal requirement for feldspar to be used in the ceramic industry is that it should be free from iron-bearing impurities and uniform in composition and particle size. It should fuse to a uniform white entirely free from specks or spots. The primary aim of all specifications is to guarantee this result. Care must be taken to keep the content of iron-bearing minerals at an absolute minimum. Biotite, garnet, hornblende, and black tourmaline are especially detrimental.

The quartz content of commercial feldspar varies considerably. For high-grade pottery it normally is limited to about 5 per cent, but for other purposes it may be 15 to 20 per cent or even higher. Irrespective of the maximum permissible limit, however, the silica content should not fluctuate but should be kept as uniform as is economically possible. The value of feldspar in glass manufacture depends upon its high alumina and alkali content.

Porcelain and white-ware manufacturers demand a finely ground product, usually 99 per cent passing a 200-mesh screen. Metal-enameling industries commonly require 100-mesh material, and glass manufacturers use 20-mesh spar with a minimum of fines. Occasionally, however, both of these industries give orders for 40, 60, 80, and 140 mesh spar.

During the past decade the attitude of producers and consumers of feldspar toward specifications has been undergoing a marked change. Ten years ago few consumers could have given purchase specifications for ground spar, and even if they had, the grinders were in no position to meet them. The need for uniformity had been evident for years, but the nature of the deposits and the methods of grinding were such that little could be done to insure a uniform product.

The present situation is in striking contrast to conditions only a few years ago. Consumers are demanding adherence to exacting chemical, mineral, and even grinding specifications, which are being met with remarkable accuracy by the grinders. The initiative for some of the improvements has been taken by the producers, even to the extent of incurring heavy expenses to educate potential consumers to the merits of improved uniform products.

One of the principal difficulties experienced in attempting to draft exact specifications has been lack of a definite classification of feldspars. In 1930, however, the division of trade standards of the Bureau of Standards appointed a committee and the results of its investigations have been published as Bureau of Standards Commercial Standard 23–30 entitled "Feldspar." This publication may be purchased from the Superintendent of Documents, Washington, D. C., for 5 cents. The information in this report, however, should be regarded primarily as a classification rather than as a definite specification. Its purpose is to provide a uniform standard on which purchase specifications may be based. It covers both screen analysis and chemical composition of ground feldspar to be used in the manufacture of glass, porcelain, enamel, white ware, and other ceramic products.

Replies to a questionnaire circulated among producers during 1931 indicated that Commercial Standard 23–30 was meeting only moderate approval in the industry but sufficient to warrant its reaffirmation for another year beginning September 1, 1931. Seven out of 12 producers replying to the questionnaire reported direct benefits from the adoption of the classification. Regardless of provisions which may not meet the approval of some grinders, the establishment of this standard represents a sincere attempt to aid in stabilizing the feldspar industry, and all producers should cooperate in proving its merits and revealing its limitations. Ultimately, modification may be necessary, but no operator should condemn the standard without a fair trial and without a conscientious effort to educate consumers to appreciation of its aims.

TECHNICAL DEVELOPMENTS

No revolutionary changes in feldspar technology were introduced during 1931, but the industry in general continued to remodel its grinding plants to meet demands for uniformity of product. Extensive improvements were added to one of the largest mills in the East, the principal feature being a system of technical control of uniformity. Apparently, the increase in costs necessary to produce a cleaner and more uniform product is justifiable; for, despite unfavorable business conditions, an especially prepared granular spar, introduced by a leading feldspar company in 1930, has been well received by the glass industry.

Perfection of processes for technical control of uniformity has virtually eliminated the necessity of trying to maintain sources of uniform crude spar. Most of the large companies meet specifications by blending two or more crude spars rather than by attempting to find a deposit which conforms to the desired chemical composition. As a result, most of the large grinders obtain their supplies of crude feldspar from farmers and other small producers in preference to operating their own mines. This situation is especially noticeable during periods of curtailed production, when mills are being operated at part capacity. In fact, although not substantiated by statistics, available evidence indicates that the relative importance of small feldspar producers who sell their crude spar to grinders was greater in 1931 than it had been for many years. No new developments in mining methods were introduced during the year.

Three papers [2] of especial technical interest to the feldspar industry appeared recently.

An innovation in railroad transportation has been announced by one of the large tank-car manufacturers. It consists of a tank car equipped with a self-unloading device to handle finely pulverized dry solids. Its application to the feldspar industry for transporting ground spar seems worthy of investigation.

ECONOMIC CONDITIONS

Excessive milling capacity probably is the most serious condition confronting feldspar producers, because it is principally responsible for the severe competition which in turn has resulted in drastic price cutting. The decline in production since 1929 has affected the situation to the extent that in 1931 the output of ground spar amounted to only about 30 per cent of the estimated total grinding capacity.

This condition should warn operators to use caution in connection with any contemplated expansion of grinding facilities. Modernization of many mills of course is necessary to meet specifications, but remodeling activities usually result in enlarged capacity as well as increased efficiency. Every potential producer or present operator who contemplates building or remodeling a grinding plant, therefore, should justify his proposed program by a careful study of available markets for his product.

Despite the seemingly pessimistic short-time outlook, however, it should be remembered that feldspar production will continue as an important branch of the mineral industry in the United States; consequently, the adjustment of output to correspond with the magnitude of available markets should result in a better economic condition among the producers. An important step toward this goal was taken during 1931 when the grinders accepted a trade-practice code. They agreed to sell no goods below cost, to make no discrimination in prices, to allow no secret rebates, refunds, or unearned discounts, and to make no misrepresentations as to quality, quantity, or origin of goods. Strict adherence to these provisions would do much toward restoring the feldspar industry to a more profitable basis of operation.

It is unfortunate that in the midst of disturbed and unsettled conditions the industry is left without any organization to foster plans for its betterment, the Feldspar Grinders' Institute having ceased all activities early in 1931. Although never a dominating factor in the feldspar industry, this institute exerted a stabilizing influence through the data it collected and the records it maintained. Its most notable achievement was the work toward standardization of feldspar which led directly to the adoption of Commercial Standard 23–30.

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[2] Burgess, B. C., Methods and Costs of Milling Feldspar at the Minpro plant, Tennessee Mineral Products Corporation, Spruce Pine, N. C.: Inf. Circ. 6488, Bureau of Mines, 1931, 22 pp.
Frantz, S. G., and Jarman, G. W., jr., Magnetic Beneficiation of Nonmetallics: Preprint Am. Inst. Min. and Met. Eng., February, 1932, 7 pp.
Coghill, W. H., and Clemmer, J. B., Soap Flotation of the Nonsulphides: Am. Inst. Min. and Met. Eng. Tech. Pub. 445, 1932, 18 pp.

Virtually all the ground spar sold in the United States is used by the ceramic industries. The pottery-producing districts of Trenton, N. J., and East Liverpool, Ohio, are important consumption centers. Other principal markets are segregated in New York, New Jersey, West Virginia, Ohio, Pennsylvania, and Indiana. The feldspar industry on the Pacific coast is maintained primarily by California glass plants and potteries. The location of any deposit with respect to markets has vital importance, for profitable operation may depend directly upon favorable freight rates.

The drastic slump in building construction has resulted in a substantial decrease in the quantity of feldspar employed for sanitary ware, electric porcelain, tile, and other feldspar-consuming ceramic products used in the building trades. Increased imports of pottery and china ware tend to accentuate the decline in feldspar consumption by the pottery manufacturers. On the other hand, the quantity of feldspar used in glass manufacture appears to be maintaining a uniform level regardless of the depressed condition of the industry. This situation of course indicates a growing appreciation of feldspar by the glass manufacturers. One of the feldspar producers, using data compiled by the Feldspar Grinders' Institute, recently estimated that about 55 per cent of the ground feldspar consumed by the ceramic industries was used in glass manufacture, 32 per cent in pottery and allied products, and 13 per cent in enamel ware.

Feldspar usually is sold in carload lots. It is shipped in bulk, in burlap bags, or in paper bags billed to the consumer at cost. Shipment in bags is preferable for small users, because of easier handling, less loss of spar, and less contamination during transit.

Most of the larger feldspar companies are completely integrated, being engaged in mining, grinding, and selling spar. Others market their product through special sales agents. Hundreds of small producers sell their crude spar output to grinding mills, many of which have no other source of crude. Seasonal fluctuation in feldspar consumption has little importance, but in some localities it is necessary to build up large stocks of crude to maintain deliveries during the winter season.

PRODUCTION

The term "crude feldspar" is applied to the lump spar shipped from the mine or quarry, as contrasted with ground spar, which is the finished product of the crushing and pulverizing mill. Statistics of production are presented separately for crude and ground spar; and in accordance with the practice common in the industry, the crude is reported in long tons of 2,240 pounds and the ground in short tons of 2,000 pounds.

Normally, the quantity of ground spar produced from domestic crude has maintained a yearly average of about 87 per cent of the crude spar output; the remaining 13 per cent includes spar used for purposes not requiring fine grinding and that lost or discarded during the grinding process. In 1929, however, sales of ground spar amounted to 95 per cent of the crude production, indicating that the grinders were forced to draw heavily upon stocks of crude to meet demands. In 1930 the relation returned to normal, but in 1931 sales of ground spar were only 80 per cent of the crude spar output. This decline means that stocks of crude spar must have increased considerably during 1931. The situation is not alarming, however, for the increase almost exactly balances the indicated depletion of crude stocks during 1929.

CRUDE FELDSPAR

Crude feldspar sold or used by producers in the United States in 1931 amounted to 147,119 long tons, valued at $861,059, a decrease of 14 per cent in quantity and 19 per cent in value as compared with 1930. The average value of crude feldspar in 1931 at the mine or shipping point nearest thereto was $5.85 a long ton, or 36 cents lower than that in 1930, 61 cents lower than 1929, and $1.80 lower than the peak in 1926. The average value for crude feldspar as reported by individual producers ranged from $2.35 to $12.60 a long ton. For New England the value ranged from $4.25 to $12.60; for New York, Pennsylvania, and Virginia, from $3.77 to $10.64; for North Carolina, from $3 to $6.73; and for the Western States, from $2.35 to $10.81. Crude feldspar production was reported from 13 States in 1931, an increase of 3 as compared with 1930. In 1931 North Carolina continued as the leading producing State, reporting 59 per cent of the total quantity; New Hampshire, displacing Maine in second place, reported nearly 9 per cent of the total; and South Dakota, rising sharply to third place, reported nearly 8 per cent of the total. South Dakota was the only one of these three States to show an increase in sales of crude feldspar.

Crude feldspar sold or used by producers in the United States, 1927–1931

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1927	202,497	$1,424,755	$7.04	1930	171,788	$1,066,636	$6.21
1928	210,811	1,418,975	6.73	1931	147,119	861,059	5.85
1929	197,699	1,276,640	6.46				

Crude feldspar sold or used by producers in the United States, 1929–1931, by States

[Value is at mine or nearest shipping point]

State	1929		1930		1931	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)			(1)	(1)
California	12,770	$84,567	6,519	$54,941	4,465	$30,857
Colorado	(1)	(1)	1,933	10,575	2,953	14,927
Connecticut	2,726	21,056	(1)	(1)	(1)	(1)
Maine	19,992	142,042	22,738	161,631	10,220	65,417
Maryland	2,624	19,610				
Minnesota					(1)	(1)
Nevada					(1)	(1)
New Hampshire	30,964	231,810	16,517	132,342	12,573	102,140
New York	12,696	103,531	5,556	37,790	6,160	29,959
North Carolina	103,273	598,938	103,163	593,552	86,429	505,525
Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	(1)	(1)	(1)	(1)	11,062	39,013
Virginia	6,677	38,628	6,760	38,048	9,331	48,545
Undistributed	5,977	36,458	8,602	37,757	3,926	24,676
	197,699	1,276,640	171,788	1,066,636	147,119	861,059

[1] Included under "Undistributed."

GROUND FELDSPAR

Almost all the feldspar consumed industrially is prepared by fine grinding. Even that used for facing cement blocks, for covering prepared roofing, for "chicken grits," and for similar purposes is crushed to small sizes and more or less graded by screening. It has not been practicable to canvass all consumers of feldspar to determine the quantities used by them, but all known merchant mills or grinders—that is, those that quarry or purchase crude spar and grind it for sale to other establishments—have been canvassed during the past 10 years for statistics of ground feldspar.

The quantity of ground feldspar sold by commercial mills in 1931 was 143,924 short tons, valued at $1,853,393, a decrease of 37,617 tons (about 21 per cent) and $597,522 (24 per cent) compared with 1930. Twenty-seven companies operating 29 mills in 14 States reported production in 1931, a decrease of 3 operators and 5 mills as compared with 1930 but an increase of 2 States, Arizona and Minnesota having reentered the list of feldspar grinders during the year. Of the mills reporting 26 worked exclusively on domestic spar and 3 exclusively on imported (Canadian) spar. Of the total quantity ground 92 per cent (132,542 short tons) was from domestic spar and 8 per cent (11,382 tons) from imported spar.

In 1931 the average value per ton of ground spar from domestic crude was $12.30, the lowest ever recorded and a decrease of 65 cents from 1930, $1.43 from 1929, and $4.54 from 1924, the year of highest recorded average. The average value in the several States ranged from $10 to $20.09. The average value of ground feldspar from imported crude dropped to $19.55, the lowest since 1923 and a decrease of 47 cents from 1930 and $1.58 from the 1927 peak.

Ground feldspar sold by merchant mills[1] in the United States, 1927–1931

Year	Number of operators	Domestic			Canadian[2]			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1927	30	194,672	$2,946,154	$15.13	[2] 29,243	[2] $617,987	$21.13	223,915	$3,564,141
1928	29	202,844	2,951,281	14.55	[2] 24,813	[2] 507,747	20.46	227,657	3,459,028
1929	29	209,808	2,880,824	13.73	20,774	415,428	20.00	230,582	3,296,252
1930	30	167,380	2,167,352	12.95	14,161	283,563	20.02	181,541	2,450,915
1931	27	132,542	1,630,917	12.30	11,382	222,476	19.55	143,924	1,853,393

[1] Does not include potters or others who grind for consumption in their own plants.
[2] Figures for 1927 and 1928 include some Cornwall stone.

Ground feldspar sold by merchant mills[1] in the United States, 1930 and 1931, by States

State	1930					1931				
	Number of operators	Domestic		Canadian		Number of operators	Domestic		Canadian	
		Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
California	3	6,016	$85,532			2	(2)	(2)		
Maine	4	16,116	256,285			3	11,225	$164,035		
New Jersey	4	14,784	276,626			3	9,244	171,985		
New York	5	6,619	88,847	(2)	(2)	3	(2)	(2)	(2)	(2)
Ohio	2	(2)	(2)	(2)	(2)	2	(2)	(2)	(2)	(2)
North Carolina	5	92,714	1,012,915			5	70,558	760,080		
Tennessee	1					1				
Undistributed[3]	6	31,131	447,147	14,161	$283,563	8	41,515	534,817	11,382	$222,476
	30	167,380	2,167,352	14,161	283,563	27	132,542	1,630,917	11,382	222,476

[1] Does not include potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."
[3] 1930: Colorado, Illinois, New Hampshire, New York (imported), Ohio, South Dakota, and Virginia. 1931: Arizona, California, Colorado, Illinois, Minnesota, New Hampshire, New York, Ohio, South Dakota, and Virginia.

INDUSTRY BY STATES

General data.—The production (or sales) of crude feldspar was reported from 13 States in 1931, 3 more than in 1930. Arizona, which reported no production for 1930, reentered the list of producers in 1931. Nevada appeared as a producer of crude feldspar for the first time; and Minnesota, after no output for many years, again reported production of both crude and ground feldspar. The producing States, arranged in order of importance, were North Carolina, New Hampshire, South Dakota, Maine, Virginia, New York, California, Colorado, Minnesota, Connecticut, Arizona, Pennsylvania, and Nevada. The three leading States accounted for 75 per cent of the total sales of crude feldspar during the year. The principal producing region is along the Atlantic seaboard from Maine to North Carolina, and this region reported 86 per cent of the total output in 1931 compared with 91 per cent in 1930. During 1931 feldspar was ground in commercial mills in each of the States producing crude feldspar except Connecticut, Nevada, and Pennsylvania; mills grinding feldspar commercially were operated also in Illinois, New Jersey, Ohio, and Tennessee. Three States—Colorado, South Dakota, and Virginia—that reported in both 1930 and 1931 showed increases in both quantity and value of crude output in 1931, but only South Dakota and Virginia showed increases in both quantity and value of ground output.

Arizona.—The feldspar quarries of the Kingman Feldspar Co., which were idle in 1930, reopened in 1931. The State ranked eleventh in output and tenth in value of crude spar. The Consolidated Feldspar Corporation established a grinding mill at Kingman; operation was begun late in 1931 and took the entire crude-spar output of the Kingman Feldspar Co.

California.—The output and value of both crude and ground feldspar in California decreased in 1931 compared with 1930. The quantity of crude spar decreased 2,054 tons (32 per cent) and the value $24,084 (44 per cent) compared with 1930. The State ranked seventh in output and sixth in value of crude spar. The decrease in quantity and value of ground spar marketed was also considerable. Two grinding mills were operated in the State—one by the American Encaustic Tiling Co. (Ltd.), Los Angeles, and the other by the Standard Sanitary Manufacturing Co., Richmond.

Colorado.—Colorado was one of the three States that showed increase in both output and value of crude feldspar in 1931 compared with 1930; the proportionate gain was large—53 per cent in quantity and 41 per cent in value—and the State ranked eighth in output and value of crude spar. A mill was operated by the Western Feldspar Milling Co. at Denver.

Connecticut.—In 1931 Connecticut ranked tenth in output and ninth in value of crude spar. No ground spar was reported from the State.

Illinois.—No crude spar is produced in Illinois, but in 1931 one mill grinding spar from South Dakota was operated by the Abingdon Sanitary Manufacturing Co. at Abingdon. Most of the spar was ground for the use of the company, but some was sold.

Maine.—In 1930 Maine ranked second among the States in production and value of crude spar but in 1931 fell to fourth place in output and third place in value, with a decrease of 12,518 tons (55 per cent) and $96,214 (60 per cent). The quantity and value of ground spar also decreased considerably—30 and 36 per cent, respectively, compared with 1930. Nevertheless, Maine reported 7 per cent of the total quantity and 8 per cent of the total value of domestic crude and 8 per cent of the total quantity and 10 per cent of the total value of domestic ground spar. Androscoggin, Cumberland, Oxford, and Sagadahoc were the producing counties, Sagadahoc reporting two-thirds of the total. Nearly all the spar mined in Maine is ground in the mills of the State, which were operated in 1931 by the Consolidated Feldspar Corporation, Trenton, N. J., with mill at Topsham; the Trenton Flint & Spar Co., Trenton, N. J., with mill at Cathance; and the Oxford Mining & Milling Co., West Paris, with mill at Bates.

Minnesota.—Minnesota reappeared in 1931 as a producer of crude and ground feldspar after more than 20 years of inactivity, the last mining of feldspar having been reported from Lake County in 1910. In 1931 the Feldspar Products Co. (Inc), Warroad, operated a quarry and mill in Lake of the Woods County. The State ranked ninth in output and eleventh in value of crude feldspar and twelfth in output and thirteenth in value of ground feldspar.

Nevada.—In 1931 Nevada reported for the first time the sale of crude feldspar. It was produced in Washoe County by Nate Kearns & Sons, Reno, and shipped to California.

New Hampshire.—In 1931 New Hampshire ranked second in output and value of crude spar, displacing Maine, but seventh in output and value of domestic ground spar. The State reported 9 per cent of the total output and 12 per cent of the total value of crude spar; however, the output declined 24 per cent in quantity and 23 per cent in value in 1931 compared with 1930. Ground spar was reported by the American Mineral Products Co. (Inc.), New York, N. Y., with mill at Cold River, and the Golding-Keene Co., with office and mill at Keene. The output and value of ground spar declined about one-third compared with 1930.

New Jersey.—New Jersey produces no crude feldspar but is an important State in the industry because its mills grind a large part of the spar consumed in its pottery industry. The mills of the Eureka Flint & Spar Co., the Golding Sons Co., and the Standard Flint & Spar Corporation are at Trenton. In 1931 the State ranked fifth in quantity and third in value of domestic ground spar. The mills reported sales of 9,244 short tons of ground spar, valued at $171,985, or 7 per cent of the total quantity and 11 per cent of the total value of domestic ground production and a decrease of 37 per cent in quantity and 38 per cent in value compared with 1930.

New York.—In 1931 New York ranked sixth in quantity and seventh in value of crude spar, the output having increased 11 per cent and the value having decreased 21 per cent compared with 1930. It ranked eighth in output and ninth in value of ground spar from domestic crude, first in both output and value of ground spar from imported crude, and third in production and second in value of total ground spar. The following four mills, three less than in 1930, were active in 1931: The Consolidated Feldspar Corporation (Trenton, N. J.), with two mills—one each at Bedford and Rochester; the Green Hill Mining Co. (Inc.), Gouverneur, with mill at De Kalb; and the Genesee Feldspar Co. (Inc.), at Rochester.

North Carolina.—In 1931, as for many years, North Carolina was the largest producer of crude spar; it was also, for the fourth time, the largest producer of ground spar. The output of crude spar in North Carolina in 1931 was 59 per cent of the total and nearly seven times that of New Hampshire, the second State. Nevertheless, the output of crude spar decreased 16 per cent and the value 15 per cent compared with 1930, both the output and value being the smallest since 1925. The average value per ton of crude spar in 1931 in North Carolina was $5.85 (also the average for the entire country), compared with $5.75 in 1930 and $5.80 in 1929. Nearly one-half of the output of the State was made by numerous small producers who sell their feldspar to some large user or distributing agency. Companies reporting such purchases in 1931 were the Carolina Mineral Co. (Inc.) and the Tennessee Mineral Products Corporation, both at Spruce Pine; the Feldspar Milling Co. (Inc.), Burnsville; the North State Feldspar Corporation, Micaville; and the Southern Feldspar (Inc.), Toecane. In 1931 about 75 per cent of the spar was produced in Mitchell County and most of the remaining 25 per cent in Avery and Yancey Counties.

Five grinding mills were operated in North Carolina during 1931—one by each of the following: The Feldspar Milling Co. (Inc.), with office at Burnsville and mill at Bowditch; the North State Feldspar Corporation, Micaville; Golding Sons Co., with office at Trenton, N. J., and mill at Spruce Pine; the Tennessee Mineral Products Corporation, Spruce Pine; and the Southern Feldspar (Inc.), Toecane. The mills in North Carolina and Tennessee reported 70,558 short tons of domestic ground spar (53 per cent of the total domestic spar sold) in 1931, valued at $760,080 (47 per cent of the total value). The output of ground feldspar in this region in 1931 decreased 22,156 tons (24 per cent) and $252,835 (25 per cent) compared with 1930; it is the smallest in both quantity and value since 1925 and represents a decline of 33 and 39 per cent, respectively, from 1929, the year of largest output and value.

Ohio.—No crude feldspar is produced in Ohio, but this State and the adjoining territory in Pennsylvania and West Virginia produce a very large portion of the high-grade general ceramic ware made in the United States; hence, the region is a large center of consumption of feldspar. The potteries in the district are supplied, in part, by mills in Ohio, which are operated by the Golding Sons Co. at East Liverpool and the Rock Products Co. at Silica near Toledo. During 1931 the Golding Sons Co. ground only domestic spar and the Rock Products Co. only Canadian spar.

Pennsylvania.—Pennsylvania ranked next to last among the States in both quantity and value of crude spar produced in 1931, as only one operator reported sales.

South Dakota.—The output of both crude and ground feldspar in South Dakota increased greatly in 1931 compared with 1930. The State ranked third in quantity and fifth in value of crude spar and fourth in quantity and fifth in value of ground spar from domestic crude.

Tennessee.—Tennessee has no feldspar mines but is a large producer of ground feldspar. In 1931 it ranked second in both quantity and value of ground feldspar sold. The Consolidated Feldspar Corporation, with office in Trenton, N. J., and mills at Erwin, was the only operator in the State to report production.

Virginia.—The output and value of crude feldspar in Virginia increased considerably in 1931—38 and 28 per cent, respectively—compared with 1930. Sales of ground spar also increased. The only mill in the State, at Brookneal, Campbell County, was operated by the Seaboard Feldspar Co., which maintains an office at Baltimore, Md. Some of the ground spar is reported to have been shipped to Paris, France.

IMPORTS[3]

For several years prior to 1931 about one-eighth of the new supply of crude feldspar had been imported from Canada, but in 1931 imports amounted to only about one-fifteenth of the total new supply. The decrease in imports of crude feldspar in 1931, as compared with 1930, was 49 per cent in quantity and 43 per cent in value, and both the quantity and the value were the smallest recorded for a full year since statistics of imports of feldspar became available. Imports of ground feldspar, which never have been important, showed large proportional gains over 1930 in both quantity and value.

Feldspar imported for consumption in the United States, 1927–1931

Year	Crude		Crushed or ground		Year	Crude		Crushed or ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1927	27,424	$206,856	(a)	$3	1930	21,006	$167,157	57	$586
1928	27,857	224,920	55	1,091	1931	10,719	95,096	79	1,500
1929	29,927	241,852	3	131					

a 250 pounds.

[3] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

TARIFF

Under the tariff act of 1930 a duty of $1 a long ton was placed upon crude feldspar (formerly free), and the duty of 30 per cent ad valorem on ground spar was retained.

In response to an application filed by a feldspar importer the United States Tariff Commission during June, 1931, instituted an investigation of the cost of production of crude feldspar. The commission found that the cost of Canadian feldspar, excluding cost of grinding and including total transportation costs from mines to United States markets, exceeded the corresponding cost of domestic spar by $2.44 a ton. The commission accordingly recommended that the maximum reduction of 50 per cent be made in the existing rate of $1 a ton on crude feldspar. No change in the duty of 30 per cent ad valorem on ground feldspar was advocated. The President approved the recommendation, and the new rate became effective January 1, 1932.

WORLD PRODUCTION

The following tables show the most recent figures of production of feldspar in the chief producing countries. Besides the United States and Canada, the most important are Czechoslovakia, Norway, and Sweden. Although Great Britain has an immense pottery industry, it appears to have produced no feldspar in recent years. Cornwall stone, a more or less decomposed natural mixture of feldspar and quartz, is extensively used as a flux in the British pottery industry.

World production of feldspar, 1927–1931, by countries, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Argentina (shipments)	185	410	427	196	(2)
Australia:					
New South Wales [3]	16	49	58	86	103
South Australia [3]	93	115	-----	-----	(2)
Western Australia (exports)	-----	-----	21	-----	106
Canada (shipments)	27,078	28,936	34,044	24,309	16,640
Finland (exports)	553	720	460	620	(2)
France	15,000	23,000	12,300	(2)	(2)
Germany (Bavaria)	7,320	6,230	7,697	5,150	5,000
Italy	4,054	4,960	6,800	5,750	4,750
Norway (exports)	27,650	24,075	26,524	19,922	(2)
Rumania	1,943	2,835	2,479	1,963	(2)
Russia [4]	19,324	20,308	(2)	(2)	(2)
Sweden	30,636	39,921	39,092	38,596	(2)
Union of South Africa	29	30	-----	-----	-----
United States (shipments)	205,747	214,195	200,872	174,545	149,480

[1] In addition to the countries listed feldspar is produced in Czechoslovakia. Official figures of output are not available, but it is estimated that the annual production is approximately 30,000 metric tons. (Stat. Com., Czechoslovakian Ceramic Society.)
[2] Data not available.
[3] Includes some china stone.
[4] Year ended Sept. 30.

Feldspar, produced in Canada, sold in 1927–1931

Year	Long tons	Value	Year	Long tons	Value
1927	26,651	$259,151	1930	23,925	$268,469
1928	28,479	284,942	1931	16,378	186,961
1929	33,506	340,471			

GYPSUM[1]

By R. M. Santmyers and Jefferson Middleton[2]

CONTENTS

INTRODUCTION

The decline of over 50 per cent in the volume of gypsum mined or sold during the past six years represents a very large loss even for an industry in the construction field. This decrease, which has been gradual since the peak year 1925, may be divided into two distinct cycles. The first cycle, 1926 to 1928, was characterized by severe price competition brought about by expansion in plant capacity and reorganization of markets. During this period the existing price structure became impaired, and the margins between prices and costs were greatly reduced if not virtually eliminated. Spurred by necessity costs were reduced, and one by one the companies revised their prices so that by the end of 1929 they once more allowed a margin of profit. Consequently, the beginning of the second cycle found the majority of the companies in a fairly strong financial position. In 1930, as the amount of new building construction dropped, sales efforts were directed toward repair work, and when even this failed to check the shrinkage in volume of business prices instead of being slashed continued their upward trend. There was no serious evidence of price cutting during 1931, although indications were that some producers intended to absorb the recent increase in freight rates on gypsum products. The unit value of sales of calcined gypsum in 1931 was $12.07 per ton, the highest recorded in the industry.

PRODUCTION AND SALES

The quantity of crude gypsum mined in the United States in 1931 was 2,559,017 short tons, a decrease of 912,376 tons (26 per cent) compared with 1930. The number of operators in 1931 was 54, a decrease of 2 from 1930. The value of uncalcined and calcined gypsum sold or used by producers was $20,801,357 in 1931, compared with $27,051,484 in 1930 and $31,292,969 in 1929—23 per cent less than in 1930 and 34 per cent less than in 1929. Of the total quantity mined

[1] Work on manuscript completed June, 1932.
[2] Figures on imports and exports (unless otherwise indicated) compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

in 1931, 773,185 tons were sold or used by producers without calcining (a decrease of 216,406 tons from 1930) and were valued at $1,565,367 ($2.02 per ton, or 11 cents more than in 1930). Calcined gypsum sold or used by producers in 1931 amounted to 1,593,753 tons, valued at $19,235,990 ($12.07 per ton); this represents an increase of 59 cents per ton over 1930.

New York continued to be the largest producer of gypsum, but like most other States showed a decrease in 1931. There were 10 active operators (the same number as in 1930); they produced 744,613 tons, a decrease of 167,457 tons (18 per cent) from the previous year. New York, as usual, was also the largest marketer of gypsum in 1931. During the year there were sold or used by producers 222,072 tons of uncalcined gypsum having a reported value of $485,904 and 459,676 tons of calcined gypsum valued at $5,625,949. These tonnages represent decreases of 19 per cent in uncalcined and 20 per cent in calcined, compared with 1930; the values represent decreases of 19 and 13 per cent, respectively. Other important States in the production of crude gypsum in 1931 follow: Michigan, 383,123 tons (519,225 tons in 1930); Iowa, 321,627 tons (481,047 tons in 1930); Texas, 239,391 tons (359,315 tons in 1930); and Nevada, 131,079 tons (165,279 tons in 1930). These five States reported 71 per cent of the total production in 1931.

Crude gypsum to Portland cement mills in 1931 amounted to 664,305 tons, valued at $1,266,146, compared with 933,381 tons, valued at $1,689,358, in 1930—decreases of 29 and 25 per cent, respectively.

The quantity of crude gypsum sold by producers in 1931 as agricultural gypsum was 28,350 tons, valued at $138,725, compared with 31,029 tons, valued at $158,538, in 1930—decreases of 9 and 12 per cent, respectively.

Gypsum mined and uncalcined and calcined gypsum sold or used by producers in the United States, 1927–1931

Year	Number of operators	Total quantity mined (short tons)	Sold or used by producers				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
1927	60	5,346,888	965,371	$2,388,663	3,912,211	$39,785,791	$42,174,454
1928	58	5,102,250	999,412	1,902,034	3,641,385	30,134,129	32,036,163
1929	59	5,016,132	1,065,697	2,096,779	3,361,580	29,196,190	31,292,969
1930	56	3,471,393	989,591	1,886,254	2,191,376	25,165,230	27,051,484
1931	54	2,559,017	773,185	1,565,367	1,593,753	19,235,990	20,801,357

Gypsum mined and uncalcined and calcined gypsum sold or used by producers in the United States in 1931, by States

State	Number of operators	Total quantity mined (short tons)	Sold or used by producers				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
California	5	90,899	(1)	(1)	(1)	(1)	$472,015
Iowa	7	321,627	98,474	$134,128	210,726	$2,453,998	2,588,126
Michigan	5	383,123	136,060	253,842	253,902	3,284,044	3,537,886
Nevada	4	131,079	41,969	118,339	71,706	674,147	792,486
New York	10	744,613	222,072	485,904	459,676	5,625,949	6,111,853
Texas	5	239,391	55,581	94,768	157,556	2,025,440	2,120,208
Utah	3	22,178	5,837	17,391	13,199	116,142	133,533
Other States [2]	15	626,107	[3] 213,192	[3] 460,995	[3] 426,988	[3] 5,056,270	5,045,250
	54	2,559,017	773,185	1,565,367	1,593,753	19,235,990	20,801,357

[1] Included under "Other States."
[2] Arizona, Colorado, Kansas, Montana, Ohio, Oklahoma, South Dakota, Virginia, and Wyoming.
[3] This figure includes also sales from California.

Gypsum sold or used by producers in the United States, 1928–1930, by uses

Use	1928		1929		1930	
	Short tons	Value	Short tons	Value	Short tons	Value
Without calcining:						
To cement mills	969,357	$1,802,164	1,020,234	$1,914,263	933,381	$1,689,358
For agriculture	25,668	90,937	38,099	161,288	31,029	158,538
For other uses [1]	4,387	8,933	7,364	21,228	25,181	38,358
Total without calcining	999,412	1,902,034	1,065,697	2,096,779	989,591	1,886,254
Calcined:						
For building purposes—						
Neat plaster	551,674	3,284,293	300,459	1,883,100	225,877	1,567,331
Sanded plaster	245,617	1,314,480	129,026	752,528	104,448	681,265
Fibered plaster	1,549,483	7,677,864	1,597,846	7,814,603	964,347	7,238,955
Plaster board and lath	[2] 252,813	4,107,848	[3] 236,761	3,591,880	[4] 217,580	4,260,087
Wall board	[5] 459,177	9,046,926	[6] 524,307	10,538,811	[7] 261,929	7,833,860
Partition tile	218,560	1,675,153	221,899	1,440,538	158,440	1,020,922
Special tile and block	5,856	70,222	7,445	98,856	(8)	(8)
For insulating	12,776	226,605	10,307	186,830	7,861	149,874
Keenes cement	54,020	848,504	52,330	767,621	39,446	571,044
Other building purposes [9]	97,520	731,669	44,686	509,046	[8] 44,903	[8] 600,032
Total for building purposes	3,447,496	28,983,564	3,125,066	27,583,813	2,024,831	23,923,370
For manufacturing uses—						
Plaster of Paris (molding and casting, pottery, foundry, terra cotta, and architectural plaster)	67,067	500,582	102,801	827,413	93,718	768,257
To plate-glass works	105,275	544,158	85,799	596,489	51,514	304,981
For other manufacturing uses [10]	21,547	105,825	47,914	188,475	21,313	168,622
Total for manufacturing uses	193,889	1,150,565	236,514	1,612,377	166,545	1,241,860
Total calcined	3,641,385	30,134,129	3,361,580	29,196,190	2,191,376	25,165,230
Grand total value	----------	32,036,163	----------	31,292,969	----------	27,051,484

[1] 1928: Includes gypsum sold for soil corrective, poultry grits, and road work and to paint mills. 1929: Includes gypsum sold for insulating material, to paint mills, and as rock dust. 1930: Includes gypsum sold to plaster mills, to plate-glass works, for insulating material, and as rock dust.
[2] 284,440,741 square feet.
[3] 267,215,128 square feet.
[4] 258,809,622 square feet.
[5] 559,936,675 square feet.
[6] 618,829,362 square feet.
[7] 316,591,528 square feet.
[8] Gypsum sold for special tile and block in 1930 included under "Other building purposes."
[9] 1928: Includes finished plaster, prepared finishes, board filler, roofing tile, etc. 1929: Includes finished plaster, prepared finishes, joint filler, roofing tile, sheet-rock finisher, etc. 1930: Includes embello, finished plaster, prepared finishes, joint filler, roofing tile, stucco for roof construction, sheet-rock finisher, tile cement, etc.
[10] 1928: Includes dental plaster, etc. 1929: Includes stucco for plaster and wall board and for filler. 1930: Includes stucco for plaster and wall board and for filler and hydrocal.

Gypsum sold or used by producers in the United States in 1931, by uses

Use	Short tons	Value
Without calcining:		
To Portland cement mills	664,305	$1,266,146
For agriculture	28,350	138,725
For other purposes [1]	80,530	160,496
Total without calcining	773,185	1,565,367
Calcined:		
For building purposes—		
Base-coat plasters	759,784	6,070,031
Sanded plasters	99,449	591,761
Finished plasters	82,371	794,289
Molding plasters	58,773	541,857
Keenes cement	27,449	394,219
Plaster board and lath	[2] 133,329	2,411,730
Wall board	[3] 219,367	6,735,040
Partition tile	[4] 102,232	716,873
Insulating materials	4,688	76,211
Calcined—Continued.		
For building purposes—Continued.		
Other building purposes [5]	28,929	$304,836
Total for building purposes	1,516,371	18,636,847
For manufacturing uses—		
To plate-glass works	24,865	122,127
To terra cotta works	6,160	43,299
For other manufacturing uses [6]	18,255	249,251
Total for manufacturing uses	49,280	414,677
For other purposes [7]	28,102	184,466
Total calcined	1,593,753	19,235,990
Grand total value		20,801,357

[1] Includes gypsum sold for filler, for insulating materials, and rock dust.
[2] 166,684,196 square feet.
[3] 270,416,778 square feet.
[4] 19,478,632 square feet.
[5] Includes joint filler, pyrofill, "roof tile" and "other tile," structolite, and stucco for roof construction.
[6] Includes gypsum for casting and for dental work, hydrocal, and "orthopedic" gypsum.
[7] Includes calcined gypsum sold to other manufacturers and for miscellaneous uses.

The amount of calcined gypsum sold or used by producers during 1931 for building purposes was 1,516,371 tons, valued at $18,636,847 (95 per cent of the quantity and 97 per cent of the value of the total calcined gypsum); the corresponding figures for 1930 were 2,024,831 tons, valued at $23,923,370 (92 per cent of the total quantity and 95 per cent of the total value). A slight change was made in 1931 in the classification of plasters. Up to 1931, gypsum plasters were divided by the Bureau of Mines into three classifications—neat, sanded, and fibered; in 1931, in cooperation with the industry, the first and last were changed to base-coat and finished plasters, respectively. Sales of base-coat plasters in 1931 amounted to 759,784 tons, valued at $6,070,031 (50 per cent of the total quantity for building purposes but only 33 per cent of the total value). Sales of wall board, the second largest item in 1931, amounted to 219,367 tons (270,416,778 square feet), valued at $6,735,040 (14 per cent of the total quantity (in tons) for building and 36 per cent of the total value). The third largest item was sales of plaster board and lath, which amounted to 133,329 tons (166,684,196 square feet), valued at $2,411,730 (9 per cent of the total quantity for building purposes and 13 per cent of the total value). Sales of Keenes cement during 1931 were 27,449 tons, valued at $394,219, compared with 39,446 tons, valued at $571,044, in 1930, decreases of 30 and 31 per cent, respectively.

The amount of calcined gypsum sold or used by producers during 1931 for manufacturing uses was 49,280 tons, valued at $414,677, or only 3 per cent of the quantity and 2 per cent of the value of the total calcined gypsum; these figures represent decreases of 117,265 tons and $827,183 from the total calcined gypsum for manufacturing purposes in 1930.

Keenes cement sold by producers in the United States, 1927–1931

Year	Manufacturers	Short tons	Value	Year	Manufacturers	Short tons	Value
1927	4	41,431	$674,698	1930	4	39,446	$571,044
1928	6	54,020	848,504	1931	5	27,449	394,219
1929	6	52,330	767,621				

Calcined gypsum used in products by producers in the United States in 1931, by States and uses, in short tons

State	Board	Tile	Plaster	Other products	Total
California			82,858	(1)	[2] 82,858
Iowa	30,271	18,256	131,372		179,899
Michigan	(1)	(1)	87,844	(1)	130,407
New York	101,697	69,868	203,105		374,670
Texas	29,974	(1)	114,471	(1)	150,046
Other States [3]	[4] 111,064	[4] 64,061	319,355	[4] 27,029	[4] 473,345
	273,006	152,185	939,005	27,029	1,391,225

[1] Included under "Other States."
[2] Figure covers plaster only; "Other products" included under "Other States."
[3] Arizona, Colorado, Indiana (crude gypsum from Michigan), Kansas, Montana, Ohio, Oklahoma, South Dakota, Utah, Virginia, and Wyoming.
[4] This figure includes also gypsum used in States as indicated by "1" and "2" above.

KETTLES AND KILNS IN OPERATION

The following table compares the number and distribution of kettles and kilns (rotary and vertical) in operation in 1930 and 1931. The number of producers reporting dropped from 46 in 1930 to 43 in 1931, with a decrease in the number of kettles in operation from 181 to 164 and a corresponding decrease in daily capacity from 22,088 to 20,003 tons. The number of rotary and vertical kilns in operation decreased from 26 in 1930 to 25 in 1931 and the daily capacity from 8,283 to 8,140 tons. The total daily capacity, based on a 24-hour operating schedule, of both kettles and kilns decreased from 30,371 tons in 1930 to 28,143 tons in 1931.

Calcining kettles and kilns reported by gypsum producers in the United States in 1931, by States

State	Number of producers	Kettles		Rotary kilns [1]		Total daily capacity (short tons)
		Number	Daily capacity (short tons)	Number	Daily capacity (short tons)	
California	3	8	790			790
Iowa	5	28	4,594			4,594
Michigan	5	26	2,776	(2)	(2)	[3] 2,776
New York	6	23	3,365	15	5,370	8,735
Texas	4	23	1,968			1,968
Utah	3	(2)	(2)	(2)	(2)	340
Other States [4]	17	[5] 56	[5] 6,510	[5] 10	[5] 2,770	[5] 8,940
Total, 1931	43	164	20,003	25	8,140	28,143
Total, 1930	46	181	22,088	26	8,283	30,371

[1] Includes vertical kilns reported in New York and Utah.
[2] Included under "Other States."
[3] Capacity of kettles only; capacity of rotary kilns included under "Other States."
[4] Arizona, Colorado, Indiana (crude gypsum from Michigan), Kansas, Montana, Nevada, Ohio, Oklahoma, South Dakota, Virginia, and Wyoming.
[5] This figure covers also certain items for States as indicated by "2" and "3" above.

IMPORTS

Imports of crude gypsum for consumption in the United States amounted to 713,880 short tons, valued at $713,313, in 1931. These figures represent decreases of 21 per cent in quantity and 22 per cent in value compared with 1930 and 31 per cent in quantity and 33 per cent in value compared with 1929, the peak year in quantity. In 1931 Canada was, as usual, the chief foreign source of supply, furnishing 667,614 tons, valued at $671,985 (94 per cent of both total quantity and total value of gypsum imported); Mexico furnished practically all the remainder.

The gypsum rock imported from Canada is destined mainly for manufacture at plants along the Atlantic seaboard, although Canadian gypsum and anhydrite (15,000 to 20,000 tons annually) are imported at Norfolk for fertilizer in growing peanuts. The Mexican rock from San Marcos Island, Lower California, goes to Standard Gypsum Co. plants at Long Beach, Calif., and Seattle, Wash.

Imports of ground or calcined gypsum increased from 6,562 tons, valued at $75,959, in 1930 to 7,236 tons, valued at $73,361, in 1931—an increase of 10 per cent in quantity but a decrease of 3 per cent in value.

Under the tariff act of 1930 the classification "Manufactures of plaster of Paris or gypsum, n. s. p. f." was changed after June 17, 1930, to read "Manufactures of which plaster of Paris is the component material of chief value, n. s. p. f." and divided into two classes as follows: "Statues, statuettes, and bas-reliefs, n. s. p. f." and "All other, n. s. p. f."

In 1931 the values of the imports under these new classifications were $25,250 and $11,575, respectively. The total—$36,825—represents a decrease of $24,497 (40 per cent) from 1930.

The imports of Keenes cement amounted to only 128 tons, valued at $3,012, in 1931, compared with 1,146 tons, valued at $37,175, in 1930.

The total value of all imports of gypsum was $826,511 in 1931, compared with $1,091,119 in 1930 (a decrease of 24 per cent).

Figures on imports of gypsum, as recorded by the Bureau of Foreign and Domestic Commerce, are given in the two tables following.

Gypsum imported for consumption in the United States, 1927–1931

Year	Crude		Ground or calcined		Manufactured plaster of Paris (value)	Keenes cement		Total value
	Short tons	Value	Short tons	Value		Short tons	Value	
1927	828,619	$1,167,581	8,650	$114,947	$89,096	655	$16,202	$1,387,826
1928	1,028,816	1,340,920	6,907	99,833	87,314	601	13,729	1,541,796
1929	1,036,385	1,060,874	4,979	69,703	71,479	430	11,327	1,213,383
1930	902,358	916,663	6,562	75,959	61,322	1,146	37,175	1,091,119
1931	713,880	713,313	7,236	73,361	36,825	128	3,012	826,511

Crude gypsum imported into the United States, 1929–1931, by countries

[General imports]

Country	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Algeria and Tunisia	1	$55				
Canada	947,331	976,455	824,964	$837,296	667,614	$671,985
Cuba	(1)	5				
Hong Kong	3	80			1	20
Mexico	89,041	84,240	77,394	79,367	46,265	41,308
United Kingdom	9	39				
	1,036,385	1,060,874	902,358	916,663	713,880	713,313

[1] Less than ½ ton.

Eight importers with 13 plants in 10 States—California, Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, Virginia, and Washington—reported to the Bureau of Mines that they imported 630,892 short tons of crude gypsum in 1931, compared with 794,970 tons in 1930 and 1,017,791 tons in 1929, decreases in 1931 of 21 per cent from 1930 and 38 per cent from 1929. Resales of crude foreign gypsum, as reported by these importers for 1931, were 78,258 tons, valued at $317,190, a decrease of 16 per cent in quantity and 19 per cent in value compared with 1930. Sales of calcined gypsum made from imported material, as reported by these importers for 1931, amounted to 538,633 tons, valued at $7,602,117, a decrease of 17 per cent in quantity and 7 per cent in value. The total value of all sales of foreign gypsum by these importers was $7,919,307 in 1931, compared with $8,602,987 in 1930, a decrease of 8 per cent.

The first of the three following tables shows the crude gypsum imported and the uncalcined and calcined gypsum made therefrom and sold in the United States from 1927 to 1931; the second and third tables show the foreign gypsum sold in the United States from 1928 to 1931, by uses.

Crude gypsum imported and uncalcined and calcined gypsum, from imported rock, sold in the United States, 1927–1931, as reported to the Bureau of Mines by the importers

Year	Number of importers	Crude imported (short tons)	Sold				
			Without calcining		Calcined		Total value
			Short tons	Value	Short tons	Value	
1927	8	785,476	107,307	$457,747	585,880	$6,431,843	$6,889,590
1928	8	954,000	121,339	449,246	805,920	7,657,460	8,106,706
1929	8	1,017,791	83,681	331,979	820,737	7,842,523	8,174,502
1930	8	794,970	93,515	391,150	648,162	8,211,837	8,602,987
1931	8	630,892	78,258	317,190	538,633	7,602,117	7,919,307

Foreign gypsum sold in the United States, 1928–1930, by uses, as reported to the Bureau of Mines by the importers

Use	1928		1929		1930	
	Short tons	Value	Short tons	Value	Short tons	Value
Without calcining:						
To cement mills	86,661	$268,040	55,418	$168,225	66,072	$236,293
For agriculture For other uses	34,678	181,206	28,263	163,754	27,443	154,857
Total without calcining	121,339	449,246	83,681	331,979	93,515	391,150
Calcined:						
For building purposes—						
Neat plaster	132,559	1,622,116	195,486	2,210,338	142,055	1,578,124
Sanded plaster	83,302	540,324	67,468	397,404	47,197	326,421
Fibered plaster	389,829	2,610,328	380,569	2,424,971	294,551	2,488,260
Plaster board	49,740	632,489	62,609	829,153	(1)	(1)
Wall board	65,124	1,171,613	87,316	1,651,032	(1)	(1)
Partition tile	15,993	127,557	[3] 8,270	[3] 133,061	15,363	117,618
Other building purposes [2]	14,435	189,869			[1] [3] 117,876	[1] [3] 3,306,746
For manufacturing uses—						
Plaster of Paris	51,372	731,718	19,019	196,564	31,120	394,668
For other manufacturing uses [4]	3,566	31,446	(3)	(3)	(3)	(3)
Total calcined	805,920	7,657,460	820,737	7,842,523	648,162	8,211,837
Grand total value		8,106,706		8,174,502		8,602,987

[1] Gypsum sold for plaster board and wall board in 1930 included under "Other building purposes."
[2] 1928: Includes acoustical and finishing plasters. 1929 and 1930: Includes gypsum for insulating use and acoustical plaster.
[3] Gypsum sold for "Other manufacturing uses" in 1929 and 1930 included under gypsum sold for "Other building purposes"; Bureau of Mines not at liberty to publish figures.
[4] 1928: Includes filler, dental plaster, etc., and gypsum sold to plate-glass works. 1929: Includes gypsum sold to plate-glass works and for patching plaster. 1930: Includes gypsum sold for patching plaster.

Foreign gypsum sold in the United States in 1931, by uses, as reported to the Bureau of Mines by the importers

Use	Short tons	Value
Without calcining:		
To Portland cement mills	48,326	$161,563
For agriculture	17,353	93,648
For other purposes	12,579	61,979
Total without calcining	78,258	317,190
Calcined:		
For building purposes—		
Base-coat plasters	273,071	2,614,718
Sanded plasters	37,858	253,645
Finished plasters	69,996	1,027,489
Molding plasters	23,595	418,465
Calcined—Continued.		
For building purposes—Continued.		
For other building purposes [1]	109,128	$3,091,595
Total for building purposes	513,648	7,405,912
For manufacturing uses [2]	24,985	196,205
Total calcined	538,633	7,602,117
Grand total value		7,919,307

[1] Includes plaster board and lath, wall board, partition tile, other tile, insulating materials, and other building purposes.
[2] Includes gypsum sold to terra cotta works to potteries, for other manufacturing uses, and to other gypsum manufacturers.

EXPORTS

Exports of gypsum and gypsum products during 1931 showed a considerable decline compared with 1930; in 1931 exports were 11,275 tons, valued at $234,540, and in 1930, 23,611 tons, valued at $420,728, decreases of 52 and 44 per cent, respectively.

Gypsum and gypsum products exported from the United States, 1927–1931 [1] [2]

Year	Short tons	Value	Year	Short tons	Value
1927	18,429	$471,106	1930	23,611	$420,728
1928	18,788	416,748	1931	11,275	234,540
1929	28,809	512,186			

[1] Exports classification for 1927 reads "Gypsum or plaster, crude, ground, calcined, and manufactures of." For 1928 to 1931 exports are recorded as follows: "Crude, crushed, or ground," 2,365 short tons, valued at $23,764, in 1928; 4,230 tons, $30,870, in 1929; 3,603 tons, $22,918, in 1930; and 4,502 tons, $37,816, in 1931; and "Plaster, calcined, and manufactures, n. e. s.," 16,423 tons, $392,984, in 1928; 24,579 tons, $481,316, in 1929; 20,008 tons, $397,810, in 1930; and 6,773 tons, $196,724, in 1931.

[2] Exports of wall board were as follows: 9,531,453 square feet, valued at $243,578, in 1927; 15,216,727 square feet, $403,227, in 1928; 18,420,455 square feet, $442,983, in 1929; 16,677,518 square feet, $431,072, in 1930; and 6,386,649 square feet, $157,897, in 1931.

REVIEW OF GYPSUM INDUSTRY [3]

There were few major developments in the gypsum industry during 1931.

The United States Gypsum Co. installed natural-gas burners at its Fort Dodge (Iowa) plant and a 40-ton tube mill at its Alabaster (Mich.) plant. Tests have been conducted at the latter plant during the past two years on the practicability of producing white-plaster products and terra alba for the paper trade. It was reported that this company built a gypsum wall-board plant at Midland, Calif., during the early part of 1931. The company now has an investment of more than $500,000 at Midland, which includes a mine, mining machinery, power plant, reduction mill, fertilizer plant, and many homes for workmen. About 50 men are employed.

The Best Bros. Keenes Cement Co. was building a new plant at Sun City, Kans. In the past the rock was transported from quarry to plant by aerial tramway; but with the completion of the Santa Fe switch the railroad will be used exclusively, making it possible to handle a much larger volume. The company abandoned its quarry during the year and confined all production to a single-level room-and-pillar mine.

The Arizona Gypsum Plaster Co. opened a new opencut mine acquired during 1931. It was also reported that during the latter part of the year final arrangements were made to open a quarry 20 miles west of Westmoreland, Imperial County, Calif.

The Great White Sands Gypsum Co., incorporated in Delaware for $500,000, expects to begin operation some time early in 1932, utilizing the gypsum sands in the Tularosa Desert 12 miles west of Alamogordo, N. Mex. These sands were first worked in 1908 by the White Sands Co.; in 1916 the name was changed to National Cement Plaster Co., but no subsequent production was reported by the new owners.

[3] Compiled principally from Rock Products and Pit and Quarry.

A group of southeastern New Mexico contractors will open a plant at Acme, N. Mex., to manufacture about 25 tons of plaster daily. The plant will cost about $15,000 and employ 15 to 18 men.

The Rockwood Co., a nonprimary producer of gypsum products, started a new "Rockwood" gypsum-lumber plant in the Los Angeles district. The cost of the new plant was estimated at approximately $100,000 and the initial capacity at about 200 tons per day. Work has been stopped, however, due to the general financial situation.

Fire did considerable damage to gypsum plants during the year. The plant at Sigurd, Utah, owned and operated by the Jumbo Plaster & Cement Co., was totally destroyed, representing a loss of $500,000. The Universal Gypsum & Lime Co. suffered a loss by fire at its Fort Dodge (Iowa) plant. A fire caused considerable damage to the New Brighton (Staten Island, N. Y.) plant of the United States Gypsum Co.; this company also partly lost its repair shop at Fort Dodge, Iowa, by fire. The plant of the Certain-teed Products Corporation at Laramie, Wyo., which had been idle since July, 1931, was destroyed by fire in December. The value of the plant was estimated at $100,000.

RESEARCH ACTIVITIES AND NEW PRODUCTS

Much of the energy expended by the gypsum industry during the year was directed toward active research in developing new products and broadening the field of usefulness of old products. One company alone developed at least three times as many new products in 1931 as in any previous year. The following new items, among others, were brought out during the year by various companies: (1) A product of unusual hardness used for mastic floors; (2) tongue-and-groove floor tile upon which any form of floor topping may be used; (3) a plaster board faced with real wood veneer for paneling; and (4) an insulating tile board. One company also brought out a panel plaster board covered with either wood veneer or printed paper to resemble wood. The tonnages of these new products, except panel plaster board, were of minor importance. A large potential market, however, was opened for finely ground crude gypsum and dead-burned gypsum. These materials are used as fillers in paper, and it is estimated that the paper industry affords a potential outlet for approximately 500,000 tons annually. One company has been furnishing this market with varying amounts for the past 20 years.

WORLD PRODUCTION

The following table shows the output of gypsum by various countries from 1927 to 1931, as far as statistics are available.

World production of gypsum, 1927–1931, by countries, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Algeria	74, 512	79, 874	107, 221	169, 474	(2)
Argentina [3]	52, 111	41, 606	36, 630	49, 458	(2)
Australia:					
New South Wales	1, 506	12, 761	10, 585	2, 914	1, 766
South Australia	95, 356	93, 004	97, 148	41, 482	24, 596
Victoria	21, 169	10, 728	13, 407	(4)	(2)
Western Australia	6, 782	4, 282	5, 374	1, 606	226
Austria [5]	40, 000	45, 000	43, 000	37, 350	48, 000
Canada	1, 003, 073	1, 189, 895	1, 111, 956	997, 942	(6)
Chile	8, 245	9, 113	15, 434	17, 178	(2)
China	45, 220	[7] 50, 000	[7] 50, 000	[7] 50, 000	[7] 50, 000
Cuba	(2)	23, 950	25, 400	27, 200	(2)
Cyprus [8]	15, 393	11, 609	12, 757	10, 452	9, 934
Egypt [7]	130, 000	130, 000	130, 000	130, 000	130, 000
Estonia	12, 172	7, 982	8, 093	1, 963	7, 851
France	2, 073, 000	2, 202, 730	2, 558, 050	(4)	(2)
Germany:					
Bavaria	59, 772	54, 482			
Prussia	538	452	[9] 845, 000	[9] 705, 000	[9] 490, 000
Other States	(2)	(2)			
Greece	2, 014	-----	-----	1, 365	(2)
India, British	38, 717	59, 998	53, 572	57, 220	(2)
Italy	673, 931	640, 587	683, 755	685, 530	587, 845
Japan	75, 498	68, 515	(4)	(4)	(2)
Latvia [10]	24, 463	28, 020	26, 875	35, 272	31, 431
Luxemburg	7, 848	2, 506	7, 206	10, 619	9, 263
New Caledonia	10, 000	15, 000	7, 116	3, 131	(2)
Palestine	1, 158	1, 341	1, 499	1, 661	491
Peru	13, 225	20, 148	[11] 15, 299	[11] 14, 000	(2)
Poland	(2)	(2)	(2)	40, 000	24, 000
Rumania	77, 724	47, 785	76, 625	51, 252	(2)
Russia [12]	283, 002	411, 365	(4)	(4)	(2)
Spain	911, 346	1, 054, 018	975, 662	1, 582, 604	(2)
Sweden	89	116	122	(4)	(2)
Tunisia	16, 000	16, 000	19, 540	20, 000	(2)
Union of South Africa	15, 430	14, 871	17, 245	17, 098	14, 847
United Kingdom:					
Great Britain	514, 364	644, 831	981, 566	851, 468	767, 011
Northern Ireland	113	17	1, 453	193	(2)
United States	4, 850, 590	4, 628, 659	4, 550, 535	3, 149, 178	2, 321, 489
Yugoslavia [13]	1, 063	1, 170	2, 340	1, 463	771
	11, 200, 000	11, 600, 000	13, 000, 000	11, 700, 000	(2)

[1] Gypsum is also produced in Switzerland where large beds are privately worked, but no statistics are available.
[2] Data not available.
[3] Rail and river shipments.
[4] Data not available; estimate included in world total.
[5] Estimate furnished by Bundesministerium für Handel und Verkehr.
[6] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 775,030 tons.
[7] Approximate production.
[8] Exports of crude and calcined gypsum.
[9] Figures supplied by Engineer Louis Martin, manager, Bauberatungstelle der deutschen Gips-Industrie e. v., Arnstadt, Germany.
[10] Exports.
[11] Sales and shipments.
[12] Year ended Sept. 30.
[13] Serbia only.

CANADA

The production (shipments) of gypsum in Canada in 1931 amounted to 854,329 short tons, valued at $2,099,381, and comprised the following items: Lump or run-of-mine, 28,638 tons, valued at $69,085; crushed, 702,684 tons, valued at $813,421; fine ground, 4,584 tons, valued at $22,056; and calcined, 118,423 tons, valued at $1,194,819. The total output decreased 20 per cent in quantity and 26 per cent in value in 1931; the unit value decreased from $2.63 in 1930 to $2.46 in 1931.

In 1931 Nova Scotia accounted, as usual, for the larger part of the Canadian output, shipping 698,394 short tons, valued at $866,517 (82 per cent of the total quantity and 41 per cent of the total value of all shipments). New Brunswick replaced Ontario as the second largest producer, its shipments during 1931 amounting to 58,957 tons, valued at $451,264 (7 per cent of the total quantity and 22 per cent of the total value). Shipments of gypsum from Ontario during 1931 were the smallest since 1918, amounting to 53,358 tons, valued at $374,469 (6 per cent of the total quantity and 18 per cent of the total value). Shipments from Manitoba declined sharply to 23,076 tons, valued at $231,124 (3 per cent of the total quantity and 11 per cent of the total value), and those from British Columbia to 20,544 tons, valued at $176,007 (2 per cent of the total quantity and 8 per cent of the total value).

In 1931 Canada exported 618,765 short tons of gypsum, valued at $741,376 (72 per cent of the total quantity shipped and 35 per cent of the total value), decreases of 100,616 tons and $130,191 compared with 1930. Except for about 22,500 tons exported from New Brunswick, Nova Scotia furnished virtually all the crude gypsum exported.

The following table shows the trade of Canada in crude gypsum and calcined gypsum products in 1929 to 1931.

Gypsum trade in Canada, 1929–1931 [1]

	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Production (shipments):						
By classes—						
Crude—						
Lump or run-of-mine	44,848	$90,071	56,628	$116,401	28,638	$69,085
Crushed	964,875	1,147,289	845,210	973,623	702,684	813,421
Fine ground	2,201	17,271	8,160	38,894	4,584	22,056
Calcined	199,765	2,091,065	160,970	1,689,870	118,423	1,194,819
	1,211,689	3,345,696	1,070,968	2,818,788	854,329	2,099,381
By Provinces—						
Nova Scotia	948,895	1,152,160	827,063	982,287	698,394	866,517
New Brunswick	70,482	485,982	82,674	513,677	58,957	451,264
Ontario	100,347	832,689	94,946	776,069	53,358	374,469
Manitoba	67,269	631,051	34,157	298,297	23,076	231,124
British Columbia	24,696	243,814	32,128	248,458	20,544	176,007
	1,211,689	3,345,696	1,070,968	2,818,788	854,329	2,099,381
Imports:						
Crude gypsum	1,244	18,671	898	25,882	484	13,491
Ground, not calcined	165	5,283	219	5,352	158	4,476
Calcined	16,356	189,438	16,608	190,832	11,050	120,516
	17,765	213,392	17,725	222,066	11,692	138,483
Exports:						
Crude gypsum	893,445	1,086,939	719,381	871,567	618,765	741,376
Plaster of Paris, prepared wall plaster	7,938	137,046	7,281	119,092	3,086	50,774
	901,383	1,223,985	726,662	990,659	621,851	792,150

[1] Preliminary Report on the Mineral Production of Canada, Ottawa.

NOTES ON CANADIAN INDUSTRY

Several new plants were put into operation in Canada during 1931. The Canadian Gypsum Co. (Ltd.) purchased a gypsum property at Willow Grove, Ontario, and began immediate construction of a plaster mill, board plant, mill office, and warehouse. This company is the Canadian subsidiary of the United States Gypsum Co. Plans were consummated during the latter part of the year by the United States Gypsum Co. for the construction of a plant at Wentworth, Nova Scotia, for the manufacture of gypsum products. This same company, through its subsidiary, completed a gypsum-products plant at Hagersville, Ontario. This plant will produce gypsum tile, plaster board, and wall board. In September, 1930, the Canadian Gypsum Co. (Ltd.) purchased the mines, quarries, plants, and property of the Albert Manufacturing Co., Hillsborough, New Brunswick. A modern wall-board plant of considerable size was erected during the winter months and began the manufacture of wall board and lath during the early part of 1931.

In Canada, as in the United States, companies spent considerable time and effort in developing new products. Gypsum, Lime & Alabastine, Canada (Ltd.) placed several new products on the market during the year, including a gypsum wall board with wood-grain veneer, two new acoustic tiling materials, and an insulating material involving new structural principles. These products are to be made at South Westminster, British Columbia; Montreal, Quebec; and Caledonia, Ontario.

The Standard Gypsum Co. of Canada announced it will erect a new plaster mill at Vancouver costing approximately $1,000,000. Two sites on the water front are under consideration. Construction is to start early in 1932. Whether the new plant will be supplied with raw material from the affiliated mines in Lower California has not yet been announced.

ASBESTOS [1]

By Oliver Bowles and B. H. Stoddard

CONTENTS

GENERAL CONDITIONS

Lessened demand and declining prices prevailed in the market for domestic unmanufactured asbestos in 1931, as in 1930. As prices were low and demand was limited, production of crude chrysotile in Arizona was greatly curtailed. Total imports of unmanufactured asbestos into the United States in 1931 decreased nearly 35 per cent in quantity and 47 per cent in value compared with 1930. As in 1930, Canada supplied over 95 per cent of the total; the remainder was furnished principally by Russia (2.8 per cent) and Africa (0.98 per cent).

GRADES

The highest grades of chrysotile asbestos, known as crude fibers, are hand cobbed and not passed through crushers or mills. Crudes and some of the highest-grade mill fibers provide material for spinning. Mill stock is obtained by crushing asbestos-bearing rock, passing it through beaters, and removing fibers by screening and air separation. The product is graded and classified according to length, because both uses and price per ton are governed by length of fiber. Canadian fiber is graded in a standard testing machine that consists of four boxes, three with screen bottoms. The top screen is 2-mesh, 11-gage; the second, 4-mesh, 17-gage; and the third, 10-mesh, 20-gage. The fourth or lowest box retains the finest materials. Sixteen ounces of asbestos are placed in the top box, and the entire set is shaken two minutes at 300 revolutions per minute on a machine with a ¾-inch eccentric. The residue in each box is weighed, and the fibers are graded by the amount that remains in each box. The longer the fiber the larger the proportion in the upper boxes. Fibers designated 2–8–4–2 show 2 ounces in the upper pan, 8 ounces in the second, 4 ounces in the third, and 2 ounces passing through all the screens.

For many years each Canadian company sold its products under its own trade designations. In 1931 Canada placed her products on a higher marketing basis by establishing a uniform classification. The nine classes agreed upon by the Quebec producers follow.

[1] Work on manuscript completed August, 1932.

New classification of Canadian asbestos

Group	Standard designation	Definition
1	Crude No. 1	Crude fiber ¾ inch or longer.
2	Crude No. 2, run-of-mine, and sundry crudes.	Crudes consisting chiefly of fiber ⅜ to ¾ inch.
3	Spinning or textile fiber	Mill fiber testing 0-8-6-2 and over.
4	Shingle fiber	Mill fiber testing below 0-8-6-2 and including 0-1½-9½-5.
5	Paper fiber	Mill fiber testing below 0-1½-9½-5 to and including 0-0-8-8.
6	Waste, stucco, or plaster	Mill fiber testing below 0-0-8-8 and above 0-0-5-11.
7	Refuse and shorts	Mill fiber testing 0-0-5-11 and below, including material testing below 0-0-1-15 if it weighs 35 pounds or less per cubic foot, loose measure.
8	Sand	Fine asbestos and rock weighing 35 to 75 pounds per cubic foot, loose measure.
9	Gravel and stone	Mill products weighing 75 pounds or more per cubic foot, loose measure.

Mill fibers, including groups 3 to 8, are divided into 36 subgrades, which are fully defined in a recent report by Dufresne and Larochelle.[2] Benefits expected from the new classification will be realized only if operators adhere to it strictly; for if they accept it in theory only and continue making sales under old trade designations, the desired objective will not be attained.

PRODUCTION

In 1931 five States—Arizona, Georgia, Maryland, Vermont, and Washington—produced the total commercial output of asbestos in the United States. The production from Arizona and Vermont was the chrysotile variety and that from the other States amphibole. Vermont ranked first in order of output, Georgia second, and Arizona third.

The quantity and value of asbestos sold or used by producers in the United States, 1927–1931, by varieties, are shown in the following table.

Asbestos sold or used by producers in the United States, 1927–1931, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	(1)	(1)	(1)	(1)	2,981	$336,882
1928	(1)	(1)	(1)	(1)	2,239	351,178
1929	1,983	$317,584	1,172	$33,420	3,155	351,004
1930	3,653	273,292	589	15,992	4,242	289,284
1931	2,857	111,708	371	7,259	3,228	118,967

[1] Bureau of Mines not at liberty to publish figures.

REVIEW BY STATES

Arizona.—Two producers contributed the total commercial output of asbestos (chrysotile) in Arizona in 1931—the Arizona Asbestos Association (subsidiary of Johns-Manville Corporation) at Chrysotile and the Bear Canyon Asbestos Co. at Globe. As the Bear Canyon mine has been closed since April, 1930, the shipments of this company in 1931 were from stock on hand.

[2] Dufresne, A. O., and Larochelle, Eugène, The Classification of Canadian Chrysotile Asbestos: Canadian Min. and Met. Bull. 240, April, 1932, pp. 224–232.

Georgia.—The shipments of mass fiber anthophyllite (amphibole) in Georgia were made by the Clayton Paving Co., 220 Capitol Boulevard, Nashville, Tenn., from stock on hand. The company's property near Helen, White County, was not operated in 1931.

Maryland.—High-grade long and short fibered anthophyllite suitable for chemical filters was produced in Maryland by the Powhatan Mining Corporation, Woodlawn, Baltimore, from the Jenkins mine near Pylesville.

Vermont.—The Vermont Asbestos Corporation, 82 Devonshire Street, Boston, Mass., which began operations in 1929 at its property in Lamoille County near Hyde Park, marketed six grades of mill fiber in 1931.

Washington.—One operator, the Asbestos-Talc Products of Washington (Inc.), Burlington, reported the use of several tons of asbestos from the company's property at Burlington in the manufacture of insulating, building, and roofing products.

FOREIGN SOURCES OF SUPPLY OF SPINNING ASBESTOS

Although the United States leads all other countries in the manufacture of asbestos products, it produces only about 2 per cent of its requirements of raw material; therefore, foreign supplies of fiber have very great importance. Canada continues to be the leading source of short fibers. For many years it supplied nearly all the spinning fiber used in the United States, but imports from Africa and Russia have assumed increasing importance.

The following table of imports, covering 20 years, indicates trends in foreign sources of supply. It is important to note that the table has no reference to short fibers.

Sources of spinning asbestos imported into the United States, 1912–1931 [1]

Year	Canada		Africa		Russia	
	Short tons	Per cent of total imports	Short tons	Per cent of total imports	Short tons	Per cent of total imports
1912	6,028	99	9	(2)	82	1
1913	13,537	99	1	(2)	187	1
1914	8,707	99			83	1
1915	12,096	100			1	(2)
1916	13,224	93	1,184	7		
1917	15,814	87	2,583	13		
1918	14,622	85	2,886	15		
1919	14,947	92	1,606	8		
1920	14,608	78	4,563	22		
1921	4,515	84	983	16	11	(2)
1922	7,572	82	1,822	18		
1923	14,265	78	3,995	21	148	1
1924	11,539	80	3,051	20	56	(2)
1925	16,524	79	4,390	20	191	1
1926	17,305	78	4,747	20	349	2
1927	14,065	65	6,096	27	1,782	8
1928	13,255	61	6,778	29	2,339	10
1929	16,997	64	8,777	31	1,426	5
1930	9,014	55	3,621	19	4,926	26
1931	7,065	62	2,290	19	2,325	19

[1] Most of the figures for tonnage are approximate only. Methods of determination are indicated in the following text.
[2] Less than one-half of 1 per cent.

For the purpose of the foregoing calculation Canadian spinning fiber includes crude No. 1, crude No. 2, crude run-of-mine, and the highest grade of mill fiber, which since 1920 has been designated "spinning fiber." Definite figures for production of Canadian asbestos by grades are published annually; and in the absence of similar figures for exports to the United States, it seems reasonable to assume that these were practically in the same proportions as the production. In other words, if 85 per cent of the total Canadian production was imported into the United States, it was assumed that 85 per cent of the spinning fibers produced in Canada was shipped to the United States.

As very little except spinning fiber is obtained from other foreign sources, approximately all imports from the more remote countries are regarded as such; however, Russian imports in 1931 were separated into crudes and mill fibers, the latter being regarded as nonspinning. Imports from Africa include not only those direct from African ports, but also those from the United Kingdom, the Netherlands, Belgium, and France because most of them probably originated in Africa. Imports listed as derived from Russia include shipments from Germany as well as those credited in the import statistics as shipped direct from Russia.

Some foreign fibers designated as crudes—for example, part of the blue asbestos and Russian fibers—are used for nonspinning purposes, but the amount is difficult to determine. Similarly, some Canadian asbestos classed as spinning fiber may be used for nonspinning purposes. In either case, however, the amounts are small, compared with the totals, and they offset each other to some extent. Although the foregoing table is to be regarded as an approximation only, it is accurate enough to indicate general movements in the spinning-asbestos trade and to show the relation of imports from each country to total supply.

Data in the table show that the past 20 years may be divided into three periods. During the first period—1912 to 1915, inclusive—Canada had a monopoly on exports to the United States. In fact, this condition had existed for many years. Russia had assumed some importance but ceased to be a source of supply during and for several years after the World War. During the second period—1916 to 1926, inclusive—Africa (first the Union of South Africa and later both Rhodesia and the Union of South Africa) were keen competitors of Canada for American trade. In the third period—beginning in 1927 and continuing through 1931—a 3-cornered struggle began with Russia, Africa, and Canada competing for the trade of the United States. The sudden and pronounced increase in imports from Russia is the most notable trend during this period.

MARKET CONDITIONS

Asbestos prices were low in 1931. Crude No. 1, quoted at $350 to $400 a ton in December, 1930, dropped to between $250 and $300 in January, 1931, but increased to $400 a ton before the end of the year. Crude No. 2, quoted at $250 to $275 in December, 1930, dropped to $200 a ton in January, 1931, and did not recover throughout the year. Shingle and cement stock maintained prices equivalent to those quoted late in 1930, but the price of paper stock in 1931 was much lower than in 1930. With building and automobile manufacture far below normal, the asbestos market was sluggish, and the volume of materials moved was exceptionally small.

OUTSTANDING EVENTS

The automobile industry continues to be the most important outlet for asbestos and its products. Free wheeling calls for more asbestos per car because brakes are larger. Molded brake linings are widely used, and the shorter grade of fiber that may be employed in making them has reduced the field for spinning asbestos. Recent announcements note the use of an asbestos compound in the manufacture of automobile bodies.

In England a conveyor belt with an asbestos-cloth surface has been developed for carrying hot clinker at cement plants and for conveying other high-temperature materials. Application of asbestos-cement coating to the surface of wall board for both heat insulation and fireproofing is a new use that promises greater consumption of short fibers.

Technical developments may have future importance, but they are now entirely overshadowed by world-wide business inactivity which has virtually paralyzed asbestos production in nearly every district. As may be noted in the following discussion of the industry by countries, several important production centers have registered unprecedented decreases in output. The introduction of a new classification of Canadian asbestos, described on page 205, is significant, for it may be interpreted as a defensive measure reflecting the pressure of African and Russian competition.

IMPORTS AND EXPORTS [3]

The total quantity of unmanufactured asbestos imported into the United States in 1931 was nearly 43 times the marketed production of asbestos in the United States during that year. About 95 per cent of the total amount imported came from Canada, most of it short-fibered chrysotile.

The following table shows the tonnage and value of unmanufactured asbestos imported for consumption in the United States over a number of years.

Asbestos (unmanufactured) imported for consumption in the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	223, 693	$8, 150, 340	1930	208, 681	$7, 064, 824
1928	230, 595	9, 017, 891	1931	136, 361	3, 749, 340
1929	262, 427	11, 153, 017			

In the following table of general imports into the United States in 1931 the countries listed are those from which the asbestos was last shipped; they are not always those in which the asbestos was produced. Asbestos shipped from Germany is chiefly of Russian origin, and that shipped from the United Kingdom is from Rhodesia or the Union of South Africa.

[3] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Asbestos (unmanufactured) imported into the United States in 1931, by countries and classes

[General imports]

Country	Crude (including blue fiber)		Mill fiber		Stucco and refuse		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Africa:								
British—Union of South Africa	823	$94, 110					823	$94, 110
Portuguese—Mozambique	514	95, 239					514	95, 239
Canada	552	130, 262	46, 788	$1, 993, 484	82, 767	$1, 108, 936	130, 107	3, 232, 682
China	1	280					1	280
Germany	108	10, 633	2	67			110	10, 700
Italy	19	9, 855			27	315	46	10, 170
Soviet Russia in Europe	2, 188	104, 271			1, 619	35, 423	3, 807	139, 694
United Kingdom	953	166, 465					953	166, 465
	5, 158	611, 115	46, 790	1, 993, 551	84, 413	1, 144, 674	136, 361	3, 749, 340

Asbestos (unmanufactured) exported from the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	309	$48, 774	1930	771	$95, 318
1928	850	346, 632	1931	1, 714	122, 391
1929	709	108, 467			

Manufactured asbestos products exported from the United States, 1930 and 1931, by grades

Grade	1930		1931	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded [1]	[2] 6, 716, 521	$1, 372, 068	(3)	$419, 763
Not molded [1] linear feet			3, 791, 500	720, 360
Paper, millboard, and roll board short tons	959	153, 232	635	125, 833
Pipe covering and cement do	3, 332	426, 573	1, 050	119, 810
Textile yarn and packing do	892	949, 116	636	662, 030
Magnesia and manufactures do	3, 422	454, 408	1, 453	200, 543
Asbestos roofing squares	65, 743	393, 036	26, 556	109, 767
Other manufactures, except roofing short tons	2, 389	445, 077	1, 196	248, 060

[1] Not separately recorded prior to 1931.
[2] Linear feet. Weight not recorded.
[3] Quantity not recorded.

WORLD PRODUCTION

World production of asbestos, 1927–1931, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
Africa:					
Portuguese East Africa				[2] 16	(3)
Southern Rhodesia	30,097	36,251	38,677	34,260	21,810
Union of South Africa	20,085	21,821	29,970	17,491	14,221
Argentina [4]	1				(3)
Australia:					
New South Wales					8
South Australia			1		6
Western Australia	11	12	259	144	116
Canada [5]	249,273	247,690	277,647	219,641	149,047
China	241	(3)	(3)	(3)	(3)
Cyprus [2]	11,079	11,765	14,017	5,487	3,628
Finland	1,298	1,462	1,563	1,188	581
France	803	730	750	(3)	(3)
India, British	69	159	324	34	(3)
Italy	3,840	4,950	2,847	851	632
Japan [6]	1,000	1,000	1,000	1,000	1,000
Russia [7]	21,156	26,492	29,520	56,900	(3)
United States	2,704	2,031	2,862	3,848	2,928

[1] In addition to the countries listed, Bolivia, Brazil, and Madagascar are reported to produce small quantities of asbestos. Statistics of production are not available for Bolivia and Brazil, but exports reported are considerably less than a ton. Production in Madagascar is reported as follows: 1927, 23 kilograms; 1928, 108 kilograms; 1929, 545 kilograms.
[2] Exports.
[3] Data not available.
[4] Rail and river shipments.
[5] Exclusive of sand and gravel, the production of which is reported as follows: 1927, 18,398 tons; 1928, 20,672 tons; 1929, 17,215 tons; 1930, 36,949 tons; 1931, 6,540 tons.
[6] Approximate production.
[7] Year ended Sept. 30.

NOTES ON PRODUCTION IN FOREIGN COUNTRIES

CANADA

Canadian production declined greatly in 1931; the tonnage of asbestos sold, exclusive of by-product sand and gravel, was 32 per cent less than in 1930. Marketed production in 1930 was 21 per cent below that in 1929. The decline in value was even more pronounced; in 1931 the value decreased 43 per cent from that in 1930, which in turn was 36 per cent below that in 1929. The tonnage was the smallest since 1922 and the value the smallest since 1915.

Production figures for Quebec in 1931, taken from the preliminary report of the Quebec Bureau of Mines, are quoted in the following table.

Production of asbestos in the Province of Quebec for 1931

Designation of grade [1]	Shipments and sales		Average value per ton	Stocks on hand Dec. 31, 1931	
	Short tons	Value		Short tons	Value [2]
Crude No. 1	206	$88,880	$431.46	298	$128,575
Crude No. 2	543	117,478	216.35	3,169	685,613
Other crudes			132.00	69	9,108
Spinning fiber	8,560	917,776	107.22	10,289	1,103,187
Shingle fiber	15,988	938,856	58.72	10,270	603,054
Paper fiber	39,867	1,381,888	34.66	9,327	323,274
Waste, stucco, or plaster	6,310	159,044	25.20	247	6,224
Refuse or shorts	92,823	1,208,964	13.02	12,604	164,104
Total	164,297	4,812,886	29.29	46,273	3,023,139
Sand, gravel, and stone (waste rock only)	7,209	5,952	.83		
Total	171,506	4,818,838			

[1] The designation of grades is according to the recently adopted classification of Canadian chrysotile asbestos.
[2] Values calculated at average price of each grade. These figures are given merely as a guide to approximate valuation of stocks on hand.

Quantity of rock mined during the year 1931, 2,274,048 tons.
Quantity of rock milled during the year 1931, 2,164,060 tons.

The Dominion Bureau of Statistics reports in addition a production in Ontario of 35 tons of actinolite, valued at $456.

AFRICA

Rhodesia.—In 1931 Rhodesian production fell 36 per cent in tonnage and 64 per cent in value below the 1930 figure. Work was confined principally to the Shabani area, where the grade of ore is higher than at Mashaba; but activity was curtailed because stocks on hand were very large. Turner & Newall (Ltd.), who practically controls the production, has placed all mines in the Shabani area under one management. The profits of this company were reduced from 11¼ per cent in 1930 to 5 per cent in 1931, but the company is in a strong financial position. The following table shows Rhodesian production for 10 years.

Asbestos produced in Rhodesia, 1922–1931

Year	Short tons	Value	Year	Short tons	Value
1922–1926 (average)	25,689	£660,244	1929	42,634	£1,186,627
1927	33,176	794,215	1930	37,765	1,070,847
1928	39,960	970,327	1931	24,042	386,493

Union of South Africa.—Reduced market demands complicated by exchange difficulties have led to a pronounced reduction in output of asbestos in the Union of South Africa.

The following table gives production for nine years.

Asbestos produced in the Union of South Africa, 1923–1931

Year	Short tons				Total value
	Transvaal	Cape Province	Natal	Total	
1923–1927 (average)	8,672	3,736		12,408	£188,682
1928	18,976	5,078		24,054	399,550
1929	26,984	6,030	23	33,037	497,393
1930	13,800	5,481		19,281	340,795
1931	12,025	3,651		15,676	246,583

The following table shows the relative importance of the different varieties of asbestos produced.

Asbestos produced in the Union of South Africa, 1929–1931, by varieties

	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Amosite (Transvaal)	9,260	£98,241	3,281	£36,885	2,087	£20,608
Chrysotile (Transvaal)	17,724	247,817	10,519	160,381	9,938	125,439
Chrysotile (Natal)	23	340				
Blue (Cape)	6,030	150,995	5,481	143,529	3,651	100,536
	33,037	497,393	19,281	340,795	15,676	246,583

OTHER COUNTRIES

Cyprus.—Marketed production of short-fibered chrysotile in Cyprus continued to decline. As reported by the Cyprus Trading Corporation (Ltd.), sales in 1931 amounted to only 1,137 long tons. According to a statement by the Government of Cyprus, exports totaled 3,571 long tons.

Russia.—Figures for production of asbestos in Russia during 1931 are not available; but exports reached 13,239 metric tons, valued at 2,485,000 rubles, compared with 15,749 metric tons, valued at 4,417,000 rubles, in 1930,[4] a decrease of 16 per cent in quantity and 44 per cent in value. Production in 1930 was reported as 56,900 metric tons.

[4] Economic Review of the Soviet Union, vol. 7, No. 11, June 1, 1932, p. 263.

ASPHALT AND RELATED BITUMENS [1]

By A. H. Redfield [2]

CONTENTS

SUMMARY TABLES

Supply and distribution of asphalt and related bitumens in the United States, 1928–1931, in short tons

	1928	1929	1930	1931
SUPPLY				
Native asphalt and related bitumens:				
Produced	807, 860	804, 027	702, 777	503, 383
Imported (chiefly lake asphalt)	119, 588	121, 019	53, 197	73, 672
Petroleum asphalt (excluding road oil):				
Produced at refineries from—				
Domestic petroleum	[a] 1, 321, 544	[a] 1, 582, 997	[a] 1, 403, 552	1, 274, 744
Foreign petroleum	2, 156, 172	2, 247, 460	1, 824, 089	1, 700, 946
	[a] 3, 477, 716	[a] 3, 830, 457	[a] 3, 227, 641	2, 975, 690
Stocks, Jan. 1	277, 197	255, 215	276, 690	287, 891
Total supply	[a] 4, 682, 361	[a] 5, 010, 718	[a] 4, 260, 305	3, 840, 636
DISTRIBUTION				
Native asphalt and related bitumens:				
Indicated domestic demand	781, 597	757, 065	679, 617	484, 406
Exports (unmanufactured)	26, 263	46, 962	23, 160	18, 977
Petroleum asphalt (excluding road oil):				
Indicated domestic demand (including lake asphalt)	[a] 3, 126, 924	[a] 3, 450, 597	[a] 2, 859, 248	2, 744, 531
Exports	492, 362	479, 404	410, 389	288, 099
Stocks, Dec. 31	255, 215	276, 690	[a] 287, 891	304, 623
Total distribution	[a] 4, 682, 361	[a] 5, 010, 718	[a] 4, 260, 305	3, 840, 636

[a] Revised figures.

[1] Work on manuscript completed September, 1932.
[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Values of principal items of asphalt and related bitumens industry in the United States, 1928–1931

	1928	1929	1930	1931
Native asphalt and related bitumens:				
Sales	$5,175,055	$5,470,493	$4,463,092	$2,930,451
Imports (chiefly lake asphalt)	865,046	955,606	457,172	726,217
Exports (unmanufactured)	683,563	1,133,058	628,673	530,822
Petroleum asphalt:				
Sales (excluding road oil) from—				
Domestic petroleum	[1] 17,103,900	[1] 17,895,560	[1] 15,159,979	10,855,688
Foreign petroleum	28,633,563	25,661,639	19,462,053	14,005,651
Total sales	[1] 45,737,463	[1] 43,557,199	[1] 34,622,032	24,861,339
Exports	9,788,501	8,542,975	7,277,032	4,940,611
Road oil:				
Sales from—				
Domestic petroleum	4,425,329	5,907,992	5,691,375	5,758,906
Foreign petroleum	1,423,303	1,396,229	1,719,414	1,185,414
Total sales	5,848,632	7,304,221	7,410,789	6,944,320

[1] Revised figures.

NATIVE ASPHALTS AND BITUMENS

BITUMINOUS ROCK

SALES

Sales of bituminous rock by producers in the United States were 29.2 per cent less in quantity and 37.1 per cent less in value in 1931 than in 1930. Kentucky and Texas furnished 82.9 per cent of the total tonnage sold in 1931, compared with 86. 5 per cent in 1930. Producers in Alabama, California, Oklahoma, Utah, and New Mexico sold minor amounts in 1931. Producers of rock asphalt in central Kentucky decreased their sales 47.2 per cent in quantity and 49.6 per cent in value in 1931. At the same time, sales of limestone rock asphalt quarried in southwestern Texas decreased 15.2 per cent in quantity and 14.5 per cent in value.

Native asphalt and related bitumens sold at mines in the United States, 1930 and 1931, by varieties and by States

[Value f. o. b. mine]

	1930		1931	
	Short tons	Value	Short tons	Value
Bituminous rock:				
Kentucky	305,024	$2,374,834	161,202	$1,197,620
Texas	270,138	825,460	228,956	705,437
Other States [1]	89,709	366,301	80,333	341,682
Total bituminous rock	664,871	3,566,595	470,491	2,244,739
Gilsonite: Utah	37,684	863,197	32,763	674,102
Wurtzilite: Utah	222	33,300	129	11,610
Grand total	702,777	4,463,092	503,383	2,930,451

[1] 1930: Alabama, California, Oklahoma, and Utah; 1931: Alabama, California, New Mexico, Oklahoma, and Utah.

DOMESTIC DEMAND

The indicated domestic demand for natural rock asphalt, calculated by subtracting exports from the total sales of natural rock asphalt, decreased from 641,711 short tons in 1930 to 451,514 tons in 1931. In several States, although more mileage of highway was built in 1931 than in 1930, expenditures were largely for lower-cost types of construction to permit spending the greater part of the available funds directly for providing employment.

EXPORTS

Exports of native asphalt and bitumen, chiefly natural rock asphalt, from the United States decreased 18.1 per cent in quantity and 15.6 per cent in value from 1930 to 1931. Decreased shipments of native asphalt to Canada, Mexico, Germany, United Kingdom, Spain, and Japan were only partly offset by increased exports to France, Italy, and Netherlands.

Native asphalt and bitumen (unmanufactured) exported from the United States, 1930 and 1931, by countries

Country	1930		1931	
	Short tons	Value	Short tons	Value
Canada	2,769	$67,952	2,332	$56,205
Cuba	197	3,289	2	69
Mexico	1,469	5,950	1,171	5,406
Brazil	22	652	35	801
Chile	18	729	101	2,418
Belgium	363	11,510	308	9,476
France	3,098	113,637	5,891	143,583
Germany	5,524	160,442	2,578	88,620
Irish Free State	34	663	4	120
Italy	550	15,738	825	25,911
Netherlands	384	$11,358	776	$28,573
Spain	676	10,733	176	6,436
United Kingdom	6,253	165,972	2,875	107,142
Japan	691	26,821	514	19,915
Australia	160	4,887	129	3,230
Other countries	952	28,340	1,260	32,917
	23,160	628,673	18,977	530,822

GILSONITE

As a result of lessened activity in building and of lowered demand for paints and varnishes, sales of gilsonite mined in northeastern Utah decreased 13.1 per cent in quantity and 21.9 per cent in value from 1930 to 1931.

WURTZILITE (ELATERITE)

Decreased demand during 1931 in the paint and varnish industry and from manufacturers of insulated electric wire and cables, as well as in the rubber and roofing industries, was reflected in decreased sales of wurtzilite (elaterite) mined in Uintah County, Utah.

PRODUCERS

Production of native asphalts and related bitumens was reported in the United States in 1931 by the following operators:

Alabama Asphaltic Limestone Co., 310 Liberty National Bank Building, Birmingham, Ala.
American Asphalt Association, 919 Wainwright Building, St. Louis, Mo.
Calrock Asphalt Co., 525 Market Street, San Francisco, Calif.
Crown Rock Co., Blymyer Building, Cincinnati, Ohio.
Dixie Minerals Corporation, 702 Empire Building, Pittsburgh, Pa.
Gilson Asphaltum Co., 1600 Arch Street, Philadelphia, Pa.

Kentucky Rock Asphalt Co., 711–718 Marion E. Taylor Building, Louisville, Ky.

Natural Bitumen Products Corporation, 1019 Monadnock Building, San Francisco, Calif.

Natural Rock Asphalt Corporation, 1210 Heyburn Building, Louisville, Ky.

Ohio Valley Rock Asphalt Co., Starks Building, Louisville, Ky.

Raven Mining Co. of Utah, 140 South Dearborn Street, Chicago, Ill.

Santa Rosa Quarries Co., 4080 Galapago Street, Denver, Colo.

D. A. Sattler, Box 285, Carpinteria, Calif.

Texas Rock Asphalt Co., 928 North Flores Street, San Antonio, Tex.

Utah Gilsonite Co., 622 Wainwright Building, St. Louis, Mo.

Utah Rock Asphalt Corporation, 732 Thatcher Building, Pueblo, Colo.

Uvalde Rock Asphalt Co., 510 Frost National Bank Building, San Antonio, Tex.

Western Paving Co., 1519 Petroleum Building, Oklahoma City, Okla.

White's Uvalde Mines, 1901–1909 Alamo National Bank Building, San Antonio, Tex.

WORLD PRODUCTION

The United States continued to lead all other countries in production of bituminous rock; Italy ranked second. Production in the United States was 29.2 per cent lower and that in Italy 15.3 per cent lower in 1931 than in 1930.

Asphalt rock, natural asphalt, and related bitumens produced in the principal producing countries, 1927–1931, in metric tons [1]

[Compiled by M. T. Latus, of the Bureau of Mines]

Country and mineral [2]	1927	1928	1929	1930	1931
ASPHALT ROCK					
Albania	3,283	2,277	2,512	(3)	(3)
Canada (Alberta) [4]	2,455	85	897	1,875	921
Czechoslovakia	----------	586	1,783	669	1,011
France	61,000	65,293	63,693	56,548	57,734
Germany	117,836	158,329	145,341	117,161	(3)
Greece	290	3,173	1,196	1,548	(3)
Italy	356,154	242,300	219,584	224,034	189,783
Netherland East Indies	1,340	1,050	15,030	8,778	2,394
Rumania	30,712	8,875	----------	----------	(3)
Russia [5]	48,378	48,620	(3)	(3)	(3)
Spain	4,514	7,735	9,002	9,480	5,135
Syria and Lebanon	----------	2,000	----------	(3)	(3)
United States	722,206	689,908	679,070	603,158	426,820
Yugoslavia	142	535	61	246	(3)
NATURAL ASPHALT AND RELATED BITUMENS					
Barbados [6]	46	60	51	10	9
Cuba	4,116	13,186	10,695	16,064	(3)
France	14	15	----------	(3)	(3)
Iraq	(3)	(3)	[7] 5,100	[7] 12,200	[7] 12,200
Italy	791	2,178	919	291	750
Peru	892	981	950	(3)	(3)
Poland [8]	736	767	835	902	261
Russia [5] [8]	843	710	(3)	(3)	(3)
Switzerland [9]	36,716	21,321	20,009	17,119	15,331
Syria and Lebanon	----------	----------	60	(3)	(3)
Trinidad	246,017	199,125	223,128	160,393	125,114
United States	38,954	42,967	50,328	34,388	29,839
Venezuela	56,906	48,749	27,915	(3)	28,985

[1] Minerals included are asphalt rock, bituminous rock used for other purposes than the extraction of oil, native asphalt, asphaltite, manjak, and ozokerite. Oil shales, including ichthyolic shale, are not included.

[2] In addition to the countries listed Colombia and Madagascar are reported to produce asphalt and related bitumens, but figures of annual output are not available.

[3] Data not available.

[4] Bituminous sands.

[5] Year ended Sept. 30.

[6] Exports of manjak.

[7] Year ended Mar. 31 of year following that stated.

[8] Ozokerite.

[9] Exports.

MANUFACTURED OR PETROLEUM ASPHALT

GENERAL STATEMENT

Decreased demand, domestic and foreign, for petroleum asphalt and increased imports of lake asphalt and grahamite reduced the 1931 output of petroleum asphalt at United States refineries compared with that in 1930 and during 1931 added to stocks held at refineries. The indicated domestic demand for petroleum and lake asphalt declined 4 per cent from that in 1930. Sales of petroleum asphalt by refineries in the United States decreased 10.7 per cent in quantity and 28.2 per cent in value from 1930 to 1931. Similarly, the tonnage of asphalt (natural, by-product, or petroleum) terminated by Class I railroads in the United States decreased 5.5 per cent from 1930 and 14.9 per cent from 1929.

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1931, by districts

District	Production	Receipts from other sources	Other petroleum products blended	Stocks	
				Dec. 31, 1930	Dec. 31, 1931
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*
East coast	1, 484, 975	6, 955	22, 724	[1] 95, 754	85, 506
Appalachian	122, 349	1, 408	----------	9, 551	19, 922
Indiana-Illinois	426, 087	148	----------	70, 831	89, 039
Oklahoma-Kansas-Missouri	18, 557	----------	569	5, 549	3, 915
Texas:					
Gulf coast	168, 679	1, 227	106	[1] 8, 619	8, 398
Rest of State	----------	----------	----------	[1]	----------
Total Texas	168, 679	1, 227	106	[1] 8, 619	8, 398
Louisiana-Arkansas:					
Louisiana Gulf coast	197, 465	----------	2, 177	[1] 41, 307	27, 311
Northern Louisiana and Arkansas	73, 549	----------	4, 344	7, 983	22, 739
Total Louisiana and Arkansas	271, 014	----------	6, 521	[1] 49, 290	50, 050
Rocky Mountain	11, 608	----------	----------	3, 917	2, 213
California	429, 924	936	12, 577	[1] 44, 380	45, 580
Grand total	2, 933, 193	10, 674	42. 497	[1] 287, 891	304, 623

District	Consumption by companies	Transfers and losses	Sales	
			Quantity	Value
	Short tons	*Short tons*	*Short tons*	
East coast	30, 136	----------	1, 494, 766	$12, 195, 063
Appalachian	653	----------	112, 733	1, 054, 952
Indiana-Illinois	1, 021	14, 103	392, 903	3, 141, 893
Oklahoma-Kansas-Missouri	128	----------	20, 632	190, 076
Texas: Gulf coast	4, 398	5, 951	159, 884	1, 362, 640
Total Texas	4, 398	5, 951	159, 884	1, 362, 640
Louisiana-Arkansas:				
Louisiana Gulf coast	141	----------	213, 497	1, 779, 339
Northern Louisiana and Arkansas	----------	----------	63, 137	447, 157
Total Louisiana and Arkansas	141	----------	276, 634	2, 226, 496
Rocky Mountain	1, 883	109	11, 320	126, 346
California	36, 036	1, 782	404, 419	4, 563, 873
Grand total	74, 396	21, 945	2, 873, 291	24, 861, 339

[1] Revised figures.

REFINERY PRODUCTION

The refinery production of petroleum asphalt (exclusive of road oil) in 1931 fell 7.8 per cent short of the output in 1930 and 22.3 per cent short of that in 1929. The 1931 figures include 42,497 tons of other petroleum products blended with asphalt to produce the required commercial grades.

The Gulf coast and California showed the principal decreases in production. On the other hand, the asphalt production of the Appalachian refineries nearly trebled. East coast refineries produced virtually the same tonnage in 1931 as in 1930.

Asphalt (exclusive of road oil) produced at petroleum refineries in the United States, 1930 and 1931, by districts, in short tons [1]

District	1930	1931
East coast	1,506,900	1,507,699
Appalachian	44,805	122,349
Indiana-Illinois	485,891	426,087
Oklahoma-Kansas-Missouri	29,743	19,126
Texas:		
Gulf coast	210,305	168,785
Rest of State	239	----------
Total Texas	210,544	168,785
Louisiana-Arkansas:		
Louisiana Gulf coast	312,065	199,642
Northern Louisiana and Arkansas	103,348	77,893
Total Louisiana and Arkansas	415,413	277,535
Rocky Mountain	7,522	11,608
California	[2] 526,823	442,501
Grand total	[2] 3,227,641	2,975,690

[1] These figures, compiled directly from returns made by petroleum refineries producing asphalt, differ from the statistics of asphalt production published in Petroleum Refinery Statistics, 1930 (Bureau of Mines Bulletin 367) chiefly because of the differences in classification. In the monthly and annual refinery statements some of the more liquid products are listed under "All other finished products."
[2] Revised figures.

SOURCE OF RAW MATERIAL

Of the petroleum asphalt manufactured in the United States in 1931, 1,700,946 short tons were made from foreign crude (imported chiefly from Venezuela, Colombia, and Mexico) compared with 1,824,089 tons in 1930 and 2,247,460 tons in 1929. The percentage of the national total made from foreign crude decreased from 58.7 per cent in 1929 to 56.5 per cent in 1930 but increased to 57.2 per cent in 1931.

Of the asphalt made from foreign crude in 1931, 1,432,309 tons (84.2 per cent) were manufactured in refineries of the Atlantic seaboard and 268,637 tons (15.8 per cent) in refineries of coastal Louisiana and Texas. In the East coast district 98.2 per cent of the total asphalt production in 1930 and 95 per cent of that in 1931 were made from foreign crude oil. Of the asphalt produced in Gulf coast refineries 65.9 per cent in 1930 and 72.9 per cent in 1931 were made from foreign raw material.

SEASONAL VARIATION IN MANUFACTURE

In 1931, 63.3 per cent of the annual total production was made in the six months from May 1 to October 31 compared with an average of 60 per cent for the corresponding six months of the preceding five years. The peak of the 1931 monthly production was in September instead of in August, as in the average for the preceding five years, and the minimum in December instead of in February.

Proportion of asphalt produced in petroleum refineries in the United States, 1930 and 1931, by months, in per cent

Month	1930	1931	Month	1930	1931
January	6.5	5.0	August	10.7	10.5
February	5.9	5.6	September	9.4	10.9
March	6.7	6.4	October	9.4	10.6
April	8.3	8.3	November	6.5	7.0
May	10.5	10.2	December	5.1	4.4
June	10.7	10.6			
July	10.3	10.5		100.0	100.0

REFINERY STOCKS

Stocks of petroleum asphalt held at refineries in the United States increased 5.8 per cent from December 31, 1930, to December 31, 1931. In terms of the indicated domestic demand for petroleum and lake asphalt in 1931 the stocks held on December 31, 1931, amounted to 40.5 days' supply compared with 36.8 days' supply on December 31, 1930, in terms of the 1930 demand.

The principal increases were in the interior districts of the United States, such as the Appalachian district, the Indiana-Illinois district, and the Northern Louisiana and Arkansas district. On the other hand, the seaboard refineries of the Atlantic and Gulf coasts decreased their inventories during 1931.

SALES BY USES

Sales of petroleum asphalt by refineries in the United States were 10.7 per cent lower in 1931 than in 1930. They decreased from 3,216,440 short tons in 1930 to 2,873,291 tons in 1931. The principal decreases were in sales of paving asphalt, which declined 17.6 per cent; roofing asphalt, 15.9 per cent; and roofing flux, 59.6 per cent. On the other hand, sales of cut-back asphalts were 70.6 per cent larger in 1931 than in 1930, and sales of emulsified asphalt by petroleum refineries increased 19.6 per cent.

As a result of lower prices the values realized from the sales of petroleum asphalt declined even more sharply than the tonnage sold—from $34,622,032 in 1930 to $24,861,339 in 1931, a drop of 28.2 per cent. The largest decreases were in receipts from the sale of paving asphalt, roofing asphalt, and roofing flux. On the contrary, sales of cut-back asphalts yielded greatly increased revenue.

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States in 1931, by varieties

[Value f. o. b. refinery]

	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration:[1]						
Asphalt for—						
Paving	378,854	$3,723,083	745,399	$6,002,271	1,124,253	$9,725,354
Roofing	325,184	2,947,021	383,666	3,106,759	708,850	6,053,780
Waterproofing	51,090	522,025	53,024	423,583	104,114	945,608
Blending with rubber	3,908	56,057	16,430	137,664	20,338	193,721
Briquetting	32,636	311,239	8,079	67,834	40,715	379,073
Mastic and mastic cake	740	10,843	217	1,738	957	12,581
Pipe coatings	9,012	121,513	3,725	32,518	12,737	154,031
Molding compounds	30	577	7,222	60,153	7,252	60,730
Miscellaneous uses	34,951	366,374	42,628	271,513	77,579	637,887
	836,405	8,058,732	1,260,390	10,104,033	2,096,795	18,162,765
Semisolid and liquid products of more than 200 penetration:[1]						
Flux for—						
Paving	69,849	573,490	43,952	332,837	113,801	906,327
Roofing	69,023	426,256	58,239	474,765	127,262	901,021
Waterproofing	150	1,094	1,509	12,823	1,659	13,917
Mastic	----------	----------	42	357	42	357
Cut-back asphalts	127,792	1,349,576	318,621	2,871,960	446,413	4,221,536
Emulsified asphalts and fluxes	12,942	190,247	3,863	32,826	16,805	223,073
Paints, enamels, japans, and lacquers	942	15,233	2,887	24,756	3,829	39,989
Other liquid products	46,795	241,060	19,890	151,294	66,685	392,354
	327,493	2,796,956	449,003	3,901,618	776,496	6,698,574
Grand total, 1931	1,163,898	10,855,688	1,709,393	14,005,651	2,873,291	24,861,339
Total, 1930	[2] 1,382,753	[2] 15,159,979	1,833,687	19,462,053	[2] 3,216,440	[2] 34,622,032

[1] DEFINITIONS

Paving asphalt.—Refined 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.
Roofing asphalt.—Asphalt and asphaltic cement used in saturating, coating, and cementing felt or other fabric and in the manufacture of asphalt shingles.
Waterproofing asphalt.—Asphalt and asphaltic cement used to waterproof and dampproof tunnels, foundations of buildings, retaining walls, bridges, culverts, etc., and for constrncting built-up roofs.
Briquetting asphalt.—Asphalt and asphaltic cement used to bind coal dust or coke breeze into briquets.
Mastic and mastic cake.—Asphalt and asphaltic cement for laying foot pavements and floors, waterproofing bridges, lining reservoirs and tanks, capable of being poured and smoothed by hand-troweling.
Pipe coatings.—Asphalt and asphaltic cement used to protect metal pipes from corrosion.
Molding compounds.—Asphalts used in the preparation of molding compositions, such as battery boxes electrical fittings, push buttons, knobs, handles, and other equipment.
Miscellaneous uses.—Asphalts and asphaltic cement used as dips and in the manufacture of acid-resisting compounds, putty, saturated building paper, fiber hoard, and floor coverings; and not included ln the preceding definitions.
Flux.—Liquid asphaltic material used in softening native asphalt or solid asphalt for paving, roofing, waterproofing, and other purposes.
Cut-back asphalts.—Asphalts softened or liquefied by mixing them with petroleum distillates.
Emulsified asphalts and fluxes.—Asphalts and fluxes emulsified with water for cold-patching, road laying and other purposes.
Other liquid products.—Petroleum asphalt, exclusive of fuel oil used for heating purposes, not included in the preceding definitions.

[2] Revised figures.

PAVING

Four refining districts furnished 95 per cent of the paving asphalt sold in the United States in 1930 and 94 per cent in 1931. East coast refineries supplied 731,967 short tons (53.7 per cent of the total) in 1930 and 667,756 tons (59.4 per cent) in 1931. Gulf coast refineries of Louisiana and Texas furnished 238,760 tons (17.5 per cent of the national total) in 1930 and 160,741 tons (14.3 per cent) in 1931. California refineries marketed 284,752 tons (20.9 per cent of the total) in 1930 and 200,811 tons (17.9 per cent) in 1931. Only 38,961 tons (2.9 per cent) of the paving asphalt sold in 1930 and only 26,985 tons (2.4 per cent) in 1931 came from the Indiana-Illinois district.

Sales of paving flux decreased 2.5 per cent in quantity and 24.5 per cent in value. The principal decreases were in the Gulf coast, East coast, and California districts.

Complete statistics of rural highways built or city streets paved during 1931 are not yet available. Statistics of State highway construction compiled by the Bureau of Public Roads, Department of Agriculture, show a large increase in the mileage of asphaltic types of surfacing in State highways built—from 1,970 miles in 1930 to 2,688 miles in 1931. The mileage of bituminous concrete and sheet asphalt laid on these highways increased from 697 in 1930 to 749 in 1931 and the mileage of bituminous macadam from 1,273 in 1930 to 1,939 in 1931. In addition, a considerable mileage of State highway was surfaced by low-cost bituminous processes; no adequate statistics of this mileage are available. Asphaltic types of surfacing, as recorded, constituted 18.3 per cent of the total mileage of hard-surfaced State highways built in 1930 and 21.5 per cent in 1931.

Asphaltic types formed 31.5 per cent of the net mileage of hard-surfaced Federal-aid roads completed in 1931, compared with 22.4 per cent in 1930 and 32 per cent in 1929. The mileage of asphaltic types laid in 1931 was more than twice that in 1930. The greatest increase in mileage was in low-cost bituminous types, which more than doubled. At the same time, the mileage of bituminous concrete laid was nearly four times that in 1930. On the other hand, about one-third less bituminous macadam was laid in 1931 than in 1930.

Net mileage of hard-surfaced Federal-aid highways completed, 1930 and 1931, by types of construction [1]

	1930	1931
Bituminous concrete	129.0	507.6
Bituminous macadam	306.3	203.3
Low-cost bituminous types	814.1	1,951.4
Total bituminous	1,249.4	2,662.3
Other hard-surfaced types [2]	4,340.1	5,801.2
Total hard-surfaced	5,589.5	8,463.5

[1] Source: Bureau of Public Roads, Department of Agriculture.
[2] Includes Portland cement concrete, brick, block, and stone.

ROOFING

A decrease of 19 per cent in factory shipments of prepared roofing (from 27,873,816 squares in 1930 to 22,570,411 squares in 1931) and of 18.7 per cent in factory shipments of roofing felt (from 228,514 short tons in 1930 to 185,803 tons in 1931) was reflected in a 15.9 per cent decline in refinery sales of roofing asphalt.

The sharpest decrease in sales of roofing asphalt was in California, where petroleum refineries sold 141,250 short tons (valued at $2,266,299) in 1930 and 50,836 tons (valued at $687,775) in 1931. Sales of roofing asphalt by refineries of the Indiana-Illinois district decreased from 271,408 tons (valued at $2,156,261) in 1930 to 185,779 tons (valued at $1,465,924) in 1931. Gulf coast refineries of Texas and Louisiana sold 114,628 tons (valued at $1,284,531) in 1930 but only 78,115 tons (valued at $689,853) in 1931. On the other hand, East coast refineries increased their sales from 262,098 tons (valued at $2,901,028) in 1930 to 338,847 tons (valued at $2,731,845) in 1931.

Sales of roofing flux in the United States decreased 59.6 per cent in quantity and 68.5 per cent in value.

MINOR USES

Sales of waterproofing asphalt increased 26.9 per cent in quantity but decreased 10 per cent in value. Increased sales in the Indiana-Illinois and Gulf coast districts more than offset decreases in the East coast and California districts.

In response to a 6.3 per cent decrease in rubber consumption in the United States from 1930 to 1931 the quantity of asphalt sold for blending with rubber decreased 5.7 per cent. The values realized by these sales declined 27.2 per cent. East coast refineries furnished 82.1 per cent of the asphalt sold for blending with rubber in 1930 and 78 per cent in 1931.

A decrease of 32.1 per cent in the manufacture of fuel briquets in the United States from 1930 to 1931 was reflected in a decline of 29.4 per cent in sales of briquetting asphalt. The values realized from these sales decreased 34.8 per cent.

Although nearly 40 per cent less pipe was laid in 1931 than in 1930, as indicated by the tonnage of iron and steel pipe and fittings terminated by Class I railroads in the United States in those two years, sales of asphaltic pipe coatings increased 22.2 per cent in quantity and 4.7 per cent in value. These figures refer to sales by petroleum refineries and do not include pipe coatings made by other manufacturers from asphalts purchased from petroleum refineries.

The mileage of secondary roads built by low-cost bituminous-mix processes was considerably larger in 1931 than in 1930. Consequently sales of cut-back asphalts by petroleum refineries increased 70.6 per cent in quantity and 35.4 per cent in value from 1930 to 1931. The greatest increase in sales of cut-back asphalts was in the East coast district, where 161,860 short tons (valued at $1,868,201) were sold in 1930 and 279,722 tons (valued at $2,498,202) in 1931.

Sales of asphalts and fluxes emulsified with water were likewise benefited by the increased use of low-cost bituminous mixtures for constructing secondary roads; however, petroleum refineries sold only 12.4 per cent of the total sales of asphalt emulsions in 1930 and only 10.8 per cent in 1931. By far the greater part of the emulsified asphalt sold in the United States was manufactured by 10 industrial companies which purchased the asphaltic raw material from petroleum refineries. The principal plants producing emulsified asphalt were located near San Francisco, New Orleans, Baton Rouge, New York, Chicago, and Philadelphia. The total national production of petroleum asphalts and fluxes emulsified with water was 27,211,169 gallons (115,647 short tons) in 1930 and 36,848,875 gallons (156,607 tons) in 1931, a gain of 35.4 per cent. Stocks of emulsified asphalt held by producers increased from 569,235 gallons (2,419 tons) on December 31, 1930, to 756,378 gallons (3,215 tons) on December 31, 1931. During 1931, 158,009 gallons (672 tons) were consumed for miscellaneous needs compared with 300,000 gallons (1,275 tons) in 1930. Sales of emulsified asphalts and fluxes by producers increased 37.1 per cent in quantity—from 26,631,806 gallons (113,185 tons, revised figures) in 1930 to 36,503,723 gallons (155,140 tons) in 1931—but only 31.5 per cent in value—from $2,692,928 in 1930 to $3,542,118 in 1931. The average sales value per gallon decreased 4 per cent—from $0.101 in 1930 to $0.097 in 1931.

Although domestic consumption of paints, varnishes, and lacquers in general, as indicated by the tonnage of paints in oil and varnishes terminated by Class I railroads in the United States, decreased 20.9 per cent from 1930 to 1931, sales of asphaltic paints, varnishes, lacquers, and japans by petroleum refineries increased 20.2 per cent. Similarly, although total sales of paints and varnishes reported by the Bureau of the Census decreased 20.1 per cent in value from 1930 to 1931, sales of asphaltic paints, varnishes, lacquers and japans by petroleum refineries gained 26.6 per cent in value. These figures do not include bituminous paints, varnishes, and lacquers made by industrial concerns from asphalt purchased from refineries and sold to consumers by these secondary manufacturers.

Sales of solid and semisolid asphalt for miscellaneous uses decreased 28.2 per cent in quantity and 26.4 per cent in value. On the other hand, sales of semisolid and liquid asphalt for miscellaneous uses were considerably larger in 1931 than in 1930. Among the miscellaneous uses for which solid and semisolid asphalts were sold in 1931 were blending and tempering other asphalts; coating and insulating compounds; dips; paint fillers; moisture proofing; putties and acid-resisting compounds; saturated floor coverings, building papers, and fiber board; and sealing storage batteries. Semisolid and liquid asphalts were sold for coating railroad rails, preservative coatings of various kinds, roofers' lap cement, waterproofing Portland cement concrete, preserving railroad ties and other timbers, and use in the manufacture of ink.

DISTRIBUTION BY RAIL

Shipments of asphalt (natural, by-product, or petroleum) originating on Class I railroads in the United States decreased 6.5 per cent from 1930 to 1931. The largest decreases were in the Central Eastern region, in the Southern region, and in the Southwestern region. On the other hand, shipments of asphalt originating on railroads of the Pocahontas region and of the Northwestern region were considerably larger in 1931 than in 1930.

Asphalt (natural, by-product, or petroleum) shipments originating on Class I railroads in the United States, 1930 and 1931, by regions, in short tons [1]

Region	1930	1931	Region	1930	1931
Eastern district:			Western district:		
New England	172, 600	172, 139	Northwestern	42, 251	83, 423
Great Lakes	333, 693	341, 126	Central Western	299, 235	295, 718
Central Eastern	1, 282, 386	1, 199, 239	Southwestern	254, 620	175, 375
Total Eastern district	1, 788, 679	1, 712, 504	Total Western district	596, 106	554, 516
Southern district:			Total United States	2, 937, 949	2, 745, 541
Pocahontas	85, 185	105, 579			
Southern	467, 979	372, 942			
Total Southern district	553, 164	478, 521			

[1] Source: Freight Commodity Statistics, Interstate Commerce Commission.

The tonnage of asphalt (natural, by-product, or petroleum) terminated by Class I railroads in the United States declined 5.5 per cent from 1930 to 1931. Decreases in the Great Lakes, Central Eastern, Southern, Central Western, and Southwestern regions were partly offset by an increase in the Northwestern region, while the quantities terminated in the New England and Pocahontas regions were little changed.

Asphalt (natural, by-product, or petroleum) terminated by Class I railroads in the United States, 1930 and 1931, by regions, in short tons [1]

Region	1930	1931	Region	1930	1931
Eastern district:			Western district:		
New England	226,945	224,720	Northwestern	177,354	246,485
Great Lakes	700,729	624,106	Central Western	299,454	270,378
Central Eastern	870,584	850,209	Southwestern	199,265	152,909
Total Eastern district	1,798,258	1,699,035	Total Western district	676,073	669,772
Southern district:			Total United States	2,959,665	2,795,457
Pocahontas	72,347	72,075			
Southern	412,987	354,575			
Total Southern district	485,334	426,650			

[1] Source: Freight Commodity Statistics, Interstate Commerce Commission.

Asphalt (natural, by-product, or petroleum) terminated by Class I railroads in the United States, 1930 and 1931, in short tons [1]

	1930 (total)	1931		
		Originating on carriers' lines	Received from connecting carriers	Total
Eastern district:				
Baltimore & Ohio	194,159	108,493	68,284	176,777
Central of New Jersey	55,644	50,535	3,011	53,546
Chicago & Eastern Illinois	57,001	1,008	14,243	15,251
Elgin, Joliet & Eastern	57,881	14,274	24,278	38,552
Erie	142,554	34,333	69,831	104,164
Lehigh Valley	41,338	24,039	19,820	43,859
Long Island	53,391	21,257	25,931	47,188
New York Central	298,690	65,053	190,700	255,753
New York, Chicago & St. Louis	41,764	5,667	38,946	44,613
New York, New Haven & Hartford	168,145	138,639	31,106	169,745
Pennsylvania	334,294	279,266	110,719	389,985
Reading	26,380	17,189	26,275	43,464
Other railroads	327,017	40,452	275,686	316,138
Total Eastern district	1,798,258	800,205	898,830	1,699,035
Southern district:				
Atlantic Coast Line	15,692	15,250	18,404	33,654
Chesapeake & Ohio	28,240	5,196	17,327	22,523
Florida East Coast	38,270	1,161	11,711	12,872
Illinois Central	147,554	[2] 96,935	[2] 37,292	[2] 134,227
Louisville & Nashville	36,388	2,877	30,628	33,505
Mobile & Ohio	6,286	27	1,095	1,122
Nashville, Chattanooga & St. Louis	26,779	----------	6,071	6,071
Norfolk & Western	36,278	20,671	19,511	40,182
Seaboard Air Line	13,204	8,554	13,002	21,556
Southern	58,096	24,929	35,151	60,080
Yazoo & Mississippi Valley	29,110	(2)	(2)	(2)
Other railroads	49,437	2,220	58,638	60,858
Total Southern district	485,334	177,820	248,830	426,650

[1] Source: Freight Commodity Statistics, Interstate Commerce Commission.
[2] Figures for the Illinois Central system in 1931 include asphalt terminated by the Yazoo & Mississippi Valley, which formerly was operated as a separate system.

Asphalt (natural, by-product, or petroleum) terminated by Class I railroads in the United States, 1930 and 1931, in short tons—Continued

	1930 (total)	1931		
		Originating on carriers' lines	Received from connecting carriers	Total
Western district:				
Atchison, Topeka & Santa Fe	46, 136	20, 296	7, 226	27, 522
Chicago & Alton	59, 391	46, 194	6, 093	52, 287
Chicago & North Western	43, 735	14, 751	36, 237	50, 988
Chicago, Burlington & Quincy	23, 505	21, 508	15, 049	36, 557
Chicago Great Western	4, 201	151	3, 159	3, 310
Chicago, Milwaukee, St. Paul & Pacific	33, 099	4, 178	52, 894	57, 072
Chicago, Rock Island & Pacific	40, 788	2, 141	30, 709	32, 850
Chicago, St. Paul, Minneapolis & Omaha	16, 252		16, 884	16, 884
Great Northern	28, 256	12, 085	26, 903	38, 988
International-Great Northern	5, 041	371	4, 503	4, 874
Kansas City Southern	8, 784	107	6, 006	6, 113
Louisiana & Arkansas	17, 332	17, 956	760	18, 716
Missouri Pacific	46, 792	7, 844	24, 049	31, 893
Northern Pacific	34, 658	14, 890	25, 248	40, 138
St. Louis-San Francisco	14, 655	4, 575	16, 460	21, 035
Southern Pacific	86, 427	58, 420	3, 327	61, 747
Texarkana & Fort Smith	22, 199	10, 215		10, 215
Texas & New Orleans	20, 181	1, 984	10, 662	12, 646
Other railroads	124, 641	9, 196	136, 741	145, 937
Total Western district	676, 073	246, 862	422, 910	669, 772
Total United States	2, 959, 665	1, 224, 887	1, 570, 570	2, 795, 457

DOMESTIC DEMAND

The indicated domestic demand for petroleum and lake asphalt, calculated by adding imports to domestic production and subtracting exports, plus or minus stock changes, was 2,744,531 short tons in 1931, a decrease of 4 per cent from the 2,859,248 tons apparently consumed in 1930 and of 20.5 per cent from the 3,450,597 tons apparently consumed in 1929.

In 1931, as in previous years, two-thirds of the annual demand for petroleum and lake asphalt in the United States was concentrated in the six months from May 1 to October 31. The following statistics of indicated demand by months in the United States are based partly on adjusted figures of monthly production and stocks. Nevertheless, they are believed to indicate with reasonable accuracy the monthly trend in the domestic demand for petroleum and lake asphalt.

Indicated demand for petroleum and lake asphalt in the United States, 1930 and 1931, by months, in short tons

Month	1930 [1]	1931	Month	1930 [1]	1931
January	187, 937	133, 371	August	318, 538	314, 733
February	134, 681	105, 068	September	325, 715	313, 267
March	169, 507	138, 361	October	284, 843	337, 236
April	234, 020	216, 998	November	159, 406	185, 255
May	288, 729	262, 723	December	125, 404	115, 612
June	319, 963	286, 367			
July	310, 505	335, 540		2, 859, 248	2, 744, 531

[1] Revised figures.

CONSUMPTION BY DISTRICTS

The tonnage of asphalt (petroleum, lake, and natural rock) distributed by rail in the United States decreased 8.4 per cent from 1930 to 1931. The most marked changes in regional distribution of asphalt were in the central third of the United States, between the Mississippi River and Lake Michigan on the east and the Rocky Mountains on the west. In the Southwestern district, lying west of the Mississippi and Pearl Rivers and south of St. Louis, Kansas City, Amarillo, and El Paso, 37.9 per cent less asphalt was terminated by rail in 1931 than in 1930. On the other hand, in the North Central district, between Lake Michigan and the Rocky Mountains and north of St. Louis, Kansas City, and Amarillo, the tonnage of asphalt terminated by rail increased 34.7 per cent from 1930 to 1931. In the Southeastern district, east of the Mississippi River and south of the Ohio and Potomac Rivers, the asphalt consumption was 13.6 per cent less in 1931 than in 1930. In the Northeastern and Pacific-Rocky Mountain districts the decreases from 1930 to 1931 in asphalt terminated were proportionately small.

Asphalt (petroleum, lake, and natural rock), exclusive of road oil, distributed by rail within districts in the United States, 1930 and 1931, in short tons

District	1930	1931
Northeastern	1,937,230	1,854,316
Southeastern	459,444	397,007
Southwestern	475,658	295,586
North Central	183,530	247,201
Pacific-Rocky Mountain [1]	[2] 249,602	233,352
	[2] 3,305,464	3,027,462

[1] Includes shipments by electric railroads, minor steam railroads, and motor trucks.
[2] Revised figures.

NORTHEASTERN DISTRICT

Of the total available asphalt supply of the Northeastern district 81 per cent in 1931 (80.1 per cent in 1930) was furnished by petroleum refineries situated chiefly near New York, Philadelphia, Baltimore, Chicago, and East St. Louis. In 1931 about 106,000 short tons of rock asphalt (4.6 per cent of the total asphalt supply of the district) and in 1930 about 181,000 tons (7.7 per cent of the total supply) were shipped across the Ohio River into Illinois, Indiana, and Ohio, chiefly from Kentucky. Shipments of petroleum asphalt from Louisiana and Texas Gulf coast refineries, carried by rail up the Mississippi Valley through the Southeastern district, decreased from 120,000 tons (5.1 per cent of the total supply) in 1930 to 114,000 tons (4.9 per cent of the total supply) in 1931. The apparent increase in receipts of asphalt by water from 1930 to 1931 is due to more data being available on these receipts.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, Northeastern district, 1930 and 1931, in short tons

	1930	1931		1930	1931
SOURCE			DISTRIBUTION		
Produced within district	1,871,439	1,886,978	Shipped by rail:		
Received by rail from:			Within district	1,937,230	1,854,316
Southeastern district	301,216	220,204	To North Central district	119,000	157,968
Southwestern district	40,000	30,000	To Southeastern district	59,932	40,341
Pacific-Rocky Mountain district	38,000	32,000	To Southwestern district	3,500	3,000
Received by water (coastwise)	51,500	108,389	Shipped by water (coastwise and river)	107,100	150,697
Withdrawn from stocks	132	----------	Added to stocks	----------	15,019
Imported	33,719	51,855	Exported	109,244	108,085
	2,336,006	2,329,426		2,336,006	2,329,426

Of the total available asphalt supply of the Northeastern district 79.6 per cent in 1931 (83 per cent in 1930) was terminated by railroads within the district itself. The total consumption of asphalt in the Northeastern district, as indicated by these figures, was 4.3 per cent less in 1931 than in 1930. Shipments by rail to the North Central district increased 32.7 per cent in tonnage from 1930 to 1931, constituting 5.1 per cent of the total supply available for distribution in 1930 and 6.8 per cent in 1931. Shipments of asphalt by water were 40.7 per cent greater in tonnage in 1931 than in 1930 but were 22.5 per cent less than in 1929. Exports, chiefly petroleum asphalt, from the Northeastern district constituted 4.7 per cent of the total supply in 1930 and 4.6 per cent in 1931.

SOUTHEASTERN DISTRICT

Of the total asphalt (petroleum, lake, and natural rock) available for consumption in the Southeastern district, 53.3 per cent in 1931 (57.9 per cent in 1930) was furnished from sources within the district. Of the domestic supply nearly one-half in 1931 (one-third in 1930) was furnished by petroleum refineries located chiefly near Norfolk, Va.; Charleston, S. C.; Savannah and Brunswick, Ga.; Latonia, Ky.; and Parkersburg, W. Va.; the remainder consisted of rock asphalt quarried in Kentucky and Alabama. Receipts of asphalt by rail from the Southwestern district, largely in transit to Illinois, Indiana, and Ohio, were 9.9 per cent less in 1931 than in 1930 but constituted 35.8 per cent of the total supply in 1931 and 31.5 per cent of that in 1930. Imports, chiefly from Trinidad, Venezuela, and Cuba, increased 17.5 per cent from 1930 to 1931; they formed 2.7 per cent of the total supply in 1931 and only 1.8 per cent in 1930.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, Southeastern district, 1930 and 1931, in short tons

	1930	1931		1930	1931
SOURCE			DISTRIBUTION		
Produced within district	496,367	361,652	Shipped by rail:		
Received by rail from:			Within district	459,444	397,007
Northeastern district	59,932	40,341	To Northeastern district	301,216	220,204
Southwestern district	269,661	242,978	To Southwestern district	35,000	30,000
Received by water (coastwise)	14,476	14,560	To North Central district	25,839	20,535
Withdrawn from stocks	802	--------	Shipped by water (coastwise and river)	2,061	4,053
Imported	15,797	18,568	Added to stocks	--------	3,312
	857,035	678,099	Exported	33,475	2,988
				857,035	678,099

Of the total supply of asphalt (petroleum, lake, and natural rock) in the Southeastern district 58.5 per cent in 1931 (53.6 per cent in 1930) was distributed by rail within the district. Three-fourths of the regional consumption in 1931 and two-thirds in 1930 consisted of petroleum asphalt; the remainder was rock asphalt mined in Kentucky and Alabama. In 1931 about 106,000 short tons of rock asphalt (15.6 per cent of the total asphalt supply of the district) and in 1930 about 181,000 tons (21.1 per cent of the total supply) were shipped across the Ohio River into the Northeastern district, and about 114,000 tons of petroleum asphalt (16.8 per cent of the total supply) in 1931 and 120,000 tons (14 per cent of the total supply) in 1930 (consisting mostly of rail receipts from Louisiana and Texas Gulf coast refineries) were shipped by rail into the Northeastern district. Exports, chiefly petroleum asphalt, amounted to only 0.4 per cent of the total supply in 1931 and 3.9 per cent in 1930.

SOUTHWESTERN DISTRICT

Of the total available supply of asphalt (petroleum, lake, and natural rock) in the Southwestern district 88.9 per cent in 1931 (91.7 per cent in 1930) was produced within the district. Two-thirds of the domestic production both in 1931 and in 1930 was petroleum asphalt made in refineries located near New Orleans and Baton Rouge, La.; Port Arthur, Tex.; El Dorado, Ark.; and Kansas City, Mo. The remaining third was bituminous limestone quarried in Uvalde and Kinney Counties, Tex., and bituminous sandstone and limestone quarried in Murray County, Okla.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, Southwestern district, 1930 and 1931, in short tons

	1930	1931		1930	1931
SOURCE			DISTRIBUTION		
Produced within district	972,708	725,482	Shipped by rail:		
Received by rail from:			Within district	475,658	295,586
Pacific-Rocky Mountain district	45,000	36,000	To Southeastern district	269,661	242,978
Northeastern district	3,500	3,000	To Northeastern district	40,000	30,000
Southeastern district	35,000	30,000	To North Central district	35,800	58,847
Received by water (coastwise)	457	17,693	Shipped by water (coastwise)	120,694	91,095
Withdrawn from stocks	1,400	1,095	Exported	119,498	97,506
Imported	3,246	2,742		1,061,311	816,012
	1,061,311	816,012			

Of the total asphalt supply available for distribution in the Southwestern district 36.2 per cent in 1931 (44.8 per cent in 1930) was distributed by rail within the district. Rail shipments to the Southeastern district and to the Northeastern district by way of the Southeastern district decreased 9.9 per cent from 1930 to 1931; they constituted 29.8 per cent of the total in 1931 and 25.4 per cent in 1930. Shipments by water from Gulf coast ports decreased 24.5 per cent from 1930 to 1931, forming 11.2 per cent of the total supply in 1931 and 11.4 per cent in 1930. Exports, chiefly petroleum asphalt, constituted 11.9 per cent of the total asphalt supply of the district in 1931 and 11.3 per cent in 1930.

NORTH CENTRAL DISTRICT

One-third more asphalt (petroleum, lake, and natural rock) was terminated in the North Central district by Class I railroads in 1931 than in 1930. Of the total available supply in the district fully 63.5 per cent in 1931 (63.8 per cent in 1930) was shipped in from refineries in the Northeastern district, chiefly in Illinois and Indiana. Receipts from Gulf coast refineries by way of the Southeastern district formed only 8.2 per cent of the total supply in 1931 but 13.8 per cent in 1930. Direct rail shipments from the Southwestern district made up 23.6 per cent of the total in 1931 and 19.2 per cent in 1930. The remainder came from the Pacific-Rocky Mountain district.

Practically all the asphalt shipped into the North Central district is consumed within the district. Only an insignificant quantity is shipped by rail to Canada.

Source and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, North Central district, 1930 and 1931, in short tons

	1930	1931		1930	1931
SOURCE			DISTRIBUTION		
Received by rail from:			Shipped by rail within district	183, 530	247, 201
Northeastern district	119, 000	157, 968	Exported	3, 109	1, 757
Southeastern district	25, 839	20, 535		186, 639	248, 958
Southwestern district	35, 800	58, 847			
Pacific-Rocky Mountain district	6, 000	11, 608			
	186, 639	248, 958			

PACIFIC-ROCKY MOUNTAIN DISTRICT

Of the total supply of asphalt (petroleum, lake, and native) available for distribution in the Pacific-Rocky Mountain district 96.5 per cent in 1931 (95.1 per cent in 1930) was furnished from sources within the district. Nine-tenths of the bituminous substances produced within the district consisted of petroleum asphalt produced in refineries near San Francisco, Los Angeles, and Casper, Wyo.; the remainder was gilsonite and wurtzilite mined in northeastern Utah and bituminous sandstone mined in Santa Cruz and Santa Barbara Counties, Calif.; Carbon County, Utah; and Guadalupe County, N. Mex.

Source and distribution of asphalt (petroleum, lake, and native), exclusive of road oil, Pacific-Rocky Mountain district, 1930 and 1931, in short tons

	1930	1931		1930	1931
SOURCE			DISTRIBUTION		
Produced within district	[1] 589, 904	504, 961	Shipped by rail:		
Received by water (coastwise)	30, 000	17, 194	Within district	168, 012	166, 624
Withdrawn from stocks		504	To North Central district	6, 000	11, 608
Imported	317	423	To Southwestern district	45, 000	36, 000
			To Northeastern district	38, 000	32, 000
	[1] 620, 221	523, 082	Shipped by water (coastwise and intraport)	100, 000	114, 035
			Shipped by electric railroads, minor steam railroads, and trucks	[1] 85, 343	66, 728
			Added to stocks	9, 650	
			Exported	168, 216	96, 087
				[1] 620, 221	523, 082

[1] Revised figures.

Of the total available supply of asphalt in the Pacific-Rocky Mountain district 44.6 per cent in 1931 (40.8 per cent in 1930) was distributed within the district by steam railroad, electric railway, or motor truck. In addition, 21.8 per cent of the total in 1931 (16.1 per cent in 1930) was shipped coastwise, chiefly to destinations along the Pacific coast or within the port of San Francisco. Exports, largely to far eastern countries, decreased 42.9 per cent in quantity and declined in relative importance from 27.1 per cent of the total supply in 1930 to 18.4 per cent in 1931.

IMPORTS AND EXPORTS

IMPORTS

Imports of native asphalt and bitumen into the United States in 1931 increased 38.5 per cent in quantity and 58.8 per cent in value from 1930. The increase of 20,475 short tons was due almost entirely to the resumption of imports of lake asphalt from eastern Venezuela. Imports of lake asphalt from Trinidad decreased 23.8 per cent in quantity, while imports of grahamite (or, rather, glance pitch) from Cuba changed little in quantity.

Native asphalt and bituminous rock imported into the United States, 1930 and 1931, by countries

[General imports]

Country	1930		1931	
	Short tons	Value	Short tons	Value
Cuba	13,508	$148,095	13,764	$199,761
Trinidad and Tobago	38,783	293,865	29,543	272,441
Venezuela			29,718	238,806
Germany	566	4,439	349	3,145
Other countries	340	10,773	298	12,064
	53,197	457,172	73,672	726,217

EXPORTS

Exports of petroleum asphalt from the United States were 29.8 per cent less in quantity and 32.1 per cent less in value in 1931 than in 1930. The largest declines were in shipments to Europe, to North American countries, and to Australasia. In contrast to the general decline exports of petroleum asphalt to western and southern Africa were larger in 1931 than in 1930.

Petroleum asphalt exported from the United States, 1930 and 1931, by countries

Country	1930		1931	
	Short tons	Value	Short tons	Value
Canada	42,064	$558,434	36,454	$443,774
Cuba	32,496	715,265	2,966	48,241
Argentina	2,746	57,003	2,399	44,974
Brazil	4,281	77,188	2,314	40,735
Chile	2,150	42,191	1,273	21,411
Peru	1,079	18,728	105	2,200
Belgium	6,733	120,585	3,056	59,205
Denmark	9,709	158,600	1,329	22,342
France	45,426	779,150	29,715	506,969
Germany	10,324	201,825	8,476	145,607
Italy	25,696	522,733	27,546	491,164
Netherlands	7,305	135,335	4,691	79,780
Spain	18,218	330,349	11,179	161,875
United Kingdom	27,391	629,207	18,696	420,159
British India	9,491	190,841	6,950	122,830
British Malaya	12,870	190,794	7,530	133,693
Ceylon	8,717	119,841	1,217	21,736
China	7,820	135,454	12,126	216,395
French Indo-China	5,310	75,810	10,046	174,428
Hong Kong	4,630	$84,247	2,442	$53,500
Japan	13,887	269,052	14,653	257,579
Netherland East Indies	24,230	348,527	19,480	336,786
Philippine Islands	10,097	144,903	7,578	135,732
Algeria and Tunisia	5,249	79,190	3,220	53,725
Morocco	594	11,344	2,524	40,480
Portuguese Africa	2,563	61,534	4,706	85,944
Union of South Africa	8,608	196,777	9,222	179,184
Australia	40,165	669,681	19,133	334,952
New Zealand	7,362	102,764	5,561	88,409
Other countries	13,178	249,680	11,512	216,802
	410,389	7,277,032	288,099	4,940,611

ROAD OIL

Greater use during 1931 of low-cost bituminous types of surfacing, especially in the construction of secondary roads, increased the sale of road oil more than one-fourth. Petroleum-refining companies in the United States sold 5,578,446 barrels (937,554 short tons) of road oil in 1930 and 7,170,102 barrels (1,200,579 short tons) in 1931. Although the quantity of road oil sold was 28.5 per cent greater in 1931 than in 1930 its value was 6.3 per cent less because of lower prices.

Five-sixths of the road oil manufactured in 1930 was made from domestic crude, compared with nine-tenths in 1931. Little more than half as much road oil was made from imported crude in 1931 as in 1930; the quantity made from Venezuelan and Mexican raw material decreased from 905,876 barrels (152,248 tons) in 1930 to 469,948 barrels (78,982 tons) in 1931. More than three-fourths of the road oil of foreign origin was made in refineries of the Atlantic seaboard and the rest in Gulf coast refineries of Louisiana and Texas.

Road oil sold by petroleum refineries in the United States, 1930 and 1931, by districts

District	1930		1931	
	Barrels	Value	Barrels	Value
East coast	719,046	$1,359,714	1,023,830	$1,302,827
Appalachian	88,667	149,522	209,667	240,309
Indiana-Illinois	1,807,437	1,909,530	2,250,744	2,104,650
Oklahoma-Kansas-Missouri	367,585	351,693	801,067	656,117
Texas:				
Gulf coast	463,451	1,089,464	83,258	103,480
Rest of State	155	102	1,362	2,825
Total Texas	463,606	1,089,566	84,620	106,305
Louisiana-Arkansas:				
Louisiana Gulf coast	132,405	218,636	110,355	124,156
Northern Louisiana and Arkansas	23,800	48,000	81,934	39,989
Total Louisiana and Arkansas	156,205	266,636	192,289	164,145
Rocky Mountain	165,374	212,296	795,277	853,594
California	1,810,526	2,071,832	1,812,608	1,516,373
Grand total	5,578,446	7,410,789	7,170,102	6,944,320

Three-fourths of the road oil sold in the United States in 1930 and 1931 came from three refining districts—the Indiana-Illinois, the California, and the East coast. Sales of road oil by Indiana-Illinois refineries were 24.5 per cent larger and those by East coast refineries 42.4 per cent larger in 1931 than in 1930; the greatest increase was in the Rocky Mountain district. On the other hand, Texas Gulf coast refineries sold less than one-fifth as much road oil in 1931 as in 1930, and Louisiana Gulf coast refineries sold one-sixth less than in 1930.

Production, stocks, consumption, and sales of road oil at petroleum refineries in the United States in 1931, by districts, in barrels

District	Production	Other petroleum products blended or transferred [1]	Stocks		Consumption at refineries and losses	Sales
			Dec. 31, 1930	Dec. 31, 1931		
East coast	365,000	659,390	15,583	16,143		1,023,830
Appalachian	208,000	13,540		11,873		209,667
Indiana-Illinois	1,710,000	745,443	79,703	125,363	159,039	2,250,744
Oklahoma-Kansas-Missouri	852,000	20,446	5,123	76,466	36	801,067
Texas:						
Gulf coast	79,733	1,025	2,500			83,258
Rest of State	1,267		464	369		1,362
Total Texas	81,000	1,025	2,964	369		84,620
Louisiana-Arkansas:						
Louisiana Gulf coast	26,000	84,355				110,355
Northern Louisiana and Arkansas	82,000	114		180		81,934
Total Louisiana and Arkansas	108,000	84,469		180		192,289
Rocky Mountain	841,000		42,606	88,329		795,277
California	1,012,000	925,879	78,439	120,862	82,848	1,812,608
Grand total	5,177,000	2,450,192	224,418	439,585	241,923	7,170,102

[1] Chiefly transfers from fuel-oil stocks.

PRODUCERS OF PETROLEUM ASPHALT AND ROAD OIL

The following operators reported the production of asphaltic material from crude petroleum in the United States in 1931:

Associated Oil Co., 79 New Montgomery Street, San Francisco, Calif.
Atlantic Refining Co., 260 South Broad Street, Philadelphia, Pa.
Barber Asphalt Co., 1600 Arch Street, Philadelphia, Pa.
James B. Berry Sons Co., 6 North Michigan Avenue, Chicago, Ill.
Cities Service Refining Co., 260 Tremont Street, Boston, Mass.
Colonial Beacon Oil Co., 30 Beacham Street, Everett, Mass.
Gilmore Oil Co., 2423 East Twenty-eighth Street, Los Angeles, Calif.
Globe Oil & Refining Co., Blackwell, Okla.
Humble Oil & Refining Co., Houston, Tex.
Indian Refining Co., Lawrenceville, Ill.
Latonia Refining Corporation, Midland Building, Cleveland, Ohio.
Lincoln Oil Refining Co., Robinson, Ill.
Lion Oil Refining Co., Seventh Floor, Exchange Building, El Dorado, Ark.
Magnolia Petroleum Co., Post Office Box 900, Dallas, Tex.
Mexican Petroleum Corporation of Louisiana (Inc.), 122 East Forty-second Street, New York, N. Y.
Mexican Petroleum Corporation of Maine (Inc.), 122 East Forty-second Street, New York, N. Y.
Mid-Continent Petroleum Corporation, Tulsa, Okla.
Midwest Refining Co., Post Office Box 240, Denver, Colo.
Orange County Refining Co., 317½ East Second Street, Los Angeles, Calif.

Paraffine Cos. (Inc.), 475 Brannan Street, San Francisco, Calif.
Pioneer Paper Co., 120 Arcade Station, Los Angeles, Calif.
Richfield Oil Co. of California, 550 South Flower Street, Los Angeles, Calif.
Seaside Oil Co., Summerland, Calif.
Shell Oil Co., Shell Building, San Francisco, Calif.
Shell Petroleum Corporation, Shell Building, St. Louis, Mo.
Sinclair Refining Co. of Louisiana (Inc.), 45 Nassau Street, New York, N. Y.
Skelly Oil Co., Skelly Building, Tulsa, Okla.
Standard Oil Co. of California, 225 Bush Street, San Francisco, Calif.
Standard Oil Co. (Indiana), 910 South Michigan Avenue, Chicago, Ill.
Standard Oil Co. of Kansas, Neodesha, Kans.
Standard Oil Co. of Louisiana, Baton Rouge, La.
Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y.
Standard Oil Co. of New York, 26 Broadway, New York, N. Y.
Standard Oil Co. of Ohio, East Ohio Gas Building, Cleveland, Ohio.
Sun Oil Co., 1608 Walnut Street, Philadelphia, Pa.
The Texas Co., Houston, Tex.
Texas Pacific Coal & Oil Co., Post Office Box 1868, Fort Worth, Tex.
Union Oil Co. of California, Union Oil Building, Los Angeles, Calif.
Utah Oil Refining Co., North Salt Lake City, Utah.
Warner-Quinlan Co., 2 Park Avenue, New York, N. Y.
White Eagle Oil Corporation, Casper, Wyo.
Yale Oil Corporation of South Dakota, Post Office Box 1035, Billings, Mont.

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CLAY [1]

By O. E. KIESSLING and K. V. HERLIHY

CONTENTS

GENERAL CONDITIONS

The largest use for clay is in the manufacture of clay products. Clay for this purpose is widely distributed throughout the United States, and there are clay-working plants in every State. The tables of production that follow represent chiefly the clay that was mined and sold as clay, or mined under royalty, or shipped into another State for fabrication; they do not include the clay that was burned into clay products by the producers themselves, unless it was mined under royalty or in a different State from that in which it was used. The quantity of clay thus sold is small compared with the total output and includes mainly clay used for making high-grade pottery and tile, paper, and refractory products. The values given for domestic production are f. o. b. mines or works; for imports, at the principal markets of the countries from which the clay was exported; and for exports, at the port of shipment.

PRODUCTION

The full effect of the lessened demand for domestic clay caused by the general business depression prevalent throughout 1931 is shown by the considerable decrease in output and value compared with 1930. Sales of clay in 1931 totaled 2,519,495 short tons, valued at $8,352,185, a decrease of 36 per cent in quantity and 33 per cent in value from 1930. Every kind of clay, as classified in this report, decreased in both quantity and value.

Sales of domestic kaolin, the chief clay used in the manufacture of high-grade ceramic wares, paper, etc., decreased 17 per cent in quantity and 24 per cent in value. On the other hand, imports of kaolin, or china clay, decreased 36 per cent in quantity; domestic mines furnished 75 per cent of the new supply in the United States compared with 69 per cent in 1930. The Southern States continued to be the chief source of supply of domestic kaolin, reporting 89 per cent of the total in 1931; Georgia is the largest producer and reported 63 per cent of the total.

Ball clay, which is used principally with kaolin in high-grade ceramic wares, decreased 11 per cent in quantity and 14 per cent in value.

[1] Work on manuscript completed August, 1932.

Slip clay, a low-fusing material formerly used mainly as a stoneware glaze, is employed now chiefly as a binder in the manufacture of abrasives. In 1931 sales of slip clay decreased 56 per cent in quantity and 49 per cent in value. In 1931 Michigan and New York were again the sources of supply of slip clay.

Stoneware clay, the principal use of which is indicated by its name, decreased 24 per cent in quantity and 10 per cent in value. The term "stoneware clay" is used rather loosely; much of the clay so classed might with equal propriety be classified as fire clay.

Fire clay, which constituted 58 per cent of the total output of clay in 1931, decreased 42 per cent in quantity and 38 per cent in value. As its name implies, the chief use of fire clay is in the refractories industries; in fact, more than two-thirds of the 1931 output was reported as put to such uses. Considerable quantities are also used in the manufacture of high-grade ceramic wares, architectural terra cotta, and other heavy-clay products.

Bentonite decreased 27 per cent (from 107,405 short tons in 1930 to 78,815 tons in 1931).

Miscellaneous clays, as shown on page 241, include those used in many industries; the larger part of the output is used in the manufacture of heavy-clay products, such as building and drainage materials. Clay included under this head is also used for cosmetics, filtering oil (after chemical treatment), flowerpots, foundries, modeling, rotary drilling, taxidermy, water softening, and other purposes.

Clay sold by producers in the United States, 1927–1931, by kinds

Year	Kaolin or china clay and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	454,245	$3,809,834	119,763	$913,976	6,137	$32,264	2,699,761	$7,719,725
1928	496,142	4,088,003	120,878	984,075	5,699	30,796	2,785,158	7,480,609
1929	518,169	4,281,301	118,190	987,306	6,369	38,582	3,178,805	8,107,586
1930	[1] 533,800	[1] 3,893,814	93,488	739,787	4,398	26,465	[1] 2,547,162	[1] 6,070,663
1931	443,300	2,946,953	83,007	639,798	1,916	13,613	1,473,161	3,741,038

Year	Stoneware clay		Bentonite		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	98,355	$203,648	(2)	(2)	470,915	$1,017,712	3,849,176	$13,697,159
1928	95,626	207,275	(2)	(2)	522,829	1,409,981	4,026,332	14,200,739
1929	87,456	181,901	(2)	(2)	438,031	1,254,068	4,347,020	14,850,744
1930	75,832	146,513	107,405	$858,927	600,818	785,326	3,962,903	12,521,495
1931	57,466	131,915	78,815	472,045	381,830	406,823	2,519,495	8,352,185

[1] Revised figures.
[2] Sales of bentonite included under "Miscellaneous clay" prior to 1930 when separate figures first became available.

Clay sold by producers in the United States in 1931, by States and kinds

State	Number of operators reporting sales	Kaolin or china clay and paper clay		Ball clay		Fire clay		Stoneware clay		Miscellaneous clay [1]		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	9					64,649	$84,480					64,649	$84,480
Arizona	2									([2])	([2])	([2])	([2])
Arkansas	1					319	1,116					319	1,116
California	41	398	$4,381	200	$2,400	90,676	215,706	2,338	$8,007	187,394	$350,255	281,006	580,749
Colorado	14					43,516	61,877			21,752	22,282	65,268	84,159
Connecticut	1									438	875	438	875
Delaware	2	([2])	([2])							([2])	([2])	([2])	([2])
Florida	2	([2])	([2])									([2])	([2])
Georgia	16	277,802	1,656,433									277,802	1,656,433
Idaho	2					259	3,036					259	3,036
Illinois	19			1,026	9,631	67,341	147,655	12,113	24,113	19,548	19,596	100,028	200,995
Indiana	13					97,057	86,732	310	465	100,215	41,663	197,582	128,860
Iowa	4					886	9,001			385	4,321	1,271	13,322
Kentucky	19			36,699	348,437	88,631	272,013					125,330	620,450
Maine	2					([2])	([2])			([2])	([2])	([2])	([2])
Maryland	11	1,000	1,500	9,927	47,996	9,341	33,051			5,620	8,040	25,888	90,587
Massachusetts	8					([2])	([2])			([2])	([2])	1,383	9,355
Michigan	4					21	150			164	1,141	185	1,291
Minnesota	4					250	1,500	11,913	26,195	164	436	12,327	28,131
Mississippi	1					([2])	([2])					([2])	([2])
Missouri	31	([2])	([2])	810	7,070	212,782	709,645	([2])	([2])	([2])	([2])	219,181	738,607
Montana	2					618	4,162			3,656	2,742	4,274	6,904
Nebraska	4									2,641	4,034	2,641	4,034
Nevada	3	227	1,929							1,796	9,616	2,023	11,545
New Jersey	32			5,168	26,928	100,309	432,656	6,640	33,656	23,420	22,581	135,537	515,821
New Mexico	4					985	5,526			459	918	1,444	6,444
New York	5					([2])	([2])			([2])	([2])	4,399	27,777
North Carolina	4	12,234	195,596					36	36	17	68	12,287	195,700
North Dakota	1					2	33					2	33
Ohio	55					249,386	506,343	19,116	27,568	333	900	268,835	534,811
Oklahoma	2									([2])	([2])	([2])	([2])
Oregon	1					51	170					51	170
Pennsylvania	61	39,018	175,579			383,679	962,304	3,100	8,450	33,023	59,276	458,820	1,205,609
South Carolina	9	78,923	539,659			1,557	47,061					80,480	586,720
South Dakota	1									650	2,700	650	2,700
Tennessee	7			29,177	197,336	14,381	60,074			3,383	3,383	46,941	260,793
Texas	11					1,089	7,225			20,174	140,251	21,263	147,476
Utah	7	([2])	([2])			5,440	10,171			([2])	([2])	5,599	10,894

[1] Includes adobe, shale, etc. Slip clay and bentonite are also included in this column as a matter of statistical convenience.
[2] Included under "Undistributed."

Clay sold by producers in the United States in 1931, by States and kinds—Continued

State	Number of operators reporting sales	Kaolin or china clay and paper clay		Ball clay		Fire clay		Stoneware clay		Miscellaneous clay		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Vermont	1	(2)	(2)									(2)	(2)
Virginia	3	(2)	(2)			(2)	(2)			(2)	(2)	2,672	$14,286
Washington	5					(2)	(2)	(2)	(2)	11,828	$6,965	21,322	20,801
West Virginia	6					27,415	$41,342					27,415	41,342
Wyoming	5									16,080	143,969	16,080	143,969
Undistributed		33,698	$371,876			12,521	38,009	1,900	$3,425	9,421	46,469	33,844	371,910
1931 Total	435	443,300	2,946,953	83,007	$639,798	[3] 1,473,161	[3] 3,741,038	57,466	131,915	[4] 462,561	[4] 892,481	2,519,495	8,352,185
1931 Average value per ton			6.65		7.71		2.54		2.30				3.32
1930 Total	491	[5] 533,800	[5] 3,893,814	93,488	739,787	[5 6] 2,547,162	[5 6] 6,070,663	75,832	146,513	[7] 712,621	[7] 1,670,718	3,962,903	12,521,495
1930 Average value per ton			[5] 7.29		7.91		[5] 2.38		1.93				3.16

[2] Included under "Undistributed."
[3] These totals include 19,662 tons of diaspore and burley clay, valued at $103,507, from Missouri.
[4] These totals include 1,916 tons of slip clay, valued at $13,613, from Michigan and New York and 78,815 tons of bentonite, valued at $472,045, from Arizona, California, Nevada, South Dakota, Texas, and Wyoming. Of the total bentonite California reported 41,562 tons, valued at $187,537; Nevada, 1,000 tons, valued at $5,000; and Wyoming, 16,080 tons, valued at $143,969.
[5] Revised figures. Clay reported for Georgia as fire clay, and so published in the 1930 report of this series, is kaolin and has been included under kaolin in these totals.
[6] These totals include 42,711 tons of diaspore and burley clay, valued at $224,722, from Missouri.
[7] These totals include 4,398 tons of slip clay, valued at $26,465, and 107,405 tons of bentonite, valued at $858,927.

In both 1930 and 1931 operators in 43 States reported the sale of clay as such. The leading 10 States in order of output in 1931 were as follows: Pennsylvania (18.2 per cent of the total output of the United States), California (11.2 per cent), Georgia (11 per cent), Ohio (10.7 per cent), Missouri (8.7 per cent), Indiana (7.8 per cent), New Jersey (5.4 per cent), Kentucky (5 per cent), Illinois (4 per cent), and South Carolina (3.2 per cent). These 10 States reported 85 per cent of the total in 1931; the first 5 of them reported 59.8 per cent of the total. In each of these 10 States except California, Georgia, Indiana, and South Carolina sales of fire clay in 1931 constituted more than two-thirds of the total sales, ranging from 67 per cent in Illinois to 97 per cent in Missouri.

PRODUCTION BY USES

Statistics showing the production of clay by uses are necessarily incomplete, as many clay miners do not know the purpose to which their clay is put, but it is believed that the figures given in the following table are sufficiently complete to serve as a guide in the study of the uses of domestic clays. In considering these figures it should be borne in mind that they represent chiefly the clay sold as clay by the original producers and do not include the much greater quantities of clay that are burned into clay products by those who mine their own clay.

Clay sold by producers in the United States in 1931, by uses, in short tons

Use	Kaolin	Ball clay	Slip clay	Fire clay	Stoneware clay	Bentonite	Miscellaneous clay	Total
White-bodied ware made from white-burning clays	36, 045	47, 067	------	681	310	--------	71	84, 174
Art pottery	1, 356	2, 185	------	346	1	--------	27	3, 915
High-grade tile	10, 262	17, 741	------	63, 350	4, 775	--------	504	96, 632
Chemical stoneware	--------	1, 039	------	3, 737	------	--------	--------	4, 776
Stoneware	105	------	64	5, 643	47, 783	--------	--------	53, 595
Enameling	17	112	------	--------	------	--------	--------	129
Paper filler	245, 126	30	------	370	1, 200	--------	--------	246, 726
Paper coating	28, 243	------	------	--------	------	--------	500	28, 743
Rubber	31, 931	145	------	2, 425	------	--------	--------	34, 501
Oilcloth or linoleum	6, 718	693	------	--------	------	--------	--------	7, 411
Paint filler or extender	8, 828	384	------	--------	------	--------	393	9, 605
Paint pigment	133	276	------	--------	------	--------	--------	409
Architectural terra cotta	--------	4, 386	------	22, 325	3, 182	--------	1, 295	31, 188
Asbestos products	570	------	------	1, 570	------	--------	10	2, 150
Plaster and plaster products	1, 896	------	------	--------	------	--------	540	2, 436
Slip for glazing purposes	--------	------	949	--------	------	--------	--------	949
Cement	31, 130	696	------	7, 726	------	--------	81, 644	121, 196
Calcimine	1, 619	------	------	--------	------	1, 287	--------	2, 906
Artificial abrasives	--------	2	903	--------	------	--------	--------	905
Crayons	218	------	------	--------	------	--------	--------	218
Chemicals	180	------	------	--------	------	--------	--------	180
Saggers	2, 507	976	------	52, 403	------	--------	388	56, 274
Pins, stilts, and spurs for potters' use	--------	600	------	604	------	--------	--------	1, 204
Wads	--------	5, 958	------	9, 681	------	--------	--------	15, 639
Gas retorts	--------	------	------	979	------	--------	--------	979
Fire brick and block	4, 444	250	------	590, 379	------	--------	6, 515	601, 588
Fire-clay mortar	24, 231	------	------	209, 331	------	--------	--------	233, 562
Bauxite and high-alumina brick	--------	5	------	11, 045	------	--------	--------	11, 050
Glasshouse pots	--------	------	------	24, 373	------	--------	2, 880	27, 253
Glasshouse supplies, blocks, tiles, etc	--------	------	------	1, 068	------	--------	--------	1, 068
Zinc retorts and condensers	--------	------	------	5, 961	------	--------	--------	5, 961
Clay crucibles	--------	------	------	748	------	--------	--------	748
Graphite crucibles and stoppers	--------	------	------	190	------	--------	--------	190
Foundries, steel works, etc	3, 217	------	------	195, 085	39	10, 355	10, 306	219, 002
Unspecified [1]	4, 524	462	------	263. 141	176	67, 173	276, 757	612, 233
Total, 1931	443, 300	83, 007	1, 916	1, 473, 161	57, 466	78, 815	381, 830	2, 519, 495
Total, 1930	[2] 533, 800	93, 488	4, 398	[2] 2, 547, 162	75, 832	107, 405	600, 818	3, 962, 903

[1] Includes clay for building brick, chimney tops, conduits, converters, cosmetics, enameled brick, filtering or decolorizing oil, flowerpots, flue lining, hollow building tile, matches, modeling, packing hoofs of horses, peanut coating, roofing tile, rotary-drilling mud, sewer pipe, smelters, soap, stopping clay, stove lining, taxidermy, toy marbles, turpentine cups, waterproofing, and water softener.

[2] Revised figures—caused by revising of detailed figures to following: Kaolin—saggers, 3,718 tons; fire brick and block, 45,353 tons; fire-clay mortar, 1,403 tons; unspecified, 15,707 tons. Fire clay—saggers, 75,685 tons; fire brick and block, 997,537 tons; fire-clay mortar, 447.570 tons; unspecified, 451,930 tons.

IMPORTS AND EXPORTS [2]

Total imports of clay in 1931 decreased 33 per cent in quantity and 43 per cent in value compared with 1930. Imports of kaolin, or china clay, which constituted 79 per cent of the total quantity of clay imported in 1931, decreased 36 per cent in quantity and 52 per cent in value.

Clay imported for consumption in the United States, 1927–1931

Year	Kaolin or china clay		Common blue and Gross-Almerode glass-pot clay		All other clays				Total	
					Unwrought		Wrought			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	339, 014	$2, 937, 113	3, 884	$39, 451	50, 017	$447, 888	1, 585	$24, 518	394, 500	$3, 448, 970
1928	307, 304	2, 962, 269	10, 259	90, 742	51, 163	429, 788	1, 653	23, 564	370, 379	3, 506, 363
1929	279, 981	2, 700, 296	28, 008	268, 011	49, 324	420, 689	12, 283	154, 158	369, 596	3, 543, 154
1930	236, 251	2, 197, 540	18, 900	154, 428	24, 883	209, 175	[1] 4, 984	[1] 143, 817	[1] 285, 018	[1] 2, 704, 960
1931	151, 426	1, 056, 393	15, 183	116, 446	15, 615	125, 326	[1] 8, 376	[1] 237, 859	[1] 190, 600	[1] 1, 536, 024

[1] Includes "clays or earths, artificially activated with acid or other material," as follows: 1930 (June 18 to Dec. 31), 2,663 short tons, valued at $100,779; 1931, 4,912 tons, $184,381; not separately classified prior to change in tariff.

Exports of domestic clays in 1931 decreased 22 per cent in quantity compared with 1930. Exports of fire clay, constituting 42 per cent of the total quantity and 26 per cent of the total value of clay exported in 1931, decreased 28 per cent in quantity and 37 per cent in value.

Domestic clay exported from the United States, 1927–1931

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	48, 106	$392, 327	51, 278	$725, 562	99, 384	$1, 117, 889
1928	60, 138	494, 241	60, 911	896, 350	121, 049	1, 390, 591
1929	76, 561	588, 770	76, 789	1, 117, 312	153, 350	1, 706, 082
1930	62, 660	519, 788	73, 870	1, 108, 586	136, 530	1, 628, 374
1931	45, 314	329, 112	61, 389	915, 743	106, 703	1, 244, 855

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

SAND AND GRAVEL[1]

By E. R. Phillips[2]

CONTENTS

PRODUCTION

The total output of sand and gravel reported as sold or used by producers in the United States in 1931 amounted to 153,479,044 short tons, valued at $86,280,320, a decrease of 22 per cent in quantity and 25 per cent in value compared with 1930. Production was reported for approximately 2,650 plants and pits in 1931 compared with 2,700 in 1930.

The quantity and value of all classes of sand and gravel materials decreased except sand utilized for fills, bank widening, and other miscellaneous purposes, which increased slightly in quantity but decreased in value. In comparison with 1930 glass sand decreased 9 per cent in quantity and 13 per cent in value and molding sand 36 and 40 per cent, building sand 25 and 28 per cent, building gravel 24 and 28 per cent, paving sand 24 and 27 per cent, and paving gravel 12 and 18 per cent, respectively.

The total output of sand in 1931 was 64,492,826 short tons, valued at $36,696,746, a decrease of 23 per cent in quantity and 26 per cent in value. The total output of gravel was 88,986,218 short tons, valued at $49,583,574, a decrease of 22 per cent in quantity and 24 per cent in value.

Eleven States each reported the production of over 5,000,000 tons of sand and gravel in 1931 compared with 14 States in 1930. New York, Illinois, and Indiana were the largest producers in 1931, New York reporting 17,155,174 tons, Illinois 10,297,943 tons, and Indiana 10,091,450 tons. California, Ohio, Pennsylvania, Michigan, Texas, Wisconsin, Massachusetts, and Louisiana (named in order of quantity) were the other States whose output in 1931 was 5,000,000 tons or more. The States leading in total value of output were New York, with $10,612,014, Pennsylvania with $6,977,246, and California with $6,222,779.

The washed and screened, or otherwise prepared, sand and gravel sold or used by producers in 1931 was 120,647,222 short tons (79 per cent of the total sand and gravel produced), valued at $75,023,189.

[1] Work on manuscript completed November, 1932.
[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

In addition to the sand sold or used by producers for the purposes listed in this report other sand was finely ground or pulverized for use in paint, pottery, fillers, and similar products. In 1931 the output of such ground material totaled 183,880 short tons, valued at $1,196,425. The production of ground sand and sandstone is discussed in the Mineral Resources chapter on Silica.

Sand and gravel sold or used by producers in the United States, 1927–1931

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	93, 588, 339	$54, 291, 398	103, 865, 930	$61, 238, 388	197, 454, 269	$115, 529, 786
1928	97, 737, 717	56, 132, 406	111, 381, 151	63, 075, 531	209, 118, 868	119, 207, 937
1929	99, 253, 054	60, 801, 357	123, 318, 851	72, 034, 622	222, 571, 905	132, 835, 979
1930	83, 658, 618	49, 721, 553	113, 393, 108	65, 454, 990	197, 051, 726	115, 176, 543
1931	64, 492, 826	36, 696, 746	88, 986, 218	49, 583, 574	153, 479, 044	86, 280, 320

Sand and gravel sold or used by producers in the United States, 1930 and 1931, by uses

Use	1930		1931	
	Short tons	Value	Short tons	Value
Sand:				
Glass	1, 849, 101	$3, 210, 973	1, 677, 882	$2, 779, 245
Molding	3, 336, 855	3, 547, 154	2, 138, 305	2, 122, 049
Building	33, 599, 524	18, 850, 936	25, 178, 572	13, 661, 056
Paving	36, 367, 468	18, 674, 649	27, 459, 581	13, 714, 822
Grinding and polishing	1, 115, 915	1, 613, 022	607, 589	1, 105, 213
Fire or furnace	258, 241	333, 727	88, 189	131, 640
Engine	1, 773, 204	1, 219, 070	1, 604, 123	1, 012, 548
Filter	80, 326	167, 947	55, 319	119, 825
Other [1]	5, 277, 984	2, 104, 075	5, 683, 266	2, 050, 348
	83, 658, 618	49, 721, 553	64, 492, 826	36, 696, 746
Gravel:				
Building	28, 271, 902	21, 346, 251	21, 426, 814	15, 449, 709
Paving	64, 408, 274	37, 349, 936	56, 716, 230	30, 605, 181
Railroad ballast [2]	20, 712, 932	6, 758, 803	10, 843, 174	3, 528, 684
	113, 393, 108	65, 454, 990	88, 986, 218	49, 583, 574
Grand total	197, 051, 726	115, 176, 543	153, 479, 044	86, 280, 320

[1] Includes some sand used for railroad ballast, fills, etc.
[2] Includes some gravel used for fills and other purposes. The quantity of gravel reported as used exclusively for railroad ballast was as follows: 1930, 16,227,543 tons, valued at $5,554,684; 1931, 8,814,907 tons, valued at $2,898,598.

Sand and gravel sold or used by producers in the United States in 1931, by States and uses

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			38,428	$23,607	181,340	$59,173	330,182	$158,354			(1)	(1)	(1)	(1)
Arizona					91,183	85,684	63,073	32,698					(1)	(1)
Arkansas	(1)	(1)	(1)	(1)	86,418	52,231	397,572	205,469					7,389	$4,372
California	(1)	(1)	23,612	56,122	1,623,722	1,000,513	2,227,875	1,322,194	11,489	$37,928	(1)	(1)	(1)	(1)
Colorado					92,563	55,153	83,881	38,238	(1)	(1)			(1)	(1)
Connecticut			346	853	249,059	139,453	194,371	145,370	1,587	4,065				
Delaware			(1)	(1)	17,530	13,504	59,298	26,249	(1)	(1)	(1)	(1)	18,300	7,320
District of Columbia					(1)	(1)	(1)	(1)						
Florida	1,500	$1,125			122,220	63,881	158,023	76,443	600	500			(1)	(1)
Georgia	5,400	5,400	(1)	(1)	106,320	28,627	316,175	122,368	14,954	7,307	1,000	$425	(1)	(1)
Idaho					670	417	(1)	(1)					(1)	(1)
Illinois	415,766	415,766	317,314	240,798	1,416,399	605,400	2,007,844	841,188	170,752	427,102	2,684	3,355	72,782	38,958
Indiana	(1)	(1)	134,575	72,631	980,183	437,599	793,090	305,083			(1)	(1)	54,281	18,380
Iowa			11,321	9,917	360,907	144,373	825,061	277,210	1,670	2,772			22,356	9,182
Kansas					859,611	381,698	669,936	325,266	(1)	(1)			74,275	45,303
Kentucky			3,904	6,935	259,999	252,436	262,929	142,628			(1)	(1)	17,989	11,470
Louisiana			80	16	554,884	196,066	1,021,852	435,059					12,394	5,175
Maine					23,369	13,787	(1)	(1)	384	516			(1)	(1)
Maryland					115,411	62,770	993,573	675,199					(1)	(1)
Massachusetts	150	750	27,969	31,966	897,948	610,501	760,547	520,455	1,451	2,329			67,325	46,403
Michigan	(1)	(1)	421,635	146,420	996,580	356,418	1,164,563	384,141	55,588	16,748	(1)	(1)	9,826	2,874
Minnesota			(1)	(1)	664,443	274,774	918,949	299,422	(1)	(1)			(1)	(1)
Mississippi					118,457	32,304	88,185	20,393					(1)	(1)
Missouri	129,146	192,401	23,104	17,758	914,930	404,502	947,896	483,048	(1)	(1)			22,689	10,973
Montana					21,496	16,957							(1)	(1)
Nebraska					401,986	149,188	419,448	190,318					68,458	22,647
Nevada	1,536	2,918	301	512	15,928	12,835	16,448	26,097						
New Hampshire					3,000	1,500	134,074	65,603						
New Jersey	115,076	154,708	326,492	370,112	1,507,036	896,780	924,568	494,944	31,343	64,790	14,001	19,836	26,215	11,782
New Mexico					29,770	22,147	(1)	(1)	(1)	(1)			9,891	7,327
New York	(1)	(1)	242,785	394,659	5,589,575	3,035,767	4,564,729	2,327,335	(1)	(1)	(1)	(1)	118,598	76,366
North Carolina					40,464	12,215	109,894	25,477					(1)	(1)
North Dakota					15,583	10,278								
Ohio	(1)	(1)	301,896	406,637	1,567,786	870,544	1,274,088	652,954	28,137	114,184	21,298	48,953	44,019	35,495
Oklahoma	(1)	(1)			251,357	116,530	218,087	101,893					23,668	13,154
Oregon					179,281	128,393	111,688	64,383					(1)	(1)
Pennsylvania	328,705	632,857	190,958	259,010	1,956,996	1,659,558	1,036,700	901,964	200,791	325,085	24,578	33,718	233,354	273,124
Rhode Island			(1)	(1)	(1)	(1)	128,341	24,299						
South Carolina					(1)	(1)	309,334	86,872						

[1] Included under "Undistributed."

Sand and gravel sold or used by producers in the United States in 1931, by States and uses—Continued

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
South Dakota					33,453	$18,846	120,816	$22,320					(1)	(1)
Tennessee			(1)	(1)	209,416	128,296	314,150	178,809	(1)	(1)			37,573	$28,026
Texas	(1)	(1)	(1)	(1)	815,503	485,839	1,130,585	655,634	(1)	(1)			30,264	13,730
Utah					38,002	18,123	(1)	(1)					46,581	21,876
Vermont					3,548	3,942	2,394	1,048	4,800	$4,800			1,697	936
Virginia	(1)	(1)	10,424	$13,671	136,717	74,490	350,515	136,762	2,431	2,485	(1)	(1)	64,009	34,344
Washington			(1)	(1)	482,190	214,370	306,825	150,379					95,384	22,421
West Virginia	423,551	$807,513	(1)	(1)	214,850	209,508	379,063	261,503	(1)	(1)			216,000	151,129
Wisconsin	(1)	(1)	24,459	18,265	796,320	258,966	826,262	251,856	(1)	(1)	(1)	(1)	48,446	9,234
Wyoming							(1)	(1)						
Undistributed [2]	257,052	565,807	38,702	52,160	134,169	44,720	496,697	257,897	81,612	94,602	24,628	$25,353	160,360	90,547
	1,677,882	2,779,245	2,138,305	2,122,049	25,178,572	13,661,056	27,459,581	13,714,822	607,589	1,105,213	88,189	131,640	1,604,123	1,012,548
Average value		1.66		0.99		0.54		0.50		1.82		1.49		0.63

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			(1)	(1)	254,728	$131,707	503,125	$340,246	(1)	(1)	1,327,686	$720,143
Arizona			(1)	(1)	136,848	141,092	43,054	33,409	(1)	(1)	388,697	312,128
Arkansas			(1)	(1)	(1)	(1)	809,301	624,152	181,627	$96,823	1,555,235	1,044,276
California	(1)	(1)	63,294	$22,368	1,901,497	1,367,487	3,015,482	2,037,261	759,044	216,015	9,673,523	6,222,779
Colorado			(1)	(1)	151,428	107,297	548,978	357,245			893,033	567,222
Connecticut			431	202	115,949	90,004	6,166	6,966	1,227	501	569,136	387,414
Delaware	(1)	(1)	(1)	(1)	(1)	(1)					110,678	64,473
District of Columbia					(1)	(1)	(1)	(1)			(1)	(1)
Florida			(1)	(1)	58,826	55,585	22,568	23,248	47,184	18,311	419,560	242,383
Georgia	4,822	$4,514	7,490	2,071	(1)	(1)	36,428	23,272			509,068	204,593
Idaho			53,550	536	11,543	8,558	468,762	320,020	190,109	19,711	740,189	358,046
Illinois	3,472	5,740	422,144	189,279	1,304,299	589,940	3,568,902	1,671,339	595,585	180,609	10,297,943	5,209,474
Indiana	(1)	(1)	3,665,793	1,269,234	1,008,181	583,171	1,578,612	884,460	1,873,548	664,749	10,091,450	4,236,521
Iowa	720	1,112	72,787	24,642	209,288	190,256	1,496,078	778,051	403,208	73,763	3,403,396	1,511,278
Kansas	(1)	(1)	(1)	(1)	73,051	44,054	953,206	515,413	249,104	17,384	2,893,249	1,333,175
Kentucky			(1)	(1)	262,623	227,548	330,297	197,685	(1)	(1)	1,164,748	849,004
Louisiana	310	360	42,868	4,276	1,078,686	841,820	1,935,251	1,588,529	365,431	195,890	5,011,756	3,267,191
Maine			5,706	2,853	58,406	28,271	3,694,577	290,095	293,735	109,990	4,094,781	454,967

Maryland			(1)	(1)	(1)	(1)	777,337	836,496	(1)	(1)	2,017,788	1,701,037
Massachusetts			9,277	4,437	604,155	607,058	2,562,944	782,555	109,021	16,301	5,040,787	2,622,755
Michigan			(1)	(1)	1,112,013	502,848	3,405,843	1,448,006	607,747	265,505	8,164,571	3,361,729
Minnesota	986	2,712	127,790	28,775	500,111	449,770	1,644,036	1,220,076	608,481	114,701	4,496,777	2,404,718
Mississippi			(1)	(1)	250,727	124,904	636,193	359,124	(1)	(1)	1,218,372	592,064
Missouri			(1)	(1)	513,706	274,798	2,110,701	1,169,017	73,210	30,108	4,807,626	2,646,756
Montana			(1)	(1)	23,716	17,881	174,050	132,100	(1)	(1)	322,201	178,739
Nebraska	(1)	(1)	(1)	(1)	399,241	198,457	1,721,730	842,157	84,687	21,458	3,103,917	1,425,956
Nevada					(1)	(1)	1,666,677	892,974	(1)	(1)	2,186,249	1,029,804
New Hampshire					(1)	(1)	1,072,062	958,306	(1)	(1)	1,221,259	1,031,494
New Jersey	24,717	54,118	62,101	100,760	667,811	826,949	544,345	406,348	86,289	32,049	4,329,994	3,433,176
New Mexico					36,260	36,347	232,001	194,094	(1)	(1)	339,640	275,086
New York	(1)	(1)	35,173	24,156	3,576,613	2,880,735	2,873,949	1,833,112	146,226	33,829	17,155,174	10,612,014
North Carolina			(1)	(1)	80,983	72,121	66,514	56,275	45,862	23,142	414,282	238,053
North Dakota					20,953	22,858	(1)	(1)	(1)	(1)	89,022	40,369
Ohio	4,762	19,460	(1)	(1)	1,448,401	866,532	2,301,292	1,406,905	1,231,478	609,472	8,387,377	5,216,816
Oklahoma	(1)	(1)	(1)	(1)	93,586	65,633	305,509	177,336	10,397	7,560	937,746	529,851
Oregon			(1)	(1)	213,537	132,545	991,829	574,266	(1)	(1)	1,861,049	1,014,092
Pennsylvania			(1)	(1)	1,969,015	1,833,312	2,242,971	1,014,030	(1)	(1)	8,238,926	6,977,246
Rhode Island			(1)	(1)	5,564	3,417	370,710	118,864			522,480	168,103
South Carolina			(1)	(1)			(1)	(1)	(1)	(1)	582,308	191,782
South Dakota			(1)	(1)	13,075	12,887	2,139,022	860,444	(1)	(1)	2,369,279	931,137
Tennessee					244,503	171,951	820,522	485,325	170,273	71,084	1,824,415	1,089,178
Texas	(1)	(1)	206,092	40,793	953,239	777,134	2,192,907	1,558,742	743,777	266,570	6,081,134	3,809,267
Utah			(1)	(1)	51,148	24,490	1,089,083	631,731	167,894	36,861	1,453,335	763,902
Vermont					8,251	8,080	86,152	49,623	41,204	3,895	148,046	72,324
Virginia	(1)	(1)	(1)	(1)	114,161	117,712	473,331	374,619			1,229,683	809,432
Washington	(1)	(1)	12,258	3,791	641,809	287,279	1,481,040	680,348	174,615	43,636	3,195,156	1,405,551
West Virginia					268,713	234,507	608,619	431,187	(1)	(1)	2,128,786	2,118,434
Wisconsin	5,760	10,286	137,655	34,945	790,870	333,446	2,203,714	956,766	294,623	47,978	5,151,686	1,960,984
Wyoming					(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed [2]	9,770	21,523	758,857	297,230	199,300	159,268	910,365	462,964	1,287,588	310,789	1,315,851	643,404
	55,319	119,825	[3] 5,683,266	[3] 2,050,348	21,426,814	15,449,709	56,716,230	30,605,181	[4] 10,843,174	[4] 3,528,684	153,479,044	86,280,320
Average value		2.17		0.36		0.72		0.54		0.33		0.56

[1] Included under "Undistributed."
[2] Includes items entered as "(1)."
[3] Includes 1,020,513 tons of sand, valued at $227,175, used for railroad ballast; some sand used by the railroads and others for fills, bank widening, and stock-car bedding; and some miscellaneous material.
[4] Includes some gravel used for fills and other purposes. The quantity of gravel reported as used exclusively for railroad ballast was 8,814,908 tons, valued at $2,898,598.

VALUES

There were decreases in average values for all classes of sand and gravel except grinding and polishing, fire or furnace, and filter sand. The average value for the total output of sand and gravel sold or used by producers was 56 cents a ton in 1931 compared with 58 cents in 1930 and 60 cents in 1929. The total output of washed and screened, or otherwise prepared, sand and gravel, considered alone, averaged 62 cents a ton in 1931 and 65 cents in both 1929 and 1930; in comparing these averages it should be noted that the 1931 figures include "otherwise prepared" as well as "washed and screened" material, whereas the 1929 and 1930 averages are based on figures reported under the latter designation only.

Average value per short ton of sand and gravel sold or used by producers in the United States, 1927–1931

[Based on amounts received for sales f. o. b. pits or nearest shipping points]

Kind	1927	1928	1929	1930	1931
Glass sand	$1.50	$1.49	$1.71	$1.74	$1.66
Molding sand	1.06	1.06	1.03	1.06	.99
Building sand	.54	.53	.57	.56	.54
Paving sand	.50	.49	.52	.51	.50
Grinding and polishing sand	1.30	1.30	1.41	1.45	1.82
Fire or furnace sand	1.10	1.18	1.10	1.29	1.49
Engine sand	.63	.64	.64	.69	.63
Filter sand	2.08	1.99	2.00	2.09	2.17
Railroad ballast gravel [1]	.33	.30	.31	.33	.36
Gravel (exclusive of railroad ballast)	.69	.65	.68	.63	.59
All sand and gravel	.59	.57	.60	.58	.56

[1] Includes some gravel used for fills and other purposes. The average value per ton for the gravel used exclusively for railroad ballast was $0.31 in 1928, $0.32 in 1929, $0.34 in 1930, and $0.33 in 1931.

GLASS SAND

The production of glass sand in 1931 totaled 1,677,882 short tons, valued at $2,779,245, a decrease of 9 per cent in quantity and 13 per cent in value compared with 1930. In 1931 glass sand was produced in 19 States, of which the largest producers (in order of quantity) were West Virginia, Illinois, Pennsylvania, Missouri, and New Jersey; the output in these States ranged from 423,551 tons in West Virginia to 115,076 tons in New Jersey. The States leading in total value of glass sand were West Virginia, Pennsylvania, Illinois, and Missouri, the total ranging from $807,513 in West Virginia to $192,401 in Missouri.

The average value per short ton f. o. b. plant or pit for the total output of glass sand was $1.66 in 1931 compared with $1.74 in 1930 and $1.71 in 1929. The average value for the total output of glass sand in the individual States ranged from 33 cents to $5 a short ton in 1931, compared with 35 cents to $5.20 in 1930.

Glass sand sold or used by producers in the United States, 1927–1931

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1927	2,171,693	$3,257,790	$1.50	1930	1,849,101	$3,210,973	$1.74
1928	2,310,828	3,435,645	1.49	1931	1,677,882	2,779,245	1.66
1929	2,219,677	3,788,471	1.71				

MOLDING SAND

The output of molding sand in 1931 was 2,138,305 short tons, valued at $2,122,049, a decrease of 36 per cent in quantity and 40 per cent in value compared with 1930. In 1931 molding sand was reported from 27 States, of which the largest producers (in order of quantity) were Michigan, New Jersey, Illinois, Ohio, New York, Pennsylvania, and Indiana; the output in these States ranged from 421,635 tons in Michigan to 134,575 tons in Indiana. The States leading in total value of molding sand were Ohio, New York, New Jersey, Pennsylvania, Illinois, Michigan, and Indiana, the total ranging from $406,637 in Ohio to $72,631 in Indiana.

The average value per short ton f. o. b. plant or pit for the total output of molding sand was 99 cents in 1931 compared with $1.06 in 1930 and $1.03 in 1929. The average value for the total output of molding sand in the individual States in 1931 ranged from 20 cents to $4.38 a short ton.

Molding sand sold or used by producers in the United States, 1927–1931

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1927	4,194,975	$4,458,508	$1.06	1930	3,336,855	$3,547,154	$1.06
1928	4,781,765	5,089,969	1.06	1931	2,138,305	2,122,049	.99
1929	6,195,343	6,410,343	1.03				

IMPORTS

Imports of sand and gravel into the United States, as recorded by the Bureau of Foreign and Domestic Commerce, were 420,721 short tons, valued at $303,901, in 1931, compared with 1,832,850 tons, valued at $719,345, in 1930, a decrease of 77 per cent in quantity and 58 per cent in value. Imports of glass sand were 35,045 tons, valued at $76,363, in 1931, compared with 24,700 tons, valued at $42,203, in 1930. Imports of "Sand, not specially provided for" were 262,198 tons, valued at $164,238, in 1931. Imports of gravel declined from 448,896 tons, valued at $202,968, in 1930 to 123,478 tons, valued at $63,300, in 1931.

Canada was the source of 88 per cent of the sand and gravel imported in 1931; 11 per cent came from Belgium, and the remaining 1 per cent came from United Kingdom, France, Netherlands, Mexico, Germany, and Cuba. Compared with 1930, imports from Canada in 1931 decreased 79 per cent in quantity and those from Belgium 45 per cent.

The values given for imports represent the foreign market value (or the export value, if higher) plus the cost of containers and all expenses incident to placing merchandise ready for shipment to the United States, including export tax, if any.

Sand and gravel imported for consumption in the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	736,271	$302,551	1930	1,832,850	$719,345
1928	788,222	392,111	1931	420,721	303,901
1929	1,666,387	751,602			

Sand and gravel imported for consumption in the United States, 1929–1931, by classes

Class	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Glass sand [1]			24,700	$42,203	35,045	$76,363
Other sand	1,106,974	$446,259	[2] 1,359,254	[2] 474,174	[3] 262,198	[3] 164,238
Gravel	559,413	305,343	448,896	202,968	123,478	63,300
	1,666,387	751,602	1,832,850	719,345	420,721	303,901

[1] Beginning June 18, 1930, classification reads "Sand containing 95 per cent silica and not more than 0.6 per cent oxide of iron and suitable for manufacture of glass."
[2] Includes 793,009 tons of "Sand, other than glass," valued at $252,380, imported June 18 to Dec. 31; not separately recorded prior to change in tariff.
[3] Classification reads "Sand, n. s. p. f."

Sand and gravel imported into the United States, 1929–1931, by countries

[General imports]

Country	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	1,539,883	$625,385	1,743,093	$597,477	371,475	$185,305
Cuba					1	15
Mexico	54,656	15,511	2,749	1,605	433	391
Europe:						
Belgium	87,457	65,019	85,110	99,109	46,849	99,863
France	1,214	10,948	980	6,906	703	4,763
Germany	1,786	1,922	101	3,826	20	307
Netherlands	519	5,916	456	5,116	449	4,885
Norway	1	5				
United Kingdom	296	2,520	183	4,890	791	8,372
Asia:						
China	(1)	8				
India (British)	2,573	24,363	167	366		
Japan			11	50		
Africa: Liberia	(1)	5				
	1,688,385	751,602	1,832,850	719,345	420,721	303,901

[1] Less than 1 ton.

EXPORTS

Exports of sand and gravel in 1931 totaled 217,870 short tons, valued at $418,441, a decrease of 33 per cent in quantity and 27 per cent in value compared with 1930.

Sand and gravel exported from the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	421,243	$557,644	1930	323,090	$570,107
1928	737,368	638,288	1931	217,870	418,441
1929	486,378	809,831			

LIME [1]

By A. T. Coons

CONTENTS

SUMMARY

Sales of lime by producers in the United States amounted to 2,707,614 short tons, valued at $18,674,913, in 1931, a decrease of 20 per cent in quantity and 27 per cent in value from 1930; sales in 1930 decreased 21 per cent in quantity and 23 per cent in value from 1929. Production in 1931 was slightly less than in 1904 (2,707,809 tons), the first year for which authoritative figures of production are recorded; the value in 1931, however, was nearly twice that in 1904. The 1931 output represented the smallest production since 1921 (2,532,153 tons) and reflected the continued country-wide industrial depression indicated by slower activity in the building, agricultural, and chemical industries. Conditions in the lime industry were unsettled, with general decreases in price and demand. Lime for construction (947,085 tons, valued at $6,940,250) was affected most by the unfavorable business situation and decreased 21 per cent in quantity and 31 per cent in value from 1930; this is the sixth consecutive year in which a decrease was recorded for this class of lime, and the output in 1931 was the smallest since 1918. Lime for chemical use (1,463,217 tons, valued at $9,810,514) decreased 20 per cent in quantity and 26 per cent in value. Lime for agricultural use (297,312 tons, valued at $1,924,149) decreased 13 per cent in quantity and 19 per cent in value. Ohio and Pennsylvania, the largest lime-producing States, decreased 11 and 22 per cent, respectively, in quantity; Illinois and Massachusetts were the only States producing considerable quantities of lime to report increased output (7 and 15 per cent, respectively). In Illinois the increase was due chiefly to the inclusion in 1931 of one company which purchases its stone and manufactures both commercial lime and lime for its own use; in Massachusetts production was increased to care for trade usually supplied by plants in States where operations were curtailed in 1931.

The total number of plants that reported operations in 1931 was 345, 30 less than in 1930. During the past 10 years numerous im-

[1] Work on manuscript completed September, 1932.

portant factors have contributed to the abandonment or consolidation of many plants. The average value per ton at the plant of the total lime sold has decreased steadily each year from $9.81 in 1923 to $6.90 in 1931. The average value per ton for building lime ($7.33) was $1.01 less than in 1930; for chemical lime ($6.70), 47 cents less; and for agricultural lime ($6.47), 45 cents less. Except for the output of 1 firm in Alabama, 1 in Utah, and 1 in Illinois whose product is partly commercial, the accompanying tables do not include lime that is not a commercial product but is burned, for use in manufacturing, from stone either quarried or purchased by the manufacturer. Such stone is reported to the Bureau of Mines as raw limestone and is included in the statistics on stone; it is used mainly by alkali works, carbide works, sugar refineries, paper mills, and smelters and other metallurgical plants.

PRODUCTION

Lime sold by producers in the United States, 1927–1931

Year	Number of plants in operation	Short tons	Value [1]	
			Total	Average
1927	417	4,414,932	$38,638,413	$8.75
1928	411	4,458,412	36,449,635	8.18
1929	381	4,269,768	33,478,848	7.84
1930	375	3,387,880	25,616,486	7.56
1931	345	2,707,614	18,674,913	6.90

[1] 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 by producers in the United States in 1931, by States

State	Number of plants in operation	Short tons	Value	State	Number of plants in operation	Short tons	Value
Alabama	8	137,423	$823,437	New Jersey	1	(1)	(1)
Arizona	4	22,567	222,785	New Mexico	2	(1)	(1)
Arkansas	2	22,520	153,733	New York	9	49,574	$412,351
California	9	41,371	389,696	North Carolina	1	(1)	(1)
Colorado	4	4,646	50,823	Ohio	24	656,441	4,007,004
Connecticut	1	(1)	(1)	Oregon	2	(1)	(1)
Florida	2	(1)	(1)	Pennsylvania	105	497,258	3,378,088
Georgia	1	5,139	34,339	Puerto Rico	12	11,302	138,122
Hawaii	1	7,332	89,911	Rhode Island	1	2,042	24,846
Idaho	3	880	8,580	South Dakota	1	2,682	29,000
Illinois	9	96,105	718,952	Tennessee	10	113,268	566,694
Indiana	8	81,925	502,232	Texas	6	45,553	384,392
Iowa	1	(1)	(1)	Utah	7	18,192	172,534
Kentucky	1	(1)	(1)	Vermont	7	30,226	271,417
Maine	3	28,157	250,028	Virginia	26	100,659	654,665
Maryland	11	36,445	268,148	Washington	5	20,619	215,033
Massachusetts	6	123,607	1,108,036	West Virginia	15	170,420	985,687
Michigan	5	46,716	334,015	Wisconsin	15	42,621	372,244
Minnesota	3	(1)	(1)	Undistributed		65,480	600,215
Missouri	12	224,416	1,481,240				
Montana	1	2,028	26,666		345	2,707,614	18,674,913
Nevada	1	(1)	(1)				

[1] Included under "Undistributed."

Lime sold by producers in the United States in 1931, by uses

Use	Quantity		Value	
	Percentage of total	Short tons	Total	Average
Agricultural	11.0	297,312	$1,924,149	$6.47
Building	35.0	947,085	6,940,250	7.33
Chemical:				
Glass works	2.2	59,148	345,780	5.85
Metallurgy	10.7	290,352	1,714,368	5.90
Paper mills	10.6	286,745	1,781,793	6.21
Refractory lime (dead-burned dolomite)	9.0	243,769	1,866,971	7.66
Sugar refineries	.7	18,185	211,625	11.64
Tanneries	2.0	54,604	372,321	6.82
Other uses [1]	18.8	510,414	3,517,656	6.89
Total chemical	54.0	1,463,217	9,810,514	6.70
	100.0	2,707,614	18,674,913	6.90
Hydrated lime (included in above totals)	41.3	1,119,266	7,729,047	6.91

[1] Details of distribution shown in table on page 256.

Lime sold by producers in the United States in 1931, by States and uses

State	Building		Agricultural		Chemical: Glass works		Chemical: Paper mills		Chemical: Sugar refineries		Chemical: Tanneries		Chemical: Metallurgy		Chemical: Other chemical		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	32, 807	$209, 898	(1)	(1)			34, 062	$171, 159	(1)	(1)			44, 964	$278, 566	25, 065	$160, 714	137, 423	$823, 437
Arizona	7, 113	85, 452	(1)	(1)	(1)	(1)					(1)	(1)	2, 229	16, 119	13, 059	119, 083	22, 567	222, 785
Arkansas	(1)	(1)					(1)	(1)							(1)	(1)	22, 520	153, 733
California	20, 299	205, 290	2, 482	$24, 588			(1)	(1)	(1)	(1)	(1)	(1)	6, 589	48, 634	8, 009	75, 076	41, 371	389, 696
Colorado	1, 461	15, 675	70	1, 050									2, 461	27, 248	654	6, 850	4, 646	50, 823
Connecticut	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Florida	(1)	(1)	(1)	(1)											(1)	(1)	(1)	(1)
Georgia	5, 139	34, 339															5, 139	34, 339
Hawaii	321	4, 810	636	2, 226					6, 375	$82, 875							7, 332	89, 911
Idaho	782	8, 256	98	324													880	8, 580
Illinois	22, 380	182, 367	(1)	(1)	(1)	(1)	2, 737	18, 498			6, 700	$52, 910	18, 321	125, 796	45, 653	337, 143	96, 105	718, 952
Indiana	16, 492	98, 917	3, 442	14, 101	1, 027	$5, 461	13, 796	73, 307			3, 412	23, 300	7, 587	41, 542	36, 169	245, 604	81, 925	502, 232
Iowa	(1)	(1)															(1)	(1)
Kentucky	(1)	(1)	(1)	(1)									(1)	(1)	(1)	(1)	(1)	(1)
Maine	10, 246	119, 426	5, 797	32, 020			(1)	(1)			(1)	(1)			2, 266	24, 900	28, 157	250, 028
Maryland	(1)	(1)	34, 860	257, 063											(1)	(1)	36, 445	268, 148
Massachusetts	87, 055	838, 679	7, 555	46, 855			(1)	(1)			(1)	(1)			14, 063	103, 311	123, 607	1, 108, 036
Michigan	1, 641	13, 086	(1)	(1)			35, 586	256, 341			(1)	(1)	(1)	(1)	8, 896	60, 241	46, 716	334, 015
Minnesota	(1)	(1)					(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)
Missouri	41, 586	326, 883	590	3, 961	(1)	(1)	14, 435	82, 405	(1)	(1)	4, 512	30, 199	29, 342	155, 814	133, 130	875, 944	224, 416	1, 481, 240
Montana	1, 736	22, 814											187	2, 487	105	1, 365	2, 028	26, 666
Nevada	(1)	(1)					(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)															(1)	(1)
New Mexico	(1)	(1)													(1)	(1)	(1)	(1)
New York	6, 674	51, 803	8, 708	64, 093			6, 597	60, 206	(1)	(1)	2, 848	27, 546	7, 591	62, 192	(1)	(1)	49, 574	412, 351
North Carolina	(1)	(1)															(1)	(1)
Ohio	378, 400	2, 158, 637	48, 885	210, 479	53, 599	308, 468	20, 284	122, 591			(1)	(1)	(1)	(1)	135, 228	1, 086, 295	656, 441	4, 007, 004
Oregon	(1)	(1)															(1)	(1)
Pennsylvania	95, 271	724, 116	142, 712	1, 022, 174	2, 550	17, 265	34, 890	222, 914	272	2, 176	19, 719	126, 495	72, 985	388, 842	128, 859	874, 106	497, 258	3, 378, 088
Puerto Rico	2, 333	32, 125	1, 812	11, 242					7, 031	92, 655					126	2, 100	11, 302	138, 122
Rhode Island	1, 163	16, 306	814	7, 570											65	970	2, 042	24, 846
South Dakota	2, 682	29, 000															2, 682	29, 000
Tennessee	33, 286	223, 806	570	2, 488			42, 726	174, 661	1, 500	8, 900	1, 701	9, 127	10, 532	43, 728	22, 953	103, 984	113, 268	566, 694
Texas	25, 767	234, 977	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	9, 195	86, 334	45, 553	384, 392
Utah	3, 341	40, 935											(1)	(1)	(1)	(1)	18, 192	172, 534
Vermont	13, 729	143, 834	2, 965	13, 715			(1)	(1)			1, 447	15, 262	(1)	(1)	9, 197	77, 543	30, 226	271, 417
Virginia	34, 153	261, 331	18, 213	111, 293			10, 689	61, 747	(1)	(1)	7, 618	42, 866	(1)	(1)	24, 850	149, 454	100, 659	654, 665
Washington	5, 248	63, 201	721	9, 020			7, 946	72, 348	17	207	90	720	2, 362	22, 658	4, 235	46, 879	20, 619	215, 033
West Virginia	16, 864	96, 840	13, 433	70, 096	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	33, 129	153, 804	97, 092	608, 175	170, 420	985, 687
Wisconsin	30, 388	246, 159	(1)	(1)			8, 709	67, 348			(1)	(1)			3, 019	54, 899	42, 621	372, 244
Undistributed	48, 728	451, 288	2, 949	19, 791	1, 972	14, 586	54, 288	398, 268	2, 990	24, 812	6, 557	43, 896	52, 073	346, 938	32, 295	283, 657	65, 480	600, 215
	947, 085	6, 940, 250	297, 312	1, 924, 149	59, 148	345, 780	286, 745	1, 781, 793	18, 185	211, 625	54, 604	372, 321	290, 352	1, 714, 368	754, 183	5, 384, 627	2, 707, 614	18, 674, 913

[1] Included under "Undistributed."

BUILDING LIME

Sales of lime for construction amounted to 947,085 short tons, valued at $6,940,250, in 1931, a decrease of 21 per cent in quantity and 31 per cent in value from 1930. The average value per ton of building lime dropped $1.01 (more than the decrease in any other class of lime), and reports of producers indicate that lime of this class apparently was affected more by building-trade conditions, competition, and price decreases than chemical or agricultural lime. Except for Indiana and Massachusetts, where there were increases, all the principal producing States showed decreased output of building lime in 1931. Ohio, Pennsylvania, Massachusetts, and Missouri were the largest producers of lime for building; sales for this purpose from Ohio, Pennsylvania, and Missouri decreased 14, 16, and 40 per cent, respectively. Ohio produced 40 per cent of the building lime sold by producers in 1931 compared with 36 per cent in both 1929 and 1930; 99 per cent of the output in 1931 was hydrated lime, of which the greater part was sold as high-grade finishing lime. Sales from Ohio, classified according to kinds of lime, are given in the following table:

Lime sold by Ohio producers for construction, 1929–1931

	1929		1930		1931	
	Short tons	Value	Short tons	Value	Short tons	Value
Quicklime	12,676	$83,102	9,090	$62,472	4,946	$31,832
Hydrated lime	576,802	4,645,914	428,684	3,268,271	373,454	2,126,805
	589,478	4,729,016	437,774	3,330,743	378,400	2,158,637

Of the total hydrated lime sold by producers in 1931, Ohio produced 426,144 short tons (10 per cent less than in 1930) or 38 per cent. Of the State total, 373,454 tons (88 per cent) were sold for construction and were distributed widely throughout continental United States. Figures of distribution of hydrated lime, as reported to the Bureau of Mines, presented for blocks of contiguous States roughly comprising various freight-rate zones, are given in the following table. Possibly some of the lime reported as supplied to the various districts is reshipped by dealers.

Shipments of hydrated lime from plants in the United States and in Ohio in 1931, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (per cent)	Short tons	Distribution (per cent)	Group total (per cent)
Illinois, Indiana, Michigan, Ohio	264,106	23.6	169,835	39.9	64.3
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	472,837	42.2	182,475	42.8	38.6
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	54,810	4.9	14,071	3.3	25.7
Florida, Georgia, North Carolina, South Carolina, Virginia	82,378	7.4	14,193	3.3	17.2
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	42,630	3.8	10,587	2.5	24.8
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	137,437	12.3	24,184	5.7	17.6
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	46,941	4.2	2,723	.6	5.8
Undistributed and exports	18,127	1.6	8,076	1.9	44.6
	1,119,266	100.0	426,144	100.0	38.1

CHEMICAL LIME

Sales of lime for chemical use amounted to 1,463,217 short tons, valued at $9,810,514, in 1931, a decrease of 20 per cent in quantity and 26 per cent in value from 1930. The demand for chemical lime in 1931, while slightly better than that for building lime, was materially smaller than in 1930 for most of the chemicals shown. In 1921, 38 per cent (960,104 tons) of the lime produced was reported for use in the manufacture of chemicals; in 1931, 54 per cent was so reported. Pennsylvania, Ohio, Missouri, and West Virginia are the largest producers of chemical lime. The quantity and value of lime used in the various chemical industries, so far as reported to the Bureau of Mines, are given in the tables on pages 253 and 254 and in the following table.

Chemical lime sold by producers in the United States for "other uses" in 1931

Use	Short tons	Value	Use	Short tons	Value
Alcohol manufacture and dehydration	2,168	$14,375	Rubber	2,899	$21,858
Alkali works (ammonia, soda, potash)	14,079	81,240	Salt refining	3,034	19,110
Bleaching powder	7,378	44,099	Sand-lime and slag brick	17,530	114,021
Bleach, liquid	14,066	104,082	Sanitation (sewage and garbage purification, etc.)	11,527	70,425
Calcium acetate	2,500	14,350	Silica brick	8,876	57,038
Calcium carbide	23,907	137,652	Soap	11,634	55,672
Coke and gas manufacture (gas purification and plant by-products)	22,584	145,320	Textiles	1,238	11,673
Glue	6,390	42,951	Water purification	160,384	1,095,946
Insecticides (spraying materials)	21,197	182,148	Wood distillation	1,098	8,898
Oil and fat manufacture	17,940	142,979	Undistributed [1]	47,665	373,202
Paint (calcimine, whitewash, varnish, etc.)	6,096	49,714	Unspecified	106,224	730,903
				510,414	3,517,656

[1] Lime used in acid neutralization and drying, acetic acid, asphalt and fertilizer filler, baking powder, bichromate refining, buffing compounds, calcium phosphate, cellulose, ceramics, corn products, creameries and dairies, cyanide manufacture, depilatories, disinfectants (chloride of lime, etc.), dyes, explosives, filtration, flotation, flour mills, food products, fruit juices, gelatin (edible), magnesia, medicine, nitrogen manufacture, oil refining, oxygen purification, retarder, stock food, and tobacco.

Sales of the various classes of chemical lime by States can not be given on account of the small number of firms reporting a given product. It is also necessary to classify much material as "unspecified," because many of the manufacturers do not report the uses of that part of their lime which they sell for chemical purposes. This lime is known to be applied to several of the uses enumerated, but the figures given are the best available.

AGRICULTURAL LIME AND OTHER LIMING MATERIALS

Sales of lime for agricultural use in 1931 (297,312 short tons, valued at $1,924,149) represented a decrease of 13 per cent in quantity and 19 per cent in value from 1930. Seventy-four per cent of the agricultural lime sold (218,920 tons, valued at $1,502,042) was hydrated lime, and 26 per cent (78,392 tons, valued at $422,107) was quicklime. Pennsylvania, Ohio, Maryland, and Virginia are the largest producers of agricultural lime. Each of these States except Ohio showed decreased output compared with 1930, but production in some of the smaller producing States increased. Lime manufactured from oyster shells and used for agriculture decreased in output, as did calcareous marl used mainly for this purpose. The oyster-shell lime given in the table that follows was all reported from Virginia. Lime is also manufactured from oyster shells in California and Texas, but it is used chiefly for chemicals and is not included here. The following table gives available data on the quantity and value of different kinds of liming materials sold by producers in 1931. The output of crushed or ground limestone used for agricultural purposes in 1931 (1,421,050 short tons, valued at $2,117,141) represented a decrease of 44 per cent in quantity and 36 per cent in value from 1930. It was reported that cheap burnt lime took the place of ground limestone for agriculture in some sections, especially the Middle West. Continued effects of the drought in many of the States that usually apply lime and limestone to the soil and the farmers' lack of purchasing power were factors in the lessened demand for pulverized limestone.

Agricultural lime and other liming materials sold by producers in the United States in 1931, by kinds

Kind	Short tons		Value	
	Gross	Effective lime content	Total	Average
Lime from limestone:				
Quicklime	78,392	66,000	$422,107	$5.38
Hydrated	218,920	145,000	1,502,042	6.86
Lime from oyster shells [1]	11,207	9,400	85,884	7.66
Limestone (pulverized)	1,421,050	611,000	2,117,141	1.49
Calcareous marl	25,056	11,000	65,935	2.63

[1] Bureau of Fisheries, Statistical Bull. 977, 1932, p. 7.

The figures in the preceding table do not include calcareous marl used for the manufacture of cement; they represent the output of fresh-water marl, chiefly for agriculture. The producing States in 1931 were California, Illinois, Michigan, Nevada, North Carolina, Ohio, Pennsylvania, Virginia, West Virginia, and Wisconsin.

HYDRATED LIME

Statistics of the output of hydrated lime include only the product made in hydrating machines; they exclude hand-slaked lime. The output in 1931 (1,119,266 short tons, valued at $7,729,047) represented a decrease of 16 per cent in quantity and 25 per cent in value from 1930. The hydrated product was reported by six less companies in 1931 than in 1930. The greater part of the hydrated lime is sold for construction; in 1931, 58 per cent of the total was sold for this purpose, 23 per cent for the manufacture of chemicals, and 19 per cent for agricultural uses. Compared with 1930, sales of hydrated lime decreased as follows: For construction, 17 per cent in quantity and 30 per cent in value; for chemical purposes, 15 per cent in quantity and 18 per cent in value; and for agricultural uses, 13 per cent in quantity and 19 per cent in value.

Hydrated lime sold by producers in the United States, 1927–1931

Year	Number of plants in operation	Short tons	Value	
			Total	Average
1927	157	1,596,906	$14,581,695	$9.13
1928	164	1,612,818	13,540,215	8.40
1929	157	1,550,771	12,771,525	8.24
1930	163	1,329,562	10,357,445	7.79
1931	157	1,119,266	7,729,047	6.91

Hydrated lime sold by producers in the United States in 1931, by States

State	Short tons	Value	State	Short tons	Value
Alabama	19,754	$145,694	Pennsylvania	183,795	$1,449,838
California	12,727	122,164	Rhode Island	950	8,816
Georgia	5,139	34,339	Tennessee	32,168	212,632
Hawaii	7,311	89,601	Texas	24,265	232,072
Illinois	28,169	219,875	Vermont	8,659	73,422
Indiana	43,534	289,713	Virginia	36,544	255,924
Maryland	24,928	192,571	West Virginia	47,515	288,421
Massachusetts	25,782	157,522	Wisconsin	8,397	65,772
Michigan	8,777	71,820	Undistributed [1]	66,646	656,316
Missouri	87,389	645,326			
New York	20,673	154,696		1,119,266	7,729,047
Ohio	426,144	2,362,513			

[1] Arizona, Arkansas, Colorado, Connecticut, Florida, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Puerto Rico, South Dakota, Utah, and Washington.

Hydrated lime sold by producers in the United States in 1931, by uses

Use	Short tons	Value	Use	Short tons	Value
Agricultural	218,920	$1,502,042	Chemical—Continued.		
Building	645,600	4,210,488	Sugar refineries	9,853	$107,846
			Tanneries	20,598	150,418
Chemical:			Other uses	190,840	1,482,812
Glass works	1,793	14,276			
Metallurgy	9,218	88,418	Total chemical	254,746	2,016,517
Paper mills	22,444	172,747			
				1,119,266	7,729,047

EXPORTS AND IMPORTS [2]

Lime exported from the United States amounted to 11,924 short tons, valued at $129,934, in 1931, a decrease of 18 per cent in quantity and 32 per cent in value from 1930. Lime (hydrated and "other" lime, exclusive of dead-burned dolomite) imported for consumption amounted to 14,458 short tons, valued at $181,867, a decrease of 30 per cent in quantity and 35 per cent in value. Hydrated lime decreased 32 per cent and "other" lime 30 per cent in quantity imported. As figures on imports of dead-burned or sintered dolomite, used as a refractory, are available for the year 1931 but only for a portion of 1930, the data can not be compared.

Lime exported from the United States, 1927–1931

Year	Short tons	Value	Year	Short tons	Value
1927	15,478	$210,977	1930	14,536	$192,421
1928	18,188	245,004	1931	11,924	129,943
1929	17,334	239,440			

[2] Figures on exports and imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Lime exported from the United States in 1931, by countries

Country	Short tons	Value	Country	Short tons	Value
North America:			South America:		
Canada	8,194	$69,498	Argentina	25	$732
Central America—			Chile	59	1,190
British Honduras	2	39	Colombia	72	1,545
Costa Rica	3	45	Ecuador	68	1,824
Guatemala	92	1,898	Peru	511	9,446
Honduras	4	76	Venezuela	10	275
Nicaragua	98	2,507	Europe:		
Panama	186	3,335	Italy	26	949
Salvador	81	942	Sweden	16	462
Mexico	1,280	11,604	United Kingdom	17	331
Newfoundland and Labrador	90	1,666	Asia:		
West Indies—			China	3	70
British—			Japan	267	10,428
Bermudas	28	446	Philippine Islands	65	2,231
Jamaica	71	1,427	Africa: Liberia	2	65
Other British	31	590	Oceania: Australia	(1)	8
Cuba	18	427			
Dominican Republic	580	5,193		11,924	129,943
Netherland	9	237			
Virgin Islands of the United States	16	457			

[1] Less than 1 ton.

Lime imported for consumption in the United States, 1927–1931

Year	Hydrated lime		Other lime		Dead-burned dolomite		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	5,010	$80,440	14,557	$276,396	(1)	(1)	19,567	$356,836
1928	5,707	88,738	12,614	255,558	(1)	(1)	18,321	344,296
1929	6,347	97,238	15,154	293,498	(1)	(1)	21,501	390,736
1930	3,336	40,381	17,370	238,516	[2] 3,024	[2] $77,918	23,730	356,815
1931	2,268	26,622	12,190	155,245	6,051	152,795	20,509	334,662

[1] Not separately recorded.
[2] June 18 to Dec. 31; not separately recorded prior to change in tariff.

Lime (exclusive of dead-burned dolomite) imported into the United States, 1930 and 1931, by countries and districts

[General imports]

Country	District	1930		1931	
		Short tons	Value	Short tons	Value
Canada	Buffalo			15	$53
	Dakota	135	$168		
	Los Angeles	2,221	35,329		
	Maine and New Hampshire	214	2,946	190	2,527
	San Francisco			1,618	26,241
	Vermont	38	427	28	294
	Washington	18,023	237,844	12,518	150,917
Germany	Indiana			(1)	86
	New York	29	1,239	12	588
Hong Kong	Hawaii			(1)	7
Japan	Washington	(1)	20	(1)	8
United Kingdom	New York			8	278
	Philadelphia	46	924	69	868
		20,706	278,897	14,458	181,867

[1] Less than 1 ton.

SHIPMENTS

Shipments of lime, as reported to the Bureau of Mines by the producers, have been combined in the following tables to show for 1931 the movement of this product according to its origin (sales), shipments into State, shipments from State, and probable consumption or supply in each State and according to its origin in and destination in State groups which approximately comprise various freight-rate zones. The figures in the second of these tables do not include a small quantity of lime (1 per cent of the total) comprising the production in Hawaii and Puerto Rico, the shipments abroad, and the product for which distribution is not recorded. No account is taken of reshipments beyond the original point of destination indicated at the time the lime left the producing plant.

Lime supplies available for consumption in continental United States in 1931, by States, in short tons

State	Sales by producers	Shipments from State	Shipments into State	Supply			
				Hydrated lime	Quicklime	Total	Pounds per capita [1]
Alabama	137,423	38,515	3,881	10,473	92,316	102,789	77
Arizona	22,567	9,379	90	1,095	12,183	13,278	60
Arkansas	22,520	13,750	2,718	4,066	7,422	11,488	12
California	41,371	4,495	21,739	19,996	38,619	58,615	20
Colorado	4,646	566	6,275	4,004	6,351	10,355	20
Connecticut	(2)	(2)	19,813	12,313	13,040	25,353	31
Delaware	----------	----------	27,727	13,089	14,638	27,727	231
District of Columbia	----------	----------	13,522	12,052	1,470	13,522	55
Florida	(2)	(2)	17,582	13,751	12,051	25,802	34
Georgia	5,139	1,307	20,272	18,191	5,913	24,104	17
Idaho	880	686	864	409	649	1,058	5
Illinois	96,105	43,597	92,780	60,061	85,227	145,288	38
Indiana	81,925	49,864	44,232	39,771	36,522	76,293	47
Iowa	(2)	----------	(2)	15,028	27,807	42,835	35
Kansas	----------	----------	26,041	16,013	10,028	26,041	28
Kentucky	(2)	(2)	26,119	8,203	18,711	26,914	20
Louisiana	----------	----------	45,520	7,550	37,970	45,520	43
Maine	28,157	10,748	27,297	11,839	32,867	44,706	112
Maryland	36,445	14,512	45,612	39,225	28,320	67,545	82
Massachusetts	123,607	93,744	34,928	20,445	44,346	64,791	30
Michigan	46,716	30,327	95,176	55,256	56,309	111,565	45
Minnesota	(2)	(2)	8,952	11,788	9,499	21,287	17
Mississippi	----------	----------	10,686	3,517	7,169	10,686	11
Missouri	224,416	170,771	18,148	27,854	43,939	71,793	39
Montana	2,028	409	1,170	1,670	1,119	2,789	10
Nebraska	----------	----------	7,696	5,518	2,178	7,696	11
Nevada	(2)	(2)	1,121	733	1,220	1,953	42
New Hampshire	----------	----------	10,218	3,263	6,955	10,218	44
New Jersey	(2)	----------	(2)	87,711	47,762	135,473	66
New Mexico	(2)	(2)	9,736	1,209	9,811	11,020	51
New York	49,574	25,925	273,412	150,900	146,161	297,061	47
North Carolina	(2)	(2)	44,531	18,759	27,855	46,614	29
North Dakota	----------	----------	5,928	4,718	1,210	5,928	17
Ohio	656,441	450,328	65,277	109,018	162,372	271,390	81
Oklahoma	----------	----------	17,559	10,620	6,939	17,559	14
Oregon	(2)	(2)	8,256	4,751	3,907	8,658	18
Pennsylvania	497,258	214,658	148,545	157,914	273,231	431,145	89
Rhode Island	2,042	492	10,222	5,694	6,078	11,772	34
South Carolina	----------	----------	12,918	7,850	5,068	12,918	15
South Dakota	2,682	----------	1,451	1,848	2,285	4,133	12
Tennessee	113,268	90,237	9,793	12,887	19,937	32,824	25
Texas	45,553	11,342	2,626	24,674	12,163	36,837	12
Utah	18,192	935	239	3,144	14,352	17,496	68
Vermont	30,226	27,823	976	1,256	2,123	3,379	19
Virginia	100,659	66,422	34,061	23,827	44,471	68,298	56
Washington	20,619	6,861	1,948	2,521	13,185	15,706	20
West Virginia	170,420	149,082	50,082	11,946	59,474	71,420	82
Wisconsin	42,621	12,253	51,580	21,876	60,072	81,948	55
Wyoming	----------	----------	1,916	843	1,073	1,916	17
Undistributed	65,480	32,879	177,198	----------	----------	----------	----------
	2,688,980	[3] 1,571,907	1,558,433	1,101,139	1,574,367	2,675,506	43

[1] Based on Bureau of the Census preliminary statement.
[2] Included under "Undistributed."
[3] Includes 13,474 tons of lime exported or unspecified by producers as to destination.

Lime shipped in continental United States in 1931, by origin and destination of shipments, in short tons

Destination	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Rhode Island, Vermont			Florida, Georgia, North Carolina, Virginia		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
Illinois, Indiana, Michigan, Ohio	232,517	240,371	472,888	5,235	43,007	48,242	40	10	50	95	541	636
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	182,825	77,343	260,168	259,862	393,225	653,087	15,107	65,719	80,826	13,930	34,435	48,365
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	14,071	1,274	15,345	6,213	23,589	29,802	34,476	78,684	113,160		1,773	1,773
Florida, Georgia, North Carolina, South Carolina, Virginia	14,193	927	15,120	4,779	11,413	16,192	3,626	174	3,800	35,736	31,650	67,386
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	11,863	7,365	19,228	664	3,431	4,095				65		65
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	39,394	46,857	86,251	1	33	34		3	3			
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	3,570	154	3,724									

Lime shipped in continental United States in 1931, by origin and destination of shipments, in short tons—Continued

Destination	Alabama, Kentucky, Tennessee			Arkansas, Iowa, Minnesota, Missouri, Texas, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quick-lime	Total	Hydrated lime	Quick-lime	Total	Hydrated lime	Quick-lime	Total	Hydrated lime	Quick-lime	Total
Illinois, Indiana, Michigan, Ohio	415	3,973	4,388	25,804	52,528	78,332				264,106	340,430	604,536
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia				1,113	334	1,447				472,837	571,056	1,043,893
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont				50	89	139				54,810	105,409	160,219
Florida, Georgia, North Carolina, South Carolina, Virginia	23,953	50,861	74,814	91	333	424				82,378	95,358	177,736
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	28,307	144,870	173,177	1,731	20,437	22,168				42,630	176,103	218,733
Arkansas, Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, Texas, Wisconsin	85	82	167	97,777	132,818	230,595	180	254	434	137,437	180,047	317,484
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming				7,729	14,923	22,652	35,642	90,887	126,529	46,941	105,964	152,905

MAGNESIUM AND ITS COMPOUNDS [1]

By P. M. Tyler [2]

CONTENTS

MAGNESITE

STATISTICAL SUMMARY

Summary of statistics for magnesite in the United States, 1927–1931

	1927	1928	1929	1930	1931
Crude:					
Mined—					
Short tons	121,490	127,200	187,660	129,320	73,602
Value	$1,090,550	$1,098,550	$1,500,000	$1,033,130	$499,239
Sales by producers—					
Short tons	1,800	620		1,120	1,325
Average value per ton [a]	$9.52	$9.18		$12.87	$11.21
Imports for consumption....short tons	856	762	300	842	499
Apparent new supply....do	2,656	1,382	300	1,962	1,824
Domestic....per cent	67.8	44.9		57.1	72.6
Caustic calcined:					
Sales by producers—					
Short tons	13,890	13,310	11,390	8,580	5,900
Average value per ton [a]	$32.60	$34.17	$35.56	$30.30	$30.68
Imports for consumption....short tons	9,568	5,474	6,500	3,911	2,891
Apparent new supply....do	23,458	18,784	17,890	12,491	8,791
Domestic....per cent	59.2	70.9	63.7	68.7	67.1
Dead-burned:					
Sales by producers—					
Short tons	40,210	45,230	78,700	49,460	28,231
Average value per ton [a]	$24.63	$23.80	$19.60	$18.27	$19.31
Imports for consumption....short tons	49,693	57,007	50,379	41,417	10,349
Apparent new supply....do	89,903	102,237	129,079	90,877	38,580
Domestic....per cent	44.7	44.2	61.0	54.4	73.2

[a] Average receipts f. o. b. mine shipping point.

[1] Work on manuscript completed July, 1932.
[2] Unless otherwise stated, statistics prepared by A. E. Davis and data on imports compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

GENERAL REVIEW

World-wide conditions in 1931 did not favor the magnesite industry. In the United States, total sales of caustic calcined magnesite declined 29.6 per cent from the already depressed figures of 1930, reflecting slowed building construction. Sales of dead-burned magnesite of both domestic and imported origin declined 57.5 per cent; this appears all the more serious compared with the reduction of only 35 per cent in basic open-hearth steel operations, normally considered a fairly good barometer of the market for dead-burned magnesite. There is reason to believe that repair work at many furnaces was neglected in 1931, and the necessity of reducing inventories all along the line prompted consumers to use their own stocks before committing themselves to further purchases. Even so, the statistician is tempted to conclude that the figures suggest further increase in the substitution of cheaper refractory materials accompanied by other changes in practice tending to reduce the amount of magnesite required per ton of steel. In previous chapters of this series, attention has been called to the substitution of chromite for magnesite. Dolomite products have long tended to displace magnesite wherever they prove more economical, and other refractory materials are also encroaching on the magnesite market.

The magnesite industry has been extraordinarily unfortunate in competing with industries producing other materials. Magnesite has been displaced by dolomite (limestone) in making sulphite paper pulp and carbon dioxide, and in sundry minor applications. Far more disappointing was the collapse in the demand for caustic magnesite for stucco. Heretofore, losses in the iron and steel industry have been offset to a large extent by the rapid growth in the aggregate demand created by the steadily increasing output of steel, but recent events again bring up the threat of actual shrinkage in ultimate demand even in this field. Before the World War 6 to 14 pounds of magnesite were consumed in making a ton of steel. In 1929 the total apparent consumption of dead-burned magnesite was 4.6 pounds per ton of steel ingots and castings produced in the United States. In 1930 the corresponding figure was somewhat less, and in 1931 the calculation on the same basis (disregarding inventory adjustments) shows scarcely 3 pounds of magnesite purchased from foreign and domestic sources per ton of steel produced.

Abroad, the most significant economic developments were the remarkable expansion of production in Russia and further increases in Yugoslavia and other new sources of supply accompanying decreases in output in the leading centers of production, especially Austria and Greece. The magnesite cartel, comprising the principal German, Austrian, and Czechoslovak producers, is said to have approached the Soviet authorities with a view to undertaking the marketing of the Russian surplus.

TECHNOLOGY

Of special significance is the announcement by A. E. Fitzgerald, General Refractories Co., of the manufacture of unburned magnesite brick that are superior to burned magnesite brick as shown by rattler tests, crushing-strength tests, spalling, permeability to gases, and various other tests. The new brick are formed from dead-burned magnesite, properly graded as to size, mixed with a colloidal lubricant and binder, and finally consolidated under a pressure of 10,000 pounds per square inch (about 10 times the pressure ordinarily used for brick that are to be burned), thereby eliminating voids and reducing to a minimum subsequent shrinkage. The new brick are better shaped than preburned brick, cost less, and promise to give better service in use. Due to its resistance to vitrification and spalling this grade of magnesite brick has been recommended for use in the burning zones of rotary Portland-cement kilns. It is stated that mixtures of cement clinker and unburned magnesite brick are more refractory than mixtures of the clinker with high-alumina lining materials.

Publicity has also been given a new magnesium chloride cement patented by Dr. Howard S. Lukens, of the chemistry department of the University of Pennsylvania. In addition to having extraordinary hardness and strength the new mixture is nonhygroscopic. Because of its superior strength a thin coat of this material—¼ to ⅜ inch thick—will replace a ¾-inch coat of ordinary gypsum wall plaster.

DOMESTIC PRODUCTION

In 1931 mines in the United States produced 73,602 short tons of crude magnesite, 43 per cent less than in 1930; the total value is estimated at $499,239, the lowest in any year since 1915. An increase of 18 per cent was reported in the quantity sold raw, but as most of the output is sold in advanced condition (either dead-burned or caustic calcined) the total estimated value is more or less nominal. However, total receipts from actual sales of all magnesite—crude, caustic calcined, and dead-burned—by producers were only $741,099, less even than in 1921 when, although the production was less than two-thirds as large as in 1931, sales consisted mainly of the relatively high-priced caustic calcined magnesite for oxychloride cements.

Sales of magnesite of domestic origin by producers in 1931 were 1,325 short tons of crude, valued at $14,849, an increase of 18 per cent in quantity and 3 per cent in value over 1930; 5,900 tons of caustic calcined, valued at $180,997, a decrease of 31 per cent in quantity and 30 per cent in value; and 28,231 tons of dead-burned, valued at $545,253, a decrease of 43 per cent in quantity and 40 per cent in value. Data for earlier years are given in the statistical summary at the beginning of this chapter.

As in previous years, the production was wholly from California and Washington.

Crude magnesite mined in the United States, 1927-1931

Year	California		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	43,750	$507,500	77,740	$583,050	121,490	$1,090,550
1928	41,300	454,300	85,900	644,250	127,200	1,098,550
1929	[1] 187,660	[1] 1,500,000	(1)	(1)	187,660	1,500,000
1930	[1] 129,320	[1] 1,033,130	(1)	(1)	129,320	1,033,130
1931	[1] 73,602	[1] 499,239	(1)	(1)	73,602	499,239

[1] Washington included with California. Bureau of Mines not at liberty to publish figures.

MARKETS AND PRICES

Dead-burned magnesite was quoted in trade journals for 1931 at $29 per short ton f. o. b. California mines through March; April 9 the quotation changed to $28 per ton, which was maintained until July 9 when the price fell to $25 per ton f. o. b. California mines, remaining at that figure until the end of the year. The quotation for the 93 per cent product (artificial periclase) was reduced from $70 to $68 on the same basis. Dead-burned magnesite was quoted at $22 f. o. b. Chewelah, Wash., throughout the year. In August the price of high-grade ground caustic calcined magnesite (95 per cent) was scaled down from $48 to $45 per ton, whereas 90 per cent caustic remained nominally at $40, both f. o. b. California producing points; producers reported sales of high-grade material as high as $38 per ton, but much of the output was sold as low as $27 per ton f. o. b. California mines.

IMPORTS

As shown in the statistical summary at the beginning of this chapter, imports of magnesite in all forms for consumption declined in 1931; for dead-burned magnesite the decrease from 1930 amounted to 75 per cent. The following tables show changes in imports from the various countries. Of special interest is the relatively large increase in imports from Soviet Russia (a new source of magnesite) in 1931 when shipments from other countries were declining. Magnesite brick of Russian origin, imported into bonded warehouse at Baltimore in 1930, were withdrawn for consumption in 1931.

Magnesite imported into the United States, 1927–1931, by countries, in short tons

[General imports]

Country	1927	1928	1929	1930	1931
Austria	39,752	34,997	31,908	26,304	10,214
Belgium	187	25	22	32	54
Canada	213	45		83	289
Czechoslovakia	9,666	21,876	12,520	19,080	5,635
Germany	74	358	59	264	95
Greece	840	760	310	976	779
India, British	5,795	3,426	4,259	2,563	1,305
Italy	317		1,634	5	14
Netherlands	3,167	1,959	2,055	1,102	713
Poland and Danzig	(1)				
Soviet Russia in Europe			276	714	4,714
United Kingdom	213	56	139	72	93
	60,224	63,502	53,182	51,195	23,905

[1] 1,100 pounds.

Magnesite imported into the United States in 1931, by countries and classes

[General imports]

Country	Crude		Caustic calcined: Lump		Caustic calcined: Ground		Dead-burned and grain (not suitable for manufacture into oxychloride cements)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Austria							10,214	$140,037
Belgium					54	$1,800		
Canada	6	$328					283	21,226
Czechoslovakia							5,635	83,465
Germany					39	2,056	56	1,506
Greece	370	3,630			409	9,520		
India, British	123	1,457	1,148	$19,143			34	322
Italy					14	370		
Netherlands			24	685	689	17,867		
Soviet Russia in Europe							4,714	84,951
United Kingdom			6	169	87	2,813		
	499	5,415	1,178	19,997	1,292	34,426	20,936	331,507

DOMESTIC INDUSTRY BY STATES

California.—Three companies operating four mines contributed to the production of California magnesite in 1931. As in former years, the mines of the C. S. Maltby Magnesite Co. (Ltd.) in Santa Clara County were the largest source of supply in the State. This company operated 4 stack kilns and 1 rotary furnace, producing both caustic calcined and dead-burned magnesite. The Sierra Magnesite Co. (Ltd.), the second largest producer in the State, operated its Bald Eagle mine in Stanislaus County, near Gustine, and its mine in Tulare County, at Magnesite, 12 miles east of Porterville. The company calcining plant is at Porterville, where both caustic calcined magnesite and "periclase," a special grade of dead-burned magnesite, are produced in two rotary kilns. The Sierra Magnesite Co. took over the Maltby mines in November, 1931, but did not ship any magnesite from the property as the plant had been destroyed by fire and the owners were engaged during the winter in constructing the rotary calcining equipment they are now using. The California Magnesite Co. continued for a time to operate the Red Mountain mine in Stanislaus County (formerly leased to the Red Mountain Magnesite Co.) and produced crude and calcined magnesite for 85 per cent magnesia heat insulation; it discontinued all operations in June, 1931. The Sampson Magnesite Co. did not operate its mine in San Benito County in 1931. Other mines and prospects in these and in Alameda, Fresno, Placer, San Bernardino, Sonoma, and Tuolumne Counties reported no production in 1931.

Nevada.—The United States Brucite Corporation, affiliated with the Standard Slag Co., Youngstown, Ohio, reported development work only in 1931 at its brucite deposits in Nye County, east of Luning. According to press reports a substantial deposit of magnesite running parallel to the brucite has been encountered in diamond drilling. By midsummer of 1931, 22 holes, some 400 feet deep, had been sunk, but continued shortage of water impeded further drilling. A new discovery of high-grade magnesite was reported in White Pine County 28 miles from Ely and readily accessible to the Tonopah-Ely highway.

Washington.—The Northwest Magnesite Co., operating the Finch mine near Chewelah, Stevens County, was again the only producer in Washington. One of its 6 rotary kilns was operated 7 months, and 2 were operated 3 months. The plant was shut down 2 months. In addition to its regular production of dead-burned magnesite the company continued the production of "Thermax," a magnesite wood product used in sound-proofing and thermoinsulation.

The Crosby Magnesite Co. and the Double Eagle Mining Co. produced no magnesite from their properties in 1931.

WORLD PRODUCTION

World production of magnesite, 1926–1930, by countries, in metric tons [1]

[Compiled by M. T. Latus, of the Bureau of Mines]

Country	1926	1927	1928	1929	1930
Australia:					
New South Wales	10,428	10,178	10,840	9,097	8,794
South Australia	230	335	46	137	37
Victoria	96	73	73	27	(2)
Austria	237,000	356,000	310,000	438,000	304,396
Canada	11,429	18,523	33,311	39,216	25,073
China	(2)	[3] 21,400	(2)	(2)	(2)
Cyprus [4]	83	16			
Czechoslovakia [5]	83,135	84,563	87,396	101,118	71,388
France			600		(2)
Greece	95,638	84,484	104,421	84,023	77,310
India, British	30,950	19,953	24,798	23,874	16,788
Italy	19,842	16,304	11,690	17,172	4,122
Norway	715	1,090	932	1,809	2,206
Russia [6]	103,017	[7] 106,583	[7] 119,985	132,710	(2)
Turkey				196	357
Union of South Africa	1,884	1,839	1,481	1,709	1,910
United States	121,109	110,213	115,393	170,241	117,317
Yugoslavia		[8] 1,680	[8] 6,267	[8] 6,615	13,068

[1] Unless otherwise stated, quantities in this table represent crude magnesite mined.
[2] Data not available.
[3] As estimated by the Geological Survey of China. (General Statement of the Mining Industry, Peiping.)
[4] Exports.
[5] Exports, less imports, of crude and sintered magnesite, the sintered being reduced to crude on the basis of 2.1 tons crude to 1 ton sintered.
[6] Year ended Sept. 30.
[7] Exclusive of magnesite sand, as follows: 1927, 77,211 tons; 1928, 8,799 tons.
[8] Serbia only.

FOREIGN SOURCES

Australia.—Magnesite has been produced in Australia principally from mines in New South Wales, but deposits of the compact or Grecian type occur in other States. Occurrences in Western Australia are described in a recent official report.[3]

Austria.[4]—The downward trend in production of raw and dead-burned magnesite which started late in 1929 continued throughout 1931. After decreasing 31 per cent from 1929 to 1930 the output of raw magnesite dropped 41 per cent in 1931 to 179,440 metric tons, from 304,396 tons in 1930. The output of dead-burned magnesite declined 69 per cent to 38,799 metric tons, from 124,226 tons in 1930. The production of magnesite brick (included in the tonnage of dead-burned magnesite) dropped from 41,083 metric tons in 1930 to 23,817 tons in 1931. On the other hand, the output of caustic calcined magnesite in 1931 reversed its recent trend and actually increased, but the quantity was relatively small (34,760 metric tons in 1931, 29,500 tons in 1930, and 35,000 tons in 1929).

[3] Simpson, E. S., Government mineralogist, The Mineral Resources of Western Australia.
[4] Harris, E. H., Am. consul general, Vienna, Mar. 2, 1932.

In 1931, as in 1930, only the two leading companies—Veitscher Magnesitwerke A. G. and Oesterreichisch-Amerikanische Magnesit A. G.—produced dead-burned magnesite. On account of excessive stocks the plant at Wald, Styria, owned by the Oesterreichische Alpine Montangesellschaft, the leading Austrian steel concern, was closed. The two leading companies were responsible for more than 83 per cent of the output of raw crystalline and amorphous magnesite; the other two companies furnished only 30,600 tons in 1931, all amorphous. About 63 per cent of the total output of caustic calcined magnesite was contributed by the Austro-American concern.

Exports of dead-burned magnesite were 27,491 metric tons compared with 58,039 in 1930, a drop of 53 per cent. Whereas in former years the United States has been a large buyer of Austrian magnesite, exports to this country in 1931 were only 6,618 tons, or less than one-fourth of the total exports. England, Germany, France, and Italy were other principal buyers of Austrian dead-burned magnesite which, however, has virtually a world market. As usual, Germany was the principal foreign purchaser of Austrian caustic calcined magnesite, and France and Czechoslovakia bought significant quantities. Notwithstanding the increase in production of this item, however, exports declined to 18,403 tons in 1931 from 26,882 tons in 1930. Austrian exports of raw magnesite, mostly to German border districts, increased to 5,039 tons from only 926 tons in 1930.

Prices are regulated by agreements among the producers, but in harmony with depressed demand they tended slightly downward. On December 31, 1931, the domestic retail price of dead-burned magnesite, including the 2 per cent turnover tax, was equivalent to $19.30 per metric ton, f. o. b. Styrian plant. The quotation for American trade was $24.70, c. i. f. United States Atlantic port.

Many important changes of ownership in the stock of leading Austrian magnesite companies occurred in 1931. A considerable number of the shares of the Veitsch company, formerly held by the Oesterreichische Credit Anstalt für Handel und Gewerbe, was sold to a foreign group. The result was apparently to increase substantially the French interest, as a majority of the 10,500 shares formerly owned by the Austrian bank (previously reported as about 17 per cent of the total) was acquired by M. de Wendel, the well-known steel manufacturer of Alsace-Lorraine.

Canada.—According to the Dominion Bureau of Statistics the production of "calcined or clinkered" magnesite in Canada was 11,411 short tons, valued at $295,579, compared with 13,336 tons, valued at $336,162, in 1930. An even more serious decline occurred in 1930. This curtailment is due to the decreased production of iron and steel in Canada and reduced exports to England. The National Research Council has aided producers in improving the quality and range of usefulness of the product, devoting special attention recently to the manufacture of refractory brick. Calcined magnesite suitable for use in the manufacture of oxychloride cement was produced and sold in Canada in 1930 for the first time on a commercial scale. The cement, a mixture of finely ground calcined magnesite with an inert filling material, is marketed under the trade name "Grenite," the source being the magnesite deposits in the Grenville district, Argenteuil County, Quebec.

Exports of dead-burned magnesite from Canada were 1,610 short tons, valued at $45,257, compared with 1,851 tons, valued at $48,536, in 1930. Formerly fairly large quantities of Canadian magnesite were shipped to the United States, but recently exports have been mainly to the United Kingdom.

Greece.—Formerly about two-thirds of the output of Grecian magnesite was shipped crude, but subsequently it has been calcined in large part locally. In 1931 exports of caustic calcined magnesite were 8,149 metric tons, of which 4,103 tons went to Germany, 1,529 tons to the Netherlands, 1,306 to France, and the remainder mainly to Italy and Great Britain. Exports of crude magnesite were only 1,222 tons, of which 517 tons went to the Netherlands and the remainder principally to France and to Belgium-Luxemburg. Very little dead-burned magnesite is produced in Greece, and none was exported in 1931. In 1928, 13,258 long tons of crude and 16,305 long tons of caustic calcined magnesite were exported from Greece; however, stocks were already increasing, and subsequently the Greek industry seems to have suffered severely from competition from Russia, Yugoslavia, and Austria, as well as from the world-wide skrinkage in demand for plastic magnesite.

The Grecian production is derived principally from Euboea. In Macedonia, however, there were five magnesite mines in 1930, and these produced 18,000 tons of crude and 7,000 tons of calcined (probably included in the figures for crude). The magnesite deposits on the island of Mytilini (formerly Turkish territory), a third source of Grecian magnesite, were recently described by a former inspector of mines of the Greek Government.[5]

Mexico.—Magnesite was mined for a time on Santa Margarita Island and shipped to California, but subsequently this ceased to be profitable. Recently attention has been drawn to deposits on the mainland, notably on the western extremity of the Santa Clara Desert west of San Ignacio, Lower California.[6]

Russia.—In 1913 Russia imported considerable quantities of magnesite to meet her own needs, but in recent years an exportable surplus has been developed. Exports, beginning with 1,059 metric tons in the fiscal year 1925–26, increased rapidly to 22,825 tons in 1929–30. Figures for later years are not available, but imports into the United States from Russia have continued to increase.

All the exports of magnesite and a large portion of the increasing domestic requirements have been mined near Satka in the Urals—in the Zlatoust district on the Samara-Zlatoust Railway. The deposit is reported to be nearly 100 feet thick and to comprise about 50,000,000 tons. After calcining the product analyzes 95.3 per cent magnesia, 1.9 per cent iron oxide, 0.8 per cent alumina, and 0.3 per cent lime.[7] Another commercial source is Chapilow in the Orenburg district. A new discovery in Khalilova in the Urals is mentioned.

South Africa.[8]—Three registered companies produce magnesite in the Union of South Africa; all have headquarters in Johannesburg. Two producers—the Apiesdoorndraai Magnesite Mine, Lydenburg

[5] Akylas, V. J., The Magnesite Deposits of Mytilini: Min. Mag. (London), vol. 45, July, 1931, pp. 18–22.
[6] Baker, D. D., Mineral Resources of Baja California: Min. Jour. (Arizona), vol. 14, No. 20, Mar. 15, 1931, pp. 5–7.
[7] British Clayworker, Russian Magnesite: Vol. 40, No. 468, 1931, p. 3.
Jour. Am. Ceram. Soc., Abs. Bull., vol. 10, No. 8, August, 1931, p. 579.
[8] The Mining and Industrial Magazine of South Africa, Magnesite in the Union: Johannesburg, vol. 12, No. 4, 1931, p. 119.

district, and the Kaapmuiden property of the South African Steel Corporation (Ltd.), Barberton—are relatively small. About 90 per cent of the present production is credited to the Althorpe Magnesite (Ltd.), which has considerable holdings on Section B, Government Ground, Barberton. Export business has been sought in South America for Transvaal magnesite; but the c. i. f. price (around £9 a ton) has been too high, and sales have been exclusively for domestic account. The Barberton material is classed as amorphous and typically contains 98.56 per cent magnesium carbonate, about 1 per cent water, 0.13 per cent alumina, only a trace of iron, and 0.27 per cent silica. The veins form stockworks in dolomite.

Yugoslavia.[9]—Magnesite occurs abundantly in several localities, chiefly in veins and pockets of serpentine, beginning in the center of the Bosnia district, extending eastward in western Serbia, and then dividing near Cacak into two main branches—one running northward to Avala (18 kilometers south of Belgrade) and the other inclining to Kraljevo and south Serbia and thence into Greece. Considerable magnesite has been mined about 25 kilometers south of Valjevo, and well-known deposits also occur in the neighborhood of Uzice. Near Cacak is a great quantity of particularly clean magnesite.

All Yugoslav mines, although under Government control, are economically independent. The magnesite is of good quality, and general conditions favor further expansion of the industry; labor costs are low, and fuel supply and transportation facilities are satisfactory.

DOLOMITE

Hatmaker discusses miscellaneous uses of dolomite in Information Circular 6524, issued in 1931 by the Bureau of Mines.

Sales of dolomite for uses that may be considered competitive with magnesite have been segregated so far as possible from other uses which it shares with limestone or other stone. A. T. Coons of the bureau compiled the following figures.

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1927–1931

	1927	1928	1929	1930	1931
Dolomite for:					
Basic magnesium carbonate—					
Short tons	69,940	94,200	84,750	111,740	80,820
Value	$115,932	$122,260	$129,383	$189,219	$122,525
Carbon dioxide	([a])	([a])	([a])	([a])	([a])
Dead-burned dolomite—					
Short tons	434,160	522,850	516,400	453,350	268,500
Value	$424,140	$509,502	$461,444	$356,025	$183,020
Dolomitic lime for:					
Refractory (dead-burned dolomite)—					
Short tons	374,415	448,761	488,032	351,740	243,769
Value	$3,459,803	$4,283,036	$4,261,942	$3,045,082	$1,866,971
Sulphite pulp—					
Short tons	50,000	46,000	51,000	38,400	32,000
Value	$441,000	$359,000	$398,000	$295,000	$233,000
Total (calculated as raw stone)—short tons	1,355,000	1,605,000	1,654,000	1,360,000	922,000

[a] Bureau of Mines not at liberty to publish figures after 1926.

[9] Kekich, E., Am. commercial attaché, Yugoslav Magnesite Resources and Production: Commerce Rept. 34, Aug. 24, 1931, p. 479.

MAGNESIUM

GENERAL REVIEW

The quantity of magnesium ingot sold or used by the producer in 1931 increased 3.7 per cent compared with 1930, exceeding the record of every previous year except 1929. Sales for deoxidizing purposes declined greatly, reflecting low activity in brass, bronze, and nickel foundries, and sales of ribbon and wire dropped off sharply with lower demand from radio-tube manufacturers and reduced purchases of flat wire which is used chiefly in electrical heating appliances to provide an insulating material around the resistor element. Sales of magnesium powder were also curtailed further due perhaps to the growing popularity of the photoflash bulb as well as to a smaller consumption in star shells and tracer ammunition for Government use. On the other hand sales of alloys and castings increased. The decreased use of sand castings in aircraft-engine manufacture was more than offset by an increased variety of other commercial uses. Magnesium die castings were made commercially in 1931 for the first time. Demand for sheet for radio rectifiers declined in 1931; but total sales of sheet gained substantially, especially in the aircraft industry for such parts as engine cowlings, cockpit furniture, and fuel tanks. The increased use in fuel tanks was due to improved methods of making gasoline-tight joints by welding. During the year the Dow Chemical Co. installed a 60-inch rolling mill for making large sheets. Forging technique continued to advance but has not yet created any important new outlets.

The main gains in new sales tonnage have been in the replacement of aluminum and bronze parts of envelope-folding machines, cigarette machines, power sewing machines, bread slicers, and portable tools and meters, and in sundry other applications for which the reduction in the price of magnesium makes it the most economical metal.

The average price of magnesium in 1915, when commercial production began in the United States, was about $5 a pound. Progressive improvement in manufacturing methods resulted in successive reductions in the price which was cut drastically in December, 1930, to 48 cents a pound and in September, 1931, to 30 cents a pound (in quantity). At the new price magnesium, being one-third lighter than aluminum, is in direct price competition with it, volume for volume. The high lights of the developments that have led to this result together with fields of use for the metal and a glimpse of the future of the industry were adequately covered by Dr. J. A. Gann, chief metallurgist of the Dow Chemical Co., in an address before the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers in February, 1932, reprinted in various journals.[10]

Since May, 1927, the entire domestic output of primary magnesium has been supplied by the Dow Chemical Co. from magnesium chloride recovered as a joint product of its salt wells near Midland, Mich. The American Magnesium Corporation, affiliated with the Aluminum Co. of America, formerly produced magnesium by the oxide process but now confines itself to partial fabrication of the metal. At the close of 1931 the Magnesium Development Corporation was organized under a joint arrangement between the Aluminum Co. of America and

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[10] Gann, J. A., Magnesium: Metal Progress, vol. 21, No. 4, April, 1932, pp. 33–38; abstract, Min. and Met. vol. 13, April, 1932, pp. 179–183.

the principal foreign magnesium producer, the I. G. Farbenindustrie A. G. This arrangement, combining the experience, technique, and patent rights of the two companies, is said to resemble that consummated some years ago by American oil interests with the same concern with respect to the exploitation of certain patents for hydrogenation of petroleum. The I. G. or German Dye Trust has been active in both aluminum and magnesium for many years through its subsidiary companies—Aluminium Werke G. m. b. H., at Bitterfeld, and Elektron Metall G. m. b. H., at Stuttgart. The new organization will be headed by Walter H. Duisberg, and the board of directors is chosen jointly by the two parent companies.

A newly constructed experimental magnesium plant, the first in Russia, began operations in Leningrad March 30, 1931. French specialists from the Cie. Alais, Froges et Camargue are employed as advisers to the Soviet Government in both magnesium and aluminum operations. The second Five-Year Plan calls for an output of 1,000 tons of magnesium in 1933, to be increased to 81,000 tons in 1937.

TECHNOLOGY

The latest addition to the magnesium alloys developed and manufactured by the leading American producer is "Dowmetal G," which has a nominal composition of 10 per cent aluminum, 0.1 per cent manganese, and the rest magnesium; it is designed for heat-treated castings where high yield point (up to 20,000 pounds per square inch) and hardness (up to 70–80 Brinell) are required. A new flux for acetylene welding has also been introduced which combines good welding characteristics with nonhygroscopic properties, and improved technique for cleaning welded joints has been developed.

An unusual amount of space in the trade press has been devoted to discussion of the protection of magnesium and its alloys from corrosion. An alloy of magnesium containing around 1.5 per cent manganese resists sea water and other corrosive agents much better than pure magnesium, but alloying alone does not seem to solve the problem. Electroplating and various other methods for providing metallic coatings (sherardizing, colorizing, etc.) have not proved satisfactory. Magnesium articles may be plated with nickel; but the deposit becomes a black powder if the articles are immersed for even a relatively short time in water, and none of the metallic coating seems to afford suitable protection against sea water. Chemical coatings are considered promising; but apparently the best results are obtained by a chemical treatment followed by the application of paint, varnish, enamel, lanolin, etc. Potassium bichromate used in one of several forms of preparatory baths has been found greatly to improve the corrosion resistance of the painted article. For surfaces that are not machined a drastic preliminary cleaning by immersion for a few seconds in 10 per cent nitric acid (which also may contain bichromate) has been recommended.

Ravier [11] has critically reviewed the various methods employed for producing magnesium.

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[11] Ravier, F., L'industrie du magnesium en France: Chim. et Ind. (France), vol. 26, No. 6, December, 1931, pp. 1263–1270, and vol. 27, No. 1, January, 1932, pp. 31–40.

DOMESTIC PRODUCTION

Magnesium metal was first produced in the United States in 1915, mainly for use in munitions. Sales of American-made metal, after reaching 284,118 pounds, valued at $615,217, in 1918, dropped to 48,000 pounds in 1921 and then advanced steadily. Sales of domestic ingots from 1928 to 1931 and of certain fabricated forms from 1927 to 1931 are shown in the two following tables.

New ingot magnesium produced and sold in the United States, 1928–1931

Year	Produced (pounds)	Sold or used by the producer	
		Pounds	Value
1928	521, 075	530, 782	$289, 658
1929	1, 329, 669	908, 351	512, 313
1930	1, 173, 557	559, 631	268, 864
1931	(1)	580, 463	199, 633

[1] Figures not available.

Manufactured magnesium products (other than ingot) sold by producers in the United States, 1927–1931, in pounds

Product	1927	1928	1929	1930	1931
Alloys	11, 835	16, 210	13, 145	12, 297	65, 314
Castings	31, 992	55, 861	116, 350	99, 443	127, 398
Powder and shavings	31, 700	28, 104	36, 663	30, 832	23, 924
Wire and ribbon	4, 748	7, 695	7, 736	7, 898	2, 906
Rod and tubing [1]	1, 191	719	1, 864	115	194
Sheet	10, 883	8, 425	8, 512	1, 348	9, 433
Other [2]	21, 941	20, 218	12, 051	13, 558	26, 945
	114, 290	137, 232	196, 321	165, 491	256, 114
Total value	$269, 403	$301, 346	$393, 916	$309, 144	$304, 260

[1] Exclusive of extruded rods or ingots sold for metallurgical purposes.
[2] Includes forgings, extruded shapes, etc.

IMPORTS

Imports of magnesium amounted to 182,939 pounds, valued at $54,448, in 1922, but subsequently they have dwindled to almost insignificant proportions.

Magnesium imported for consumption in the United States, 1930 and 1931, by classes

Class	1930		1931	
	Pounds	Value	Pounds	Value
Metallic and scrap			140	$190
Alloys (magnesium content)	407	$346	30	81
Powder (magnesium content)	4, 144	18, 136	2, 199	2, 191
Sheets, tubing, ribbons, wire, and other n. s. p. f. (magnesium content)	1, 138	1, 117	85	118
	5, 689	19, 599	2, 454	2, 580

MAGNESIUM SALTS

DOMESTIC PRODUCTION

The production of magnesium salts—including magnesium sulphate, chloride, and carbonate—from natural salt and bittern waters in the United States in 1931 was 66,137,418 pounds, valued at $982,814, compared with 73,255,090 pounds, valued at $1,071,112, in 1930. As there were less than three producers of each of these compounds the Bureau of Mines is not at liberty to publish production figures separately.

Magnesium sulphate was produced in the United States in 1931 by the Dow Chemical Co., Midland, Mich., by treatment of the natural chloride bitterns from its salt wells by the process described in the chapter of this series for 1929. Extensive deposits of epsomite in Okanogan County, Wash., owned by the Magnesia Products Co., Portland, Oreg., which yielded a small production during the summer of 1930, were idle in 1931. Commercial magnesium chloride (flake), containing 97 per cent $MgCl_2.6H_2O$, is made by the Dow Chemical Co. and by the California Chemical Corporation which is affiliated with the Sierra Magnesite Co. and United Chemicals. The operations of the California Chemical Corporation and its principal plant at Newark on the east shore of San Francisco Bay have been described by one of its officials.[12] Long-term contracts with the three principal western salt producers assure an abundant supply of bitterns containing over 6 per cent magnesium chloride and 4 per cent magnesium sulphate, with some bromine and potassium chloride and a considerable amount of common salt. In addition to the chloride various other magnesium compounds can be produced from these bitterns, including a light magnesia and periclase. These products duplicate in fact those of the Porterville and Bald Eagle operations of the Sierra Magnesite Co., which employ magnesite as raw material. Similar bitterns have also been purchased by the Plant Rubber & Asbestos Co., Redwood City, Calif., for use in the manufacture of technical carbonate. In 1931 the Marine Chemicals Co. (Ltd.), South San Francisco, Calif., was again active in the production of magnesium carbonate from sea water by its patented process. The United States Metallic Magnesium Co. of Salt Lake City has erected a building at Harold, Utah, and pending necessary financial arrangements proposes to produce magnesium carbonates and oxides from dolomite. The State Securities Commission has granted the company permission to sell 300,000 shares of stock at not more than 25 cents a share.

IMPORTS

Magnesium compounds imported for consumption in the United States, 1927–1931

Year	Magnesium chloride (hydrated and anhydrous)		Magnesium sulphate (Epsom salts)		Calcined magnesia		Carbonate, precipitated		Magnesium silicofluoride or fluosilicate	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1927	8,185,363	$59,950	11,620,675	$60,527	259,357	$48,093	348,383	$20,115	486,504	$21,259
1928	5,799,750	41,712	10,459,596	61,600	300,897	60,325	283,264	17,512	355,917	17,675
1929	3,291,856	23,120	13,541,189	82,416	471,545	83,866	517,414	29,902	212,503	12,856
1930	2,000,081	14,480	8,079,298	54,646	392,160	73,991	446,981	24,989	67,524	4,195
1931	1,320,071	19,660	9,465,098	61,718	420,026	78,649	570,805	32,310	103,551	4,938

[12] Seaton, M. Y., Bromine and Magnesium Compounds Drawn from Western Bays and Hills: Chem. and Met. Eng., vol. 38, No. 11, November, 1931, pp. 639–641.

FOREIGN SOURCES

Germany is the principal foreign source of world supply of magnesium salts, producing about 125,000 metric tons of magnesium sulphate and 50,000 tons of solid magnesium chloride as well as quantities of chloride sold in solution. German exports of sulphate have ranged from 90,000 to 100,000 metric tons annually. Exports of chloride, which reached 43,000 tons in 1929, dropped to 40,230 tons in 1930 and 35,200 tons in 1931. The German producers are affiliated in an association under agreements that are provisionally valid until 1934 and subsequently may be extended automatically for periods of five years unless six months notice of termination is given. Notes on foreign conditions appeared in Commerce Reports.[13]

Upon recommendation of the Tariff Board the Government of India has placed a duty of 7 annas (about $0.16) per hundredweight on imports of magnesium chloride for seven years.[14]

NOTES ON USES

In the Czechoslovak rayon industry, which produced 3,200 metric tons of viscose rayon in 1930, zinc sulphate has replaced magnesium sulphate. The latter was formerly made largely from German kieserite, but as this raw material was cut off by the German potash interests zinc sulphate was promptly substituted in the precipitating solution.[15]

An interesting example of the use of magnesium sulphate for reclaiming a greenhouse soil has been described in England.[16] Water containing sodium chloride had converted part of the soil to sodium clay, rendering it unproductive. When treatment with rain water and renewal of the top soil failed to remedy the condition a base exchange was effected by treatment with 10 cwt. of magnesium sulphate per acre followed by leaching out the sodium sulphate.

Magnesium sulphate has recently been used in addition to magnesium chloride in magnesium oxychloride cements, being added in quantities sufficient just to neutralize the active lime compounds in the caustic calcined magnesite. A still later development is the use of magnesium oxysulphate cements in which no magnesium chloride is employed. Magnesium sulphate is not hygroscopic, and the oxysulphate cements do not suffer from certain disadvantages of oxychloride cements; the latter have a strong attraction for moisture and consequently absorb moisture from the air in greater or less amount, depending upon humidity and other controlling factors. The oxysulphate compositions are less corrosive than the oxychlorides but in other respects tend to be inferior. As ordinarily made they are somewhat more brittle, they gain their strength more slowly, and even after attaining their ultimate strength they are not quite so strong. A more serious defect is their loss of strength when immersed in water and their failure to recover satisfactorily even upon drying out again. The wet strength of a representative sample of oxychlo-

[13] Commerce Reports, Production and Uses of Magnesium Sulphate and Chloride: No. 7, Feb. 15, 1932, pp. 362–363.

[14] Industrial and Engineering Chemistry (news edition), Duty Levied on Magnesium Chloride: Vol. 9, No. 20, Oct. 20, 1931, p. 313.

[15] Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemicals, etc.: Vol. 6, No. 1, Jan. 4, 1932, p. 1.

[16] Taylor, E. McK., Woodman, R. M., and Hanley, F., A Note on the Reclamation of a Greenhouse Soil Containing Sodium Clay: Chem. News (London), vol. 143, Nov 13, 1931, pp. 309–311.

ride cement, for example, is roughly one-half of the dry strength, and the " recovered " strength after being dried again appreciably exceeds the original dry strength. The wet strength of oxysulphate cement, on the other hand, is only about one-fifth of the dry strength, and the " recovered " strength is only two-fifths of the original dry strength. A small amount of citric acid or of some of its salts (notably sodium citrate), however, very greatly improves the resistance of magnesium oxysulphate cements to the leaching effect of water, as disclosed in United States Patents 1853521 and 1853522 issued to Leroy C. Stewart of the Dow Chemical Co. In making oxysulphate cement, a solution of 24° to 30° B. magnesium sulphate is usually employed, and the actual quantity used may be such that the ratio by weight of magnesium sulphate ($MgSO_4.7H_2O$) to plastic magnesia in the resulting mixture is somewhat more than 1.0.

According to Swanger and Caldwell [17] of the United States Bureau of Standards magnesium oxide crucibles have been used at temperatures up to 1,800° C.; but this oxide volatilizes rapidly between 2,000° C. and its melting point (2,800° C.), especially under reduced pressure or in contact with carbon. The commercial fused magnesium oxide is not pure enough for use with pure metals; for these the chemical reagent or C.P. grade of unfused oxide has to be purchased as a bulky powder and calcined before the crucible is formed, as it shrinks to about half its volume when heated to 1,600° to 1,800° C. For ordinary purposes, however, electrically fused magnesium oxide ground to 60 mesh or finer is mixed with a water solution of magnesium chloride before being tamped into the crucible mold. The proportion recommended is 2 percent $MgCl_26H^2O$ and enough water to moisten the material sufficiently.

[17] Swanger, W. H., and Caldwell, F. R., Special Refractories for Use at High Temperature: U. S. Bureau of Standards Research Paper 327, 1931, 13 pp.

MICA[1]

By B. H. Stoddard[2]

CONTENTS

INTRODUCTION

In 1931 the mica industry in the United States experienced unfavorable trade conditions which caused declines in both quantity and value of marketed production of unmanufactured mica. Demand for domestic mica was notably curtailed, and prices reported by individual producers dropped 5 to 25 per cent.

Imports of unmanufactured mica for consumption in the United States in 1931 were 4,549,122 pounds, valued at $132,865; corresponding figures for 1930 were 4,549,461 pounds, valued at $405,760. In both 1930 and 1931 about 90 per cent of both the quantity imported and the domestic production was scrap mica.

Because of the difference in grading domestic and imported mica it is possible to compare only three of the classes—uncut mica splittings, scrap mica, and ground mica.

Imports of uncut mica splittings for consumption in 1931 were 1,523,862 pounds, valued at $450,974, compared with 2,325,695 pounds, valued at $760,643, in 1930. Consumption of uncut mica splittings in the United States exceeded imports in 1930 by 710,185 pounds and in 1931 by 522,228 pounds. This excess may be accounted for by the utilization of stocks remaining from the abnormally large imports in 1929, as the domestic production of splittings is small.

Imports of scrap mica for consumption in 1931 were 2,065 short tons (4,129,216 pounds), valued at $22,057. Commercial production of scrap mica in the United States during the same year was 6,621 short tons, valued at $99,415.

Imports of ground mica for consumption in 1931 were comparatively small, amounting to only 1,200 pounds, valued at $36. Domestic production in 1931, however, was reported to be 15,613,052 pounds, valued at $436,436.

[1] Work on manuscript completed October, 1932.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

PRODUCTION

General.—The total domestic unmanufactured mica (including sheet and scrap) sold or used by producers in the United States in 1931 was 7,102 short tons, valued at $211,245. Of the total, 481 tons (962,953 pounds), valued at $111,830, were sheet mica (757,647 pounds of punch mica, valued at $33,317, and 205,306 pounds of mica larger than punch, valued at $78,513); and 6,621 tons, valued at $99,415, were scrap mica. A small quantity of uncut domestic splittings is included in the sales of sheet mica. In 1931, as in former years, the commercial production of mica in the United States was limited almost entirely to muscovite.

Mica was produced in 11 States, as follows: Alabama, Colorado, Connecticut, Georgia, Maine, New Hampshire, New Mexico, North Carolina, South Carolina, South Dakota, and Virginia.

Domestic mica sold or used by producers in the United States, 1927–1931

Year	Sheet mica						Scrap mica		Total	
	Uncut punch mica		Uncut mica larger than punch		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1927	1,314,742	$95,011	197,750	$117,471	1,512,492	$212,482	6,280	$110,139	7,036	$322,621
1928	1,468,482	90,931	213,295	140,025	1,681,777	230,956	7,760	132,422	8,601	363,378
1929	1,752,044	98,989	283,084	187,332	2,035,128	286,321	6,253	117,901	7,271	404,222
1930	1,253,782	61,230	211,703	116,077	1,465,485	177,307	6,732	109,100	7,465	286,407
1931	757,647	33,317	205,306	78,513	962,953	111,830	6,621	99,415	7,102	211,245

Mica sold or used by producers in chief producing States, 1927–1931

State and year	Sheet mica						Scrap mica		Total	
	Uncut punch mica		Uncut mica larger than punch		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
New Hampshire:										
1927	674,219	$60,744	46,000	$18,105	720,219	$78,849	1,284	$22,909	1,644	$101,758
1928	727,775	45,354	46,368	18,116	774,143	63,470	1,291	25,232	1,678	88,702
1929	913,552	48,885	71,226	33,772	984,778	82,657	1,657	35,977	2,149	118,634
1930	616,204	29,275	56,860	24,029	673,064	53,304	449	8,743	786	62,047
1931	349,168	17,342	91,996	19,026	441,164	36,368	295	5,465	516	41,833
North Carolina:										
1927	528,978	27,347	136,382	87,167	665,360	114,514	2,995	50,505	3,328	165,019
1928	640,585	33,326	136,810	96,380	777,395	129,706	4,419	69,638	4,808	199,344
1929	737,473	40,081	156,727	110,212	894,200	150,293	3,245	53,855	3,692	204,148
1930	610,216	30,567	138,858	81,884	749,074	112,451	4,744	75,400	5,119	187,851
1931	310,366	12,894	79,060	38,763	389,426	51,657	5,312	79,601	5,507	131,258

Sheet mica.—In this report sheet mica comprises punch mica, mica larger than punch, and a very small quantity of domestic splittings. The terms "uncut sheet" and "unmanufactured sheet" are used to designate mica that has been trimmed but not cut to any specified shape.

Scrap and ground mica.—Scrap mica, usually ground to a powder before being used, is employed in various ways. The following tables show the distribution of the 1931 sales of ground mica in the United States, by methods of grinding and by consuming industries, in so far as data have been reported by producers.

In Mitchell County, N. C., commercial production of mica was obtained as a by-product of clay washing. As this product, after being screened, dried, and sized, is sold and used in the roofing industry for the same purposes as ground mica, figures of production have been included with those for both scrap and ground mica.

Ground mica sold in the United States, 1927–1931, by methods of grinding

Year	Dry ground		Wet ground		Total	
	Pounds	Value	Pounds	Value	Pounds	Value
1927	5,187,063	$90,968	6,398,320	$332,511	11,585,383	$423,479
1928	5,743,052	95,151	6,633,965	358,458	12,377,017	453,609
1929	3,637,192	62,029	5,395,005	328,332	9,032,197	390,361
1930 [1]	11,912,232	190,635	3,149,545	161,623	15,061,777	352,258
1931 [1]	10,724,952	168,783	4,888,100	267,653	15,613,052	436,436

[1] Includes sales of mica suitable for roofing purposes without grinding.

Ground mica sold to various industries in the United States in 1931

Industry	Quantity		Value
	Pounds	Per cent of total	
Roofing [1]	7,182,794	46	$83,017
Wall paper	5,330,220	34	252,908
Rubber	2,058,082	13	76,781
Miscellaneous [2]	1,041,956	7	23,730
	15,613,052	100	436,436

[1] Includes sales of mica suitable for roofing purposes without grinding.
[2] Figures cover mica used for molded electric insulation, surfacing on asphalt shingles, filler for fancy paints, ornamental tile, Christmas-tree snow, manufacture of axle greases and oil, annealing, concrete and foundry facing, pipe-line enamel, and plastic specialties.

FORMS IN WHICH MARKETED

Mica is prepared for market in the following forms: Punch mica, circle mica, mica splittings, mica larger than punch (sizes in inches), scrap mica, ground mica, and mica plate (built-up mica).

Sheet, punch, and circle mica.—Domestic sheet mica is sold on the basis of size and quality, the rectangular sizes ranging from 1½ by 2 inches to 8 by 10 inches and over. Punch mica will not yield a clear rectangle as large as 1½ by 2 inches but should yield a disk of usable mica 1½ inches in diameter if stained and 1¼ inches in diameter if clear. Circle mica will yield a somewhat larger circle and is considered as lying between punch and the smallest rectangular piece; it should contain a usable disk nearly 2 inches in diameter.

The system of classification of mica by sizes differs in the United States, Canada, and India. The following table, which has been approved by the American Society for Testing Materials, shows the present system of grading Indian mica and the approximate corresponding sizes in United States classification.

Grading of Indian mica

Grade	Area of usable mica (in square inches), based on rectangular sizes	Sizes of rectangles that can be cut (in inches)				Approximate corresponding sizes in United States classification (in inches)
		Width		Length		
		Minimum	Maximum	Minimum	Maximum	
6	1 to 2⅜					Punch.
5½	2½ to 2⅞					1½ by 2
5	3 to 5⅞	1	2	2	2½	2 by 2
4	6 to 9⅞	1½	2½	2½	3	2 by 3 3 by 3
3	10 to 14⅞	1½	3	3	4½	3 by 4
2	15 to 23⅞	1½	3½	4½	6	3 by 5
1	24 to 35⅞	3	5	5	7	4 by 6
A-1	36 to 47⅞	4	6	7	9	5 by 8
Special	48 to 59⅞					6 by 8
Extra special	60 to 79⅞					8 by 8
Extra extra special	80 and over					8 by 10

PRICES

In 1931 the range of prices per pound for domestic rough-trimmed unmanufactured sheet mica, as reported to the Bureau of Mines by producers and others engaged in the industry, was as follows:

Range of prices per pound for domestic rough-trimmed uncut sheet mica in 1931

Size	Clear	Stained	Size	Clear	Stained
Punch	$0.035-$0.05	$0.03-$0.05	3 by 4 inches	$1.15-$1.75	$0.75-$1.25
1½ by 2 inches	.20 - .35	.06- .20	3 by 5 inches	1.30- 2.00	1.00- 1.50
2 by 2 inches	.35 - .50	.20- .30	4 by 6 inches	1.60- 2.75	1.10- 2.00
2 by 3 inches	.70 - .80	.40- .50	6 by 8 inches	2.00- 4.00	
3 by 3 inches	1.00 - 1.35	.50- 1.00	8 by 10 inches	(1)	(1)

[1] None reported for 1931.

Prices of scrap mica per short ton ranged approximately from $7 to $20.

CONSUMPTION OF MICA SPLITTINGS

Utilization of splittings is the major branch of the mica industry in the United States. As the domestic production of mica splittings is very small, foreign splittings must be imported to meet the requirements of the industry.

In 1931 the consumption of mica splittings (domestic and foreign) in the United States was 2,046,090 pounds, valued at $764,672, or more than twice the quantity of commercial domestic sheet mica produced during the year. The total consumed comprised the following: Indian splittings, 1,713,954 pounds, valued at $648,169; Canadian splittings, 163,091 pounds, valued at $52,258; Madagascan splittings, 162,545 pounds, valued at $63,443; and domestic splittings, 6,500 pounds, valued at $802. These figures may not indicate total consumption, as some consumers may not have responded fully to the inquiries made of them.

IMPORTS AND EXPORTS

The following table shows the quantity and value of mica imported for consumption in the United States in 1931, by kinds.

Mica imported for consumption in the United States in 1931, by kinds

Kind	Pounds	Value
Unmanufactured:		
Waste and scrap, valued at not more than 5 cents per pound	4,129,216	$22,057
Untrimmed phlogopite mica from which rectangular pieces not exceeding in size 1 inch by 2 inches may be cut	182,785	20,661
Other—		
Valued at not above 15 cents per pound	70,416	8,608
Valued at above 15 cents per pound	166,705	81,539
	4,549,122	132,865
Manufactured:		
Cut mica	16,707	19,774
Films and splittings—		
Not cut or stamped to dimensions—		
Not above 12 ten-thousandths of an inch in thickness	1,513,253	439,094
Over 12 ten-thousandths of an inch in thickness	10,609	11,880
Cut or stamped to dimensions	3,794	12,954
Mica plates and built-up mica	1,787	3,483
All manufactures of which mica is the component material of chief value	1,947	698
Mica ground or pulverized	1,200	36
	1,549,297	487,919
	6,098,419	620,784

The following table shows the countries from which the mica imported into the United States in 1931 was last shipped. They are not necessarily those where the mica was produced.

Mica imported into the United States in 1931, by kinds and by countries

[General imports]

Country	Unmanufactured								Manufactured															
	Waste and scrap, valued at not more than 5 cents per pound (duty 25 per cent)		Untrimmed phlogopite mica from which rectangular pieces not exceeding in size 1 inch by 2 inches may be cut (duty 15 per cent)		Other				Cut mica (duty 40 per cent)		Films and splittings						Mica plates and built-up mica (duty 40 per cent)		All manufactures of which mica is the component material of chief value (duty 40 per cent)		Mica ground or pulverized (duty 20 per cent)	
					Valued at not above 15 cents per pound (duty 4 cents per pound)		Valued at above 15 cents per pound (duty 4 cents per pound+25 per cent)				Not cut or stamped to dimensions				Cut or stamped to dimensions (duty 45 per cent)							
											Not above 12 ten-thousandths of an inch in thickness (duty 25 per cent)		Over 12 ten-thousandths of an inch in thickness (duty 40 per cent)									
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Africa:																						
Madagascar							803	$658			115,212	$20,970										
Mozambique					1,679	$152																
Union of South Africa	927,352	$5,143			597	73	391	167														
Argentina					6,662	787	17,043	5,363														
Belgium							330	125														
Brazil	2,404	35	2,442	$665	18,624	2,046	61,814	28,090	198	$19												
Canada	2,755,000	14,660	207,871	22,063	2,728	351	10	3	42	87	33,465	12,698					70	$69				
France							9,130	5,501	234	672	130,254	25,678			668	$2,712	655	2,170				
Germany					118	17	1,782	701	1,605	1,773	1,000	397	95	$99	1,331	6,493	1,008	999				
India, British	444,460	2,219			38,509	4,940	21,912	17,752	9,504	10,882	812,569	203,746	9,478	9,667	935	511			688	$314	10,080	$219
Italy											11,023	1,771							120	34		
Japan											4,066	968										
New Zealand					680	60	487	227														
Switzerland																			40	126		
United Kingdom					6,025	738	40,946	17,291	4,260	6,311	68,590	16,201	1,098	1,716	238	1,270	51	218	1,099	224	1,200	36
	4,129,216	22,057	210,313	22,728	75,622	9,164	154,648	75,878	15,843	19,744	1,176,179	282,429	10,671	11,482	3,172	10,986	1,784	3,456	1,947	698	11,280	255

Mica and manufactures of mica exported in 1931 amounted to 5,239,007 pounds, valued at $258,135. As the classes of mica are not shown in export schedules, it is impossible to state what kinds of mica are exported.

Mica exported from the United States in 1931, by countries

Country	Pounds	Value
North America:		
Canada	3,751,964	$75,031
Central America—		
British Honduras	15	42
Guatemala	18	13
Honduras	512	520
Nicaragua	13	29
Panama	230	259
Salvador	40	93
Mexico	3,901	1,948
Miquelon and St. Pierre Islands	36	13
Newfoundland and Labrador	79	124
West Indies—		
British—		
Bermudas	2	27
Jamaica	66	172
Trinidad and Tobago	5	1
Cuba	253	385
Netherland	31	38
South America:		
Argentina	8,142	4,385
Bolivia	67	67
Brazil	926	764
Chile	1,031	1,788
Colombia	42	87
Ecuador	1	18
Peru	64	36
Uruguay	511	563
Venezuela	187	215
Europe:		
Azores and Madeira Islands	5	1
Belgium	203,731	25,055
Czechoslovakia	548	531
Denmark	131	61
France	142,632	8,959
Germany	194,862	12,767
Italy	10,128	4,639
Europe—Continued.		
Netherlands	691	$1,707
Norway	15	4
Soviet Russia	1,419	5,052
Spain	507	599
Sweden	7,736	320
United Kingdom	885,292	99,331
Asia:		
Ceylon	84	20
China	3,307	1,967
East Indies—		
British—		
India	719	1,404
Malaya (Straits Settlements)	23	6
Japan (including Chosen)	13,423	5,484
Java and Madura	976	281
Palestine	17	5
Persia	41	10
Philippine Islands	169	398
Syria	40	10
Africa:		
British—		
Union of South Africa	3,102	2,006
French—		
Algeria and Tunisia	50	1
Portuguese—		
Mozambique	25	94
Other	3	1
Oceania:		
British—		
Australia	1,100	747
New Zealand	95	57
	5,239,007	258,135

WORLD PRODUCTION

World production of mica, 1927–1931, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country [1]	1927	1928	1929	1930	1931
North America:					
Canada (sales)	2,484	3,320	3,677	1,061	1,135
Guatemala	7	[2] 13	[2] 1	(3)	(3)
United States (sales)	6,383	7,803	6,596	6,772	6,443
South America:					
Argentina [4]	106	120	119	100	(3)
Bolivia [2]	17	11	2	15	1
Brazil [2]	39	44	45	52	54
Europe:					
Italy	----------	----------	----------	----------	12
Norway [2]	8	85	59	53	(3)
Russia [5]	15	266	(3)	(3)	(3)
Sweden	10	12	66	73	65
Asia:					
Chosen	35	29	26	29	(3)
India, British [6]	3,937	4,850	5,897	4,212	(3)
Russia [5]	1,505	1,227	(3)	(3)	(3)
Africa:					
Ethiopia	2	----------	----------	----------	----------
Kenya Colony and Protectorate	----------	(7)	2	----------	----------
Madagascar [8]	505	861	380	348	235
Rhodesia—					
Northern	8	4	3	4	1
Southern	186	186	172	164	67
Tanganyika Territory	43	34	29	21	9
Union of South Africa (Transvaal) (sales)	1,454	3,419	1,464	501	477
Oceania:					
Australia—					
Central Australia	2	23	24	26	28
New South Wales	----------	----------	3	----------	----------
Queensland	1	----------	----------	----------	----------
South Australia	----------	2	----------	----------	2
Western Australia [2]	4	----------	----------	----------	----------

[1] In addition to the countries listed, Ceylon exported 610 kg of mica in 1929.
[2] Exports.
[3] Data not available.
[4] Rail and river shipments.
[5] Year ended Sept. 30.
[6] Exports. The figures for output are incomplete, and a more accurate idea of the size of the industry is to be obtained from the export figures. (Rec. Geol. Surv. of India, vol. 59, pt. 3, p. 273. Calcutta, 1926.) Output is reported as follows: 1927, 2,165 tons; 1928, 2,292 tons; 1929, 2,704 tons; 1930, 2,679 tons.
[7] Less than 1 ton.
[8] Exports reported as follows: 1927, 544 tons; 1928, 635 tons; 1929, 427 tons; 1930, 397 tons; 1931, 120 tons.

MINING METHODS, COSTS, AND RECOVERIES [3]

The information circular cited is one of a series designed to disseminate technical information regarding mining methods used in mica mines of the Southern Appalachian States. In addition to data on mining methods, costs, and recoveries, it contains information concerning other features of the mica industry. Copies may be obtained without charge, as long as a supply is available, by application to the Bureau of Mines.

MINERALS AND MATERIALS ALLIED TO MICA

The minerals and materials allied to mica by similarity in composition, physical characteristics, and uses include: (1) Biotite mica schist; (2) chlorite schist; (3) muscovite mica schist; (4) sericite schist; and (5) vermiculite. The figures for commercial production of these minerals and materials are not included in the figures given for mica in this report. In 1931 the combined total marketed production of chlorite schist, muscovite schist, and vermiculite was approximately 4,000 short tons, valued at $47,500.

[3] Urban, H. M., Mica-Mining Methods, Costs, and Recoveries at No. 10 and No. 21 Mines of the Spruce Pine Mica Co., Spruce Pine, N. C.: Inf. Circ. 6616, Bureau of Mines, 1932, 16 pp.

Chlorite schist.—Chlorite schist, composed of clinochlore, has been mined and sold for many years at Canton, Ga. In 1927 Thompson-Weinman & Co. (Inc.), Cartersville, Ga., began operations at the property, succeeding the American Mica Co. The product, a micaceous-looking mineral but a member of the chlorite group and not the mica group, is ground to various sizes by roller mills and used in the manufacture of roofing materials, in the paint trade, and to some extent in the manufacture of rubber goods, automobile tires, foundry facing, and lubricants.

Muscovite mica schist.—Muscovite mica schist has been ground and sold by the Victor Mica Co., Spruce Pine, N. C., for the last four years. In 1931 the mica schist sold was purchased from various miners in Mitchell County, N. C., and ground (dry) for use in the manufacture of prepared roofing materials.

Vermiculite.—Vermiculite is a form of altered biotite or phlogopite mica whose chief physical characteristic is expansion to about 16 times its normal size when subjected to heat treatment. Three producers contributed the total commercial output in 1931. J. M. Kyrl, 1526 West Twenty-second Street, Chicago, Ill., operated the Goldenite and Silverite mine in Fremont County, Colo., near Hillside. In Montana vermiculite was produced and sold by the Vermiculite & Asbestos Co. and the Zonolite Co., whose offices are in Libby and properties near Libby.

The Zonolite Co. markets its calcined product under the trade name "Zonolite." Its output is sold, however, both crude and calcined and finds application largely in the building-materials supply business as a fireproof product for house insulation (against both heat and cold), as a vermin-proof product, and for deadening sound. Other applications include use in the manufacture of calcimine or water paint; in various roofing compositions; in foundry and decorative work; in secondary or insulating refractories; and in many other ways. Among several new uses developed for zonolite in 1931 are its utilization as an acoustic panel, as a slab or board for cold insulation, and in a new roofing composition. To keep pace with the increased demand for vermiculite the company in 1931 extended its plant operations by installing new machinery and storage bins, and agency contracts have been established in several States for installing expanding plants. Through the cooperation of F. E. Schundler & Co., Joliet, Ill., the Zonolite Co. has recently arranged for the construction and operation of a heat-processing plant near Chicago. The zonolite activities of F. E. Schundler & Co. will be carried on under the name of The Zonolite Products Co. and will cover the exclusive distribution of zonolite in the United States east of the Mississippi River. The Zonolite Co. also has a licensing arrangement for installing its expanding equipment at factories of large consumers.

According to a recent communication, Gustavus Sessinghaus, Engineers Building, Denver, Colo., shipped several tons of vermiculite in 1932 from a deposit 8 miles from Buena Vista, Colo.

A deposit of vermiculite about 9 miles west of Rye, Colo., is reported to have been worked by the Nonmetallic Corporation of Chicago, Ill., in cooperation with E. F. Gobatti, Pueblo, Colo.

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BARITE AND BARIUM PRODUCTS[1]

By R. M. SANTMYERS and B. H. STODDARD[2]

CONTENTS

STATISTICAL SUMMARY

Summary of statistics on barite and barium products in the United States, 1927–1931

	1927	1928	1929	1930	1931
Crude barite:					
Produced ... short tons	214,194	259,761	275,945	237,505	210,930
Sold or used by producers—					
Short tons	254,265	269,544	277,269	234,932	174,520
Value[1]—					
Total	$1,670,878	$1,754,924	$1,850,706	$1,538,171	$994,655
Average	$6.57	$6.51	$6.67	$6.55	$5.70
Imports for consumption—					
Short tons	70,274	61,765	85,729	52,111	73,080
Value[2]—					
Total	$253,284	$190,756	$284,436	$179,579	$329,114
Average	$3.60	$3.09	$3.32	$3.45	$4.50
Apparent new supply[3] ... short tons	324,539	331,309	362,998	287,043	247,600
Domestic ... per cent	78.3	81.4	76.4	81.8	70.5
Reported consumption (total) ... short tons	330,190	334,695	334,406	325,195	265,270
Barium products:					
Sold or used by producers—					
Short tons	258,595	298,862	299,225	250,712	228,326
Value	$19,847,908	$22,451,298	$23,154,685	$18,793,515	$16,365,522
Imports for consumption—					
Short tons	24,372	28,349	23,311	18,201	12,912
Value	$1,111,020	$1,314,780	$1,168,760	$905,091	$624,272
Exports of lithopone—					
Short tons	2,110	3,326	4,556	3,665	3,821
Value	$222,585	$337,565	$463,235	$380,047	$341,257

[1] F. o. b. mine shipping point.
[2] Declared value f. o. b. foreign market.
[3] Barite sold or used by producers plus imports.

INTRODUCTION

The crude barite industry in the United States in 1931 was characterized by declines in mine production, shipments, and prices. Although the decrease in quantity of crude barite mined during the year was only 11 per cent compared with 1930, the tonnage sold or

[1] Work on manuscript completed September, 1932.
[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

used by producers was 26 per cent less than in 1930 and represents the smallest quantity since 1922. The reduction in 1931 was due to marked declines in the building construction and petroleum industries, the largest consumers of barite.

The one bright spot in the domestic barite industry during the year was the increased demand for precipitated barium sulphate (blanc fixe) by pigment manufacturers. Two additional plants made this product in 1931. The apparent total barium chemicals sold or used by producers increased 41 per cent in quantity and 54 per cent in value over 1930, but the drop in consumption of ground barite and lithopone brought the total quantity of barium products sold or used by producers to the lowest figure since 1925.

On the other hand, the quantity of crude barite imported for consumption in the United States was larger in 1931 than in any other year except 1929 and represents an increase of 40 per cent over 1930. This growth in imports when domestic production was sharply reduced is significant, especially as it does not appear to be due solely to price considerations. Much of the imported material shows a higher percentage of barium sulphate than domestic material and compares favorably in content of such impurities as iron, silica, and manganese. Additional advantages in physical characteristics are attributed to foreign barite, which is said to be easier to grind and to contribute a larger ultimate yield of lithopone than many grades of domestic barite offered to consumers along the Atlantic seaboard. Russia[3] is the latest addition to the list of countries shipping barite to the United States. Russian barite is reported to contain up to 98 per cent $BaSO_4$ with only 0.1 per cent iron (Fe_2O_3).

During the year considerable interest was shown in the discovery of a deposit of barite in northern Hot Spring County, Ark. A report of this deposit is contained in Information Circular 1, A Barite Deposit in Hot Spring County, Ark., by Bryan Parks and George C. Branner, Arkansas Geological Survey, 1932.

There were several changes in the industry during 1931. The Chemical & Pigment Co. (Inc.) closed its Democrat mine in Nevada County, Calif., and centered all production effort on its newly opened Austin mine in Shasta County, Calif. The Bertha Mineral Co. (subsidiary of the New Jersey Zinc Co.) closed its mine at Sweetwater, Tenn., and reported no output from its property at Cartersville, Ga. The Carlin mine, Elko County, Nev., belonging to the American Development Co., began operations during the year. The output from Arizona was centered in a mine in Maricopa County, 20 miles northeast of Mesa.

CRUDE BARITE

SALES

As Missouri is by far the leading barite-producing State, it bore the brunt of the reduction in quantity of crude barite sold or used by producers in 1931; its tonnage dropped about 30 per cent compared with a drop of 26 per cent for the United States. All the producing States, however, reported smaller sales totals except Georgia, which reported a slight increase, and Arizona, which had not reported any production since 1926.

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[3] Hardy, Charles, Barium and Strontium: Mineral Industry During 1930, vol. 39, p. 65.

Crude barite sold or used by producers in the United States, 1930 and 1931, by States

State	1930				1931			
	Short tons	Per cent of total	Value f. o. b. at mine		Short tons	Per cent of total	Value f. o. b. at mine	
			Total	Average			Total	Average
Arizona					2,139	1.2	$14,275	$6.67
California	19,517	8.3	$114,310	$5.86	17,500	10.0	102,085	5.83
Georgia	41,746	17.8	230,769	5.53	(1)	(1)	(1)	
Missouri	132,640	56.5	938,812	7.08	93,417	53.5	539,152	5.77
Nevada	2,647	1.1	19,457	7.35	1,400	.8	9,600	6.86
Tennessee	17,006	7.2	111,981	6.58	10,170	5.9	62,903	6.19
Virginia	10,250	4.4	73,168	7.14	(1)	(1)	(1)	
Other States[2]	11,126	4.7	49,674		49,894	28.6	266,640	
	234,932	100.0	1,538,171	6.55	174,520	100.0	994,655	5.70

[1] Included under "Other States."
[2] 1930: Figures cover South Carolina and Wisconsin; 1931: Georgia and Virginia.

CONSUMPTION BY USES

During 1931 the barite-consuming industries of the United States used 265,270 short tons of domestic and imported barite compared with 325,195 tons in 1930, a decrease of 18 per cent. This barite was apportioned as follows: For the manufacture of ground barite, 35,393 tons in 1931 compared with 69,426 tons in 1930, a decrease of 49 per cent; for lithopone, 157,181 tons, a decrease of 12 per cent from a total of 178,944 tons in 1930; and for barium chemicals, 72,696 tons compared with 76,825 tons in 1930, a decrease of 5 per cent.

Thirty plants in 13 States consumed crude barite in 1931 compared with 26 plants in 12 States in 1930. Increases in the number of plants in operation in 1931 were reported in California and New York, whereas Colorado closed its only plant. New plants were placed in operation in Kansas and Texas.

Crude barite (both domestic and imported) used in the manufacture of barium products in the United States, 1927–1931, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite	Litho-pone	Barium chem-icals			Ground barite	Litho-pone	Barium chem-icals	
1927	73,119	222,791	34,280	330,190	1930	69,426	178,944	76,825	325,195
1928	74,814	211,592	48,289	334,695	1931	35,393	157,181	72,696	265,270
1929	58,770	223,188	52,448	334,406					

Domestic and imported crude barite used in the manufacture of barium products in the United States in 1931, by States

State	Product manufactured	Plants [1]	Barite used
			Short tons
Missouri	Ground barite and chemicals	4	62,768
Illinois	Lithopone and chemicals	6	55,530
Delaware and Maryland	Lithopone	2	42,264
Pennsylvania	do	2	36,411
New Jersey	do	3	28,814
California	Ground barite, lithopone, and chemicals	6	17,220
West Virginia	Chemicals	1	22,263
Kansas	Lithopone	1	
South Carolina	Ground barite	1	
New York	Ground barite and chemicals	2	
Georgia	Ground barite	1	
Texas	do	1	
		30	265,270

[1] A plant producing more than 1 product is counted but once in arriving at State totals.

IMPORTS

Imports of crude barite for consumption in the United States in 1931 were 73,080 short tons, valued at $329,114, as compared with 52,111 tons, valued at $179,579, in 1930. The average declared or foreign market value per ton increased $1.05 (30 per cent)—from $3.45 in 1930 to $4.50 in 1931.

Crude barite imported for consumption in the United States, 1927–1931

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1927	70,274	$253,284	1930	52,111	$179,579
1928	61,765	190,756	1931	73,080	329,114
1929	85,729	284,436			

[1] Value at port of shipment on which duty is levied. Does not include railroad and ship freight charges to this country or import duty.

WORLD PRODUCTION

The following table shows the output of barite by various countries from 1927 to 1931, as far as statistics are available.

World production of barite, 1927–1931, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country	1927	1928	1929	1930	1931
Algeria	500		1,200	2,403	944
Australia:					
New South Wales	203	20	154	176	124
South Australia	1,916	2,404	2,001	1,560	1,468
Tasmania			10		
Western Australia			2		
Austria	1,924	2,243	300	496	87
Belgium	1,630	740			(1)
Canada	51	115	95	60	15
France	28,300	30,050	41,625	(1)	(1)
Germany:					
Bavaria	20,035	23,872	23,406	17,778	7,835
Prussia	154,794	232,858	260,811	217,925	160,482
Saxony		1,401	1,870	480	2,534
Great Britain	47,605	50,702	58,011	59,647	46,312
India (British)	1,747	3,146	3,810	6,906	5,745
Irish Free State	(1)		41	1,524	864
Italy	30,677	27,116	25,955	23,420	23,565
Rhodesia, Southern	13	77	264	249	
Russia [2]	8,496	3,937	(1)	(1)	(1)
Spain	[3] 7,716	[3] 6,163	5,806	5,552	8,539
United States	230,664	244,525	251,533	213,126	158,321

[1] Data not available.
[2] Year ended Sept. 30.
[3] Includes following quantities reported produced from quarries: 1927, 2,760 tons; 1928, 2,300 tons.

BARIUM PRODUCTS

SALES

Crude barite is used principally for the manufacture of ground barite, lithopone, and barium chemicals. The aggregate quantity of barium products sold or used by producers in 1931 was 228,326 short tons, a decrease of 9 per cent from 1930; and the aggregate value was $16,365,522, a decrease of 13 per cent. These declines follow decreases of 16 per cent in quantity and 19 per cent in value from 1929 to 1930.

The total ground barite sold or used by producers in 1931 was 32,297 short tons, valued at $656,769, a decrease of 42 per cent in both quantity and value from 1930. Missouri, as usual the center of the grinding industry, produced 93 per cent of the total.

Lithopone, a chemical precipitate containing barium sulphate and zinc sulphide in the usual ratio of about 70 to 30, is the principal outlet for crude barite. The number of plants making lithopone was reduced from 12 in 1930 to 11 in 1931, and the quantity sold or used by producers declined only 7 per cent. Compared with the peak year, 1929, the decline was 26 per cent, a remarkably good record in view of the drastic curtailment in 1931 in most of the industries in which lithopone is used. Except for the rubber industry which consumed almost as much lithopone in 1931 as in 1930, the distribution figures, as reported to the Bureau of Mines for 1931 and shown on page 294, reveal a somewhat smaller relative reduction in consumption by the paint and varnish industries compared with 1929 and 1930 than the total lithopone industry, whereas consumption in floor coverings and textiles and for certain miscellaneous purposes suffered larger percentage reductions. The comparatively large drop in the unit value of lithopone is attributable partly to lower prices for zinc. About one-half of the lithopone produced is furnished by plants at or near the Atlantic seaboard and favorably situated for the delivery of foreign barite.

The barium chemicals showed very favorable increases during 1931; the total sold or used by producers was 44,179 short tons, valued at $2,709,163, increases of 41 per cent in quantity and 54 per cent in value from 1930. An important factor in the increasing consumption of blanc fixe is the expanding use of certain titanium pigments.

To avoid duplication, the barium chemicals reported herein do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market.

Barium products sold or used by producers in the United States, 1926–1931 [1]

Year	Ground barite			Lithopone			Blanc fixe (precipitated barium sulphate)		
	Plants	Short tons	Value	Plants	Short tons	Value	Plants	Short tons	Value
1926	5	57,812	$1,186,563	13	159,931	$16,062,197	2	(2)	(2)
1927	7	57,658	1,166,294	13	176,994	17,163,620	3	13,395	$876,842
1928	8	64,425	1,332,228	12	200,468	19,073,914	4	(2)	(2)
1929	8	54,472	914,516	12	206,315	19,773,864	4	(2)	(2)
1930	6	55,284	1,140,305	12	164,065	15,897,683	5	(2)	(2)
1931	9	32,297	656,769	11	151,850	12,999,590	7	31,151	1,827,713

[1] To avoid duplication, the barium chemicals reported here do not include the output of firms that make these chemicals from such products as barium chemicals and imported barite and witherite purchased in the open market; the total for barium chemicals is therefore not shown here.
[2] Included under "Other barium chemicals."

Barium products sold or used by producers in the United States, 1926–1931—Contd.

Year	Artificial barium carbonate (chemically precipitated)			Barium chloride			Other barium chemicals [3]		
	Plants	Short tons	Value	Plants	Short tons	Value	Plants	Short tons	Value
1926	4	5,394	$298,121	4	4,592	$279,510	2	11,925	$747,631
1927	3	5,969	313,613	4	3,708	213,446	4	871	114,093
1928	3	7,626	416,227	3	5,224	301,490	5	21,119	1,327,439
1929	4	7,902	450,041	5	6,545	412,902	7	23,991	1,603,362
1930	6	5,224	260,284	(2)	(2)	(2)	7	26,139	1,495,243
1931	6	5,687	253,189	(2)	(2)	(2)	7	7,341	628,261

[2] Included under "Other barium chemicals."
[3] Figures cover chemicals as follows—1926: Hydroxide, sulphate, and sulphide; 1927: Binoxide, hydroxide and sulphide; 1928 and 1929: Binoxide, hydroxide, sulphate, and sulphide; 1930: Binoxide, chloride, hydroxide, monoxide, oxide crystals, sulphate, and sulphide; 1931: Binoxide, chloride, oxide, and sulphide.

Lithophone sold or used by producers, 1929–1931, by consuming industries

Industry	1929		1930		1931	
	Short tons	Per cent of total	Short tons	Per cent of total	Short tons	Per cent of total
Paints, varnish, and lacquers	150,804	73.1	126,076	76.8	119,446	78.7
Floor coverings and textiles	37,506	18.2	23,656	14.4	20,780	13.7
Rubber	7,176	3.5	5,997	3.7	5,833	3.8
Other	10,829	5.2	8,336	5.1	5,791	3.8
	206,315	100.0	164,065	100.0	151,850	100.0

Barium, lead, and zinc pigments sold or used by producers in the United States, 1927–1931, in short tons

Year	Lithopone	Barium sulphate (blanc fixe)	Lead pigments [1]	Zinc pigments [2]	Year	Lithopone	Barium sulphate (blanc fixe)	Lead pigments [1]	Zinc pigments [2]
1927	176,994	13,395	171,177	177,310	1930	164,065	(3)	112,448	136,421
1928	200,468	(3)	169,974	185,127	1931	151,850	31,151	106,158	114,277
1929	206,315	(3)	162,611	187,760					

[1] White lead (dry and in oil) and white lead sulphate.
[2] Zinc oxide and leaded zinc oxide.
[3] Bureau of Mines not at liberty to publish figures.

IMPORTS AND EXPORTS

Except for barium nitrate and barium hydroxide, imports of barium compounds for consumption in the United States decreased in both quantity and value in 1931 as compared with 1930. Of the imports, Germany furnished most of the barium chemicals, Germany and Italy most of the ground barite, and Germany and the Netherlands most of the lithopone. The United States receives its supplies of foreign witherite and barium hydroxide principally from the United Kingdom.

Barium compounds imported for consumption in the United States, 1927–1931

[Value at port of shipment]

Year	Ground barite		Lithopone		Barium binoxide		Blanc fixe (precipitated barium sulphate)		Artificial barium carbonate (chemically precipitated)	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	3,259	$38,568	7,979	$656,166	6	$1,264	2,400	$107,179	4,918	$119,014
1928	3,098	33,378	9,885	808,200	6	1,310	3,680	168,923	5,222	116,241
1929	2,924	34,619	8,409	725,554	(1)	21	3,501	168,367	3,206	69,236
1930	2,331	26,905	7,018	595,597	(2)	28	2,994	133,260	2,662	52,427
1931	1,851	22,415	5,674	428,523	(3)	11	930	38,083	1,110	20,839

Year	Natural barium carbonate (witherite)		Barium chloride		Barium nitrate		Barium hydroxide		Barium oxide	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	3,300	$65,821	1,577	$45,285	711	$65,284	222	$12,439	(4)	(4)
1928	4,311	82,434	1,172	25,253	789	69,010	186	10,031	(4)	(4)
1929	4,376	99,335	78	3,049	615	56,770	202	11,809	(4)	(4)
1930	[5] 2,562	[5] 52,282	7	372	407	31,985	220	12,235	(4)	(4)
1931	[5] 2,352	[5] 39,964	6	201	423	29,796	345	25,570	221	$18,870

[1] 133 pounds.
[2] 222 pounds.
[3] 122 pounds.
[4] Not separately recorded prior to 1931.
[5] Beginning June 18, 1930, imports recorded as "Witherite, crude, unground."

Exports of lithopone increased slightly in quantity but decreased appreciably in value from 1930. Of the 3,821 short tons exported during 1931 Canada purchased 3,318 tons (87 per cent) and the United Kingdom and Cuba nearly all the remainder.

Lithopone exported from the United States, 1927–1931

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1927	2,110	$222,585	$105.49	1930	3,665	$380,047	$103.70
1928	3,326	337,565	101.49	1931	3,821	341,257	89.31
1929	4,556	463,235	101.68				

MARKETS AND PRICES

Trade-journal quotations for crude barite were somewhat lower in 1931 than in previous years, reflecting active competition due to restricted consumption.

The price of domestic ground barite remained unchanged during the year, although some concessions were probably made on several shipments. The imported ground material was subject to slight fluctuations from time to time due perhaps to offerings of Russian ground barite. Lithopone nominally held its own throughout most of the year, although the actual valuations of sales reported by producers declined considerably.

Barium chemicals, due to increased demand, did not follow the downward price trend of most barium products, but even in this group there may have been occasional price shading.

Range of quotations on barite and barium products, 1929–1931

Designation	Unit	1929	1930	1931
Crude barite, f. o. b. mines, Missouri	Short ton	[1] $7.00–$8.00	[2] $7.00– $8.00	[3] $5.50–$6.50
Ground barite, domestic, in barrels, St. Louis	do	23.00	23.00	23.00
Lithopone, in barrels, carload	Pound	.05¼	.05	.05
Barium carbonate, in bags, works	Short ton	57.50–60.00	47.00	47.00
Barium chlorate, in kegs	Pound	.14– .15	.14– .15	.14– .15
Barium chloride, crystals, in bags, works	Short ton	63.00–65.00	63.00– 65.00	63.00–65.00
Barium nitrate, in casks	Pound	.08– .08½	.07¼– .08	.06– .08
Barium sulphate (blanc fixe), dry, in barrels, carload. f. o. b. works	do	.03¾	.04½	.03¾–.04½
Barium sulphate (blanc fixe), pulp, works	Short ton	42.50–45.00	42.50– 45.00	42.50–45.00

[1] 93 per cent barium sulphate.
[2] 95 per cent barium sulphate and less than 1 per cent iron.
[3] 93 per cent barium sulphate, 1 per cent iron, January–July, $6.00; August–December, $5.50; 93 per cent barium sulphate, less than 1 per cent iron, January–February, $6.50; 95 per cent barium sulphate, less than 1 per cent iron, March–July, $6.50; August–December, $6.00.

For crude barite the average receipts actually obtained from sales as reported to the Bureau of Mines were slightly better than the prices reported in trade journals; they ranged from $5.30 per ton, f. o. b. Georgia mines, to $6.86, f. o. b. Nevada mines. The total average value for the United States was $5.70 per ton in 1931 as compared with $6.55 in 1930. Declines were most marked in Missouri and Virginia; much smaller reductions were reported in Georgia, Tennessee, and Nevada; and the average value in California was practically unchanged.

The average prices reported by producers for all barium products except lithopone closely correspond to trade-journal quotations.

STONE [1]

By A. T. Coons

CONTENTS

SUMMARY OF PRODUCTION

The total stone sold or used by producers in the United States in 1931 amounted to 97,933,180 short tons, valued at $135,085,627—the smallest output since 1922—and represented a decrease of 23 per cent in quantity and 25 per cent in value from 1930, following a decrease in 1930 of 10 per cent in quantity and 12 per cent in value from 1929.

The decrease in 1930 and the greater decrease in 1931 are readily explained when it is considered how closely the production of stone is allied to the iron, steel, building, agricultural, chemical, and other manufacturing industries, all of which were notably affected by the the trade conditions that prevailed. Federal, State, and municipal campaigns to reduce unemployment by construction of public buildings, bridges, and highways prevented a still greater decrease in output of stone.

The tables in this report give quantities sold or used by producers and values f. o. b. quarries and mills, so far as these are obtainable. The value of the stone sold by producers of dimension stone for construction, monumental, or memorial use, who operate mills in connection with their quarries, is reported according to unit value received by the producer. In consequence, the total values listed include those for both rough and finished stone; however, the values of these products are separated in the tables showing production by States and uses for the different varieties of stone. Stone quarried and used by the producer is considered as sold and is included in the figures for sales. The figures do not, however, include stone made into abrasives (such as grindstones, etc.), glass sand, lime, or cement and reported in terms of finished product. These products are considered in the Mineral Resources chapters on Abrasives, Sand and Gravel, Lime, and Cement. The total limestone used for all purposes is estimated on page 317.

[1] Work on manuscript completed September, 1932.

Stone sold or used by producers in the United States, 1927–1931, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1927	10,706,740	$35,287,206	13,210,570	$17,399,949	600,060	$15,625,872	99,662,270	$112,439,824
1928	9,556,500	33,994,527	15,327,760	19,693,945	579,490	16,402,986	96,864,650	110,231,974
1929	10,826,730	34,225,110	14,871,780	18,946,197	553,660	16,545,312	100,686,960	113,906,071
1930	10,047,430	30,423,853	14,532,250	17,053,031	477,240	12,905,596	88,741,440	100,002,114
1931	8,068,470	25,973,510	12,552,880	13,822,835	350,420	10,419,834	66,751,040	71,875,886

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	5,050,600	$10,923,035	7,114,890	$6,971,336	136,345,130	$198,647,222
1928	4,716,530	10,498,440	6,824,580	5,998,825	133,869,510	196,820,697
1929	5,790,200	11,023,981	8,380,250	8,046,091	141,109,580	202,692,762
1930	4,594,310	10,285,391	8,603,670	8,278,626	126,996,340	178,948,611
1931	4,581,780	7,575,320	5,628,590	5,418,242	97,933,180	135,085,627

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any main group.

All the dominant stone products decreased in both quantity and total value in 1931 compared with 1930. Quarrymen in general reported poor demand, declines in prices, and sharp competition with cheaper materials. The following table gives total sales of stone by principal uses. Sales, by uses, of the particular varieties of stone (granite, basalt, marble, limestone, sandstone, and miscellaneous varieties) follow under their respective headings.

Stone sold or used by producers in the United States, 1930 and 1931, by uses

Use	1930		1931	
	Quantity	Value	Quantity	Value
Building stone .... cubic feet..	30,169,270	$39,111,527	21,461,440	$28,111,058
Approximate equivalent in short tons	2,321,650		1,669,440	
Monumental stone .... cubic feet..	3,517,870	13,157,550	2,869,150	9,634,168
Approximate equivalent in short tons	290,720		236,650	
Paving blocks .... number..	31,586,260	2,669,511	22,440,590	1,938,158
Approximate equivalent in short tons	294,560		197,020	
Curbing .... cubic feet..	3,358,583	3,176,102	2,135,690	2,241,586
Approximate equivalent in short tons	262,170		171,120	
Flagging .... cubic feet..	1,095,780	705,775	611,920	446,525
Approximate equivalent in short tons	81,680		50,020	
Rubble .... short tons..	1,066,590	921,937	432,230	592,243
Riprap .... do....	4,292,030	4,739,122	4,222,570	4,276,626
Crushed stone .... do....	87,110,890	87,554,354	72,624,410	70,404,964
Furnace flux (limestone and marble) .... do....	17,090,710	12,362,159	9,727,230	7,193,944
Refractory stone (ganister, mica schist, and dolomite) .... short tons..	1,197,500	1,406,776	611,070	633,199
Agricultural limestone .... do....	2,542,100	3,309,329	1,421,050	2,117,141
Manufacturing industries (limestone and marble) .... short tons..	6,021,200	5,324,274	4,501,370	3,842,158
Other uses .... do....	4,424,540	4,510,195	2,069,000	3,653,857
Total (quantities approximate, in short tons)..	126,996,340	178,948,611	97,933,180	135,085,627

Building stone sold or used by producers in the United States in 1931, by kinds

Kind	Rough			
	Constructional		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	3,220,590	$475,909	1,066,210	$1,289,304
Basalt	144,400	15,306		
Marble			337,910	610,587
Limestone	2,733,760	317,852	3,594,270	1,574,720
Sandstone	1,215,450	167,518	451,390	438,373
Miscellaneous	266,990	84,587		
	7,581,190	1,061,172	5,449,780	3,912,984

Kind	Finished				Total	
	Sawed [1]		Cut [1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	[1] 253,340	[1] $748,354	[1] 852,280	[1] $4,703,071	5,392,420	$7,216,638
Basalt					144,400	15,306
Marble	332,220	1,042,790	991,220	6,189,119	1,661,350	7,842,496
Limestone	2,034,719	1,651,094	3,344,091	7,315,031	11,706,840	10,858,697
Sandstone	347,360	453,687	275,240	1,033,756	2,289,440	2,093,334
Miscellaneous					266,990	84,587
	2,967,639	3,895,925	5,462,831	19,240,977	21,461,440	28,111,058

[1] For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

Building stone.—Aggregate sales of building stone of all kinds decreased 29 per cent in quantity and 28 per cent in value from 1930. The decrease was general for all classes of building stone; that sold as sawed stone and as dressed construction stone showed the largest decrease in quantity (42 per cent) and that sold as cut stone the smallest (21 per cent); sales of rough architectural stone decreased 36 per cent in quantity and sales of stone for rough construction 22 per cent. In the oolitic limestone district of Indiana, which normally produces about 40 per cent of the building stone used, production decreased 36 per cent. Although there were individual records of increased output most of the important districts producing building stone reported decreases, as may be seen in the quantity reported by States under the different varieties of stone.

Rubble and riprap.—In addition to the building stone shown in the preceding table, a large quantity of stone is reported used for construction in the form of rubble stone or irregularly shaped stone of all sizes. Such stone is used for rough walls, foundations, and other rough construction work where the stone is embedded in mortar or plaster, but it is not included in the figures for regular building stone. The quantity of such stone reported for 1931 decreased 59 per cent from 1930, while the total value decreased only 36 per cent. Some quarrymen use the term "rubble" to include stone sold for riprap; the latter is generally a larger-size stone and, when used for walls and foundations (usually as a protection against encroachment of water), is in loose piles without cementing material. Compared with 1930 the quantity of riprap produced in 1931 decreased 1.6 per cent; the decrease was small chiefly because the use of stone was continued in repair work necessitated by floods on the Missouri and Mississippi Rivers. Production of riprap is irregular and is usually accounted for by local conditions.

Monumental stone.—Stone for monumental and memorial work in 1931 decreased 18 per cent in quantity and 27 per cent in value from 1930. The stone used for this class of work is chiefly granite (78 per cent of the total in 1931) and marble (22 per cent); a small quantity of limestone, not included in these figures, is also used for this work. Quarriers of both varieties of monumental stone sell their product in rough blocks and as finished stone, and the quantity and value of both rough and finished monumental granite and marble sold decreased in 1931. Vermont and Georgia produce more marble for memorials than any other States; Vermont, Georgia, and Minnesota produce more granite.

Paving blocks, curbstone, flagstone, and crushed stone (road metal and concrete and railroad ballast).—All classes of stone sold for street work decreased in quantity and value in 1931 from 1930. The year 1931 marked the eighth consecutive year of decreased output of paving blocks, the total number reported sold (22,440,590 blocks, valued at $1,938,158) being 29 per cent less than in 1930; the decrease was chiefly in sandstone blocks (73 per cent) and granite blocks (22 per cent); the total value decreased 27 per cent. Curbstone (2,135,690 cubic feet, valued at $2,241,586) decreased 36 per cent in quantity and 29 per cent in value, and the decrease was general for all varieties of stone sold for this purpose. Stone for flagging (611,920 cubic feet, valued at $446,525) decreased 44 per cent in quantity and 37 per cent in value; sales of both sandstone and limestone for this purpose decreased. Crushed stone for concrete and road metal and railroad ballast comprised 74 per cent of the total stone output in 1931. The total output of crushed stone (72,624,410 short tons, valued at $70,404,964) decreased 17 per cent in quantity and 20 per cent in value; crushed stone for concrete and road metal (65,811,520 tons, valued at $64,908,509) decreased 11 per cent in quantity and 16 per cent in value, and that reported for railroad ballast (6,812,890 tons, valued at $5,496,455) decreased 47 per cent in quantity and 46 per cent in value.

Fluxing stone.—Stone (limestone and marble) used by blast furnaces, open-hearth steelworks, smelters, and other metallurgical plants for fluxing (9,727,230 short tons, valued at $7,193,944) decreased 43 per cent in quantity and 42 per cent in value from 1930.

Refractory stone.—Stone (dolomite, quartzite, and mica schist) reported for refractory use (611,070 short tons, valued at $633,199) decreased 49 per cent in quantity and 55 per cent in value from 1930. Fifty-four per cent of the refractory stone in 1931 was quartzite (ganister), used chiefly for the manufacture of silica brick but to some extent for furnace and kiln linings, manufacture of ferrosilicon, etc.; the output of this stone (327,970 tons, valued at $406,266) decreased 54 per cent in quantity. Mica schist used for furnace and kiln linings (14,600 tons, valued at $43,913) decreased 43 per cent in quantity and 55 per cent in value. High-magnesium limestone (dolomite) reported as raw stone for refractory use (268,500 tons, valued at $183,020) decreased 41 per cent in quantity and 49 per cent in value. Exact figures for the raw dolomite used for refractories are difficult to obtain, because sales to furnaces and smelters tend to cause it to be reported as fluxing stone. Dolomite is used either as raw stone or is dead-burned. Operators who both quarry and dead-burn or sinter dolomite reported 243,769 short tons of the sintered material, valued at $1,866,971, a decrease of 31 per cent in quantity and 39 per cent in value from 1930.

Agricultural limestone.—Sales of agricultural limestone in 1931 (1,421,050 short tons, valued at $2,117,141) decreased 44 per cent in quantity and 36 per cent in value from 1930. Drought conditions in many States and inability of farmers to buy, especially in the Central States, curtailed demand for stone of this class. Burned lime used for agriculture (297,312 short tons, valued at $1,924,149, as given in the report of this series on Lime) decreased 13 per cent in quantity and 19 per cent in value.

Manufacturing industries and "Other uses."—The total quantity of stone for manufacturing industries and "Other uses" decreased in 1931, due to decreased consumption of stone for some of the chief chemicals that employ limestone in their manufacturing processes and to local conditions that influenced the demand for some of the miscellaneous uses.

PRODUCTION BY STATES

New York ranked as the largest producer of stone in 1931, followed by Pennsylvania, Ohio, Michigan, California, and Illinois. New York also ranked first in value of stone produced, followed by Pennsylvania and Indiana. New York, Pennsylvania, and Michigan produce chiefly crushed stone products, and Indiana and Ohio produce high-grade building stone and crushed stone. Although all the large stone-producing States showed decreased output in 1931 some of the smaller producing States showed noticeable increases due chiefly to local demand.

Stone sold or used by producers in the United States in 1931, by States

State	Number of active plants	Short tons (approximate)	Value	State	Number of active plants	Short tons (approximate)	Value
Alabama	21	[1] 546,810	[1] $1,671,539	Nebraska	4	74,030	$117,611
Arizona	18	467,950	358,419	Nevada	3	58,600	64,048
Arkansas	11	390,710	410,091	New Hampshire	26	188,310	1,217,020
California	190	5,751,820	6,482,202	New Jersey	41	[1] 2,381,700	[1] 2,994,241
Colorado	37	[1] 343,520	[1] 565,443	New Mexico	26	375,650	537,740
Connecticut	39	1,986,500	2,463,145	New York	153	12,528,020	15,598,054
Delaware	2	(2)	(2)	North Carolina	31	1,140,900	2,485,640
District of Columbia	1	(2)	(2)	Ohio	159	9,416,610	8,093,741
Florida	26	[1] 1,359,460	[1] 1,219,214	Oklahoma	28	1,731,680	1,410,782
Georgia	38	1,516,270	6,040,740	Oregon	79	1,641,090	1,515,556
Hawaii	11	370,660	681,666	Pennsylvania	369	[1] 11,123,680	[1] 11,926,265
Idaho	37	884,130	841,258	Puerto Rico	6	31,450	55,526
Illinois	84	5,323,030	3,970,428	Rhode Island	13	129,580	516,053
Indiana	87	[1] 2,831,910	[1] 10,257,555	South Carolina	11	1,721,720	2,431,320
Iowa	33	1,271,310	1,208,755	South Dakota	25	222,510	636,841
Kansas	43	[1] 1,099,400	[1] 1,035,663	Tennessee	54	1,552,890	4,109,842
Kentucky	86	2,214,000	1,955,879	Texas	41	1,347,100	1,285,558
Louisiana	1	(2)	(2)	Utah	19	170,710	201,735
Maine	43	300,100	2,422,766	Vermont	39	346,630	6,051,294
Maryland	56	[1] 1,098,350	[1] 1,484,265	Virginia	82	3,044,530	2,907,238
Massachusetts	73	2,401,250	5,480,707	Washington	124	1,836,150	1,743,453
Michigan	33	6,203,220	4,055,019	West Virginia	69	2,467,050	2,380,694
Minnesota	54	[1] 349,390	[1] 3,036,920	Wisconsin	145	[1] 2,627,140	[1] 4,080,275
Mississippi	2	(2)	(2)	Wyoming	11	[1] 167,090	[1] 236,696
Missouri	146	3,526,230	4,767,396	Undistributed		1,285,470	1,961,451
Montana	21	[1] 86,870	[1] 117,883		2,751	97,933,180	135,085,627

[1] To avoid disclosing confidential information, certain State totals are slightly incomplete, the figures not included being combined under "Undistributed."

[2] Included under "Undistributed."

EXPORTS AND IMPORTS[2]

Exports.—The inclusion of "cement manufactures" with manufactures of natural stone makes classification of stone exported unsatisfactory but shows in a relative way the trend of the export trade. The figures in the following table indicate that the value of the total exports decreased 52 per cent and the value of the exports of "marble in blocks, rough or dressed" 62 per cent.

Stone[1] exported from the United States, 1927–1931, by classes

Year	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
1927	65,380	$237,233	384,340	$851,716	$1,005,636	$2,094,585
1928	64,326	254,266	653,108	473,166	1,245,792	1,973,224
1929	98,478	394,654	825,254	682,632	1,487,993	2,565,279
1930	84,550	375,964	731,359	594,177	1,066,584	2,036,725
1931	32,443	141,216	284,050	209,353	627,771	978,340

[1]Figures not separately recorded for stone and for cement building blocks and for stone and for cement manufactures.

Stone[a] exported from the United States in 1931, by classes and countries

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
North America:						
Canada	28,935	$126,383	274,816	$193,969	$462,856	$783,208
Central America—						
British Honduras					949	949
Costa Rica					166	166
Guatemala					352	352
Honduras					348	348
Nicaragua	40	335			309	644
Panama	44	114			8,324	8,438
Salvador					135	135
Mexico	474	1,930	5,461	1,867	18,782	22,579
Newfoundland and Labrador	1,239	6,982			2,321	9,303
West Indies—						
British—						
Bermudas	26	237			2,762	2,999
Jamaica					4,231	4,231
Trinidad and Tobago	25	205			857	1,062
Cuba			26	178	11,868	12,046
Dominican Republic	58	350			1,865	2,215
Haiti	8	23			203	226
Netherland					142	142
Virgin Islands of the United States	13	121			780	901
Other	70	422	110	132	1,043	1,597
South America:						
Argentina					915	915
Brazil	17	160			759	919
Chile					427	427
Colombia	880	1,560			2,383	3,943
Ecuador					100	100
Peru					1,296	1,296

[a] Figures not separately recorded for stone and for cement building blocks and for stone and for cement manufactures.

[2] Figures on exports and imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Stone exported from the United States in 1931, by classes and countries—Contd.

Country	Marble in blocks, rough or dressed		Other building or monumental stone (including cement building blocks)		Value of other manufactures of stone (including other cement manufactures)	Total value
	Cubic feet	Value	Cubic feet	Value		
South America—Continued.						
Venezuela					$1,796	$1,796
Other					206	206
Europe:						
France			128	$400	12,981	13,381
Germany			113	335	11,229	11,564
Netherlands					6,123	6,123
United Kingdom	598	$2,244	46	2,070	3,712	8,026
Other			3,325	10,162	1,718	11,880
Asia:						
China			15	150	2,027	2,177
India (British)					20,823	20,823
Japan					10,308	10,308
Philippine Islands					2,526	2,526
Other	16	150	10	90	14,626	14,866
Africa:						
Union of South Africa					4,454	4,454
Other					341	341
Oceania:						
Australia					9,556	9,556
New Zealand					957	957
Other					215	215
	32,443	141,216	284,050	209,353	627,771	978,340

Imports.—The value of the total stone imported for consumption in the United States in 1931 decreased 52 per cent from 1930. The value of the marble imported decreased 56 per cent; that of the granite 35 per cent; and that of all other stone (including travertine and quartzite, reported separately beginning June 18, 1930) 53 per cent.

Value of stone imported for consumption in the United States, 1927–1931

1927	$4,536,407	1930	$3,145,861
1928	3,491,353	1931	1,497,696
1929	3,589,259		

Stone imported for consumption in the United States in 1931, by classes

Class	Quantity	Value	Class	Quantity	Value
Marble, breccia, and onyx:			Quartzite ....short tons..	81,538	$132,506
In blocks, rough, etc. ....cubic feet..	252,309	$591,867	Travertine stone (unmanufactured) ....cubic feet..	85,500	64,521
Sawed ....do....	148	475			
Slabs or paving tiles ....superficial feet..	442,189	164,346	Stone (other):		
All other manufactures		198,833	Dressed		22,413
Mosaic cubes of marble or onyx:			Rough (monumental or building stone) ....cubic feet..	26,319	22,868
Loose		3,126	Rough (other)		11,779
Attached to paper		5,358			57,060
		964,005	Grand total		1,497,696
Granite:					
Dressed ....cubic feet..	25,913	138,168			
Rough ....do....	84,428	141,436			
	110,341	279,604			

Stone imported into the United States in 1931, by classes and countries

[General imports]

Country	Marble, breccia, and onyx: Rough, Cubic feet	Marble, breccia, and onyx: Rough, Value	Marble, breccia, and onyx: Manufactures (value)	Granite: Cubic feet	Granite: Value	Other building or monumental stone (value)	Other stone, n. e. s. (value)	Total value
Canada			$129	32,730	$59,626	$2,097	$133,870	$195,722
Cuba			375			40		415
Mexico	1,475	$12,000	69			103		12,172
Other North America[1]						7	200	207
Total North America	1,475	12,000	573	32,730	59,626	2,247	134,070	208,516
Austria			7,372			965		8,337
Belgium	37,712	77,042	52,959			5,995		135,996
Czechoslovakia			1,290	2,138	14,251	4,132		19,673
Finland				41,555	120,091			120,091
France	50,979	94,794	47,420	833	924	19,016		162,154
Germany	11,563	33,603	37,932	4,676	22,327	58,818	521	153,201
Greece	3,238	11,543						11,543
Italy	103,268	242,193	211,926	2,294	1,359	206,919		662,397
Netherlands			93	8	56	77		226
Norway				1,095	2,748	3,830		6,578
Portugal	11,271	28,347	23					28,370
Soviet Russia			103	5,153	10,307			10,410
Spain	12,896	21,135	140			256		21,531
Sweden				16,588	39,691			39,691
United Kingdom	585	2,587	9,810	1,010	6,266	18,034	2,943	39,640
Other Europe[2]			1,411			671		2,082
Total Europe	231,512	511,244	370,479	75,350	218,020	318,713	3,464	1,421,920
China			1,171			62,362		63,533
Japan			670	25	64	23,212		23,946
Other countries[3]	4,420	40,010	699			2,890	763	44,362
Grand total	237,407	563,254	373,592	108,105	277,710	409,424	138,297	1,762,277

[1] Includes Trinidad and Tobago and British West Indies ("Other").
[2] Includes Denmark, Gibraltar, Rumania, and Switzerland.
[3] Includes Algeria and Tunisia, Argentina, Brazil, Egypt, Hong Kong, India (British), Malaya (British), Palestine, Persia, Syria, and Uruguay.

PRODUCTION BY KINDS AND STATES

GRANITE

The output of granite in 1931 was 8,068,470 short tons, valued at $25,973,510, a decrease of 20 per cent in quantity and 15 per cent in value from 1930. Except for an increase in quantity and value of crushed stone sold, both quantity and value for all the principal uses for which granite was sold decreased. Total crushed granite for concrete and road metal and railroad ballast (6,338,870 tons, valued at $7,109,432), representing 79 per cent of the total quantity of granite in 1931, increased 7 per cent in quantity and 2 per cent in value; crushed granite for concrete and road metal (5,223,550 tons, valued at $6,142,768) increased 17 per cent in quantity and 8 per cent in value, but that sold for railroad ballast (1,115,320 tons, valued at $966,664) decreased 24 per cent in both quantity and value. Granite paving blocks and granite curbing decreased 22 and 6 per cent, respectively, in quantity. Granite sold for rubble decreased 60 per cent in quantity, and that for riprap decreased 19 per cent. Granite sold for miscellaneous uses showed the largest decrease (88 per cent); this can be ascribed to completion of the construction of a dam in California where granite was used as a filler in 1929 and 1930. Granite for use in memorials (2,231,320 cubic feet, valued at $7,456,512), which, with that sold for construction, represents the highest grade of granite, decreased 15 per cent in quantity and 25 per cent in value; the decrease was in sales of both rough and dressed stone. Granite for construction (5,392,420 cubic feet, valued at $7,216,638) decreased 6 per cent in quantity and 7 per cent in value. The quantity of rough architectural granite sold by quarry operators increased, but that sold for rough and dressed construction decreased. (See table on page 299.)

In 1931 South Carolina was the largest producer of granite in the United States. California, North Carolina, Massachusetts, Virginia, and Georgia followed in order. All these States but California showed increased output, due chiefly to increases in crushed-stone output in Georgia, South Carolina, and Virginia and in construction-stone output in Massachusetts. The leading State in value of granite output, however, was Massachusetts, followed by Vermont, South Carolina, North Carolina, Maine, Minnesota, Georgia, Wisconsin, and California. The principal uses of the granite products of individual States have been discussed in preceding reports of this series.

Granite sold or used by producers in the United States in 1931, by uses

Use	Quantity	Value
Building stone (rough and dressed) cubic feet	5,392,420	$7,216,638
Approximate equivalent in short tons	444,640	
Monumental stone cubic feet	2,231,320	7,456,512
Approximate equivalent in short tons	182,470	
Paving number of blocks	21,287,500	1,859,485
Approximate equivalent in short tons	184,120	
Curbing linear feet	2,151,090	1,611,800
Approximate equivalent in short tons	112,980	
Rubble short tons	108,130	114,180
Riprap do	433,340	389,501
Crushed stone do	6,338,870	7,109,432
Other uses do	263,920	215,962
Total (quantities approximate, in short tons)	8,068,470	25,973,510

Granite sold or used by producers in the United States in 1931, by States

[Quantities approximate]

State	Short tons	Value	State	Short tons	Value
California	1,140,110	$1,580,438	North Carolina	1,096,520	$2,430,498
Colorado	33,540	209,531	Oklahoma	1,110	74,390
Connecticut	47,670	293,789	Oregon	(1)	(1)
Delaware	(1)	(1)	Pennsylvania	116,360	328,546
District of Columbia	(1)	(1)	Rhode Island	42,150	394,954
Georgia	711,230	2,031,845	South Carolina	1,721,720	2,431,320
Idaho	(1)	(1)	South Dakota	6,730	360,463
Maine	210,660	2,315,860	Texas	45,170	171,286
Maryland	151,370	296,005	Utah	(1)	(1)
Massachusetts	782,330	3,418,603	Vermont	125,100	2,595,052
Minnesota	45,480	2,147,044	Virginia	746,340	674,945
Missouri	3,790	38,591	Washington	56,450	102,882
Montana	910	14,480	Wisconsin	244,960	1,753,805
New Hampshire	179,260	1,182,883	Undistributed	210,860	333,324
New Jersey	(1)	(1)			
New York	348,650	792,976		8,068,470	25,973,510

1 Included under "Undistributed."

The following table shows the uses of the granite produced and sold by quarrymen in the various States.

Granite sold or used by producers in the United States in 1931, by States and uses

State	Number of active plants	Building						Monumental				Paving blocks	
		Rough				Dressed		Rough		Dressed			
		Construction		Architectural									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Number	Value
California	35	560	$112	(1)	(1)	1 73,820	1 $394,708	16,310	$31,627	24,250	$210,216	(2)	(2)
Colorado	11			(1)	(1)	1 13,420	1 28,676	480	674	16,830	139,235		
Connecticut	13	4,410	6,889	5,470	$9,870	22,410	69,082	13,760	36,187	13,520	78,029	222,560	$20,807
Delaware	2	(2)	(2)										
District of Columbia	1	(2)	(2)										
Georgia	26	1,420	1,495	(1)	(1)	1 231,580	1 630,689	185,440	212,240	69,460	242,752	2,148,550	134,732
Idaho	1	(2)	(2)										
Maine	36	28,840	29,360	362,940	411,222	178,280	712,047	71,060	93,056	8,840	26,594	8,369,030	794,860
Maryland	14	100,370	174,190	(1)	(1)	1 14,000	1 13,171	(2)	(2)	(2)	(2)	(2)	(2)
Massachusetts	43	10,970	11,385	291,570	347,662	213,520	830,132	126,080	251,075	12,530	150,391	2,920,720	244,651
Minnesota	26			51,120	139,687	194,360	816,805	65,950	147,652	186,840	1,036,851		
Missouri	4			(2)	(2)			5,580	11,150			119,000	10,000
Montana	8							5,820	14,080				
New Hampshire	24	8,360	14,573	88,320	83,535	91,000	587,501	17,430	35,234	23,240	89,678	1,790,660	131,255
New Jersey	2												
New York	15	11,120	38,860			48,350	378,572			(2)	(2)		
North Carolina	27	11,680	30,802	(1)	(1)	1 175,720	1 782,259	3 31,000	3 143,283	(3)	(3)	829,720	58,897
Oklahoma	5					(2)	(2)	4,560	9,301	6,950	62,098		
Oregon	2					(2)	(2)			(2)	(2)		
Pennsylvania	16	33,640	87,398	6,270	3,343			32,020	56,908	11,880	80,109	32,480	4,162
Rhode Island	7	(2)	(2)	(2)	(2)	(2)	(2)	(1)	(1)	1 73,280	1 288,909		
South Carolina	11	(2)	(2)					(2)	(2)	(2)	(2)	(2)	(2)
South Dakota	10	(2)	(2)	(2)	(2)			11,880	27,685	45,030	325,473		
Texas	5	41,370	62,055	3 25,440	3 49,499	(3)	(3)	(1)	(1)	1 19,620	1 59,047		
Utah	1	(2)	(2)										
Vermont	19			(2)	(2)	(2)	(2)	867,060	2,351,918	20,930	124,434		
Virginia	7			(2)	(2)								
Washington	11					1,000	5,000	720	1,078	2,540	29,166		
Wisconsin	21					34,370	292,541	3,170	3,743	79,630	775,424	4,084,410	427,381
Undistributed		12,380	18,790	13,300	23,606	35,570	131,122	142,260	281,430	6,370	29,785	770,370	32,740
	403	265,120	475,909	1,066,210	1,289,304	1,105,620	5,451,425	1,664,220	3,865,840	567,100	3,590,672	21,287,500	1,859,485

State	Curbing: Linear feet	Curbing: Value	Rubble: Short tons	Rubble: Value	Riprap: Short tons	Riprap: Value	Crushed stone: Concrete and road metal: Short tons	Crushed stone: Concrete and road metal: Value	Crushed stone: Railroad ballast: Short tons	Crushed stone: Railroad ballast: Value	Other uses: Short tons	Other uses: Value	Total: Short tons (approximate)	Total: Value
California	(3)	(3)	7,610	$6,488	148,960	$133,997	649,290	$618,029	126,010	$53,854	198,070	$127,015	1,140,110	$1,580,438
Colorado			(2)	(2)			(2)	(2)					33,540	209,531
Connecticut	45,500	$50,522	14,550	9,982	16,850	9,708	(2)	(2)			(2)	(2)	47,670	293,789
Delaware					(2)	(2)	(2)	(2)					(2)	(2)
District of Columbia													(2)	(2)
Georgia	435,410	204,741	10,180	9,104	49,910	41,021	516,650	522,592	35,730	16,671	15,570	15,808	711,230	2,031,845
Idaho													(2)	(2)
Maine	177,400	164,193	(2)	(2)	5,260	4,811	44,020	79,237			(2)	(2)	210,660	2,315,860
Maryland			(2)	(2)			32,780	71,356	(2)	(2)	1,340	3,198	151,370	296,005
Massachusetts	889,970	807,412	37,380	25,210	30,890	16,605	573,110	725,106			2,430	8,974	782,330	3,418,603
Minnesota					(2)	(2)	(2)	(2)					45,480	2,147,044
Missouri			(2)	(2)	1,150	1,041							3,790	38,591
Montana					(2)	(2)					(2)	(2)	910	14,480
New Hampshire	147,700	102,881	1,890	5,147	3,800	3,147	120,750	129,762			330	170	179,260	1,182,883
New Jersey							(2)	(2)	(2)	(2)			(2)	(2)
New York	(1)	(1)	7,490	12,610			144,090	152,872	154,060	164,187	22,650	8,870	348,650	792,976
North Carolina	358,640	252,412	(2)	(2)	(2)	(2)	787,370	913,016	244,060	208,183	4,330	27,246	1,096,520	2,430,498
Oklahoma			(2)	(2)									1,110	74,390
Oregon													(2)	(2)
Pennsylvania			16,780	20,629	4,070	2,467	52,100	65,972	4,790	5,400	780	2,158	116,360	328,546
Rhode Island			(2)	(2)			34,950	39,444					42,150	394,954
South Carolina	(3)	(3)	(2)	(2)	32,110	33,865	1,631,530	2,048,043	44,580	36,485			1,721,720	2,431,320
South Dakota					(2)	(2)	(2)	(2)					6,730	360,463
Texas											100	685	45,170	171,286
Utah													(2)	(2)
Vermont			6,500	9,553			43,230	48,300					125,100	2,595,052
Virginia					(2)	(2)	273,020	254,051	(2)	(2)			746,340	674,945
Washington			170	81	9,450	4,707	46,480	62,850					56,450	102,882
Wisconsin	(2)	(2)			81,360	78,879	87,820	125,041	(2)	(2)	17,900	21,045	244,960	1,753,805
Undistributed	96,470	29,639	5,580	15,376	49,530	59,253	186,360	287,097	506,090	481,884	420	793	210,860	333,324
	2,151,090	1,611,800	108,130	114,180	433,340	389,501	5,223,550	6,142,768	1,115,320	960,664	[4] 263,920	[4] 215,962	8,068,470	25,973,510

[1] Rough stone included under dressed stone.
[2] Included under "Undistributed."
[3] Dressed stone included under rough stone.
[4] Includes 3,790 tons of Durax blocks, valued at $30,411, made in Massachusetts, North Carolina, and Wisconsin.

The following tables summarize essential statistics covering important granite-producing districts.

Monumental granite sold by the quarrymen at Quincy, Mass., 1927–1931 [1]

Year	Number of active plants	Short tons (approximate)	Value	Year	Number of active plants	Short tons (approximate)	Value
1927	5	21,130	$375,613	1930	5	8,030	$224,165
1928	6	12,400	369,184	1931	5	8,110	192,671
1929	6	10,840	288,492				

[1] Quincy granite sold also for construction as follows: 1929, 15,000 tons, valued at $18,300; 1930, 14,410 tons, valued at $11,646; 1931, 14,620 tons, valued at $12,450. Corresponding figures for 1927 and 1928 not available.

Monumental granite sold by the quarrymen in the Barre district, Vermont, 1927–1931 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1927	1,115,400	$3,426,732	1930	1,024,600	$2,996,032
1928	1,225,800	3,395,628	1931	823,160	2,295,179
1929	1,140,540	3,485,191			

[1] Barre granite is sold also for construction, paving blocks, and crushed stone.

Estimated output of monumental granite in Barre district, Vermont, 1929–1931 [1]

	1929	1930	1931
Total quarry output, rough stock ......cubic feet..	1,268,178	1,125,840	842,922
Shipped out of Barre district in rough ......do....	253,636	225,168	168,584
Manufactured in Barre district ......do....	1,014,542	900,672	674,338
Light stock consumed in district ......do....	634,091	562,920	421,460
Dark stock consumed in district ......do....	380,451	337,752	252,878
Number of cutters in district	1,500	1,500	900
Average daily wage	$9.00	$9.00	$9.00
Average number of days worked	256	256	200
Total pay roll for year	$3,456,000	$3,456,000	$1,620,000
Estimated overhead	1,728,000	1,728,000	810,000
Estimated value of light stock	2,853,396	2,026,512	1,517,256
Estimated value of dark stock	2,044,942	1,452,333	1,087,367
Estimated polishing cost	802,377	712,317	533,316
Output from saws	267,459	237,439	177,772
Total value of granite	11,152,174	9,612,601	5,745,711

[1] Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen.

BASALT AND RELATED ROCKS (TRAP ROCK)

Basalt and related rocks (trap rock) are quarried and sold chiefly for crushed stone. The total output in 1931 (12,552,880 short tons, valued at $13,822,835) decreased 14 per cent in quantity and 19 per cent in value. The principal product, crushed stone (12,222,440 tons, valued at $13,353,426) representing 97 per cent of the total basalt produced in 1931, decreased 11 per cent in quantity and 17 per cent in value; crushed basalt for concrete and road metal (11,669,830 tons, valued at $12,792,313) decreased 5 per cent in quantity and 12 per cent in value, and that for railroad ballast (552,610 tons, valued at $561,113) decreased 63 per cent in quantity and 64 per cent in value. Total basalt used for construction, riprap, and rubble increased. Under "Other" are reported roofing granules made chiefly from altered diabase (greenstone); the output of such granules amounted to 47,790 tons, valued at $254,308, a decrease of 45 per cent in quantity and 57 per cent in value from 1930. In the figures for granite, sandstone, and miscellaneous varieties of stone also is included an output of "roofing granules" which increases the total roofing granules made from stone to 87,960 tons, valued at $546,320. An output of 229,980 tons of slate, valued at $1,312,517, for use as slate granules or "flour" is shown in the report of this series on Slate.

Basalt and related rocks (trap rock) sold or used by producers in the United States in 1931, by uses

Use	Quantity	Value
Building stone .... cubic feet	144,400	$15,306
Approximate equivalent in short tons	12,310	....
Rubble .... short tons	8,790	6,305
Riprap .... do	244,030	184,165
Crushed stone .... do	12,222,440	13,353,426
Other .... do	65,310	263,633
Total (quantities approximate, in short tons)	12,552,880	13,822,835

Basalt and related rocks (trap rock) sold or used by producers in the United States in 1931, by States

[Quantities approximate]

State	Short tons	Value	State	Short tons	Value
California	837,940	$885,593	New Jersey	2,207,760	$2,641,524
Connecticut	1,870,270	1,924,443	New Mexico	(1)	(1)
Hawaii	369,690	678,212	New York	997,620	1,297,825
Idaho	726,900	709,669	Oregon	1,504,700	1,318,432
Maine	(1)	(1)	Pennsylvania	693,110	938,264
Maryland	271,250	387,970	Texas	(1)	(1)
Massachusetts	1,242,340	1,301,068	Virginia	(1)	(1)
Michigan	116,500	128,960	Washington	1,422,940	1,208,557
Minnesota	(1)	(1)	Wisconsin	(1)	(1)
Montana	7,220	5,949	Undistributed	284,640	396,369
Nevada	(1)	(1)			
				12,552,880	13,822,835

1 Included under "Undistributed."

Basalt and related rocks (trap rock) sold or used by producers in the United States in 1931, by States and uses

State	Number of active plants	Building, rough construction		Rubble and riprap		Crushed stone				Other uses		Total	
						Concrete and road metal		Railroad ballast					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
California	26	20	$200	29,220	$36,216	803,380	$845,455	5,320	$3,722			837,940	$885,593
Connecticut	18	6,600	5,595	1,900	3,461	1,720,860	1,778,354	140,910	137,033			1,870,270	1,924,443
Hawaii	10	270	800	1,060	1,257	360,080	661,719	3,470	5,352	4,810	$9,084	369,690	678,212
Idaho	26			12,390	6,925	714,510	702,744					726,900	709,669
Maine	1					(1)	(1)					(1)	(1)
Maryland	8	(1)	(1)	(1)	(1)	260,800	375,284	(1)	(1)	(1)	(1)	271,250	387,970
Massachusetts	14					1,173,640	1,241,230	68,700	59,838			1,242,340	1,301,068
Michigan	9					116,500	128,960					116,500	128,960
Minnesota	2			(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)
Montana	4			7,220	5,949							7,220	5,949
Nevada	1			(1)	(1)							(1)	(1)
New Jersey	31			640	523	2,106,560	2,527,020	100,560	113,981			2,207,760	2,641,524
New Mexico	1					(1)	(1)					(1)	(1)
New York	3					997,620	1,297,825					997,620	1,297,825
Oregon	69	100	156	159,940	101,872	1,341,960	1,213,264	2,700	3,140			1,504,700	1,318,432
Pennsylvania	19	4,300	7,382	2,620	3,045	550,930	648,497	94,690	114,496	40,570	164,844	693,110	938,264
Texas	1					(1)	(1)	(1)	(1)			(1)	(1)
Virginia	1	(1)	(1)			(1)	(1)					(1)	(1)
Washington	89			33,140	27,533	1,359,670	1,153,123	26,000	27,126	4,130	775	1,422,940	1,208,557
Wisconsin	1			(1)	(1)	(1)	(1)					(1)	(1)
Undistributed		1,020	1,173	4,690	3,689	163,320	218,838	110,260	96,425	15,800	88,930	284,640	396,369
	334	12,310	15,306	252,820	190,470	11,669,830	12,792,313	552,610	561,113	65,310	263,633	12,552,880	13,822,835

[1] Included under "Undistributed."

MARBLE

The total marble sold by producers in 1931 (350,420 short tons, valued at $10,419,834) represented a decrease of 27 per cent in quantity and 19 per cent in value from 1930. Dimension stone used for monumental and construction work (2,299,180 cubic feet, valued at $10,020,152) decreased 31 per cent in quantity and 19 per cent in value. Marble used for construction (1,661,350 cubic feet, valued at $7,842,496) decreased 33 per cent in quantity and 14 per cent in value. Marble used for monumental and memorial work (637,830 cubic feet, valued at $2,177,656) decreased 27 per cent in quantity and 33 per cent in value. Rough marble sold by tonnage for terrazzo, stucco, mosaic, marble dust, and by-product stone, such as rubble, riprap, flux, and other rough stone, decreased 21 per cent in quantity and 29 per cent in value.

Marble sold by producers in the United States in 1931, by uses

Use	Quantity	Value
Building stone:		
Rough—		
Exterior ... cubic feet	52,260	$102,229
Interior ... do	285,650	508,358
Finished—		
Exterior ... do	542,450	2,884,672
Interior ... do	780,990	4,347,237
Total exterior ... do	594,710	2,986,901
Total interior ... do	1,066,640	4,855,595
Total building stone ... do	[1] 1,661,350	[1] 7,842,496
Monumental stone:		
Rough ... do	91,080	68,145
Finished ... do	546,750	2,109,511
Total monumental stone ... do	[1] 637,830	[1] 2,177,656
Total building and monumental ... do	2,299,180	10,020,152
Total building and monumental ... approximate short tons	195,710	
Marble for other uses (by-products) ... short tons	154,710	399,682
Total marble, approximate short tons	350,420	10,419,834

[1] 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.

On account of the small number of operators in the marble-producing States it is impossible to show the output of the States by uses. The following table, however, shows the output of States in such detail as may be published. As few changes were made in the names and addresses of operators during 1931 the usual list of producing companies is omitted.

Marble sold by producers in the United States in 1931, by States and uses

State	Building and monumental (rough and finished)		Other uses		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	46,390	$201,976	28,570	$62,700	32,520	$264,676
California	15,390	46,399	1,820	12,818	3,140	59,217
Georgia	497,370	3,323,421	16,060	26,930	58,330	3,350,351
Missouri	216,730	553,291	170	470	18,200	553,761
New York	22,770	56,059	39,150	130,345	41,100	186,404
Tennessee	525,900	2,407,878	41,010	36,612	85,370	2,444,490
Vermont	905,280	3,187,431	13,920	20,071	91,870	3,207,502
Other States [1]	69,350	243,697	14,010	109,736	19,890	353,433
	2,299,180	10,020,152	154,710	399,682	350,420	10,419,834

[1] Arizona, Arkansas, Colorado, Idaho, Maryland, Massachusetts, Pennsylvania, Utah, Virginia, and Washington.

SERPENTINE

The figures showing sales of serpentine (verde antique) for interior and exterior building, dimension stone, and by-products are included in the figures for marble; those showing sales of serpentine as crushed stone for road metal, ballast, riprap, and other low-grade material are included in the figures for "miscellaneous" stone. The States represented in the production of serpentine in 1931 are California, Georgia, Maryland, Massachusetts, Vermont, Washington, and Wyoming.

Serpentine (verde antique) sold by producers in the United States in 1931, by uses

Use	Quantity	Value
Building and ornamental stone ... cubic feet	39,150	$218,098
Rough construction, crushed, etc. ... short tons	126,740	163,523
	------------	381,621

LIMESTONE

The output of limestone in 1931, as covered by the figures in this report, amounted to 66,751,040 short tons, valued at $71,875,886, a decrease of 25 per cent in quantity and 28 per cent in value from 1930. Crushed stone (46,601,900 tons, valued at $42,752,286) for use as road metal, concrete, and railroad ballast, representing 70 per cent of the total limestone output, decreased 18 per cent in quantity and 21 per cent in value; crushed stone for concrete and road metal (42,121,430 tons, valued at $39,197,029) decreased 13 per cent in quantity and 18 per cent in value, and that for railroad ballast (4,480,470 tons, valued at $3,555,257) decreased 48 per cent in quantity and 44 per cent in value. Fluxing stone (9,674,800 tons, valued at $7,160,630), the next largest limestone product, decreased 43 per cent in quantity and 42 per cent in value. Limestone for construction (11,706,840 cubic feet, valued at $10,858,697) decreased 25 per cent in quantity and 41 per cent in value. Limestone sold for rubble (229,510 tons, valued at $296,426) showed a large decrease in both quantity and value. Stone for riprap (2,508,160 tons, valued at $2,763,571) decreased 14 per cent in quantity and 17 per cent in value. Stone for street work (curbing, flagging, and paving) decreased in output in 1931, as did that sold to glass factories and paper mills, for agricultural limestone, and for "Other uses." Stone sold to sugar factories increased in both quantity and value. Most of the products classed under "Other uses" decreased notably. (See table on page 317.)

Limestone sold or used by producers in the United States in 1931, by uses

Use	Quantity	Value
Building stone[1] ... cubic feet	11,706,840	$10,858,697
Approximate equivalent in short tons	872,630	
Curbing, flagging, and paving ... cubic feet	166,260	85,175
Approximate equivalent in short tons	15,220	
Rubble ... short tons	229,510	296,426
Riprap ... do	2,508,160	2,763,571
Crushed stone ... do	46,601,900	42,752,286
Fluxing stone ... do	9,674,800	7,160,630
Sugar factories ... do	453,640	748,682
Glass factories ... do	159,220	244,466
Paper mills ... do	194,310	288,143
Agriculture ... do	1,421,050	2,117,141
Other uses[2] ... do	4,620,600	4,560,669
Total (quantities approximate, in short tons)	66,751,040	71,875,886

[1] Figures for building stone include small amounts of monumental stone.
[2] See table on p. 317 for further distribution of limestone products.

New York produced more limestone in 1931 than any other State, followed in order by Ohio, Pennsylvania, Michigan, and Illinois. Georgia and Louisiana were the only States that showed notable increase in output. Indiana, which usually ranks first in value of limestone production on account of its output of high-grade building stone, ranked second to New York in 1931. The following tables show production by States.

Limestone sold or used by producers in the United States in 1931, by States

[Quantities approximate]

State	Short tons	Value	State	Short tons	Value
Alabama	514,290	$1,406,863	Nevada	(1)	(1)
Arizona	31,780	31,802	New Jersey	137,820	$329,456
Arkansas	87,250	101,438	New Mexico	195,550	380,440
California	240,180	549,792	New York	10,860,980	12,586,558
Colorado	233,780	293,660	North Carolina	(1)	(1)
Connecticut	37,270	95,901	Ohio	8,886,640	5,958,261
Florida	1,359,460	1,219,214	Oklahoma	1,534,410	1,203,166
Georgia	746,710	658,544	Oregon	(1)	(1)
Hawaii	970	3,454	Pennsylvania	8,350,060	8,552,692
Idaho	7,820	14,890	Puerto Rico	31,450	55,526
Illinois	5,278,170	3,945,064	Rhode Island	60	174
Indiana	2,831,910	10,257,555	South Dakota	39,370	37,320
Iowa	1,271,310	1,208,755	Tennessee	1,462,600	1,535,836
Kansas	1,099,400	1,035,663	Texas	1,125,790	951,775
Kentucky	2,179,530	1,897,793	Utah	164,450	173,362
Louisiana	(1)	(1)	Vermont	39,660	115,240
Maine	57,590	82,953	Virginia	2,201,430	2,115,133
Maryland	509,180	566,495	Washington	131,600	213,916
Massachusetts	69,480	255,080	West Virginia	2,017,570	1,768,278
Michigan	6,059,770	3,805,607	Wisconsin	2,231,190	2,143,927
Minnesota	284,960	816,484	Wyoming	166,110	232,892
Mississippi	(1)	(1)	Undistributed	770,060	1,097,393
Missouri	3,350,660	3,962,469			
Montana	78,740	97,454		66,751,040	71,875,886
Nebraska	74,030	117,611			

[1] Included under "Undistributed."

Limestone sold or used by producers in the United States in 1931, by States and uses

State	Number of active plants	Building: Rough constuction: Short tons	Building: Rough constuction: Value	Building: Rough architectural: Cubic feet	Building: Rough architectural: Value	Building: Finished (cut and sawed): Cubic feet	Building: Finished (cut and sawed): Value	Rubble: Short tons	Rubble: Value	Riprap: Short tons	Riprap: Value	Crushed stone: Concrete and road metal: Short tons	Crushed stone: Concrete and road metal: Value	Crushed stone: Railroad ballast: Short tons	Crushed stone: Railroad ballast: Value
Alabama	15			[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	14,040	$12,344	9,130	$5,201
Arizona	5									[1]	[1]	[1]	[1]		
Arkansas	4											74,500	89,676	10,960	9,137
California	23	660	$1,853									76,310	131,948		
Colorado	15			[1]	[1]	[1]	[1]								
Connecticut	4											1,570	3,116		
Florida	24			[1]	[1]	41,500	$174,755	[1]	[1]	[1]	[1]	1,152,470	859,290	170,700	144,586
Georgia	8											717,400	590,519		
Hawaii	1														
Idaho	3														
Illinois	81	21,010	18,374	940	$188			2,570	$4,260	505,070	$510,334	3,648,820	2,454,221	361,640	241,618
Indiana	86			3,222,100	1,281,080	4,652,370	7,314,532	58,130	29,770	115,050	52,918	1,703,110	1,248,093	118,460	87,513
Iowa	33							4,730	5,046	31,850	31,176	1,020,030	994,608	66,360	38,320
Kansas	41	[1]	[1]	[1]	[1]	[1]	[1]	6,160	3,940	54,810	80,916	705,880	639,558	314,830	287,289
Kentucky	83	7,330	9,200	36,250	20,009			1,400	2,000	85,700	110,604	1,697,220	1,463,930	286,570	184,582
Louisiana	1											[1]	[1]	[1]	[1]
Maine	4									[1]	[1]				
Maryland	21	2,400	2,953					8,370	6,697			482,250	525,193	[1]	[1]
Massachusetts	9	[1]	[1]									[1]	[1]		
Michigan	20									260,730	403,356	693,570	465,501	36,170	25,327
Minnesota	22	3,740	10,868	68,770	69,971	113,780	421,531	5,370	12,107	[1]	[1]	216,970	227,173		
Mississippi	2														
Missouri	134	830	2,076			31,340	24,707	97,030	162,546	823,830	1,014,401	2,228,850	2,493,223	31,640	32,952
Montana	7									6,200	2,732	11,950	10,413		
Nebraska	4	200	400							17,120	17,644	30,930	9,251		
Nevada	1													[1]	[1]
New Jersey	3											54,980	74,872		
New Mexico	12											195,550	380,440		
New York	83	7,320	6,200			[1]	[1]	[1]	[1]	460,050	358,888	8,659,240	10,114,602	497,090	585,696
North Carolina	3											[1]	[1]		
Ohio	140							6,390	13,141	[1]	[1]	6,438,130	4,185,482	578,490	406,803
Oklahoma	20			[1]	[1]			[1]	[1]	12,050	9,626	1,184,900	971,230	328,060	185,009
Oregon	2														
Pennsylvania	215	12,910	20,583					9,970	12,496			4,733,400	5,002,202	141,530	131,287
Puerto Rico	6	[1]	[1]					[1]	[1]	[1]	[1]	24,270	29,385		
Rhode Island	1														
South Dakota	7											37,870	35,820		

Tennessee	47									1,800	1,500	996,460	1,048,785	335,010	255,549
Texas	31	(1)	(1)	102,720	32,549	(1)	(1)			38,470	32,015	815,860	605,070	203,280	161,699
Utah	13			(1)	(1)							1,080	725	41,820	26,995
Vermont	9											24,630	44,180		
Virginia	68	(1)	(1)					(1)	(1)			1,216,410	1,207,457	563,740	453,975
Washington	7									40,000	80,000				
West Virginia	29											626,750	627,514	311,260	240,776
Wisconsin	108	159,540	224,851	30,380	18,372	26,290	33,827	21,470	37,061	15,480	14,951	1,906,060	1,618,553	32,900	23,618
Wyoming	8	(1)	(1)							(1)	(1)	(1)	(1)	(1)	(1)
Undistributed		5,030	20,494	133,110	15,551	513,530	996,773	7,920	7,362	39,950	42,510	729,970	1,032,655	40,830	27,325
	1,463	220,970	317,852	3,594,270	1,574,720	5,378,810	8,966,125	229,510	296,426	2,508,160	2,763,571	42,121,430	39,197,029	4,480,470	3,555,257

State	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	441,620	$395,943							(1)	(1)	(1)	(1)	514,290	$1,406,863
Arizona	9,500	6,734							(1)	(1)	(1)	(1)	31,780	31,802
Arkansas									1,790	$2,625			87,250	101,438
California	21,310	42,890	59,600	$163,170	12,690	$35,530			4,050	14,052	65,560	$160,349	240,180	549,792
Colorado	149,770	112,664	82,350	123,729									233,780	293,660
Connecticut									17,130	48,951	18,570	43,834	37,270	95,901
Florida									(1)	(1)	25,240	30,397	1,359,460	1,219,214
Georgia									(1)	(1)	(1)	(1)	746,710	658,544
Hawaii									970	3,454			970	3,454
Idaho			5,110	10,367					60	118	2,650	4,405	7,820	14,890
Illinois	418,730	344,899			8,280	9,520			254,680	228,606	57,290	133,044	5,278,170	3,945,064
Indiana	49,280	13,341			(1)	(1)	(1)	(1)	82,760	79,847	92,040	97,500	2,831,910	10,257,555
Iowa	(1)	(1)	(1)	(1)					126,610	105,554	(1)	(1)	1,271,310	1,208,755
Kansas									12,170	8,379	3,360	9,846	1,099,400	1,035,663
Kentucky	20	48							90,420	82,704	8,130	24,716	2,179,530	1,897,793
Louisiana													(1)	(1)
Maine	(1)	(1)					24,510	$39,188	2,410	9,228	10,950	12,276	57,590	82,953
Maryland	(1)	(1)									(1)	(1)	509,180	566,495
Massachusetts	7,660	12,009							50,260	207,414	2,640	12,492	69,480	255,080
Michigan	2,708,380	1,629,346	(1)	(1)	(1)	(1)	(1)	(1)	89,900	67,876	2,198,210	1,125,926	6,059,770	3,805,607
Minnesota	(1)	(1)							11,130	9,796	6,500	34,156	284,960	816,484
Mississippi									(1)	(1)			(1)	(1)
Missouri	24,120	25,777			30,540	35,657			60,370	50,113	50,900	121,017	3,350,660	3,962,469
Montana	(1)	(1)	30,940	43,668							(1)	(1)	78,740	97,454
Nebraska			(1)	(1)					(1)	(1)	(1)	(1)	74,030	117,611
Nevada	(1)	(1)	(1)	(1)									(1)	(1)
New Jersey	(1)	(1)							(1)	(1)	(1)	(1)	137,820	329,456

[1] Included under "Undistributed."

Limestone sold or used by producers in the United States in 1931, by States and uses—Continued

State	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
New Mexico													195,550	$380,440
New York	60,690	$51,130					11,710	$17,021	77,320	$235,801	1,081,300	$1,208,567	10,860,980	12,586,558
North Carolina	(1)	(1)							(1)	(1)			(1)	(1)
Ohio	1,473,290	941,788	(1)	(1)	35,450	$53,277	(1)	(1)	125,400	145,608	200,680	172,735	8,886,640	5,958,261
Oklahoma					(1)	(1)			(1)	(1)	(1)	(1)	1,534,410	1,203,166
Oregon							(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Pennsylvania	3,069,030	2,579,331			23,820	39,432	17,010	15,861	84,750	229,887	257,640	521,613	8,350,060	8,552,692
Puerto Rico									4,880	24,597	(1)	(1)	31,450	55,526
Rhode Island	50	150									10	24	60	174
South Dakota			1,500	$1,500									39,370	37,320
Tennessee	6,940	7,306							85,960	136,457	36,430	86,239	1,462,600	1,535,836
Texas	(1)	(1)							(1)	(1)	(1)	(1)	1,125,790	951,775
Utah	87,040	67,955	29,290	57,056							(1)	(1)	164,450	173,362
Vermont	(1)	(1)					(1)	(1)	10,310	44,719	2,770	23,404	39,660	115,240
Virginia	28,590	29,137					(1)	(1)	83,500	110,335	302,540	304,452	2,201,430	2,115,133
Washington	18,770	15,266	1,430	3,579			68,110	101,310	1,320	3,085	1,970	10,676	131,600	213,916
West Virginia	1,010,110	799,353			1,900	3,526			17,770	40,501	49,780	56,608	2,017,570	1,768,278
Wisconsin	(1)	(1)					(1)	(1)	38,220	51,980	37,770	108,108	2,231,190	2,143,927
Wyoming	(1)	(1)	136,690	204,870									166,110	232,892
Undistributed	89,900	85,563	106,730	140,743	46,540	67,524	72,970	114,763	86,910	175,454	122,890	343,460	770,060	1,097,393
	9,674,800	7,160,630	453,640	748,682	159,220	244,466	194,310	288,143	1,421,050	2,117,141	4,635,820	4,645,844	66,751,040	71,875,886

[1] Included under "Undistributed."

Limestone sold or used by producers in the United States for miscellaneous uses in 1931

Use	Short tons	Value	Use	Short tons	Value
Alkali works	3,340,290	$2,186,422	Poultry grit	31,320	$159,971
Asphalt filler	247,450	778,045	Refractory stone (dolomite)	268,500	183,020
Calcium carbide works	164,180	96,158	Road base	(1)	(1)
Carbonic acid works	2,670	5,698	Roofing gravel	(1)	(1)
Coal-mine dusting	38,040	117,715	Stucco, terrazzo, and artificial stone.	45,760	122,181
Fertilizer filler	(1)	(1)	Whiting substitute	73,420	408,880
Filter beds	56,100	53,195	Other [1]	176,530	166,156
Magnesia works (dolomite)	80,820	122,525			
Mineral food	21,880	93,310			
Mineral (rock) wool	73,640	67,393		4,620,600	4,560,669

[1] Includes stone for ammonia, baking powder, dye works, lime burners, nitrates, phosphates, powder, purification of copper, soap, sulphuric acid, and uses not specified.

A considerable quantity of the limestone reported in the tables by uses is burned into lime—particularly limestone reported by iron and steel producers and by alkali, carbide, sugar, and paper manufacturers as quarried by them and used in their own plants and limestone sold to manufacturers of these and other commodities who may burn it into lime before using it. To avoid duplication, such lime is not included in the figures of production in the report of this series on Lime. Limestone manufactured into lime and into cement and reported in terms of finished product is treated in separate chapters. The quantities so used are estimated in the following table.

Limestone used for all purposes in the United States, 1930 and 1931, in short tons

Use	1930	1931
Limestone (as given in this report)	88,741,440	66,751,040
Portland cement (including "cement rock")	40,500,000	31,500,000
Natural cement ("cement rock")	341,000	236,000
Lime	6,780,000	5,420,000
	136,362,440	103,907,040

BUILDING STONE

Of the total quantity (21,461,440 cubic feet) of building stone reported for 1931, 55 per cent (11,706,840 cubic feet) was limestone; the latter decreased 25 per cent in quantity from 1930. The high-grade limestone classed as architectural building stone and sold entirely as dimension stone is obtained from a few well-known localities. Available figures covering the output of these districts for a series of years are given in the tables that follow.

Alabama.—Oolitic limestone used as high-grade building stone is quarried at Rockwood near Russellville, Franklin County, by the Alabama-Oolitic Stone Co., Cedar Creek quarry (address, First National Bank Building, Nashville, Tenn.) (quarry idle in 1931), and the Rockwood Alabama Stone Co. Rockwood, Aday, and Spout Springs quarries (address, Fuller Building, New York City).

Colorado.—Limestone (travertine) sold in rough blocks for architectural building is quarried in Fremont County near Salida (Wellsville quarry) by the Colorado Travertine Co. (address, Continental Oil Building, Denver). Siliceous limestone used as a building stone was quarried during 1930 and 1931 by the Manitou Greenstone Quarries (address, Beaumont, Tex.) near Manitou, El Paso County.

Florida.—Building stone was quarried in 1931 in Manatee County by the Florida Travertine Corporation ("Floridene") from quarries near Bradenton and by the Mizner Industries (Inc.) (address, Palm Beach) at Ellenton. Stone is also quarried and shipped from Quarry Key, Windlys Island, Monroe County, by C. Ed. de Brauwere Co. (address, Miami).

Indiana.—The largest quarry center for building stone in the United States is the oolitic limestone district which includes Bedford, Lawrence County; Bloomington, Monroe County; and Romona, Owen County, Ind. In 1931 the output of building stone in this district (7,865,210 cubic feet, valued at $8,570,563) decreased 36 per cent in quantity and 44 per cent in value from 1930. The quarry operators in the district in 1931 and their addresses were as follows: The Carl Furst Co., Heltonville Limestone Co., Indiana Limestone Co., Ingalls Stone Co., and Reed-Powers Cut Stone Co., Bedford; Bloomington Limestone Co., Empire Stone Co., Hoadley Bros. (Inc.), B. G. Hoadley Quarries (Inc.), Hunter Bros. Stone Co., Independent Limestone Co., Indian Hill Stone Co., Monon Stone Co., Sare-Hoadley Stone Co., Shawnee Stone Co., and H. A. Woolery & Son, Bloomington; and Victor Oolitic Stone Co., Victor.

The St. Paul Stone Quarries Co. operates a quarry for building stone at St. Paul, Decatur County.

Statistics of production in the Indiana oolitic limestone district for a series of years follow:

Limestone sold by producers in the Indiana oolitic limestone district, 1927–1931

Year	Construction		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1927	13, 572, 950	$16, 407, 170	423, 320	$381, 455	1, 407, 360	$16, 788, 625
1928	14, 520, 260	17, 760, 622	429, 890	302, 819	1, 482, 610	18, 063, 441
1929	14, 009, 850	17, 419, 183	414, 140	250, 578	1, 429, 840	17, 669, 761
1930	12, 308, 340	15, 276, 487	538, 490	364, 365	1, 430, 840	15, 640, 852
1931	7, 865, 210	8, 570, 563	313, 100	200, 754	883, 330	8, 771, 317

Limestone sold by producers in the Indiana oolitic limestone district in 1931, by classes

Class	Quantity	Value
Construction:		
Rough blocks ......cubic feet	3, 218, 240	$1, 277, 776
Sawed ......do	1, 807, 060	1, 308, 399
Semifinished ......do	49, 920	43, 446
Cut ......do	2, 789, 990	5, 940, 942
Total construction ......do	7, 865, 210	8, 570, 563
Other stone ......short tons	313, 100	200, 754
Grand total (quantities approximate, in short tons)	883, 330	8, 771, 317

Considerable stone is sold by quarry operators to the finishing mills of the district, and a few of the quarry operators who operate mills obtain rough stone from other quarries, mill it, and resell it. Duplication is avoided by including this milled product in the table showing the output of the mills in the district, whereas the rough stone involved is included in the quarry report of the producing company. The names and addresses of mills in the Indiana oolitic limestone district operating in 1931 on stone purchased from quarry operators were as follows: Bedford Cut Stone Co., The Ed. Edinger Co., J. P. Falt Co., Alexander King Stone Co., and John A. Rowe Rustic Monumental Works, Bedford; Fluck Stone Co., J. M. Hoadley (Inc.), Matthews Bros. Co., Mutual Oolitic Stone Co., Walker Bros. Stone Co., and Wallis Stone Co., Bloomington; Harding & Cogswell (Inc.) and A. J. Thompson Stone Co., Ellettsville; and Swenson Stone Co., Stinesville.

Indiana oolitic limestone sold by mills not operated by quarry companies, 1927–1931[1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1927	1,670,470	$3,646,445	1930	1,991,000	$4,645,824
1928	1,177,320	2,594,224	1931	1,394,130	2,930,978
1929	1,370,200	3,374,490			

[1] Includes some stone purchased by quarry operators and milled and resold.

Indiana oolitic limestone sold by mills not operated by quarry companies, 1930 and 1931, by classes[1]

Year	Sawed		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1930	197,990	$124,946	1,793,010	$4,520,878	1,991,000	$4,645,824
1931	77,550	72,737	1,316,580	2,858,241	1,394,130	2,930,978

[1] Includes some stone purchased by quarry operators and milled and resold.

Kansas.—The Arkansas City Sand & Gravel Co. (address, Arkansas City, Kans.) sells stone for rough and sawed architectural work from quarries near Silverdale, Cowley County.

Kentucky.—Oolitic limestone is quarried at Bowling Green, Warren County, Ky., by the Bowling Green Quarries Co. and by William Murphy (idle in 1931). Several quarries in the vicinity are operated for crushed stone. The following table shows the production of the county for the past five years.

Limestone sold by producers in Warren County, Ky., 1927–1931

Year	Building and monumental stone (rough blocks)		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1927	198,770	$119,054	73,350	$86,400	87,660	$205,454
1928	116,180	82,648	52,920	80,896	61,290	163,544
1929	30,620	27,251	7,000	10,500	9,200	37,751
1930	73,660	67,274	24,830	34,115	30,130	101,389
1931	22,440	11,819	50,000	63,750	51,630	75,569

Minnesota.—The following table shows the sales of limestone at Mankato and Kasota, Minn., for the past five years.

Limestone sold by producers at Mankato and Kasota, Minn., 1927–1931

Year	Building stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1927	199, 640	$414, 350	41, 990	$26, 766	57, 760	$441, 116
1928	184, 610	339, 291	30, 900	19, 850	45, 560	359, 141
1929	230, 290	495, 895	38, 410	22, 962	56, 590	518, 857
1930	211. 400	451, 683	50, 170	42, 193	68, 420	493, 876
1931	216, 720	469, 684	74, 150	65, 659	90, 420	535, 343

T. R. Coughlan Co. and The Mankato Lime Co., Mankato, and Babcock & Wilcox, Breen Stone & Marble Co., and Kasota Stone Quarries Corporation, Kasota, are the producers of the Mankato and Kasota stone. The Biesanz Stone Co. quarries architectural building stone ("Travertine") at Winona.

Missouri.—The stone quarried at Carthage, Jasper County, and used for architectural building and monumental stone is classed as marble and is included in the figures of production of marble in Missouri on page 312. Its chief use, however, like that of Indiana stone, is for exterior building; the figures of production are given here for convenience in comparison. The crushed stone and low-grade material are included under limestone. All grades are combined here to show the total production. The Carthage Marble Corporation operates the dimension-stone quarries. In common with other districts producing high-grade stone the Carthage district showed considerable falling off in production from 1930.

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo.' 1927–1931, by classes

Year	Building stone (rough and dressed)		Monumental stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1927	339, 260	$724, 265	10, 740	$17, 429	93, 480	$151, 795	122, 710	$893, 489
1928	450, 670	1, 009, 927	14, 720	23, 231	118, 130	182, 171	156, 890	1, 215, 329
1929	278, 340	553, 468	21, 610	43, 202	174, 810	228, 941	199, 860	825, 611
1930	158, 270	436. 593	8, 200	14, 253	133, 830	109. 912	147, 730	560, 758
1931	105, 310	305, 810	6, 140	11, 228	91, 850	110, 192	101, 150	427, 230

New York.—Onondaga limestone for building stone is quarried near Syracuse, Onondaga County, by the Jones Cut Stone Co.

Texas.—Limestone quarried and sold for architectural building stone in Texas in 1931 was reported by the following operators: A. C. Fox and the Lueders Building Stone Co., Lueders, Jones County; Del Rio Stone Co., Brackettville, Kinney County; and Texas Quarries (Inc.) (address, Austin), Cedar Park, Williamson County. The combined output of these quarries is given in the table on page 315.

Wisconsin.—Considerable limestone sold for building stone, curbing, and flagstone is produced near Lannon, Waukesha County. The principal producers are Davis Bros. Stone Co., Lake Shore Sand & Stone Co., Lannon Quarries Corporation, Schneider Stone Co., Wisconsin Lannon Stone Co., and Waukesha Lime & Stone Co. The combined output of these quarries is given in the table on pages 315 and 316.

SANDSTONE

The output of sandstone in 1931 amounted to 4,581,780 short tons, valued at $7,575,320, a decrease of less than 1 per cent in quantity but of 26 per cent in value from 1930. The decrease of but 1 per cent in output (2,604,560 tons, valued at $2,600,968) of crushed sandstone (57 per cent of the total sandstone production in 1931), the increase of 86 per cent in output of riprap and of 57 per cent in output of rubble, and the large increase in sandstone sold for "Other uses" offset to a great extent decreases ranging from 40 to 73 per cent in other classes of sandstone. These decreases, chiefly in stone of higher unit value (building stone, paving blocks, curbstone, and flagging), were responsible for the considerable decrease in total value.

Sandstone for construction decreased 54 per cent in quantity and 38 per cent in value, paving blocks 73 per cent in quantity and 76 per cent in value, curbing 56 per cent in quantity and 55 per cent in value, flagging 40 per cent in quantity and 38 per cent in value, and quartzite (ganister), used chiefly as furnace lining and in the manufacture of silica brick, 54 per cent in quantity and 57 per cent in value. Crushed sandstone for concrete and road metal (2,355,340 tons, valued at $2,385,408) increased 10 per cent in quantity and 2 per cent in value, but that for railroad ballast (249,220 tons, valued at $215,560) decreased 50 per cent in quantity and 51 per cent in value. The large increase in "Other uses" was due to the production of quartzite for use in manufacture of ferro-alloys.

Sandstone sold or used by producers in the United States in 1931, by uses

Use	Quantity	Value
Building stone ... cubic feet	2,289,440	$2,093,334
Approximate equivalent in short tons	176,360	
Paving blocks ... number	1,153,090	78,673
Approximate equivalent in short tons	12,900	
Curbing ... cubic feet	746,230	610,729
Approximate equivalent in short tons	56,510	
Flagging ... cubic feet	466,890	380,407
Approximate equivalent in short tons	36,430	
Crushed stone ... short tons	2,604,560	2,600,968
Rubble ... do	44,650	64,971
Riprap ... do	979,290	889,591
Refractory stone (ganister) ... do	327,970	406,266
Other uses ... do	343,110	450,381
Total (quantities approximate, in short tons)	4,581,780	7,575,320

Sandstone sold or used by producers in the United States in 1931, by States

[Quantities approximate]

State	Short tons	Value	State	Short tons	Value
Alabama	(1)	(1)	New Mexico	(1)	(1)
Arizona	(1)	(1)	New York	[2] 242, 420	[2] $692, 091
Arkansas	(1)	(1)	Ohio	473, 510	2, 096, 791
California	826, 680	$698, 445	Oklahoma	196, 160	133, 226
Colorado	30, 220	43, 277	Oregon	(1)	(1)
Connecticut	31, 290	149, 012	Pennsylvania	[2] 1, 189, 320	[2] 1, 678, 959
Idaho	40, 850	37, 419	South Dakota	168, 590	229, 288
Illinois	44, 860	25, 364	Tennessee	4, 920	129, 516
Indiana	(1)	(1)	Texas	52, 000	52, 000
Kansas	(1)	(1)	Utah	(1)	(1)
Kentucky	34, 470	58, 086	Virginia	85, 810	64, 494
Maryland	30, 500	44, 507	Washington	173, 210	151, 591
Massachusetts	(1)	(1)	West Virginia	449, 480	612, 416
Michigan	(1)	(1)	Wisconsin	97, 710	149, 042
Minnesota	18, 950	73, 392	Wyoming	980	3, 804
Missouri	130, 430	158, 485	Undistributed	259, 100	292, 644
Montana	(1)	(1)			
New Jersey	320	1, 471		4, 581, 780	7, 575, 320

[1] Included under "Undistributed." [2] Includes bluestone.

Sandstone sold or used by producers in the United States in 1931, by States and uses

State	Number of active plants	Building stone: Rough construction		Building stone: Rough architectural		Building stone: Dressed (sawed and cut)		Refractory stone (ganister)		Paving blocks		Curbing	
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Number	Value	Cubic feet	Value
Alabama	3							(1)	(1)				
Arizona	2							(1)	(1)				
Arkansas	1												
California	27	3,500	$13,400	(1)	(1)			(1)	(1)				
Colorado	4							9,530	$15,173				
Connecticut	4	(1)	(1)	(1)	(1)	(1)	(1)						
Idaho	3			(1)	(1)	(1)	(1)						
Illinois	3							(1)	(1)				
Indiana	1			(1)	(1)	(1)	(1)						
Kansas	2												
Kentucky	3	(1)	(1)			(1)	(1)						
Maryland	5	30	30					2,000	2,560				
Massachusetts	1			(1)	(1)	(1)	(1)						
Michigan	2												
Minnesota	4			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)		
Missouri	3												
Montana	2												
New Jersey	1	320	1,471										
New Mexico	1												
New York	39	5,700	34,940	2,770	$2,129	49,420	$102,246			279,300	$18,712	153,120	$200,066
Ohio	15	1,740	6,510	273,650	242,472	417,680	973,917					491,470	351,453
Oklahoma	3												
Oregon	5	(1)	(1)										
Pennsylvania	70	5,480	9,942	56,930	51,107	83,070	245,699	234,670	283,676	863,790	59,571	57,340	45,521
South Dakota	5					(1)	(1)	8,640	10,799	(1)	(1)		
Tennessee	4	940	6,363	(1)	(1)	(1)	(1)						
Texas	2	20,000	20,000										
Utah	1												
Virginia	3			(1)	(1)	(1)	(1)						
Washington	14	950	822	13,110	40,524								
West Virginia	40											44,300	13,689
Wisconsin	12	(1)	(1)	(1)	(1)	3,320	6,554	57,480	66,357				
Wyoming	2			4,000	2,880								
Undistributed		56,950	74,040	100,930	99,261	69,110	159,027	15,650	27,701	10,000	390		
	287	95,610	167,518	451,390	438,373	622,600	1,487,443	327,970	406,266	1,153,090	78,673	746,230	610,729

[1] Included under "Undistributed."

Sandstone sold or used by producers in the United States in 1931, by States and uses—Continued

State	Flagging		Rubble		Riprap		Crushed stone				Other uses		Total	
							Concrete and road metal		Railroad ballast					
	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama													(1)	(1)
Arizona					(1)	(1)							(1)	(1)
Arkansas					(1)	(1)							(1)	(1)
California	30,680	$13,060	770	$1,643	240,060	$177,541	552,760	$462,576	15,040	$15,049	8,050	$2,884	826,680	$698,445
Colorado	2,220	1,076			1,730	2,600	18,790	24,428					30,220	43,277
Connecticut	(1)	(1)	(1)	(1)	(1)	(1)	20,000	20,000					31,290	149,012
Idaho							(1)	(1)					40,850	37,419
Illinois							(1)	(1)					44,860	25,364
Indiana	(1)	(1)	(1)	(1)									(1)	(1)
Kansas	(1)	(1)					(1)	(1)					(1)	(1)
Kentucky	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)	34,470	58,086
Maryland	19,150	7,667					27,000	34,250					30,500	44,507
Massachusetts													(1)	(1)
Michigan					(1)	(1)	(1)	(1)					(1)	(1)
Minnesota					(1)	(1)	(1)	(1)	(1)	(1)	10,940	30,250	18,950	73,392
Missouri					130,430	158,485							130,430	158,485
Montana			(1)	(1)					(1)	(1)			(1)	(1)
New Jersey													320	1,471
New Mexico							(1)	(1)					(1)	(1)
New York	91,640	61,713	1,020	630	1,020	459	207,030	271,106			20	90	242,420	692,091
Ohio	215,110	125,568	3,140	1,569	366,070	382,739					1,210	12,563	473,510	2,096,791
Oklahoma			80	80	196,080	133,146							196,160	133,226
Oregon							(1)	(1)					(1)	(1)
Pennsylvania	73,010	60,102	5,490	9,754	360	360	758,930	749,423	149,750	151,358	2,720	12,446	1,189,320	1,678,959
South Dakota			(1)	(1)	650	606	135,120	167,886			19,830	25,847	168,590	229,288
Tennessee	27,790	106,951					100	364					4,920	129,516
Texas					17,000	17,000	15,000	15,000					52,000	52,000
Utah							(1)	(1)					(1)	(1)
Virginia							6,080	3,877	78,750	47,050			85,810	64,494
Washington	800	1,243					167,890	107,548	890	479	2,440	975	173,210	151,591
West Virginia			(1)	(1)			127,930	228,008			294,410	335,259	449,480	612,416
Wisconsin			(1)	(1)	1,710	1,113	31,810	38,495			(1)	(1)	97,710	149,042
Wyoming							580	924					980	3,804
Undistributed	6,490	3,027	34,150	51,295	24,180	15,542	286,320	261,523	4,790	1,624	3,490	30,067	259,100	292,644
	466,890	380,407	44,650	64,971	979,290	889,591	2,355,340	2,385,408	249,220	215,560	343,110	450,381	4,581,780	7,575,320

[1] Included under "Undistributed."

BLUESTONE

Figures for bluestone are included in those for sandstone, but on account of the local importance of bluestone they are also given separately. Except for a few of the large quarries, the Bureau of Mines uses figures of sales reported by dealers rather than those of quarrymen as more nearly representative of this industry.

Bluestone sold in New York and Pennsylvania in 1931, by uses

State	Building stone		Curbing		Flagging		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
New York	44,090	$101,475	131,270	$176,544	86,880	$57,733	5,810	$10,179	27,960	$345,931
Pennsylvania	7,560	14,867	17,900	19,269	68,510	57,913	15,570	9,420	23,510	101,469
	51,650	116,342	149,170	195,813	155,390	115,646	21,380	19,599	51,470	447,400

MISCELLANEOUS STONE

The material included under "Miscellaneous" stone is used mainly for concrete, road metal, and railroad ballast. Because of the nature and irregularity of production of materials in this classification the output is apt to vary greatly. In 1931 a total of 5,628,590 short tons, valued at $5,418,242, was reported, a decrease of 35 per cent in both quantity and value from 1930. California contributed the largest quantity of miscellaneous stone in 1931, although its production decreased 50 per cent from 1930. The output of the State includes rhyolite tuff (used as a building stone), andesite, rhyolite, trachyte, and other light-colored volcanic rocks, decomposed granite, hornblende-mica schist, and stone crushed from bowlders taken from river beds. The crushed bowlders are mostly from Los Angeles County, where part of the material taken out is sand, part screened gravel, and the rest chiefly bowlders which are crushed. The sand and screened gravel obtained are included in the report of this series on Sand and Gravel. The varieties of stone reported were discussed in detail on page 369 of the 1930 report of this series.

Miscellaneous varieties of stone [1] sold or used by producers in the United States in 1931, by uses

Use	Quantity	Value
Building stone ... cubic feet	266,990	$84,587
Approximate equivalent in short tons	21,970	
Riprap and rubble ... short tons	98,900	160,159
Crushed stone ... do	4,856,640	4,588,852
Refractory stone (mica schist) ... do	14,600	43,913
Other uses ... do	636,480	540,731
Total (quantities approximate, in short tons)	5,628,590	5,418,242

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any main group.

Miscellaneous varieties of stone sold or used by producers in the United States in 1931, by States

[Quantities approximate]

State	Short tons	Value	State	Short tons	Value
Arizona	417, 490	$309, 660	North Carolina	(1)	(1)
Arkansas	301, 530	282, 163	Ohio	56, 460	$38, 689
California	2, 703, 770	2, 708, 717	Oregon	(1)	(1)
Colorado	45, 980	18, 975	Pennsylvania	774, 830	427, 804
Florida	(1)	(1)	Rhode Island	87, 370	120, 925
Idaho	107, 130	78, 148	South Dakota	7, 820	9, 770
Maine	(1)	(1)	Texas	(1)	(1)
Maryland	136, 050	189, 288	Utah	5, 200	3, 783
Massachusetts	303, 500	412, 637	Vermont	90, 000	133, 500
Michigan	(1)	(1)	Virginia	(1)	(1)
Missouri	23, 150	54, 090	Washington	(1)	(1)
Nevada	(1)	(1)	Wisconsin	53, 280	33, 501
New Hampshire	9, 050	34, 137	Wyoming	(1)	(1)
New Jersey	35, 800	21, 790	Undistributed	318, 830	371, 165
New Mexico	114, 100	127, 300			
New York	37, 250	42, 200		5, 628, 590	5, 418, 242

[1] Included under "Undistributed."

Miscellaneous varieties of stone sold or used by producers in the United States in 1931, by States and uses

State	Number of active plants	Building		Riprap and rubble		Crushed stone				Other uses		Total	
						Concrete and road metal		Railroad ballast					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Arizona	10	540	$540	15,940	$9,594	239,110	$248,600	144,740	$33,766	17,160	$17,160	417,490	$309,660
Arkansas	4			37,440	35,000	229,090	227,163	35,000	20,000			301,530	282,163
California	73	6,990	17,800	39,630	107,177	2,404,080	2,263,077	201,000	114,906	52,070	205,757	2,703,770	2,708,717
Colorado	4					43,600	18,775	2,380	200			45,980	18,975
Florida	2					(1)	(1)					(1)	(1)
Idaho	3					(1)	(1)			(1)	(1)	107,130	78,148
Maine	2					(1)	(1)					(1)	(1)
Maryland	6	11,370	34,685			101,620	125,713	22,150	23,561	910	5,329	136,050	189,288
Massachusetts	4			(1)	(1)	301,500	408,887			(1)	(1)	303,500	412,637
Michigan	2									(1)	(1)	(1)	(1)
Missouri	1					23,150	54,090					23,150	54,090
Nevada	1					(1)	(1)					(1)	(1)
New Hampshire	2			2,190	4,044	4,000	7,500			2,860	22,593	9,050	34,137
New Jersey	4	(1)	(1)			(1)	(1)					35,800	21,790
New Mexico	12					114,100	127,300					114,100	127,300
New York	5					(1)	(1)			(1)	(1)	37,250	42,200
North Carolina	1					(1)	(1)					(1)	(1)
Ohio	4					(1)	(1)			(1)	(1)	56,460	38,689
Oregon	1					(1)	(1)					(1)	(1)
Pennsylvania	48	1,750	3,400			214,960	199,137			558,120	225,267	774,830	427,804
Rhode Island	5					87,370	120,925					87,370	120,925
South Dakota	3					7,820	9,770					7,820	9,770
Texas	2			(1)	(1)			(1)	(1)			(1)	(1)
Utah	3					(1)	(1)			(1)	(1)	5,200	3,783
Vermont	2					90,000	133,500					90,000	133,500
Virginia	1	(1)	(1)									(1)	(1)
Washington	1					(1)	(1)					(1)	(1)
Wisconsin	3					53,280	33,501					53,280	33,501
Wyoming	1					(1)	(1)			(1)	(1)	(1)	(1)
Undistributed		1,320	28,162	3,700	4,344	527,690	413,053	10,000	5,428	19,960	108,538	318,830	371,165
	210	21,970	84,587	98,900	160,159	4,441,370	4,390,991	415,270	197,861	651,080	584,644	5,628,590	5,418,242

[1] Included under "Undistributed."

CRUSHED STONE (CONCRETE AND ROAD METAL AND RAILROAD BALLAST)

The crushed stone sold or used by producers for concrete and road metal and for railroad ballast in the United States in 1931 amounted to 72,624,410 short tons, valued at $70,404,964, a decrease of 17 per cent in quantity and 20 per cent in value from 1930; crushed stone for concrete and road metal (65,811,520 tons, valued at $64,908,509) decreased 11 per cent in quantity and 16 per cent in value, and that for railroad ballast (6,812,890 tons, valued at $5,496,455) decreased 47 per cent in quantity and 46 per cent in value. The total average value per ton was $0.97 in 1931, 4 cents less than in 1930. The average value of crushed stone for concrete and road metal ($0.99) was 5 cents less and that for railroad ballast ($0.81) 1 cent more than in 1930. The figures for crushed stone include reports given by various railroads relative to the noncommercial material used by them; such information as was obtainable from highway departments of the different States on the noncommercial crushed stone used for road construction; and information supplied by a large number of cities, towns, and counties that crush stone for road and repair work. The information from the various municipalities is difficult to obtain on account of the irregularity of operation and the incomplete records kept.

Crushed stone sold or used by producers in the United States in 1931, by kinds and uses

Kind	Concrete and road metal		Railroad ballast		Total		
						Value	
	Short tons	Value	Short tons	Value	Short tons	Total	Average
Granite	5,223,550	$6,142,768	1,115,320	$966,664	6,338,870	$7,109,432	$1.12
Basalt and related rocks (trap rock)	11,669,830	12,792,313	552,610	561,113	12,222,440	13,353,426	1.09
Limestone	42,121,430	39,197,029	4,480,470	3,555,257	46,601,900	42,752,286	.92
Sandstone	2,355,340	2,385,408	249,220	215,560	2,604,560	2,600,968	1.00
Miscellaneous	4,441,370	4,390,991	415,270	197,861	4,856,640	4,588,852	.94
	65,811,520	64,908,509	6,812,890	5,496,455	72,624,410	70,404,964	
Average value per ton		0.99		0.81		0.97	

Crushed stone sold or used by producers in the United States, 1927–1931, by uses

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1927	78,544,210	$84,177,237	16,404,560	$13,297,030	94,948,770	$97,474,267
1928	74,384,490	81,041,349	16,880,870	13,144,910	91,265,360	94,186,259
1929	76,174,770	80,685,493	16,546,490	13,702,385	92,721,260	94,387,878
1930	74,293,090	77,347,379	12,817,800	10,206,975	87,110,890	87,554,354
1931	65,811,520	64,908,509	6,812,890	5,496,455	72,624,410	70,404,964

Crushed stone sold or used by producers in the United States in 1931, by States and uses

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	14,040	$12,344	9,130	$5,201	23,170	$17,545
Arizona	[1] 239,110	[1] 248,600	144,740	33,766	[1] 383,850	[1] 282,366
Arkansas	303,590	316,839	45,960	29,137	349,550	345,976
California	4,485,820	4,321,085	347,370	187,531	4,833,190	4,508,616
Colorado	[1] 62,390	[1] 43,203	2,380	200	[1] 64,770	[1] 43,403
Connecticut	[1] 1,742,430	[1] 1,801,470	140,910	137,033	[1] 1,883,340	[1] 1,938,503
Delaware	(2)	(2)			(2)	(2)
Florida	[1] 1,152,470	[1] 859,290	170,700	144,586	[1] 1,323,170	[1] 1,003,876
Georgia	1,234,050	1,113,111	35,730	16,671	1,269,780	1,129,782
Hawaii	360,080	661,719	3,470	5,352	363,550	667,071
Idaho	862,150	815,637			862,150	815,637
Illinois	[1] 3,648,820	[1] 2,454,221	361,640	241,618	[1] 4,010,460	[1] 2,695,839
Indiana	1,703,110	1,248,093	118,460	87,513	1,821,570	1,335,606
Iowa	1,020,030	994,608	66,360	38,320	1,086,390	1,032,928
Kansas	[1] 705,880	[1] 639,558	314,830	287,289	[1] 1,020,710	[1] 926,847
Kentucky	[1] 1,697,220	[1] 1,463,930	286,570	184,582	[1] 1,983,790	[1] 1,648,512
Louisiana	(2)	(2)	(2)	(2)	(2)	(2)
Maine	75,870	103,190			75,870	103,190
Maryland	904,450	1,131,796	53,760	70,066	958,210	1,201,862
Massachusetts	[1] 2,048,250	[1] 2,375,223	68,700	59,838	[1] 2,116,950	[1] 2,435,061
Michigan	[1] 810,070	[1] 594,461	36,170	25,327	[1] 846,240	[1] 619,788
Minnesota	[1] 216,970	[1] 227,173	(2)	(2)	271,900	303,730
Missouri	2,252,000	2,547,313	31,640	32,952	2,283,640	2,580,265
Montana	11,950	10,413	(2)	(2)	[1] 11,950	[1] 10,413
Nebraska	30,930	9,251			30,930	9,251
Nevada	(2)	(2)	(2)	(2)	23,290	12,438
New Hampshire	124,750	137,262			124,750	137,262
New Jersey	[1] 2,161,540	[1] 2,601,892	[1] 100,560	[1] 113,981	[1] 2,262,100	[1] 2,715,873
New Mexico	375,650	537,740			375,650	537,740
New York	[1] 10,007,980	[1] 11,836,405	651,150	749,883	[1] 10,659,130	[1] 12,586,288
North Carolina	830,930	966,485	244,060	208,183	1,074,990	1,174,668
Ohio	[1] 6,438,130	[1] 4,185,482	578,490	406,803	[1] 7,016,620	[1] 4,592,285
Oklahoma	1,184,900	971,230	328,060	185,009	1,512,960	1,156,239
Oregon	1,405,720	1,284,331	2,700	3,140	1,408,420	1,287,471
Pennsylvania	6,310,320	6,665,231	390,760	402,541	6,701,080	7,067,772
Puerto Rico	24,270	29,385			24,270	29,385
Rhode Island	122,320	160,369			122,320	160,369
South Carolina	1,631,530	2,048,043	44,580	36,485	1,676,110	2,084,528
South Dakota	[1] 180,810	[1] 213,476			[1] 180,810	[1] 213,476
Tennessee	996,560	1,049,149	335,010	255,549	1,331,570	1,304,698
Texas	[1] 830,860	[1] 620,070	314,490	252,678	[1] 1,145,350	[1] 872,748
Utah	6,290	4,326	41,820	26,995	48,110	31,321
Vermont	157,860	225,980			157,860	225,980
Virginia	[1] 1,495,510	[1] 1,465,385	[1] 642,490	[1] 501,025	2,612,170	2,388,554
Washington	[1] 1,574,040	[1] 1,323,521	26,890	27,605	[1] 1,600,930	[1] 1,351,126
West Virginia	754,680	855,522	311,260	240,776	1,065,940	1,096,298
Wisconsin	[1] 2,078,970	[1] 1,815,590	[1] 32,900	[1] 23,618	2,197,290	1,975,147
Wyoming	189,710	139,419	(2)	(2)	[1] 189,710	[1] 139,419
Undistributed	1,346,510	1,779,688	529,150	475,202	1,237,850	1,607,812
	65,811,520	64,908,509	6,812,890	5,496,455	72,624,410	70,404,964

[1] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

NATURAL GASOLINE [1]

By G. R. Hopkins and E. M. Seeley

CONTENTS

ILLUSTRATIONS

SUMMARY

Production of natural gasoline in the United States in 1931 totaled 1,831,918,000 gallons, a decrease of 17 per cent from 1930. (See fig. 4.) This material decline resulted primarily from the severe curtailment in crude-oil production, the only active area (east Texas) having a low gas-oil ratio.

The total world production of natural gasoline in 1931 was 2,122-168,000 gallons, a decrease of 15 per cent from 1930. Although the United States still ranks far ahead of other nations in natural-gasoline production its share of the world total declined from 89 per cent in 1930 to 86 per cent in 1931.

The year was characterized by unprecedented low prices. Natural-gasoline prices were low at the beginning of 1931, by the end of April had declined about 46 per cent, and at the end of the year were 23 per cent below January quotations. This decrease reflected chiefly the decline in motor-fuel prices. Continuation of low prices in 1931 forced many small companies to close or dispose of their plants. Accordingly, the number of operators and plants declined further, but the total capacity continued to increase.

To meet the competition of absorption gasoline produced at refineries the production of finished motor fuel for direct distribution to consumers was increased. The resulting change in quality was brought about principally by increased stabilization, and the average yield again declined. Exports of natural gasoline also decreased in 1931.

California continued to be the leading natural gasoline-producing State, with Oklahoma second and Texas third. Wyoming and New Mexico alone increased in output in 1931.

[1] Work on manuscript completed October, 1932.

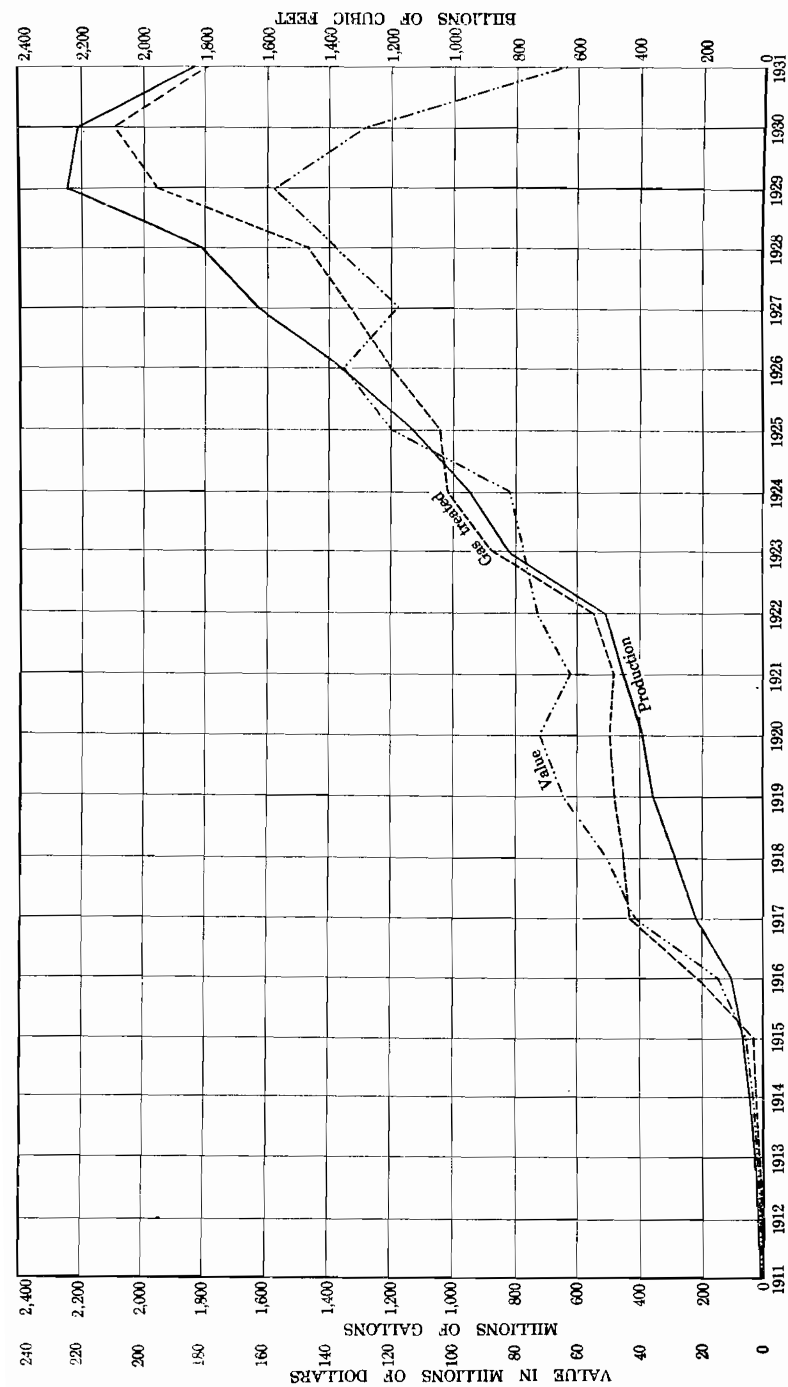

FIGURE 4.—Quantity and value of natural gasoline produced and volume of natural gas treated at plants, 1911-1931.

Summary of statistics for natural gasoline in the United States, 1920, 1925' 1929–1931

	1920	1925	1929	1930	1931
Number of plants operating	1,154	1,081	1,087	1,035	937
Production:					
By States—					
California .... millions of gallons	48	303	840	830	680
Oklahoma .... do	179	391	676	591	455
Texas .... do	33	214	420	491	427
Louisiana .... do	11	43	65	74	58
West Virginia .... do	59	58	73	63	53
Other .... do	55	118	160	161	159
	385	1,127	2,234	2,210	1,832
By types of process—					
Compression process .... do	281	238	259	250	212
Absorption and combination processes .... do	104	882	1,950	1,942	1,609
Charcoal .... do		7	25	18	11
	385	1,127	2,234	2,210	1,832
Stocks at natural-gasoline plants at end of year .... do	(1)	15	26	24	27
Value:					
Total (at plants) .... millions of dollars	72	120	158	128	64
Average per gallon (at plant) .... cents	18.7	10.7	7.1	5.8	3.5
Average spot price, Oklahoma natural gasoline, grade A .... cents	21.3	12.0	7.1	5.4	3.2
Natural gas treated .... millions of cubic feet	496,431	1,040,290	1,959,294	2,088,778	1,790,119
Average yield per thousand cubic feet .... gallons	0.78	1.08	1.14	1.06	1.02

[1] Figures not available.

PRODUCTION

Number of plants and operators.—The decline in natural-gasoline prices in recent years has been reflected in both the number of operating plants and operators. The marginal (high-cost) producers have been compelled to close their plants or be absorbed by stronger units. Accordingly, the number of operating plants has declined from 1,119 in 1927 to 937 in 1931 and the number of operators from 394 to 324 in the same period. Although reduced prices have made a pronounced change in the personnel of the industry they have not had a similar effect on the productive capacity of the plants; in fact, a recent Bureau of Mines survey[2] showed that total capacity had increased between January 1, 1930, and January 1, 1932, because the marginal plants which dropped out were small, whereas the few new ones are of large capacity.

During 1931 the average total daily capacity of the operating plants was approximately 10,600,000 gallons, and the average daily production was 5,019,000 gallons. These figures indicate that the industry operated at an average of 47 per cent of its capacity during 1931, compared with 58 per cent in 1930. Oklahoma continued to rank first in number of plants and California first in total capacity.

Output by States.—Although the output of natural gasoline in California declined 18 per cent in 1931 the State easily retained its rank as the leading producer. Oklahoma, with a production of 454,886,000 gallons, retained second place. The gain in Wyoming undoubtedly resulted from the return of excess residue gas to the producing sands at Salt Creek; that in New Mexico was related to the increase in the production of crude oil and natural gas in the Hobbs field.

[2] Hopkins, G. R., and Seeley, E. M., Natural-Gasoline Plants in the United States, Jan. 1, 1932: Inf. Circ. 6635, Bureau of Mines, 1932, 28 pp.

Natural gasoline produced in the United States, 1920, 1925, 1929–1931, by States, in thousands of gallons

Year	Alaska	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	New Mexico	New York
1920	--------	--------	48, 208	--------	6, 055	--------	4, 331	4, 497	10, 610	--------	411
1925	33	19, 686	303, 180	35	9, 874	--------	19, 592	7, 685	43, 489	--------	414
1929	35	33, 455	840, 325	1, 630	7, 080	2	36, 227	6, 006	64, 957	1, 077	264
1930	39	30, 637	829, 713	1, 322	6, 867	2	35, 106	6, 641	73, 693	3, 663	208
1931	32	26, 282	680, 339	659	5, 024	1	32, 690	5, 464	58, 034	17, 775	132

Year	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Total		
							Thousands of gallons	Value at plant	
								Thousands of dollars	Average per gallon (cents)
1920	10, 016	178, 857	21, 151	32, 956	58, 941	8, 711	384, 744	71, 788	18. 7
1925	8, 701	390, 861	18, 850	214, 092	58, 201	32, 777	1, 127, 470	120, 383	10. 7
1929	11, 166	676, 030	18, 411	419, 485	72, 994	44, 544	2, 233, 688	158, 410	7. 1
1930	8, 937	591, 194	16, 713	491, 299	63, 328	51, 132	2, 210, 494	128, 160	5. 8
1931	5, 199	454, 886	14, 339	426, 695	52, 844	51, 523	1, 831, 918	63, 732	3. 5

Natural gasoline produced and natural gas treated in the United States in 1931, by States

State	Number of operators [1]	Number of plants operating	Natural gasoline produced			Estimated quantity of natural gas treated	
			Thousands of gallons	Value at plant		Millions of cubic feet	Average yield per M cubic feet (gallons)
				Thousands of dollars	Average per gallon (cents)		
Alaska	1	1	32	5	15. 6	25	1. 28
Arkansas	10	14	26, 282	921	3. 5	8, 788	2. 99
California	45	136	680, 339	29, 505	4. 3	470, 096	1. 45
Colorado	1	2	659	21	3. 2	824	. 80
Illinois	23	79	5, 024	204	4. 1	2, 106	2. 39
Indiana	1	1	1	(2)	16. 2	(3)	2. 40
Kansas	10	20	32, 690	935	2. 9	54, 861	. 60
Kentucky	5	6	5, 464	266	4. 9	23, 281	. 23
Louisiana	21	44	58, 034	1, 731	3. 0	134, 238	. 43
New Mexico	2	3	17, 775	419	2. 4	12, 590	1. 41
New York	1	1	132	9	6. 8	487	. 27
Ohio	13	23	5, 199	271	5. 2	25, 666	. 20
Oklahoma	88	237	454, 886	12, 619	2. 8	285, 029	1. 60
Pennsylvania	81	124	14, 339	706	4. 9	36, 414	. 39
Texas	53	138	426, 695	11, 887	2. 8	579, 327	. 74
West Virginia	30	99	52, 844	2, 436	4. 6	128, 670	. 41
Wyoming	5	9	51, 523	1, 797	3. 5	27, 717	1. 86
Total, 1931	[1] 324	937	1, 831, 918	63, 732	3. 5	1, 790, 119	1. 02
Total, 1930	350	1, 035	2, 210, 494	128, 160	5. 8	2, 088, 778	1. 06

[1] A producer operating in more than one State is counted only once.
[2] Less than $500.
[3] Less than 500,000 cubic feet.

Output by months.—The output of natural gasoline in 1931 was at its highest at the beginning of the year, followed by a general decline until October. In October, November, and December production increased, coincident with a gain in production of crude petroleum and increased demand for natural gas because of colder weather.

Summary of monthly natural-gasoline statistics in the United States in 1931, in millions of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	The year
Production by fields:													
Appalachian	8.9	7.6	8.4	6.8	5.9	4.2	3.7	4.0	4.4	5.3	6.1	7.2	72.5
Kentucky, Illinois, and Indiana	1.2	1.0	1.1	.8	.8	.6	.6	.7	.7	.9	1.0	1.1	10.5
Oklahoma—													
Oklahoma City	3.8	3.5	4.7	4.9	5.9	5.6	5.3	1.5	.8	3.5	6.4	7.9	53.8
Osage County	7.7	5.7	6.2	5.9	5.8	5.3	5.3	4.3	5.2	5.2	5.2	4.9	66.7
Seminole	18.6	17.6	19.6	18.9	18.4	16.5	16.9	11.6	9.5	12.1	15.0	14.0	188.7
Rest of State	14.0	13.0	14.1	12.9	13.6	11.4	11.9	9.6	11.0	11.4	11.2	11.6	145.7
Total, Oklahoma	44.1	39.8	44.6	42.6	43.7	38.8	39.4	27.0	26.5	32.2	37.8	38.4	454.9
Kansas	2.9	2.8	3.2	3.0	2.7	2.4	2.5	2.5	2.6	2.7	2.6	2.8	32.7
Texas—													
North Texas	3.5	3.1	3.3	3.0	2.6	2.5	2.4	2.1	2.6	2.3	2.3	2.1	31.8
Panhandle	20.0	17.8	18.6	17.8	17.4	16.9	17.0	17.6	16.6	19.0	16.6	17.0	212.3
West central	11.1	9.8	10.7	10.3	10.0	8.9	8.9	8.6	7.7	7.9	7.8	8.0	109.7
Rest of State	6.2	6.0	6.8	6.1	5.7	6.0	5.7	5.9	5.8	5.8	6.3	6.6	72.9
Total, Texas	40.8	36.7	39.4	37.2	35.7	34.3	34.0	34.2	32.7	35.0	33.0	33.7	426.7
Louisiana	5.7	5.7	5.8	5.5	4.9	4.7	4.3	3.4	4.3	4.3	4.9	4.5	58.0
Arkansas	2.5	2.4	2.5	2.5	2.4	2,3	2.2	2.0	1.9	2.0	1.9	1.7	26.3
Rocky Mountain	5.7	4.9	5.3	5.5	6.1	6.0	5.9	6.1	6.4	6.5	5.8	5.8	70.0
California—													
Huntington Beach	2.0	1.8	2.0	1.9	1.9	1.7	1.7	1.7	1.7	1.7	1.5	1.5	21.1
Kettleman Hills	16.5	11.9	14.8	15.0	15.6	15.7	15.9	14.4	11.7	12.6	13.7	14.3	172.1
Long Beach	13.8	12.4	13.5	11.9	11.8	11.1	10.9	10.6	9.9	10.1	9.7	9.7	135.4
Santa Fe Springs	12.2	10.0	11.3	10.9	11.3	9.9	10.0	9.8	9.5	9.7	9.3	9.2	123.1
Ventura Avenue	4.9	4.4	5.2	4.9	4.8	4.5	4.4	4.4	4.4	4.5	4.2	4.5	55.1
Rest of State	15.5	13.9	15.7	14.8	15.3	14.3	14.4	14.6	13.8	14.5	13.4	13.3	173.5
Total, California	64.9	54.4	62.5	59.4	60.7	57.2	57.3	55.5	51.0	53.1	51.8	52.5	680.3
Total, United States	176.7	155.3	172.8	163.3	162.9	150.5	149.9	135.4	130.5	142.0	144.9	147.7	1,831.9
Daily average	5.7	5.5	5.6	5.4	5.3	5.0	4.8	4.4	4.4	4.6	4.8	4.8	5.0
Stocks at end of period	25.5	29.1	37.1	42.3	41.8	36.1	35.9	30.3	25.8	22.0	26.9	27.1	27.1
Indicated deliveries	175.5	151.7	164.8	158.1	163.4	156.2	150.1	141.0	135.0	145.8	140.0	147.5	1,829.1
Blending at plants:													
Natural gasoline used [1]	.5	.6	.6	.6	.6	.6	.6	.5	.5	.5	.4	.2	6.2
Naphtha used [1]	.6	.6	.7	.6	.7	.7	.7	.7	.7	.6	.6	.3	7.5
Stocks of blends at end of period	.5	.5	.5	.4	.4	.3	.4	.5	.4	.4	.3	.3	.3

[1] East of California.

Output by counties.—Natural gasoline was produced in 146 counties in 16 States in 1931, the same number of producing States as in 1930 but a decrease of 11 in the number of producing counties. Los Angeles County, Calif., was again the leading producing county, with Seminole County, Okla., again second.

Natural gasoline produced in the United States in 1931, by States and by counties

State	County	Thousands of gallons	Thousands of dollars
Alaska	Third division	32	5
Arkansas	Ouachita	5,004	169
	Union	21,278	752
		26,282	921
California	Fresno and Kings	168,708	7,674
	Kern	45,067	2,436
	Los Angeles	332,243	13,760
	Orange	44,082	1,933
	Santa Barbara	25,705	1,034
	Ventura	64,534	2,668
		680,339	29,505
Colorado	Larimer	659	21
Illinois	Clark and Cumberland	471	21
	Crawford	2,004	87
	Lawrence	2,549	96
		5,024	204
Indiana	Pike	1	[1]
Kansas	Barber, McPherson, and Sedgwick	12,132	388
	Butler, Chautauqua, and Montgomery	1,818	57
	Cowley	6,851	206
	Greenwood	10,240	239
	Sumner	1,649	45
		32,690	935
Kentucky	Boyd, Clark, and Martin	4,812	239
	Lee	652	27
		5,464	266
Louisiana	Bossier, DeSoto, and Red River	2,250	58
	Caddo	6,564	218
	Claiborne	12,860	385
	Morehouse	763	21
	Ouachita	5,427	134
	Richland	24,108	751
	Webster	6,062	164
		58,034	1,731
New Mexico	Eddy and Lea	17,775	419
New York	Allegany	132	9
Ohio	Fairfield, Licking, Richland, and Wayne	3,794	190
	Jefferson and Noble	245	12
	Monroe	360	19
	Washington	800	50
		5,199	271
Oklanoma	Beckham, Custer, and Harmon	5,552	156
	Carter	8,818	272
	Creek	66,564	1,950
	Garfield	7,664	221
	Grady, Stephens, and Wagoner	781	24
	Hughes	5,381	160
	Kay	6,914	193
	Lincoln	4,448	122
	Logan	5,863	182
	Muskogee	578	17
	Noble	8,775	243

[1] Less than $500.

Natural gasoline produced in the United States in 1931, by States and by counties—Continued

State	County	Thousands of gallons	Thousands of dollars
Oklahoma (Contd.)	Nowata	649	20
	Okfuskee	3,416	76
	Oklahoma	53,821	1,407
	Okmulgee	4,581	141
	Osage	66,668	1,989
	Pawnee	4,250	126
	Payne	4,284	116
	Pottawatomie	36,770	1,020
	Seminole	151,432	3,947
	Tulsa	6,455	190
	Washington	1,222	47
		454,886	12,619
Pennsylvania	Allegheny	1,467	59
	Armstrong, Elk, and Lawrence	209	9
	Beaver	144	8
	Butler	420	19
	Clarion	223	10
	Crawford	172	8
	Forest	495	23
	Greene	3,986	162
	McKean	1,258	82
	Venango	3,380	211
	Warren	1,734	81
	Washington	851	34
		14,339	706
Texas	Anderson, Navarro, and Van Zandt	15,043	400
	Archer, Clay, Cooke, and Jack	5,415	147
	Austin, Caldwell, and Refugio	4,614	125
	Brown	4,718	123
	Carson	22,604	696
	Coleman and Comanche	2,152	61
	Crane, Ector, Pecos, and Reagan	46,982	1,178
	Eastland	47,316	1,317
	Erath and Palo Pinto	6,976	146
	Gray	96,535	2,669
	Harrison, Panola, and Rusk	3,998	114
	Hutchinson	78,575	2,272
	Moore and Potter	7,710	221
	Shackelford and Wilbarger	8,297	255
	Stephens	39,402	1,122
	Wheeler	6,855	180
	Wichita	24,023	710
	Young	5,480	151
		426,695	11,887
West Virginia	Brooke and Marshall	614	31
	Clay, Doddridge, and Gilmer	634	23
	Harrison	2,182	98
	Jackson	2,741	139
	Kanawha	21,224	957
	Lewis	4,881	209
	Lincoln and Wayne	1,197	50
	Marion	1,130	41
	Monongalia	510	20
	Pleasants	1,236	78
	Ritchie and Wirt	631	29
	Roane	1,830	82
	Tyler	1,805	101
	Wetzel	12,229	578
		52,844	2,436
Wyoming	Carbon, Fremont, Hot Springs, and Niobrara	3,429	103
	Natrona	48,094	1,694
		51,523	1,797
United States		1,831,918	63,732

Output by types of process.—In 1931 the number of plants using the absorption process, or a combination of the absorption process with others, declined relatively more than the number using the compression process. On the basis of output plants using the absorption and combination processes produced practically the same proportion of the total as in 1930. The charcoal process continued to decline in relative importance.

Natural gasoline produced in the United States in 1931, by States and by methods of manufacture

State	Number of plants operating			Production (thousands of gallons)		
	Compression	Absorption [1]	Charcoal	Compression	Absorption [1]	Charcoal
Alaska		1			32	
Arkansas	1	11	2	2,348	21,984	1,950
California	2	134		2,374	677,965	
Colorado		2			659	
Illinois	79			5,024		
Indiana	1			1		
Kansas	6	14		5,579	27,111	
Kentucky	2	3	1	190	4,459	815
Louisiana	10	32	2	7,127	50,884	23
New Mexico		3			17,775	
New York		1			132	
Ohio	17	5	1	441	3,807	951
Oklahoma	84	153		90,710	364,176	
Pennsylvania	103	19	2	5,123	8,778	438
Texas	25	112	1	39,131	387,509	55
West Virginia	56	35	8	11,531	34,373	6,940
Wyoming	2	7		41,874	9,649	
Total, 1931	388	532	17	211,453	1,609,293	11,172
Total, 1930	422	593	20	250,479	1,942,280	17,735

[1] Includes combination of absorption process with compression and charcoal processes.

Yields.—The average yield of natural gasoline per thousand cubic feet of gas treated was 1.02 gallons in 1931, compared with 1.06 gallons in 1930. The explanation of this decrease is undoubtedly the same as that given in the 1930 report of this series; that is, it has become necessary for the manufacturer to do more stabilizing to remove the light ends, thus reducing the volume.

World production.—According to Swanson [3] the world production of natural gasoline totaled 2,122,168,000 gallons in 1931, a decrease of 360,537,000 gallons (15 per cent) from the record total of 2,482,705,000 gallons reported for 1930. The decline in world production resulted

[3] Swanson, E. B., World Production of Natural Gasoline, 1931: Min. Market Rept. 121, June 9, 1932.

from the drop of 17 per cent in output in the United States, as total production in foreign countries increased 7 per cent. Rumania, Russia, and Argentina reported substantial increases in crude-oil production and corresponding gains in natural-gasoline output, whereas such countries as Netherland East Indies, Persia, Peru, and Venezuela, where crude-oil production was curtailed during 1931, reported smaller output of natural gasoline. Output of natural gasoline was reported from 18 countries for 1931. Ecuador was added to the list in 1930.

World production of natural gasoline, 1927–1931, by countries, in thousands of gallons

Country	1927	1928	1929	1930	1931
United States	1,641,144	1,814,034	2,233,688	2,210,494	1,831,918
Netherland East Indies	32,724	44,611	56,025	75,035	66,382
Rumania	7,014	12,120	17,805	36,243	50,281
Russia	7,804	9,786	15,162	22,344	31,521
Peru	17,453	25,385	30,657	32,419	30,585
Persia	7,984	19,333	29,263	28,468	28,271
Colombia	3,255	10,291	13,793	16,429	17,635
Poland	11,086	12,710	13,768	15,359	16,351
Venezuela	3,508	10,538	13,094	17,395	15,875
Argentina	881	3,460	5,982	7,158	7,997
Mexico	565	3,404	4,956	7,190	6,766
Japan	2,848	2,835	3,251	3,599	[1] 3,780
India, British	3,348	4,401	4,195	3,768	3,612
Trinidad	----------	----------	162	253	3,607
British Borneo (Sarawak)	952	2,047	3,202	3,479	3,277
Taiwan (Formosa)	211	548	491	1,935	[1] 2,100
Egypt	708	903	889	1,109	2,058
Ecuador	----------	----------	----------	28	152
Canada	258	7	----------	----------	----------
	1,741,743	1,976,413	2,446,383	2,482,705	2,122,168

[1] Estimated.

CONSUMPTION

Summary.—Of the total output of natural gasoline in 1931 plus withdrawals from stocks, 1,426,908,000 gallons (77.4 per cent) were blended at refineries; 47,964,000 gallons (2.6 per cent) were run through pipe lines in California; 6,216,000 gallons (0.3 per cent) were blended at plants east of California; and 178,500,000 gallons (9.7 per cent) were exported or sold to jobbers; leaving 184,234,000 gallons (10.0 per cent) for losses and quantities not accounted for. These data indicate principally declines in percentage utilized by refiners and exported and sold to jobbers, with a comparable increase in losses and quantities unaccounted for. (See fig. 5.)

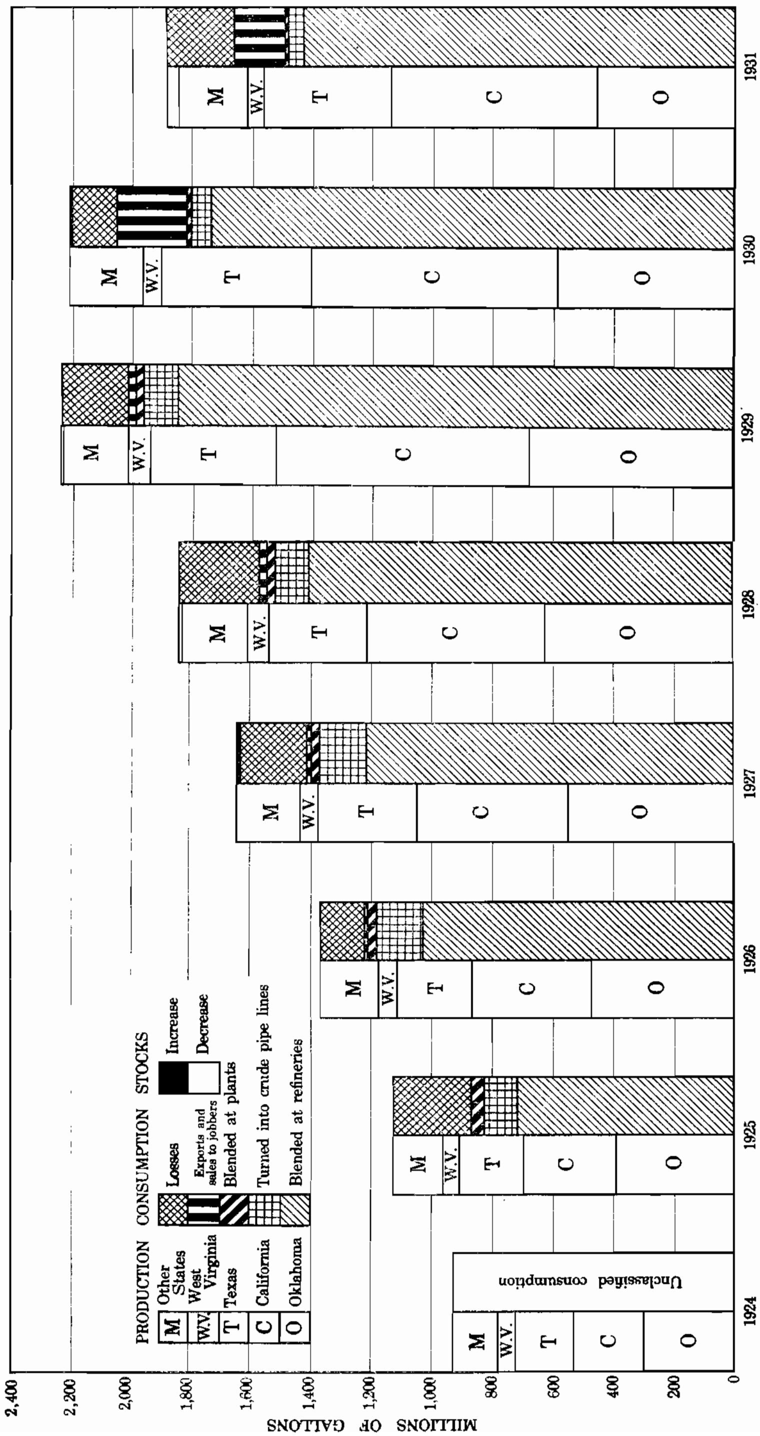

FIGURE 5.—Production and consumption of natural gasoline, 1924–1931.

Distribution of natural gasoline in 1931, by months, in thousands of gallons

	January	February	March	April	May	June
Production	176, 700	155, 300	172, 800	163, 300	162, 918	150, 500
Decrease in stocks						374
	176, 700	155, 300	172, 800	163, 300	162, 918	150, 874
Blended at refineries	133, 098	126, 756	126, 336	117, 138	126, 462	117, 684
Run through pipe lines in California	2, 898	3, 066	3, 066	3, 696	3, 612	4, 494
Blended at plants [1]	538	540	570	562	584	620
Exports and sales to jobbers	14, 700	13, 650	14, 700	10, 500	16, 800	9, 450
Increase in stocks	6, 362	1, 509	17, 234	13, 371	507	
Balance	19, 104	9, 779	10, 894	18, 033	14, 953	18, 626
	176, 700	155, 300	172, 800	163, 300	162, 918	150, 874

	July	August	September	October	November	December	The year
Production	149, 900	135, 400	130, 500	142, 000	144, 900	147, 700	1, 831, 918
Decrease in stocks	12, 972	20, 869	5, 292	21, 497			11, 904
	162, 872	156, 269	135, 792	163, 497	144, 900	147, 700	1, 843, 822
Blended at refineries	108, 612	103, 950	109, 158	126,882	120, 876	109, 956	1, 426, 908
Run through pipe lines in California	4, 410	2, 814	6, 510	6, 720	3, 402	3, 276	47, 964
Blended at plants [1]	599	533	530	495	435	210	6, 216
Exports and sales to jobbers	16, 800	29, 400	12, 684	16, 716	8, 400	14, 700	178, 500
Increase in stocks					395	9, 722	
Balance	32, 451	19, 572	6, 910	12, 684	11, 392	9, 836	184, 234
	162, 872	156, 269	135, 792	163, 497	144, 900	147, 700	1, 843, 822

[1] East of California.

Blending at refineries.—The blending of natural gasoline with naphtha at refineries in the production of motor fuel continued to rank far in the lead as the chief use of natural gasoline; however, it has become increasingly difficult for natural-gasoline manufacturers to retain their refinery market and at the same time maintain prices. This condition is not of recent origin but was a small factor as early as 10 years ago. The chief reason for the growing apathy of refiners toward the use of natural gasoline is that volatility and antiknock, the chief qualities imparted through the use of natural gasoline, may usually be obtained at lower cost through proper operation of cracking equipment. In addition, most of the large refiners have installed vapor-recovery systems, whereby "absorption gasoline," a product similar to natural gasoline, is produced. That the substantial increases in cracking and in production of "absorption gasoline" at refineries in recent years have not caused a material decline in the proportion of the total distribution blended at refineries is due mainly to the fact that many large refiners are also leaders in natural-gasoline production.

California refineries continued to be the chief users of natural gasoline; 16 per cent of the total gasoline output of the State consisted of natural gasoline compared with 11.5 per cent for the Arkansas-Inland Louisiana district (which ranked second) and an average of 8.1 per cent for the entire country. In the East coast district only 2.2 per cent of the total gasoline output was attributed to the blending of natural gasoline, chiefly owing to high transportation costs and the relatively high proportion of cracked gasoline.

Natural gasoline blended at refineries in the United States in 1931, by districts and months, in thousands of gallons

	January	February	March	April	May	June
East coast	10, 164	9, 618	5, 460	3, 318	3, 780	2, 688
Appalachian	2, 100	1, 512	1, 806	1, 764	2, 226	1, 596
Indiana, Illinois, Kentucky, etc	11, 046	9, 408	9, 198	9, 450	9, 450	6, 636
Oklahoma, Kansas, and Missouri	18, 228	17, 640	18, 060	17, 724	18, 942	18, 438
Texas:						
Gulf coast	30, 366	21, 294	24, 822	18, 060	22, 470	24, 822
Rest of State	10, 878	10, 836	9, 870	15, 498	12, 852	11, 718
Total, Texas	41, 244	32, 130	34, 692	33, 558	35, 322	36, 540
Louisiana-Arkansas:						
Louisiana Gulf coast	5, 334	6, 930	8, 400	7, 686	7, 560	4, 704
Northern Louisiana and Arkansas	4, 116	3, 906	4, 620	4, 200	4, 074	3, 990
Total, Louisiana and Arkansas	9, 450	10, 836	13, 020	11, 886	11, 634	8, 694
Rocky Mountain	5, 544	3, 822	4, 032	3, 906	4, 284	4, 326
California	38, 220	44, 856	43, 134	39, 228	44, 436	43, 260
Total, United States, 1931	135, 996	129, 822	129, 402	120, 834	130, 074	122, 178
1930	136, 752	133, 980	135, 618	143, 052	132, 804	136, 500

	July	August	September	October	November	December	The year
East coast	2, 142	3, 486	5, 586	7, 056	4, 956	5, 124	63, 378
Appalachian	1, 848	1, 680	1, 344	1, 848	2, 310	1, 596	21, 630
Indiana, Illinois, Kentucky, etc	7, 728	6, 846	10, 038	13, 986	16, 044	11, 886	121, 716
Oklahoma, Kansas, and Missouri	21, 210	17, 808	18, 312	19, 530	20, 202	18, 648	224, 742
Texas:							
Gulf coast	24, 234	21, 420	19, 194	19, 026	21, 042	18, 396	265, 146
Rest of State	11, 382	11, 676	12, 012	15, 036	13, 902	12, 768	148, 428
Total, Texas	35, 616	33, 096	31, 206	34, 062	34, 944	31, 164	413, 574
Louisiana-Arkansas:							
Louisiana Gulf coast	3, 024	4, 872	3, 990	3, 906	3, 444	4, 620	64, 470
Northern Louisiana and Arkansas	3, 192	2, 940	2, 646	3, 318	2, 562	2, 184	41, 748
Total, Louisiana and Arkansas	6, 216	7, 812	6, 636	7, 224	6, 006	6, 804	106, 218
Rocky Mountain	4, 242	4, 536	5, 208	5, 040	4, 326	3, 906	53, 172
California	34, 020	31, 500	37, 338	44, 856	35, 490	34, 104	470, 442
Total, United States, 1931	113, 022	106, 764	115, 668	133, 602	124, 278	113, 232	1, 474, 872
1930	154, 602	152, 544	164, 976	157, 332	146, 622	148, 260	1, 743, 042

Turned into pipe lines.—Transportation of natural gasoline by pipe line apparently declined in 1931; only 66,869,000 gallons were reported so shipped compared with 88,028,000 gallons in 1930. However, the two figures are not strictly comparable, as large quantities of natural gasoline are transported with crude oil in pipe lines in Texas but are reported as "blended at refineries." Even if allowance is made for natural gasoline so reported California probably outranks Texas in this class of transportation.

Blending at plants.—The quantity of natural gasoline blended with naphtha in the production of motor fuel at gasoline plants is of interest chiefly as a barometer of the manufacturers' progress in distributing their product direct to consumers. However, the fact that the quantity of natural gasoline so blended declined from 10,621,000 gallons in 1930 to 6,216,000 gallons in 1931 indicates that the margins between prices of natural gasoline, naphtha, and motor fuel were too narrow to be compatible with any increase in this class of distribution.

Natural gasoline and naphtha used in motor blends at natural-gasoline plants in the United States (east of California) in 1931, by districts and months, in thousands of gallons

	January	February	March	April	May	June
Natural gasoline:						
Appalachian	70	70	69	74	78	76
Oklahoma-Kansas	108	140	143	115	148	158
Texas	149	108	119	135	118	155
Louisiana-Arkansas	211	222	239	238	240	231
	538	540	570	562	584	620
Naphtha:						
Appalachian	84	84	82	91	96	92
Oklahoma-Kansas	116	135	133	118	141	172
Texas	237	188	252	222	273	265
Louisiana-Arkansas	186	185	191	192	195	185
	623	592	658	623	705	714

	July	August	September	October	November	December	The year
Natural gasoline:							
Appalachian	72	71	71	69	70	69	859
Oklahoma-Kansas	139	138	114	84	123	73	1,483
Texas	165	121	121	117	36	26	1,370
Louisiana-Arkansas	223	203	224	225	206	42	2,504
	599	533	530	495	435	210	6,216
Naphtha:							
Appalachian	83	83	85	81	83	81	1,025
Oklahoma-Kansas	146	133	135	114	109	90	1,542
Texas	261	273	282	200	158	156	2,767
Louisiana-Arkansas	187	180	239	203	228	28	2,199
	677	669	741	598	578	355	7,533

Exports and sales to jobbers.—In recent years an important outlet for natural gasoline has been built up in the export trade. This development was fostered by improved manufacturing technique; in fact, it may be said to have begun with the production of a stabilized gasoline that could be shipped in bulk without excessive losses. Complete figures for exports of natural gasoline are not available, but such shipments from California declined from 106,848,000 gallons in 1930 to 104,202,000 gallons in 1931, and exports from the Gulf of Mexico probably decreased to an even greater extent.

The sale of stabilized natural gasoline to jobbers who sell direct to motorists, like the amount of natural gasoline blended at the plants, indicates the extent to which manufacturers have made themselves independent of refiners in marketing their product. Data as to this particular class of distribution are very meager, but indications are that it at least held its own in 1931, even though the total distribution declined materially.

STOCKS

Stocks of natural gasoline on December 31,1931, totaled 118,336,000 gallons, a decrease of 11,904,000 gallons contrasted with 1930, when stocks gained nearly 4,000,000 gallons. California led in storage of natural gasoline as 79,128,000 gallons (67 per cent of the United States total) were stored in the State on December 31, 1931.

Stocks of natural gasoline held at plants and at refineries in the United States at end of each month of 1931, by refining districts, in thousands of gallons

District	Jan.	Feb.	Mar.	Apr.	May	June
East coast:						
At refineries	5,208	6,762	9,534	9,786	9,198	11,340
Appalachian:						
At plants	4,197	4,761	5,608	5,574	5,601	4,500
At refineries	588	630	462	588	420	462
Indiana, Illinois, and Kentucky:						
At plants	327	546	565	543	497	443
At refineries	2,352	2,730	1,722	1,344	798	2,142
Oklahoma-Kansas:						
At plants	10,453	12,093	14,735	17,982	18,009	13,416
At refineries	1,470	2,772	3,318	2,730	1,974	714
Texas:						
At plants	6,357	7,380	10,876	11,473	9,995	9,275
At refineries	14,238	12,810	12,978	11,550	12,768	9,282
Louisiana-Arkansas:						
At plants	1,319	1,159	1,259	1,413	1,027	970
At refineries	630	840	882	504	378	504
Rocky Mountain:						
At plants	608	745	992	1,016	1,118	731
At refineries		42			42	
California:						
At plants	2,209	2,395	3,080	4,253	5,590	6,794
At refineries	86,646	82,446	89,334	99,960	101,808	108,276
Total, 1931:						
At plants	25,470	29,079	37,115	42,254	41,837	36,129
At refineries	111,132	109,032	118,230	126,462	127,386	132,720
Total, 1930:						
At plants	25,671	24,033	28,281	29,791	38,657	38,974
At refineries	80,304	90,762	94,038	93,954	101,514	100,128

District	July	Aug.	Sept.	Oct.	Nov.	Dec.
East coast:						
At refineries	12,180	8,904	9,408	5,334	2,142	3,486
Appalachian:						
At plants	3,978	2,980	2,358	1,957	2,203	2,328
At refineries	336	336	168	126	126	462
Indiana, Illinois, and Kentucky.						
At plants	451	365	263	243	256	373
At refineries	1,344	1,050	1,932	2,604	1,848	1,974
Oklahoma-Kansas:						
At plants	12,384	9,671	7,971	5,890	7,485	9,213
At refineries	1,176	1,092	588	1,218	1,302	1,218
Texas:						
At plants	9,600	9,021	6,093	5,460	8,070	6,005
At refineries	4,662	5,796	9,030	7,686	6,426	11,676
Louisiana-Arkansas:						
At plants	1,024	1,144	1,103	1,029	1,245	1,440
At refineries	840	882	840	462	420	336
Rocky Mountain:						
At plants	687	692	577	608	693	655
At refineries					42	42
California:						
At plants	7,801	6,471	7,443	6,806	6,972	7,056
At refineries	99,414	86,604	81,942	68,796	69,384	72,072
Total, 1931:						
At plants	35,925	30,344	25,808	21,993	26,924	27,070
At refineries	119,952	104,664	103,908	86,226	81,690	91,266
Total, 1930:						
At plants	31,123	31,261	22,429	23,481	25,036	24,316
At refineries	109,032	94,962	84,000	75,474	74,928	75,558 [1] 105,924

[1] For comparison with 1931.

Stocks of motor blends held at natural-gasoline plants in the United States at end of each month of 1931, by districts, in thousands of gallons

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Appalachian	220	222	223	212	235	175	189	192	191	165	166	191
Oklahoma-Kansas	129	141	126	107	73	84	89	112	101	83	85	76
Texas	111	88	78	55	69	57	72	55	59	46	26	23
Louisiana-Arkansas	25	64	29	24	24	19	39	93	28	56	52	16
Total, 1931	485	515	456	398	401	335	389	452	379	350	329	306
Total, 1930	626	514	480	558	499	529	493	505	512	518	559	485

LIQUEFIED PETROLEUM GASES

Production of butane and propane, which comprise the bulk of what is termed "liquefied petroleum gases," has increased rapidly in recent years due to growth in stabilization at both natural-gasoline plants and refineries. For example, the Bureau of the Census[4] reports production of liquefied petroleum gases in 1931 at refineries alone as 255,139,669 gallons. Production at natural-gasoline plants is not known, but it was undoubtedly somewhat less than the total produced at refineries. The major portion of the output of liquefied petroleum gases is used as fuel where produced; in fact, total sales in 1931 amounted to less than 10 per cent of the total production. The marketing of liquefied petroleum gases in 1931 has been outlined by Swanson[5] as follows:

An increase of nearly 10,500,000 gallons, representing a gain over 1930 sales of 58 per cent, brought the 1930 marketed production of liquefied petroleum gases to a total of 28,502,819 gallons. The 1931 increase exceeded that recorded for 1930, when marketed production was approximately 8,000,000 gallons higher than in the preceding year.

Marketed production of liquefied petroleum gases, 1922–1931

Year	Gallons	Year	Gallons
1922	222, 641	1927	1, 091, 005
1923	276, 863	1928	4, 522, 899
1924	376, 488	1929	9, 930, 964
1925	403, 674	1930	18, 017, 347
1926	465, 085	1931	28, 502, 819

An approximate segregation of the gases marketed indicates that the 1931 distribution of propane was about 15,000,000 gallons, as compared with 11,500,000 gallons in 1930, and that the distribution of butane, pentane, and the mixtures of these gases more than doubled, being about 13,500,000 gallons in 1931 as compared with 6,500,000 in 1930. Information assembled in the survey shows that shipments made in cylinders and drums totaled approximately 14,000,000 gallons, while bulk shipments were slightly more than 14,500,000 gallons. Bulk shipments were made by tank truck or car and by pipe line. Some portion of these bulk shipments was used by distributors in filling their own cylinders for local distribution.

Marketed production in the Pacific Coast States, reported by 4 companies, totaled 5,056,362 gallons, while the marketed production east of the Rocky Mountains, reported by 10 companies, totaled 23,446,457 gallons.

Segregation of the 1931 marketed production, according to the three principal types of use, showed that 54 per cent was marketed for domestic uses; 24 per cent for industrial and miscellaneous purposes; and 22 per cent for gas manufacturing, either as a raw material for gas manufacture or as an enriching agent.

Segregation by uses of 1931 marketed production

Use	Gallons	Per cent
Domestic	15, 294, 648	53. 7
Gas manufacturing	6, 184, 655	21. 7
Industrial and miscellaneous	7, 023, 516	24. 6
Total	28, 502, 819	100. 0

It is estimated that approximately 150,000 "bottled gas" customers were served during 1931, as compared with 117,000 during 1930, 55,000 in 1929, and 20,000 in 1928. An average consumption of approximately 100 gallons per installation was indicated.

Through the American Gas Association, it was learned that 118 communities in 28 States were supplied with liquefied petroleum gas by 59 companies at the

[4] Petroleum Refining, Census of Manufactures, 1931.
[5] Swanson, E. B., Marketed Production of Liquefied Petroleum Gases Increases 58 Per Cent during 931: Press statement, Bureau of Mines, Feb. 11, 1932.

close of 1931. Undiluted gas was distributed in 24 communities by 7 companies, the remainder being butane-air plants. One butane-air plant was reported operating in Canada. In comparison with installations in operation at the beginning of the year, when 59 plants were reported, an even 100 per cent growth is indicated.

PRICES AND VALUES

The natural gasoline produced in 1931 had a total value at the plants of $63,732,000, less than half that in 1930. The average value per gallon in 1931 was 3.5 cents, a new low record and a decline of 2.3 cents (40 per cent) from 1930.

The daily average posted price of grade A natural gasoline in Oklahoma in 1931 was 3.24 cents per gallon, a decline of 40 per cent from 1930. The record for 1931 shows that after a brief period of improvement in the early part of the year prices weakened steadily until the latter part of April, when the low of 1.75 cents per gallon was reached. Some improvement was recorded in May, June, and July, but the greatest recovery occurred in August, when a curtailment in production exerted its influence. Prices declined somewhat in September and were steady in October and November but again weakened materially in December.

Spot price of Oklahoma natural gasoline, grade A, on specified dates in 1931, with monthly and yearly averages in cents per gallon

[Oil and Gas Journal]

Date	Cents	Date	Cents
Jan. 1	3.25	July 7	2
Jan. 6	3.25	July 14	2.13
Jan. 13	3.5	July 21	2.25
Jan. 20	3.75	July 28	2.75
Jan. 27	3.75	Average	2.16
Average	3.61	Aug. 4	3.25
Feb. 3	3.75	Aug. 11	4.5
Feb. 10	3.75	Aug. 18	5
Feb. 17	3.75	Aug. 25	5.25
Feb. 24	3.5	Average	4.33
Average	3.71	Sept. 1	5.25
Mar. 3	3.25	Sept. 8	4.25
Mar. 10	3.25	Sept. 15	3.88
Mar. 17	3	Sept. 22	4
Mar. 24	2.88	Sept. 29	4
Mar. 31	2.63	Average	4.32
Average	3.10	Oct. 6	4.25
Apr. 7	2.25	Oct. 13	4.25
Apr. 14	2.25	Oct. 20	4.38
Apr. 21	2	Oct. 27	4.75
Apr. 28	1.75	Average	4.32
Average	2.22	Nov. 3	4.75
May 5	1.75	Nov. 10	4.75
May 12	1.75	Nov. 17	4.63
May 19	1.75	Nov. 24	4.25
May 26	1.88	Average	4.60
Average	1.77	Dec. 1	3.5
June 2	2	Dec. 8	2.88
June 9	2	Dec. 15	2.75
June 16	1.88	Dec. 22	2.5
June 23	1.88	Dec. 29	2.5
June 30	1.88	Average	2.87
Average	1.93		
		Average, 1931	3.24
		1930	5.4

SUMMARY OF NATURAL-GAS STATISTICS

In 1931 the trends in production of natural gas and natural gasoline were similar, as the former declined 13 per cent and the latter 17 per cent, contrasted with 1930, when natural gas increased in output and natural gasoline decreased.

The total output of natural gas in 1931 was 1,686,436,000,000 cubic feet, imports from Canada totaled 44,000,000 cubic feet, and exports to Canada and Mexico were 2,231,000,000 cubic feet; the total consumption within the United States was 1,684,249,000,000 cubic feet. Of the total consumption 34 per cent was used for field purposes, 23 per cent for domestic and commercial purposes, 12 per cent for carbon black, 8 per cent at electric public-utility power plants, 4 per cent at petroleum refineries, 2 per cent at Portland cement plants, and 17 per cent for other industrial purposes. Compared with 1930 these data represent gains in the proportions distributed for domestic and commercial consumption, electric public-utility power plants, and general industrial uses at the expense of the four other classes of consumption.

Summary of statistics for natural gas in the United States, 1920, 1925, 1929–1931

	1920	1925	1929	1930	1931
Produced and delivered to consumers:					
Arkansas......millions of cubic feet..	9,027	41,878	19,928	18,585	13,300
California......do....	66,041	187,789	342,214	334,789	305,930
Kansas......do....	21,158	26,917	38,469	37,630	38,742
Kentucky......do....	3,345	10,770	27,588	28,023	27,870
Louisiana......do....	58,274	152,620	261,138	278,341	224,155
Ohio......do....	58,938	43,235	57,936	63,394	56,326
Oklahoma......do....	154,467	249,285	357,893	348,116	263,685
Pennsylvania......do....	125,787	101,632	101,951	88,706	74,797
Texas......do....	37,063	134,872	464,928	517,880	464,580
West Virginia......do....	239,719	180,345	167,333	144,180	124,797
Wyoming......do....	10,312	45,539	44,648	43,219	39,770
Other......do....	14,079	13,689	33,667	40,558	52,484
	798,210	1,188,571	1,917,693	1,943,421	1,686,436
Consumed:					
Domestic......do....	286,001	272,146	359,853	[1] 295,700	294,406
Commercial......do....				[1] 80,707	86,491
Industrial—					
Field......do....	202,108	423,524	705,083	723,165	571,365
Carbon-black plants......do....	40,599	140,366	261,107	266,625	195,396
Petroleum refineries......do....	(2)	87,842	103,729	98,842	75,548
Electric public-utility power plants [3]......do....	24,702	46,521	112,707	120,290	138,343
Portland cement plants [4]......do....	(2)	(2)	41,643	41,256	31,381
Other industrial......do....	244,800	218,040	333,329	315,059	291,319
	798,210	1,188,439	1,917,451	1,941,644	1,684,249
Domestic......per cent..	36	23	19	16	18
Commercial......do....				4	5
Industrial......do....	64	77	81	80	77
Treated for natural gasoline:					
Total......millions of cubic feet..	496,431	1,040,390	1,959,294	2,088,778	1,790,119
Per cent of total consumption......	62	88	102	108	106
Consumers:					
Domestic......thousands..	2,615	3,508	5,098	[1] 5,035	6,456
Commercial......do....				[1] 413	520
Industrial......do....	21	(5)	(5)	[6] 21	[6] 28
Value at wells:					
Total......thousands of dollars..	(5)	112,047	157,596	147,048	117,505
Average per M cubic feet......cents..	(5)	9.4	8.2	7.6	7.0
Value at points of consumption:					
Total......thousands of dollars..	196,194	265,184	413,153	415,519	392,156
Domestic......do....	109,302	152,494	223,172	[1] 200,615	208,262
Commercial......do....				[1] 38,558	41,347
Industrial......do....	86,892	112,690	189,981	176,346	142,547
Average per M cubic feet—					
Domestic......cents..	(5)	(5)	(5)	[1] 67.8	70.7
Commercial......do....	(5)	(5)	(5)	[1] 47.8	47.8
Industrial......do....	17.0	12.3	12.2	11.3	10.9
Domestic and commercial......do....	38.2	56.0	62.0	63.5	65.5
Domestic, commercial, and industrial...do....	24.6	22.3	21.5	21.4	23.3

[1] Revised figures.
[2] Included under "Other industrial"; separate figures not available.
[3] U. S. Geological Survey.
[4] Bagley, B. W., Mineral Resources, chapters on Cement.
[5] Figures not available.
[6] Exclusive of oil and gas field operators.

NATURAL GAS [1]

By G. R. Hopkins and H. Backus

CONTENTS

ILLUSTRATIONS

SUMMARY

The steady expansion which characterized the natural-gas industry during the past decade was interrupted in 1931, when production declined for the first time since 1921. The total marketed production of natural gas in 1931 was 1,686,436,000,000 cubic feet, 256,985,000,000 cubic feet (13 percent) below 1930. This decline may be attributed chiefly to decreased demand for the gas for field purposes and for manufacture of carbon black. Exports to Canada and Mexico totaled 2,231,000,000 cubic feet in 1931, an increase of 24 percent over 1930. Imports in 1931 totaled 44,000,000 cubic feet, or more than double the 1930 figure.

Drilling of natural-gas wells decreased materially in 1931, although the decline was relatively less than for oil wells. The number of gas wells completed in 1931, exclusive of California, totaled 1,985, compared with 2,866 in 1930. The Tioga-Wayne district in Pennsylvania and New York was the most active area in 1931 from the standpoint of drilling.

The total consumption of natural gas in 1931 was 1,684,249,000,000 cubic feet; like production, this represented a decline of 13 percent from 1930. Of the total consumption, 34 percent was used for field purposes, 23 percent for domestic and commercial purposes, 12 percent for carbon black, 8 percent at electric public-utility power plants, 4 percent at petroleum refineries, 2 percent at portland cement plants, and 17 percent for general industrial purposes. Compared with 1930 these data represent gains in proportions distributed for domestic and commercial consumption, electric public-utility power plants, and general industrial uses at the expense of the other four classes.

[1] Work on manuscript completed December 1932.

Summary of statistics for natural gas in the United States, 1911, 1921, and 1929–31

	1911	1921	1929	1930	1931
Natural gas:					
Production ____ millions of cubic feet	512, 993	662, 052	1, 917, 693	1, 943, 421	1, 686, 436
Exports:					
To Canada ____ do			103	107	74
To Mexico ____ do			139	1, 691	2, 157
Imports from Canada ____ do				21	44
Consumption:					
Domestic ____ do	175, 442	248, 334	359, 853	[1] 295, 700	294, 406
Commercial ____ do				[1] 80, 707	86, 491
Industrial:					
Field ____ do	(2)	182, 305	705, 083	723, 165	571, 365
Carbon-black plants ____ do	(2)	50, 565	261, 107	266, 625	195, 396
Petroleum refineries ____ do	(2)	(2)	103, 729	98, 842	75, 548
Electric public-utility power plants [3] ____ do	(2)	24	112, 707	120, 290	138, 343
Portland cement plants [4] ____ do	(2)	(2)	41, 643	41, 256	31, 381
Other industrial ____ do	337, 551	180, 824	333, 329	315, 059	291, 319
	512, 993	662, 052	1, 917, 451	1, 941, 644	1, 684, 249
Domestic ____ percent	34	38	19	16	18
Commercial ____ do				4	5
Industrial ____ do	66	62	81	80	77
Number of consumers:					
Domestic ____ thousands	1, 498	2, 631	5, 098	[1] 5, 035	6, 456
Commercial ____ do				[1] 413	520
Industrial ____ do	14	21	(5)	[6] 21	[6] 28
Value (at wells) of gas produced:					
Total ____ thousands of dollars	(5)	(5)	157, 596	147, 048	117, 505
Average per M cubic feet ____ cents	(5)	(5)	8. 2	7. 6	7. 0
Value (at points of consumption) of gas consumed:					
Total ____ thousands of dollars	74, 622	174, 617	413, 153	415, 519	392, 156
Domestic ____ do	44, 400	110, 337	223, 172	[1] 200, 615	208, 262
Commercial ____ do				[1] 38, 558	41, 347
Industrial ____ do	30, 222	64, 280	189, 981	176, 346	142, 547
Average per M cubic feet:					
Domestic ____ cents	(5)	(5)	(5)	[1] 67. 8	70. 7
Commercial ____ do	(5)	(5)	(5)	[1] 47. 8	47. 8
Industrial ____ do	9. 0	15. 5	12. 2	11. 3	10. 9
Domestic and commercial ____ do	25. 3	44. 4	62. 0	63. 5	65. 5
Domestic, commercial, and industrial ____ cents	14. 6	26. 4	21. 5	21. 4	23. 3
Treated for natural gasoline:					
Quantity ____ millions of cubic feet	2, 476	465, 097	1, 959, 294	2, 088, 778	1, 790, 119
Per cent of total consumption	0. 5	70	102	108	106
Natural gasoline:					
Production ____ thousands of gallons	7, 426	449, 934	2, 233, 688	2, 210, 494	1, 831, 918
Value of plants:					
Total ____ thousands of dollars	532	61, 815	158, 410	128, 160	63, 732
Average per gallon ____ cents	7. 2	13. 7	7. 1	5. 8	3. 5
Carbon black:					
Production ____ thousands of pounds	(5)	59, 766	366, 442	379, 942	280, 907
Value at plants:					
Total ____ thousands of dollars	(5)	5, 446	18, 720	14, 852	8, 621
Average per pound ____ cents	(5)	9. 1	5. 1	3. 9	3. 1

[1] Revised figures.
[2] Included under "Other industrial"; separate figures not available.
[3] U.S. Geological Survey.
[4] Bagley, B. W., Mineral Resources, chapters on Cement.
[5] Figures not available.
[6] Exclusive of oil and gas field operators.

Although the total pipe-line mileage constructed in 1931 was far below that in 1930, several new systems were opened to service in 1931 and more new communities and customers were added to the ranks of natural-gas consumers than in any previous year. The number of domestic and commercial consumers served in 1931 totaled 6,976,450, an increase of 28 percent over 1930; however, the major portion of the new consumers were served with mixed gas and may also be considered consumers of manufactured gas. The total consumption of natural gas for domestic and commercial purposes increased in 1931, but, because of the abnormal gain in number of consumers, the average consumption per customer declined. The fact that many consumers were served for only part of the year is another reason for this decline.

The general trend in prices of natural gas used for domestic and commercial purposes has been upward in recent years, whereas the trend in prices of that used for industrial purposes has been downward. The year 1931 proved no exception to this general rule, as the price paid by domestic and commercial consumers rose from 63.5 cents per thousand cubic feet in 1930 to 65.5 cents in 1931, whereas the price paid by industrial users declined from 11.3 to 10.9 cents per thousand cubic feet.

PRODUCTION

The total production of natural gas in the United States during 1931 was 1,686,436,000,000 cubic feet, a decline of 13 percent from 1930. Production, as interpreted by these statistics, covers only gas marketed and does not include gas blown into the air or the large quantities of "unaccounted-for" gas lost in transmission.

Production of natural gas in all the leading States fell in 1931. Production in Texas decreased 10 percent from 1930, but the State continued to be the leading producer. Production in Oklahoma declined more than in California with the result that the latter displaced the former in second place. Production in Louisiana showed a material decline in 1931 as the demand of carbon-black producers fell off, but the State retained its rank as fourth.

Natural gas produced in the United States and delivered to consumers, 1911, 1921, and 1929–31, by States, in millions of cubic feet

Year	Arkansas	California	Illinois	Indiana	Kansas	Kentucky	Louisiana	Montana	New York	Ohio
1911	([1])	6,390	6,762	4,365	38,800	1,275	[2] 9,786	--------	5,240	49,450
1921	4,260	75,942	2,646	1,066	15,717	4,820	58,004	336	6,583	47,412
1929	19,928	342,214	2,983	1,012	38,469	27,588	261,138	9,659	8,387	57,936
1930	18,585	334,789	2,890	1,217	37,630	28,023	278,341	10,060	9,624	63,394
1931	13,300	305,930	2,130	1,337	38,742	27,870	224,155	10,949	7,868	56,326

Year	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Others	Total	Value at points of consumption	
								Total (thousands of dollars)	Average per M cubic feet (cents)
1911	67,276	108,869	5,503	206,891	([1])	2,386	512,993	74,622	14.5
1921	124,058	86,144	44,504	174,921	15,608	31	662,052	174,617	26.4
1929	357,893	101,951	464,928	167,333	44,648	11,626	1,917,693	413,276	21.6
1930	348,116	88,706	517,880	144,180	43,219	16,767	1,943,421	416,090	21.4
1931	263,685	74,797	464,580	124,797	39,770	30,200	1,686,436	392,816	23.3

[1] Included under "Others." [2] Includes Alabama.

Drilling of gas wells to establish reserves for the large pipe-line systems declined materially in 1931. The number of wells drilled in the Texas Panhandle, the most important gas field so far discovered, decreased from 172 in 1930 to 77 in 1931; however, the average daily initial production of the 1931 completions in the Texas Panhandle was estimated as 26,600,000 cubic feet, and the shut-in production of the field showed a substantial gain. Reserves of the Panhandle field were also increased somewhat through continuation of the practice of plugging back certain wells that could no longer be operated as oil wells at a profit. There were 59 gas wells completed in the Monroe-Richland field of Louisiana in 1931, raising the total daily open-flow capacity to about 10,000,000,000 cubic feet from about 1,100 wells. As the daily average withdrawals from the field in 1931 were approximately 500,000,000 cubic feet production was only 5 percent of the potential output. The Hugoton field of Kansas, which constitutes a reserve for several large systems running north from the Texas Panhandle, was quiet throughout the year, and only 29 gas wells were completed compared with 104 in 1930. A drilling campaign was carried on in the Cut Bank field, Glacier County, Mont., in 1931 to establish a reserve for the line to Butte and Anaconda. Seventeen wells were completed in the Cut Bank field during the year; the combined open-flow capacity of these wells was approximately 225,000,000 cubic feet daily. The only real excitement in field work in 1931 occurred in the Tioga-Wayne district of Pennsylvania and New York, which was opened to extensive exploration by the discovery of the Wayne-Dundee field in New York in February 1930, and the Tioga field in Pennsylvania in September 1930. About 90 wells were completed in the Wayne-Dundee area in 1931, bringing the total open-flow capacity to about 280,000,000 cubic feet daily. About 25 wells were completed in the Tioga field in 1931, of which some were unusually large for the Eastern States, and the combined open-flow capacity of the field at the end of the year was estimated at about 450,000,000 cubic feet. Exploratory drilling in the general vicinity of these two fields was extensive in 1931, but except for a discovery near Hebron, Potter County, Pa., the results were generally disappointing.

Natural gas produced and consumed in the United States in 1931, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at the wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)
Ala.							8,458,000	0.5	$2,328,000	27.5
Alaska	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ariz.[2]							(1)	(1)	(1)	(1)
Ark.	13,300,000	0.8	$681,000	5.1	$2,696,000	20.3	32,278,000	1.9	6,545,000	20.3
Calif.	305,930,000	18.1	21,446,000	7.0	76,345,000	25.0	305,930,000	18.2	76,345,000	25.0
Colo.	2,536,000	.2	71,000	2.8	940,000	37.1	16,892,000	1.0	6,313,000	37.4
D. C.[2]							1,388,000	.1	1,304,000	93.9
Fla.[2]							357,000	(3)	69,500	19.5
Ga.							4,904,000	.3	2,995,000	61.1
Ill.	2,130,000	.1	169,000	7.9	999,000	46.9	14,050,000	.8	6,584,000	46.9
Ind.	1,337,000	.1	342,000	25.6	699,000	52.3	4,695,000	.3	2,530,000	53.9
Iowa							3,522,000	.2	1,094,000	31.1
Kans.	38,742,000	2.3	3,088,000	8.0	11,498,000	29.7	65,609,000	3.9	18,292,000	27.9
Ky.	27,870,000	1.7	4,144,000	14.9	10,151,000	36.4	15,533,000	.9	6,693,000	43.1
La.	224,155,000	13.3	6,523,000	2.9	37,595,500	16.8	131,986,000	7.8	14,319,000	10.8
Md.							679,000	(3)	571,000	84.1
Mich.	472,000	(3)	68,000	14.4	111,000	23.5	472,000	(3)	111,000	23.5
Minn.[2]							(4)	(4)	(4)	(4)

[1] Utah includes Alaska, Arizona (consumption only), and Washington.
[2] Service inaugurated in 1931, hence figures represent operations for partial year.
[3] Less than 0.1 percent.
[4] North Dakota includes Minnesota.

Natural gas produced and consumed in the United States in 1931, by States—Con.

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at the wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Percent of total	Total	Average per M cubic feet (cents)
Miss.	6,048,000	0.4	$250,000	4.1	$1,458,000	24.1	4,370,000	0.3	$1,491,000	34.1
Mo.	1,534,000	.1	123,000	8.0	685,000	44.7	24,261,000	1.4	10,463,000	43.1
Mont.	10,949,000	.7	446,000	4.1	3,299,000	30.1	[5] 8,359,000	.5	2,447,000	29.3
Nebr.	----------	------	----------	------	----------	------	4,817,000	.3	1,783,000	37.0
N.Mex.	19,354,000	1.1	410,000	2.1	2,401,000	12.4	12,443,000	.7	1,420,000	11.4
N.Y.	[6] 7,868,000	.5	2,559,000	32.5	5,363,000	68.2	16,956,000	1.0	11,560,000	68.2
N.Dak.	----------	------	----------	------	----------	------	[4] 885,000	[4] .1	[4] 344,200	[4] 38.9
Ohio	56,326,000	3.3	9,654,000	17.1	32,061,000	56.9	107,460,000	6.4	61,418,000	57.2
Okla.	263,685,000	15.6	11,629,000	4.4	32,593,000	12.4	248,949,000	14.8	26,163,000	10.5
Pa.	[7] 74,797,000	4.4	21,123,000	28.2	37,827,000	50.6	92,629,000	5.5	44,359,000	47.9
S.Dak.	12,000	(3)	1,000	8.3	4,000	33.3	2,803,000	.2	829,000	29.6
Tenn.	25,000	(3)	4,000	16.0	9,000	36.0	7,623,000	.4	2,810,000	36.9
Tex.	[8] 464,580,000	27.5	10,081,000	2.2	73,704,600	15.9	447,632,000	26.6	59,326,000	13.3
Utah	[1] 219,000	(1 3)	[1] 15,000	[1] 6.8	[1] 100,400	[1] 45.8	[1] 6,497,000	[1] .4	[1] 2,154,800	[1] 33.2
Va.[2]	----------	------	----------	------	----------	------	75,000	(3)	71,000	94.7
Wash.	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
W.Va.	124,797,000	7.4	23,549,000	18.9	58,123,000	46.6	55,115,000	3.3	16,537,000	30.0
Wyo.	39,770,000	2.4	1,129,000	2.8	4,153,500	10.4	36,622,000	2.2	2,886,500	7.9
Total, 1931	1,686,436,000	100.0	117,505,000	7.0	392,816,000	23.3	1,684,249,000	100.0	392,156,000	23.3
Total, 1930	1,943,421,000	100.0	147,048,000	7.6	416,090,000	21.4	1,941,644,000	100.0	415,519,000	21.4

[1] Utah includes Alaska, Arizona (consumption only), and Washington.
[2] Service inaugurated in 1931, hence figures represent operations for partial year.
[3] Less than 0.1 percent.
[4] North Dakota includes Minnesota.
[5] Includes 44,000 M cubic feet piped from Canada.
[6] Includes 38,000 M cubic feet piped to Canada.
[7] Includes 36,000 M cubic feet piped to Canada.
[8] Includes 2,157,000 M cubic feet piped to Mexico.

CONSUMPTION

Total consumption.—The total consumption of natural gas (production plus imports minus exports) was 1,684,249,000,000 cubic feet in 1931, a decline of 13 percent from 1930. (See fig. 6.) This total does not include approximately 40,000,000,000 cubic feet reported as returned to producing sands. Of the total, 1,303,352,000,000 cubic feet (77 percent) were consumed for industrial purposes, and 380,897,000,000 cubic feet (23 percent) were utilized by domestic and commercial consumers. These data indicate a further decline in the relative importance of industrial consumption.

Domestic consumption.—The consumption of natural gas for domestic and commercial purposes, although not the most important in quantity, is easily the leading class from the standpoint of value and general interest.

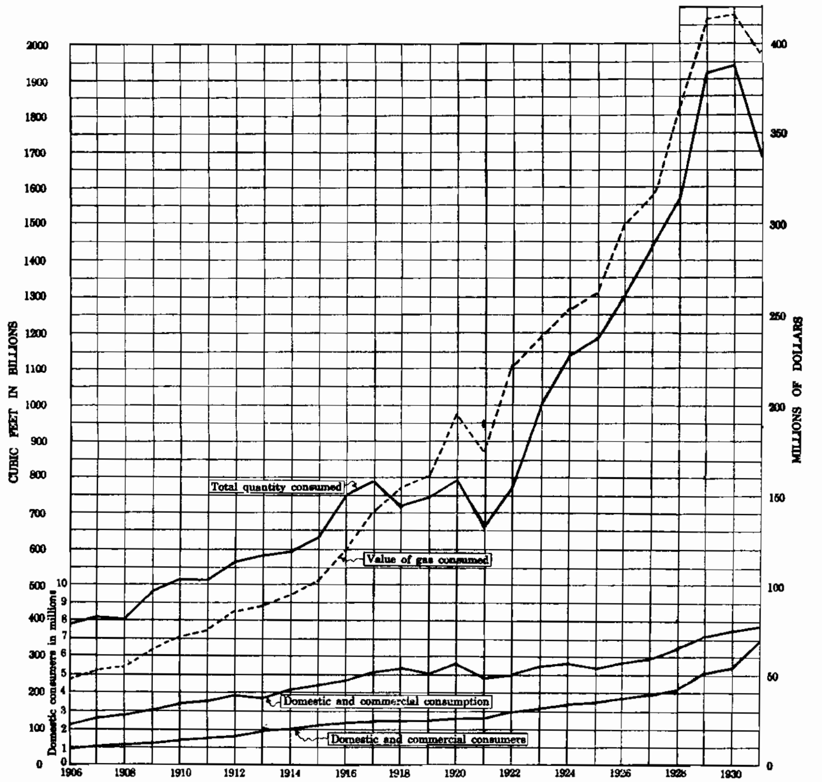

FIGURE 6.—Growth of natural-gas consumption in the United States, 1906–31.

Natural gas consumed in the United States, 1911, 1921, and 1929–31

Year	Domestic and commercial consumption							
	Consumers (thousands)			Billions of cubic feet			Average number of M cubic feet used per domestic and commercial consumer	Average value at points of consumption per M cubic feet (cents)
	Domestic	Commercial	Total	Domestic	Commercial	Total		
1911	[1] 1,498	([1])	1,498	[1] 175	([1])	175	117.1	25.3
1921	[1] 2,631	([1])	2,631	[1] 248	([1])	248	94.4	44.4
1929	[1] 5,098	([1])	5,098	[1] 360	([1])	360	70.6	62.0
1930	[2] 5,035	[2] 413	5,448	[2] 296	[2] 81	377	69.1	63.5
1931	[3] 6,456	[4] 520	6,976	294	87	381	54.6	65.5

[1] Domestic includes commercial; separate figures not available.
[2] Revised figures.
[3] Includes 1,604,530 consumers served with mixed gas; for 1930 see p. 356.
[4] Includes 106,750 consumers served with mixed gas; for 1930 see p. 356.

Natural gas consumed in the United States, 1911, 1921, and 1929–31—Contd.

Year	Industrial consumption								Total consumption	
	Billions of cubic feet							Average value at points of consumption per M cubic feet (cents)	Billions of cubic feet	Average value at points of consumption per M cubic feet (cents)
	Field	Carbon black	Petroleum refineries	Electric public-utility power plants [5]	Portland cement plants [6]	Other industrial	Total industrial			
1911	(7)	(7)	(7)	(7)	(7)	(7)	338	9.0	513	14.5
1921	182	51	(8)	24	(8)	[8] 157	414	15.5	662	26.4
1929	705	261	104	113	41	333	1,557	12.2	1,917	21.5
1930	723	267	99	120	41	315	1,565	11.3	1,942	21.4
1931	571	196	76	138	31	291	1,303	10.9	1,684	23.3

[5] U.S. Geological Survey.
[6] Bagley, B. W., Mineral Resources, chapters on Cement.
[7] Figures not available.
[8] "Other industrial" includes gas used at petroleum refineries and at portland cement plants; separate figures not available.

Except in 1919 the number of domestic and commercial consumers has increased steadily for nearly 30 years. This growth has resulted chiefly from steady expansion in pipe-line mileage whereby more and more communities have been served with natural gas. The largest annual increases have occurred since about 1927, when the first long large-diameter natural-gas lines were constructed. The number of domestic and commercial consumers in 1931 totaled 6,976,450, an increase of 1,528,270 (28 percent) over 1930; the number of domestic consumers in 1931 was 6,456,350, an increase of 1,420,860 (28 percent) over 1930, and the number of commercial consumers was 520,100, a gain of 107,410 (26 percent). These material gains resulted primarily from the opening of new lines traversing several States, of which a notable example was the Chicago line; however, the majority of the new customers were served with mixed gas and were also consumers of manufactured gas. The majority of the domestic and commercial consumers of mixed gas were added in 1931; in fact, the number of such consumers rose from 301,780 in 1930 to 1,711,280 in 1931. If these figures are deducted from the respective totals for the number of domestic and commercial consumers, the number in these two classes using straight natural gas in 1931 totaled 5,265,170, an increase of only 2.3 percent over 1930; the number of domestic consumers of straight natural gas was 4,851,820, an increase of 1.9 percent; and the number of commercial consumers of straight natural gas rose from 385,010 in 1930 to 413,350 in 1931, a gain of 7.4 percent.

Consumption of natural gas mixed with manufactured gas in the United States in 1931, by States [1]

State	Domestic		Commercial		Industrial		Total	
					Field	Other		
	Consumers	M cubic feet	Consumers	M cubic feet	M cubic feet	M cubic feet	M cubic feet	Value at points of consumption
District of Columbia	117,990	1,039,000	6,370	155,000		193,000	1,387,000	$1,304,000
Illinois	927,230	2,901,000	54,200	657,000		575,000	4,133,000	4,906,000
Indiana	32,290	348,000	1,500	60,000		33,000	441,000	552,000
Iowa	35,950	84,000	2,100	14,000		60,000	158,000	117,000
Kentucky	65,090	3,047,000	7,050	836,000		417,000	4,300,000	2,008,000
Maryland	9,080	67,300	280	1,500		2,200	71,000	72,000
Missouri	179,440	116,000	12,260	62,000		420,000	598,000	208,000
Nebraska	1,000	11,000	280	5,000		3,000	19,000	22,000
New York	46,430	955,000	2,520	139,000	6,000	147,000	1,247,000	997,000
Ohio	152,090	7,674,000	18,640	2,492,000		1,402,000	11,568,000	7,116,000
Pennsylvania	31,090	127,000	1,410	22,000		33,000	182,000	229,000
Virginia	6,850	40,100	140	5,500		1,400	47,000	60,000
Total, 1931	1,604,530	16,409,400	106,750	4,449,000	6,000	3,286,600	24,151,000	17,591,000
Total, 1930	274,100	11,510,000	27,680	3,610,000	18,000	2,188,000	17,326,000	9,964,000

[1] This table has been introduced into the chapter to show the quantity of natural gas mixed with manufactured gas and to allow separation of data for straight natural gas.

The consumption of natural gas by domestic and commercial consumers in 1931 totaled 380,897,000,000 cubic feet, an increase of 4,490,000,000 cubic feet (1.2 percent) over 1930. The total consumption by domestic consumers in 1931 was 294,406,000,000 cubic feet, a loss of 0.4 percent from 1930; the consumption by commercial consumers increased from 80,707,000,000 cubic feet in 1930 to 86,491,000,000 cubic feet in 1931, a gain of 7.2 percent. These data indicate that, although consumption of natural gas in homes is still several times more important than consumption by commercial establishments, the disparity was lessened in 1931 when domestic consumption declined but commercial consumption increased.

Average prices per thousand cubic feet paid by domestic and commercial consumers vary widely, depending largely on distance from producing fields. In 1931 the average domestic prices ranged from $1.875 per thousand cubic feet, paid by Florida consumers, to 37.7 cents, paid in West Virginia. Commercial prices showed a smaller differential; the range was from $1.09 in Illinois to 28.6 cents in Mississippi.

Average consumption per household or domestic consumer continued to fall in 1931 and was 45,600 cubic feet compared with 58,700 cubic feet in 1930; the average consumption per commercial consumer decreased from 195,600 cubic feet in 1930 to 166,300 cubic feet in 1931. These decreases were due to the fact that a number of large companies operated only part of the year and to the use of mixed gas by many consumers. If the number of consumers of mixed gas and the quantity of natural gas used by them are eliminated from the statistics, the average consumption of straight natural gas per domestic consumer in 1931 was 57,300 cubic feet compared with 59,700 cubic feet in 1930, and the average consumption per commercial consumer was 198,500 cubic feet compared with 200,200 cubic feet in 1930.

The natural gas used by domestic and commercial consumers in 1931 had a total value at points of consumption of $249,609,000, an average of 65.5 cents per thousand cubic feet. Separately the values were $208,262,000, an average of 70.7 cents per thousand cubic feet, for domestic and $41,347,000, an average of 47.8 cents, for commercial. These data indicate continuation of the long-time trend toward higher prices. On the basis of the prevailing prices, each domestic consumer paid $32.24 for natural gas in 1931 compared with $39.80 in 1930; the average commercial consumer paid $79.49 in 1931 compared with $93.50 in 1930. These statistics show material declines in the average bill per consumer for 1931, for the same reasons that caused the decline in average consumption. If the mixed-gas data are eliminated, the average bill for each domestic consumer of straight natural gas was $40.23 in 1931, 44 cents less than in 1930; the average bill for each commercial consumer was $93.10, $2 below that in 1930.

Domestic and commercial consumption of natural gas in the United States in 1931, by States [1]

State	Domestic				Commercial				Total			
	Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption		Consumers	M cubic feet	Value at points of consumption	
			Total	Average (cents)			Total	Average (cents)			Total	Average (cents)
Alabama	21,690	686,000	$970,000	141.4	310	112,000	$50,000	44.6	22,000	798,000	$1,020,000	127.8
Arizona	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Arkansas	57,860	5,309,000	2,887,000	54.4	8,670	2,314,000	997,000	43.1	66,530	7,623,000	3,884,000	51.0
California	1,278,640	46,347,000	44,420,000	95.8	66,890	8,382,000	5,674,000	67.7	1,345,530	54,729,000	50,094,000	91.5
Colorado	88,420	4,168,000	3,494,000	83.8	7,430	1,224,000	732,000	59.8	95,850	5,392,000	4,226,000	78.4
District of Columbia	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Florida	2,730	5,600	10,500	187.5	260	200	200	100.0	2,990	5,800	10,700	184.5
Georgia	57,970	1,639,000	2,214,000	135.1	2,640	617,000	344,000	55.8	60,610	2,256,000	2,558,000	113.4
Illinois	943,450	2,964,000	3,842,000	129.6	55,390	667,000	727,000	109.0	998,840	3,631,000	4,569,000	125.8
Indiana	64,370	1,149,000	1,266,000	110.2	2,730	209,000	161,000	77.0	67,100	1,358,000	1,427,000	105.1
Iowa	50,030	371,000	465,000	125.3	2,580	100,000	54,000	54.0	52,610	471,000	519,000	110.2
Kansas	173,850	12,730,000	8,609,000	67.6	19,440	6,672,000	2,536,000	38.0	193,290	19,402,000	11,145,000	57.4
Kentucky	143,930	8,634,000	4,429,000	51.3	16,540	2,152,000	1,031,000	47.9	160,470	10,786,000	5,460,000	50.6
Louisiana	123,620	6,505,000	4,375,000	67.3	13,320	3,185,000	1,190,000	37.4	136,940	9,690,000	5,565,000	57.4
Maryland	[3] 146,950	[3] 1,638,000	[3] 1,533,000	[3] 93.6	[3] 7,800	[3] 239,000	[3] 209,000	[3] 87.4	[3] 154,750	[3] 1,877,000	[3] 1,742,000	[3] 92.8
Michigan	2,850	28,000	30,000	107.1	60	4,000	3,000	75.0	2,910	32,000	33,000	103.1
Mississippi	21,030	1,111,000	893,000	80.4	2,940	850,000	243,000	28.6	23,970	1,961,000	1,136,000	57.9
Missouri	297,350	6,812,000	5,883,000	86.4	29,580	2,922,000	1,732,000	59.3	326,930	9,734,000	7,615,000	78.2
Montana	20,920	2,510,000	1,238,000	49.3	4,080	1,294,000	468,000	36.2	25,000	3,804,000	1,706,000	44.8
Nebraska	38,150	876,000	839,000	95.8	4,620	287,000	198,000	69.0	42,770	1,163,000	1,037,000	89.2
New Mexico	10,490	641,000	483,000	75.4	1,210	703,000	218,000	31.0	11,700	1,344,000	701,000	52.2
New York	246,600	13,653,000	9,468,000	69.3	27,270	1,784,000	1,235,000	69.2	273,870	15,437,000	10,703,000	69.3
North Dakota	3,220	331,000	191,000	57.7	550	244,000	87,000	35.7	3,770	575,000	278,000	48.3
Ohio	1,100,010	66,650,000	42,768,000	64.2	98,320	13,552,000	7,813,000	57.7	1,198,330	80,202,000	50,581,000	63.1
Oklahoma	221,000	19,123,000	9,963,000	52.1	25,710	7,150,000	2,512,000	35.1	246,710	26,273,000	12,475,000	47.5
Pennsylvania	609,620	40,241,000	25,041,000	62.2	55,680	8,144,000	4,814,000	59.1	665,300	48,385,000	29,855,000	61.7
South Dakota	11,320	537,000	342,000	63.7	1,150	605,000	225,000	37.2	12,470	1,142,000	567,000	49.6
Tennessee	37,850	1,505,000	1,385,000	92.0	4,080	1,243,000	526,000	42.3	41,930	2,748,000	1,911,000	69.5
Texas	491,100	27,461,000	22,527,000	82.0	40,830	15,476,000	5,379,000	34.8	531,930	42,937,000	27,906,000	65.0
Utah	[2] 22,450	[2] 1,260,400	[2] 1,096,500	[2] 87.0	[2] 590	[2] 191,800	[2] 66,800	[2] 34.8	[2] 23,040	[2] 1,452,200	[2] 1,163,300	[2] 80.1
Virginia	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Washington	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(2)	(2)	(2)	(2)

West Virginia	153,680	17,050,000	6,435,000	37.7	17,550	5,160,000	1,768,000	34.3	171,230	22,210,000	8,203,000	36.9
Wyoming	15,200	2,471,000	1,165,000	47.1	1,880	1,008,000	354,000	35.1	17,080	3,479,000	1,519,000	43.7
Total, 1931	6,456,350	294,406,000	208,262,000	70.7	520,100	86,491,000	41,347,000	47.8	6,976,450	380,897,000	249,609,000	65.5
Total, 1930	[4] 5,035,490	[4] 295,700,000	[4] 200,615,000	[4] 67.8	[4] 412,690	[4] 80,707,000	[4] 38,558,000	[4] 47.8	5,448,180	376,407,000	239,173,000	63.5

[1] Includes data for mixed gas as shown on p. 356.
[2] Utah includes Arizona and Washington.
[3] Maryland includes District of Columbia and Virginia.
[4] Revised figures—caused by revising detailed figures to following:
Ohio—Domestic, 1,138,340 consumers, 75,718,000 M cubic feet, $48,939,000; commercial, 100,960 consumers, 15,161,000 M cubic feet, $8,945,000.
Pennsylvania—Domestic, 585,130 consumers, 42,655,000 M cubic feet, $26,491,000; commercial, 52,090 consumers, 9,319,000 M cubic feet, $5,398,000.
West Virginia—Domestic, 154,230 consumers, 17,350,000 M cubic feet, $6,600,000; commercial, 18,670 consumers, 6,474,000 M cubic feet, $2,199,000.

Industrial consumption.—The total consumption of natural gas for industrial purposes in 1931 was 1,303,352,000,000 cubic feet, a decrease of 17 percent from 1930. Of this total, 571,365,000,000 cubic feet (44 percent) were used for field purposes, 195,396,000,000 cubic feet (15 percent) were used in the manufacture of carbon black, 138,343,000,000 cubic feet (11 percent) were burned as fuel at electric public-utility power plants, 75,548,000,000 cubic feet (6 percent) were utilized as fuel at petroleum refineries, 31,381,000,000 cubic feet (2 percent) were burned at portland cement plants, and 291,319,000,000 cubic feet (22 percent) were used for general industrial purposes. (See fig. 7.) Compared with 1930 these data represent gains in proportions distributed for electric public-utility power plants and general industrial uses at the expense of proportions distributed for the remaining four major classes of consumption. Quantitatively, consumption by electric public-utility power plants alone increased over 1930.

In 1931, as in 1930, an attempt was made to obtain data on the number of industrial consumers of natural gas in the United States. The total, partly estimated, for 1931 was 28,000, an increase of about 33 percent over 1930. This material increase resulted solely from the gain in number of industrial plants served with mixed gas; in fact, when such operations are eliminated from the statistics the number of industrial consumers declined from 1930 to 1931.

The use of natural gas for field purposes—that is, for drilling, pumping, etc.—has constituted the largest item in consumption since natural-gas statistics were first compiled. This widespread use of gas in the field is related to its accessibility. The total consumption of natural gas for field purposes in 1931 was 571,365,000,000 cubic feet, a decline of 21 percent from 1930, due largely to a decrease in drilling, as only 12,432 wells were completed in 1931 compared with 21,240 in 1930. Furthermore, a substantial proportion (29 percent) of the completions in 1931 were in the East Texas field, an area noted for its low gas-oil ratio. Had the East Texas field been normal as regards gas production, many wells drilled with fuel oil would have been drilled with gas, and the national total for field purposes would have shown a smaller decline. Oklahoma, California, and Texas, the three leading oil-producing States in 1931, were also the three leading consumers of natural gas for field purposes. These three States utilized 85 percent of the total used for field purposes in 1931; they produced 82 percent of the crude oil and 61 percent of the natural gas.

The use of natural gas as the raw material for the manufacture of carbon black, which had increased rapidly up to 1930, slumped materially in 1931. The quantity burned in 1931 totaled 195,396,000,000 cubic feet, a decrease of 27 percent from 1930. This substantial decrease resulted primarily from voluntary restrictions placed on production by the carbon-black producers. Of additional interest to the natural-gas industry was the continued westward migration of the center of the industry, as illustrated by the fact that 75 percent of the total output of carbon black in 1931 was produced in Texas compared with 72 percent in 1930.

Consumption of natural gas in the generation of electricity at public-utility power plants has rapidly become one of the major items of consumption. In 1931 the total utilization for this purpose was 138,343,000,000 cubic feet, an increase of 15 percent over 1930.

Consumption of natural gas at petroleum refineries has declined steadily in recent years, as many refiners have found it cheaper to utilize fuels made at their plants (fuel oil, refinery gas, and coke) than to buy natural gas from outside companies. Although fuel oil

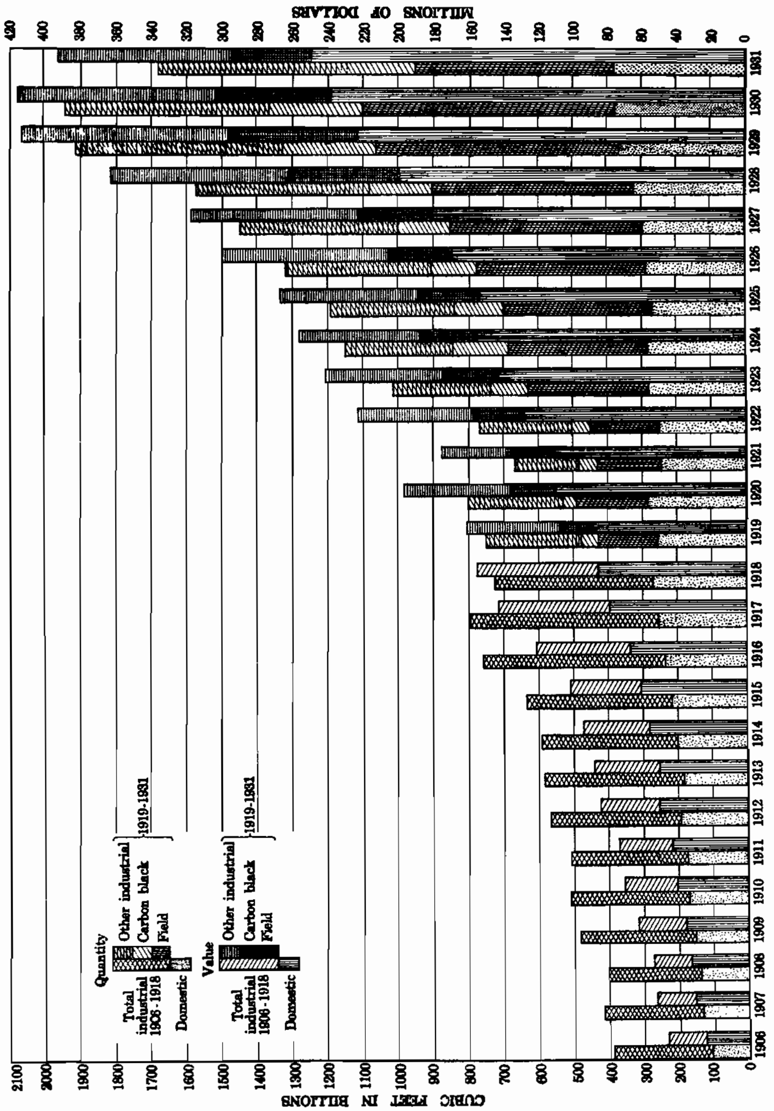

FIGURE 7.—Quantity and value of natural gas consumed in the United States, 1906-31.

is still the most important refinery fuel, the competition of refinery gas has been the largest single factor in reducing the purchases of natural gas by refiners.

Because of its purity and ease of control natural gas makes an ideal fuel for use in the manufacture of cement. The consumption of natural gas at the 31 cement plants utilizing it as fuel in 1931 totaled

31,381,000,000 cubic feet, compared with 41,256,000,000 cubic feet at 28 plants in 1930. This material decline resulted primarily from curtailment of operations at the plants.

Data on consumption of natural gas by the steel, glass, brick, and similar industries are not available; hence the total utilization of natural gas for general industrial purposes is obtained by subtracting the quantities consumed by the five major classes (field, carbon black, electric public-utility power plants, petroleum refineries, and cement plants) from the total industrial consumption. As one would naturally expect, the general decline in industrial activity in 1931 was reflected in the consumption of natural gas for general industrial purposes, and such consumption fell from 315,059,000,000 cubic feet in 1930 to 291,319,000,000 cubic feet in 1931, or 8 percent. It is notable, however, that this decline was relatively less than that suffered by consumption as a whole.

The average value at points of consumption of the total natural gas distributed in 1931 was 23.3 cents per thousand cubic feet; the average for domestic and commercial consumption was 65.5 cents, and that for industrial consumption was 10.9 cents. The industrial average has declined steadily in recent years, reflecting principally the increased competition with other fuels. The exact range of prices paid for natural gas by industrial users is not known, but the low point is probably close to the average paid by carbon-black producers—2.1 cents per thousand cubic feet in 1931 compared with 2.3 cents in 1930. The average price paid for natural gas in the field declined from 8.2 cents per thousand cubic feet in 1930 to 7.1 cents in 1931, and the average paid by all other industrial users decreased from 19.3 cents in 1930 to 18.3 cents in 1931. These data have particular interest, as they indicate the minimum prices at which natural gas can compete with other fuels.

Industrial consumption of natural gas in the United States in 1931, by States and uses

State	Field (drilling, pumping, and operating gasoline recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, electric public-utility power plants, portland cement plants, and other industrial						Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet				Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland cement plants	Other industrial	Total	Average (cents)		Total	Average (cents)
Alabama								(1)	[2] 7,660,000	$1,308,000	17.1	7,660,000	$1,308,000	17.1
Alaska	(3)	(3)							(3)	(3)	(3)	(3)	(3)	(3)
Arizona									(3)	(3)	(3)	(3)	(3)	(3)
Arkansas	10,113,000	$808,000				2,117,000	1,803,000	(1)	[2] 10,622,000	1,853,000	12.7	24,655,000	2,661,000	10.8
California	150,331,000	10,404,000				18,234,000	45,907,000	(1)	[2] 36,729,000	15,847,000	15.7	251,201,000	26,251,000	10.5
Colorado	413,000	10,000				5,000	150,000	(1)	[2] 10,932,000	2,077,000	18.7	11,500,000	2,087,000	18.1
District of Columbia									(4)	(4)	(4)	(4)	(4)	(4)
Florida									351,200	58,800	16.7	351,200	58,800	16.7
Georgia							1,232,000		1,416,000	437,000	16.5	2,648,000	437,000	16.5
Illinois	2,038,000	161,000				11,000			8,370,000	1,854,000	22.1	10,419,000	2,015,000	19.3
Indiana	20,000	5,000					1,377,000		1,940,000	1,098,000	33.1	3,337,000	1,103,000	33.1
Iowa							358,000	(1)	[2] 2,693,000	575,000	18.8	3,051,000	575,000	18.8
Kansas	10,287,000	1,201,000				2,230,000	11,315,000	5,681,000	16,694,000	5,946,000	16.6	46,207,000	7,147,000	15.5
Kentucky	1,316,000	223,000							3,431,000	1,010,000	29.4	4,747,000	1,233,000	26.0
Louisiana	11,806,000	479,000	52,204,000	$1,467,000	2.8	8,634,000	18,612,000		31,040,000	6,808,000	11.7	122,296,000	8,754,000	7.2
Maryland									[4] 265,000	[4] 204,000	[4] 77.0	[4] 265,000	[4] 204,000	[4] 77.0
Michigan	43,000	6,000							397,000	72,000	18.1	440,000	78,000	17.7
Minnesota									(5)	(5)	(5)	(5)	(5)	(5)
Mississippi	13,000	1,000					44,000		2,352,000	354,000	14.8	2,409,000	355,000	14.7
Missouri	7,000	800				1,106,000	1,106,000	(1)	[2] 12,308,000	2,847,200	19.6	14,527,000	2,848,000	19.6
Montana	890,000	98,000	206,000	4,000	1.9	125,000	569,000		2,765,000	639,000	18.5	4,555,000	741,000	16.3
Nebraska							1,084,000	(1)	[2] 2,570,000	746,000	20.4	3,654,000	746,000	20.4
New Mexico	8,427,000	300,000					2,357,000		315,000	419,000	15.7	11,099,000	719,000	6.5
New York	255,000	101,000				1,000	25,000		1,238,000	756,000	59.8	1,519,000	857,000	56.4
North Dakota							175,000		[5] 135,000	[5] 66,200	[5] 21.4	[5] 310,000	[5] 66,200	[5] 21.4

[1] Included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.
[2] Includes gas used at portland cement plants.
[3] Utah includes Alaska and Arizona.
[4] Maryland includes District of Columbia and Virginia.
[5] North Dakota includes Minnesota.

Industrial consumption of natural gas in the United States in 1931, by States and uses—Continued

State	Field (drilling, pumping, and operating gasoline recovery plants)		Manufacture of carbon black			Fuel at petroleum refineries, electric public-utility power plants, portland cement plants, and other industrial						Total industrial		
	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet				Value at points of consumption		M cubic feet	Value at points of consumption	
				Total	Average (cents)	Petroleum refineries	Electric public-utility power plants	Portland cement plants	Other industrial	Total	Average (cents)		Total	Average (cents)
Ohio	3,643,000	$996,000				11,000	3,180,000		20,424,000	$9,841,000	41.7	27,258,000	$10,837,000	39.8
Oklahoma	185,915,000	9,176,000	(1)	(1)	(1)	7,510,000	7,935,000	(1)	[2,6] 21,316,000	[6] 4,512,000	12.3	222,676,000	13,688,000	6.1
Pennsylvania	5,039,000	1,668,000				785,000	54,000		38,366,000	12,836,000	32.7	44,244,000	14,504,000	32.8
South Dakota								(1)	[2] 1,661,000	262,000	15.8	1,661,000	262,000	15.8
Tennessee							3,729,000		1,146,000	899,000	18.4	4,875,000	899,000	18.4
Texas	149,034,000	11,260,000	135,653,000	$2,279,000	1.7	25,308,000	37,028,000	8,350,000	49,322,000	17,872,000	14.9	404,695,000	31,420,000	7.8
Utah	[3] 2,000	[3] 200	(1)	(1)	(1)				[3,6] 5,042,800	[3,6] 991,300	[3] 19.7	[3] 5,044,800	[3] 991,500	[3] 19.7
Virginia									(4)	(4)	(4)	(4)	(4)	(4)
West Virginia	13,326,000	2,992,000				876,000	80,000		18,623,000	5,342,000	27.3	32,905,000	8,334,000	25.3
Wyoming	18,447,000	570,000	(1)	(1)	(1)	8,595,000	223,000		[6] 5,878,000	[6] 797,500	5.4	33,143,000	1,367,500	4.1
Miscellaneous			7,333,000	298,000	4.1			17,350,000						
Total, 1931	571,365,000	40,469,000	195,396,000	4,048,000	2.1	75,548,000	138,343,000	31,381,000	291,319,000	98,030,000	18.3	1,303,352,000	142,547,000	10.9
Total, 1930	723,165,000	59,118,000	266,625,000	6,002,000	2.3	98,842,000	120,290,000	41,256,000	315,059,000	111,226,000	19.3	1,565,237,000	176,346,000	11.3

[1] Included under "Miscellaneous" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.
[2] Includes gas used at portland cement plants.
[3] Utah includes Alaska and Arizona.
[4] Maryland includes District of Columbia and Virginia.
[6] Includes gas consumed in manufacture of carbon black.

"Unaccounted-for" gas.—In spite of rapid progress in recent years in the technique of piping natural gas, the quantity of gas lost is still large. Many companies do not keep separate figures for "unaccounted-for" gas, and this fact has generally discouraged compilation of such data. If it is assumed in such cases that losses are equal to the difference between receipts and sales, the unaccounted-for gas in 1931 was 209,411,000,000 cubic feet, the equivalent of 12 percent of the total turned into the lines.

INTERSTATE TRANSPORTATION

The interstate transportation of natural gas increased in complexity in 1931, although the total amount delivered declined from 380,601,000,000 cubic feet in 1930 to 332,538,000,000 cubic feet in 1931. These data indicate a decline of 13 percent in interstate deliveries in 1931, but the actual decrease was considerably less as certain duplications were eliminated in 1931 for the first time.

The largest single interstate movement recorded in 1931 (50,925,000,000 cubic feet) was from West Virginia to Ohio. (See fig. 8.) The second largest movement (41,520,000,000 cubic feet) was from Louisiana to Texas. Each of these movements was about 10,000,000,000 cubic feet below the respective total in 1930.

Most of the new interstate movements in 1931 were due to inauguration of service as follows: On the line of the Natural Gas Pipeline Co. of America from the Texas Panhandle to Chicago by way of Kansas, Nebraska, and Iowa; the line of the Panhandle-Eastern Pipe Line Co. from the Panhandle to Indiana via Kansas, Missouri, and Illinois; the line of the Northern Gas & Pipe Line Co. from the Panhandle and Hugoton fields to Nebraska, Iowa, and Minnesota; and the line of the Columbia Gas & Electric Co. to Washington, D.C., and suburban areas in Maryland and Virginia. Florida and Arizona entered the ranks of natural gas-consuming States, the former through an extension from Mobile to Pensacola and the latter by means of an extension of the Lea-El Paso line.

Louisiana displaced West Virginia as the leading State in interstate shipments. Texas ranked first in number of movements, 14 States and Mexico receiving natural gas from Texas in 1931. The total movement from Texas in 1931 was 67,958,000,000 cubic feet, of which about 63,000,000,000 cubic feet (93 percent) were from the Panhandle.

Interstate transportation of natural gas in 1931

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Colorado	Wyoming	Utah	1,590,000
		Wyoming	105,000
			1,695,000
Indiana		Kentucky	201,000
Kansas		Colorado	165,000
	Missouri	Illinois	26,000
	do. Illinois	Indiana	28,000
	Nebraska	Iowa	1,795,000
	do. Iowa	Minnesota	4,000
		Missouri	3,033,000
		Nebraska	2,802,000
		Oklahoma	613,000
	Nebraska Iowa	South Dakota	8,000
			8,474,000

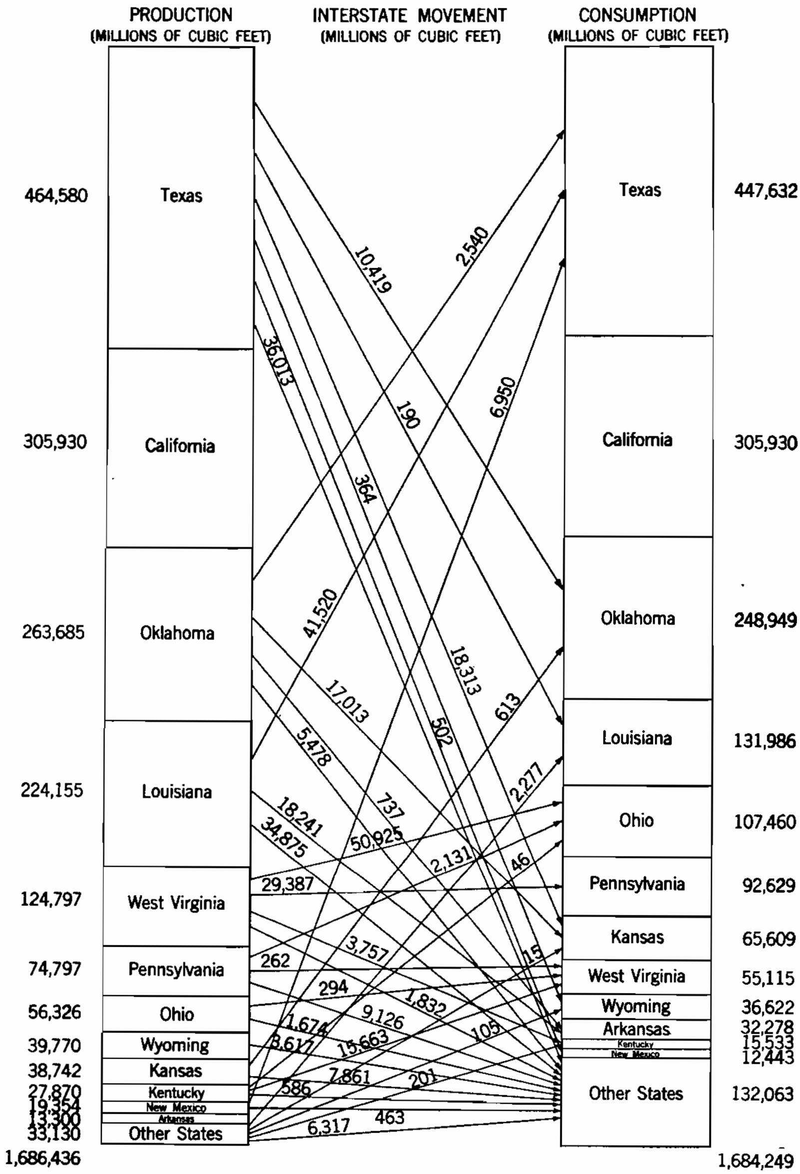

FIGURE 8.—Interstate movement of natural gas in the United States in 1931 and relative importance of principal States in production and consumption.

Interstate transportation of natural gas in 1931—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Kentucky	Virginia Maryland	District of Columbia	259,000
		Indiana	276,000
	Virginia Maryland District of Columbia	Maryland	14,000
		Ohio	46,000
	Virginia Maryland District of Columbia	Virginia	9,000
	West Virginia	do	28,000
		West Virginia	15,663,000
			16,295,000
Louisiana	Mississippi	Alabama	8,103,000
		Arkansas	18,241,000
	Mississippi Alabama	Georgia	4,904,000
	Arkansas Missouri	Illinois	7,553,000
		Mississippi	1,311,000
	Arkansas	Missouri	5,406,000
	do Mississippi	Tennessee	7,598,000
		Texas	41,520,000
			94,636,000
Mississippi		Alabama	355,000
	Alabama	Florida	357,000
		Louisiana	2,277,000
			2,989,000
Missouri		Illinois	175,000
	Illinois	Indiana	186,000
		Kansas	15,000
			376,000
Montana		North Dakota	878,000
		South Dakota	2,776,000
			3,654,000
New Mexico	Texas New Mexico	Arizona	357,000
		Colorado	106,000
		Texas	6,950,000
			7,413,000
New York		Canada	38,000
Ohio		Indiana	1,674,000
		West Virginia	294,000
			1,968,000
Oklahoma		Arkansas	737,000
		Kansas	17,013,000
	Kansas	Missouri	5,447,000
	do	Nebraska	31,000
		Texas	2,540,000
			25,768,000
Pennsylvania	New York	Canada	36,000
		New York	9,126,000
		Ohio	642,000
	West Virginia	do	1,489,000
		West Virginia	262,000
			11,555,000
Texas	New Mexico	Arizona	1,882,000
	do	Colorado	15,779,000
	Oklahoma Kansas Nebraska Iowa	Illinois	4,148,000

Interstate transportation of natural gas in 1931—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Texas (continued)	Oklahoma Kansas Missouri	Illinois	18,000
	Oklahoma Kansas Nebraska Iowa Illinois	Indiana	1,376,000
	Oklahoma Kansas Missouri Illinois	do	19,000
	Oklahoma Kansas Nebraska	Iowa	1,727,000
	Oklahoma	Kansas	18,313,000
		Louisiana	190,000
		Mexico	2,157,000
	Oklahoma Kansas Nebraska Iowa	Minnesota	3,000
	Oklahoma Kansas	Missouri	9,217,000
	Oklahoma Kansas	Nebraska	1,837,000
		New Mexico	502,000
		Oklahoma	10,419,000
	Oklahoma Kansas Nebraska Iowa	South Dakota	7,000
	New Mexico Colorado	Wyoming	364,000
			67,958,000
West Virginia	Pennsylvania Maryland	District of Columbia	1,129,000
		Kentucky	3,757,000
		Maryland	608,000
	Pennsylvania Maryland District of Columbia	do	57,000
		Ohio	44,968,000
	Kentucky	do	5,957,000
		Pennsylvania	29,387,000
	Pennsylvania Maryland District of Columbia	Virginia	38,000
			85,901,000
Wyoming		Colorado	1,000
		Montana	1,020,000
		Nebraska	147,000
		Utah	2,449,000
			3,617,000
			332,538,000

NATURAL-GAS WELLS

The approximate number of gas wells operated in 1931 amounted to 55,756, an increase of 736 over 1930. These data represent wells producing gas only; that is, they do not include any of the 320,000 or more oil wells that operated in 1931 and produced about 60 per cent of the total output of natural gas. According to the Oil and Gas Journal the number of gas wells completed in 1931, exclusive of California, totaled 1,985, indicating that 1,249 wells were abandoned or disconnected in 1931. This figure is considerably below abandonments in 1930 and reflects a firm market in States like Pennsylvania which have a large number of small wells.

Pennsylvania, with slightly more than 20,000 gas wells, again ranked first; West Virginia, with 12,858 gas wells, was second and was far ahead of Ohio, the State ranking third, which had only 6,754 gas wells.

Approximate number of gas wells operated in the United States, 1930 and 1931

State	1930	1931	State	1930	1931
Arkansas	162	178	Montana	175	208
California	50	55	New York	2,134	2,174
Colorado, New Mexico, Utah, and Washington	50	66	Ohio	6,849	6,754
Illinois	88	87	Oklahoma	3,217	3,091
Indiana	1,134	1,114	Pennsylvania	19,764	20,034
Kansas	3,992	4,005	Texas	1,514	1,643
Kentucky and Tennessee	1,402	1,728	West Virginia	12,983	12,858
Louisiana and Mississippi	1,266	1,309	Wyoming	92	121
Michigan	27	33		55,020	55,756
Missouri and South Dakota	[1] 121	298			

[1] Includes Iowa and North Dakota.

Although the number of new gas wells in Ohio declined from 653 in 1930 to 475 in 1931, the State continued to lead in completions. Completions in West Virginia showed only a small decline in 1931, and the State rose to second place above both Texas and Oklahoma. In general, the decrease in number of gas wells completed in 1931 in the Eastern States was relatively less than in States west of the Mississippi, indicating principally a firmer demand in the East. Among the counties or parishes that showed material decline in number of gas wells completed in 1931 were Stevens, Kans.; Ohio, Ky.; Richland, La.; Ashland, Athens, and Muskingum, Ohio; Muskogee and Seminole, Okla.; and Mirando, Panola, Refugio, and Wheeler, Tex. Those which showed a material gain in completions in 1931 were McPherson, Kans.; Glacier, Mont.; Stark and Seneca, Ohio; Calhoun, W.Va.; and the Tioga-Wayne district of Pennsylvania and New York.

Gas wells drilled in the United States in 1931, by States and by counties or districts [1]

State and county or district	Number of gas wells	State and county or district	Number of gas wells	State and county or district	Number of gas wells
Arkansas:		Indiana:		Kansas:	
Crawford	1	Allen	1	Barber	1
Franklin	1	Crawford	1	Butler	3
Johnson	2	Daviess	4	Chase	2
Sebastian	1	Dearborn	1	Chautauqua	1
		Gibson	1	Cowley	8
	5	Greene	3	McPherson	52
Total for 1930	12	Hancock	1	Marion	1
California	(2)	Harrison	1	Morris	7
Colorado:		Henry	1	Morton	3
Larimer	2	Jay	1	Reno	3
Moffat	2	Knox	7	Rice	3
Montezuma	1	Madison	2	Rush	2
		Monroe	5	Stevens	26
		Pike	7		
	5	Porter	1		112
Total for 1930	10	Rush	1	Total for 1930	168
Illinois:		Sullivan	8		
Crawford	1	Vanderburg	1	Kentucky:	
				Barren	17
	1		47	Bath	1
Total for 1930	3	Total for 1930	55	Bell	1
				Caldwell	1

[1] Oil and Gas Journal. [2] California not reported.

Gas wells drilled in the United States in 1931, by States and by counties or districts—Continued

State and county or district	Number of gas wells
Kentucky—Continued	
Carroll	4
Christian	3
Clay	3
Cumberland	1
Daviess	1
Estill	1
Floyd	4
Grayson	1
Green	6
Hancock	7
Hart	21
Henderson	3
Hopkins	5
Knox	2
McCracken	1
McLean	1
Meade	1
Metcalfe	2
Muhlenberg	5
Ohio	10
Perry	1
Shelby	1
Warren	1
Webster	10
Wolfe	1
	116
Total for 1930	157
Louisiana:	
Gulf coast:	
Lockport	2
Miscellaneous	1
	3
Total for 1930	1
Northern:	
Bossier	7
Caddo	8
Claiborne	1
Concordia	1
Morehouse	1
Ouachita	5
Richland	44
Union	9
	76
Total for 1930	254
Total Louisiana, 1931	79
1930	255
Michigan:	
Clare	2
Gratiot	6
Isabella	7
Lenawee	1
Missaukee	2
Monroe	2
Muskegon	1
Washtenaw	1
Wayne	8
	30
Total for 1930	29
Mississippi:	
Hinds	18
Monroe	2
Rankin	16
	36
Total for 1930	31
Montana:	
Carbon	1
Glacier	17
Hill	3
Liberty	4
Toole	8
Miscellaneous	3
	36
Total for 1930	40
New Mexico:	
Eddy	2
Harding	1
Lea	2
San Juan	5
Torrance	1
	11
Total for 1930	11
Ohio:	
Central and Eastern:	
Ashland	17
Ashtabula	3
Athens	39
Belmont	29
Columbiana	1
Coshocton	10
Cuyahoga	2
Fairfield	17
Guernsey	10
Hocking	1
Holmes	3
Jefferson	1
Knox	10
Licking	17
Lorain	26
Medina	10
Monroe	3
Muskingum	39
Noble	7
Perry	7
Pickaway	1
Richland	4
Stark	78
Summit	15
Tuscarawas	12
Vinton	9
Washington	5
Wayne	9
	385
Total for 1930	581
Northwestern:	
Darke	2
Erie	1
Fulton	1
Hardin	11
Henry	10
Huron	2
Logan	3
Lucas	1
Mercer	2
Ottawa	1
Paulding	4
Sandusky	1
Seneca	34
Shelby	1
Wood	1
Wyandot	15
	90
Total for 1930	72
Total Ohio, 1931	475
1930	653
Oklahoma:	
Creek	31
Garfield	1
Grady	9
Haskell	4
Hughes	6
Kay	1
Latimer	5
Le Flore	3
Lincoln	4
McIntosh	2
Muskogee	27
Noble	3
Okfuskee	3
Oklahoma—Continued	
Oklahoma	1
Okmulgee	16
Osage	5
Pawnee	5
Payne	1
Pittsburg	22
Pottawatomie	9
Seminole	5
Stephens	2
Texas	3
Tulsa	4
Wagoner	10
Miscellaneous	4
	186
Total for 1930	403
Pennsylvania and New York:	
Allegany	1
Butler-Armstrong	11
Southwest Pennsylvania	48
Tioga-Wayne	122
Venango-Clarion	28
	210
Total for 1930	129
Tennessee:	
Coffee	1
Morgan	3
	4
Total for 1930	12
Texas:	
Gulf coast:	
Hull	1
Humble	1
Raccoon Bend	2
Refugio	7
Miscellaneous	11
	22
Total for 1930	43
Rest of State:	
Northern, Central, Eastern, and Southwestern:	
Agua Dulce	1
Brown	7
Callahan	3
Chapman	1
Chittim	1
Clay	2
Coleman	9
Dobrowolski	1
Eastland	14
Foard	1
Hood	1
Jack	4
McFaddin	4
Mirando	22
Palo Pinto	24
Panola	6
Parker	1
Pettus	2
Pryor	2
Saxet	3
Shackelford	3
Stephens	6
Throckmorton	3
Van Zandt	7
Walsh	1
Welder	2
Miscellaneous	11
	142
Total for 1930	263

Gas wells drilled in the United States in 1931, by States and by counties or districts—Continued

State and county or district	Number of gas wells
Texas—Continued	
Rest of State—Contd.	
Panhandle:	
Carson	35
Gray	13
Hutchinson	11
Moore	13
Potter	2
Wheeler	3
	77
Total for 1930	172
West Texas:	
Pecos	1
Taylor	1
Terrell	1
	3
Total for 1930	5
Total "Rest of State," 1931	222
1930	440
Total Texas, 1931	244
1930	483
Utah:	
1931	------
1930	1
West Virginia:	
Boone	50
Cabell	20
Calhoun	86
Clay	7
Doddridge	8
Fayette	1
Gilmer	28
Harrison	7
Jackson	2
Kanawha	27
Lewis	2
Lincoln	24
Logan	1
Marion	11
Marshall	15
Mingo	17
Monongalia	8
Pleasants	2
Putnam	2
West Virginia—Contd.	
Raleigh	1
Ritchie	10
Roane	14
Tyler and Wetzel	23
Wayne	11
Wirt	1
Wyoming	1
	379
Total for 1930	397
Wyoming:	
Big Horn	1
Converse	1
Fremont	3
Niobrara	3
Park	1
	9
Total for 1930	17
United States, 1931	[3] 1,985
1930	[3] 2,866

[3] Exclusive of California.

SURVEY OF NATURAL-GAS PIPE LINES

Construction of long large-diameter natural-gas lines, a matter of considerable public interest in 1928, 1929, and 1930, declined in 1931. This decrease in new construction was due chiefly to the fact that the major projects holding most promise of success were completed or well under way before 1931.

The pipe-line system running from Kentucky to Washington, D.C., and vicinity was completed late in 1931, and Kentucky natural gas was used as an enricher in place of natural gas from West Virginia. Development of the Tioga field in Tioga County, Pa., led to construction of a 14-inch line about 50 miles long to Williamsport, Pa., and a 20-inch line about 110 miles long to Syracuse, N.Y. The major part of the construction in the Mid-Continent area involved completion of the Panhandle-Chicago and Panhandle-Indianapolis lines and extension of the system linking the Panhandle and Hugoton fields with Nebraska, Iowa, and Minnesota. The chief new work in the South was construction of a system across southern Louisiana to Franklin, La., and extensions of the Monroe-Atlanta system. Montana was the scene of considerable pipe-line construction in 1931; lines were laid from the Cut Bank field to Helena, Anaconda, and Butte and from the Dry Creek field to Bozeman. The Lea-El Paso line was extended into the mining districts of Arizona during the year. The most important work in California in 1931 involved completion of a 26-inch line from the Kettleman Hills field to the Los Angeles district.

SUMMARY OF STATISTICS FOR NATURAL GASOLINE AND CARBON BLACK

Because of the close relationship between the natural-gas, natural-gasoline, and carbon-black industries, it is thought advisable to include in this report summary tables for the natural-gasoline and carbon-black industries. Complete details for those commodities will be found in the annual chapters on those subjects in Mineral Resources of the United States.

Summary of statistics for natural gasoline in the United States, 1920, 1925, and 1929–31

	1920	1925	1929	1930	1931
Number of plants operating	1,154	1,081	1,087	1,035	937
Production:					
By States:					
California ... millions of gallons	48	303	840	830	680
Oklahoma ... do	179	391	676	591	455
Texas ... do	33	214	420	491	427
Louisiana ... do	11	43	65	74	58
West Virginia ... do	59	58	73	63	53
Other States ... do	55	118	160	161	159
	385	1,127	2,234	2,210	1,832
By processes:					
Compression process ... do	281	238	259	250	212
Absorption and combination processes ... do	104	882	1,950	1,942	1,609
Charcoal ... do		7	25	18	11
	385	1,127	2,234	2,210	1,832
Stocks at natural-gasoline plants Dec. 31 ... do	(1)	15	26	24	27
Value:					
Total (at plants) ... millions of dollars	72	120	158	128	64
Average per gallon (at plant) ... cents	18.7	10.7	7.1	5.8	3.5
Average spot price, Oklahoma natural gasoline, grade A ... cents	21.3	12.0	7.1	5.4	3.2
Natural gas treated ... millions of cubic feet	496,431	1,040,390	1,959,294	2,088,778	1,790,119
Average yield per thousand cubic feet ... gallons	0.78	1.08	1.14	1.06	1.02

[1] Figures not available.

Summary of statistics for carbon black made from natural gas in the United States, 1921, 1925, and 1929–31

	1921	1925	1929	1930	1931
Number of producers reporting	23	42	35	33	26
Number of plants	41	63	71	69	58
Quantity produced:					
By States:					
Kentucky ... pounds	2,697,075	7,309,378			
Louisiana ... do	31,003,615	129,839,907	127,345,000	96,729,000	57,485,000
Texas ... do		26,219,510	228,183,000	271,749,000	210,878,000
West Virginia ... do	25,073,000	10,847,794	578,000	(1)	
Wyoming ... do	419,400	(1)	(1)	(1)	(1)
Other States ... do	573,225	3,200,789	10,336,000	11,464,000	12,544,000
	59,766,315	177,417,378	366,442,000	379,942,000	280,907,000
By processes:					
Channel process ... do	(2)	143,701,153	327,552,000	350,254,000	255,322,000
Other processes [3] ... do	(2)	33,716,225	38,890,000	29,688,000	25,585,000
Stocks held by producers Dec. 31 ... do	(2)	96,023,448	132,203,000	259,245,000	280,010,000
Losses ... do	(2)	1,433,850	673,000	1,361,000	1,716,000
Quantity sold:					
Domestic:					
To rubber companies ... do	(2)	86,328,826	138,474,000	128,572,000	134,315,000
To ink companies ... do	(2)	22,388,807	27,350,000	19,220,000	15,184,000
To paint companies ... do	(2)	11,757,601	17,257,000	11,922,000	6,760,000
For miscellaneous purposes ... do	(2)	11,973,457	8,896,000	7,565,000	5,453,000
	(2)	132,448,691	191,977,000	167,279,000	161,712,000
Export ... do	(2)	43,182,635	91,829,000	84,260,000	96,714,000
	(2)	175,631,326	283,806,000	251,539,000	258,426,000
Value (at plants) of carbon black produced:					
Total ... dollars	5,445,878	9,639,585	18,720,000	14,852,000	8,621,000
Average per pound ... cents	9.11	5.43	5.11	3.91	3.07
Estimated quantity of natural gas used ... M cubic feet	50,565,000	140,366,000	261,107,000	266,625,000	195,396,000
Average yield per M cubic feet ... pounds	1.18	1.26	1.40	1.43	1.44

[1] Included under "Other States."
[2] Figures not available.
[3] 1925: Chain, disk, plate, ring, roller, "special", and thermatomic; 1929 and 1930: Disk, Lewis, roller, "special", and thermatomic; 1931: Disk, roller, "special", and thermatomic.

COKE AND BY-PRODUCTS

By F. G. Tryon and H. L. Bennit

CONTENTS

ILLUSTRATIONS

INTRODUCTION

The urgent need for economy in public expenditure impels the Bureau of Mines to omit the usual discussion of developments in the coke industry in 1931 and to confine this report to presenting, through selected tables, the essential facts of the statistical record for the year.

As the reports for 1928, 1929, and 1930 were exceptionally complete the reader is referred to them for historical data, for explanation of the methods employed in collecting the statistics, and for interpretation of the trends of development.

The present report also omits numerous derivative figures such as average yields and prices, as the reader who needs such data can make his own calculations if he is supplied with the primary record. If not readily found, any derivative figures carried in earlier reports will be furnished by the bureau upon application.

The report covers only coke made by high-temperature carbonization of coal in beehive and by-product ovens. It is important to note, however, that by-product coke produced by city gas companies is included. Adaptation of the by-product coke oven to the needs of city-gas manufacture has led a number of gas companies to install batteries of by-product ovens to supplement or replace their coal-gas or water-gas plants. From the standpoint of ownership and accounting, these installations are part of the gas utility system, and the Bureau of the Census therefore groups them within the manufactured-gas industry under the title "Gas, manufactured, illuminating and heating." From other points of view, however, these installations are part of the by-product coke industry, and they are so included in the statistics of the Bureau of Mines. The differences in classification are followed advisedly by the Bureau of the Census and Bureau of Mines after consultation with leaders of the gas and coke industries, and the two offices have collaborated in the collection and analysis of the statistics. To enable the reader to reconcile the two sets of figures and to ascertain the total production of gas and coke from all sources without duplication a table is given on pages 413 and 414 in which the production of those by-product coke ovens operated by city gas companies is shown separately.

Coke is also made by other processes not included in this report, among them the following: About 2,500,000 tons of gas-house coke are made by the high-temperature carbonization of coal in types of equipment other than coke ovens, chiefly in horizontal retorts. Statistics of gas-house coke are given in Coke and By-Products in 1930, page 495. Petroleum coke is a by-product of petroleum refining; production in 1931 amounted to 2,032,000 tons, a substantial increase over 1930 in spite of the depression. Much experimental work has been done in the field of low-temperature carbonization of coal, but the commercial feasibility of the process has not been demonstrated in the United States. The manufacture of coke from coal-tar pitch, on the other hand, is established on a commercial basis, but the tonnage produced is small. None of these kinds of coke are covered in this report. Gas-house coke, petroleum coke, and low-temperature coke are not adapted for blast-furnace and foundry purposes, which consume the great bulk of all the coke produced, and the production of coal-tar pitch coke is so limited as to have small importance. Practically, therefore, the coke trade is concerned with beehive and by-product oven coke.

The standard unit of measurement in the coke industry is the short or net ton of 2,000 pounds, and unless otherwise specified it is the unit employed throughout this chapter.

STATISTICAL SUMMARY

TABLE 1.—*Salient statistics of the coke industry in 1931*

	By-product	Beehive	Total
Coke produced:			
Quantity .... net tons	32, 355, 549	1, 128, 337	33, 483, 886
Value	$158, 090, 123	$3, 518, 601	$161, 608, 724
Screenings and breeze produced:			
Quantity .... net tons	3, 126, 285	49, 432	3, 175, 717
Value	$6, 637, 976	$73, 809	$6, 711, 785
Coal charged into ovens:			
Quantity .... net tons	46, 846, 277	1, 766, 783	48, 613, 060
Value	$166, 161, 532	$2, 758, 198	$168, 919, 730
Average value	$3. 55	$1. 56	$3. 47
Average yield in per cent of coal charged:			
Coke	69. 07	63. 86	68. 88
Breeze (at plants actually recovering)	6. 67	4. 81	6. 63

TABLE 1.—*Salient statistics of the coke industry in 1931*—Continued

	By-product	Beehive	Total
Ovens:			
In existence Jan. 1	12,831	23,907	36,738
In existence Dec. 31	13,108	21,588	34,696
Dismantled during year		2,357	2,357
In course of construction Dec. 31			
Daily capacity of ovens in existence Dec. 31...net tons	173,948	(1)	(1)
oke used by operator:			
In blast furnaces—			
Quantity...net tons	16,622,325		16,622,325
Value	$68,650,546		$68,650,546
For other purposes—			
Quantity...net tons	1,691,407	233	1,691,640
Value	$10,684,995	$586	$10,685,581
Disposal of coke:			
Sold for furnace use to affiliated corporations—			
Quantity...net tons	1,123,349	64,105	1,187,454
Value	$5,039,315	$229,199	$5,268,514
Merchant sales of furnace coke—			
Quantity...net tons	703,312	403,444	1,106,756
Value	$3,227,742	$1,101,945	$4,329,687
Sold for foundry use—			
Quantity...net tons	1,106,518	250,758	1,357,276
Value	$6,763,737	$984,356	$7,748,093
Sold for domestic use—			
Quantity...net tons	8,376,652	118,665	8,495,317
Value	$47,957,814	$297,839	$48,255,653
Sold for manufacture of water gas—			
Quantity...net tons	594,339	28,578	622,917
Value	$3,668,437	$71,981	$3,740,418
Sold for industrial and other use—			
Quantity...net tons	957,274	258,375	1,215,649
Value	$5,201,376	$921,203	$6,122,579
Disposal of screenings and breeze:			
Used by operator—			
Quantity...net tons	2,574,304	41,260	2,615,564
Value	$5,190,308	$11,589	$5,201,897
Sold—			
Quantity...net tons	642,847	21,029	663,876
Value	$1,623,863	$28,226	$1,652,089
Average receipts per ton sold:			
Furnace coke (merchant sales)	$4.589	$2.731	$3.912
Foundry coke	$6.113	$3.926	$5.709
Domestic coke	$5.725	$2.510	$5.680
For manufacture of water gas	$6.172	$2.519	$6.005
Other industrial coke	$5.434	$3.565	$5.036
Screenings and breeze	$2.526	$1.342	$2.487
By-products produced:			
Gas...M cubic feet	524,097,485		524,097,485
Wasted...per cent	1.2		1.2
Burned in coking process...do	36.1		36.1
Surplus sold or used...do	62.7		62.7
Tar...gallons	450,856,092		450,856,092
Ammonium sulphate or equivalent...pounds	1,139,971,003		1,139,971,003
Crude light oil...gallons	122,529,148		122,529,148
Yield of by-products per ton of coal:			
Gas...M cubic feet	11.19		11.19
Tar...gallons	9.62		9.62
Ammonium sulphate or equivalent...pounds	24.33		24.33
Crude light oil...gallons	3.03		3.03
Value of by-products sold:			
Gas (surplus)	$67,429,913		$67,429,913
Tar—			
Sold	12,440,567		12,440,567
Used by producer	8,173,810		8,173,810
Ammonium sulphate or equivalent	14,278,420		14,278,420
Crude light oil and derivatives	14,389,960		14,389,960
Other by-products [2]	1,654,232		1,654,232
Total value of coke, breeze, and by-products [3]	283,095,001	$3,592,410	286,687,411

[1] Data not available.
[2] Includes naphthalene and tar derivatives.
[3] Includes value of tar used by the coke plants.

TABLE 2.—*Statistical trends of the coke industry, 1923 and 1928–1931*

	1923	1928	1929	1930	1931
Coke-produced:					
Beehive net tons	19, 379, 870	4, 492, 803	6, 472, 019	2, 776, 316	1, 128, 337
By-product do	37, 597, 664	48, 313, 025	53, 411, 826	45, 195, 705	32, 355, 549
Total do	56, 977, 534	52, 805, 828	59, 883, 845	47, 972, 021	33, 483, 886
Per cent of total from by-product ovens	66. 0	91. 5	89. 2	94. 2	96. 6
Disposal of coke (beehive and by-product):					
Furnace coke (including all coke used by producer) net tons	47, 774, 408	41, 952, 336	46, 785, 722	34, 524, 554	20, 608, 175
Foundry coke do	3, 600, 719	2, 710, 606	2, 888, 508	2, 127, 715	1, 357, 276
Other industrial (including water gas) net tons	2, 283, 888	1, 764, 374	2, 334, 999	2, 030, 103	1, 838, 566
Domestic coke do	2, 733, 414	6, 332, 720	7, 511, 023	8, 027, 823	8, 495, 317
Number of ovens in existence:					
Beehive	62, 349	46, 288	30, 082	23, 907	21, 588
By-product	11, 156	12, 544	12, 649	12, 831	13, 108
Number of new by-product ovens under construction at end of year	629	145	408	276	------------
Cost of coal charged, by-product ovens, average per ton	$4. 76	$3. 57	$3. 50	$3. 48	$3. 55
Prices of coke:					
Average spot price of Connellsville furnace coke f. o. b. ovens	$5. 33	$2. 69	$2. 75	$2. 56	$2. 43
Average realization on by-product coke sold—					
Furnace coke (merchant sales)	$6. 74	$4. 99	$5. 38	$4. 95	$4. 589
Foundry coke	$10. 54	$6. 98	$6. 97	$6. 57	$6. 113
Other industrial (including water gas)	$9. 06	$6. 58	$5. 77	$5. 88	$5. 717
Domestic	$9. 05	$6. 23	$6. 28	$6. 03	$5. 725
Yield of by-products per ton of coal charged:					
Tar gallons	8. 1	9. 0	8. 9	9. 20	9. 62
Ammonium sulphate or equivalent pounds	21. 2	22. 8	22. 3	23. 47	24. 33
Light oil gallons	2. 7	3. 0	2. 9	3. 06	3. 03
Surplus gas sold or used M cubic feet	5. 9	6. 5	6. 6	6. 75	7. 02
Average gross receipts of by-products per ton of coke produced:					
Tar sold or used	$0. 51	$0. 69	$0. 65	$0. 656	$0. 637
Ammonia and its compounds	. 84	. 57	. 54	. 502	. 441
Light oil and its derivatives	. 51	. 60	. 58	. 527	. 447
Surplus gas sold or used	1. 37	1. 58	1. 58	1. 754	2. 084
Total by-products, including breeze	3. 48	3. 66	3. 60	3. 708	3. 863

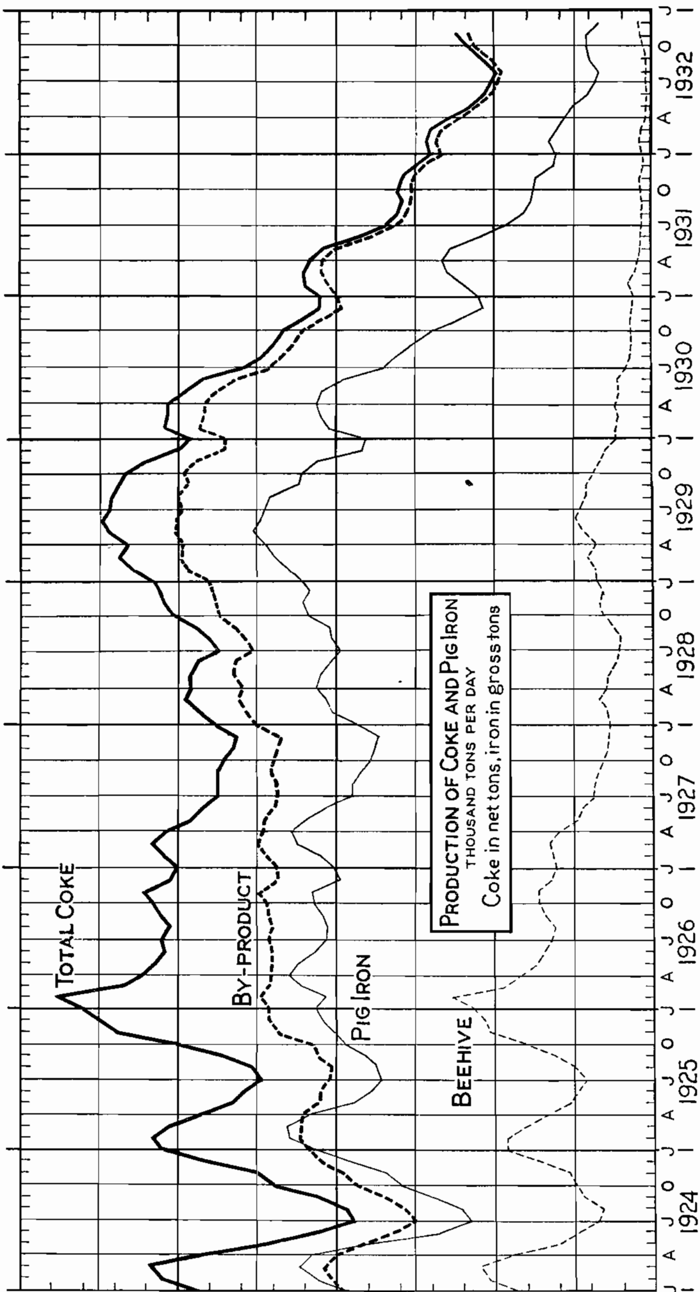

FIGURE 9.—Average daily production of beehive and by-product coke and of pig iron, by months, 1924–1932

TABLE 3.—*Summary of coke produced, value, number of ovens, coal charged, and average yield, by States, in 1931*

[Exclusive of screenings and breeze]

State	By-product								Beehive						Total	
	Plants in existence	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
		Built	Under construction Dec. 31				Total	Per ton					Total	Per ton		
Alabama	8	1,388		4,171,455	70.55	2,943,143	$8,023,595	$2.73							2,943,143	$8,023,595
Colorado	1	151		328,869	68.65	225,760	(1)	(1)	378	(2)	(2)	(2)	(2)	(2)	[3] 225,760	(1)
Connecticut	1	61		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Illinois	8	950		3,644,269	68.02	2,478,984	14,042,457	5.66							2,478,984	14,042,457
Indiana	6	1,550		3,889,127	70.89	2,757,135	16,431,416	5.96							2,757,135	16,431,416
Kentucky	1	108		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Maryland	1	361		1,108,751	73.78	817,995	(1)	(1)							817,995	(1)
Massachusetts	3	430		1,603,177	71.75	1,150,270	9,061,415	7.88							1,150,270	9,061,415
Michigan	7	587		3,453,963	70.55	2,436,630	11,632,284	4.77							2,436,630	11,632,284
Minnesota	3	196		652,171	67.54	440,489	3,521,295	7.99							440,489	3,521,295
Missouri	1	64		(2)	(2)	(2)	(2)	(2)							(2)	(2)
New Jersey	2	202		1,314,883	70.80	930,912	(1)	(1)							930,912	(1)
New York	9	1,024		5,135,778	69.67	3,578,311	22,115,932	6.18							3,578,311	22,115,932
Ohio	15	1,836		5,788,166	67.95	3,932,939	17,588,581	4.47							3,932,939	17,588,581
Oklahoma									100							
Pennsylvania	13	3,478		11,250,490	66.88	7,524,722	30,039,070	3.99	15,366	1,309,929	65.31	855,527	$2,419,114	$2.83	8,380,249	32,458,184
Rhode Island	1	65		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Tennessee	1	24		115,270	72.38	83,439	356,285	4.27	723	33,923	50.33	17,074	53,362	3.13	100,513	409,647
Utah	1	56		270,172	54.33	146,788	(1)	(1)	819	(2)	(2)	(2)	(2)	(2)	[3] 146,788	(1)
Virginia									1,642	164,621	60.32	99,305	364,854	3.67	99,305	364,854
Washington	1	20		55,736	54.01	30,104	210,728	7.00	80	957	60.82	582	5,054	8.68	30,686	215,782
West Virginia	4	362		1,821,755	69.44	1,265,039	2,838,554	2.24	2,480	190,767	59.56	113,627	366,090	3.22	1,378,666	3,204,644
Wisconsin	2	195		(2)	(2)	(2)	(2)	(2)							(2)	(2)
Combined States				2,242,245	71.93	1,612,889	10,616,635	6.58		66,586	63.41	42,222	310,127	7.35	1,655,111	10,926,762
Undistributed							11,611,876	5.47								11,611,876
	89	13,108		46,846,277	69.07	32,355,549	158,090,123	4.89	21,588	1,766,783	63.86	1,128,337	3,518,601	3.12	33,483,886	161,608,724

[1] Included under "Undistributed."
[2] Included under "Combined States."
[3] By-product only. Beehive included under "Combined States."

COKE AND COKE BREEZE

MONTHLY AND WEEKLY PRODUCTION

TABLE 4.—*By-product, beehive, and total coke produced in the United States, 1928-1931, by months, and average per day, in net tons*

Month	1928		1929		1930		1931	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
By-product:								
January	3,906,000	126,000	4,355,000	140,500	4,167,100	134,400	3,082,700	99,400
February	3,731,000	128,700	4,084,800	145,900	3,977,200	142,100	2,889,000	103,200
March	4,074,000	131,400	4,607,600	148,600	4,361,400	140,700	3,246,300	104,700
April	3,934,000	131,100	4,451,700	148,400	4,216,800	140,600	3,136,900	104,600
May	4,109,000	132,500	4,658,700	150,300	4,234,800	136,600	3,116,000	100,500
June	3,970,000	132,300	4,504,200	150,200	3,927,500	130,900	2,706,900	90,200
July	3,920,000	126,400	4,608,200	148,700	3,746,700	120,900	2,560,900	82,600
August	4,004,000	129,200	4,637,300	149,600	3,611,100	116,500	2,435,400	78,600
September	3,967,000	132,300	4,407,700	146,900	3,376,100	112,600	2,303,100	76,800
October	4,229,000	136,400	4,604,600	148,500	3,407,800	109,900	2,381,800	76,800
November	4,142,000	138,100	4,316,400	143,900	3,114,000	103,800	2,269,400	75,600
December	4,327,000	139,600	4,175,600	134,700	3,055,200	98,600	2,227,200	71,800
	48,313,000	132,000	53,411,800	146,300	45,195,700	123,900	32,355,600	88,600
Beehive:								
January	385,000	14,800	515,500	19,100	318,000	11,800	144,400	5,300
February	400,000	16,000	473,700	19,700	279,000	11,600	144,300	6,000
March	459,000	17,100	574,000	22,100	288,700	11,100	132,100	5,100
April	387,000	15,500	503,200	19,300	299,600	11,500	96,200	3,700
May	386,000	14,300	642,800	23,800	270,100	10,000	83,200	3,200
June	311,000	11,900	648,200	25,900	259,800	10,400	77,300	3,000
July	280,000	11,200	645,800	24,800	213,100	8,200	67,200	2,600
August	297,000	10,900	604,500	22,400	168,300	6,500	61,600	2,400
September	322,000	12,800	542,600	21,700	166,900	6,400	68,900	2,700
October	431,000	16,000	505,900	18,800	176,600	6,600	93,400	3,500
November	427,000	16,400	444,700	17,100	166,300	6,700	87,100	3,500
December	408,000	16,300	371,100	14,800	169,900	6,500	72,600	2,800
	4,493,000	14,400	6,472,000	20,800	2,776,300	8,900	1,128,300	3,600
Total coke:								
January	4,291,000	140,800	4,870,500	159,600	4,485,100	146,200	3,227,100	104,700
February	4,131,000	144,700	4,558,500	165,600	4,256,200	153,700	3,033,300	109,200
March	4,533,000	148,500	5,181,600	170,700	4,650,100	151,800	3,378,400	109,800
April	4,321,000	146,600	4,954,900	167,700	4,516,400	152,100	3,233,100	108,300
May	4,495,000	146,800	5,301,500	174,100	4,504,900	146,600	3,199,200	103,700
June	4,281,000	144,200	5,152,400	176,100	4,187,300	141,300	2,784,200	93,200
July	4,200,000	137,600	5,254,000	173,500	3,959,800	129,100	2,628,100	85,200
August	4,301,000	140,100	5,241,800	172,000	3,779,400	123,000	2,497,000	81,000
September	4,289,000	145,100	4,950,300	168,600	3,543,000	119,000	2,372,000	79,500
October	4,660,000	152,400	5,110,500	167,300	3,584,400	116,500	2,475,200	80,300
November	4,569,000	154,500	4,761,100	161,000	3,280,300	110,500	2,356,500	79,100
December	4,735,000	155,900	4,546,700	149,500	3,225,100	105,100	2,299,800	74,600
	52,806,000	146,400	59,883,800	167,100	47,972,000	132,800	33,483,900	92,200

TABLE 5.—*Coke shipped from the Connellsville and Lower Connellsville districts, Pennsylvania, 1927-1931, by months, in net tons* [1]

Month	1927	1928	1929	1930	1931
January	570,720	221,200	292,842	124,552	88,110
February	552,150	222,550	270,314	132,627	84,620
March	630,990	299,400	338,624	130,354	70,820
April	579,330	261,000	324,140	137,546	41,773
May	468,340	218,060	457,792	130,987	35,937
June	401,310	185,570	440,028	127,252	33,760
July	302,280	130,380	450,395	95,807	33,487
August	306,000	137,560	419,595	82,847	32,056
September	273,290	145,660	337,974	78,431	32,227
October	222,280	260,470	281,206	80,304	43,870
November	187,320	269,010	207,520	67,061	44,413
December	187,690	254,090	160,330	70,082	35,890
	4,681,700	2,604,950	3,980,760	1,257,850	576,963

[1] From the Connellsville Courier. For 1929, 1930, and 1931, the weekly shipments as reported by the Courier have been prorated on a monthly basis by the Bureau of Mines.

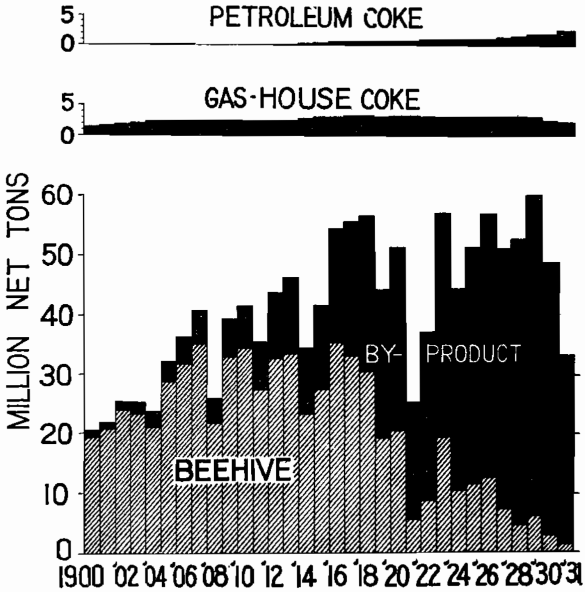

FIGURE 10.—Production of petroleum coke, gas-house coke, and beehive and by-product coke in the United States, 1900–1931. No figures on production of petroleum coke are available before 1914, in which year the production was 213,777 tons

TABLE 6.—*Beehive coke produced in the United States in 1931, by weeks*

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 1–3 [1]	15,800	May 16	19,300	Sept. 26	16,000
Jan. 10	29,800	May 23	18,000	Oct. 3	17,200
Jan. 17	29,800	May 30	16,500	Oct. 10	19,400
Jan. 24	31,800	June 6	17,700	Oct. 17	22,100
Jan. 31	36,500	June 13	17,800	Oct. 24	20,800
Feb. 7	36,900	June 20	19,200	Oct. 31	22,200
Feb. 14	36,700	June 27	17,000	Nov. 7	23,400
Feb. 21	38,300	July 4	14,100	Nov. 14	22,500
Feb. 28	32,100	July 11	17,200	Nov. 21	21,000
Mar. 7	34,000	July 18	14,500	Nov. 28	17,100
Mar. 14	32,200	July 25	14,300	Dec. 5	16,800
Mar. 21	30,700	Aug. 1	15,100	Dec. 12	19,300
Mar. 28	26,300	Aug. 8	14,000	Dec. 19	16,400
Apr. 4	25,700	Aug. 15	12,800	Dec. 26	14,000
Apr. 11	22,400	Aug. 22	14,400	Dec. 28–31 [2]	11,500
Apr. 18	21,500	Aug. 29	15,300		
Apr. 25	21,100	Sept. 5	16,000		1,128,300
May 2	20,600	Sept. 12	14,900		
May 9	22,300	Sept. 19	16,000		

[1] 3 days only. [2] 4 days only.

TABLE 7.—*By-product coke produced in the United States in 1931, by months and by States, in net tons*

[Based on reports from all producers]

State	January	February	March	April	May	June	July
Alabama	281,300	257,400	289,700	285,200	290,200	275,400	275,600
Colorado	30,600	27,100	31,100	19,200	26,400	19,000	20,500
Illinois	268,700	248,200	272,500	239,600	219,900	186,700	181,900
Indiana	278,600	266,000	320,100	319,400	301,000	242,100	197,000
Maryland	85,200	80,100	81,700	72,000	73,600	59,100	63,100
Massachusetts	110,200	89,700	96,700	92,600	96,100	91,400	93,200
Michigan	201,600	189,000	209,700	205,300	216,400	211,200	184,900
Minnesota	41,900	37,200	40,000	37,600	39,500	34,500	29,700
New Jersey	78,300	71,700	80,400	77,700	79,400	76,700	78,700
New York	292,700	291,400	318,900	297,200	302,200	267,900	288,100
Ohio	401,500	378,700	414,900	404,800	396,500	310,200	289,300
Pennsylvania	723,400	695,100	811,300	819,200	798,000	666,500	590,600
Tennessee	7,800	7,300	7,400	6,800	6,700	6,500	6,500
Utah	17,200	14,500	16,400	14,300	15,500	13,900	7,000
Washington	2,700	2,400	2,500	2,500	2,400	2,600	2,700
West Virginia	116,400	103,800	115,400	112,300	116,900	112,500	116,700
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	144,600	129,400	137,600	131,200	135,300	130,700	135,400
	3,082,700	2,889,000	3,246,300	3,136,900	3,116,000	2,706,900	2,560,900

State	August	September	October	November	December	Total
Alabama	226,800	199,500	196,300	188,100	177,700	2,943,200
Colorado	20,900	14,400	12,500	2,600	1,500	225,800
Illinois	175,800	173,300	178,200	163,500	170,700	2,479,000
Indiana	178,900	170,500	158,600	156,500	168,400	2,757,100
Maryland	62,500	56,100	60,800	69,000	54,800	818,000
Massachusetts	83,100	86,300	108,400	98,700	103,900	1,150,300
Michigan	239,900	191,000	201,600	193,000	193,000	2,436,600
Minnesota	33,800	37,200	37,500	35,000	36,600	440,500
New Jersey	78,400	76,700	79,000	75,900	78,000	930,900
New York	303,100	300,400	319,500	297,600	299,300	3,578,300
Ohio	269,900	268,900	273,600	271,200	253,400	3,932,900
Pennsylvania	505,200	483,700	500,900	478,600	452,200	7,524,700
Tennessee	6,000	5,900	6,200	9,600	6,700	83,400
Utah	5,600	10,100	10,700	10,400	11,200	146,800
Washington	2,500	2,600	2,200	2,500	2,500	30,100
West Virginia	109,700	91,800	95,600	85,500	88,400	1,265,000
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	133,300	134,700	140,200	131,700	128,900	1,613,000
	2,435,400	2,303,100	2,381,800	2,269,400	2,227,200	32,355,600

PRODUCTION BY FURNACE AND NONFURNACE PLANTS

TABLE 8.—*Number and production of by-product coke plants connected with iron furnaces and of other by-product plants, 1913, 1918, and 1929–1931*

Year	Number of active plants		Coke produced (net tons)		Percentage of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
1913	20	16	9,277,832	3,436,868	73.0	27.0
1918	36	24	19,220,342	6,777,238	73.9	26.1
1929	46	41	41,224,387	12,187,439	77.2	22.8
1930	46	43	33,206,054	11,989,651	73.5	26.5
1931	46	42	20,817,240	11,538,309	64.3	35.7

TABLE 9.—*Monthly and average daily production of by-product coke by plants associated with iron furnaces and by all other plants, 1929–1931, in net tons*

	1929		1930		1931	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	3, 375, 600	979, 400	3, 102, 500	1, 064, 600	2, 052, 400	1, 030, 300
February	3, 156, 800	928, 000	3, 008, 200	969, 000	1, 956, 300	932, 700
March	3, 586, 900	1, 020, 700	3, 317, 000	1, 044, 400	2, 234, 700	1, 011, 600
April	3, 458, 600	993, 100	3, 205, 900	1, 010, 900	2, 188, 200	948, 700
May	3, 630, 100	1, 028, 600	3, 197, 500	1, 037, 300	2, 158, 300	957, 700
June	3, 497, 400	1, 006, 800	2, 955, 500	972, 000	1, 776, 100	930, 800
July	3, 592, 900	1, 015, 300	2, 759, 000	987, 700	1, 615, 500	945, 400
August	3, 602, 000	1, 035, 300	2, 620, 300	990, 800	1, 445, 800	989, 600
September	3, 386, 700	1, 021, 000	2, 432, 400	943, 700	1, 369, 800	933, 300
October	3, 536, 500	1, 068, 100	2, 439, 900	967, 900	1, 393, 300	988, 500
November	3, 293, 100	1, 023, 300	2, 136, 500	977, 500	1, 338, 700	930, 700
December	3, 107, 800	1, 067, 800	2, 031, 400	1, 023, 800	1, 288, 200	939, 000
	41, 224, 400	12, 187, 400	33, 206, 100	11, 989, 600	20, 817, 300	11, 538, 300
Average daily production:						
January	108, 900	31, 600	100, 100	34, 300	66, 200	33, 200
February	112, 800	33, 100	107, 400	34, 600	69, 900	33, 300
March	115, 700	32, 900	107, 000	33, 700	72, 100	32, 600
April	115, 300	33, 100	106, 900	33, 700	72, 900	31, 600
May	117, 100	33, 200	103, 100	33, 500	69, 600	30, 900
June	116, 600	33, 500	98, 500	32, 400	59, 200	31, 000
July	115, 900	32, 800	89, 000	31, 900	52, 100	30, 500
August	116, 200	33, 400	84, 500	32, 000	46, 600	31, 900
September	112, 900	34, 000	81, 100	31, 500	45, 700	31, 100
October	114, 100	34, 400	78, 700	31, 200	44, 900	31, 900
November	109, 800	34, 100	71, 200	32, 600	44, 600	31, 000
December	100, 300	34, 400	65, 500	33, 000	41, 600	30, 300
Average	112, 900	33, 400	91, 000	32, 800	57, 000	31, 600

PRODUCTION BY STATES AND DISTRICTS

TABLE 10.—*By-product and beehive coke produced, by States, 1918 and 1928–1931, in net tons*

State	1918	1928	1929	1930	1931
By-product:					
Alabama	2, 634, 451	4, 327, 324	4, 753, 967	3, 986, 920	2, 943, 143
Colorado	230, 663	605, 822	565, 031	379, 070	225, 760
Connecticut		(1)	(1)	(1)	(1)
Illinois	2, 285, 610	3, 240, 964	4, 204, 116	3, 576, 577	2, 478, 984
Indiana	3, 898, 215	6, 094, 201	6, 455, 378	4, 984, 620	2, 757, 135
Kentucky	517, 749	(1)	(1)	(1)	(1)
Maryland	474, 368	1, 186, 398	1, 393, 052	1, 169, 016	817, 995
Massachusetts	556, 397	687, 356	776, 679	862, 663	1, 150, 270
Michigan	(1)	2, 399, 656	2, 679, 971	2, 603, 815	2, 436, 630
Minnesota	784, 065	622, 696	746, 004	641, 205	440, 489
Missouri	(1)	(1)	(1)	(1)	(1)
New Jersey	682, 148	903, 177	897, 530	918, 814	930, 912
New York	1, 069, 587	3, 802, 657	4, 299, 470	3, 849, 563	3, 578, 311
Ohio	5, 226, 334	7, 786, 199	8, 521, 132	6, 163, 324	3, 932, 939
Pennsylvania	4, 586, 981	13, 475, 349	14, 489, 283	12, 529, 255	7, 524, 722
Rhode Island		(1)	(1)	(1)	(1)
Tennessee	124, 469	113, 134	113, 285	100, 439	83, 439
Utah		246, 503	267, 939	225, 361	146, 788
Washington	30, 129	40, 755	40, 879	36, 221	30, 104
West Virginia	603, 393	1, 367, 481	1, 431, 314	1, 479, 431	1, 265, 039
Wisconsin	(1)	(1)	(1)	(1)	(1)
Combined States	2, 293, 021	1, 413, 353	1, 776, 796	1, 689, 411	1, 612, 889
	25, 997, 580	48, 313, 025	53, 411, 826	45, 195, 705	32, 355, 549

[1] Included under "Combined States."

TABLE 10.—*By-product and beehive coke produced, by States, 1918 and 1928–1931, in net tons*—Continued

State	1918	1928	1929	1930	1931
Beehive:					
Alabama	1,717,721				
Colorado	758,784	144,200	156,426	79,373	(1)
Georgia	22,048	(1)			
Kentucky	301,036	(1)			
New Mexico	597,072				
Ohio	138,909	(1)	(2)		
Oklahoma	(1)				
Pennsylvania	22,136,664	3,442,006	[2] 5,367,685	2,011,324	855,527
Tennessee	302,637	103,791	95,881	25,473	17,074
Utah	(1)	28,097	14,055	6,508	(1)
Virginia	1,234,256	247,734	314,859	219,656	99,305
Washington	93,659	18,747	25,844	12,252	582
West Virginia	2,716,613	431,419	497,269	421,730	113,627
Combined States	461,393	76,809			42,222
	30,480,792	4,492,803	6,472,019	2,776,316	1,128,337
Grand total	56,478,372	52,805,828	59,883,845	47,972,021	33,483,886

[1] Included under "Combined States."
[2] A small amount of beehive coke produced in Ohio is included with Pennsylvania.

TABLE 11.—*By-product and beehive coke produced in Pennsylvania in 1931, by districts*

[The figures of number of plants and ovens include those that were idle during the year]

District	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
By-product:								
Eastern Pennsylvania [1]	6	864		2,425,858	69.96	1,697,153	$10,028,892	$5.91
Western Pennsylvania [2]	7	2,614		8,824,632	66.04	5,827,569	20,010,178	3.43
	13	3,478		11,250,490	66.88	7,524,722	30,039,070	3.99
Beehive:								
Allegheny Mountain and Allegheny Valley	3	454		42,400	64.73	27,447	117,613	4.29
Connellsville	35	6,764		252,665	67.04	169,378	502,157	2.96
Lower Connellsville	24	5,176		682,913	65.58	447,883	1,064,163	2.38
Upper Connellsville	7	974		219,365	63.00	138,200	442,386	3.20
Pittsburgh [3] and other districts [4]	9	1,998		112,586	64.50	72,619	292,795	4.03
	78	15,366		1,309,929	65.31	855,527	2,419,114	2.83
Grand total	91	18,844		12,560,419	66.72	8,380,249	32,458,184	3.87

[1] Includes plants at Bethlehem, Chester, Lebanon, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[3] There was no production in the Pittsburgh district during 1931.
[4] Includes Bedford, Huntingdon, and parts of Indiana and Westmoreland Counties.

TABLE 12.—*By-product coke produced in Ohio in 1931, by districts*

District	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
Canton, Cleveland, and Massillon	5	595		1,614,998	67.60	1,091,741	$4,917,720	$4.50
Youngstown	3	594		1,658,072	65.64	1,088,424	4,630,090	4.25
Other districts [1]	7	647		2,515,096	69.69	1,752,774	8,040,771	4.59
Total	15	1,836		5,788,166	67.95	3,932,939	17,588,581	4.47

[1] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

TABLE 13.—*Coke ovens completed and abandoned in 1931, and total number in existence at end of year, by States*

State	Plants in existence Dec. 31	Ovens [1]				
		New [2]		Abandoned during year	In existence Dec. 31	
		Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)
By-product:						
Alabama	8				1,388	16,160
Colorado	1				151	2,233
Connecticut	1				61	(3)
Illinois	8	[4] 45	650		950	13,057
Indiana	6	[4] 138	2,400		1,550	21,840
Kentucky	1				108	(3)
Maryland	1				361	5,128
Massachusetts	3				430	4,483
Michigan	7				587	7,647
Minnesota	3				196	2,597
Missouri	1				64	(3)
New Jersey	2				202	2,485
New York	9	[5] 68	1,103		1,024	15,126
Ohio	15	25	350		1,836	24,919
Pennsylvania	13				3,478	46,067
Rhode Island	1				65	(3)
Tennessee	1				24	360
Utah	1				56	1,015
Washington	1				20	120
West Virginia	4				362	5,071
Wisconsin	2				195	(3)
Undistributed						5,640
Total	89	[6] 276	4,503		13,108	173,948
At merchant plants	42	93	1,453		3,522	42,916
At furnace plants	47	183	3,050		9,586	131,032
Beehive:						
Colorado	2				378	(7)
Ohio				202		(7)
Oklahoma	1				100	(7)
Pennsylvania	78			2,117	15,366	(7)
Tennessee	4				723	(7)
Utah	1				819	(7)
Virginia	8				1,642	(7)
Washington	1				80	(7)
West Virginia	18			38	2,480	(7)
Total	113			2,357	21,588	(7)

[1] There were no new ovens under construction at the end of 1931.
[2] Represents new construction. Does not include ovens repaired and put into commission.
[3] Included under "Undistributed."
[4] Completed but not put into operation.
[5] Includes 37 ovens completed but not put into operation.
[6] Includes 220 ovens completed but not put into operation.
[7] Data not available.

TABLE 14.—*By-product ovens of each type at the end of the year, by States, in 1931*

State	Koppers [1]	Semet-Solvay	Wilputte	United Otto [2]	Cambria-Belgian	Roberts [3]	American Foundation	Klönne	Piette	Total
Alabama	908	420	60							1,388
Colorado	151									151
Connecticut	61									61
Illinois	662	120	88			80				950
Indiana	1,269	161	120							1,550
Kentucky		108								108
Maryland	361									361
Massachusetts	175		55	200						430
Michigan	131	336	120							587
Minnesota	196									196
Missouri	56								8	64
New Jersey	202									202
New York	743	226					55			1,024
Ohio	1,543	293								1,836
Pennsylvania	3,018	218	97		120	25				3,478
Rhode Island	65									65
Tennessee		24								24
Utah	56									56
Washington								20		20
West Virginia	316		46							362
Wisconsin	115	80								195
Total	10,028	1,986	586	200	120	105	55	20	8	13,108
At merchant plants	1,913	1,080	221	200		25	55	20	8	3,522
At furnace plants	8,115	906	365		120	80				9,586

[1] Includes the Koppers-Becker type.
[2] Includes the Otto-Hoffman type.
[3] Includes the Roberts-Morrissey type.

CAPACITY OF BY-PRODUCT OVENS

TABLE 15.—*Estimated annual potential production of coke and coal required for charge of by-product coke ovens in the United States, 1929–1931, when operated at different percentages of maximum capacity, in millions of net tons*

Percentage of maximum capacity	1929				1930				1931	
	Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31 [1]	
	Coke	Coal [2]	Coke	Coal [2]	Coke	Coal [2]	Coke	Coal [2]	Coke	Coal [2]
100	60.2	86.0	62.6	89.4	61.5	87.9	63.1	90.1	63.5	90.7
90	54.2	77.4	56.3	80.5	55.4	79.1	56.8	81.1	57.2	81.6
85	51.2	73.1	53.2	76.0	52.3	74.7	53.6	76.6	54.0	77.1
75	45.2	64.5	47.0	67.1	46.1	65.9	47.3	67.6	47.6	68.0
50	30.1	43.0	31.3	44.7	30.8	44.0	31.6	45.1	31.8	45.4

[1] No ovens under construction at end of 1931.
[2] Coal for charge estimated on basis of 70 per cent yield in coke.

TABLE 16.—*Relation (per cent) of production to maximum capacity at by-product coke plants, 1926–1931, by months*

	1926	1927	1928	1929	1930	1931		1926	1927	1928	1929	1930	1931
January	94.6	84.5	80.4	88.6	82.8	59.2	August	88.3	79.8	82.8	93.6	69.2	46.8
February	96.4	85.4	82.2	91.3	87.5	61.5	September	88.7	80.8	84.3	91.9	66.7	45.7
March	93.8	87.2	83.2	93.0	86.6	62.4	October	88.5	76.4	86.3	92.3	64.9	45.8
April	89.5	84.8	82.6	92.8	85.7	62.3	November	88.9	74.2	86.8	89.0	60.5	45.0
May	89.0	83.9	83.5	94.0	82.7	59.9	December	84.7	74.6	87.8	83.1	57.5	42.7
June	88.4	82.3	83.2	93.9	79.2	53.7							
July	89.3	79.3	81.0	93.0	72.3	49.2	The year	89.9	80.9	83.7	91.4	73.5	52.8

QUANTITY AND COST OF COAL CHARGED

TABLE 17.—*Coal consumed in coke ovens, 1929–1931, by months, in net tons*

[For figures 1912 to 1928, inclusive, see Coke and By-Products in 1928, pp. 731–733]

Month	1929			1930			1931		
	By-product	Beehive	Total	By-product	Beehive	Total	By-product	Beehive	Total
January	6, 250, 200	798, 600	7, 048, 800	6, 043, 800	490, 700	6, 534, 500	4, 457, 400	226, 500	4, 683, 900
February	5, 870, 200	734, 300	6, 604, 500	5, 760, 600	430, 600	6, 191, 200	4, 179, 700	226, 200	4, 405, 900
March	6, 621, 200	889, 800	7, 511, 000	6, 323, 100	445, 500	6, 768, 600	4, 692, 700	207, 000	4, 899, 700
April	6, 395, 400	779, 300	7, 174, 700	6, 112, 400	462, 400	6, 574, 800	4, 529, 400	150, 500	4, 679, 900
May	6, 693, 900	995, 900	7, 689, 800	6, 134, 000	416, 800	6, 550, 800	4, 496, 600	130, 100	4, 626, 700
June	6, 471, 000	1, 004, 500	7, 475, 500	5, 689, 000	400, 900	6, 089, 900	3, 904, 800	120, 900	4, 025, 700
July	6, 620, 300	1, 000, 200	7, 620, 500	5, 433, 700	328, 800	5, 762, 500	3, 688, 500	105, 200	3, 793, 700
August	6, 662, 000	936, 900	7, 598, 900	5, 241, 400	259, 700	5, 501, 100	3, 536, 100	96, 200	3, 632, 300
September	6, 335, 700	840, 500	7, 176, 200	4, 902, 400	257, 500	5, 159, 900	3, 349, 900	107, 800	3, 457, 700
October	6, 623, 200	783, 600	7, 406, 800	4, 942, 400	272, 500	5, 214, 900	3, 468, 300	146, 300	3, 614, 600
November	6, 208, 400	689, 300	6, 897, 700	4, 513, 200	256, 700	4, 769, 900	3, 303, 900	136, 400	3, 440, 300
December	6, 007, 500	574, 600	6, 582, 100	4, 425, 300	262, 100	4, 687, 400	3, 239, 000	113, 700	3, 352, 700
	76, 759, 000	10, 027, 500	86, 786, 500	65, 521, 300	4, 284, 200	69, 805, 500	46, 846, 300	1, 766, 800	48, 613, 100

TABLE 18.—*Total quantity and value at ovens of coal used in the manufacture of coke, by States, in 1931*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
By-product plants:					
Alabama	4, 171, 455	$9, 132, 527	$2. 19	1. 42	$3. 11
Colorado	328, 869	(1)	(1)	1. 46	------
Illinois	3, 644, 269	15, 789, 478	4. 33	1. 47	6. 37
Indiana	3, 889, 127	17, 188, 053	4. 42	1. 41	6. 23
Maryland	1, 108, 751	(1)	(1)	1. 36	------
Massachusetts	1, 603, 177	7, 459, 349	4. 65	1. 39	6. 46
Michigan	3, 453, 963	14, 573, 187	4. 22	1. 42	5. 99
Minnesota	652, 171	3, 386, 477	5. 19	1. 48	7. 68
New Jersey	1, 314, 883	(1)	(1)	1. 41	------
New York	5, 135, 778	21, 898, 283	4. 26	1. 44	6. 13
Ohio	5, 788, 166	19, 672, 026	3. 40	1. 47	5. 00
Pennsylvania	11, 250, 490	31, 168, 739	2. 77	1. 50	4. 16
Tennessee	115, 270	342, 864	2. 97	1. 38	4. 10
Utah	270, 172	(1)	(1)	1. 84	------
Washington	55, 736	285, 356	5. 12	1. 85	9. 47
West Virginia	1, 821, 755	3, 608, 422	1. 98	1. 44	2. 85
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2, 242, 245	9, 283, 915	4. 14	1. 39	5. 75
Undistributed	------------	12, 372, 856	4. 09	-------	------
Total	46, 846, 277	166, 161, 532	3. 55	1. 45	5. 15
At merchant plants	16, 306, 278	69, 473, 738	4. 26	1. 41	6. 01
At furnace plants	30, 539, 999	96, 687, 794	3. 17	1. 47	4. 66
Beehive plants:					
Pennsylvania	1, 309, 929	1, 988, 421	1. 52	1. 53	2. 33
Tennessee	33, 923	39, 611	1. 17	1. 99	2. 33
Virginia	164, 621	259, 513	1. 58	1. 66	2. 62
Washington	957	4, 182	4. 37	1. 64	7. 17
West Virginia	190, 767	281, 029	1. 47	1. 68	2. 47
Colorado and Utah	66, 586	185, 442	2. 78	1. 58	4. 39
	1, 766, 783	2, 758, 198	1. 56	1. 57	2. 45

[1] Included under "Undistributed."

TABLE 19.—*Average cost per net ton of coal charged into by-product coke ovens, by States, 1927–1931*

State	1927	1928	1929	1930	1931
Alabama	$2.64	$2.62	$2.49	$2.39	$2.19
Illinois	4.67	4.30	4.29	4.32	4.33
Indiana	5.05	4.75	4.61	4.52	4.42
Kentucky	(1)	(1)	(1)	(1)	(1)
Massachusetts	4.92	4.86	4.70	4.61	4.65
Michigan	4.70	4.37	4.29	3.96	4.22
Minnesota	5.48	5.31	5.04	4.97	5.19
New York	4.71	4.33	4.22	4.18	4.26
Ohio	3.88	3.43	3.31	3.48	3.40
Pennsylvania	$2.95	$2.77	$2.73	$2.69	$2.77
Tennessee	3.31	3.12	3.02	3.02	2.97
Washington	5.21	5.28	5.26	5.21	5.12
West Virginia	2.84	2.57	2.41	2.18	1.98
Average	3.87	3.57	3.50	3.48	3.55
Cost of coal per ton of coke	5.57	5.18	5.04	5.05	5.15

[1] Not at liberty to publish.

PREPARATION AND SOURCE OF COAL CHARGED

TABLE 20.—*Washed and unwashed coal used in the manufacture of by-product and beehive coke, by States in which used, in 1931, in net tons*

State	Washed	Unwashed	Total
By-product ovens:			
Alabama	[1] 4,171,455	(1)	4,171,455
Colorado		328,869	328,869
Illinois	(2)	[2] 3,644,269	3,644,269
Indiana	(2)	[2] 3,889,127	3,889,127
Maryland		1,108,751	1,108,751
Massachusetts	55,486	1,547,691	1,603,177
Michigan		3,453,963	3,453,963
Minnesota		652,171	652,171
New Jersey		1,314,883	1,314,883
New York	825,627	4,310,151	5,135,778
Ohio	671,560	5,116,606	5,788,166
Pennsylvania	2,189,505	9,060,985	11,250,490
Tennessee	115,270		115,270
Utah		270,172	270,172
Washington	55,736		55,736
West Virginia		1,821,755	1,821,755
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin		2,242,245	2,242,245
Total	[1 2] 8,084,639	[1 2] 38,761,638	46,846,277
At merchant plants	1,352,920	15,282,227	16,635,147
At furnace plants	6,900,447	23,310,683	30,211,130
Beehive ovens:			
Colorado	59,151		59,151
Pennsylvania	242,352	1,067,577	1,309,929
Tennessee	33,923		33,923
Utah		7,435	7,435
Virginia		164,621	164,621
Washington	957		957
West Virginia	49,811	140,956	190,767
	386,194	1,380,589	1,766,783

[1] A small amount of unwashed coal, which can not be shown separately, is included with the washed.
[2] A small amount of washed coal, which can not be shown separately, is included with the unwashed.

TABLE 21.—*Coal used in the manufacture of by-product coke in 1931, by fields of origin, in net tons*

[Based upon detailed reports from each coke plant. The difference between these totals and those shown in Tables 3, 17, etc., is due to change in stock, loss of weight in handling, and the fact that these sometimes represent purchases during the year rather than actual consumption]

State and district where coal was produced	Total used	States where coal was consumed—in order of importance
Alabama	4,306,610	Alabama.
Colorado:		
Trinidad	331,013	Colorado.
Pitkin County	9,480	Utah.
Canon, Crested Butte, and Walsen districts.	40,161	Colorado.
Illinois: Southern	434,708	Illinois.
Kentucky:		
Eastern Kentucky—		
Elkhorn	1,557,183	New York, Ohio, Indiana, Illinois, Missouri, Kentucky, Minnesota, Michigan, Massachusetts.
Harlan	1,854,317	Indiana, Illinois, Minnesota, Ohio.
Kenova-Thacker	476,165	Indiana, Wisconsin.
Pond Creek	1,291,592	Michigan, Ohio.
Pennsylvania:		
Central Pennsylvania, high volatile	19,778	Massachusetts.
Central Pennsylvania, low volatile	568,408	Pennsylvania, New York.
Connellsville	9,764,894	Pennsylvania, Ohio, West Virginia, Michigan, Illinois, New York, Minnesota.
Freeport	983,505	West Virginia, Ohio, New York, Massachusetts.
Pittsburgh	6,672,770	Pennsylvania, New York, Ohio, Michigan, Massachusetts, Minnesota, Wisconsin, Illinois, New Jersey.
Somerset	274,694	Ohio, Pennsylvania, West Virginia, New York.
Westmoreland	650,561	Maryland, New York.
Tennessee	102,690	Tennessee.
Utah: Carbon County	260,692	Utah.
Virginia: Wise, Lee, and Dickenson Counties.[1]	868,887	New York, New Jersey, Missouri, Massachusetts.
Washington: Pierce County	55,736	Washington.
West Virginia:		
Northern	1,958,962	Ohio, Maryland, Pennsylvania, West Virginia, New Jersey, Massachusetts.
Kanawha and Logan	6,586,007	Massachusetts, Illinois, Indiana, Ohio, Pennsylvania, Michigan, New York, New Jersey, Wisconsin, Connecticut, Rhode Island, West Virginia, Kentucky, Minnesota, Missouri.
New River and Winding Gulf	1,958,977	New York, New Jersey, Massachusetts, Illinois, Pennsylvania, Missouri, Connecticut, Rhode Island, Ohio.
Pocahontas [1]	5,839,103	Indiana, Ohio, Michigan, New York, Illinois, Pennsylvania, Maryland, West Virginia, Minnesota, Wisconsin, Kentucky, Connecticut, Alabama, Tennessee.
Miscellaneous	6,333	Tennessee, Missouri.
	46,873,226	

[1] Coal from the extension of the Pocahontas field in Tazewell County, Va., is included under West Virginia (Pocahontas).

TABLE 22.—*Source of coal used in the manufacture of by-product coke in 1931, by States where consumed, separating merchant and furnace plants*

State where coal was used	Coal produced in—				
	Alabama	Colorado	Illinois	Kentucky	Pennsylvania
Alabama:					
Merchant plants	746,022				
Furnace plants	3,560,588				
Total	4,306,610				
Colorado: Furnace plants		371,174			
Illinois:					
Merchant plants				306,303	(1)
Furnace plants			434,708	691,023	355,510
Total			434,708	997,326	[2] 355,510
Indiana: Furnace plants				1,542,452	
Maryland: Furnace plants					342,470
Massachusetts: Merchant plants				4,771	233,977
Michigan:					
Merchant plants				(1)	(1)
Furnace plants				(1)	
Total				(1)	(1)
Minnesota:					
Merchant plants				83,032	157,316
Furnace plants				(1)	75,815
Total				[2] 83,032	233,131
New Jersey: Merchant plants					21,939
New York:					
Merchant plants				(1)	1,532,128
Furnace plants					1,179,075
Total				(1)	2,711,203
Ohio:					
Merchant plants				(1)	
Furnace plants				308,725	3,146,349
Total				[2] 308,725	3,146,349
Pennsylvania:					
Merchant plants					150,312
Furnace plants					9,513,835
Total					9,664,147
Utah: Furnace plants		9,480			
West Virginia: Furnace plants					1,254,576
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants				464,238	(1)
Undistributed:					
Merchant plants				487,300	971,308
Furnace plants				1,291,413	
Total				1,778,713	971,308
Grand total	4,306,610	380,654	434,708	5,179,257	18,934,610
Merchant plants	746,022			1,345,644	3,066,980
Furnace plants	3,560,588	380,654	434,708	3,833,613	15,867,630

[1] Included under "Undistributed." [2] Excluded items included under "Undistributed."

TABLE 22.—*Source of coal used in the manufacture of by-product coke in 1931, by States where consumed, separating merchant and furnace plants*—Continued

State where coal was used	Coal produced in—Continued: Tennessee	Utah	Virginia	Washington	West Virginia	Total
Alabama:						
Merchant plants					55,086	801,108
Furnace plants						3,560,588
Total					55,086	4,361,696
Colorado: Furnace plants						371,174
Illinois:						
Merchant plants					1,399,541	[2] 1,705,844
Furnace plants					345,809	1,827,050
Total					1,745,350	[2] 3,532,894
Indiana:						
Merchant plants					717,236	717,236
Furnace plants					1,631,438	3,173,890
Total					2,348,674	3,891,126
Maryland: Furnace plants					766,281	1,108,751
Massachusetts: Merchant plants			2,803		1,360,061	1,601,612
Michigan:						
Merchant plants					939,182	[2] 939,182
Furnace plants					(1)	(1)
Total					[2] 939,182	[2] 939,182
Minnesota:						
Merchant plants					182,669	423,017
Furnace plants					60,413	[3] 136,228
Total					243,082	[3] 559,245
New Jersey: Merchant plants			345,410		933,789	1,301,138
New York:						
Merchant plants			512,401		1,043,353	[3] 3,087,882
Furnace plants					460,427	1,639,502
Total			512,401		1,503,780	[3] 4,727,384
Ohio:						
Merchant plants					429,357	[2] 429,357
Furnace plants					1,835,156	5,290,230
Total					2,264,513	[2] 5,719,587
Pennsylvania:						
Merchant plants					712,943	863,255
Furnace plants					894,942	10,408,777
Total					1,607,885	11,272,032
Tennessee: Merchant plants	102,690				18,619	[3] 127,331
Utah: Furnace plants		260,692				270,172
Washington: Merchant plants				55,736		55,736
West Virginia:						
Merchant plants					445,694	445,694
Furnace plants					119,857	1,374,433
Total					565,551	1,820,127
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants			(1)		1,664,437	[2] [3] 2,128,986

[1] Included under "Undistributed."
[2] Excludes items included under "Undistributed."
[3] Includes a small quantity of miscellaneous coal.

TABLE 22.—*Source of coal used in the manufacture of by-product coke in 1931, by States where consumed, separating merchant and furnace plants*—Continued

State where coal was used	Coal produced in—Continued					Total
	Tennessee	Utah	Virginia	Washington	West Virginia	
Undistributed:						
Merchant plants			8,273			1,466,881
Furnace plants					326,759	1,618,172
Total			8,273		326,759	3,085,053
Grand total	102,690	260,692	868,887	55,736	16,343,049	[3] 46,873,226
Merchant plants	102,690		868,887	55,736	9,901,967	[3] 16,094,259
Furnace plants		260,692			6,441,082	30,778,967

[3] Includes a small quantity of miscellaneous coal.

YIELD OF COKE PER TON OF COAL

TABLE 23.—*Percentage yield of coke from coal in by-product and beehive ovens, by States, 1928–1931*

State	1928		1929		1930		1931	
	By-product	Beehive	By-product	Beehive	By-product	Beehive	By-product	Beehive
Alabama	69.6		70.9		70.93		70.55	
Colorado	68.0	65.4	68.0	65.7	68.59	64.98	68.65	(1)
Georgia		(1)						
Illinois	68.8		70.3		69.52		68.02	
Indiana	74.3		73.8		72.24		70.89	
Kentucky	(1)	(1)	(1)		(1)		(1)	
Maryland	72.5		72.8		71.77		73.78	
Massachusetts	66.4		69.0		69.90		71.73	
Michigan	70.6		71.3		70.55		70.55	
Minnesota	69.2		70.2		68.38		67.54	
New Jersey	72.1		71.9		71.95		70.80	
New York	69.1		69.5		69.16		69.67	
Ohio	67.9	(1)	69.2	(2)	67.71		67.95	
Pennsylvania	66.3	65.4	66.9	[2] 65.5	66.73	66.63	66.88	65.31
Tennessee	74.7	59.8	70.4	56.6	72.94	53.66	72.38	50.33
Utah	55.0	57.7	54.2	60.2	54.39	58.66	54.33	(1)
Virginia		58.9		59.7		60.86		60.32
Washington	63.2	63.9	62.1	74.1	60.53	76.92	54.01	60.82
West Virginia	69.5	58.8	69.6	59.3	69.73	59.56	69.44	59.56
Average	68.9	64.0	69.6	64.5	68.98	64.80	69.07	63.86

[1] Not at liberty to publish data.
[2] Ohio included with Pennsylvania.

COKE BREEZE

TABLE 24.—*Coke breeze recovered at coke plants, by States, in 1931*

State	Yield per ton of coal (per cent)	Produced		Used by producer				Sold		On hand Dec. 31 (net tons)	Wasted (net tons)
				For steam raising		For other purposes					
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
By-product ovens:											
Alabama	3.74	156,015	$185,529	129,165	$146,382	7,079	$11,451	48,864	$47,849	37,672	12,755
Colorado	4.96	16,312	(1)	15,436	(1)					1,105	
Illinois	6.82	248,650	669,984	211,072	536,907	31,768	81,544	63,546	188,607	59,897	
Indiana	5.72	222,416	566,011	170,006	397,324	22,615	47,858	37,690	133,154	7,455	
Maryland	6.55	72,591	(1)	36,656	(1)	11,991	(1)	25,545	(1)	20,996	
Massachusetts	7.52	120,525	350,714	6,289	21,633	7,630	22,539	105,413	303,592	27,954	
Michigan	6.19	213,696	558,715	143,999	398,605	985	2,736	33,324	67,479	42,898	
Minnesota	8.77	57,188	182,436	33,353	82,837	(1)	(1)	25,905	116,723	15,759	
New Jersey	5.01	65,909	(1)	44,385	(1)			32,995	(1)	1,245	
New York	5.33	273,961	722,507	172,971	431,065	58,514	193,983	35,929	75,285	37,352	
Ohio	7.03	407,165	783,080	294,964	513,840	46,645	120,149	62,936	144,160	70,090	409
Pennsylvania	8.69	977,669	1,507,083	780,988	1,125,094	103,875	217,767	97,974	214,700	31,304	2,495
Tennessee	3.15	3,630	5,336	5,504	8,090					5,469	
Utah	9.67	26,121	(1)			3,613	(1)	25,934	(1)	50,343	
Washington	10.99	6,124	42,868	6,124	42,868						
West Virginia	3.90	70,994	71,798	71,675	71,690	(1)	(1)	4,599	3,390	1,800	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	8.35	187,319	589,498	124,651	297,750	25,898	180,849	42,193	113,169	17,034	
Undistributed			402,417		198,450	6,453	38,897		215,755		
Total	6.67	3,126,285	6,637,976	2,247,238	4,272,535	327,066	917,773	642,847	1,623,863	428,373	15,659
From merchant ovens	6.46	1,053,859	2,793,474	644,893	1,625,895	108,581	421,775	332,107	795,702	194,669	
From furnace ovens	6.79	2,072,426	3,844,502	1,602,345	2,646,640	218,485	495,998	310,740	828,161	233,704	15,659
Beehive ovens:											
Colorado and Utah	[2] 3.42	2,277	3,341	1,007	2,388			1,270	953		
Pennsylvania	[2] 5.31	41,108	64,199	37,664	7,591			16,408	23,114	320	34,095
Tennessee, Virginia, and West Virginia	[2] 3.25	6,047	6,269	2,172	217	417	1,393	3,351	4,159	20	107
Total	[2] 4.81	49,432	73,809	40,843	10,196	417	1,393	21,029	28,226	340	[3] 34,202

[1] Included under "Undistributed."
[2] Yield computed by dividing the production of the breeze at the few plants reporting by the quantity of coal charged at these plants.
[3] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources, 1922, Pt. II, pp. 726–727.

CONSUMPTION OF COKE

TABLE 25.—*Quantity of coke consumed in the manufacture of pig iron and for other purposes, 1913, 1918, and 1929–1931, in net tons*

Year	Total production of coke	Imports	Exports	Net changes in stocks	Indicated United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Per cent	Quantity	Per cent
1913	46, 299, 530	101, 212	987, 395	(3)	45, 413, 347	37, 192, 287	81. 9	8, 221, 060	18. 1
1918	56, 478, 372	30, 168	1, 687, 824	(3)	54, 820, 716	45, 703, 594	83. 4	9, 117, 122	16. 6
1929	59, 883, 845	119, 724	1, 238, 035	+412, 999	58, 352, 535	43, 601, 743	74. 7	14, 750, 792	25. 3
1930	47, 972, 021	132, 674	1, 003, 866	+1, 036, 959	46, 063, 870	32, 130, 070	69. 8	13, 933, 800	30. 2
1931	33, 483, 886	103, 563	754, 302	+1, 127, 825	31, 705, 322	18, 352, 522	57. 9	13, 352, 800	42. 1

[1] Production plus imports minus exports, plus or minus the decrease or increase, respectively, of the net changes in stocks.
[2] From Annual Report of American Iron and Steel Institute. Figures include coke consumed in the manufacture of ferro-alloys.
[3] Data not available.

TABLE 26.—*Pounds of coke and of coking coal consumed per gross ton of pig iron made in the United States, 1913, 1918, and 1929–1931*

Year	Pounds of coke per gross ton of pig iron and ferro-alloys [1]	Per cent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys	Year	Pounds of coke per gross ton of pig iron and ferro-alloys [1]	Per cent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys
1913	2, 433. 3	66. 9	3, 637. 2	1930	2, 046. 8	68. 7	2, 978. 5
1918	2, 375. 2	66. 4	3, 577. 1	1931	2, 015. 1	68. 9	2, 923. 2
1929	2, 058. 6	69. 0	2, 983. 5				

[1] From Annual Statistical Report of American Iron and Steel Institute, 1931, p. 17. Beginning in 1926 the institute began to show the consumption per ton of pig iron only, excluding the furnaces making ferro-alloys. The results were 2,060.9 pounds in 1926; 2,094.1 in 1927; 2,059.3 in 1928; 2,030.9 in 1929; 2,015.8 in 1930; and 1,981.0 in 1931.

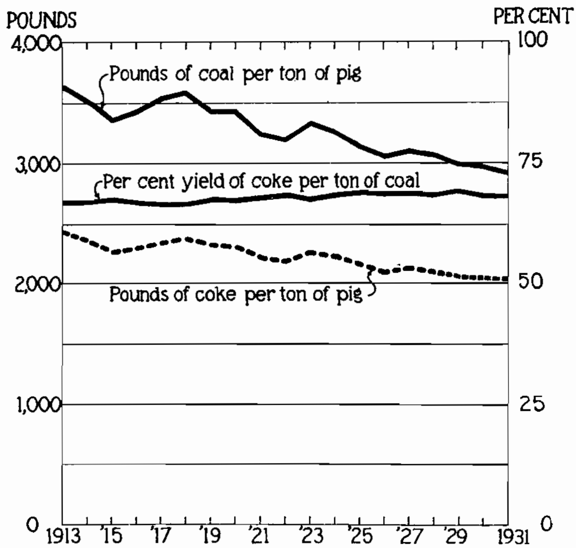

FIGURE 11.—Declining consumption of blast-furnace coke per gross ton of pig iron, 1913–1931. The quantity of coke consumed per ton of pig iron has been declining. At the same time the yield of coke per ton of coal carbonized has increased slightly, so that the consumption of coking coal per ton of pig iron produced has declined from 3,637 pounds in 1913 to 2,923 pounds in 1931.

FURNACE, FOUNDRY, AND OTHER COKE

TABLE 27.—*By-product coke produced and sold or used by the producer, by States, in 1931*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace, etc.[1]		Sold									
					Furnace[2]		Foundry		Domestic use		Industrial and other use (including water gas)[3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	2,943,143	$8,023,595	2,160,695	$5,571,248	2,881	$4,952	311,784	$1,227,421	338,971	$920,202	65,281	$217,276	718,917	$2,369,851
Colorado	225,760	(4)	207,226	(4)	988	(4)	15,049	(4)	128	(4)	------	------	16,165	(4)
Illinois	2,478,984	14,042,457	1,464,319	8,375,463	(4)	(4)	(4)	(4)	743,234	4,163,909	76,091	374,384	911,301	5,166,771
Indiana	2,757,135	16,431,416	2,259,599	13,816,899	(4)	(4)	(4)	(4)	324,207	1,556,432	42,895	209,920	472,583	2,476,618
Maryland	817,995	(4)	722,234	(4)	------	------	------	------	776	(4)	101,619	(4)	102,395	(4)
Massachusetts	1,150,270	9,061,415	94,087	592,510	(4)	(4)	(4)	(4)	510,607	4,257,626	(4)	(4)	882,902	7,096,362
Michigan	2,436,630	11,632,284	488,278	2,307,114	(4)	(4)	(4)	(4)	1,563,291	7,489,596	(4)	(4)	1,879,535	8,999,922
Minnesota	440,489	3,521,295	6,649	42,580	------	------	(4)	(4)	(4)	(4)	(4)	(4)	315,923	2,562,673
New Jersey	930,912	(4)	57,340	(4)	------	------	36,535	(4)	589,660	(4)	166,841	(4)	793,036	(4)
New York	3,578,311	22,115,932	1,191,366	7,745,849	551,455	2,702,332	(4)	(4)	1,405,293	8,857,453	(4)	(4)	2,254,081	13,455,854
Ohio	3,932,939	17,588,581	2,821,642	13,021,953	123,593	485,486	110,219	723,356	734,412	2,738,318	115,512	484,228	1,083,736	4,431,388
Pennsylvania	7,524,722	30,039,070	5,613,480	20,303,603	697,959	2,829,836	77,406	559,796	773,268	4,616,970	160,667	804,508	1,709,300	8,811,110
Tennessee	83,439	356,285	14,454	65,691	------	------	16,472	83,192	33,749	127,349	------	------	50,221	210,541
Utah	146,788	(4)	101,130	(4)	41,159	(4)	2,408	(4)	------	------	------	------	43,567	(4)
Washington	30,104	210,728	10,465	73,255	------	------	589	4,123	19,050	133,350	------	------	19,639	137,473
West Virginia	1,265,039	2,838,554	999,487	2,021,751	------	------	(4)	(4)	(4)	(4)	(4)	(4)	216,757	653,694
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,612,889	10,616,635	101,281	593,340	102,505	481,852	220,705	1,543,557	902,874	6,273,430	165,302	923,261	1,391,386	9,222,100
Undistributed	------	11,611,876	------	4,804,285	306,121	1,762,599	315,351	2,622,292	437,132	6,823,179	657,405	5,856,236	------	6,264,064
Total	32,355,549	158,090,123	18,313,732	79,335,541	1,826,661	8,267,057	1,106,518	6,763,737	8,376,652	47,957,814	1,551,613	8,869,813	12,861,444	71,858,421
At merchant plants	11,538,309	71,258,291	1,680,544	10,677,268	534,000	2,664,133	874,548	5,542,021	6,403,893	39,527,449	1,323,237	7,994,755	9,135,678	55,728,358
At furnace plants	20,817,240	86,831,832	16,633,188	68,658,273	1,292,661	5,602,924	231,970	1,221,716	1,972,759	8,430,365	228,376	875,058	3,725,766	16,130,063

[1] Totals include 1,691,407 tons, valued at $10,684,995, used for other purposes than in blast furnaces.
[2] Totals include 1,123,349 tons, valued at $5,039,315, sold to affiliated corporations, and 703,312 tons, valued at $3,227,742, reported as merchant sales.
[3] Totals include 594,339 tons, valued at $3,668,437, sold for manufacture of water gas.
[4] Included under "Undistributed."

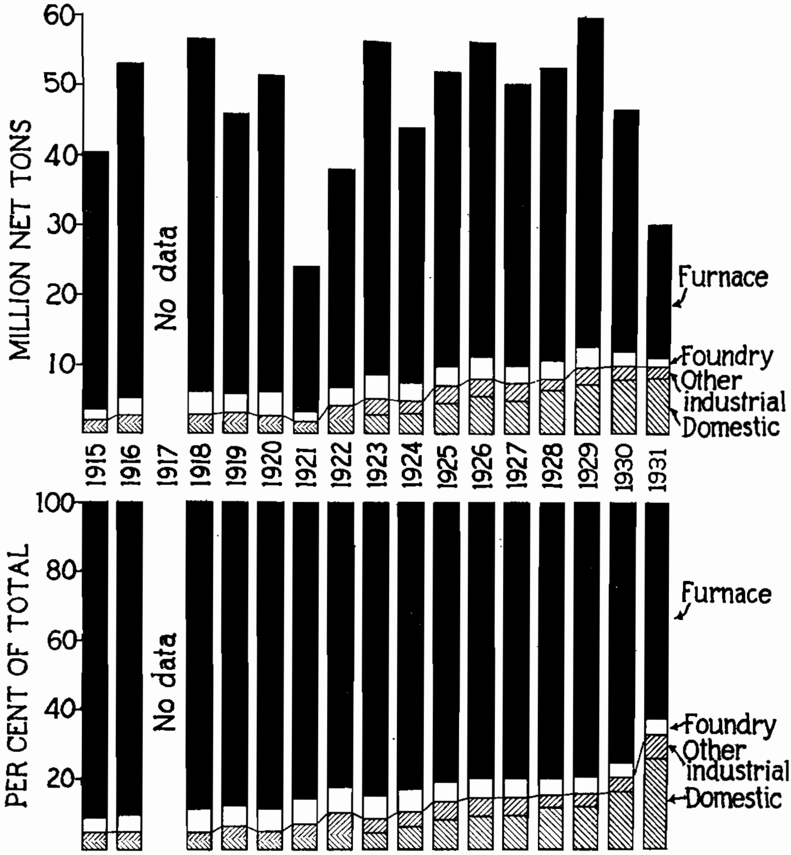

FIGURE 12.—By-product and beehive coke sold for furnace, foundry, other industrial, and domestic use. Figures for furnace coke include all coke used by producer and not sold. The data represent the disposition made of the total production, including the exports, except that in 1915 and 1916 the exports are not included.

TABLE 28.—*Beehive coke produced and sold or used by the producer, by States, in 1931*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace, etc.		Sold			
					Furnace [1]		Foundry	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Pennsylvania	855, 527	$2, 419, 114			438, 609	$1, 246, 616	163, 469	$623, 312
Washington	582	5, 054						
West Virginia	113, 627	366, 090	200	$460	15, 503	43, 716	50, 645	203, 148
Colorado, Tennessee, Utah, and Virginia	158, 601	728, 343	33	126	13, 437	40, 812	36, 644	157, 896
	1, 128, 337	3, 518, 601	233	586	467, 549	1, 331, 144	250, 758	984, 356

[1] Includes 64,105 tons, valued at $229,199, sold to affiliated corporations, and 403,444 tons, valued at $1,101,945, reported as merchant sales.

TABLE 28.—*Beehive coke produced and sold or used by the producer, by States, in 1931*—Continued

State	Sold—Continued					
	Domestic use		Industrial and other use (including water gas) [1]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value
Pennsylvania	107,586	$265,293	143,527	$377,272	853,191	$2,512,493
Washington			582	5,054	582	5,054
West Virginia	11,079	32,546	35,135	83,649	112,362	363,059
Colorado, Tennessee, Utah, and Virginia			107,709	527,209	157,790	725,917
	118,665	297,839	286,953	993,184	1,123,925	3,606,523

[1] Includes 28,578 tons, valued at $71,981, sold for manufacture of water gas.

DOMESTIC COKE

TABLE 29.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1928–1931*

[Wherever available the figures represent the quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. In cases where such figures are not available but where the fuel is known to be used chiefly for domestic purposes, the total production (or imports) is shown in order to indicate the trend of growth]

	1924	1928	1929	1930	1931
Solid fuels (net tons)					
Pennsylvania anthracite production:					
Shipments of domestic sizes	56,576,296	46,218,403	46,141,575	42,508,088	35,437,946
Shipments of buckwheat No. 1 [1]	9,510,508	8,769,923	8,597,053	8,570,032	7,956,978
Shipments of smaller steam sizes	11,160,695	11,499,274	10,555,951	10,123,937	9,240,931
Local sales	3,043,939	3,184,825	3,233,023	3,144,434	2,901,117
Total commercial production	80,291,438	69,672,425	68,527,602	64,346,491	55,536,972
Anthracite exported	4,017,785	3,336,272	3,406,369	2,551,659	1,778,308
Anthracite imported, chiefly from United Kingdom and Russia	117,951	384,707	487,172	674,812	637,951
Fuel briquets produced	580,470	947,423	1,212,415	1,028,865	698,316
Fuel briquets imported	38	71,485	89,458	73,418	60,950
By-product coke sold for domestic use	2,812,771	6,254,382	7,376,320	7,886,432	8,376,652
Beehive coke sold for domestic use	139,886	78,338	134,703	141,391	118,665
Coke imported	82,833	147,701	119,724	132,674	103,563
Gas-house coke sold	[2] 1,400,000	[2] 1,450,000	1,400,000	[2] 1,300,000	[2] 1,300,000
Petroleum coke produced [3]	761,100	1,426,600	1,820,600	1,940,000	2,032,000
Anthracite and semianthracite produced outside of Pennsylvania	704,513	712,406	842,313	708,221	507,140
Bituminous coal for domestic use	(4)	(4)	(4)	(4)	(4)
Oil (barrels) [5]					
Oil used for heating houses	[2] 5,021,000	14,271,000	19,581,000	[6] 25,771,000	24,659,000
Oil used for heating offices, hotels, apartments, schools, hospitals, and buildings other than houses	(7)	16,427,000	17,820,000	[6] 17,508,000	15,731,000
Gas (million cubic feet)					
Natural gas consumed for domestic use	285,152	320,877	359,853	376,407	380,897
Manufactured gas sold for domestic purposes	(7)	(7)	[8] 285,552	(7)	[8] 260,520

[1] A considerable part of the buckwheat No. 1 is used for domestic purposes.
[2] Partly estimated.
[3] How much petroleum coke was used for house fuel prior to 1928 is not known. For that year 235,000 tons were reported to have been consumed for domestic heating, according to E. B. Swanson in Economic Paper 9, Bureau of Mines.
[4] Between 56,000,000 and 77,000,000 tons a year.
[5] Based on surveys by E. B. Swanson, Bureau of Mines.
[6] Revised since last report.
[7] Data not available.
[8] From Census of Manufactures.

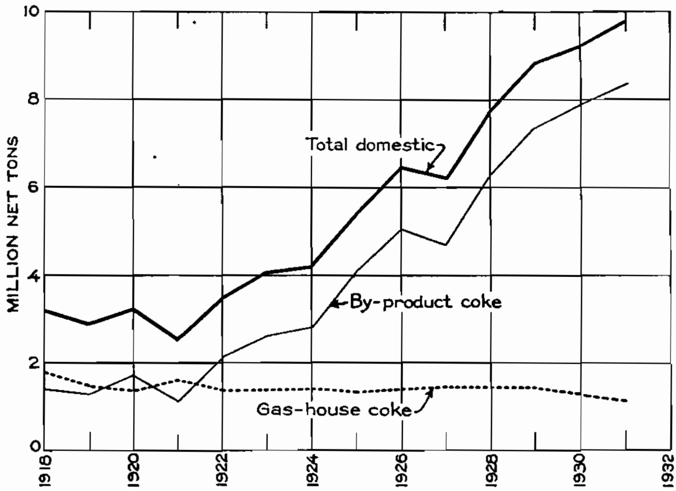

FIGURE 13.—Growth of sales of domestic by-product coke and gas-house coke, 1918–1931.

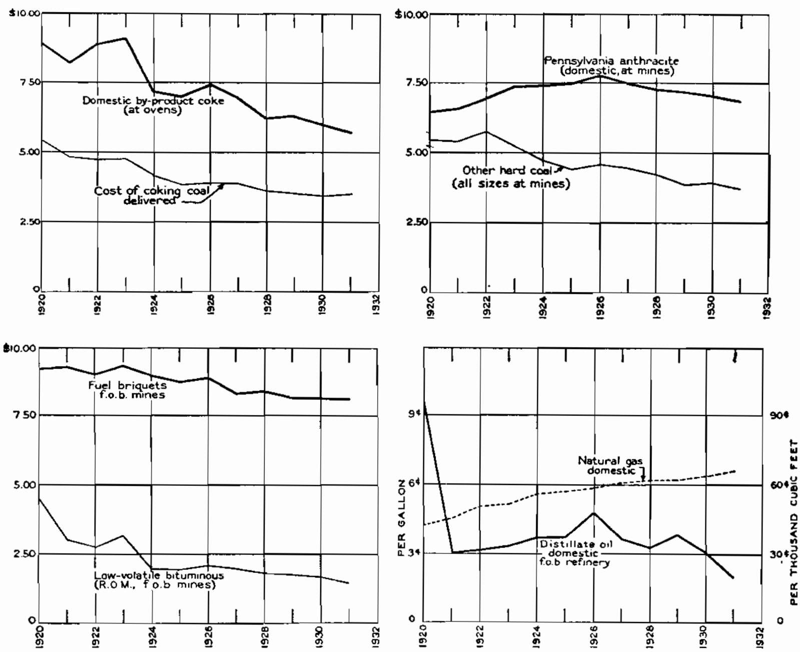

FIGURE 14.—Price trends of domestic fuels, 1920–1931. As the figures are not retail prices, they do not show comparative costs to the consumer, but they do indicate the general movement of prices. Prices of solid fuels are all per net ton, including anthracite.

THE RETAIL DEALER AS A DISTRIBUTOR OF COKE

TABLE 30.—*Relative proportions of coke, anthracite, and bituminous coal in the deliveries made by 875 representative dealers*

[The figures cover a selected list of retailers who handle about 20 per cent of the total retail trade. They cover four periods of two months each; namely, February-March, May-June, August-September, November-December, 1931. Figures for coke include retort coke and possibly some beehive-oven coke]

	Total of 4 stock surveys (net tons delivered to consumers)				Per cent of total		
	Bituminous	Anthracite	Coke	Total	Bituminous	Anthracite	Coke
1. New England	1,966,445	1,385,532	117,524	3,469,501	56.7	39.9	3.4
Maine	144,673	99,919	8,657	253,249	57.1	39.5	3.4
New Hampshire	101,536	31,623	5,142	138,301	73.4	22.9	3.7
Vermont	17,354	34,051	1,546	52,951	32.8	64.3	2.9
Massachusetts	1,087,562	855,811	82,042	2,025,415	53.7	42.3	4.0
Rhode Island	386,150	118,921	9,825	514,896	75.0	23.1	1.9
Connecticut	229,170	245,207	10,312	484,689	47.3	50.6	2.1
2. Middle Atlantic	1,616,325	3,915,272	187,218	5,718,815	28.2	68.5	3.3
New York	557,866	2,913,333	137,996	3,609,195	15.5	80.7	3.8
New Jersey	42,239	368,557	8,820	419,616	10.1	87.8	2.1
Eastern Pennsylvania	84,625	416,811	9,409	510,845	16.6	81.6	1.8
Western Pennsylvania	495,128	11,748	27,557	534,433	92.6	2.2	5.2
Delaware	17,664	57,105	2,754	77,523	22.8	73.7	3.5
Maryland	87,380	70,669	346	158,395	55.2	44.6	.2
District of Columbia	331,423	77,049	336	408,808	81.1	18.8	.1
3. Ohio	624,570	9,954	29,360	663,884	94.1	1.5	4.4
4. Southern Michigan	507,452	46,067	131,447	684,966	74.1	6.7	19.2
5. Illinois and Indiana	2,777,619	148,790	131,408	3,057,817	90.8	4.9	4.3
Illinois	2,416,194	145,735	112,814	2,674,743	90.3	5.5	4.2
Indiana	361,425	3,055	18,594	383,074	94.3	.8	4.9
6. Lower Missouri Valley	711,814	19,795	30,552	762,161	93.4	2.6	4.0
Missouri	366,106	11,320	20,109	397,535	92.1	2.8	5.1
Iowa	282,588	6,734	7,582	296,904	95.2	2.3	2.5
Nebraska	56,305	1,197	2,806	60,308	93.4	2.0	4.6
Kansas	6,815	544	55	7,414	91.9	7.3	.8
7. Lake Dock Territory	531,474	58,807	86,225	676,506	78.6	8.7	12.7
Wisconsin	238,191	36,292	50,892	325,375	73.2	11.2	15.6
Northern Michigan	29,839	1,651	2,175	33,665	88.6	4.9	6.5
Minnesota	221,453	19,404	32,095	272,952	81.1	7.1	11.8
North Dakota	17,538	422	683	18,643	94.1	2.2	3.7
South Dakota	24,453	1,038	380	25,871	94.5	4.0	1.5
8. Southeast	891,348	22,204	7,947	921,499	96.7	2.4	.9
West Virginia	9,945	237	40	10,222	97.3	2.3	.4
Virginia	115,531	18,586	744	134,861	85.7	13.8	.5
North Carolina	27,256	2,341		29,597	92.1	7.9	
South Carolina	30,124	86	108	30,318	99.4	.3	.3
Georgia	226,391	18	417	226,826	99.8	(1)	.2
Florida	5,404	497	297	6,198	87.2	8.0	4.8
Kentucky	238,713	251	1,417	240,381	99.3	.1	.6
Tennessee	177,335	46	3,256	180,637	98.2	(1)	1.8
Alabama	43,443	142	1,540	45,125	96.3	.3	3.4
Mississippi	17,206		128	17,334	99.3		.7
9. Southwest, Mountain, and Pacific	466,999	11,775	3,762	482,536	96.8	2.4	.8
Louisiana	93,079	372	300	93,751	99.3	.4	.3
Arkansas	1,951	380		2,331	83.7	16.3	
Oklahoma	2,175	24	20	2,219	98.0	1.1	.9
Texas	4,119	1,096		5,215	79.0	21.0	
New Mexico	38,209	7,350		45,559	83.9	16.1	
Arizona	6,094	342		6,436	94.7	5.3	
Colorado	82,710	1,387	700	84,797	97.6	1.6	.8
Utah	49,626		2,107	51,733	95.9		4.1
Nevada	4,757		4	4,761	99.9		.1
Wyoming	4,055			4,055	100.0		
Montana	32,471			32,471	100.0		
Idaho	55,334			55,334	100.0		
Washington	53,682	200	41	53,923	99.5	.4	.1
Oregon	15,551		343	15,894	97.8		2.2
California	23,186	624	247	24,057	96.4	2.6	1.0
Total United States	10,094,046	5,618,196	725,443	16,437,685	61.4	34.2	4.4

1 Less than one-tenth of 1 per cent.

STOCKS OF COKE

TABLE 31.—*Stocks of furnace, foundry, and domestic coke, and of breeze on January 1, 1932, by States, in net tons*

[Based on complete reports from all producers]

State	Furnace	Foundry	Domestic and other	Total coke	Breeze
By-product plants:					
Alabama	475,151	210,227	63,096	748,474	37,672
Colorado	5,318	322		5,640	1,105
Illinois	[1] 163,701	(1)	411,963	575,664	59,897
Indiana	44,163	198	157,256	201,617	7,455
Maryland	4,165	11		4,176	20,996
Massachusetts		170	246,829	246,999	27,954
Michigan	442	1,639	212,423	214,504	42,898
Minnesota	100,745		134,189	234,934	15,759
New Jersey			213,079	213,079	1,245
New York	[1] 27,105	(1)	327,599	354,704	37,352
Ohio	203,391	4,851	204,261	412,503	70,090
Pennsylvania	288,896	3,233	316,271	608,400	31,304
Tennessee	42,893	93	2,722	45,708	5,469
Utah	5,976		9,019	14,995	50,343
Washington			6,570	6,570	
West Virginia	61,148		71,320	132,468	1,800
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	[1] 1,213	(1)	357,622	358,835	17,034
	[1] 1,424,307	[1] 220,744	2,734,219	4,379,270	428,373
At merchant plants	67,470	94,242	2,293,774	2,455,486	194,669
At furnace plants	1,309,432	173,907	440,445	1,923,784	233,704
Beehive plants:					
Colorado	183			183	
Pennsylvania	22,548	4,384	12,215	39,147	320
Tennessee		392		392	
Utah		114		114	
Virginia	1,097	1,230		2,327	20
West Virginia	1,411	2,393	472	4,276	
	25,239	8,513	12,687	46,439	340

[1] A small amount of foundry coke is included with furnace.

TABLE 32.—*Summary of total stocks of coke on hand at all by-product and beehive plants at the first of the year, 1927–1932*

	Jan. 1, 1927	Jan. 1, 1928	Jan. 1, 1929	Jan. 1, 1930	Jan. 1, 1931	Jan. 1, 1932
By-product plants:						
Furnace	532,831	627,869	750,318	931,654	1,106,996	1,424,307
Foundry	37,414	29,371	24,426	26,943	230,766	220,744
Domestic and other	697,135	1,156,991	1,018,205	1,256,612	1,916,526	2,734,219
Total	1,267,380	1,814,231	1,792,949	2,215,209	3,254,288	4,379,270
Beehive plants:						
Furnace	25,425	54,441	38,446	30,131	31,691	25,239
Foundry	6,890	13,615	8,020	7,929	6,061	8,513
Domestic and other	6,446	4,147	8,511	7,656	5,844	12,687
Total	38,761	72,203	54,977	45,716	43,596	46,439
Total:						
Furnace	558,256	682,310	788,764	961,785	1,138,687	1,449,546
Foundry	44,304	42,986	32,446	34,872	236,827	229,257
Domestic and other	703,581	1,161,138	1,026,716	1,264,268	1,922,370	2,746,906
Total	1,306,141	1,886,434	1,847,926	2,260,925	3,297,884	4,425,709

TABLE 33.—*Total stocks of coke on hand at all furnace and nonfurnace by-product plants on the first of each month, 1930 and 1931*

[Includes furnace, foundry, and domestic, but not breeze]

Date	Furnace plants		Other plants		Total	
	1930	1931	1930	1931	1930	1931
Jan. 1	1,070,114	1,454,950	1,145,095	1,799,338	2,215,209	3,254,288
Feb. 1	1,029,043	1,512,204	905,396	1,430,512	1,934,439	2,942,716
Mar. 1	1,031,059	1,476,402	812,295	1,336,845	1,843,354	2,813,247
Apr. 1	1,087,305	1,495,882	905,468	1,328,870	1,992,773	2,824,752
May 1	1,155,233	1,538,965	964,417	1,463,725	2,119,650	3,002,690
June 1	1,144,859	1,580,184	1,135,683	1,481,967	2,280,542	3,062,151
July 1	1,180,079	1,611,968	1,286,744	1,643,992	2,466,823	3,255,960
Aug. 1	1,194,057	1,649,724	1,546,952	1,895,944	2,741,009	3,545,668
Sept. 1	1,226,496	1,687,863	1,865,501	2,102,994	3,091,997	3,790,857
Oct. 1	1,232,194	1,747,830	1,955,414	2,306,591	3,187,608	4,054,421
Nov. 1	1,311,437	1,757,445	1,862,835	2,456,850	3,174,272	4,214,295
Dec. 1	1,387,255	1,814,413	1,944,656	2,475,836	3,331,911	4,290,249

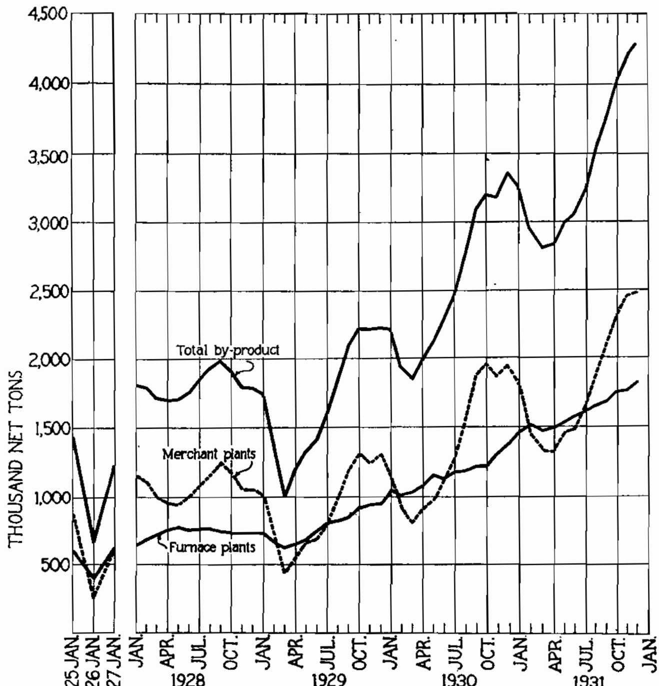

FIGURE 15.—Total stocks of by-product coke at producers' plants on the first of each month. The figures in this diagram include all by-product plants.

VALUE AND PRICE

TABLE 34.—*Average receipts per net ton for coke sold, by States, in 1931*

State	By-product				Beehive			
	Furnace	Foundry	Domestic	Other industrial, etc.	Furnace	Foundry	Domestic	Other industrial, etc.
Alabama	$1.72	$3.94	$2.72	$3.33				
Colorado and Utah	5.04	4.51	3.33			$6.26		$7.45
Illinois	5.08	(1)	5.60	4.92				
Indiana	(1)	6.74	4.80	4.89				
Maryland and New Jersey		8.27	6.75	6.27				
Massachusetts	(1)	8.24	8.34	(1)				
Michigan	(1)	(1)	4.79	(1)				
Minnesota		(1)	8.10	8.76				
New York	4.90	(1)	6.30	6.03				
Ohio	3.93	6.56	3.73	4.19				
Pennsylvania	4.05	7.23	5.97	5.01	$2.84	3.81	$2.47	2.63
Tennessee		5.05	3.77			6.04		2.91
Virginia					3.04	4.02		3.62
Washington		7.00	7.00					8.68
West Virginia		(1)	2.43	(1)	2.82	4.01	2.94	2.38
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	4.70	6.99	6.95	5.59				
Undistributed	5.83	7.07		6.51				
	4.53	6.11	5.73	5.72	2.85	3.93	2.51	3.46
At merchant plants	4.99	6.34	6.17	6.04	(2)	(2)	(2)	(2)
At furnace plants	4.33	5.27	4.27	3.83	(2)	(2)	(2)	(2)

[1] Included under "Undistributed." [2] Not available.

TABLE 35.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1927–1931* [1]

Month	Furnace coke					Foundry coke				
	1927	1928	1929	1930	1931	1927	1928	1929	1930	1931
January	$3.50	$2.70	$2.75	$2.55	$2.50	$4.50	$3.75	$3.75	$3.50	$3.50
February	3.38	2.68	2.90	2.60	2.50	4.31	3.75	3.75	3.50	3.50
March	3.35	2.60	2.98	2.60	2.50	4.40	3.75	3.75	3.50	3.50
April	3.20	2.60	2.78	2.60	2.50	4.06	3.75	3.75	3.50	3.50
May	2.94	2.60	2.75	2.53	2.45	4.00	3.75	3.75	3.50	3.50
June	2.93	2.60	2.75	2.50	2.40	4.00	3.75	3.75	3.50	3.50
July	3.00	2.63	2.75	2.50	2.40	4.00	3.75	3.75	3.50	3.50
August	3.00	2.75	2.73	2.58	2.40	4.00	3.75	3.75	3.50	3.50
September	2.85	2.75	2.65	2.60	2.40	4.00	3.75	3.75	3.50	3.50
October	2.85	2.83	2.65	2.60	2.40	4.00	3.75	3.75	3.50	3.50
November	2.77	2.75	2.65	2.53	2.40	3.85	3.75	3.75	3.50	3.50
December	2.75	2.75	2.64	2.50	2.34	3.75	3.75	3.75	3.50	3.25
Average	3.04	2.69	2.75	2.56	2.43	4.11	3.75	3.75	3.50	3.48

[1] Iron Age, Jan. 7, 1932, p. 150.

TABLE 36.—*Average monthly prices of by-product foundry coke, in 10 markets, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Ashland, Ky. (at ovens):[1]													
1930	$6.50	$6.50	$6.50	$6.50	$6.50	$6.50	$6.30	$5.50	$5.50	$5.50	$5.50	$5.50	$6.06
1931	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
Birmingham, Ala. (at ovens):													
1930	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1931	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.75	5.00
Buffalo, N. Y. (at ovens):													
1930	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.00	8.00	8.00	8.00	8.00	8.44
1931	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Chicago, Ill. (at ovens):													
1930	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
1931	8.00	8.00	8.00	8.00	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.65
Detroit, Mich. (at ovens):													
1930	9.00	9.00	9.00	8.90	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.66
1931	8.50	8.50	8.50	8.50	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Indianapolis, Ind. (delivered at consumers' works):													
1930	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25
1931	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25	8.25
Newark, N. J. (delivered at consumers' works):													
1930	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
1931	9 00	9.00	9.00	9.00	9.00	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.83
New England (delivered at consumers' works):													
1930	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
1931	11.00	11.00	11.00	11.00	11.00	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.71
Portsmouth, Ohio (at ovens):[1]													
1930	6.50	6.50	6.50	6.50	6.50	6.50	6.30	5.50	5.50	5.50	5.50	5.50	6.06
1931	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
St. Louis, Mo. (at ovens):													
1930	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
1931	9.00	9.00	9.00	9.00	9.00	8.60	8.50	8.50	8.50	8.50	8.50	8.50	8.72

[1] Prices at ovens, Ashland and Portsmouth, quoted on Connellsville ovens basis.

SHIPMENTS BY RAIL AND WATER

TABLE 37.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States in 1931, by routes, as reported by the coke producers*

Route	State	Quantity (net tons)		Per cent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania West Virginia	42,951 32,139	75,090	6.6
Buffalo, Rochester & Pittsburgh	Pennsylvania	24,457	24,457	2.1
Chesapeake & Ohio	West Virginia	53,875	53,875	4.7
Denver & Rio Grande Western	Colorado Utah	38,786 3,713	42,499	3.7
Huntingdon & Broad Top	Pennsylvania	500	500	(1)
Interstate	Virginia	63,403	63,403	5.6
Ligonier Valley	Pennsylvania	71,042	71,042	6.2
Monongahela	do	332,934	332,934	29.1
Nashville, Chattanooga & St. Louis	Tennessee	4,460	4,460	.4
New York Central	West Virginia	21,558	21,558	1.9
Norfolk & Western	Virginia West Virginia	35,565 7,032	42,597	3.7
Northern Pacific	Washington	582	582	.1
Pennsylvania	Pennsylvania	338,645	338,645	29.6
Pittsburgh & Lake Erie	do	6,506	6,506	.6
Southern	Tennessee	12,695	12,695	1.1
Western Maryland	West Virginia	548	548	.1
Total railroad shipments		1,091,391	1,091,391	95.5
Waterway: Monongahela River	Pennsylvania	51,026	51,026	4.5
Grand total		1,142,417	1,142,417	100.0

[1] Less than one-tenth of 1 per cent.

EXPORTS AND IMPORTS [1]

TABLE 38.—*Coke exported from the United States, 1929–1931, by customs districts*

District	1929		1930		1931	
	Net tons	Value	Net tons	Value	Net tons	Value
Alaska	1	$17				
Arizona	1,038	8,421	1,089	$7,352	128	$989
Buffalo	627,231	4,028,991	456,230	2,930,901	218,193	1,373,823
Chicago			15,954	76,271		
Dakota	18,388	129,910	11,939	81,121	10,622	66,033
Duluth-Superior	3,528	20,941	2,450	17,704	1,729	11,298
El Paso	20	319	9	145	2	23
Florida	13,662	137,339	12,155	121,452	3,513	34,168
Galveston	553	3,723			8,833	62,889
Los Angeles	35	481	7	112		
Maine and New Hampshire	3,720	27,032	2,736	20,290	1,247	8,978
Maryland	5,347	30,711	741	2,889	1,135	8,508
Michigan	426,771	2,448,380	404,054	2,193,859	392,979	1,887,501
Mobile	26,362	239,447	12,333	148,122	5,881	55,065
New Orleans	5,338	56,038	11,250	62,625	15,455	84,472
New York	3,035	30,122	1,752	26,341	300	5,392
Ohio	71,690	386,433	53,981	243,188	78,103	370,339
Philadelphia	1,163	10,568	2,331	13,757	196	3,127
Puerto Rico	53	748	37	564	6	150
Rochester	45	311	50	506		
Sabine	9,184	123,000			1,120	8,000
St. Lawrence	5,311	44,754	5,159	43,321	4,626	31,416
San Antonio	816	4,374	491	2,446		
San Diego			34	354	233	2,547
San Francisco	43	764	35	616	28	482
Vermont	8,574	61,565	6,971	52,471	3,576	26,975
Virginia	3,916	30,250	1,145	10,198	2,615	22,253
Washington	2,211	15,729	933	10,713	357	3,952
Wisconsin					3,425	16,588
	1,238,035	7,840,368	1,003,866	6,067,318	754,302	4,084,968

[1] Figures on exports and imports, unless otherwise indicated, compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

TABLE 39.—*Coke exported from the United States, 1929–1931, by countries of destination*

Destination	1929		1930		1931	
	Net tons	Value	Net tons	Value	Net tons	Value
North America:						
Bermudas					1	$20
Canada	1,170,008	$7,179,895	960,459	$5,670,345	722,571	3,851,280
Central America—						
Costa Rica	38	651	16	266	20	341
Guatemala	35	469	56	871	37	558
Honduras	127	1,126	2,010	10,359	75	860
Nicaragua	34	622			54	890
Panama	263	2,432	324	7,002	218	4,958
Salvador	58	1,066	222	2,699	29	438
Mexico	2,333	18,068	1,903	12,915	576	5,014
Newfoundland and Labrador	75	546	26	466		
West Indies—						
British—						
Jamaica	1	23	6	109	4	72
Trinidad and Tobago	2	24	7	77	361	3,123
Other	28	275			8	88
Cuba	32,118	221,687	25,931	171,733	20,163	98,028
Dominican Republic	69	1,036	55	872	17	368
Haiti					4	75
Netherland	22	275	4	52		
Virgin Islands of the United States	1	8				
South America:						
Argentina			177	2,248		
Bolivia	45	540				
Brazil	37	499			22	350
Chile	5,667	32,931	1,052	5,284	11	104
Colombia	147	2,337	19	325	27	499
Ecuador	32	391			27	267
Peru	218	3,618	62	1,021		
Venezuela	95	1,786	64	1,194	8	103
Europe:						
Belgium	336	6,000	573	9,616		
France	15,349	221,593	1,401	25,020	1,254	22,400
Germany	2,448	38,700	3,264	47,280	1,680	18,000
Italy	5,422	78,490	4,716	76,610	3,718	39,098
Netherlands	1,143	10,406	560	5,000	2,296	29,500
Norway					1,120	8,512
Sweden	1	10				
United Kingdom	1,881	14,824	223	3,980		
Asia:						
British India			354	3,448		
Java and Madura			382	8,526		
Other					1	22
Oceania: French	2	40				
	1,238,035	7,840,368	1,003,866	6,067,318	754,302	4,084,968

TABLE 40.—*Coke imported into the United States, 1929–1931, by customs districts*

District	1929		1930		1931	
	Net tons	Value	Net tons	Value	Net tons	Value
Arizona	30	$300				
Buffalo	29,344	534,085	25,097	$472,504	13,745	$242,477
Duluth-Superior			6,085	9,509		
Hawaii			112	1,486	682	7,135
Los Angeles	23,450	166,277	31,522	156,657	24,449	114,790
Massachusetts					16,757	70,183
Maine and New Hampshire	459	3,130	531	4,320	2,642	17,141
Michigan	2,336	14,585	373	3,810	1,174	20,059
Montana and Idaho	22,638	170,997	29,219	200,589	9,847	73,498
New York	189	2,361	4	37	12,690	46,427
Oregon	3,549	16,313	4,530	20,571	2,234	10,996
Rochester	4,968	29,176	16	72		
St. Lawrence			9	59	35	237
San Antonio	1,686	13,195	309	2,277	88	729
San Francisco	16,468	72,183	23,250	110,956	15,538	68,983
Vermont	124	883	572	3,977	27	179
Washington	14,483	68,750	11,045	57,196	3,655	18,184
	119,724	1,092,235	132,674	1,044,020	103,563	691,018

TABLE 41.—*Coke imported into the United States, 1929–1931, by countries of origin*

Country	1929		1930		1931	
	Net tons	Value	Net tons	Value	Net tons	Value
Belgium	2,014	$10,152	2,452	$13,201	4,540	$23,680
Canada	56,762	733,833	63,928	705,691	25,394	340,165
Chile	-------	-------	1	22	-------	-------
Germany	5,846	33,855	2,857	15,815	22,768	98,111
Japan	-------	-------	-------	-------	1	7
Mexico	1,716	13,495	309	2,277	88	729
Netherlands	18,136	153,348	9,499	57,460	6,316	33,217
United Kingdom	35,250	147,552	53,628	249,554	44,456	195,109
	119,724	1,092,235	132,674	1,044,020	103,563	691,018

WORLD PRODUCTION

TABLE 42.—*Coke produced in the principal countries of the world, 1927–1931, in metric tons* [1]

[Compiled by M. T. Latus, of the Bureau of Mines]

Country	1927	1928	1929	1930	1931
Australia:					
New South Wales	720,727	528,550	471,813	373,675	221,000
Queensland	4,263	4,123	4,144	3,499	2,317
Belgium	5,879,970	6,322,920	6,192,960	5,551,560	(2)
Bulgaria	1,448	898	-------	-------	(2)
Canada	1,366,623	1,675,421	1,986,532	1,716,091	1,252,946
China (exports)	[3] 12,989	14,211	13,467	10,557	8,130
Chosen	130,356	(4)	(4)	(4)	(2)
Czechoslovakia	2,428,584	2,821,423	3,170,629	2,714,670	2,046,371
France	7,118,000	7,957,000	9,080,127	9,271,140	7,940,000
Germany [5]	33,242,495	34,774,959	39,421,033	32,699,520	22,700,127
Saar	2,232,000	2,373,000	2,423,000	2,560,000	1,941,000
Great Britain [6]	12,027,121	12,035,326	13,637,421	11,698,821	8,606,664
Hungary	457	1,072	2,092	(4)	2,184
India, British [7]	661,506	757,501	843,504	821,020	(2)
Indo-China	(4)	2,500	637	6,000	1,000
Italy	578,445	636,399	791,607	813,325	740,266
Japan:					
Manufactured coke	[8] 1,086,023	1,237,754	(4)	(4)	(2)
Natural coke	143,447	165,883	(4)	(4)	(2)
Netherlands	1,478,822	1,573,392	2,402,566	2,599,403	2,739,343
Peru	13,812	19,331	35,899	35,974	9,269
Poland	1,402,008	1,667,906	1,858,052	1,581,974	1,354,743
Rhodesia, Southern	146,966	139,719	100,001	77,043	39,866
Russia [9]	3,327,904	5,103,741	(4)	(4)	(2)
Spain	714,243	680,555	768,040	675,546	503,115
Sweden	115,756	104,805	103,778	96,942	126,642
Union of South Africa	98,249	94,089	99,297	89,429	86,371
United States	46,349,770	47,904,391	54,325,427	43,519,258	30,375,912
	121,284,000	128,727,000	144,272,000	123,457,000	(2)

[1] Gas-house coke is not included.
[2] Data not available.
[3] Production estimated as 500,000 tons in 1927 (General Statement on the Mining Industry. China Geol. Surv. Special Rept. No. 3, Peiping). Similar figures not available for other years.
[4] Estimate included in total.
[5] Exclusive of the Saar, which is shown separately.
[6] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1927, 12,562,447 tons; 1928, 12,411,903 tons; 1929, 12,610,467 tons; 1930, 12,514,392 tons; 1931, 12,301,695 tons.
[7] Figures represent only coke made at collieries.
[8] Exclusive of small quantity for which value only is reported.
[9] Year ended Sept. 30.

COKE-OVEN BY-PRODUCTS

SUMMARY OF BY-PRODUCTS IN 1931

TABLE 43.—*By-products obtained from coke-oven operations in the United States in 1931* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales: Quantity	Sales: Value: Total	Sales: Value: Average
Tar .... gallons	450,856,092	273,164,573	$12,440,567	$0.046
Ammonia:				
Sulphate .... pounds	983,614,651	1,007,561,803	12,812,422	.013
Ammonia liquor (NH_3 content) .... do	39,089,088	37,347,144	1,465,998	.039
			14,278,420	
Sulphate equivalent of all forms .... do	1,139,971,003	1,156,950,379		
Gas:				
Used under boilers, etc .... M cubic feet	[2] 524,097,485	14,274,493	810,673	.057
Used in steel or affiliated plants .... do		132,761,886	14,243,420	.107
Distributed through city mains .... do		161,881,123	49,023,725	.303
Sold for industrial use .... do		19,989,961	3,352,095	.168
		328,907,463	67,429,913	.205
Light oil and derivatives:				
Crude light oil .... gallons	[3] 122,529,148	8,739,202	710,106	.081
Benzol, crude and refined .... do	14,772,297	14,267,081	2,209,839	.155
Motor benzol .... do	61,960,025	61,471,006	7,209,157	.117
Toluol, crude and refined .... do	11,832,932	12,693,294	3,099,452	.244
Solvent naphtha .... do	3,772,025	3,463,950	591,628	.171
Xylol .... do	2,028,729	2,074,126	444,850	.214
Other light oil products .... do	4,163,028	2,007,860	124,928	.062
	[4] 98,529,036	104,716,519	14,389,960	.137
Naphthalene, crude and refined .... pounds	7,622,929	7,360,309	78,946	.011
Tar derivatives:				
Creosote oil, distillate as such .... gallons	13,740,196	13,686,594	1,218,227	.089
Creosote oil in coal-tar solution .... do	2,551,402	2,141,073	144,402	.067
Pitch of tar .... net tons	78,983	4,951	30,247	6.109
Other tar derivatives			55,032	
Phenol .... gallons	94,097	110,352	29,783	.270
Other products [5]			97,595	
Value of all by-products sold			[6] 110,193,092	

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name, excepting, however, phenol and other tar acids produced at Clairton, Pa.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on the premises to make the derived products shown, 117,625,416 gallons.
[4] Total gallons of derived products.
[5] Carbolate, crude products, cyanogen, sodium prussiate, and sulphur.
[6] Exclusive of the value of breeze production, which in 1931 amounted to $6,637,976.

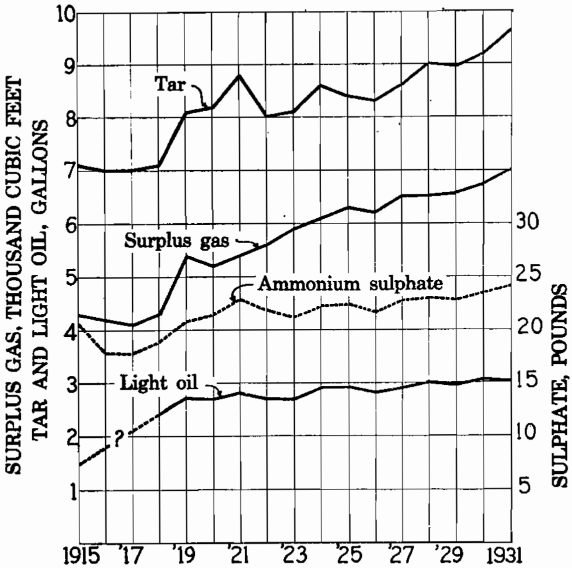

FIGURE 16.—Average yield of the principal by-products per net ton of coal carbonized in by-product coke ovens, 1915–1931. Figures for light oil represent the average at plants recovering light oil.

TABLE 44.—*Coal equivalent of the by-products of by-product coking, 1914, 1918, and 1929–1931*

Year	Quantity of by-products				Rough equivalent in heating value (billion B. t. u.)					Coal equivalent	
	1	2	3	4	5	6	7	8	9	10	11
	Coke breeze (thousand net tons)	Surplus gas (billion cubic feet)	Tar produced (thousand gallons)	Light oil produced (thousand gallons)	Coke breeze (1×20)	Surplus gas (2×550)	Tar (3× 0.150)	Light oil (4× 0.130)	Total (5+6+7+8)	Net tons (9÷0.0262)	Per cent which this forms of coal made into coke
1914	667	61	109, 901	8, 464	13, 340	33, 550	16, 485	1, 100	64, 475	2, 461, 000	4. 8
1918	1, 999	158	263, 299	87, 562	39, 980	86, 900	39, 495	11, 383	177, 758	6, 785, 000	8. 0
1929	4, 853	508	680, 864	200, 594	97, 060	279, 400	102, 130	26, 077	504, 667	19, 262, 000	22. 2
1930	4, 337	442	602, 486	178, 326	86, 740	243, 100	90, 373	23, 182	443, 395	16, 923, 000	24. 2
1931	3, 126	329	450, 856	122, 529	62, 520	180, 950	67, 628	15, 929	327, 027	12, 482, 000	25. 8

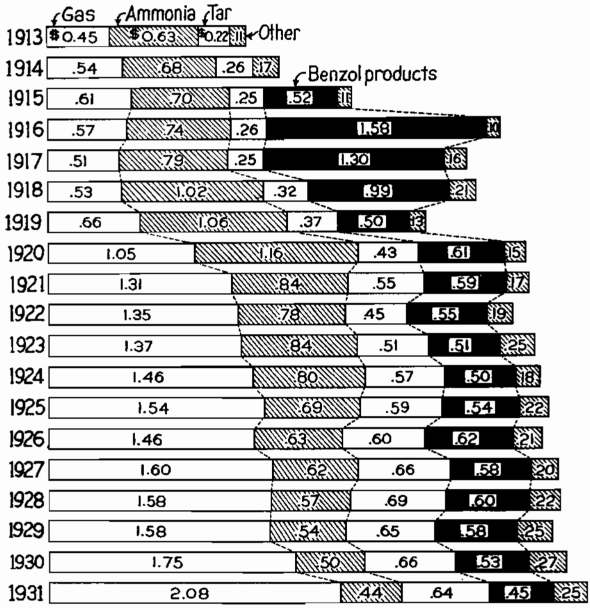

FIGURE 17.—Gross value of the several by-products per ton of by-product coke produced, 1913–1931.

TAR

TABLE 45.—*Coke-oven tar produced and sold in the United States in 1931, by States* [1]

State	Total produced (gallons)	Sold: For use as fuel (gallons)[2]	Sold: For refining into tar products (gallons)	Sold: Total sold (gallons)	Value: Total	Value: Average
Alabama	38, 161, 321	(3)	(3)	29, 063, 273	$1, 426, 654	$0. 049
Colorado	3, 413, 568	-----------	2, 434	2, 434	(3)	(3)
Illinois	32, 394, 897	2, 566, 452	27, 623, 545	30, 189, 997	1, 424, 976	. 047
Indiana	29, 449, 085	-----------	13, 930, 110	13, 930, 110	530, 952	. 038
Maryland	8, 520, 798	-----------	8, 121, 293	8, 121, 293	(3)	(3)
Massachusetts	14, 597, 436	1, 065, 862	13, 241, 570	14, 307, 432	796, 301	. 056
Michigan	32, 298, 250	-----------	18, 420, 477	18, 420, 477	749, 118	. 041
Minnesota	5, 594, 301	(3)	(3)	4, 998, 166	267, 831	. 054
New Jersey	10, 699, 023	10, 718, 848	-----------	10, 718, 848	(3)	(3)
New York	51, 963, 736	8, 627, 153	35, 731, 757	44, 358, 910	1, 993, 430	. 045
Ohio	58, 127, 906	10, 691, 982	15, 314, 229	26, 006, 211	1, 136, 032	. 044
Pennsylvania	121, 678, 511	13, 975, 060	18, 586, 143	32, 561, 203	1, 359, 530	. 042
Tennessee	825, 989	856, 745	-----------	856, 745	43, 828	. 051
Utah	3, 171, 050	-----------	3, 189, 005	3, 189, 005	(3)	(3)
Washington	422, 894	-----------	419, 888	419, 888	25, 193	. 060
West Virginia	21, 259, 181	(3)	(3)	17, 963, 837	734, 066	. 041
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	18, 278, 146	-----------	18, 056, 744	18, 056, 744	890, 572	. 049
Undistributed	-----------	9, 577, 887	42, 447, 389	-----------	1, 062, 084	. 048
Total	450, 856, 092	58, 079, 989	215, 084, 584	273, 164, 573	12, 440, 567	. 046
From merchant ovens	149, 097, 576	22, 068, 395	125, 912, 390	147, 980, 785	7, 024, 136	. 047
From furnace ovens	301, 758, 516	36, 011, 594	89, 172, 194	125, 183, 788	5, 416, 431	. 043

[1] This table excludes the quantity of tar "refined at plant," which in 1931 amounted to 33,190,356 gallons.
[2] Includes tar sold to affiliated corporations and to other purchasers.
[3] Included under "Undistributed" to avoid disclosing individual operations.

TABLE 45.—*Coke-oven tar produced and sold in the United States in 1931, by States*—Continued

State	Used by producer (gallons)			On hand Dec. 31 (gallons)
	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
Alabama	253,401	8,774,241	201,032	3,232,204
Colorado		1,619,636	2,401	419,269
Illinois		1,249,551	45,367	3,953,602
Indiana		16,690,041		1,259,214
Maryland		19,330		1,215,226
Massachusetts			65	2,383,033
Michigan	6,366,738	7,904,431		2,304,268
Minnesota		(3)		399,741
New Jersey				727,557
New York		(3)	232,139	4,164,822
Ohio	(3)	29,825,574		5,061,753
Pennsylvania	1,068,142	74,759,781	1,115,036	7,702,172
Utah			3,885	40,440
Washington			1,880	17,330
West Virginia	(3)	4,033,429		446,250
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin			50	1,187,472
Undistributed	989,159	6,687,353		
Total	8,677,440	151,563,367	1,601,855	34,514,353
From merchant ovens			246,286	11,133,234
From furnace ovens	8,677,440	151,563,367	1,355,569	23,381,119

[3] Included under "Undistributed" to avoid disclosing individual operations.

AMMONIA

TABLE 46.—*Ammonia produced at coke-oven plants, by States, in 1931, in pounds*

State	Sulphate	Liquor (NH_3 content)	Sulphate equivalent of all forms	
			Total	Per ton of coal coked
Alabama	(1)	(1)	107,706,291	25.82
Colorado	8,167,208		8,167,208	24.83
Illinois	(1)	(1)	87,896,427	24.12
Indiana	71,910,059	2,800,683	83,112,791	21.37
Maryland	23,803,298		23,803,298	21.47
Massachusetts	(1)	(1)	39,312,716	24.52
Michigan	38,534,696	11,068,586	82,809,040	23.98
Minnesota	15,037,812		15,037,812	23.06
New Jersey	27,932,037		27,932,037	21.24
New York	(1)	(1)	123,871,665	24.12
Ohio	119,820,172	6,422,821	145,511,456	25.14
Pennsylvania	283,723,123	1,602,153	290,131,735	25.79
Tennessee	3,369,182		3,369,182	29.23
Utah	7,560,400		7,560,400	27.98
Washington		358,142	1,432,568	25.70
West Virginia	41,899,890		41,899,890	23.00
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	25,456,203	6,240,071	50,416,487	22.48
Undistributed	316,400,571	10,596,632		
Total	983,614,651	39,089,088	1,139,971,003	24.33
From merchant ovens	257,324,513	32,348,440	386,718,273	23.72
From furnace ovens	726,290,138	6,740,648	753,252,730	24.66

[1] Included under "Undistributed."

LIGHT OIL AND ITS DERIVATIVES

TABLE 47.—*Crude light oil produced at coke-oven plants in the United States in 1931, by States, in gallons* [1]

State	Average yield per ton of coal coked	Produced	Refined on the premises	Total derived products obtained from refining operations
Alabama	2.96	12,336,292	11,564,072	9,874,961
Colorado	3.29	1,080,396	1,088,656	880,596
Illinois	2.70	9,318,380	4,404,006	3,543,016
Indiana	2.92	9,852,804	10,608,241	8,869,847
Maryland	3.25	3,600,000	3,600,000	2,914,137
Michigan	2.72	8,547,483	5,280,035	4,428,460
New York	2.53	8,722,260	15,200,859	12,777,695
Ohio	3.12	18,037,005	16,589,467	13,219,176
Pennsylvania	3.46	35,458,701	35,038,214	30,324,216
Tennessee	2.40	276,648	279,723	227,997
Utah	3.95	1,066,350	1,066,350	858,450
West Virginia	3.36	5,658,191	5,668,293	4,928,442
Kentucky, Massachusetts, Minnesota, Missouri, and Wisconsin	2.56	8,574,638	7,237,500	5,682,043
Total	3.03	122,529,148	117,625,416	98,529,036
From merchant ovens	2.53	26,247,323	22,518,347	18,353,414
From furnace ovens	3.20	96,281,825	95,107,069	80,175,622

[1] In addition to the quantity refined on the premises a few plants reported the sale of crude light oil. The total quantity sold in 1931 was 8,739,202 gallons, valued at $710,106, or 8.1 cents per gallon.

COKE-OVEN GAS

TABLE 48.—*Coke-oven gas produced and sold in the United States in 1931, by States*

State	Number of active plants	Produced (M cubic feet)	Used in heating ovens (M cubic feet)	Surplus sold or used			Wasted (M cubic feet)
				M cubic feet	Value		
					Total	Average	
Alabama	8	47,072,928	22,456,523	22,126,474	$1,736,131	$0.078	2,489,931
Colorado	1	3,916,287	2,102,108	1,806,458	(1)	(1)	7,721
Illinois	8	39,087,159	9,339,942	29,712,084	6,916,881	.233	35,133
Indiana	6	42,289,801	19,815,105	22,211,806	5,592,995	.252	262,890
Maryland	1	12,783,552	4,429,536	8,354,016	(1)	(1)	----------
Massachusetts	3	17,527,519	3,489,739	13,976,842	4,019,726	.288	60,938
Michigan	7	39,662,948	12,570,365	27,081,964	6,493,518	.240	10,619
Minnesota	3	7,451,490	3,205,591	4,245,858	1,585,998	.374	41
New Jersey	2	15,813,032	3,876,793	11,936,239	(1)	(1)	----------
New York	9	60,068,275	12,169,350	47,276,169	15,735,718	.333	622,756
Ohio	15	61,377,166	26,847,919	33,961,778	4,052,269	.119	567,469
Pennsylvania	12	127,032,697	53,986,959	71,561,132	9,910,220	.138	1,484,606
Tennessee	1	1,098,301	493,758	604,543	168,353	.278	----------
Utah	1	3,431,488	1,571,048	1,571,607	(1)	(1)	288,833
Washington	1	640,585	----------	588,219	141,755	.241	52,366
West Virginia	4	19,542,117	6,430,195	13,004,834	1,249,497	.096	107,088
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	25,302,140	6,297,234	18,887,440	5,382,906	.285	117,466
Undistributed	----------	----------	----------	----------	4,443,946	.188	----------
Total	88	524,097,485	189,082,165	328,907,463	67,429,913	.205	6,107,857
From merchant ovens	42	184,296,537	39,917,290	142,611,965	43,484,897	.305	1,767,282
From furnace ovens	46	339,800,948	149,164,875	186,295,498	23,945,016	.129	4,340,575

[1] Included under "Undistributed."

TABLE 49.—*Disposition of surplus coke-oven gas in the United States in 1931, by States*

State	Used by producer					
	Under boilers			In steel or other affiliated plants		
	M cubic feet	Value: Total	Value: Average	M cubic feet	Value: Total	Value: Average
Alabama	5,988,110	$270,165	$0.045	11,165,027	$738,447	$0.066
Colorado				1,806,458	(1)	
Illinois	8,408	1,126	.134	1,295,172	183,996	.142
Indiana	72,885	6,180	.085	13,858,506	1,944,754	.140
Maryland				3,334,413	(1)	
Massachusetts	18,290	6,859	.375			
Michigan	(1)	(1)		(1)	(1)	
Minnesota	29,012	4,539	.156	(1)	(1)	
New York	1,143,307	67,689	.059	8,918,729	999,104	.112
Ohio	1,231,134	135,363	.110	24,763,487	2,452,710	.099
Pennsylvania	1,842,802	105,632	.057	49,089,705	4,392,927	.089
Tennessee	85,023	3,146	.037			
Utah	1,270,076	(1)				
Washington	2,102	1,471	.700			
West Virginia	1,149,331	52,771	.046	9,698,381	765,302	.079
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	(1)	(1)				
Undistributed	1,434,013	155,732		8,832,008	2,766,180	
Total	14,274,493	810,673	.057	132,761,886	14,243,420	107
From merchant ovens	5,900,237	397,949	.067	1,004,678	127,416	.127
From furnace ovens	8,374,256	412,724	.049	131,757,208	14,116,004	.107

State	Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value: Total	Value: Average	M cubic feet	Value: Total	Value: Average
Alabama	2,513,664	$377,591	$0.150	2,459,673	$349,928	$0.142
Illinois	28,176,504	6,672,483	.237	232,000	59,276	.256
Indiana	5,514,528	3,139,966	.569	2,765,887	502,095	.182
Maryland	5,019,603	(1)				
Massachusetts	13,925,414	4,007,565	.288	33,138	5,302	.160
Michigan	16,777,318	4,023,434	.240	295,755	64,431	.218
Minnesota	4,204,490	1,579,479	.376	(1)	(1)	
New Jersey	11,936,239	(1)				
New York	35,794,7[illegible]3	14,235,453	.398	1,419,357	433,472	.305
Ohio	4,518,631	988,493	.219	3,448,526	475,703	.138
Pennsylvania	16,064,809	4,687,859	.292	4,563,816	723,802	.159
Tennessee	519,520	165,207	.318			
Utah	213,519	(1)		88,012	(1)	
Washington	586,117	140,284	.239			
West Virginia				(1)	(1)	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	16,115,991	5,059,687	.314	(1)	(1)	
Undistributed		3,946,224		4,683,797	738,086	
Total	161,881,123	49,023,725	.303	19,989,961	3,352,095	.168
From merchant ovens	125,554,894	41,222,048	.328	10,152,156	1,737,484	171
From furnace ovens	36,326,229	7,801,677	.215	9,837,805	1,614,611	.164

[1] Included under "Undistributed."

CREOSOTE OIL AND PITCH

The addition of creosote oil to the list of by-products is the most striking development in by-product recovery during recent years. In 1930 coke operators reported a production of 25,679,882 gallons of creosote oil; and even under the depressed conditions of 1931, 16,291,598 gallons were recovered. Of this, 13,740,196 gallons were reported as creosote-oil distillate, as such, and 2,551,402 gallons as creosote oil in coal-tar solution.

Included in these totals is the output of the tar refinery at the Clairton (Pa.) by-product plant. The carbolic oils, phenols, and cresylic acids of this plant have not been counted by the Bureau of Mines as they were covered in former years by the Tariff Commission's annual census of dyes, but the light-oil products and the creosote oil are included in the compilations of the bureau. In addition to the Clairton plant, a number of other by-product plants were producing creosote oil by fractional condensation in stills of a new continuous type.

The sales of creosote oil in 1931 amounted to 15,827,667 gallons, and the average price obtained was $0.086 per gallon.

The quantity of pitch produced in 1931 was 78,983 tons, most of which was mixed with virgin tar and burned about the plant as fuel. A total of 4,951 tons was reported as sold at an average price of $6.11 a ton.

PHENOL AND SULPHUR

Research in the utilization of waste materials has recently developed two other by-products.

Production of crude phenol was first recorded separately by the bureau in 1928, when 57,794 gallons were reported. In 1930 the production was 136,971 gallons, and in 1931 it was 94,097 gallons. The sales in 1931 brought an average realization of $0.27 a gallon.

The recovery of sulphur in the process of gas purification is another achievement of applied research in extending the list of coke-oven by-products. In 1931 three plants reported the recovery of 1,285,751 pounds of sulphur, of which 1,279,251 pounds were sold at an average price of $0.008 a pound. The process of recovery is described by A. C. Fieldner in Reports of Investigations 3079, issued by the Bureau of Mines.

NAPHTHALENE

TABLE 50.—*Naphthalene sold by by-product coke operators, 1918 and 1928–1931*

Year	Quantity (pounds)			Value	Average receipts per pound (cents)		Receipts per ton of coke (cents)
	Crude	Refined	Total		Crude	Refined	
1918	10,403,758	5,486,689	15,890,447	$650,229	2.8	6.6	2.5
1928	[1] 10,937,429		10,937,429	135,693	[1] 1.2		.3
1929	[1] 19,659,367		19,659,367	320,272	[1] 1.6		.6
1930	[1] 13,028,904		13,028,904	161,264	[1] 1.2		.4
1931	[1] 7,360,309		7,360,309	78,946	[1] 1.1		.2

[1] Crude and refined not separated.

BY-PRODUCT COKE OVENS OWNED BY CITY GAS COMPANIES, INCLUDED BY BUREAU OF THE CENSUS IN MANUFACTURED-GAS INDUSTRY

Reference has already been made to the group of by-product coke plants installed by city gas companies, which the Bureau of the Census classifies as a part of the manufactured-gas industry and which the Bureau of Mines includes with the by-product coke industry.

The difference in classification is maintained by the two offices advisedly, in the interest of those who can use the statistics. For some purposes the census grouping is the more useful, and for others—particularly the design of ovens, technique of manufacture, and supply and demand for coal and coke—the grouping used by the Bureau of Mines is the more significant.

To compare or combine the two sets of figures, however, allowance must be made for the difference in classification, which can be done by means of the data in Table 51 prepared for the purpose by the Bureau of Mines. The table shows in parallel columns separate figures for the group of by-product coke plants operated by city gas companies (grouped by the Bureau of the Census with the manufactured-gas industry) and for all other by-product coke plants. Thus, in 1931 there were 21 active plants in the group owned by city gas companies; and they produced 3,548,818 tons of coke, 61,608,068 M cubic feet of gas, 51,652,127 gallons of tar, and 4,118,452 gallons of crude light oil. By subtracting their production from the census figures for the manufactured-gas industry anyone interested may obtain the quantities of the several products produced by gas works proper; that is, coal, oil, and water gas plants.

The table also shows the operations of the 67 plants not owned by city gas companies, which in 1931 produced 28,806,731 tons of coke, 462,489,417 M cubic feet of gas, 399,203,965 gallons of tar, and 118,410,696 gallons of crude light oil. This group of plants is that covered by the census classification of "Coke, not including gas-house coke, made in by-product ovens." The figures are compiled by the Bureau of Mines from the reports of the coke producers and are accepted by the Bureau of the Census as its record of production in the years covered by the Census of Manufactures.

The totals for both groups of plants given in the last column of the table are the figures for the by-product coke industry as defined by the Bureau of Mines and given in the other tables of this report.

TABLE 51.—*Production of coke, breeze, gas, and by-products at by-product coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other by-product coke plants, 1930 and 1931*

Product	1930			1931		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [1]	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [1]	Total
Number of active plants	67	22	89	67	21	88
Coke:						
Production ... net tons	41, 848, 344	3, 347, 361	45, 195, 705	28, 806, 731	3, 548, 818	32, 355, 549
Value	$177, 059, 474	$22, 564, 431	$199, 623, 905	$134, 540, 601	$23, 549, 522	$158, 090, 123
Average value	$4. 23	$6. 74	$4. 42	$4. 67	$6. 64	$4. 89
Screenings and breeze:						
Production ... net tons	4, 000, 267	336, 845	4, 337, 112	2, 763, 971	362, 314	3, 126, 285
Sales ... do	837, 744	3, 838	841, 582	623, 303	19, 544	642, 847
Value	$2, 318, 212	$12, 804	$2, 331, 016	$1, 558, 486	$65, 377	$1, 623, 863
Average value	$2. 77	$3. 34	$2. 77	$2. 50	$3. 35	$2. 53
Coal charged into ovens:						
Quantity ... net tons	60, 559, 470	4, 961, 851	65, 521, 321	41, 640, 819	5, 205, 458	46, 846, 277
Coke:						
Used by producer—						
Quantity ... net tons	28, 643, 611	831, 989	29, 475, 600	17, 288, 832	1, 024, 900	18, 313, 732
Value	$121, 856, 140	$6, 047, 058	$127, 903, 198	$72, 026, 931	$7, 308, 610	$79, 335, 541
Sales—						
Quantity ... net tons	12, 168, 039	2, 291, 666	14, 459, 705	10, 535, 723	2, 325, 721	12, 861, 444
Value	$68, 721, 472	$15, 137, 332	$83, 858, 804	$56, 957, 186	$14, 901, 235	$71, 858, 421

[1] Includes all by-product ovens built by city gas companies, some of which are operated in conjunction with coal, oil, and water gas plants. Does not include independent by-product plants which may sell gas to public-utility companies for distribution.

Table 51.—*Production of coke, breeze, gas, and by-products at by-product coke plants owned by city gas companies (public utilities) and included by Bureau of the Census in manufactured-gas industry, and at all other by-product coke plants, 1930 and 1931*—Continued

Product	1930			1931		
	Plants not owned by city gas companies	Plants owned by city gas companies public (utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
By-products:						
Gas—						
Production ....M cubic feet..	665, 584, 212	58, 518, 792	724, 103, 004	462, 489, 417	61, 608, 068	524, 097, 485
Sales of surplus—						
Used under boilers—						
Quantity ....M cubic feet..	20, 383, 891	24, 768	20, 408, 659	14, 254, 066	20, 427	14, 274, 493
Value..............	$1, 180, 130	$5, 285	$1, 185, 415	$802, 333	$8, 340	$810, 673
Used in steel or affiliated plants—						
Quantity ......M cubic feet..	230, 760, 545	472, 007	231, 232, 552	132, 630, 399	131, 487	132, 761, 886
Value..............	$24, 813, 131	$90, 775	$24, 903, 906	$14, 197, 053	$46, 367	$14, 243, 420
Distributed through city mains—						
Quantity ......M cubic feet..	117, 249, 384	47, 440, 343	164, 689, 727	108, 654, 245	53, 226, 878	161, 881, 123
Value..............	$29, 655, 463	$19, 283, 289	$48, 938, 752	$28, 264, 860	$20, 758, 865	$49, 023, 725
Sold for industrial use—						
Quantity ......M cubic feet..	23, 498, 272	2, 289, 118	25, 787, 390	18, 679, 873	1, 310, 088	19, 989, 961
Value..............	$3, 301, 518	$964, 546	$4, 266, 064	$2, 856, 895	$495, 200	$3, 352, 095
Tar—						
Production.....gallons..	554, 159, 771	48, 326, 158	602, 485, 929	399, 203, 965	51, 652, 127	450, 856, 092
Sales—						
Quantity.......do....	267, 307, 177	47, 558, 117	314, 865, 294	222, 129, 463	51, 035, 110	273, 164, 573
Value..............	$13, 145, 309	$2, 417, 654	$15, 562, 963	$9, 980, 449	$2, 460, 118	$12, 440, 567
Average value.........	$0. 049	$0. 051	$0. 049	$0. 045	$0. 048	$0. 046
Ammonia—						
Production (NH_3 equivalent of all forms) ....pounds..	356, 340, 566	28, 170, 557	384, 511, 123	255, 247, 138	29, 745, 613	284, 992, 751
Liquor (NH_3 equivalent)—						
Production.pounds..	45, 310, 725	3, 720, 408	49, 031, 133	35, 757, 003	3, 332, 085	39, 089, 088
Sales............do....	41, 713, 100	3, 655, 190	45, 368, 290	33, 982, 437	3, 364, 707	37, 347, 144
Value..............	$2, 105, 647	$130, 416	$2, 236, 063	$1, 390, 392	$75, 606	$1, 465, 998
Sulphate—						
Production.pounds..	1, 244, 119, 364	97, 800, 596	1, 341, 919, 960	877, 960, 541	105, 654, 110	983, 614, 651
Sales............do....	1, 215, 183, 826	95, 404, 496	1, 310, 588, 322	905, 244, 708	102, 317, 095	1, 007, 561, 803
Value..............	$18, 896, 958	$1, 551, 675	$20, 448, 633	$11, 469, 496	$1, 342, 926	$12, 812, 422
Crude light oil—						
Production.....gallons..	175, 120, 265	3, 205, 687	178, 325, 952	118, 410, 696	4, 118, 452	122, 529, 148
Sales..............do....	8, 249, 015	1, 692, 889	9, 941, 904	5, 724, 245	3, 014, 957	8, 739, 202
Value..............	$818, 581	$164, 959	$983, 540	$478, 576	$231, 530	$710, 106
Light-oil derivatives—						
Production.....gallons..	144, 215, 469	1, 217, 358	145, 432, 827	97, 693, 830	835, 206	98, 529, 036
Sales ....do....	140, 187, 172	1, 179, 438	141, 366, 610	95, 101, 844	875, 473	95, 977, 317
Value..............	$22, 455, 182	$216, 168	$22, 671, 350	$13, 534, 164	$145, 690	$13, 679, 854
Naphthalene, crude and refined—						
Production....pounds..	12, 566, 302	73, 800	12, 640, 102	7, 613, 612	9, 317	7, 622, 929
Sales..............do....	12, 955, 104	73, 800	13, 028, 904	7, 350, 992	9, 317	7, 360. 309
Value..............	$160, 674	$590	$161, 264	$78, 806	$140	$78, 946
All other products, value.	$2, 682, 959	$52, 812	$2, 735, 771	$1, 537, 388	$37, 898	$1, 575, 286

COAL[1]

CONTENTS

Part I—Bituminous coal, by W. H. Young, L. Mann, and F. G. Tryon

Part II—Pennsylvania anthracite, by F. E. Berquist, H. L. Bennit, and F. G. Tryon

ILLUSTRATIONS

[1] Work on manuscript completed December, 1932.

Part 1.—BITUMINOUS COAL

By W. H. Young, L. Mann, and F. G. Tryon

REVIEW OF INDUSTRY IN 1931

Unusually mild weather and the general business recession were the principal factors influencing the bituminous coal-mining industry adversely in 1931. The total production for the year—382,089,396 net tons—represented a decrease of 18.3 per cent compared with 1930 and a decrease of 26.4 per cent compared with the average for the 5 years 1926 to 1930. Indeed, in no year since 1909, when 379,744,257 tons were produced, has production fallen so low. The output in 1931 was 8.1 per cent below that in 1921, the year of postwar depression.

Important developments in the bituminous-coal industry in 1931 are summarized graphically in Figure 18. The long-time trend of production, which reflects changing business conditions, is well illustrated in Figure 19.

Influence of depression.—Of the two major influences that affected the bituminous-coal market during the past year the depression was, of course, the more important. Since approximately three-fourths of the bituminous coal produced is used for industrial purposes, the soft-coal industry has always been highly sensitive to changes in business conditions. (See fig. 19.) Frequently, however, the close relationship between rate of industrial activity and bituminous-coal production is obscured by other factors such as unusual demand from abroad, requirements of the household trade, and flow of coal in and out of storage. Thus, in 1930, the first year of the current depression, coal mining was to some extent sustained by the demand from certain important coal-consuming industries which were the beneficiaries of the public-works program undertaken in an effort to relieve unemployment. The prolonged drought in 1930 also aided the coal industry, since it curtailed the output of hydroelectricity and consequently stimulated consumption of coal by the electric public utilities. Largely as a result of these circumstances the production of bituminous coal in 1930 fell only 12.6 per cent short of the 1929 level, although manufacturing activity (as measured by the Federal Reserve Board's composite index) declined 20.6 per cent.

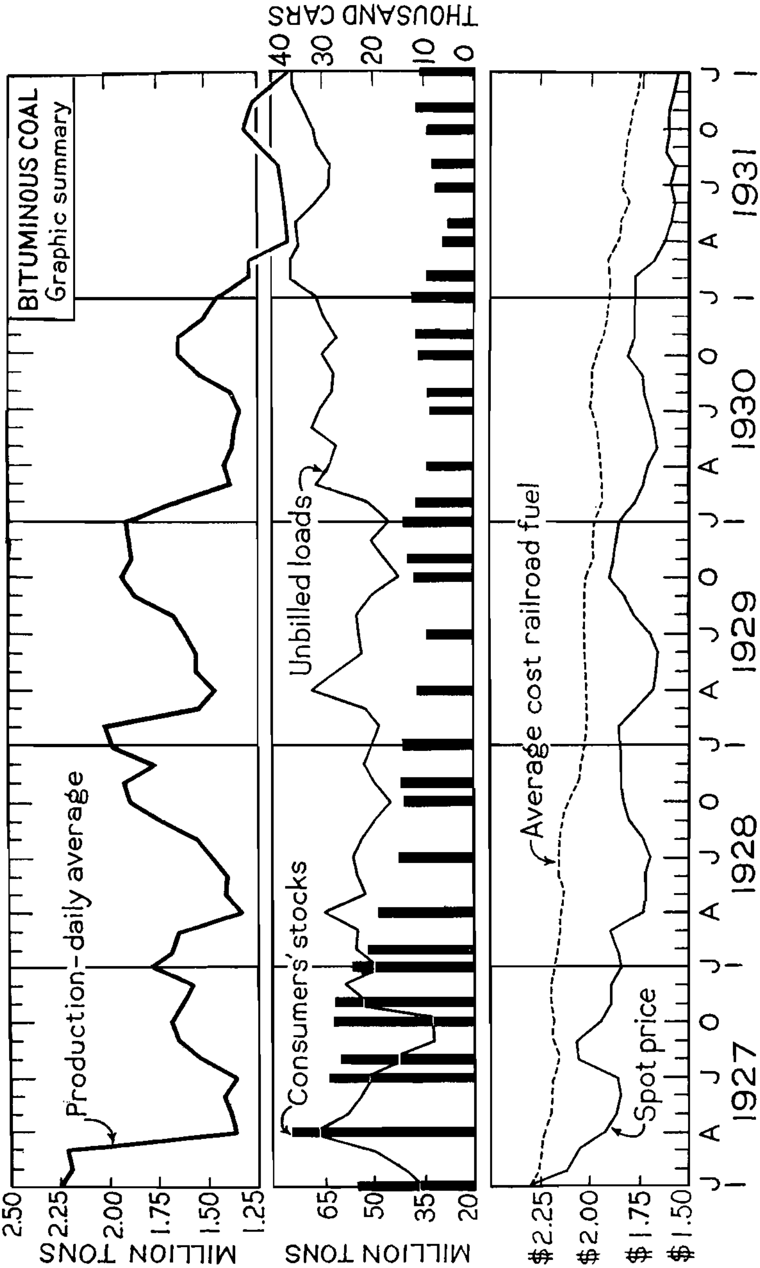

FIGURE 18.—Current trends of production, stocks, and prices of bituminous coal, 1927–1931

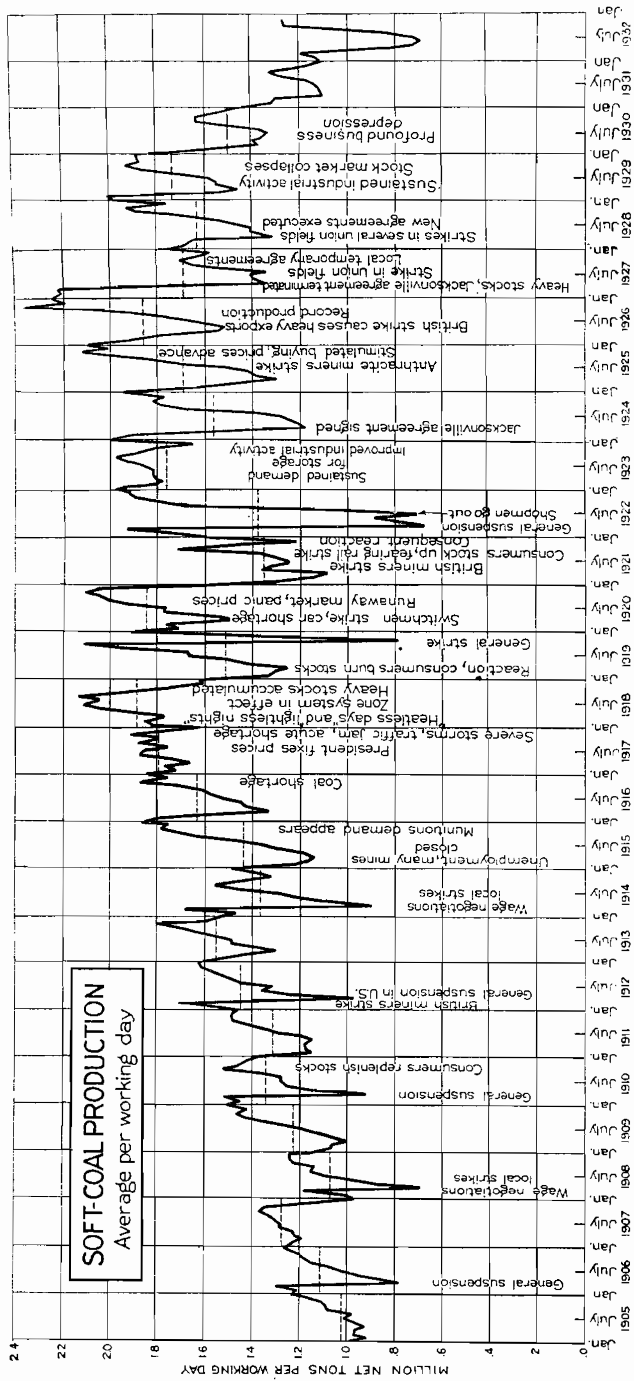

FIGURE 19.—Average production of bituminous coal per working day in each month, 1905–1931

Both of the factors which had tended to buoy up coal mining in 1930 disappeared in 1931. Mounting State and Federal deficits resulted in retrenchment of the public construction programs; the requirements of coal for the production of electricity were reduced by the return of normal water supplies for hydroelectric plants; and the extremely warm weather cut down demand, increasing distress in the coal industry. The contraction in bituminous production in 1931 (18.3 per cent) was much more pronounced than that in manufacturing activity (15.6 per cent as shown in the Federal Reserve Board's composite index).

In spite of this marked reduction, the soft-coal industry fared somewhat better than certain other branches of business. Pig-iron production in 1931, for example, was 41.8 per cent less than in the preceding year, while declines of 31.2 per cent and 32 per cent were recorded in the automobile and construction industries, respectively. Loadings of revenue freight in 1931 were 18.5 per cent below the level of the previous year.

Effect of abnormal weather.—Although it is impossible to measure in quantitative terms the influence of the weather on the demand for coal, it has long been recognized that variations in temperature averages are registered in the ebb and flow of coal consumption from year to year. These variations in temperature are not only reflected in household consumption but also in consumption for heating purposes in factories, railroad stations, and office buildings. Industrial and locomotive consumption are likewise affected materially by changes in weather conditions. The consumption of coal by the railroads per ton-mile, for example, is materially higher in winter than in summer.

That the weather during 1931 was highly conducive to a curtailed consumption of coal is indicated by the reports of the United States Weather Bureau, which show that unseasonably warm weather prevailed throughout the year in virtually all parts of the country. The most pronounced departure from normal weather conditions was in the Lake Dock Territory, embracing Minnesota, Wisconsin, Michigan, and Iowa, where the average mean temperature for the year was the highest ever recorded by the Weather Bureau. All previous records were likewise broken in New Jersey. With the exception of 1921, the highest mean temperature since the beginning of the record was registered in New York, Pennsylvania, Ohio, Indiana, Illinois, and Missouri. The average temperature in New England in 1931 was exceeded only twice in the past 44 years.

Most significant to the coal trade, however, was the fact that the high temperatures were especially marked during the months of the heating season. In Minnesota, for example, the average mean temperature for the year as a whole was only 6° above normal; but in January the temperature was 13° above normal, in February 15.4°, and in December 10.4°. Much the same condition prevailed in New England and the Middle Atlantic and Central States, all important coal-consuming areas. Thus, there can be little doubt that the unusually mild weather had an important influence in restricting the demand for coal in 1931.

Inroads of competitive fuels.—Still another factor to be taken into account in any appraisal of the coal market in 1931 is the influence of competitive sources of power. During the past decade fuel oil and natural gas have made serious inroads on bituminous coal, and competition from these fuels continued to be a disturbing factor in the coal trade in 1931. Fuel-oil deliveries in 1931 totaled 356,536,829 barrels (11 per cent less than the 401,209,692 barrels in 1930), while the production of bituminous coal slumped 18.3 per cent. The contrast is still more striking if the consumption of fuel oil for certain uses is considered; for example, consumption for domestic heating declined only 4.3 per cent, while that by the United States Navy was 6 per cent more than in 1930. The railroads used 16.9 per cent less bituminous coal in 1931 than in 1930 but only 14.4 per cent less fuel oil. Coal lost further ground to fuel oil for bunkering purposes, the decrease being 37.2 per cent for coal and only 11.3 per cent for fuel oil. Examination of the fuel-oil data on a regional basis shows that the consumption fell least in the New England States and in the Middle Atlantic States, regions which for many years were supplied entirely by coal. In the distribution of fuel oil by regions, the Rocky Mountain area lost

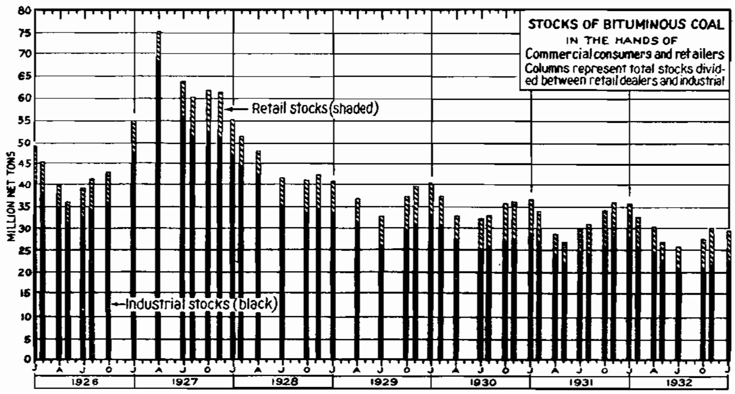

FIGURE 20.—Trend of stocks of bituminous coal in the hands of commercial consumers and retailers

nearly 30 per cent in 1931 compared with 1930, and deliveries declined approximately 20 per cent in the Pacific Coast States. The South Central States and the South Atlantic States required about 10 per cent less fuel oil in 1931 than in 1930. The smallest losses in 1931 were in the New England States (5 per cent) and the Middle Atlantic States (3 per cent). Thus it is obvious that fuel oil continues to be a serious competitor of coal.

Measured in terms of proportionate increases or decreases, natural gas proved an even more formidable competitor of coal than was fuel oil in 1931; however, in judging the following data it must be remembered that natural gas was also a competitor of fuel oil in 1931. The marketable production of natural gas totaled 1,686,436 million cubic feet, 13 per cent less than in 1930. Uses that are definitely not competitive with coal, however, accounted for most of the decline; for instance, the consumption of natural gas in the field and in the manufacture of carbon black, representing 45.5 per cent of the total consumption in 1931, declined 22.5 per cent compared with 1930, while consumption for all other uses fell only 3.6 per cent. Particularly significant to coal producers is the fact that the domestic and commercial consumption of natural gas increased 1.2 per cent and the consumption of natural gas by electric public-utility power plants 15.8 per cent, while their consumption of coal declined 9.7 per cent. With extension of long-distance pipe lines into Indiana, Illinois, Ohio, and Missouri, natural gas began definite invasion of coal-consuming territory, Ohio being the largest consumer of natural gas for domestic and commercial uses in 1931. Natural gas therefore appears to be

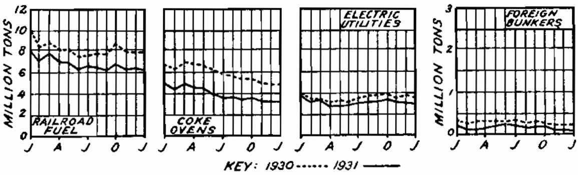

FIGURE 21.—Monthly consumption of bituminous coal by locomotives of Class I railroads, by-product and beehive coke ovens, electric public utilities, and ships engaged in foreign trade, 1930 and 1931

one of the important factors in accounting for the low production of bituminous coal in 1931.

A detailed analysis of the various phases of the situation in the bituminous industry in 1931 reveals the effects of the above factors on the industry. Frequently, all three assisted by other minor factors, influenced the situation, and the following analysis is made in the light of these influences.

Liquidation of consumers' stocks.—Contrary to what has sometimes occurred during periods of recession, stocks of coal in the hands of consumers decreased in 1931. Production fell short of consumption during the first half of 1931, and there was a substantial draft on

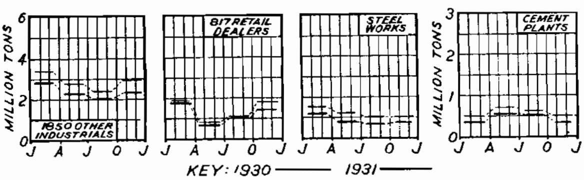

FIGURE 22.—Average monthly rate of consumption at steel works, cement plants, representative industrial plants, and the average rate of deliveries of a selected list of retail coal dealers, 1930 and 1931

stocks. In the fall consumers added appreciably to their reserves so that the net decline in stocks for the year was only 1,700,000 tons. (See fig. 20.)

Downward trends in consumption and distribution.—The extent to which depressing influences affected the situation is revealed in the low consumption of bituminous coal in the United States in 1931. Allowing for exports, imports, and changes in commercial stocks consumption during the year totaled 371,869,000 tons compared with 454,990,000 tons in 1930, a decline of 18.3 per cent.

All the principal consumers used less coal in 1931 than in 1930, although some were affected more seriously than others. These differences are reflected in Figure 21, which traces the monthly trend in four important branches of consumption. It is particularly interesting to note that consumption of bituminous coal by Class I railroads declined 16.9 per cent in 1931 compared with 1930; by coke plants, 30.4 per cent; by electric public utilities, 9.7 per cent; and of bunker coal supplied to ships in foreign trade, 37.2 per cent.

Figure 22 summarizes the trend of consumption for four other important groups of consumers.

The reduced consumption was also reflected in the major movements of coal to market. (See fig. 23.) The tidewater trade dropped 9.9 per cent compared with the previous year and the lake coal traffic 17.7 per cent, while the movement to New England decreased 9.7 per cent. Exports fell 23.6 per cent, being the lowest since 1910.

Decline in prices.—Although prices were lower in 1931 than in 1930 the drop was not as serious as that in other commodities. In contrast with a decline of 9.4 per cent in average sales realization at the mines, the index of wholesale prices for all commodities, compiled by the Bureau of Labor Statistics, dropped 17.6 per cent.

Decrease in mines, miners, and working time.—The coal industry is still composed of many competing units. In all, 5,642 commercial mines, only 249 less than in 1930, managed to operate, even during

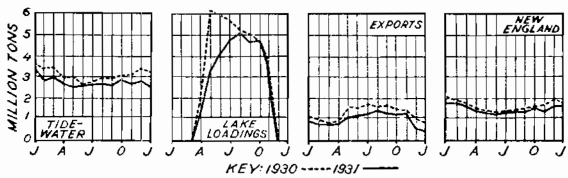

FIGURE 23.—Monthly movement of bituminous coal in the major currents of distribution, 1930 and 1931

the distressed conditions of 1931. The number of men employed was 450,213 compared with 493,202 in 1930, a shrinkage of only 8.7 per cent. There was a sharp reduction in working time, however; the average number of days worked dropped from 187 in 1930 to 160 in 1931. As the potential working time is 308 days the bituminous mines operated 52 per cent of full time. (See fig. 24.) Compared with the severe curtailment in other industries, such as steel, the showing made by coal does not present such a discouraging picture.

Continued progress in mechanization, output per man per day, and fuel efficiency.—Continued progress was made in efficiency of mining and of coal utilization in 1931. The average production per man per day rose from 5.06 tons in 1930 to 5.30 tons in 1931. The gain reflected in some degree the closing of less efficient properties under pressure of competition but was due largely to the advance of mechanization. Although the total tonnage produced by hand mining fell 21 per cent, mechanized loading increased 1.2 per cent. Moreover, the record for the year shows a larger proportion of the total output mined by stripping methods than ever before; a gain was also reported in the proportion undercut by machines.

All major branches of consumption, including railroads, electric public-utility power plants, and iron and steel works, recorded additional savings in the utilization of bituminous coal in 1931. This fact doubtless influenced the low consumption of coal during the year.

ACKNOWLEDGMENTS

This report marks the fifty-first year of the continuous statistical record of coal production in Mineral Resources of the United States. Like its predecessors, the report is made possible by the voluntary cooperation of those interested in the coal industry, and it is a pleasure to record the generous support of the thousands of individual producers, distributors, and consumers who have supplied information. Detailed reports on production and mine operation have been made

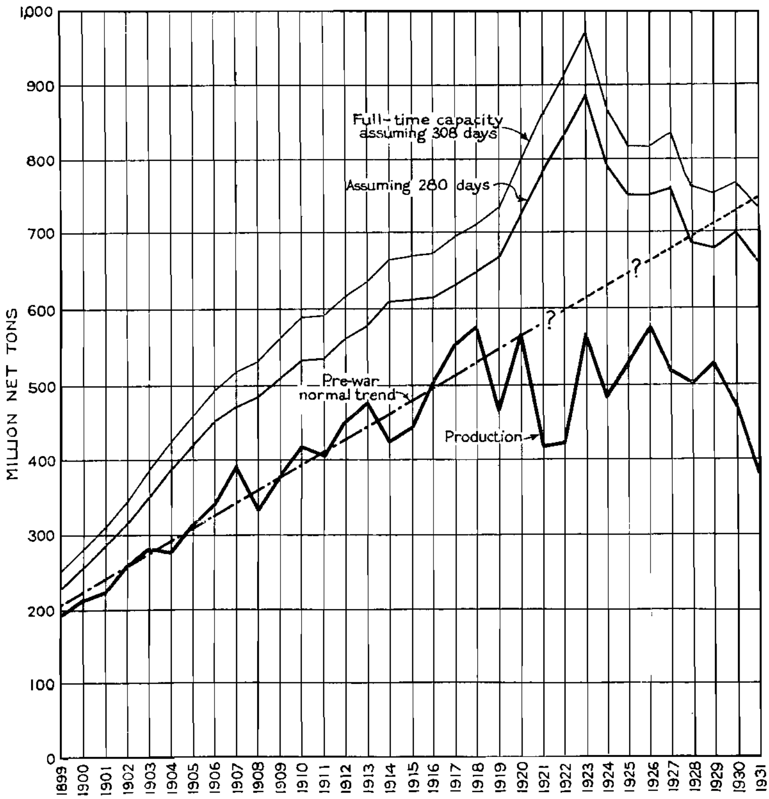

FIGURE 24.—Trend of bituminous-coal production and coal-mine capacity in the United States, 1899–1931

by about 5,700 commercial mines and on stocks and consumption by approximately 5,000 representative consumers.

Particularly valuable has been the help afforded by the traffic managers of the coal-originating railroads, who have furnished detailed records of shipments on their lines. For the weekly and daily information on cars of coal loaded, which forms the principal basis of the current estimates of weekly production, the bureau is under obligations to M. J. Gormley, chairman of the car-service division of the American Railway Association, and particularly to H. E. Ewin and G. Freeburg. Current records of shipments by waterways have been furnished by the United States Engineers.

Acknowledgment is also made of the generous help of the State mine inspectors, who have assisted in the collection of returns by furnishing information in their files, thereby increasing the accuracy of the statistics. Data have been given by W. B. Hillhouse, chief mine inspector, Birmingham, Ala.; Claude Speegle, State inspector of mines, Fort Smith, Ark.; James Dalrymple, chief inspector of coal mines, Denver, Colo.; J. S. Millhouse, director department of mines and minerals, Springfield, Ill.; A. C. Dally, chief mine inspector, Indianapolis, Ind.; P. R. Clarkson, secretary to the mine inspectors, Des Moines, Iowa; William Keegan, State mine inspector, Pittsburg, Kans.; J. F. Daniel, chief inspector of mines, Lexington, Ky.; John J. Rutledge, chief mine engineer, Maryland Bureau of Mines, Baltimore, Md.; F. G. Fenix, chief inspector, Joplin, Mo.; Edward Davies, State coal-mine inspector, Helena, Mont.; Edwin Rupp, State coal-mine inspector, Bismarck, N. Dak.; J. B. Gilbert, chief division of labor statistics, Columbus, Ohio; James R. Ballard, department of mines, Oklahoma City, Okla.; W. H. Glasgow, secretary of mines, department of mines, Harrisburg, Pa.; A. W. Evans, chief mine inspector, Nashville, Tenn.; W. A. Roy, State mine inspector, Laredo, Tex.; W. A. Wilson, chief mine inspector, Seattle, Wash.; R. M. Lambie, chief, department of mines, Charleston, W. Va.; and Lyman Fearn, chief coal-mine inspector, Rock Springs, Wyo.

The bureau finds of especial value the cooperation of the secretaries of local associations of coal operators on account of their intimate knowledge of conditions in their several districts. Many of them have supplied current reports of production by fields. For information on 1931 the bureau is indebted to P. H. Greenlaw, secretary, Fifth and Ninth District Coal Traffic Bureau, St. Louis, Mo.; Jonas Waffle, managing director, Coal Trade Association of Indiana, Terre Haute, Ind.; C. E. Reed, secretary, West Kentucky Coal Bureau, Louisville, Ky.; J. E. Johnson, secretary, Hazard Coal Operators' Exchange, Lexington, Ky.; George S. Ward, secretary, Harlan County Coal Operators' Association, Harlan, Ky.; R. F. Chumley, statistician, Utah Coal Producers' Association, Salt Lake City, Utah; C. B. Neel, secretary, Virginia Coal Operators' Association, Norton, Va.; A. W. Laing, treasurer, Winding Gulf Operators' Association, Beckley, W. Va.; S. C. Higgins, secretary-traffic manager, New River Coal Operators' Association, Mount Hope, W. Va.; T. N. Moran, secretary, Fairmont Coal Operators' Association, Fairmont, W. Va.; A. O. Wilson, statistician, Kanawha Coal Operators' Association, Charleston, W. Va.; D. F. Hurd, secretary, Eastern Ohio Coal Operators' Association, Cleveland, Ohio; Walter A. Jones, secretary, Central Pennsylvania Coal Producers' Association; and C. W. Gibbs, secretary, Coal Operators' Association of the Thick Vein Freeport Seam, Harwick, Pa. To these and many others who have supplied information cordial acknowledgment is made.

STATISTICAL SUMMARY

TABLE 1.—*Salient statistics of the coal industry in 1931*

	Bituminous	Anthracite
Production ... net tons	382,089,396	59,646,652
Value at mines	$588,895,000	$296,355,000
Average value per ton	$1.54	$4.97
Number of active mines of commercial size	5,642	[1] 264
Stocks of commercial consumers:		
Jan. 1 ... net tons	37,200,000	[2]
Dec. 31 ... do	35,500,000	[2]
Net change during year ... do	−1,700,000	[2]
Exports ... do	12,126,299	1,778,000
Imports ... do	206,303	638,000
Consumption (calculated) ... do	371,869,000	58,408,000
Capacity of mines with present labor force (assuming 303.5 working days in the anthracite field and 308 working days in the bituminous field) ... net tons	736,000,000	100,000,000
Average number of days worked	160	181
Average days idle:		
All causes	148	122.5
Through strikes and lockouts	3	4.1
Other causes	145	118.4
Average number employed:		
Miners, loaders, and shot firers	289,866	74,435
Haulage and track	50,069	12,774
Other underground	47,859	22,071
Surface	62,419	30,151
Output per man:		
Per day ... net tons	5.30	2.37
Per year ... do	849	428
Number of cutting machines	13,216	203
Quantity cut by machines ... net tons	302,262,746	1,587,265
Per cent of output cut by machines	79.1	2.8
Number of power shovels in strip pits	314	189
Quantity mined by stripping ... net tons	18,932,381	3,813,237

[1] Number of breakers, washeries, dredges, and a small number of independent operations.
[2] Data not available. For changes in producers' stocks see Table 3.

TABLE 2.—*Summary of coal produced, value, men employed, days worked, and output per man per year, by States, in 1931*

State	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Underground: Miners, loaders, and shot firers	Underground: Haulage and track	Underground: All others	Surface: In strip pits	Surface: All others	Total		
Alabama	11,645,980	288,739	64,062		11,998,781	$21,866,000	$1.82	14,969	2,438	2,580	179	2,807	22,973	136	522
Alaska	99,500	5,300	1,100		105,900	556,000	5.25	30	6	13		31	80	277	1,324
Arizona		7,120			7,120	42,000	5.90	20	2	2		3	27	115	264
Arkansas	1,121,368	23,730	8,457		1,153,555	3,511,000	3.04	3,344	426	340	36	587	4,733	95	244
California, Idaho, Nevada, and Oregon	5,952	10,430	1,003		17,385	88,000	5.06	60	15	16		25	116	86	150
Colorado	5,348,313	1,051,513	145,392	59,151	6,604,369	15,944,000	2.41	6,735	1,026	736	12	1,519	10,028	142	659
Georgia	20,880	50	650		21,580	45,000	2.09	45	7	4		6	62	180	348
Illinois	39,957,676	3,660,872	684,747		44,303,295	75,527,000	1.70	29,865	5,734	6,742	1,516	5,828	49,685	136	892
Indiana	13,135,525	920,239	239,401		14,295,165	20,735,000	1.45	6,963	1,352	1,126	1,635	1,235	12,311	146	1,161
Iowa	2,442,377	907,308	38,670		3,388,355	8,575,000	2.53	5,840	752	635		670	7,897	142	429
Kansas	1,747,815	215,831	23,224		1,986,870	3,771,000	1.90	2,448	295	183	523	364	3,813	123	521
Kentucky	38,834,905	845,176	283,540		39,963,621	50,745,000	1.27	29,631	5,818	5,744	85	6,488	47,766	159	837
Maryland	1,894,369	100,807	10,597		2,005,773	2,907,000	1.45	2,252	347	275		350	3,224	190	622
Michigan	329,364	18,087	11,952		359,403	1,094,000	3.04	949	192	136		95	1,372	96	262
Missouri	3,134,936	449,885	35,676		3,620,497	7,248,000	2.00	3,241	381	326	919	495	5,362	142	675
Montana	2,234,392	125,714	17,946		2,378,052	4,299,000	1.81	913	227	124	56	352	1,672	153	1,422
New Mexico	1,434,784	64,484	53,554		1,552,822	4,597,000	2.96	1,948	280	189		413	2,830	145	549
North Carolina	1,600	583	180		2,363	9,000	3.81	17	3	3		9	32	83	74
North Dakota	1,147,142	355,262	16,903		1,519,307	2,155,000	1.42	632	86	54	275	253	1,300	166	1,169
Ohio	18,535,771	1,766,367	108,857		20,410,995	25,371,000	1.24	17,888	2,170	2,076	400	2,551	25,085	174	814
Oklahoma	1,825,893	61,434	21,067		1,908,394	4,614,000	2.42	2,971	491	423	285	464	4,634	115	412
Pennsylvania, bituminous	89,830,912	5,816,448	739,434	1,271,904	97,658,698	155,060,000	1.59	81,954	10,712	11,094	194	12,772	116,726	169	837
South Dakota	7,023	20,462			27,485	64,000	2.33	11	3	3	34	5	56	127	491
Tennessee	4,542,520	105,824	39,281	33,923	4,721,548	6,942,000	1.47	5,118	754	581		995	7,448	171	634
Texas	703,477	2,666	9,877		716,020	1,070,000	1.49	782	124	98	24	120	1,148	140	624
Utah	3,273,762	61,936	6,911	7,435	3,350,044	7,442,000	2.22	1,854	448	274		692	3,268	140	1,025
Virginia	9,392,255	102,918	39,386	164,121	9,698,680	14,060,000	1.45	6,479	1,577	1,664		1,637	11,357	175	854
Washington	1,622,947	197,540	25,017	957	1,846,461	5,800,000	3.14	1,692	260	281		429	2,662	170	694
West Virginia	98,316,214	2,546,451	420,316	190,191	101,473,172	132,762,000	1.31	58,377	13,507	11,688	7	14,208	97,787	176	1,038
Wyoming	4,690,401	145,286	157,999		4,993,686	11,996,000	2.40	2,838	636	449	25	811	4,759	154	1,049
Total bituminous, 1931	357,278,053	19,878,462	3,205,199	1,727,682	382,089,396	588,895,000	1.54	289,866	50,069	47,859	6,205	56,214	450,213	160	849
Total bituminous, 1930	437,398,569	22,121,055	3,992,760	4,013,915	467,526,299	795,483,000	1.70	313,617	57,343	55,782	66,460		493,202	187	948
Pennsylvania anthracite, 1931	52,635,855	2,901,117	3,985,786		[1] 59,645,652	296,355,000	4.97	74,435	12,774	22,071	2,232	27,919	139,431	181	428
Pennsylvania anthracite, 1930	61,202,057	3,144,434	5,038,346		69,384,837	354,574,000	5.11	78,770	13,736	26,244	32,054		150,804	208	460
Grand total, 1931	409,913,908	22,779,579	7,190,985	1,727,682	[1] 441,735,048	885,250,000	2.00	364,301	62,843	69,930	8,437	84,133	589,644	165	749
Grand total, 1930	498,600,626	25,265,489	9,031,106	4,013,915	536,911,136	1,150,057,000	2.14	392,387	71,079	82,026	98,514		644,006	192	834

[1] Includes 122,894 tons of anthracite stored at collieries.

TABLE 3.—*Production, imports, exports, and consumption of anthracite and bituminous coal, 1927–1931, in net tons*

Calendar year	Production	Imports	Exports to— Canada and Mexico	Exports to— All other countries	Net changes in stocks [1]	Consumption in the United States [2]
Anthracite:						
1927	80,096,000	119,000	3,248,000	78,000	+2,218,000	74,671,000
1928	75,348,000	385,000	3,298,000	38,000	−1,254,000	73,651,000
1929	73,828,000	487,000	3,378,000	28,000	−548,000	71,457,000
1930	69,385,000	675,000	2,533,000	19,000	−119,000	67,627,000
1931	59,646,000	638,000	1,773,000	5,000	+98,000	58,408,000
Bituminous:						
1927	517,763,000	550,000	14,724,000	3,288,000	+500,000	499,801,000
1928	500,745,000	547,000	14,050,000	2,114,000	−13,700,000	498,828,000
1929	534,989,000	495,000	14,727,000	2,702,000	−1,500,000	519,555,000
1930	467,526,000	241,000	13,667,000	2,210,000	−3,100,000	454,990,000
1931	382,089,000	206,000	10,647,000	1,479,000	−1,700,000	371,869,000

[1] Anthracite figures are producers' stocks; bituminous, consumers' stocks. Plus sign denotes coal produced but added to stocks and not consumed; minus sign denotes coal consumed that was withdrawn from stocks carried over from preceding year. Bituminous data from reports on consumers' stocks of bituminous coal, issued by U. S. Bureau of Mines.

[2] Production tonnage, plus imports and minus exports, plus or minus the decrease or increase, respectively, of the net change in coal stocks.

TABLE 4.—*Coal produced underground per man employed underground per day worked, 1927–1931, in net tons*

Year	Anthracite	Bituminous	Year	Anthracite	Bituminous
1927	2.58	5.11	1930	2.63	5.61
1928	2.60	5.26	1931	2.70	5.85
1929	2.64	5.42			

METHODS OF COLLECTING STATISTICS

The principal statistics for each State in 1931 are given in Table 2. They are based upon written reports from the producers, and most of them were signed by responsible officers of the operating companies. It is believed that virtually complete returns are received for all mines, big and little, which ship by rail or water and for all those of commercial size which serve a purely local market. The figures, however, do not purport to cover the thousands of country banks and small wagon mines from which less than 1,000 tons of coal a year are mined.

In the present report the standard unit of measurement is the net or short ton of 2,000 pounds.

In statistical reports of the Bureau of Mines the anthracite industry of Pennsylvania and the bituminous-coal industry are listed separately. The statistics of the bituminous-coal industry published in this and preceding reports include data for anthracite and semianthracite mined outside of Pennsylvania, as well as for lignite.

More detailed information on the methods of collecting the statistics appears in coal reports for previous years.

RELATIVE RATE OF GROWTH OF COAL AND OTHER SOURCES OF POWER

The national production of energy during 1931 was 10.7 per cent greater than in 1921, the year of the last major depression. In 1931 the total supply of available energy in the form of coal, oil, natural gas, and water power was 20,557 trillion B. t. u., as against 18,563 trillion in 1921. Compared with 1930 the year 1931 shows a 13.8 per cent decrease. (See fig. 25.)

The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons

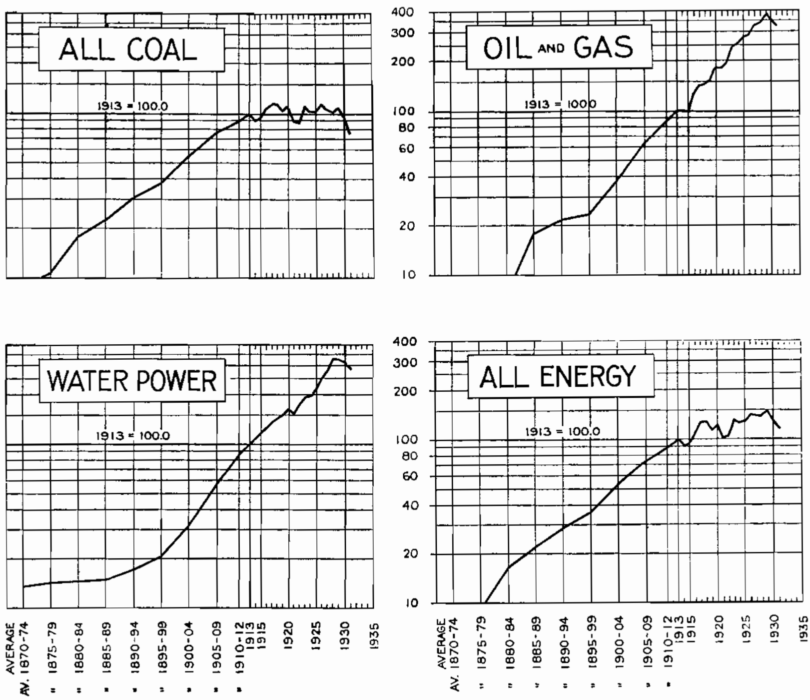

FIGURE 25.—Relative rate of growth of annual supply of coal, oil and gas, and water power in the United States, 1870-1931

of coal, barrels of oil, and cubic feet of gas. Table 5 summarizes the equivalent of each fuel in British thermal units. Water power is represented by the equivalent of the coal necessary to perform the same work.

It is important to note that the figures for "domestic oil," as in earlier reports, represent the entire production of crude petroleum. They include, therefore, not only energy used in the form of fuel oil under boilers, and consequently competing more or less directly with coal, but also that used in the form of gasoline, kerosene, and other refined products. Even the latter involve a measure of indirect competition with coal, for the energy market of the country is becoming more and more interchangeable and competitive, and a demand which can not be met by one source of supply tends to fall back on the others. The purpose of these tables is to measure the total demand for energy.

TABLE 5.—*Annual supply of energy from mineral fuels and water power in the United States, 1913, 1923, and 1929–1931*

[Figures represent trillions of British thermal units and because of rounding do not always add across exactly. In calculating thermal equivalents, the gross British thermal unit values are used. Water power is represented by British thermal units of coal necessary to produce the same amount of power. Figures represent production except those for oil imports and take no account of changes of stock. Corresponding data for earlier years will be found in Coal in 1930, p. 623]

Year	Anthracite	Bituminous coal	Total coal	Domestic oil (total crude, including that refined)	Natural gas (total production)	Imported oil (total crude, including that refined)	Total oil and gas	Total mineral fuels	Water power	Grand total, including water power
1913	2,490	12,535	15,025	1,491	626	102	2,219	17,243	588	17,831
1923	2,539	14,791	17,330	4,394	1,082	492	5,968	23,298	1,136	24,434
1929	2,008	14,017	16,025	6,044	2,062	474	8,580	24,605	1,929	26,534
1930	1,887	12,249	14,136	5,388	2,089	373	7,850	21,986	1,856	23,842
1931	1,622	10,011	11,633	5,106	1,813	284	7,203	18,836	1,721	20,557

PRODUCTION

PRODUCTION SUMMARIES, BY STATES

TABLE 6.—*Coal produced in 1931, by States, and highest recorded production*

State	1931 (net tons)	Maximum production		State	1931 (net tons)	Maximum production	
		Year	Net tons			Year	Net tons
Alabama	11,998,781	1926	21,000,962	North Carolina	2,363	1922	78,570
Alaska	105,900	1928	126,100	North Dakota	1,519,307	1929	1,862,130
Arkansas	1,153,555	1907	2,670,438	Ohio	20,410,995	1920	45,878,191
California	[1] 24,505	1880	280,155	Oklahoma	1,908,394	1920	4,849,288
Colorado	6,604,369	1917	12,483,336	Pennsylvania, bituminous	97,658,698	1918	178,550,741
Georgia	21,580	1903	416,951	South Dakota	27,485	1931	27,485
Illinois	44,303,295	1918	89,291,105	Tennessee	4,721,548	1910	7,121,380
Indiana	14,295,165	1918	30,678,634	Texas	716,020	1913	2,429,144
Iowa	3,388,355	1917	8,965,830	Utah	3,350,044	1920	6,005,199
Kansas	1,986,870	1918	7,561,947	Virginia	9,698,680	1926	14,133,386
Kentucky	39,963,621	1927	69,123,998	Washington	1,846,461	1918	4,082,212
Maryland	2,005,773	1907	5,532,628	West Virginia	101,473,172	1927	145,122,447
Michigan	359,403	1907	2,035,858	Wyoming	4,993,686	1920	9,630,271
Missouri	3,620,497	1917	5,670,549	Pennsylvania anthracite	59,645,652	1917	99,611,811
Montana	2,378,052	1918	4,532,505				
New Mexico	1,552,822	1918	4,023,239				

[1] Includes Arizona, Idaho, Nevada, and Oregon.

TOTAL PRODUCTION SINCE BEGINNING OF MINING

TABLE 7.—*Coal produced, by States, 1927–1931, with cumulative total production from the earliest record to the end of 1931, in thousands of net tons*

State	1927	1928	1929	1930	1931	Total production from earliest record to end of 1931
Alabama	19,766	17,621	17,944	15,570	11,999	569,033
Arkansas	1,549	1,661	1,695	1,533	1,154	65,304
Colorado	9,724	9,848	9,921	8,197	6,604	355,309
Georgia	77	58	45	7	22	10,769
Illinois	46,848	55,948	60,658	53,731	44,303	2,146,677
Indiana	17,936	16,379	18,344	16,490	14,295	627,870
Iowa	2,950	3,684	4,241	3,893	3,388	287,067
Kansas	3,444	2,810	2,976	2,430	1,987	213,862
Kentucky	69,124	61,860	60,463	51,209	39,964	964,675
Maryland	2,815	2,687	2,649	2,271	2,006	230,429
Michigan	757	617	805	661	359	40,625
Missouri	3,064	3,733	4,030	3,853	3,621	189,710
Montana	3,144	3,324	3,408	3,022	2,378	99,513
New Mexico	2,935	2,712	2,623	1,969	1,553	96,321
North Carolina	53	61	52	29	2	1,013
North Dakota	1,528	1,650	1,862	1,700	1,519	26,125
Ohio	15,800	15,641	23,689	22,552	20,411	1,210,917
Oklahoma	3,818	3,501	3,774	2,794	1,908	120,960
Oregon	(1)	(1)	(1)	(1)	(1)	[2] 2,380
Pennsylvania, bituminous	132,965	131,202	143,516	124,463	97,659	5,331,994
Tennessee	5,783	5,611	5,405	5,130	4,721	224,289
Texas	1,326	1,182	1,101	834	716	52,634
Utah	4,781	4,843	5,161	4,258	3,350	113,667
Virginia	12,916	11,901	12,748	10,907	9,699	288,702
Washington	2,635	2,520	2,521	2,302	1,846	115,370
West Virginia	145,122	132,952	138,519	121,473	101,473	2,636,493
Wyoming	6,754	6,572	6,705	6,088	4,994	246,228
Other States	149	167	134	160	158	46,052
Total bituminous	517,763	500,745	534,989	467,526	382,089	16,313,988
Pennsylvania anthracite	80,096	75,348	73,828	69,385	59,646	3,921,199
Grand total	597,859	576,093	608,817	536,911	441,735	20,235,187

[1] Included under "Other States."
[2] Total through 1920.

PRODUCTION, BY FIELDS

Many requests are received for information on production by trade fields as distinct from States and counties. In Table 8 the operators' reports to the Bureau of Mines have been retabulated on the basis determined by the United States Coal Commission, which classified the bituminous coal-mining area into 92 separate fields. Corresponding figures for 1920 to 1930, inclusive, may be found in coal chapters for previous years. The boundaries of the fields are accurately delimited on pages 2034 to 2052 of the commission's report.

TABLE 8.—*Bituminous coal produced and number of mines active in the several fields adopted by the U. S. Coal Commission, 1923 and 1931*

[The definitions of these fields are given in detail on pages 2034–2052, Pt. IV of the U. S. Coal Commission]

U. S. Coal Commission field No.	State	General name of field	1923 Number of mines	1923 Production (net tons)	1931 Number of mines	1931 Production (net tons)
1	Pennsylvania	Pittsburgh	452	42,209,000	175	24,478,000
2	do	Connellsville	312	37,882,000	112	17,009,000
3	do	Westmoreland-Ligonier	171	14,563,000	74	7,819,000
4a,b	do	Freeport (thick and thin)	123	12,338,000	71	7,785,000
5	do	Butler-Mercer	110	2,587,000	69	1,069,000
6	do	Blossburg	20	496,000	15	230,000
7	do	Broad Top	63	1,430,000	37	1,048,000
8	do	Somerset	232	5,772,000	111	5,406,000
9a	do	Central Pennsylvania, western.			49	2,012,000
9b	do	Central Pennsylvania, middle.	1,385	54,364,000	83	8,226,000
9c	do	Central Pennsylvania, eastern.			451	22,575,000
10	Maryland-West Virginia	Maryland-Potomac	159	3,890,000	101	3,122,000
11	West Virginia	Fairmont	309	22,883,000	118	16,237,000
12	Ohio-West Virginia	Panhandle-Pittsburgh No. 8	233	25,529,000	141	14,480,000
13	do	Pomeroy	41	1,309,000	24	400,000
14	West Virginia	Putnam County	10	345,000	3	305,000
15	Kentucky-West Virginia	Kenova	38	2,103,000	17	2,048,000
16	do	Thacker	89	6,149,000	47	5,813,000
17	West Virginia	Tug River	87	4,555,000	46	6,618,000
18	Virginia-West Virginia	Pocahontas	107	16,481,000	76	14,569,000
19	West Virginia	Winding Gulf	78	7,228,000	56	9,869,000
20	do	New River	145	8,810,000	96	11,646,000
21	do	Kanawha	285	12,741,000	101	13,167,000
22	do	Coal River	29	1,397,000	11	1,502,000
23	do	Logan	155	12,831,000	74	14,556,000
24a	do	Coal and Coke	39	1,158,000	6	579,000
24b	do	Preston County	58	1,937,000	31	808,000
24c	do	Taylor County, Junior, Philippi, and Gauley.	176	6,140,000	88	3,604,000
25	Virginia	Southwestern Virginia	123	8,148,000	56	6,347,000
26	do	Clinch Valley	34	2,464,000	16	1,841,000
27	do	Virginia "anthracite"	[1] 8	[1] 217,000	[1] 6	[1] 183,000
28	do	Richmond Basin	(1)	(1)	(1)	(1)
29	Ohio	Massillon-Palmyra-Lisbon	90	2,815,000	79	1,606,000
30	do	Coshocton-Goshen	155	3,174,000	141	1,989,000
31	do	Cambridge	55	4,780,000	37	1,958,000
32	do	Crooksville	60	1,015,000	42	810,000
33	do	Hocking	241	7,517,000	50	2,884,000
34	do	Jackson and Ironton	89	610,000	39	377,000
36	Kentucky	Northeast Kentucky [2]	225	9,602,000	88	9,135,000
37	do	Hazard [3]	128	6,660,000	66	6,215,000
38	do	Harlan	75	8,752,000	54	9,588,000
39	Kentucky-Tennessee	Southern Appalachian	221	6,765,000	99	4,827,000
40	do	Jellico	55	1,003,000	19	408,000
41	Kentucky	Western Kentucky	172	10,890,000	117	8,580,000
42	Tennessee	Rockwood-Soddy	89	2,563,000	33	1,682,000
43	do	Fentress	13	541,000	5	521,000
44	Alabama	Big Seam Group	45	5,954,000	43	5,011,000
45	Alabama-Georgia	Cahaba Group	109	5,846,000	94	3,402,000
46	Alabama	Pratt Group	137	8,696,000	65	3,607,000
47	Indiana	Indiana	272	25,793,000	150	13,776,000
48	do	Brazil Block	29	345,000	18	519,000
49	Illinois	Northern Illinois	60	2,334,000	46	1,525,000
50	do	Fulton-Peoria	119	4,190,000	148	3,908,000
51	do	Danville	32	4,178,000	49	2,508,000
52	do	Central Illinois	108	25,205,000	79	12,329,000
53	do	Belleville	106	10,193,000	86	5,499,000
54	do	Murphysboro	10	557,000	9	383,000
55	do	Southern Illinois	140	32,595,000	119	18,151,000
56	Michigan	Michigan	13	1,172,000	6	359,000
57	Arkansas	Sebastian	54	906,000	23	585,000
58	do	Excelsior-Logan	21	106,000	29	319,000
59	do	Arkansas "anthracite"	19	221,000	17	249,000
60	Colorado	Colorado "domestic"	145	4,430,000	158	2,585,000
61	do	Trinidad	44	3,182,000	34	1,338,000
62	do	Northern Colorado	47	2,715,000	39	2,682,000
63	Iowa	Marion-Monroe-Polk	89	4,485,000	150	2,452,000
64	do	Appanoose	62	1,217,000	81	937,000

[1] Virginia "anthracite" field includes Richmond Basin field (No. 28).
[2] Northeastern Kentucky field includes McRoberts district.
[3] Hazard field includes Whitesburg district.

TABLE 8.—*Bituminous coal produced and number of mines active in the several fields adopted by the U. S. Coal Commission, 1923 and 1931*—Continued

U. S. Coal Commission field No.	State	General name of field	1923 Number of mines	1923 Production (net tons)	1931 Number of mines	1931 Production (net tons)
65	Kansas	Pittsburg	192	4,135,000	114	1,860,000
66	do	Lightning Creek				
67	do	Osage	27	115,000	33	57,000
68	do	Leavenworth [4]	4	137,000	4	100,000
69	Missouri	Southern Missouri	[5] 79	[5] 2,114,000	101	2,862,000
70	do	Lafayette	69	1,141,000	98	730,000
71	do	Grundy	(5)	(5)	(4)	(4)
72	do	Platte	(4)	(4)	(4)	(4)
73	Montana	Montana	48	3,144,000	79	2,378,000
74	New Mexico	Gallup	13	939,000	14	708,000
75	do	Cerrillos and Carthage	11	248,000	8	162,000
76	do	Raton	15	1,678,000	9	658,000
76a	do	Monero	3	33,000	11	25,000
77	North Dakota	Southern North Dakota	72	910,000	104	899,000
78	do	Northern North Dakota	50	447,000	65	620,000
79	Oklahoma	McAlester Vein	25	640,000	15	235,000
80	do	Oklahoma, eastern	90	2,200,000	91	1,674,000
81	Texas	Texas (bituminous)	10	175,000	4	60,000
82	do	Texas (lignite)	34	1,012,000	18	656,000
83	Utah	Utah	37	4,720,000	41	3,350,000
84	Washington	Kittitas County	12	1,358,000	7	794,000
85	do	Pierce-King (bituminous)	18	738,000	16	341,000
86	do	Subbituminous	26	830,000	27	711,000
87	Wyoming	Wyoming	62	7,559,000	66	4,994,000
88	South Dakota	South Dakota	15	10,000	19	28,000
89	Oregon	Oregon	(6)	(6)	(6)	(6)
90	California	California [6]	5	20,000	10	17,000
91	Nevada	Nevada			(6)	(6)
92	North Carolina	North Carolina	2	36,000	3	2,000
	Unclassified		12	120,000	12	113,000
			9,331	563,422,000	5,642	382,089,000

[4] Leavenworth field, Kans., includes Platte field, Mo. (No. 72), in 1923 and 1931 and Grundy field, Mo. (No. 71), in 1931.
[5] Southern Missouri field includes Grundy field (No. 71).
[6] California includes Idaho and Oregon in 1923 and Idaho, Nevada, and Oregon in 1931.

PRODUCTION, BY WEEKS AND MONTHS

The following tables summarize the statistics of weekly and monthly production of bituminous coal first published in the Bureau of Mines weekly coal reports. The figures are estimates based upon daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the Monongahela, Allegheny, Ohio, and Kanawha Rivers. The estimates are revised afterwards to agree with the results of the annual statistical reports from the coal producers; therefore, the figures given here differ slightly from the estimates originally issued in the weekly reports.

For the method used in counting holidays see Coal in 1930, page 631.

Figure 26 shows for certain more important producing fields the monthly trend of output in 1931 compared with that in 1929 and 1930. It will be noted that, although the business depression tended to curtail production everywhere, there were wide variations in the degree to which individual fields were affected. For the country as a whole the 1931 production fell 18.3 per cent below the level of the previous year, but for the 16 fields shown the decline ranged from 6.9 per cent in Ohio No. 8 to 28.8 per cent in the Harlan field.

An interesting feature brought out by Figure 26 is wide seasonal variation in the different fields. The majority are at a low point in April, the beginning of the coal year, and rise to a peak in the fall or early winter; but in some, such as Colorado and southern Illinois, which supply especially large tonnages for domestic heating, the seasonal trend is highly accentuated. On the other hand, the fields producing chiefly industrial coals show less violent seasonal fluctuations.

TABLE 9.—*Estimated weekly production of bituminous coal in 1931*

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 3	[1] 3,326,000	[1] 2.3	[2] 1,598,000	July 18	6,855,000	6	1,143,000
Jan. 10	9,281,000	6	1,547,000	July 25	6,826,000	6	1,138,000
Jan. 17	9,292,000	6	1,549,000	Aug. 1	6,884,000	6	1,147,000
Jan. 24	8,928,000	6	1,488,000	Aug. 8	6,874,000	6	1,146,000
Jan. 31	8,122,000	6	1,354,000	Aug. 15	7,063,000	6	1,177,000
Feb. 7	7,915,000	6	1,319,000	Aug. 22	7,191,000	6	1,199,000
Feb. 14	8,301,000	6	1,384,000	Aug. 29	7,574,000	6	1,262,000
Feb. 21	7,988,000	6	1,331,000	Sept. 5	7,701,000	6	1,284,000
Feb. 28	7,533,000	5.9	1,277,000	Sept. 12	6,855,000	5.3	1,293,000
Mar. 7	7,786,000	6	1,298,000	Sept. 19	7,320,000	6	1,220,000
Mar. 14	8,459,000	6	1,410,000	Sept. 26	7,510,000	6	1,252,000
Mar. 21	7,488,000	6	1,248,000	Oct. 3	7,943,000	6	1,324,000
Mar. 28	7,588,000	6	1,265,000	Oct. 10	7,931,000	6	1,322,000
Apr. 4	7,290,000	5.8	1,257,000	Oct. 17	8,234,000	6	1,372,000
Apr. 11	6,855,000	6	1,143,000	Oct. 24	8,230,000	6	1,372,000
Apr. 18	6,393,000	6	1,066,000	Oct. 31	8,100,000	6	1,350,000
Apr. 25	6,380,000	6	1,063,000	Nov. 7	7,771,000	5.9	1,317,000
May 2	6,490,000	6	1,082,000	Nov. 14	7,599,000	5.6	1,357,000
May 9	6,786,000	6	1,131,000	Nov. 21	7,132,000	6	1,189,000
May 16	6,854,000	6	1,142,000	Nov. 28	6,498,000	5.1	1,274,000
May 23	6,698,000	6	1,116,000	Dec. 5	7,302,000	6	1,217,000
May 30	6,549,000	5.4	1,213,000	Dec. 12	7,367,000	6	1,228,000
June 6	6,654,000	6	1,109,000	Dec. 19	7,130,000	6	1,188,000
June 13	6,744,000	6	1,124,000	Dec. 26	5,387,000	5	1,077,000
June 20	6,705,000	6	1,118,000	Jan. 2	[1] 4,819,000	[1] 4	[2] 1,151,000
June 27	6,823,000	6	1,137,000				
July 4	6,024,000	5	1,205,000		382,089,000	307.3	1,243,000
July 11	6,741,000	6	1,124,000				

[1] Figures represent output and number of working days in that part of the week included in the calendar year shown. Figures of total production for these weeks are as follows: January 3, 1931, 8,469,000 net tons; January 2, 1932, 6,100,000 net tons.
[2] Average daily production for the entire week and not for the working days in the calendar year shown.

TABLE 10.—*Holidays commonly recognized in the bituminous-coal fields and the average fraction of a working day for the country, as a whole, that each holiday represented, 1930 and 1931*

	Average fraction of full working day			Average fraction of full working day	
	1930	1931		1930	1931
January: New Year's Day	0.4	0.3	November:		
February: Washington's Birthday	.9	.9	General election	0.5	0.9
April: Eight-Hour Day (Apr. 1)	.8	.8	Armistice Day	.6	.6
May: Memorial Day	.4	.4	Thanksgiving Day	.2	.1
July: Independence Day			December: Christmas Day		
September: Labor Day	.3	.3			

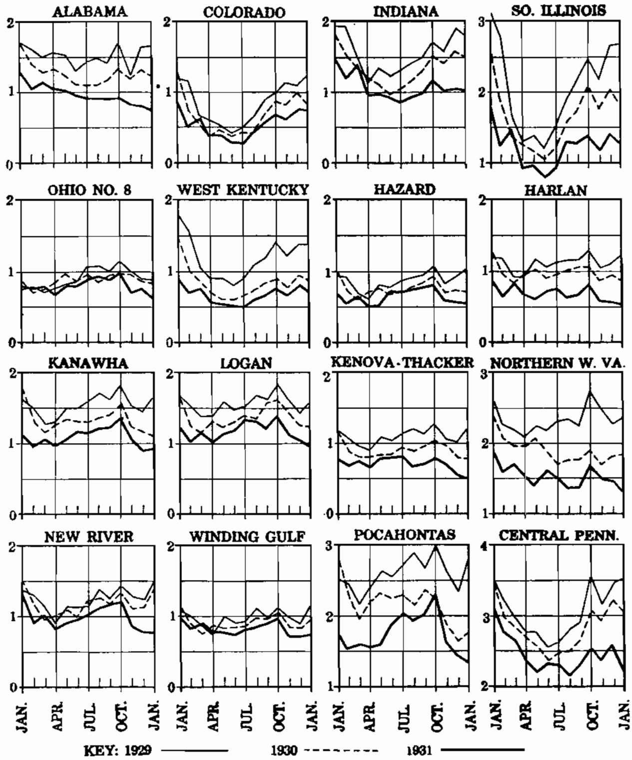

FIGURE 26.—Monthly trend of bituminous-coal production in selected fields, 1929, 1930, and 1931. The diagrams have all been plotted on the same scale, except that in certain of the largest districts, such as in southern Illinois, northern West Virginia, and Pocahontas, it was necessary to start at the bottom with 1,000,000 tons instead of zero or even, in central Pennsylvania, to start with 2,000,000 tons. Note also that the diagram for Pocahontas includes the output of Tug River

TABLE 11.—*Estimated monthly production of coal, by States, in 1931, in thousands of net tons*

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,285	1,067	1,148	1,051	1,043	998	923	929	925	917	861	852	11,999
Arkansas	144	58	62	47	34	43	60	93	141	229	129	114	1,154
Colorado	839	527	631	406	405	307	287	436	613	718	643	792	6,604
Illinois	5,092	3,930	4,443	3,137	3,053	2,842	2,863	3,415	3,470	4,187	3,631	4,240	44,303
Indiana	1,627	1,275	1,495	1,061	1,057	1,013	935	998	1,089	1,302	1,122	1,321	14,295
Iowa	390	291	360	238	222	232	203	209	254	338	294	357	3,388
Kansas	245	161	184	137	124	117	137	133	167	182	173	227	1,987
Kentucky:													
Eastern	3,015	2,387	2,660	2,277	2,427	2,675	2,760	2,848	2,860	3,010	2,331	2,134	31,384
Western	984	742	835	607	565	538	524	658	730	848	716	833	8,580
Maryland	226	179	187	162	136	137	148	144	153	185	169	180	2,006
Michigan	61	55	56	11	6	7	7	7	15	59	33	42	359
Missouri	349	252	307	258	218	204	277	267	285	380	402	422	3,621
Montana	255	190	196	155	141	147	136	162	204	237	265	290	2,378
New Mexico	172	125	138	126	124	121	104	102	114	134	135	158	1,553
North Dakota	167	117	124	85	75	78	81	95	136	181	184	196	1,519
Ohio	1,965	1,673	1,800	1,458	1,473	1,630	1,786	1,747	1,767	1,890	1,596	1,626	20,411
Oklahoma	240	118	140	97	83	118	132	174	198	249	173	186	1,908
Pennsylvania, bituminous	9,847	8,796	8,858	8,047	7,898	7,884	8,111	7,610	7,660	8,469	7,388	7,091	97,659
Tennessee	523	425	469	392	333	326	352	398	401	414	347	341	4,721
Texas	60	52	57	52	50	52	59	76	71	75	57	55	716
Utah	485	243	245	185	159	121	112	174	342	352	423	509	3,350
Virginia	951	736	836	739	792	783	770	838	847	903	774	730	9,699
Washington	186	152	154	138	112	121	114	125	144	187	205	208	1,846
West Virginia	9,331	7,788	8,404	7,501	7,705	8,684	8,925	8,843	9,188	10,082	7,856	7,166	101,473
Wyoming	487	382	421	397	365	303	289	367	468	534	498	483	4,994
Other States	23	16	16	13	13	10	8	10	13	13	21	26	182
Total bituminous	38,949	31,737	34,226	28,777	28,613	29,491	30,103	30,858	32,255	36,075	30,426	30,579	382,089
Pennsylvania anthracite	6,183	5,400	4,754	5,709	5,013	4,552	3,960	4,324	4,362	6,561	4,149	4,679	59,646
Grand total	45,132	37,137	38,980	34,486	33,626	34,043	34,063	35,182	36,617	42,636	34,575	35,258	441,735

NUMBER AND SIZE OF MINES

The fundamental unit in the statistical record of the bureau is the mine, and operating companies are asked to make a separate report for each. Tables 12 and 13 show the number of active mines and do not include figures for idle or abandoned operations.

Table 12 covers the commercial mines only and classifies them by size. This table compares figures for the years 1913, 1923, and 1929 to

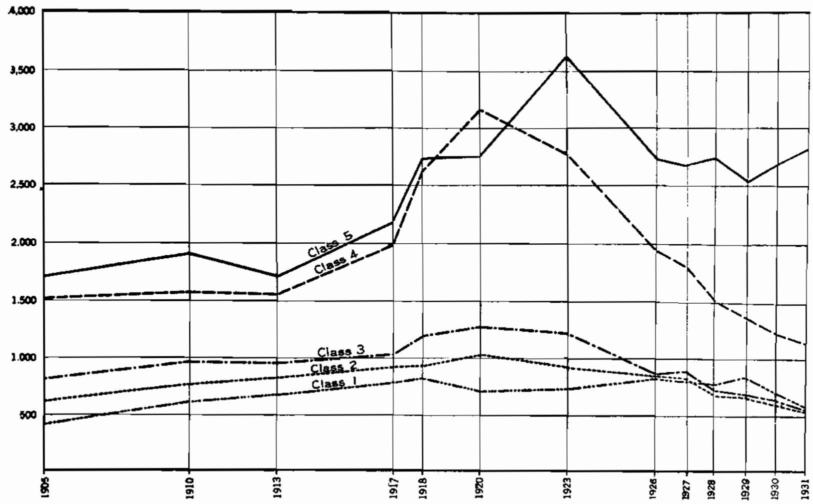

FIGURE 27.—Number of commercial bituminous-coal mines in each size class, 1905–1931

1931, while the record for a series of years is shown graphically in Figure 27. The number of operating mines of all sizes increased fairly steadily up to the period of the war, climbed rapidly to a peak in 1920–1923, and since declined. The reduction has come chiefly in the intermediate-size classes. There has been an actual increase in the number of large mines and with this increase gradual concentration of the output in the larger units. In 1905, 40.2 per cent of the bituminous production came from class 1 mines. By 1923 the proportion had increased to 47.2 per cent and by 1931 to 59.9 per cent.

Table 13 shows in detail the number of mines in each size class and each State for 1931.

TABLE 12.—*Number and yearly output of commercial bituminous-coal mines, by size classes, 1913, 1923, and 1929–1931* [1]

[Exclusive of wagon mines producing less than 1,000 tons]

Year	Class 1A (more than 500,000 tons)	Class 1B (200,000 to 500,000 tons)	Class 2 (100,000 to 200,000 tons)	Class 3 (50,000 to 100,000 tons)	Class 4 (10,000 to 50,000 tons)	Class 5 (less than 10,000 tons)	Total
Number of mines:							
1913	694		837	959	1,558	1,728	5,776
1923	748		935	1,176	2,742	3,730	9,331
1929	209	618	660	668	1,361	2,541	6,057
1930	173	543	608	644	1,239	2,684	5,891
1931	126	452	536	551	1,144	2,833	5,642
Net tons produced (thousands):							
1913	241,463		118,476	69,018	42,292	6,280	477,529
1923	265,869		130,804	84,342	68,769	13,639	563,423
1929	158,454	190,571	95,783	48,400	33,827	7,954	534,989
1930	129,479	165,735	87,068	46,143	31,176	7,925	467,526
1931	90,095	138,548	76,601	39,572	29,348	7,925	382,089
Per cent of total number of mines:							
1913	12.0		14.5	16.6	27.0	29.9	100.0
1923	8.0		10.0	12.6	29.4	40.0	100.0
1929	3.4	10.2	10.9	11.0	22.5	42.0	100.0
1930	3.0	9.2	10.3	10.9	21.0	45.6	100.0
1931	2.2	8.0	9.5	9.8	20.3	50.2	100.0
Per cent of total tonnage:							
1913	50.6		24.8	14.4	8.9	1.3	100.0
1923	47.2		23.2	15.0	12.2	2.4	100.0
1929	29.6	35.6	17.9	9.1	6.3	1.5	100.0
1930	27.7	35.4	18.6	9.9	6.7	1.7	100.0
1931	23.6	36.3	20.0	10.3	7.7	2.1	100.0

[1] This table shows mines, not companies, and should not be confused with other tables that include country banks and many wagon mines shipping by rail.

TABLE 13.—*Number and production of commercial bituminous-coal mines, by size classes, in each State, in 1931*

[No canvass of wagon mines producing less than 1,000 tons was made]

State	Class 1A (more than 500,000 tons)					Class 1B (200,000 to 500,000 tons)					Class 2 (100,000 to 200,000 tons)					Class 3 (50,000 to 100,000 tons)				
	Mines		Production			Mines		Production			Mines		Production			Mines		Production		
	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent
Alabama	1	0.5	540,611	540,611	4.5	17	8.5	5,404,161	317,892	45.1	15	7.4	1,984,772	132,318	16.5	41	20.4	3,028,659	73,870	25.2
Arizona																				
Arkansas																5	7.2	358,950	71,790	31.1
Colorado						6	2.6	1,556,348	259,391	23.6	16	6.9	2,263,276	141,455	34.2	17	7.4	1,193,078	70,181	18.1
Georgia																				
Illinois	30	5.6	22,723,296	757,443	51.3	43	8.0	14,021,187	326,074	31.6	21	3.9	2,915,567	138,837	6.6	30	5.6	2,035,946	67,865	4.6
Indiana	4	2.4	2,438,405	609,601	17.1	19	11.3	6,456,651	339,824	45.2	23	13.7	3,346,365	145,494	23.4	12	7.1	920,358	76,697	6.4
Iowa						2	.9	514,973	257,487	15.2	6	2.6	927,915	154,653	27.3	9	3.9	646,432	71,826	19.1
Kansas						1	.7	238,128	238,128	12.0	4	2.7	608,687	152,172	30.6	8	5.4	621,356	77,670	31.3
Kentucky:																				
Eastern	3	1.0	2,280,980	760,327	7.3	46	14.9	13,284,478	288,793	42.3	64	20.8	9,262,046	144,719	29.5	49	15.9	3,532,929	72,101	11.3
Western						11	9.4	3,195,407	290,492	37.3	24	20.5	3,321,485	138,395	38.7	17	14.5	1,279,160	75,245	14.9
Maryland											6	8.3	797,555	132,926	39.7	7	9.7	566,976	80,997	28.3
Missouri						6	3.0	1,592,376	265,396	44.0	2	1.0	292,843	146,422	8.1	8	4.0	546,934	68,367	15.1
Montana	1	1.3	818,936	818,936	34.4	1	1.3	414,481	414,481	17.4	6	7.6	851,332	141,889	35.8	1	1.2	70,000	70,000	3.0
New Mexico						1	2.4	310,956	310,956	20.0	4	9.5	600,536	150,134	38.7	4	9.5	291,573	72,893	18.8
North Carolina																				
North Dakota						3	1.8	680,110	226,703	44.8	2	1.2	289,645	144,823	19.0	2	1.2	121,158	60,579	8.0
Ohio	6	1.2	4,054,279	675,713	19.9	24	4.8	7,853,551	327,231	38.5	22	4.4	3,176,463	144,385	15.5	36	7.1	2,697,924	74,942	13.2
Oklahoma											3	2.8	400,815	133,605	21.0	4	3.8	269,267	67,317	14.1
Pennsylvania	44	3.5	33,201,110	754,571	34.0	90	7.2	28,042,561	311,584	28.7	124	10.0	17,855,500	143,996	18.3	127	10.2	9,100,512	71,658	9.3
South Dakota																				
Tennessee						4	4.9	939,898	234,975	19.9	13	15.9	1,820,926	140,071	38.6	17	20.7	1,175,979	69,175	24.9
Texas						1	4.5	208,701	208,701	29.1	1	4.5	103,891	103,891	14.5	2	9.1	142,199	71,100	19.9
Utah						7	17.1	1,861,880	265,983	55.6	5	12.2	789,369	157,874	23.6	5	12.2	344,993	68,999	10.3
Virginia	4	4.9	2,192,563	548,141	22.6	15	18.3	4,106,064	273,738	42.3	14	17.1	1,902,801	135,914	19.6	17	20.6	1,105,279	65,016	11.4
Washington						3	6.0	722,631	240,877	39.1	3	6.0	489,327	163,109	26.5	2	4.0	196,718	98,359	10.7
West Virginia	33	4.0	21,845,172	661,975	21.5	142	17.4	44,462,138	313,114	43.8	148	18.1	21,066,368	142,340	20.8	121	14.8	8,522,947	70,438	8.4
Wyoming						10	15.2	2,681,648	268,165	53.8	8	12.1	1,282,611	160,326	25.7	8	12.1	686,564	85,821	13.7
Other States [1]											2	8.0	251,337	125,669	52.1	2	8.0	115,758	57,879	24.0
	126	2.2	90,095,352	715,042	23.6	452	8.0	138,548,328	306,523	36.3	536	9.5	76,601,432	142,913	20.0	551	9.8	39,571,649	71,818	10.3

State	Class 4 (10,000 to 50,000 tons)					Class 5 (less than 10,000 tons)					Total		
	Mines		Production			Mines		Production			Mines	Production (net tons)	
	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent	Number	Per cent	Total (net tons)	Average per mine (net tons)	Per cent		Total	Average per mine
Alabama	29	14.4	835,366	28,806	7.0	98	48.8	205,212	2,094	1.7	201	11,998,781	59,695
Arizona						3	100.0	7,120	2,373	100.0	3	7,120	2,373
Arkansas	30	43.5	641,819	21,394	55.6	34	49.3	152,786	4,494	13.3	69	1,153,555	16,718
Colorado	49	21.2	1,277,127	26,064	19.3	143	61.9	314,540	2,200	4.8	231	6,604,369	28,590
Georgia	1	100.0	21,580	21,580	100.0						1	21,580	21,580
Illinois	68	12.7	1,650,417	24,271	3.7	344	64.2	956,882	2,782	2.2	536	44,303,295	82,655
Indiana	34	20.2	862,279	25,361	6.0	76	45.3	271,107	3,567	1.9	168	14,295,165	85,090
Iowa	36	15.6	846,387	23,511	25.0	178	77.0	452,648	2,543	13.4	231	3,388,355	14,668
Kansas	12	8.1	249,345	20,779	12.5	123	83.1	269,354	2,190	13.6	148	1,986,870	13,425
Kentucky:													
Eastern	91	29.5	2,830,078	31,100	9.0	55	17.9	193,610	3,520	.6	308	31,384,121	101,896
Western	28	24.0	647,361	23,120	7.5	37	31.6	136,087	3,678	1.6	117	8,579,500	73,329
Maryland	20	27.8	529,489	26,474	26.4	39	54.2	111,753	2,865	5.6	72	2,005,773	27,858
Missouri	38	18.8	876,705	23,071	24.2	148	73.2	311,639	2,106	8.6	202	3,620,497	17,923
Montana	6	7.6	116,628	19,438	4.9	64	81.0	106,675	1,667	4.5	79	2,378,052	30,102
New Mexico	7	16.7	281,767	40,252	18.1	26	61.9	67,990	2,615	4.4	42	1,552,822	36,972
North Carolina						3	100.0	2,363	788	100.0	3	2,363	788
North Dakota	8	4.7	127,659	15,957	8.4	154	91.1	300,735	1,953	19.8	169	1,519,307	8,990
Ohio	78	15.5	1,801,032	23,090	8.8	338	67.0	827,746	2,449	4.1	504	20,410,995	40,498
Oklahoma	47	44.3	1,083,301	23,049	56.8	52	49.1	155,011	2,981	8.1	106	1,908,394	18,004
Pennsylvania	309	24.8	7,506,275	24,292	7.7	553	44.3	1,952,740	3,531	2.0	1,247	97,658,698	78,315
South Dakota	1	5.3	14,000	14,000	50.9	18	94.7	13,485	749	49.1	19	27,485	1,447
Tennessee	21	25.6	653,709	31,129	13.8	27	32.9	131,036	4,853	2.8	82	4,721,548	57,580
Texas	10	45.5	225,962	22,596	31.6	8	36.4	35,267	4,408	4.9	22	716,020	32,546
Utah	11	26.8	319,204	29,019	9.5	13	31.7	34,598	2,661	1.0	41	3,350,044	81,708
Virginia	13	15.9	318,154	24,473	3.3	19	23.2	73,819	3,885	.8	82	9,698,680	118,277
Washington	13	26.0	357,841	27,526	19.4	29	58.0	79,944	2,757	4.3	50	1,846,461	36,929
West Virginia	172	21.0	4,903,205	28,507	4.8	202	24.7	673,342	3,333	.7	818	101,473,172	124,050
Wyoming	9	13.6	276,723	30,747	5.5	31	47.0	66,140	2,134	1.3	66	4,993,686	75,662
Other States [1]	3	12.0	94,697	31,566	19.6	18	72.0	20,896	1,161	4.3	25	482,688	19,308
	1,144	20.3	29,348,110	25,654	7.7	2,833	50.2	7,924,525	2,797	2.1	5,642	382,089,396	67,722

[1] Includes Alaska, California, Idaho, Michigan, Nevada, and Oregon.

VALUE AND PRICES

As given in this report, the total value is the amount received at the mine f. o. b. cars minus the selling expense. The average value per ton is the average amount received, obtained by dividing the total value by the number of tons sold or produced.

If an operator who is known to have produced coal during the year makes no report of the value of his product to the Bureau of Mines, an estimate of the value is included in the total to make it complete. Since the proportion of the total value actually reported in 1931 was 93.9 per cent, the results would seem to be thoroughly representative for the country as a whole. A detailed explanation of the method used in making the estimates and in calculating average value may be found in Coal in 1930, pages 645 and 646.

The average value of coal per net ton, by States, for 1931 is shown in Table 2. It is noteworthy that in 1931 the grand average declined to $1.54 per ton, the lowest realization since 1916.

Data on spot prices, previously shown in this report, are not given in 1931, owing to discontinuance of the "Coal Age" average of spot prices in September, 1931.

AVERAGE COST OF RAILROAD FUEL

TABLE 14.—*Average cost per net ton of coal used by Class I railroads in road-train and yard-switching service, by months, 1930 and 1931* [1]

Month	1930		1931		Month	1930		1931	
	Including direct freight charges	Excluding direct freight charges	Including direct freight charges	Excluding direct freight charges		Including direct freight charges	Excluding direct freight charges	Including direct freight charges	Excluding direct freight charges
January	$2.35	$1.97	$2.29	$1.90	August	$2.34	$1.98	$2.19	$1.83
February	2.35	1.94	2.30	1.89	September	2.34	1.98	2.18	1.82
March	2.35	1.94	2.29	1.89	October	2.32	1.95	2.16	1.80
April	2.34	1.94	2.27	1.85	November	2.30	1.93	2.15	1.78
May	2.34	1.96	2.25	1.84	December	2.30	1.91	2.16	1.77
June	2.35	1.97	2.22	1.82					
July	2.35	1.98	2.22	1.84	Average	2.34	1.95	2.21	1.83

[1] As reported currently to the Interstate Commerce Commission.

AVERAGE RETAIL PRICES

TABLE 15.—*Average retail price per net ton of bituminous coal in 38 cities, as compiled by the Bureau of Labor Statistics, by months, 1930 and 1931*

Month	1930		1931		Month	1930		1931	
	Average price	Relative price 1913=100.0	Average price	Relative price 1913=100.0		Average price	Relative price 1913=100.0	Average price	Relative price 1913=100.0
January	$9.11	167.6	$8.87	163.2	August	$8.70	160.1	$8.11	149.3
February	9.04	166.4	8.83	162.5	September	8.79	161.7	8.17	150.4
March	9.02	166.0	8.71	160.3	October	8.88	163.3	8.22	151.3
April	8.84	162.7	8.46	155.8	November	8.94	164.6	8.23	151.4
May	8.53	157.0	8.04	148.0	December	8.94	164.4	8.19	150.8
June	8.54	157.2	8.00	147.3					
July	8.65	159.1	8.09	148.9	Average	8.83	162.5	8.33	153.3

LABOR STATISTICS

MEN EMPLOYED

The method of collecting employment statistics is explained in detail in Coal in 1929, pages 738 to 740. These statistics are believed to represent the most accurate returns obtainable under present conditions, both as to the records generally available in mine offices and as to the funds allotted to the Bureau of Mines for collecting data.

For a detailed explanation of the classification of mine employees see Coal in 1930, page 651. Table 2, page 426, shows the number of men employed underground and on the surface, by States, during 1931. Data for previous years may be found in Coal in 1930, page 653.

DAYS WORKED BY MINES

The number of potential working days per year averages somewhat more than 300; however, few bituminous mines in the country approach this maximum, and at most mines the operating time is much less. The seriousness of the situation in 1931 is indicated by the fact that the average operating time for the country as a whole was only 160 days compared with 187 days in 1930. Table 2 indicates that the decline in the number of days worked was almost country wide.

LENGTH OF WORKING DAY

The established working day in the coal mines of the United States is now generally eight hours. (See Table 16.) However, the nominal working day measures neither the length of time spent by the men at work nor the length of time they are underground. (See Coal in 1930, page 656.) For data on the time spent at the working place and the total time in the mine see publications of the Bureau of Labor Statistics, United States Department of Labor, as follows: Monthly Labor Review for July, 1925, pages 68–87; for February, 1926, pages 77–87; and for October, 1931, pages 910–922; also, Bulletins 316, 416, and 454.

TABLE 16.—*Number of bituminous-coal mines in the United States having established working day of certain length and number of men employed in 1931*

State	8 hours [1]		9 hours		10 hours		All others [2]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama	66	5,290	51	13,597	26	2,615	58	1,471	201	22,973
Alaska	9	80							9	80
Arkansas	67	4,725					2	8	69	4,733
Arizona, California, Idaho, Nevada, and Oregon	8	132					5	11	13	143
Colorado	126	9,655					105	373	231	10,028
Georgia	1	62							1	62
Illinois	329	48,193	2	12			205	1,480	536	49,685
Indiana	129	12,064	1	55			38	192	168	12,311
Iowa	132	7,393	2	20			97	484	231	7,897
Kansas	83	3,077	5	35			60	701	148	3,813
Kentucky	364	42,577	25	4,542	4	236	32	411	425	47,766
Maryland	50	3,153					22	71	72	3,224
Michigan	6	1,372							6	1,372
Missouri	105	4,528	9	277	2	85	86	472	202	5,362
Montana	23	1,421	1	67	2	13	53	171	79	1,672
New Mexico	31	2,786					11	44	42	2,830
North Carolina	2	24			1	8			3	32
North Dakota	28	636			5	200	136	464	169	1,300
Ohio	279	24,162	2	57	6	73	217	793	504	25,085

[1] Includes outside employees working 9 or 10 hours a day at many mines where the established time for underground workers is 8 hours.
[2] Includes employees in mines where the established working day was changed during the year, where the working day was irregular, or which failed to answer the inquiry.

TABLE 16.—*Number of bituminous-coal mines in the United States having established working day of certain length and number of men employed in 1931*—Continued

State	8 hours		9 hours		10 hours		All others		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Oklahoma	79	4,252	8	291			19	91	106	4,634
Pennsylvania	1,032	111,997	39	2,871			176	1,858	1,247	116,726
South Dakota	1	15					18	41	19	56
Tennessee	68	6,256	6	1,072	2	22	6	98	82	7,448
Texas	12	567	8	365	1	163	1	53	22	1,148
Utah	39	3,261					2	7	41	3,268
Virginia	76	10,809	3	418	1	8	2	122	82	11,357
Washington	38	2,608					12	54	50	2,662
West Virginia	700	93,537	26	3,328	9	514	83	408	818	97,787
Wyoming	57	4,728					9	31	66	4,759
	3,940	409,360	188	27,007	59	3,937	1,455	9,909	5,642	450,213

TABLE 17.—*Per cent of men employed in bituminous-coal mines that had established working days of 8, 9, and 10 hours, 1913, 1923, and 1929–1931* [1]

Year	Per cent of total employees in—			Weighted average working day (hours)	Year	Per cent of total employees in—			Weighted average working day (hours)
	8-hour mines	9-hour mines	10-hour mines			8-hour mines	9-hour mines	10-hour mines	
913	61.9	15.2	22.9	8.60	1930	92.4	6.6	1.0	8.09
923	94.7	4.2	1.1	8.06	1931	93.0	6.1	.9	8.08
1929	92.5	6.7	.8	8.08					

[1] Calculated on basis of total number of men in mines definitely reported as having 8, 9, or 10 hour day. A small number of mines that work more than 10 hours or less than 8 hours have been excluded, as have also all mines for which the reports were defective or which changed their working day during the year.

OUTPUT PER MAN

TABLE 18.—*Bituminous coal produced underground per man employed underground, by States, in 1931*

State	Total mined underground (tons)	Total number of underground men	Average number of days worked	Average per underground man (tons)	
				Per year	Per day
Alabama	11,924,442	19,987	136	597	4.39
Alaska	105,900	49	277	2,161	7.80
Arizona	7,120	24	115	297	2.58
Arkansas	1,124,340	4,110	95	274	2.88
Colorado	6,585,891	8,497	142	775	5.46
Georgia	21,580	56	180	385	2.14
Illinois	37,977,698	42,341	136	897	6.60
Indiana	8,990,271	9,441	146	952	6.52
Iowa	3,388,355	7,227	142	469	3.30
Kansas	833,711	2,926	123	285	2.32
Kentucky	39,896,721	41,193	159	969	6.09
Maryland	2,005,773	2,874	190	698	3.67
Michigan	359,403	1,277	96	281	2.93
Missouri	1,312,134	3,948	142	332	2.34
Montana	1,557,341	1,264	153	1,232	8.05
New Mexico	1,552,822	2,417	145	642	4.43
North Carolina	2,363	23	83	103	1.24
North Dakota	616,358	772	166	798	4.81
Ohio	19,469,085	22,134	174	880	5.06
Oklahoma	1,590,894	3,885	115	409	3.56
Pennsylvania	97,216,726	103,760	169	937	5.54
South Dakota	4,136	17	127	243	1.91
Tennessee	4,721,548	6,453	169	732	4.33
Texas	607,123	1,004	140	605	4.32
Utah	3,350,044	2,576	140	1,300	9.29
Virginia	9,698,680	9,720	175	998	5.70
Washington	1,846,461	2,233	170	827	4.86
West Virginia	101,471,281	83,572	176	1,214	6.90
Wyoming	4,901,429	3,923	154	1,249	8.11
Other States	17,385	91	86	191	2.22
	363,157,015	387,794	160	936	5.85

STRIKES, SUSPENSIONS, AND LOCKOUTS

TABLE 19.—*Strikes, suspensions, and lockouts in coal mines, by States, in 1931*

State	Total number of men employed	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account of strike: Per man employed	Average number of days lost on account of strike: Per man on strike
Alabama	22,973				
Arkansas	4,733	860	21,153	4	25
Colorado	10,028				
Illinois	49,685	9,400	397,263	8	42
Indiana	12,311	883	14,181	1	16
Iowa	7,897	824	24,500	3	30
Kansas	3,813	38	570	(1)	15
Kentucky	47,766	2,920	59,240	1	20
Maryland	3,224				
Michigan	1,372	597	26,185	19	44
Missouri	5,362	679	34,671	6	51
Montana	1,672				
New Mexico	2,830				
North Dakota	1,300				
Ohio	25,085	5,591	138,155	6	25
Oklahoma	4,634	501	19,812	4	40
Pennsylvania, bituminous	116,726	12,783	398,932	3	31
Tennessee	7,448	1,133	28,767	4	25
Texas	1,148				
Utah	3,268				
Virginia	11,357				
Washington	2,662				
West Virginia	97,787	8,441	393,883	4	47
Wyoming	4,759	8	8	(1)	1
Other States	373				
Total bituminous	450,213	44,658	1,557,320	3	35
Pennsylvania anthracite	139,431	65,907	570,664	4	9
Grand total	589,644	110,565	2,127,984	4	19

1 One-half day or less.

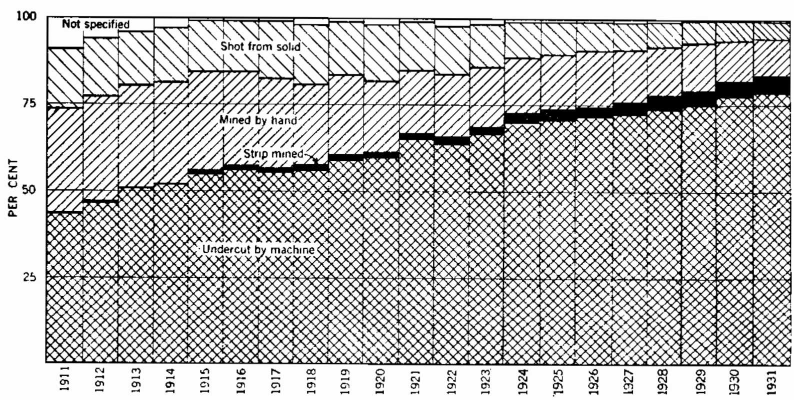

FIGURE 28.—Percentage of total output of bituminous coal mined by different methods, 1911–1931

EQUIPMENT AND METHODS OF MINING AND PREPARATION

The economic difficulties of the bituminous industry in recent years have diverted attention from its brilliant progress in the field of engineering. To record the rapid changes in both mining and preparation practices, the following section presents statistics on mechanical equipment of the mines.

Figure 28 records outstanding changes in mining methods in recent years.

METHODS OF RECOVERY

TABLE 20.—*Bituminous coal mined by different methods, by States, in 1931*

State	Mined by hand		Shot off the solid		Cut by machines		From strip pits		Not specified		Total production (net tons)
	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent	Net tons	Per cent	
Alabama	1,059,714	8.8	1,888,184	15.8	8,959,332	74.7	74,339	0.6	17,212	0.1	11,998,781
Alaska	10,590	10.0	95,310	90.0							105,900
Arizona	1,350	19.0	5,770	81.0							7,120
Arkansas	460		377,207	32.7	746,673	64.7	29,215	2.6			1,153,555
Colorado	1,924,671	29.1	274,135	4.2	4,341,595	65.7	18,478	.3	45,490	.7	6,604,369
Georgia			21,580	100.0							21,580
Illinois	1,497,441	3.4	3,372,991	7.6	32,981,148	74.4	6,325,597	14.3	126,118	.3	44,303,295
Indiana	96,773	.7	1,123,336	7.8	7,761,673	54.3	5,304,894	37.1	8,489	.1	14,295,165
Iowa	402,157	11.9	1,894,751	55.9	1,055,711	31.1			35,736	1.1	3,388,355
Kansas	107,003	5.4	555,213	27.9	150,013	7.6	1,153,159	58.0	21,482	1.1	1,986,870
Kentucky:											
Eastern	1,580,058	5.0	313,882	1.0	29,480,813	94.0			9,368		31,384,121
Western	11,389	.1	385,842	4.5	8,113,819	94.6	66,900	.8	1,550		8,579,500
Maryland	1,459,158	72.8			540,023	26.9			6,592	.3	2,005,773
Michigan			501	.1	358,902	99.9					359,403
Missouri	223,881	6.2	278,173	7.7	769,224	21.2	2,308,363	63.8	40,856	1.1	3,620,497
Montana	21,802	.9	108,318	4.6	1,403,785	59.0	820,711	34.5	23,436	1.0	2,378,052
New Mexico	707,761	45.6	475,513	30.6	363,166	23.4			6,382	.4	1,552,822
North Carolina			2,363	100.0							2,363
North Dakota	53,108	3.5	153,939	10.1	367,805	24.2	902,949	59.5	41,506	2.7	1,519,307
Ohio	293,940	1.4	91,056	.5	18,989,879	93.0	941,910	4.6	94,210	.5	20,410,995
Oklahoma	6,779	.4	263,073	13.8	1,314,472	68.9	317,500	16.6	6,570	.3	1,908,394
Pennsylvania	18,496,847	18.9	2,319,740	2.4	76,345,346	78.2	441,972	.4	54,793	.1	97,658,698
South Dakota							23,349	85.0	4,136	15.0	27,485
Tennessee	629,723	13.3	970,795	20.6	3,121,030	66.1					4,721,548
Texas	167,420	23.4	421,743	58.9	17,960	2.5	108,897	15.2			716,020
Utah	9,232	.3	[1] 448,876	13.4	2,891,936	86.3					3,350,044
Virginia	45,233	.5	1,106,796	11.4	8,546,651	88.1					9,698,680
Washington	927,184	50.2	451,916	24.5	465,335	25.2			2,026	.1	1,846,461
West Virginia	10,616,465	10.5	1,302,264	1.3	89,533,372	88.2	1,891		19,180		101,473,172
Wyoming	498,911	10.0	[1] 762,410	15.3	3,640,108	72.9	92,257	1.8			4,993,686
Other States	2,030	11.7	12,380	71.2	2,975	17.1					17,385
	40,851,080	10.7	[1] 19,478,057	5.1	302,262,746	79.1	18,932,381	5.0	565,132	.1	382,089,396

[1] Includes some tonnage reported by the companies as "pillar coal," the method of mining which, of course, differs materially from solid shooting in rooms or entries.

UNDERCUTTING MACHINES

TABLE 21.—*Number of coal-cutting machines in bituminous-coal mines, average output per machine, and per cent of total product of underground mines cut by machines, by States, in 1931*

State	Number of coal-cutting machines in use: "Permissible"	Number of coal-cutting machines in use: All others	Number of coal-cutting machines in use: Total	Average output per machine (net tons)	Per cent of total product of underground mines cut by machines
Alabama	115	313	428	20,933	75.1
Arkansas	76	56	132	5,657	66.4
Colorado	180	224	404	10,747	65.9
Illinois	162	1,462	1,624	20,309	86.8
Indiana	71	303	374	20,753	86.3
Iowa	72	40	112	9,426	31.2
Kansas	16	18	34	4,412	18.0
Kentucky	541	1,073	1,614	23,293	94.2
Maryland	10	32	42	12,858	26.9
Michigan	14	41	55	6,525	99.9
Missouri	27	85	112	6,868	58.6
Montana	12	65	77	18,231	90.1
New Mexico	14	51	65	5,587	23.4
North Dakota	9	6	15	24,520	59.7
Ohio	19	886	905	20,983	97.5
Oklahoma	70	98	168	7,824	82.6
Pennsylvania	2,282	1,569	3,851	19,825	78.5
Tennessee	53	90	143	21,825	66.1
Texas	------	2	2	8,980	3.0
Utah	4	124	128	22,593	86.3
Virginia	32	204	236	36,215	88.1
Washington	1	24	25	18,613	25.2
West Virginia	1,028	1,390	2,418	37,028	88.2
Wyoming	39	211	250	14,560	74.3
Other States	2	------	2	1,488	23.5
	4,849	[1] 8,367	13,216	22,871	83.2

[1] Probably includes some "permissible" machines not so specified by the operators.

STRIPPING OPERATIONS

The sharp differences between open-pit and underground mining make it desirable for many purposes to separate the two in the statistical record. In Table 22 the reports of stripping operations are tabulated separately in as great geographic detail as possible.

A larger proportion of the total bituminous-coal production was recovered by stripping methods in 1931 than ever before. The output of the strip pits during the year was 18,932,381 tons (5 per cent of the total soft-coal production). This branch of mining has grown with extreme rapidity in the bituminous fields since 1914. (See Coal in 1930, p. 666.)

The causes of the rapid increase in the tonnage of soft coal obtained by stripping methods are fully discussed in a special study, The Economics of Strip-Coal Mining, by O. E. Kiessling, F. G. Tryon, and L. Mann, published as Bureau of Mines Economic Paper 11. Copies may be obtained from the Superintendent of Documents, Washington, D. C., price 10 cents.

TABLE 22.—*Stripping operations of all types in the bituminous-coal fields, by States and counties, in 1931*

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels		Coal produced (net tons)		Total value at same mines	Average value per ton	Number of employees					Average number of days worked	Per cent of county or State total that was mined by stripping	Man-days	Average per man per day, tons
								Underground		Surface						
		Steam	Electric	Mined by stripping	Total at same mines			Miners, loaders, and shot firers	All others[1]	In strip pits	All others	Total				
Alabama:																
Bibb, Blount, Jefferson, and Winston	4	2	2	8,309	8,309	$12,000	$1.44			35		35	131	0.1	4,600	1.81
Walker	4	8		66,030	84,758	181,000	2.14	30	6	144	29	209	80	1.9	16,657	5.09
State total	[2] 8	10	2	74,339	93,067	193,000	2.07	30	6	179	29	244	87	[3] .7	21,257	4.38
Illinois:																
Fulton	6		11	747,716	747,716	1,123,000	1.50			173	19	192	171	56.1	32,783	22.81
Gallatin, Henry, Jackson, McDonough, Peoria, St. Clair, Saline, Schuyler, Vermilion, and Will	13	9	23	3,173,706	3,173,706	6,401,000	2.02			686	178	864	200	24.5	172,739	18.37
La Salle	4			7,565	7,565	21,000	2.78			18		18	76	2.5	1,360	5.56
Livingston	4			6,373	6,373	18,000	2.82			23		23	111	29.1	2,560	2.49
Perry	5	6	14	2,361,643	2,361,643	2,976,000	1.26			517	51	568	174	81.0	98,946	23.87
Williamson	9	3		28,594	28,594	46,000	1.61			99	7	106	46	1.3	4,865	5.88
State total	[2] 41	18	48	6,325,597	6,325,597	10,585,000	1.67			1,516	255	1,771	177	14.3	313,253	20.19
Indiana:																
Clay	4	10	2	566,408	566,408	826,000	1.46			265	48	313	153	88.9	47,809	11.85
Greene	5	6	3	962,899	962,899	1,379,000	1.43			286	2	288	200	59.3	57,622	16.71
Owen, Sullivan, Vermillion, Vigo, and Warrick	7	10	10	1,267,743	1,267,743	1,713,000	1.35			454	5	459	152	18.9	69,671	18.20
Pike	5	8	10	2,507,844	2,507,844	2,863,000	1.14			630	25	655	198	92.2	129,406	19.38
State total	21	34	25	5,304,894	5,304,894	6,781,000	1.28			1,635	80	1,715	178	37.1	304,508	17.42

Kansas:															
Bourbon, Labette, and Linn	5	4	------	23,408	23,408	38,000	1.62	------	------	26	2	28	166	73.6	4,646	5.04
Cherokee	6	3	1	189,848	189,848	383,000	2.02	------	------	80	------	80	114	75.5	9,084	20.90
Crawford	23	21	4	939,903	939,903	1,572,000	1.67	------	------	417	10	427	138	59.3	59,126	15.90
State total	[2] 34	28	5	1,153,159	1,153,159	1,993,000	1.73	------	------	523	12	535	136	58.0	72,856	15.83
Kentucky: Hopkins and Muhlenberg	3	6	------	66,900	78,271	81,000	1.03	14	4	85	2	105	60	[3] 1.2	6,310	12.40
Missouri:															
Barton	11	14	7	1,268,264	1,268,264	2,078,000	1.64	------	------	472	30	502	135	96.6	67,759	18.72
Bates	5	5	1	585,051	585,051	1,032,000	1.76	------	------	234	------	234	221	97.0	51,744	11.31
Boone, Callaway, Jasper, Johnson, and Vernon	8	8	------	39,246	39,246	93,000	2.37	------	------	70	4	74	155	41.2	11,500	3.41
Henry	4	4	3	415,802	415,802	708,000	1.70	------	------	143	24	167	210	97.8	35,056	11.86
State total	[2] 28	31	11	2,308,363	2,308,363	3,911,000	1.69	------	------	919	58	977	170	63.8	166,059	13.90
Montana:															
McCone and Valley	2	------	------	1,275	1,275	3,000	2.35	------	------	7	------	7	51	100.0	360	3.54
Rosebud	2	3	5	819,436	819,436	1,229,000	1.50	------	------	49	21	70	282	100.0	19,730	41.53
State total	[2] 4	3	5	820,711	820,711	1,232,000	1.50	------	------	56	21	77	261	[3] 100.0	20,090	40.85
North Dakota:															
Burke	5	2	1	184,262	184,262	251,000	1.36	------	------	31	30	61	108	100.0	6,578	28.01
Burleigh, Divide, Dunn, McKenzie, Mercer, Mountrail, Oliver, and Stark	13	4	4	374,009	374,009	504,000	1.35	------	------	94	43	137	142	50.8	19,455	19.22
Grant	4	1	------	12,619	12,619	19,000	1.51	------	------	18	4	22	237	49.5	5,221	2.42
Hettinger	7	------	------	10,455	10,455	16,000	1.52	------	------	20	------	20	168	57.1	3,358	3.11
McLean	5	4	------	75,372	75,372	124,000	1.65	------	------	74	2	76	203	76.0	15,430	4.88
Morton	4	------	------	2,881	2,881	5,000	1.74	------	------	6	2	8	166	10.8	1,329	2.17
Ward	3	2	2	243,351	243,351	307,000	1.26	------	------	32	20	52	94	74.8	4,891	49.75
State total	[2] 41	13	7	902,949	902,949	1,226,000	1.36	------	------	275	101	376	150	59.5	56,262	16.05
Ohio:															
Harrison	8	20	------	685,327	685,327	613,000	.89	------	------	285	2	287	152	34.2	43,674	15.69
Hocking, Jackson, Jefferson, Muskingum, Perry, and Stark	7	6	2	233,687	234,607	283,000	1.21	3	------	100	2	105	193	4.5	20,311	11.55
Tuscarawas	5	3	------	22,896	25,718	37,000	1.44	3	1	15	1	20	158	3.3	3,156	8.15
State total	[2] 20	29	2	941,910	945,652	933,000	.99	6	1	400	5	412	163	4.6	67,141	14.08

[1] Includes haulage and trackmen.
[2] Includes some pits in which the stripping is done by hand.
[3] Per cent of county totals, not State.

TABLE 22.—*Stripping operations of all types in the bituminous-coal fields, by States and counties, in 1931*—Continued

State and county	Number of strip pits	Number of power shovels		Coal produced (net tons)		Total value at same mines	Average value per ton	Number of employees					Average number of days worked	Per cent of county or State total that was mined by stripping	Man-days	Average per man per day, tons
								Underground		Surface						
		Steam	Electric	Mined by stripping	Total at same mines			Miners, loaders, and shot firers	All others	In strip pits	All others	Total				
Oklahoma:																
Craig, Haskell. Muskogee, Pittsburg, Tulsa, and Wagoner	7	8		259,472	287,291	$655,000	$2.28	53	14	224	14	305	130	24.5	39,635	7.25
Rogers	3	4		58,028	58,028	127,000	2.19			61	7	68	156	100.0	10,634	5.46
State total	[2] 10	12		317,500	345,319	782,000	2.26	53	14	285	21	373	135	16.6	50,269	6.87
Pennsylvania: Allegheny, Clearfield, Fayette, Jefferson, Somerset, and Washington	7	15		441,972	758,436	1,121,000	1.48	264	53	194	67	578	224	.4	129,278	5.87
South Dakota:																
Corson, Harding, and Zeibach	4			1,193	1,193	2,000	1.68			7		7	47	59.0	330	3.62
Dewey	3		1	18,800	18,800	44,000	2.34			21	3	24	145	100.0	3,480	5.40
Perkins	3			3,356	3,356	8,000	2.38			6		6	218	60.5	1,310	2.56
State total	[2] 10		1	23,349	23,349	54,000	2.31			34	3	37	138	85.0	5,120	4.56
Other States [4]	[2] 8	6	3	250,738	250,738	256,000	1.02			104	3	107	107	[3] 12.4	11,466	21.87
Grand total	235	205	109	18,932,381	19,310,505	29,148,000	1.51	367	78	6,205	657	7,307	167	5.0	1,223,869	15.78

[2] Includes some pits in which the stripping is done by hand. [3] Per cent of county totals, not State. [4] Arkansas, Colorado, Texas, West Virginia, and Wyoming.

TABLE 23.—*Summary of operations of power strip pits proper in the bituminous-coal fields, by States, in 1931*

[Corresponding figures for each year from 1914 to 1928 are given in Bureau of Mines Economic Paper 11 and for 1929 and 1930 in the coal reports for those years]

State	Number of strip pits	Number of power shovels: Steam	Number of power shovels: Electric	Amount mined by stripping (net tons)[1]	Average value per ton[2]	Number of men employed[2]	Average number of days worked[2]	Average per man per day, tons[2]
Power strip pits proper:								
Alabama	4	8	2	59,577	$1.91	147	77	5.29
Illinois	19	18	48	6,287,801	1.67	1,674	180	20.82
Indiana	21	34	25	5,304,894	1.28	1,715	178	17.42
Kansas	30	28	5	1,150,159	1.73	523	137	16.02
Kentucky	2	4		39,100	.97	75	27	19.07
Missouri	27	31	11	2,307,715	1.69	974	170	13.92
Montana	1	3	5	818,936	1.50	67	290	42.15
North Dakota	11	13	7	858,184	1.35	276	151	20.55
Ohio	14	27	2	925,195	.97	381	166	14.61
Oklahoma	9	12		316,932	2.23	295	123	8.73
Pennsylvania	4	10		194,579	2.02	126	135	11.47
South Dakota	1		1	14,000	2.57	15	150	6.22
Other States[3]	5	6	3	247,313	1.01	97	107	23.72
Total	148	194	109	18,524,385	1.51	6,365	165	17.68
Horse stripping operations	79			109,063	1.83	275	122	3.24
Mines combining stripping and underground methods in same operation[4]	8	11		298,933	1.40	667	213	4.76
Grand total	235	205	109	18,932,381	1.51	7,307	167	15.78

[1] Exclusive of coal produced by underground mining in the same operation.
[2] Items in these columns include underground mining conducted in the same operation.
[3] Includes Arkansas, Colorado, Texas, West Virginia, and Wyoming.
[4] Includes all operations in which 10 per cent or more of the output was obtained by underground methods (including 2 small operations without power shovels). In addition to the 298,933 tons produced by stripping, this group of 8 mines obtained 378,124 tons by underground methods, its total production by both methods being 677,057 tons.

LOADING MACHINES AND CONVEYORS

SUMMARY

Mechanization of bituminous-coal mines established new records in 1931. Compared with 1930 the number of mechanical loaders—mobile machines, scrapers, and duckbills—in use increased from 2,876 to 3,428. The mines using hand-loaded face conveyors increased from 146 to 152. The total tonnage produced by "mechanized mining" increased from 46,982,000 to 47,562,000 tons. Thus, in a year when hand mining slumped 21.2 per cent, mechanical mining actually increased 1.2 per cent.

These figures refer only to mechanical devices designed to reduce the labor of hand shoveling into mine cars, although in a larger sense the introduction of any machine, such as a cutting machine or haulage locomotive, is a form of mechanization.

The figures are based upon complete reports courteously furnished by coal operators to the Bureau of Mines.[2]

The tonnage of bituminous coal produced by mechanized mining in 1931 is summarized in Table 24. The total—47,562,000 tons—relates only to operations underground and does not include coal loaded by power shovels in strip pits, 18,932,000 tons in 1931. Neither does it include anthracite; 4,253,000 net tons were mined mechanically in 1931 according to the Pennsylvania Department of Mines.

[2] The bureau appreciates the cooperation of the manufacturers of loading equipment and of the Pennsylvania Department of Mines, the Illinois Department of Mines and Minerals, the State coal-mine inspector of Wyoming, and Jonas Waffle of Indiana in furnishing information used in the compilation.

It is also important to note that the figures in Table 24 represent production and not capacity and that because of the depression many mines were working short time.

Of the total tonnage handled mechanically underground, 40.8 per cent was loaded by mobile loading machines, 3.1 per cent by scraper loaders, and 56.1 per cent by pit-car loaders and conveyors including duckbills.

TABLE 24.—*Tonnage of bituminous coal produced by mechanized mining in 1931*

	Net tons	Per cent
Loaded by machine:		
Mobile loading machines	19,407,000	85.5
Scraper loaders	1,471,000	6.5
Duckbills and other self-loading conveyors	1,811,000	8.0
Total loaded by machine	22,689,000	100.0
Handled by conveyors:		
Duckbills and other self-loading conveyors	1,811,000	6.8
Pit-car loaders	19,172,000	71.8
Other hand-loaded conveyors	5,701,000	21.4
Total handled by conveyors	26,684,000	100.0
Recapitulation, less duplications:		
Mobile loading machines	19,407,000	40.8
Scraper loaders	1,471,000	3.1
Pit-car loaders	19,172,000	40.3
Other conveyors, including duckbills	7,512,000	15.8
Grand total, mechanized mining	47,562,000	100.0

TONNAGE LOADED BY MACHINE AND TONNAGE SHOVELED ON CONVEYORS

The total quantity of bituminous coal loaded by machine in 1931 (see Table 25) was 22,689,000 tons, including all types of machines that eliminate hand shoveling except for incidental clean-up. In addition, 24,873,000 tons were shoveled by hand on pit-car loaders (locally often called "conveyors") or on hand-loaded face conveyors. These devices, though not loading machines proper, greatly reduce the labor of hand shoveling by reducing the height to which the miner must lift the coal. When these mechanical aids are included the total produced by mechanized mining in 1931 is 47,562,000 tons.

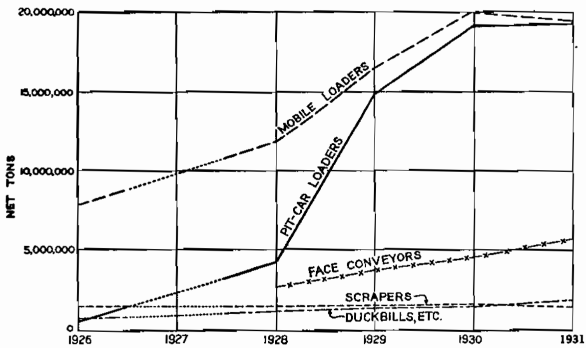

FIGURE 29.—Increase in tonnage of bituminous coal loaded mechanically, classified by types of machines, 1926–1931

INCREASE OR DECREASE BY TYPES OF MACHINES, 1930–31

Compared with 1930 the total "mechanized" tonnage increased 1.2 per cent. Table 25 shows that the increase was contributed by the conveyor types. The tonnage handled on conveyors equipped with duckbills made a substantial gain. That handled on pit-car loaders continued to grow, although, as was to be expected, the spectacular advance of 1928 to 1930, when this device was invading the Illinois-Indiana field, was not maintained. (See fig. 29.)

The surprise of the year was the large gain in tonnage handled on hand-loaded face conveyors, which increased from 4,528,000 in 1930 to 5,701,000 in 1931, or 25.9 per cent.

The tonnage handled by mobile loading machines and scrapers declined; but this recession was more apparent than real, being due entirely to the depression. In fact, the number of these machines in use actually increased.

TABLE 25.—*Comparative increase or decrease in tonnage handled by principal types of machines, 1930 and 1931*

	1930 (net tons)	1931 (net tons)	Increase or decrease	
			Net tons	Per cent
Mobile loading machines	20,073,000	19,407,000	−666,000	−3.3
Scraper loaders	1,637,000	1,471,000	−166,000	−10.1
Duckbills and other self-loading conveyors	1,628,000	1,811,000	+183,000	+11.2
Total loaded by machines	23,338,000	22,689,000	−649,000	−2.8
Pit-car loaders	19,116,000	19,172,000	+56,000	+.3
Other hand-loaded conveyors	4,528,000	5,701,000	+1,173,000	+25.9
Grand total mechanized	46,982,000	47,562,000	+580,000	+1.2

INCREASE OR DECREASE BY STATES

The changes from 1930 to 1931 by States are significant. Among the principal States, Pennsylvania and Alabama show large gains in tonnage handled. Illinois, Wyoming, and Utah fell a little short of their 1930 records. The largest decrease was in Kentucky and the Virginias, reflecting in part the competition of low wage rates for hand labor.

This year the figures for Ohio can be published without revealing individual operations. In 1931 the State mined 1,265,000 tons mechanically and took its place among the large contributors to the national total.

In 22 States mechanized mining has passed the experimental stage and is now established commercially.

PRODUCTION BY TYPES OF MACHINES, BY STATES

Figures can not be published for each type of machine by States, as it would involve disclosure of individual operations. Table 26, however, breaks down the total into two major groups. The first column shows the tonnage loaded without hand shoveling; that is, by mobile loading machines, scrapers, and duckbills. Illinois, with 10,064,000 tons, is far in the lead; second place is held by Pennsylvania, third by Wyoming, and fourth by Indiana. The second column indicates tonnage loaded with machines that require hand shoveling, such as pit-car loaders and hand-loaded face conveyors. In this group, also, Illinois is far in the lead with 12,513,000 tons. Pennsylvania again is second, Alabama third, and Indiana fourth.

In the total tonnage produced by mechanical mining of all types, Illinois has first place, followed by Pennsylvania, Indiana, Wyoming, Alabama, West Virginia (not including Virginia), Ohio, and Montana, in the order named.

TABLE 26.—*Total tonnage produced by loading machines, pit-car loaders, and conveyors, by States, in 1931*

State	Loaded by machine	Handled on pit-car loaders and hand-loaded conveyors	Total produced by mechanized mining	State	Loaded by machine	Handled on pit-car loaders and hand-loaded conveyors	Total produced by mechanized mining
Illinois	10,064,000	12,513,000	22,577,000	Ohio	1,119,000	146,000	1,265,000
Pennsylvania	2,924,000	5,926,000	8,850,000	Montana	963,000	64,000	1,027,000
Indiana	2,026,000	1,485,000	3,511,000	Kentucky	150,000	730,000	880,000
Wyoming	2,383,000	393,000	2,776,000	Utah	854,000	7,000	861,000
West Virginia and Virginia	1,744,000	719,000	2,463,000	Other States [1]	242,000	872,000	1,114,000
Alabama	220,000	2,018,000	2,238,000	Total	22,689,000	24,873,000	47,562,000

[1] Washington, Arkansas, Colorado, Tennessee, Missouri, Maryland, New Mexico, Iowa, Oklahoma, North Dakota, and North Carolina.

RANK OF STATES IN PER CENT OF "MECHANIZED" OUTPUT

A fairer test of the progress of mechanization is the percentage of the total deep-mined output of the State produced by mechanized mining. Judged by this standard, the high-wage-rate fields of the Rocky Mountains and the Middle West lead in the proportion mechanized. First place in 1931 was attained by Montana, where 65.9 per cent of the deep-mined tonnage was won by mechanized mining. Next in rank came Illinois with 59.4 per cent, Wyoming with 56.6 per cent, Indiana with 39.1 per cent, and Utah with 25.7 per cent. Among the Southern States, Alabama was far in the lead. (See Table 27.)

TABLE 27.—*Rank of States in percentage of total bituminous product of underground mines by mechanized mining in 1931*

State	Per cent loaded by machine	Per cent handled on pit-car loaders and hand-loaded conveyors	Total per cent mined mechanically	State	Per cent loaded by machine	Per cent handled on pit-car loaders and hand-loaded conveyors	Total per cent mined mechanically
Montana	61.8	4.1	65.9	Ohio	5.7	0.8	6.5
Illinois	26.5	32.9	59.4	West Virginia and Virginia	1.6	.6	2.2
Wyoming	48.6	8.0	56.6	Kentucky	.4	1.8	2.2
Indiana	22.6	16.5	39.1				
Utah	25.5	.2	25.7				
Alabama	1.9	16.9	18.8	United States	6.2	6.9	13.1
Pennsylvania	3.0	6.1	9.1				

GROWTH OF MECHANIZATION

Table 28 shows the extremely rapid growth of mechanized mining. The use of all types of machines has increased since 1926, the first year of complete records. The greatest proportional increase has been in the use of pit-car loaders, which have jumped from 523,000 tons handled in 1926 to 19,172,000 in 1931. A very large increase is also shown in the mobile loader types, which still lead all others in total tonnage handled.

For mechanical loading proper, as opposed to types involving hand shoveling onto the loader or conveyors, the record can be carried back to 1923. From 1,880,000 tons in 1923 the tonnage loaded mechanically without hand shoveling has increased to 22,689,000, or twelvefold in 8 years.

TABLE 28.—*Recapitulation of tonnage of bituminous coal handled by principal types of mechanical loading devices, 1923 and 1926–1931*

[No figures have been published for 1927]

Type	1923	1926	1928	1929	1930	1931
Mobile loading machines	[1]1,880,000	7,786,000	11,811,000	16,432,000	20,073,000	19,407,000
Scraper loaders		1,554,000	1,548,000	1,550,000	1,637,000	1,471,000
Duckbills and other self-loading conveyors		682,000	1,200,000	1,309,000	1,628,000	1,811,000
Total loaded by machine	1,880,000	10,022,000	14,559,000	19,291,000	23,338,000	22,689,000
Pit-car loaders	([2])	523,000	4,117,000	14,979,000	19,116,000	19,172,000
Other hand-loaded conveyors	([2])	([2])	2,883,000	3,592,000	4,528,000	5,701,000
Grand total, mechanized mining	([2])	10,545,000	21,559,000	37,862,000	46,982,000	47,562,000

[1] Separation by types not available before 1926. [2] No data.

RECORD IN FULL

Table 29 is designed to stress the progress of mechanical loading in each State so far as it can be shown without disclosing individual makes of machines or individual mines. It will be seen that the total production of the mechanized mines, including that by hand methods, was 89,737,000 tons.

Quite apart from introducing machines in other mines, therefore, it is clear that there is a large potential market for loading equipment simply in completing the process of mechanization at properties where it has been started but not yet fully applied.

TABLE 29.—*Mechanical loading underground in bituminous-coal mines, by States, in 1931*

State	Number of mines				Number of machines				
	Using loading machines only (including scrapers, duckbills, etc.)	Using conveyors only (that is, pit-car loaders and hand-loaded conveyors)	Using both loading machines and conveyors	Total, less duplications	Mobile loading machines	Scrapers	Duckbills and other self-loading conveyors	Pit-car loaders	Installations of hand-loaded conveyors [1]
Alabama	4	22	2	28	([2])	34	([2])	167	14
Arkansas	2	11	-	13	-	5	-	-	11
Colorado	3	8	1	12	7	-	6	11	5
Illinois	12	39	25	76	294	([2])	-	2,162	8
Indiana	7	13	5	25	67	-	-	196	-
Iowa	-	1	-	1	-	-	-	-	([2])
Kentucky	5	7	-	12	7	([2])	5	116	([2])
Maryland	-	3	-	3	-	-	-	-	3
Missouri	1	2	-	3	([2])	-	-	-	([2])
Montana	3	4	4	11	27	-	9	16	5
New Mexico	2	-	-	2	-	6	-	-	-
North Carolina	1	-	-	1	-	1	-	-	-
North Dakota	-	1	-	1	-	-	-	([2])	-
Ohio	5	1	2	8	26	-	8	47	([2])
Oklahoma	1	1	-	2	-	([2])	-	-	([2])
Pennsylvania	16	78	16	110	53	72	19	563	70
Tennessee	-	2	1	3	([2])	-	([2])	-	3
Utah	8	2	1	11	29	([2])	6	([2])	([2])
Virginia	2	7	-	9	8	-	-	-	7
Washington	-	4	1	5	-	-	([2])	([2])	4
West Virginia	22	14	2	38	28	10	13	48	10
Wyoming	13	5	9	27	32	11	95	99	3
Undistributed	-	-	-	-	5	7	4	3	9
	107	225	69	401	583	146	165	3,428	152

[1] Number of mines in which hand-loaded conveyors (other than pit-car loaders) were used.
[2] Included under "Undistributed" to avoid disclosing individual operations.

TABLE 29.—*Mechanical loading underground in bituminous-coal mines, by States, in 1931*—Continued

State	Production mechanically mined, in net tons			Total production of mechanized mines, in net tons			
	Loaded by machine	Handled by pit-car loaders and hand-loaded conveyors	Total	Mines using loading machines only (including scrapers, duckbills, etc.)	Mines using conveyors only (that is, pit-car loaders and hand-loaded conveyors)	Mines using both loading machines and conveyors	Total, less duplications
Alabama	220, 223	2, 017, 671	2, 237, 894	(2)	(2)	(2)	4, 634, 276
Arkansas	(2)	(2)	207, 520	(2)	(2)	----------	221, 444
Colorado	78, 178	54, 064	132, 242	(2)	(2)	(2)	1, 234, 686
Illinois	10, 064, 194	12, 512, 700	22, 576, 894	3, 774, 568	11, 299, 045	10, 430, 432	25, 504, 045
Indiana	2, 026, 568	1, 484, 696	3, 511, 264	1, 103, 891	1, 734, 750	1, 699, 059	4, 537, 700
Iowa	----------	(2)	(2)	----------	(2)	----------	(2)
Kentucky	149, 742	729, 734	879, 476	1, 151, 328	1, 276, 215	----------	2, 427, 543
Maryland	----------	70, 362	70, 362	----------	435, 825	----------	435, 825
Missouri	(2)	(2)	89, 065	(2)	(2)	----------	89, 428
Montana	962, 812	63, 771	1, 026, 583	516, 878	144, 700	589, 909	1, 251, 487
New Mexico	(2)	----------	(2)	(2)	----------	----------	(2)
North Carolina	100	----------	100	800	----------	----------	800
North Dakota	----------	(2)	(2)	----------	(2)	----------	(2)
Ohio	1, 118, 858	146, 526	1, 265, 384	1, 789, 025	(2)	(2)	2, 696, 746
Oklahoma	(2)	(2)	(2)	(2)	(2)	----------	(2)
Pennsylvania	2, 923, 809	5, 926, 390	8, 850, 199	3, 534, 346	18, 902, 584	5, 844, 358	28, 281, 288
Tennessee	(2)	(2)	95, 118	----------	(2)	(2)	501, 653
Utah	854, 034	7, 028	861, 062	1, 774, 302	(2)	(2)	1, 957, 145
Virginia	(3)	(3)	776, 123	(3)	(3)	----------	2, 482, 114
Washington	(2)	(2)	459, 446	----------	(2)	(2)	505, 710
West Virginia	[3] 1, 743, 791	[3] 719, 136	1, 686, 804	[3] 6, 566, 207	[3] 3, 436, 251	884, 455	8, 404, 799
Wyoming	2, 383, 207	392, 791	2, 775, 998	1, 588, 766	529, 199	2, 018, 771	4, 136, 736
Undistributed	163, 690	748, 033	60, 574	1, 727, 383	5, 934, 439	1, 049, 381	433, 442
	22, 689, 206	24, 872, 902	47, 562, 108	23, 527, 494	43, 693, 008	22, 516, 365	89, 736, 867

[2] Included under "Undistributed" to avoid disclosing individual operations.
[3] West Virginia includes Virginia.

CONSUMPTION, STOCKS, AND DISTRIBUTION

CONSUMPTION

Consumption in 1931, allowing for imports, exports, and changes in stocks, totaled 371,869,000 tons, a decrease of 18.3 per cent compared with 1930 and 5.1 per cent compared with 1921, the year of the last major depression. Table 30 and Figure 30 indicate how the decline was distributed among certain important consumers.

TABLE 30.—*Changes in the United States consumption of bituminous coal by such classes of consumers as report currently, and by all other consumers, 1927–1931, in thousands of net tons*

[Information on several other classes of consumers is available for certain years. The items shown in this table are selected because they are available in strictly comparable form for each year]

Year	Consumed in the United States								Exported		Total of consumption and exports [7]
	Colliery fuel	Electric public utilities [1]	Bunkers, foreign trade [2]	Locomotive fuel, Class I roads [3]	Coke beehive ovens [4]	Coke by-product ovens [4]	All other uses [5]	Total consumption [6]	To Canada and Mexico	To all other countries	
1927	4,930	41,888	4,565	115,883	11,208	63,240	258,087	499,801	14,724	3,288	517,813
1928	4,602	41,350	4,294	112,382	7,018	70,166	259,016	498,828	14,050	2,114	514,992
1929	4,663	44,937	4,287	113,894	10,028	76,759	264,987	519,555	14,727	2,702	536,984
1930	3,993	42,898	3,497	98,400	4,284	65,521	236,397	454,990	13,667	2,210	470,867
1931	3,205	38,735	2,195	81,725	1,767	46,846	197,396	371,869	10,647	1,479	383,995

[1] U. S. Geological Survey. Includes a small amount of anthracite.
[2] Bureau of Foreign and Domestic Commerce.
[3] Interstate Commerce Commission. Note that consumption in shops, roundhouses, and stations is excluded, also the entire consumption of Class II and III roads.
[4] U. S Bureau of Mines.
[5] Obtained by subtracting the known items from the total consumption. Includes general manufacturing, domestic, and many miscellaneous uses. From other sources it is known that consumption in steel works and general manufacturing is decreasing and that consumption for domestic uses is increasing.
[6] Production plus imports minus exports, plus or minus changes in consumers' stocks, as calculated in Table 3.
[7] Note that consumption includes the small amount imported.

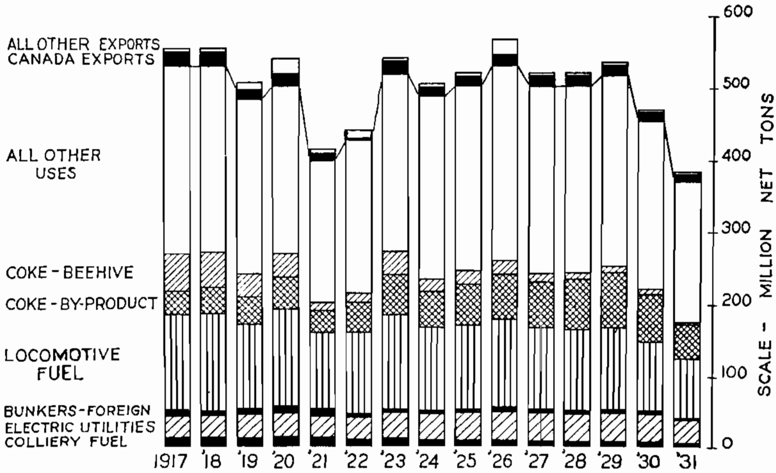

FIGURE 30.—Tonnage of bituminous coal absorbed by the principal branches of consumption, 1917–1931. The diagram shows that, although there has been no great change in the aggregate consumption of bituminous coal during the past 15 years, shifts have occurred in many of the important uses. A marked decline has taken place in the consumption of colliery, bunker, and locomotive fuel, but these losses have been offset through increased consumption by the electric public utilities. The total quantity used for coke making at present is not greatly different from that in 1917, but the relative position of the beehive and by-product ovens has been reversed. In the group of "all other uses" a decline in manufacturing consumption has been offset by an increase in consumption for domestic use

FUEL ECONOMY

In addition to the depression, abnormally high temperatures, and competition from other sources of energy the bituminous-coal industry in 1931 was also affected by the continued advance in efficiency of fuel utilization. (See Table 31 and fig. 31.) All branches of consumption shown in Table 31, except the manufacture of pig iron, achieved further economy in 1931.

The subject is discussed more fully in Coal in 1927, pages 415 to 421, and in a special study prepared for the World Power Conference.[3]

Table 31.—*Indicators of the effect of fuel economy on consumption of coal per unit of performance since the World War*

	Pounds	Reduction (per cent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service—		
Average, 1919-20	170	
Average, 1931	119	30.0
Pounds per passenger-train car-mile—		
Average, 1919-20	18.5	
Average, 1931	14.5	21.6
Electric public-utility power plants:		
Pounds per kilowatt-hour, 1919	3.2	
Pounds per kilowatt-hour, 1931	1.5	53.1
Iron and steel—pounds coking coal per ton of pig: [1]		
1918	3,577	
1931	2,923	18.3
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of by-product in place of beehive coking, 1913 to 1931, expressed as per cent of coal used for all coke in 1931 [2]		20.3

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron. Excludes economies through recovery of by-products, which are treated in next item.

[2] These by-products are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

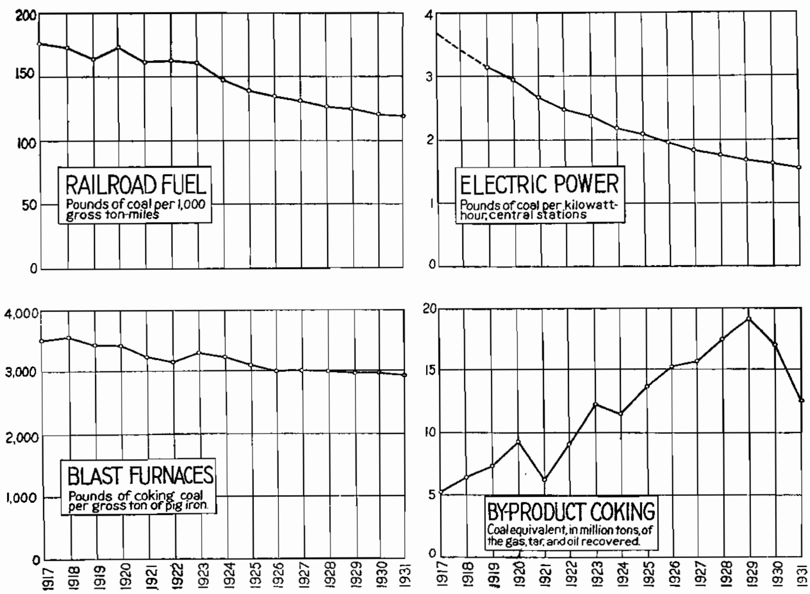

FIGURE 31.—Trends in fuel efficiency in the United States, 1917-1931

STOCKS OF COAL HELD BY CONSUMERS

The reserves of bituminous coal in the hands of commercial consumers and retail coal dealers dropped from 37,200,000 tons on January 1, 1931, to 26,900,000 tons on May 1, 1931; but with the approach of colder weather there was a normal seasonal advance and

[3] Tryon, F. G., and Rogers, H. O., Statistical Studies of Progress in Fuel Efficiency: Trans. Second World Power Conference, Berlin, 1930, vol. 6, pp. 343-365

the year closed with stocks at 35,500,000 tons—1,700,000 tons less than at the beginning. (See Table 32.) For earlier records of stocks of coal see Coal in 1930, page 682.

TABLE 32.—*Stocks of bituminous coal in hands of commercial consumers and stocks of anthracite and bituminous coal in retail dealers' yards in 1931*

[From periodic stock reports of the Bureau of Mines. Coal for steamship fuel, on lake docks, in transit, and in the bins of householders is not included]

Date	Total stock of bituminous coal, estimated (tons)	Days' supply at current rate of consumption on date of stock taking								
		By-product coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Coal dealers, bituminous	Railroads	Total bituminous	Anthracite in retail yards
Jan. 1	37,200,000	38	37	31	65	47	27	24	31	43
Feb. 1	34,200,000	33	30	30	67	50	23	23	29	31
Apr. 1	29,500,000	26	29	27	59	47	15	20	24	21
May 1	26,900,000	28	40	28	58	51	36	20	30	45
July 1	30,100,000	31	40	31	53	51	46	22	33	60
Aug. 1	30,900,000	43	52	37	59	48	39	23	36	75
Oct. 1	34,500,000	49	50	38	65	52	45	23	39	75
Nov. 1	36,100,000	55	47	39	66	53	34	25	38	60
Dec. 31	35,500,000	51	44	39	62	53	31	28	37	54

DISTRIBUTION

Tables showing the movement of coal to the Great Lakes, to tidewater, and to New England and certain other major currents of distribution have been included in earlier reports of this series (see Coal in 1928, pp. 512–527) and are this year published in the Monthly Coal Distribution Report of the Bureau of Mines. Table 33 records one feature of the distribution of bituminous coal which bears closely on the statistics of production. Figure 32 shows changes in the disposition of bituminous coal since 1890.

BITUMINOUS COAL LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS, AS REPORTED BY OPERATORS

The sum of the coal charged into coke ovens at the mines, the local sales, and the mine fuel in 1931 was 24,811,343 tons out of a total production of 382,089,396 tons. The remainder, 357,278,053 tons, was loaded at the mines for shipment. Of this remainder, 14,606,238 tons were loaded into barges and other river vessels and 342,671,815 tons were loaded into railroad cars. Table 33 shows the quantity so originated on each railroad and waterway, as reported by mine operators in answer to the following inquiry:

Railroads or waterways on which product was first loaded for shipment:
Name of road or waterway --

(Give shipments over each road separately)	Tons
--	------
--	------
--	------

As these statistics include nonrevenue railroad fuel they may differ from statistics compiled by the railroad companies, which often show only revenue freight and include coal received from connecting lines or coal shipped off the lake docks as well as that originating at mines on the lines reporting.

Where the road serving the district is a subsidiary of a larger road some operators may report their coal as loaded on the subsidiary and

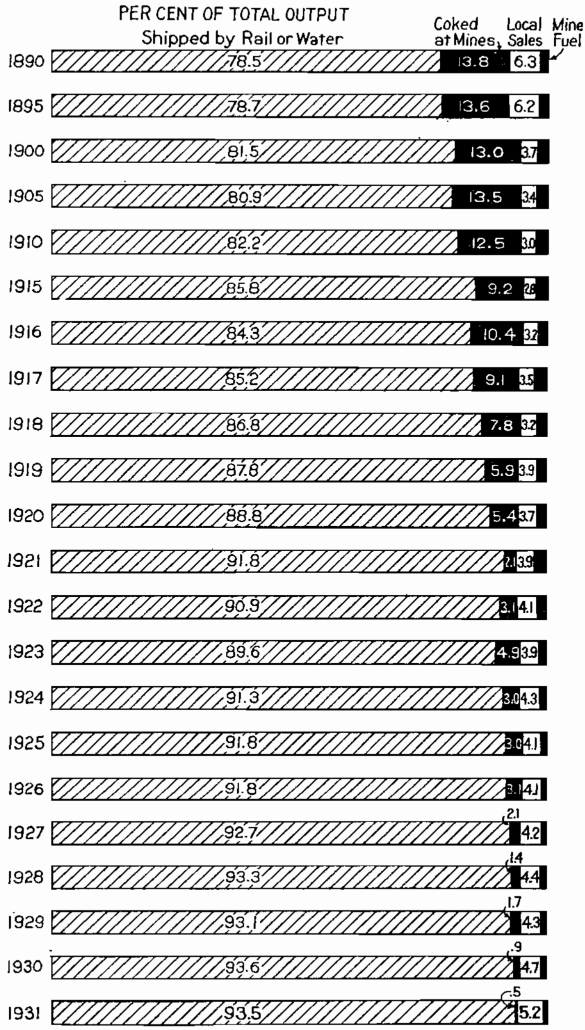

FIGURE 32.—Shifts in disposition of total output of bituminous coal, 1890–1931

others as loaded on the parent system (a few subsidiaries have been consolidated under the name of the parent road). For instance, the shipments over the Vandalia, the Pittsburgh, Cincinnati, Chicago & St. Louis, the Pennsylvania Co., the Ohio River & Western, and the Wheeling Terminal have been included under the Pennsylvania System. In general, the figures are given under the name reported by the operator; and the Bureau of Mines does not attempt to combine them under the name of the larger system, believing that such combination can best be made by those using the figures, as they are probably familiar with coal-traffic problems. To approximate the total for the Southern System, for example, the reader should add to the total shown for the Southern Railway the figures of the Alabama Great Southern, Northern Alabama, Cincinnati, New Orleans & Texas Pacific, and Harriman & Northeastern lines. If such combination is made, the total will usually be found to check reasonably well with the statistics issued by railroads that keep records of total coal originated.

The figures for the Chicago & Eastern Illinois Railroad include coal loaded in cars of the Elgin, Joliet & Eastern and moved by the latter road over the rails of the Chicago & Eastern Illinois under a trackage agreement.

The quantities shown in the following table as shipped by waterways do not all agree with statistics on river traffic published by the United States Engineer Office. According to the United States Engineering Office at Pittsburgh, shipments of coal on the Monongahela River totaled 12,259,060 tons in 1931. The discrepancies between these records and the reports of the operators to the Bureau of Mines are due to various causes, partly to the fact that shipments of coal loaded in cars at the mines and later transferred to boats would be classified by the bureau as "rail" and by the engineer office as "river."

TABLE 33.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1931, in net tons*

Route	State	Quantity	
		By State	Total for route
RAILROADS			
Alabama Central	Alabama	74,285	74,285
Alabama Great Southern	do	109,747	109,747
Alaska	Alaska	99,500	99,500
Algers, Winslow & Western	Indiana	668,287	668,287
Alton	Illinois	1,561,572	1,601,372
	Missouri	39,800	
Artemus Jellico	Kentucky	235,320	235,320
Atchison, Topeka & Santa Fe	Colorado	367,351	2,220,801
	Illinois	266,603	
	Kansas	102,994	
	Missouri	336,604	
	New Mexico	1,127,087	
	Oklahoma	20,162	
Baltimore & Ohio	Illinois	555,332	24,848,824
	Indiana	419,179	
	Maryland	40,161	
	Ohio	4,184,867	
	Pennsylvania	7,656,955	
	West Virginia	11,992,330	
Bessemer & Lake Erie	Pennsylvania	1,971,958	1,971,958
Bevier & Southern	Missouri	111,829	111,829
Buffalo & Susquehanna	Pennsylvania	891,924	891,924
Buffalo Creek & Gauley	West Virginia	399,965	399,965
Buffalo, Rochester & Pittsburgh	Pennsylvania	5,607,925	5,607,925
Cambria & Indiana	do	3,107,476	3,107,476
Campbell's Creek	West Virginia	690,997	690,997
Carbon County	Utah	275,137	275,137
Caseyville	Illinois	102,319	102,319
Central of Georgia	Alabama	897,312	918,192
	Georgia	20,880	
Chaffee	Maryland	139,114	139,114
Chesapeake & Ohio	Kentucky	7,153,404	46,175,157
	Ohio	1,279,202	
	West Virginia	37,742,551	
Cheswick & Harmar	Pennsylvania	636,611	636,611

TABLE 33.—*Bituminous coal loaded for shipment by individual railroads and water ways, as reported by operators, in 1931, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
Chicago & Eastern Illinois	Illinois	2,236,061	3,897,853
	Indiana	1,661,792	
Chicago & Illinois Midland	Illinois	3,212,629	3,212,629
Chicago & North Western	do	2,433,697	2,646,565
	Iowa	189,841	
	Wyoming	23,027	
Chicago, Burlington & Quincy	Colorado	287,917	8,585,514
	Illinois	7,139,713	
	Iowa	285,057	
	Missouri	60,561	
	Wyoming	812,266	
Chicago Great Western	Iowa	36,597	36,597
Chicago, Indianapolis & Louisville	Indiana	1,226,177	1,226,177
Chicago, Milwaukee, St. Paul & Pacific	Illinois	2,707	5,295,912
	Indiana	3,869,447	
	Iowa	643,831	
	Missouri	62,513	
	Montana	647,115	
	North Dakota	48,065	
	South Dakota	7,023	
	Washington	15,211	
Chicago, Rock Island & Pacific	Colorado	1,580	2,058,233
	Illinois	558,651	
	Iowa	790,537	
	Missouri	82,904	
	Oklahoma	589,011	
	Texas	35,550	
Chicago, Springfield & St. Louis	Illinois	510,218	510,218
Cincinnati, New Orleans & Texas Pacific	Tennessee	14,900	14,900
Cleveland, Cincinnati, Chicago & St. Louis	Illinois	3,490,145	5,145,081
	Indiana	1,654,936	
Clinchfield	Kentucky	50,055	1,869,610
	Virginia	1,819,555	
Colorado & Southeastern	Colorado	264,289	264,289
Colorado & Southern	do	933,585	933,585
Colorado & Wyoming	do	280,585	280,585
Conemaugh & Black Lick	Pennsylvania	78,298	78,298
Crystal River & San Juan	Colorado	9,592	9,592
Cumberland & Pennsylvania	Maryland	924,883	924,883
Dardanelle & Russellville	Arkansas	67,900	67,900
Dents Run	Pennsylvania	44,165	44,165
Denver & Intermountain	Colorado	109,903	109,903
Denver & Rio Grande Western	do	1,358,994	3,051,031
	New Mexico	16,183	
	Utah	1,675,854	
Denver & Salt Lake	Colorado	526,229	526,229
Des Moines & Central Iowa	Iowa	158,861	158,861
Detroit, Toledo & Ironton	Ohio	4,788	4,788
East Broad Top Railroad & Coal Co	Pennsylvania	542,130	542,130
Eastern Railway & Lumber Co	Washington	11,751	11,751
East Kentucky Southern	Kentucky	50	50
Erie	Ohio	1,723	947,892
	Pennsylvania	946,169	
Evansville & Ohio Valley	Indiana	20,708	20,708
Evansville, Indianapolis & Terre Haute	do	329,424	329,424
Evansville, Suburban & Newburgh	do	98,361	98,361
Fort Dodge, Des Moines & Southern	Iowa	2,067	2,067
Fort Smith & Western	Oklahoma	63,218	63,218
Fort Smith, Subiaco & Rock Island	Arkansas	3,774	3,774
Great Northern	Montana	362,020	749,389
	North Dakota	229,511	
	Washington	157,858	
Harriman & Northeastern	Tennessee	211,563	211,563
Houston & Texas Central	Texas	4,170	4,170
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	319,105	319,105
Illinois Central	Alabama	213,422	13,372,548
	Illinois	7,527,225	
	Indiana	142,199	
	Kentucky	5,489,702	
Illinois Terminal	Illinois	805,904	805,904
Indian Creek Valley	Pennsyvania	220,849	220,849
International & Great Northern	Texas	49,493	49,493
Interstate	Kentucky	225,359	2,048,971
	Virginia	1,823,612	

TABLE 33.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1931, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
Iowa Southern Utilities Co.	Iowa	203,723	203,723
Johnstown & Stony Creek	Pennsylvania	240	240
Joplin & Pittsburg	Kansas	253,480	253,480
Kanawha & Michigan	West Virginia	(1)	(1)
Kanawha Central	do	111,136	111,136
Kanawha, Glen Jean & Eastern	do	934,208	934,208
Kansas City, Clay County & St. Joseph	Missouri	23,726	23,726
Kansas City Southern	Arkansas	13,220	682,617
	Kansas	27,673	
	Missouri	612,480	
	Oklahoma	29,244	
Kansas, Oklahoma & Gulf	do	62,605	62,605
Kelly Creek & Northwestern	West Virginia	740,897	740,897
Kentucky & Tennessee	Kentucky	563,013	563,013
Lake Erie, Franklin & Clarion	Pennsylvania	99,115	99,115
Laramie, North Park & Western	Colorado	35,400	35,400
Ligonier Valley	Pennsylvania	247,733	247,733
Litchfield & Madison	Illinois	423,589	423,589
Louisville & Nashville	Alabama	2,797,913	24,602,750
	Illinois	65,401	
	Kentucky	20,758,518	
	Tennessee	665,974	
	Virginia	314,944	
Mary Lee	Alabama	725,118	725,118
Michigan Central	Michigan	179,170	179,170
Midland Valley	Arkansas	161,125	518,284
	Oklahoma	357,159	
Minneapolis & St. Louis	Illinois	311,746	340,335
	Iowa	28,589	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	397,620	397,620
Missouri-Illinois	Illinois	81,561	81,561
Missouri-Kansas-Texas	Kansas	189,019	584,392
	Missouri	60,628	
	Oklahoma	251,187	
	Texas	83,558	
Missouri Pacific	Arkansas	672,477	6,317,359
	Illinois	3,971,408	
	Kansas	703,960	
	Missouri	962,852	
	Texas	6,662	
Mobile & Ohio	Alabama	158,015	435,251
	Illinois	277,236	
Monongahela	Pennsylvania	4,689,833	11,562,154
	West Virginia	6,872,321	
Montana	Arkansas	48,801	48,801
Montana, Wyoming & Southern	Montana	319,790	319,790
Montour	Pennsylvania	5,518,942	5,518,942
Nashville & Atlantic	Tennessee	11,050	11,050
Nashville, Chattanooga & St. Louis	do	895,828	895,828
New York Central (includes some coal shipped over subsidiary roads: Kanawha & Michigan, Toledo & Ohio Central, and Zanesville & Western)	Illinois	1,180	9,333,891
	Ohio	4,803,304	
	Pennsvylvania	3,693,661	
	West Virginia	835,746	
New York, Chicago & St. Louis	Illinois	390,785	390,785
Norfolk & Western	Kentucky	3,708,486	30,349,245
	Virginia	3,017,935	
	West Virginia	23,622,824	
Norfolk Southern	North Carolina	1,600	1,600
Northeast Oklahoma	Kansas	990	990
Northern Alabama	Alabama	456,953	456,953
Northern Pacific	Montana	905,467	2,457,260
	North Dakota	471,946	
	Washington	1,079,847	
Ohio & Kentucky	Kentucky	14,102	14,102
Ohio River Electric	Ohio	538	538
Oklahoma City-Ada-Atoka	Oklahoma	48,516	48,516
Oregon Short Line	Wyoming	493,422	493,422
Oregon-Washington Railroad & Navigation Co.	Washington	100,442	100,442
Pacific Coast	do	256,573	256,573
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago & St. Louis)	Illinois	397,823	39,843,491
	Indiana	1,729,131	
	Ohio	5,026,270	
	Pennsylvania	31,415,442	
	West Virginia	1,274,825	

1 Included under New York Central.

TABLE 33.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1931, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
Peoria & Eastern	Illinois	173,520	173,520
Peoria & Pekin Union	do	169,966	169,966
Peoria Terminal	do	821,365	821,365
Pere Marquette	Michigan	150,194	150,194
Peru, La Salle & Deer Park	Illinois	24,900	24,900
Pittsburg & Shawmut	Pennsylvania	1,334,649	1,334,649
Pittsburg County	Oklahoma	20,000	20,000
Pittsburg, Shawmut & Northern	Pennsylvania	573,284	573,284
Pittsburgh & Lake Erie	do	3,942,355	3,942,355
Pittsburgh & Susquehanna	do	8,531	8,531
Pittsburgh & West Virginia (includes West Side Belt)	Ohio	135,434	2,522,306
	Pennsylvania	2,350,759	
	West Virginia	36,113	
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	113,627	113,627
Pittsburgh, Lisbon & Western	do	7,120	7,120
Preston	West Virginia	160,675	160,675
Quincy, Omaha & Kansas City	Missouri	57,704	57,704
Rio Grande & Eagle Pass	Texas	10,742	10,742
Rio Grande Eastern	New Mexico	1,291	1,291
Rio Grande Southern	Colorado	9,521	9,521
Rockdale, Sandow & Southern	Texas	102,658	102,658
Rutland, Toluca & Northern	Illinois	4,106	4,106
St. Louis & Belleville Electric	do	3,426	3,426
St. Louis & Hannibal	Missouri	6,878	6,878
St. Louis & O'Fallon	Illinois	229,340	229,340
St. Louis & Ohio River	do	270,558	270,558
St. Louis-San Francisco	Alabama	1,441,790	3,109,884
	Arkansas	154,071	
	Kansas	459,284	
	Missouri	669,948	
	Oklahoma	384,791	
St. Louis Southwestern of Texas	Texas	356,080	356,080
Santa Fe, San Juan & Northern	New Mexico	3,723	3,723
Scott's Run	West Virginia	416,517	416,517
Seaboard Air Line	Alabama	2,400	2,400
Southern	do	1,852,238	7,670,039
	Illinois	178,266	
	Indiana	1,315,884	
	Kentucky	302,573	
	Tennessee	1,678,495	
	Virginia	2,342,583	
Southern Illinois Railway & Power Co.	Illinois	25,326	25,326
Southern Pacific	California	5,902	292,402
	New Mexico	286,500	
Strouds Creek & Muddlety	West Virginia	14,500	14,500
Susquehanna & New York	Pennsylvania	28,180	28,180
Tennessee	Tennessee	491,738	491,738
Tennessee Central	do	572,972	572,972
Tennessee Coal, Iron & Railroad Co.	Alabama	1,532,975	1,532,975
Texas & Pacific	Texas	10,940	10,940
Texas Short Line	do	43,624	43,624
Thomas & Sayreton	Alabama	538,764	538,764
Toledo & Ohio Central	Ohio	(1)	(1)
Toledo, Peoria & Western	Illinois	5,048	5,048
Twin City Electric	Washington	1,265	1,265
Uintah	Colorado	6,286	6,286
Union	Pennsylvania	44,300	44,300
Union Pacific	Idaho	50	4,562,566
	Colorado	1,157,081	
	Kansas	10,415	
	Utah	33,334	
	Wyoming	3,361,686	
Unity	Pennsylvania	610,820	610,820
Utah	Utah	1,289,437	1,289,437
Virginian	Virginia	73,626	8,311,685
	West Virginia	8,238,059	
Wabash	Illinois	1,728,350	1,878,133
	Iowa	103,274	
	Missouri	46,509	
Western Allegheny	Pennsylvania	192,831	192,831
Western Maryland	Maryland	790,211	3,981,633
	Pennsylvania	443,615	
	West Virginia	2,747,807	
West Side Belt	Pennsylvania	(2)	(2)

[1] Included under New York Central. [2] Included under Pittsburgh & West Virginia.

TABLE 33.—*Bituminous coal loaded for shipment by individual railroads and waterways, as reported by operators, in 1931, in net tons*—Continued

Route	State	Quantity: By State	Quantity: Total for route
RAILROADS—continued			
West Virginia Northern	West Virginia	143,566	143,566
Wheeling & Lake Erie	Ohio	2,784,401	2,784,401
Winfield	Pennsylvania	9,697	9,697
Winifrede	West Virginia	14,470	14,470
Woodward Iron Co	Alabama	697,697	697,697
Zanesville & Western	Ohio	(1)	(1)
Total railroad shipments		342,671,815	342,671,815
WATERWAYS			
Allegheny River	Pennsylvania	485,313	485,313
Black Warrior River	Alabama	147,351	147,351
Green River	Kentucky	57,995	57,995
Kanawha River	West Virginia	910,712	910,712
Monongahela River	Pennsylvania	11,997,300	11,997,300
Muskingum River	Ohio	304,086	304,086
Ohio River	Kentucky	274,896	702,049
	Ohio	11,158	
	West Virginia	415,995	
Tradewater River	Kentucky	1,432	1,432
Total waterway shipments		14,606,238	14,606,238
Grand total, loaded at mines for shipment by railroads and waterways		357,278,053	357,278,053
Sold to local trade and used by employees		19,878,462	19,878,462
Used at mines for power and heat		3,205,199	3,205,199
Made into coke at mines		1,727,682	1,727,682
		382,089,396	382,089,396

[1] Included under New York Central.

IMPORTS AND EXPORTS

IMPORTS

Although this country has a large exportable surplus, foreign coal, chiefly bituminous coal from Canada, is imported in certain districts—Washington, Montana, Idaho, and New England. (See Table 34.) For the past several years imports have been declining steadily.

TABLE 34.—*Bituminous coal imported, by countries and districts, 1930 and 1931, in net tons*

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

Country and district	1930	1931	Country and district	1930	1931
COUNTRY OF ORIGIN			DISTRICT OF ENTRY—continued		
North America:			Chicago	1	--------
Canada	237,086	202,862	Dakota	8,210	4,103
Mexico	500	684	Duluth-Superior	312	351
Europe:			Maine and New Hampshire	29,240	64,226
Germany	673	--------	Massachusetts	71	448
Soviet Russia	71	--------	Michigan	400	56
United Kingdom	310	504	Montana-Idaho	126,671	87,927
Asia:			New York	555	--------
French Indo-China	2,240	1,131	Oregon	6	--------
Japan	6	--------	Philadelphia	6	--------
Oceania: Australia	--------	1,122	St. Lawrence	3	52
	240,886	206,303	San Antonio	500	690
DISTRICT OF ENTRY			San Francisco	560	2,309
			Vermont	1	95
			Washington	50,458	26,808
Alaska	23,892	17,795			
Buffalo	--------	1,443		240,886	206,303

EXPORTS

In considering exports of bituminous coal it is well to distinguish between the movement to Canada, the sea-borne exports to near-by destinations (especially in the Caribbean), and the shipments to what

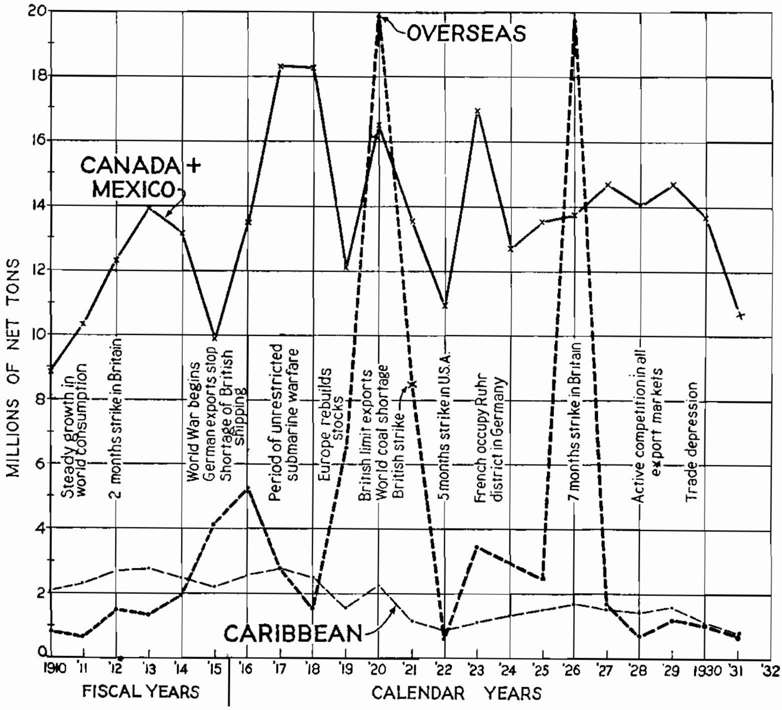

FIGURE 33.—Twenty-two years' exports of bituminous coal to (1) Canada and Mexico, (2) the Caribbean, and (3) overseas destinations. Exports to Canada (including also the small shipments to Mexico) have been relatively stable, except for the changes in general business conditions, and ran closely parallel to the domestic demand within the United States. Exports to the Caribbean region and other destinations adjacent to North America are also comparatively stable, because American shippers have a decided advantage in these markets. Exports overseas have been small except when competition of British or German coal was shut off. In 1920 and 1926 overseas exports increased so as to be a dominant influence on prices in the internal markets of the country

may be called "overseas" destinations which are farther from our shores. Figure 33 and Table 35 show the exports so subdivided for a number of years past. For a detailed analysis of the fluctuations in exports over a series of years, see Coal in 1930, pages 692 to 695.

Exports to virtually all countries decreased substantially in 1931 compared with 1930. (See Table 36.)

TABLE 35.—*Exports of bituminous coal to (1) Canada and Mexico, (2) the West Indies and Central America, and (3) "overseas" destinations, 1927–1931*

[Figures represent thousands of net tons]

Year	(1) Canada and Mexico	(2) West Indies and Central America[1]	(3) "Overseas" (all other countries)							Grand total
			Newfoundland, Miquelon, and Bermuda	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1927	14,723	1,543	102	741	793	22	88	--------	1,746	18,012
1928	14,049	1,434	99	273	255	1	53	--------	681	16,164
1929	14,727	1,500	211	332	567	8	84	--------	1,202	17,429
1930	13,667	1,180	95	353	469	14	97	2	1,030	15,877
1931	10,647	755	98	306	246	18	56	--------	724	12,126

[1] Includes Bahamas, Virgin Islands, and Panama.

TABLE 36.—*Bituminous coal exported, by countries, 1930 and 1931, in net tons*[1]

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

Country	1930	1931
North America:		
Bermudas	10,465	14,063
British Honduras	347	183
Canada	13,603,118	10,630,898
Central America—		
Costa Rica	1,136	2,432
Guatemala	561	319
Honduras	971	538
Nicaragua	242	78
Panama	224,462	178,656
Salvador	39	29
Greenland	----------	448
Mexico	63,953	16,206
Miquelon and St. Pierre Islands	12,140	2,317
Newfoundland and Labrador	72,359	81,523
West Indies—		
British—		
Barbados	16,256	4,945
Jamaica	68,863	44,769
Trinidad and Tobago	58,635	29,237
Other British	39,370	6,255
Cuba	534,828	354,630
Dominican Republic	3,014	1,438
French	118,690	86,701
Haiti	46	2
Netherland	24,610	3,949
Virgin Islands of the United States	87,665	40,750
	14,941,770	11,500,366
South America:		
Argentina	93,784	72,920
Brazil	208,060	197,284
Colombia	344	118
Ecuador	78	230
Falkland Islands	----------	4,758
Guiana—		
British	1,269	----------
Surinam (Netherland)	5,786	1,922
South America—Continued.		
Peru	12,618	2,744
Uruguay	31,092	26,570
Venezuela	24	18
	353,055	306,564
Europe:		
Denmark	----------	3,494
France	55,140	37,974
Germany	----------	109
Italy	414,023	204,302
Norway	214	----------
United Kingdom	25	----------
	469,402	245,879
Asia:		
Aden	----------	5,123
Arabia	----------	601
British Malaya	----------	6,628
Ceylon	----------	1,121
East Indies—		
Netherlands—		
Java and Madura	8,734	4,236
Other	5,159	----------
Philippine Islands	----------	6
Soviet Russia in Asia	7	----------
Other Asia	----------	1
	13,900	17,716
Africa:		
Algeria and Tunisia	45,843	29,721
Egypt	51,185	26,053
	97,028	55,774
Oceania: British—Australia	2,252	----------
	2,252	----------
Grand total	15,877,407	12,126,299

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated, in 1930, 3,496,680 tons; and in 1931, 2,195,089 tons.

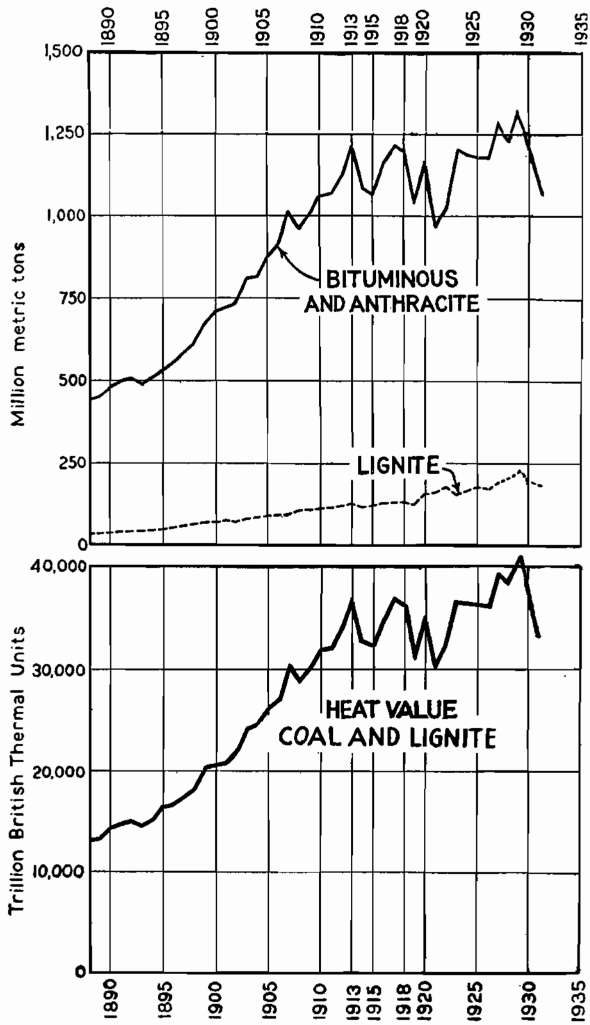

FIGURE 34.—World production of coal and lignite, 1888–1931

TABLE 37.—*Bituminous coal exported, by districts and ports, 1930 and 1931, in net tons*

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

Customs district	1930	1931	Customs district	1930	1931
North Atlantic:			Rail gateways on Canadian border:		
Massachusetts	75	----------	Eastern—		
New York	3,207	959	Maine and New Hampshire	41,451	5,273
Philadelphia	133,010	56,618	Vermont	4,321	3,081
Maryland	260,406	160,199	St. Lawrence	812,338	702,607
Virginia	1,843,602	1,234,208	Rochester [3]	1,652,752	1,131,358
South Atlantic:			Buffalo	2,536,678	2,278,831
South Carolina	77,539	35,808	Michigan	1,602,902	1,140,933
Florida	28,138	28,087	Western—		
Mobile	4,946	1,055	Duluth, Superior and International Falls	39,517	29,836
New Orleans	3,061	2,203	Dakota	16,253	7,950
Mexican border:			Montana-Idaho	151	49
Arizona	16,061	3,783	Miscellaneous:		
El Paso	30,099	11,281	Alaska	19	11
San Antonio	1,497	410	Puerto Rico	72	113
Pacific coast:					
Washington [1]	23,959	8,319			
San Francisco	99	623			
Los Angeles	65	----------			
San Diego	32	40			
Lake Erie ports: Ohio [2]	6,745,157	5,282,664		15,877,407	12,126,299

[1] Both rail to Canada and by tide to foreign ports.
[2] Lower lake docks as follows: Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, and Erie.
[3] Rail, car ferry, and Lake Ontario.

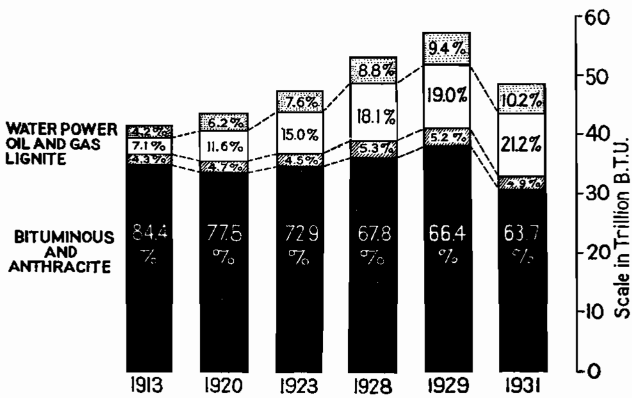

FIGURE 35.—World consumption of coal, oil and gas, and water power, 1913, 1920, 1923, 1928, 1929, and 1931. Consumption of each source of energy has been reduced to a common denominator in British thermal units. Water power is represented by the amount of fuel necessary to perform the same work. Figures in the bars represent percentage of total energy consumption for the year

SHIPMENTS TO ALASKA, HAWAII, AND PUERTO RICO

In addition to the export trade proper, the United States supplies a small tonnage to the Territories of Alaska, Hawaii, and Puerto Rico. In 1931, 30,772 tons were shipped to Alaska, 11,376 tons to Hawaii, and 30,672 tons to Puerto Rico.

WORLD PRODUCTION OF COAL

The effect of the business recession which so drastically curtailed production in the United States during 1931 was evident throughout the world. The total world production of all grades of coal dropped to 1,256,000,000 metric tons in 1931, a decline of 11.2 per cent compared with 1930. (See Table 38.) The trend of world production and consumption over a series of years is shown in Figures 34 and 35. Data for earlier years appear in previous issues of this report.

TABLE 38.—*Coal and lignite produced in the principal countries of the world in the calendar years 1927–1931, in metric tons*

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1927	1928	1929	1930	1931
North America:					
Canada—					
Coal	12,340,507	12,439,470	12,272,806	10,367,432	8,468,416
Lignite	3,468,793	3,494,505	3,599,720	3,132,608	2,638,380
Greenland	2,900	3,000	3,600	4,800	4,700
Mexico	1,031,308	1,022,475	1,054,196	1,294,259	922,289
United States—					
Anthracite	72,661,094	68,354,261	66,975,462	62,944,536	54,109,343
Bituminous and lignite	469,704,558	454,265,822	485,330,952	424,130,508	346,623,858
South America:					
Argentina	(1)	(1)	(1)	(1)	(1)
Brazil [2]	400,000	400,000	400,000	400,000	400,000
Chile	1,481,511	1,375,616	1,507,866	1,442,144	1,100,382
Colombia	(1)	(1)	(1)	(1)	(1)
Peru	158,601	177,513	219,654	200,014	179,000
Venezuela	[3] 16,104	[3] 15,812	[3] 16,859	9,443	2,801
Europe:					
Albania—Lignite	3,115	2,985	4,117	4,283	3,159
Austria—					
Coal	175,601	202,098	208,020	215,888	228,144
Lignite	3,064,068	3,262,570	3,524,792	3,062,981	2,982,076
Belgium	27,550,960	27,578,300	26,939,930	27,414,730	27,038,000
Bulgaria—					
Coal	69,192	69,536	78,855	70,652	85,629
Lignite	1,168,454	1,360,790	1,572,964	1,522,389	1,436,911
Czechoslovakia—					
Coal	14,016,300	14,560,305	16,521,457	14,435,002	13,102,712
Lignite	19,620,637	20,451,421	22,560,796	19,193,669	17,931,635
France—					
Coal	51,791,821	51,365,247	53,779,780	53,884,035	50,022,775
Lignite	1,083,041	1,074,627	1,197,220	1,142,733	1,040,017
Germany [4]—					
Coal	153,599,355	150,860,599	163,440,632	142,698,728	118,640,113
Lignite	150,503,914	165,588,097	174,455,946	146,010,044	133,310,720
Saar [5]	13,595,824	13,106,718	13,579,348	13,235,771	11,367,011
Greece—Lignite	143,346	120,639	156,526	129,623	(1)
Hungary—					
Coal	785,922	783,279	826,270	811,548	776,412
Lignite	6,244,275	6,510,070	7,043,920	6,176,484	6,197,055
Irish Free State	(1)	(1)	86,554	(1)	(1)
Italy—					
Coal	168,528	127,932	223,348	231,126	235,693
Lignite	912,458	697,033	782,045	576,860	364,487
Netherlands—					
Coal	9,488,412	10,920,054	11,581,202	12,211,084	12,901,391
Lignite	201,382	196,696	156,568	144,150	122,199
Poland—					
Coal	38,084,086	40,616,384	46,236,037	37,505,649	38,265,010
Lignite	78,464	73,560	74,321	54,962	39,400
Portugal—					
Coal	178,554	201,348	196,901	212,199	201,225
Lignite	25,713	26,450	29,343	34,474	25,836
Rumania—					
Coal	373,457	397,564	370,947	298,825	286,530
Lignite	2,850,011	2,629,676	2,675,080	2,071,057	1,631,861
Russia [6]—					
Coal	25,944,341	28,827,819	36,384,000	39,952,000	50,400,000
Lignite	1,763,196	1,978,570			

[1] Estimate included in total.
[2] Approximate production.
[3] Exclusive of output of State of Falcón (about 8,000 tons), for which estimate is included in total.
[4] Exclusive of mines in the Saar under French control.
[5] Mines under French control.
[6] 1927 to 1930, inclusive, figures for fiscal year ended Sept. 30; 1931 figures for calendar year.

TABLE 38.—*Coal and lignite produced in the principal countries of the world in the calendar years 1927–1931, in metric tons*—Continued

Country	1927	1928	1929	1930	1931
Europe—Continued.					
Spain—					
Coal	6,562,936	6,370,508	7,108,316	7,119,807	7,185,856
Lignite	429,602	422,504	438,951	388,032	352,530
Svalbard (Spitsbergen)	[7] 303,000	275,019	251,185	188,419	243,107
Sweden	398,298	358,513	394,975	397,960	343,197
Switzerland [2]	7,000	7,000	7,000	4,000	4,000
Turkey—Lignite	4,000	(1)	312	800	
United Kingdom—					
Great Britain	255,264,615	241,283,355	262,046,206	247,796,127	222,981,267
Northern Ireland—Lignite	510	650	327		
Yugoslavia—					
Coal	287,728	457,472	408,611	366,203	427,893
Lignite	4,458,491	4,694,408	5,242,527	4,909,679	4,534,726
Asia:					
British Borneo	80,466	79,721	73,100	74,345	47,953
China	24,172,009	25,091,760	25,845,000	26,455,000	27,682,000
Chosen	709,578	815,817	937,902	884,138	(1)
Federated Malay States	470,432	565,523	672,131	574,650	408,813
India, British	22,436,757	22,904,685	23,794,605	24,185,087	22,064,984
Indo-China—					
Coal	1,482,900	1,954,098	1,941,310	1,937,000	1,704,000
Lignite	7,000	15,472	30,713	29,000	22,500
Japan—					
Japan proper—					
Coal	33,387,160	33,694,298	34,100,000	31,200,000	25,795,485
Lignite	178,613	121,923	139,031	128,624	(1)
Karafuto	362,777	548,140	645,715	655,326	(1)
Taiwan	1,857,257	1,583,598	1,530,025	1,598,728	(1)
Netherland East Indies	1,620,205	1,703,526	1,833,665	1,870,823	1,399,931
Philippine Islands	23,410	27,857	17,321	20,751	18,968
Russia [6]—					
Coal	[8] 3,907,499	[8] 3,916,129			
Lignite	869,262	903,758	6,489,000	6,504,000	8,200,000
Sakhalin—Coal	46,274	126,551			
Turkey—					
Coal	1,323,833	1,250,639	1,421,008	1,595,159	1,115,877
Lignite	6,555	5,169	7,659	7,372	7,774
Africa:					
Algeria	21,269	16,631	16,130	17,193	25,592
Belgian Congo—					
Coal	86,950	97,780	114,450	133,800	85,713
Lignite			2,800		
Madagascar	5	33	26		
Morocco, French				1,000	5,663
Nigeria	363,643	365,083	350,473	353,425	332,940
Portuguese East Africa	15,834	6,455	(1)	(1)	(1)
Southern Rhodesia	908,744	1,094,843	1,036,816	938,736	587,255
Union of South Africa	12,580,314	12,606,576	13,018,328	12,222,501	10,880,906
Oceania:					
Australia—					
New South Wales	11,304,688	9,599,841	7,740,000	7,206,899	6,535,622
Queensland	1,116,680	1,093,615	1,390,713	1,112,246	854,811
Tasmania	113,854	130,562	132,382	140,942	125,815
Victoria—					
Coal	695,227	668,889	715,124	714,777	(1)
Lignite	1,478,842	1,617,407	1,769,122	1,860,903	(1)
Western Australia	509,554	536,901	553,462	509,473	439,340
New Caledonia	9,000	16,565	21,000	9,670	(1)
New Zealand—					
Coal	1,311,247	1,370,379	1,389,107	1,403,873	995,359
Lignite	1,093,484	1,105,483	1,187,458	1,179,019	1,197,029
Total, all grades	1,477,000,000	1,465,000,000	1,561,000,000	1,414,000,000	1,256,000,000
Lignite (total of items shown above)	200,000,000	216,000,000	230,000,000	195,000,000	180,000,000
Bituminous and anthracite (by subtraction)	1,277,000,000	1,249,000,000	1,331,000,000	1,219,000,000	1,076,000,000

[1] Estimate included in total.
[2] Approximate production.
[6] 1927 to 1930, inclusive, figures for fiscal year ended Sept. 30; 1931 figures for calendar year.
[7] Production less consumption at mines, for which data are not available.
[8] Exclusive of Sakhalin.

DETAILED STATISTICS OF BITUMINOUS COAL, BY STATES AND COUNTIES

TABLES OF PRODUCTION, VALUE, MEN EMPLOYED, DAYS WORKED, AND OUTPUT PER MAN IN 1931

The following table (Table 39) presents detailed statistics for each coal-producing county from which three or more operators reported production. If less than three reports were received, the figures for two or more counties have been combined to avoid disclosing individual returns, unless permission to publish has been granted by the producers.

The series gives the details of total value of product, average value per ton, men employed by broad occupational groups, average number of days worked by the mines, and output per man per day. The figures include stripping operations as well as deep mines. Separate particulars for the stripping operations in each county are given in Table 22. If the reader will deduct the stripping figures as given in that table from the totals for all mines in the following table, he will find that the remainder represents the operations of the deep mines. By this means figures can be obtained for the deep mines separately in any State or county desired.

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*

[Note that figures relate only to active mines of commercial size; no canvass was made of wagon mines producing less than 1,000 tons. Waste and refuse are not included in tonnage]

ALABAMA

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
								Underground			Surface				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others	Total		
Bibb	506,007	10,737	4,349	-------	521,093	$1,080,000	$2.07	741	155	66	2	163	1,127	139	462
Blount	161,355	4,694	6,015	-------	172,064	337,000	1.96	425	58	26	10	87	606	96	284
Cullman	-------	7,926	-------	-------	7,926	19,000	2.40	19	5	5	-------	6	35	156	226
Jefferson	5,833,637	135,593	20,578	-------	5,989,808	11,151,000	1.86	7,106	1,212	1,513	3	1,228	11,062	150	541
Marion	213,422	7,343	-------	-------	220,765	526,000	2.38	394	32	37	-------	72	535	85	413
St. Clair	721,673	11,580	25,879	-------	759,132	1,514,000	1.99	728	98	107	-------	122	1,055	164	720
Shelby	515,666	26,897	423	-------	542,986	1,286,000	2.37	810	121	81	-------	204	1,216	146	447
Tuscaloosa	191,444	15,070	292	-------	206,806	416,000	2.01	551	88	68	-------	155	862	78	240
Walker	3,388,750	65,192	6,526	-------	3,460,468	5,355,000	1.55	4,012	648	666	144	739	6,209	121	557
Winston	6,000	992	-------	-------	6,992	9,000	1.29	12	2	2	20	4	40	112	175
Other counties (Etowah and Fayette)	108,026	2,715	-------	-------	110,741	173,000	1.56	171	19	9	-------	27	226	118	490
Total, 1931	11,645,980	288,739	64,062	-------	11,998,781	21,866,000	1.82	14,969	2,438	2,580	179	2,807	22,973	136	522
Total, 1930	15,129,163	346,698	94,197	-------	15,570,058	31,616,000	2.03	15,173	2,700	3,004	3,516		24,393	189	638

ALASKA

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Value: Average per ton	Miners, loaders, and shot firers	Haulage and track	Underground: All others	In strip pits	Surface: All others	Total	Average number of days worked	Average tons per man per year
Total, 1931	99,500	5,300	1,100	-------	105,900	$556,000	$5.25	30	6	13	-------	31	80	277	1,324
Total, 1930	112,900	6,000	1,200	-------	120,100	631,000	5.25	40	7	20	-------	32	99	294	1,213

ARIZONA

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Value: Average per ton	Miners, loaders, and shot firers	Haulage and track	Underground: All others	In strip pits	Surface: All others	Total	Average number of days worked	Average tons per man per year
Total, 1931	-------	7,120	-------	-------	7,120	$42,000	$5.90	20	2	2	-------	3	27	115	264
Total, 1930	-------	9,084	-------	-------	9,084	29,000	3.19	18	3	2	-------	1	24	196	378

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

ARKANSAS

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Underground			Surface		Total		
								Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others			
Franklin	120,684	933	2,984		124,601	$320,000	$2.57	350	48	33	36	44	511	69	244
Johnson	163,808	10,909	2,602		177,319	642,000	3.62	789	138	127		225	1,279	61	139
Logan	262,339	970	10		263,319	987,000	3.75	686	65	59		87	897	99	294
Pope and Scott	81,920	3,304	1,169		86,393	377,000	4.36	247	41	29		35	352	124	245
Sebastian	492,617	7,614	1,692		501,923	1,185,000	2.36	1,272	134	92		196	1,694	119	296
Total, 1931	1,121,368	23,730	8,457		1,153,555	3,511,000	3.04	3,344	426	340	36	587	4,733	95	244
Total, 1930	1,513,574	8,471	11,389		1,533,434	5,153,000	3.36	3,185	469	387	585		4,626	115	331

CALIFORNIA, IDAHO, AND OREGON

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others (underground)	In strip pits	All others (surface)	Total employees	Average number of days worked	Average tons per man per year
Total, 1931 [1]	5,952	10,430	1,003		17,385	$88,000	$5.06	60	15	16		25	116	86	150
Total, 1930	12,300	4,713	1,525		18,538	100,000	5.39	57	7	9		65	138	74	134

COLORADO

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others (underground)	In strip pits	All others (surface)	Total employees	Average number of days worked	Average tons per man per year
Boulder	254,003	223,625	20,460		498,088	$1,318,000	$2.65	341	76	45		89	551	222	904
Delta	30,590	25,989	3,950		60,529	139,000	2.30	68	4	6		23	101	110	599
El Paso	146,836	188,824	10,101		345,761	736,000	2.13	260	35	15		42	352	226	982
Fremont	245,181	95,626	5,075		345,882	1,050,000	3.04	522	78	83		156	839	160	412
Garfield	9,286	21,999	300		31,585	82,000	2.60	27	4	3		10	44	205	718
Gunnison	382,301	7,781	12,035		402,117	898,000	2.23	328	79	36		96	539	129	746
Huerfano	938,526	31,007	8,735		978,268	2,433,000	2.49	1,417	231	131		337	2,116	121	462
Jackson and Larimer	35,400	6,629	1,261		43,290	54,000	1.25	37	5	6	9	5	62	140	698
Jefferson	109,903	28,011	2,400		140,314	352,000	2.51	59	19	16		24	118	246	1,189
La Plata	13,148	16,920			30,068	68,000	2.26	41	6	4		10	61	146	493
Las Animas	1,208,796	47,017	21,289	59,151	1,336,253	3,206,000	2.40	1,830	235	159		322	2,546	130	525

Mesa	49,146	38,528	2,724		90,398	200,000	2.21	100	12	8		21	141	179	641
Moffat		5,147			5,147	12,000	2.33	8	1	1		3	13	163	396
Montezuma	48	6,630			6,678	27,000	4.04	11	1	1		3	16	147	417
Montrose and Ouray		1,665			1,665	4,000	2.40	6	1	1		1	9	79	185
Park and Pitkin	9,592	713	68		10,373	31,000	2.99	12	1	1		6	20	148	519
Rio Blanco		6,931			6,931	16,000	2.31	10	1	1		3	15	225	462
Routt	526,229	19,254	25,403		570,886	1,659,000	2.91	591	91	71		216	969	70	[2] 589
Weld	1,389,328	275,959	31,591		1,696,878	3,651,000	2.15	1,064	145	147		151	1,507	173	1,126
Other counties (Archuleta and Elbert)		3,258			3,258	8,000	2.46	3	1	1	3	1	9	160	362
Total, 1931	5,348,313	1,051,513	145,392	59,151	6,604,369	15,944,000	2.41	6,735	1,026	736	12	1,519	10,028	142	659
Total, 1930	7,004,510	891,447	180,119	120,834	8,196,910	21,485,000	2.62	7,411	1,134	958	1,588		11,091	169	739

GEORGIA

Total, 1931	20,880	50	650		21,580	$45,000	$2.09	45	7	4		6	62	180	348
Total, 1930	7,033	47	12		7,092	18,000	2.54	43	7	4		6	60	71	118

ILLINOIS

Bond, Clinton, and Marion	505,428	62,211	48,012		615,651	$827,000	$1.34	549	142	117		141	949	105	649
Bureau		9,173	1,470		10,643	25,000	2.35	41	6	5		5	57	134	187
Cass, Morgan, and Scott		2,218			2,218	6,000	2.71	8	2	2		3	15	116	148
Christian	2,742,298	129,116	26,526		2,897,940	5,084,000	1.75	1,453	387	445		384	2,669	126	1,086
Crawford and Edgar		10,963	1,602		12,565	27,000	2.15	20	4	4		4	32	144	393
Franklin	9,202,943	41,133	99,111		9,343,187	16,215,000	1.74	5,250	1,465	1,801		1,417	9,933	145	941
Fulton	1,188,333	141,372	3,811		1,333,516	2,151,000	1.61	829	112	86	173	126	1,326	130	1,006
Gallatin		22,643	624		23,267	38,000	1.63	33	4	4	2	10	53	155	439
Greene and Jersey		6,415	100		6,515	9,000	1.38	13	2	1		4	20	167	326
Grundy and Will	946,479	70,788	3,997		1,021,264	3,575,000	3.50	80	10	4	157	51	302	217	3,382
Hancock and Pike		3,750	30		3,780	12,000	3.17	8	1	1		2	12	165	315
Henry	522,228	96,691	4,409		623,328	935,000	1.50	228	28	22	64	82	424	186	1,470
Jackson	1,857,222	44,785	7,961		1,909,968	2,685,000	1.41	288	96	101	149	206	840	179	2,274
Jefferson and White	4,301	4,262	3,866		12,429	27,000	2.17	90	9	12		7	118	41	105
Knox	263,134	63,772	785		327,691	730,000	2.23	284	38	20		36	378	203	867
La Salle	90,839	215,445	1,485		307,769	856,000	2.78	494	40	69	18	62	683	165	451
Livingston		21,239	628		21,867	64,000	2.93	27	10	6	23	9	75	140	292
Logan and Macon	55,115	132,718	9,105		196,938	533,000	2.71	284	29	47		41	401	166	491
McDonough		5,758			5,758	21,000	3.65	13	3	2	10	3	31	149	186
Macoupin	3,814,637	54,141	101,216		3,969,994	5,574,000	1.40	1,875	358	732		313	3,278	176	1,211
Madison	940,962	176,612	32,220		1,149,794	1,703,000	1.48	1,060	144	320		191	1,715	112	670
Marshall		2,800			2,800	6,000	2.14	6	1	1		2	10	90	280

[1] Includes Nevada.

[2] In this county certain mines have in recent times followed the practice of reducing their forces in periods of dull market and of working every day underground when the tipple works only 1, 2, or 3 days a week. As the days worked represent tipple time, the result is not comparable with the returns for other counties, and the average for the State is affected also.

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

ILLINOIS—Continued

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Underground			Surface		Total		
								Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others			
Menard		88,984	3,230		92,214	$205,000	$2.22	111	17	12		25	165	175	559
Mercer		18,773	450		19,223	58,000	3.02	38	5	5		8	56	133	343
Montgomery	1,198,994	34,583	21,855		1,255,432	1,848,000	1.47	857	158	170		164	1,349	164	931
Peoria	1,023,105	181,504	3,161		1,207,770	2,203,000	1.82	1,140	134	98	8	88	1,468	160	823
Perry	2,815,029	74,355	27,807		2,917,191	4,007,000	1.37	887	96	147	517	203	1,850	106	1,577
Putnam and Woodford	29,108	26,109	3,940		59,157	196,000	3.31	326	22	19		37	404	73	146
Randolph	401,290	52,377	14,479		468,146	838,000	1.79	532	112	71		121	836	109	560
Rock Island		27,230	730		27,960	70,000	2.50	60	10	9		9	88	165	318
St. Clair	1,910,411	800,873	58,420		2,769,704	3,891,000	1.40	1,914	297	312	58	350	2,931	145	945
Saline	2,808,900	52,214	55,401		2,916,515	5,469,000	1.88	2,398	510	441	110	459	3,918	124	744
Sangamon	2,933,563	359,884	38,251		3,331,698	5,736,000	1.72	3,293	504	532		341	4,670	145	713
Schuyler		26,330	720		27,050	52,000	1.92	28	5	4	15	9	61	164	443
Shelby	3,050	29,527	3,579		36,156	61,000	1.69	113	12	13		21	159	103	227
Stark		8,077			8,077	20,000	2.48	25	4	4		7	40	159	202
Tazewell	187,431	150,950	955		339,336	624,000	1.84	327	34	22		47	430	198	789
Vermilion	2,259,803	223,098	16,439		2,499,340	4,729,000	1.89	1,854	360	389	113	232	2,948	138	848
Wabash		6,217	70		6,287	9,000	1.43	15	3	3		7	28	120	225
Warren		3,351			3,351	11,000	3.28	9	2	1		3	15	132	223
Washington	288,626	80,698	14,026		383,350	615,000	1.60	160	53	55		53	321	167	1,194
Williamson	1,964,447	97,733	74,276		2,136,456	3,782,000	1.77	2,845	505	633	99	545	4,627	77	462
Total, 1931	39,957,676	3,660,872	684,747		44,303,295	75,527,000	1.70	29,865	5,734	6,742	1,516	5,828	49,685	136	[3] 892
Total, 1930	48,922,279	3,993,263	815,688		53,731,230	93,484,000	1.74	33,893	5,844	6,713	7,153		53,603	156	[3] 1,002

INDIANA

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others	Total	Average number of days worked	Average tons per man per year
Clay	589,773	26,194	21,133		637,100	$937,000	$1.47	158	28	24	265	75	550	121	1,158
Daviess		16,989	874		17,863	31,000	1.74	34	7	6		14	61	127	293
Dubois and Martin		7,578			7,578	13,000	1.72	11	1	1		3	16	148	474
Fountain and Parke	140	21,206	500		21,846	32,000	1.46	34	5	3		8	50	156	437

Gibson	813,028	38,478	10,625		862,131	1,235,000	1.43	473	108	72		127	780	146	1,105
Greene	1,572,959	28,447	21,523		1,622,929	2,450.000	1.51	567	109	100	286	57	1,119	152	1,450
Knox	1.398,463	46,064	14,611		1,459,138	1,813,000	1.24	763	145	89		169	1,166	151	1,251
Owen	105,472	249	4,850		110,571	105,000	1.49	34	3	3	40	4	84	133	1,316
Perry		7,408	100		7,508	16,000	2.13	10	2	2		1	15	156	501
Pike	2,677,139	15,801	28,364		2,721,304	3,154,000	1.16	65	16	7	630	52	770	195	3.534
Spencer and Vanderburg	82,100	133,715	10,000		225,815	261,000	1.16	228	35	48		39	350	162	645
Sullivan	2,169,916	57,837	30,231		2,257,984	3,859,000	1.71	1,344	335	299	90	236	2,304	143	980
Vermillion	1,384,833	22,668	25,657		1,433,158	2,352,000	1.64	950	131	123	130	98	1,432	168	1,001
Vigo	1,597,803	390,504	61,410		2,049,717	3,424,000	1.67	1,814	352	294	69	256	2,785	112	736
Warrick	743,899	107,101	9,523		860,523	993,000	1.15	478	75	55	125	96	829	181	1,038
Total, 1931	13,135,525	920,239	239,401		14,295,165	20,735,000	1.45	6,963	1,352	1,126	1,635	1,235	12,311	146	[3] 1,161
Total, 1930	15,235,765	942,854	311,343		16,489,962	26,178,000	1.59	8,050	1,485	1,327	3,019		13,881	157	[3] 1,188
IOWA															
Adams		13,380			13,380	$41,000	$3.06	31	6	4		8	49	171	273
Appanoose	477,591	66,202	738		544,531	1,248,000	2.29	1,502	164	100		153	1,919	120	284
Boone	288,144	74,548	2,994		365,686	1,188,000	3.25	789	114	61		69	1,033	141	354
Dallas	356,361	18,031	1,750		376,142	992,000	2.64	537	60	37		35	669	149	562
Davis		1,254			1,254	4,000	3.19	9	1	1		4	15	57	84
Greene and Webster		18,053	10		18,063	57,000	3.16	51	7	3		13	74	97	244
Guthrie		9,256			9,256	31,000	3.35	29	6	6		8	49	146	189
Jasper		56,204	3,062		59,266	153,000	2.58	92	15	16		18	141	160	420
Jefferson and Keokuk		4,420			4,420	11,000	2.49	11	3	2		3	19	136	233
Lucas	460,380	4,254	6,131		470,765	1,192,000	2.53	469	55	102		52	678	142	694
Mahaska	56	48,836	180		49,072	115,000	2.34	92	14	10		27	143	143	343
Marion	340,173	44,766	7,723		392,662	918,000	2.34	578	81	106		70	835	148	470
Monroe	312,822	29,321	2,772		344,915	731,000	2.12	502	55	40		61	658	159	524
Page	1,320	24,376			25,696	92,000	3.58	58	11	8		8	85	174	302
Polk	156,942	347,405	7,210		511,557	1,273,000	2.49	703	106	81		70	960	171	533
Taylor	870	7,772			8,642	30,000	3.47	36	5	3		5	49	135	176
Van Buren	236	8,685	150		9,071	26,000	2.87	17	3	3		5	28	99	324
Wapello	375	78,826	870		80,071	210,000	2.62	141	20	15		29	205	144	391
Warren	43,537	37,549	3,580		84,666	215,000	2.54	145	20	31		20	216	127	292
Wayne	3,570	14,170	1,500		19,240	48,000	2.49	48	6	6		12	72	118	267
Total, 1931	2,442,377	907,308	38,670		3,388,355	8.575,000	2.53	5,840	752	635		670	7,897	142	429
Total, 1930	2,933,518	903,038	56,015		3,892,571	10,385,000	2.67	5,883	675	713		630	7,901	155	498
KANSAS															
Bourbon		15,192	416		15,608	$27,000	$1.73	8	2	2	20	3	35	149	446
Cherokee	214,116	36,709	785		251,610	503,000	2.00	134	22	14	80	39	289	107	871
Crawford	1,487,217	74,865	22,023		1,584,105	2,905,000	1.83	1,732	170	106	417	169	2,594	103	611

[3] Much of the output is obtained from strip pits or by the use of loading machines, in which types of operations the production per man is large.

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

KANSAS—Continued

County	Net tons: Loaded at mines for shipment	Net tons: Sold to local trade and used by employees	Net tons: Used at mines for power and heat	Net tons: Made into coke at mines	Net tons: Total quantity	Value: Total	Value: Average per ton	Number of employees: Underground: Miners, loaders, and shot firers	Number of employees: Underground: Haulage and track	Number of employees: Underground: All others	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days worked	Average tons per man per year
Linn		7,783			7,783	$15,000	$1.93	29	5	4	3	12	53	86	147
Osage	16,677	31,178			47,855	165,000	3.45	272	37	31		40	380	97	126
Other counties (Franklin, Labette, and Leavenworth)	29,805	50,104			79,909	156,000	1.95	273	59	26	3	101	462	268	173
Total, 1931	1,747,815	215,831	23,224		1,986,870	3,771,000	1.90	2,448	295	183	523	364	3,813	123	521
Total, 1930	2,109,151	287,919	32,859		2,429,929	5,231,000	2.15	3,160	367	212	1,116		4,855	126	501

KENTUCKY

County	Net tons: Loaded at mines for shipment	Net tons: Sold to local trade and used by employees	Net tons: Used at mines for power and heat	Net tons: Made into coke at mines	Net tons: Total quantity	Value: Total	Value: Average per ton	Number of employees: Underground: Miners, loaders, and shot firers	Number of employees: Underground: Haulage and track	Number of employees: Underground: All others	Number of employees: Surface: In strip pits	Number of employees: Surface: All others	Number of employees: Total	Average number of days worked	Average tons per man per year
Eastern district:															
Bell	1,278,483	103,201	7,736		1,389,420	$1,778,000	$1.28	1,606	288	200		305	2,399	148	579
Breathitt	81,935	45,122	10,000		137,057	171,000	1.25	192	26	42		30	290	130	473
Clay	31,796	1,150	1,000		33,946	34,000	1.00	98	11	10		17	136	111	250
Floyd	3,323,354	19,815	6,226		3,349,395	4,580,000	1.37	2,495	483	482		577	4,037	167	830
Harlan	9,250,422	77,289	11,240		9,338,951	13,598,000	1.46	6,338	1,167	1,180		1,247	9,932	175	940
Jackson		5,942			5,942	10,000	1.68	14	2	2		5	23	146	258
Johnson	659,785	7,847	3,910		671,542	1,128,000	1.68	663	140	81		168	1,052	125	638
Knott	609,926	5,077	4,243		619,246	661,000	1.07	366	62	45		72	545	207	1,136
Knox	342,320	3,839	4,400		350,559	396,000	1.13	307	43	49		84	483	210	726
Laurel	4,373	4,028	17		8,418	12,000	1.43	63	9	5		13	90	34	94
Letcher	4,427,863	48,179	57,934		4,533,976	6,227,000	1.37	3,032	727	645		784	5,188	169	874
Martin	279,990	159	732		280,881	255,000	.91	141	41	35		44	261	148	1,076
Perry	4,895,692	69,857	3,432		4,968,981	5,672,000	1.14	2,866	539	656		713	4,774	185	1,041
Pike	4,611,094	25,650	22,356		4,659,100	5,936,000	1.27	3,149	714	658		806	5,327	173	875
Whitley	262,900	4,283	14,375		281,558	478,000	1.70	446	48	75		74	643	103	438

Other counties (Boyd, Carter, Lee, McCreary, Morgan, Rockcastle, and Wayne)	710,304	37,645	7,200		755,149	1,119,000	1.48	833	196	167		165	1,361	130	555
Total, 1931	30,770,237	459,083	154,801		31,384,121	42,055,000	1.34	22,609	4,496	4,332		5,104	36,541	168	859
Total, 1930	39,613,774	469,101	210,819		40,293,694	63,854,000	1.58	26,205	5,609	5,280		5,584	42,678	200	944
Western district:															
Butler	8,993	5,000			13,993	21,000	1.50	29	4	3		8	44	191	318
Daviess		47,342	430		47,772	59,000	1.24	55	9	4		10	78	158	612
Henderson	60,857	72,069	8,325		141,251	159,000	1.13	148	33	22		30	233	176	606
Hopkins	2,723,318	85,203	10,856		2,819,377	3,080,000	1.09	2,386	352	468	10	420	3,636	120	775
Muhlenberg	2,659,227	79,701	57,683		2,796,611	2,721,000	.97	1,942	395	492	75	462	3,366	138	831
Ohio	585,199	10,477	3,552		599,228	496,000	.83	762	192	32		114	1,100	123	545
Union	517,357	28,687	29,117		575,161	581,000	1.01	545	118	107		100	870	126	661
Webster	1,356,761	23,832	16,776		1,397,369	1,384,000	.99	1,025	196	264		217	1,702	124	821
Other counties (Christian, Crittenden, and McLean)	152,956	33,782	2,000		188,738	189,000	1.00	130	23	20		23	196	194	963
Total, 1931	8,064,668	386,093	128,739		8,579,500	8,690,000	1.01	7,022	1,322	1,412	85	1,384	11,225	130	764
Total, 1930	10,398,085	348,566	168,650		10,915,301	12,332,000	1.13	8,802	1,475	1,821		1,898	13,996	148	780
Total all Kentucky, 1931	38,834,905	845,176	283,540		39,963,621	50,745,000	1.27	29,631	5,818	5,744	85	6,488	47,766	159	837
Total all Kentucky, 1930	50,011,859	817,667	379,469		51,208,995	76,186,000	1.49	35,007	7,084	7,101		7,482	56,674	187	904

MARYLAND

Allegany	1,264,471	91,517	1,100		1,357,088	$2,005,000	$1.48	1,648	242	223		242	2,355	192	576
Garrett	629,898	9,290	9,497		648,685	902,000	1.39	604	105	52		108	869	186	746
Total, 1931	1,894,369	100,807	10,597		2,005,773	2,907,000	1.45	2,252	347	275		350	3,224	190	622
Total, 1930	2,148,045	111,828	10,720		2,270,593	3,690,000	1.63	2,293	356	293		357	3,299	197	688

MICHIGAN

Bay, Midland, and Saginaw	329,364	18,087	11,952		359,403	$1,094,000	$3.04	949	192	136		95	1,372	96	262
Total, 1931	329,364	18,087	11,952		359,403	1,094,000	3.04	949	192	136		95	1,372	96	262
Total, 1930	609,195	20,802	31,116		661,113	2,323,000	3.51	884	182	122		106	1,294	187	511

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

MISSOURI

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
								Underground			Surface				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others	Total		
Adair	84,206	22,071	3,090		109,367	$233,000	$2.13	193	29	30		37	289	163	378
Audrain		5,499			5,499	16,000	2.91	16	3	2		5	26	161	212
Barton	1,303,347	4,853	4,137		1,312,337	2,172,000	1.66	87	13	3	472	37	612	130	[4] 2,144
Bates	593,393	6,519	3,450		603,362	1,063,000	1.76	30	4	4	234	13	285	205	[4] 2,117
Boone		34,599	365		34,964	92,000	2.63	72	12	9	13	16	122	167	287
Caldwell and Platte	7,875	14,847	2,949		25,671	125,000	4.87	114	6	10		12	142	80	181
Callaway		29,679	28		29,707	86,000	2.89	55	6	3	17	10	91	196	326
Cedar, Dade, and Jasper		6,930			6,930	17,000	2.45	3	1		6	3	13	130	[4] 533
Chariton		3,436			3,436	9,000	2.62	13	2	1		4	20	130	172
Clay	52,047	25,873	1,059		78,979	223,000	2.82	189	18	18		14	239	173	330
Franklin, Howard, Monroe, and Ralls	6,878	4,906			11,784	33,000	2.80	42	4	2		5	53	152	222
Grundy, Harrison, and Schuyler	3,200	8,521	175		11,896	41,000	3.45	62	4	6		6	78	128	153
Henry	365,659	52,183	7,500		425,342	734,000	1.73	20	4	2	143	31	200	199	[4] 2,127
Johnson	2,900	3,178	132		6,210	18,000	2.90	29	4	5	9	6	53	62	117
Lafayette	239,820	52,537	5,194		297,551	756,000	2.54	794	79	64		91	1,028	130	289
Linn	8,509	18,735	150		27,394	77,000	2.81	103	17	14		24	158	101	173
Macon	138,991	28,564	4,770		172,325	390,000	2.26	272	32	30		39	373	146	462
Putnam	895	11,461			12,356	22,000	1.78	41	9	8		17	75	109	165
Randolph	99,883	66,432	1,813		168,128	377,000	2.24	257	31	36		42	366	196	459
Ray	213,620	44,321	464		258,405	728,000	2.82	841	101	77		81	1,100	118	235
Vernon	13,713	4,741	400		18,854	36,000	1.91	8	2	2	25	2	39	85	[4] 483
Total, 1931	3,134,936	449,885	35,676		3,620,497	7,248,000	2.00	3,241	381	326	919	495	5,362	142	675
Total, 1930	3,253,497	545,836	53,817		3,853,150	8,967,000	2.33	3,560	441	395	1,304		5,700	166	676

MONTANA

Blaine, Chouteau, and Judith Basin	----------	10, 247	----------	----------	10, 247	$29, 000	$2. 83	20	2	2	--------	6	30	123	342
Carbon	406, 894	22, 006	11, 525	----------	440, 425	1, 019, 000	2. 31	295	113	49	--------	139	596	114	739
Cascade	354, 708	29, 421	142	----------	384, 271	664, 000	1. 73	191	32	14	--------	34	271	250	1, 418
Daniels and Valley	----------	4, 013	----------	----------	4, 013	7, 000	1. 74	2	1	1	3	1	8	219	502
Dawson and McCone	----------	2, 942	----------	----------	2, 942	5, 000	1. 70	2	----------	----------	4	1	7	96	420
Fergus	----------	5, 308	----------	----------	5, 308	16, 000	3. 01	9	1	1	--------	2	13	159	408
Hill	----------	4, 586	----------	----------	4, 586	13, 000	2. 83	14	3	2	--------	4	23	102	199
Musselshell	647, 115	15, 023	5, 706	----------	667, 844	1, 249, 000	1. 87	313	65	47	--------	124	549	134	1, 216
Pondera and Toole	----------	1, 713	----------	----------	1, 713	10, 000	5. 84	4	1	1	--------	1	7	229	245
Richland	7, 312	5, 646	----------	----------	12, 958	21, 000	1. 62	24	5	3	--------	7	39	88	332
Roosevelt	----------	2, 140	----------	----------	2, 140	4, 000	1. 87	6	1	1	--------	1	9	101	238
Rosebud	818, 363	500	573	----------	819, 436	1, 229, 000	1. 50	----------	----------	----------	49	21	70	282	[5] 11, 706
Sheridan	----------	14, 104	----------	----------	14, 104	21, 000	1. 49	23	2	2	--------	7	34	210	415
Wibaux	----------	5, 884	----------	----------	5, 884	7, 000	1. 19	7	1	1	--------	3	12	222	490
Other counties (Golden Valley and Powder River)	----------	2, 181	----------	----------	2, 181	5, 000	2. 29	3	----------	----------	--------	1	4	255	545
Total, 1931	2, 234, 392	125, 714	17, 946	----------	2, 378, 052	4, 299, 000	1. 81	913	227	124	56	352	1, 672	153	1, 422
Total, 1930	2, 827, 378	154, 724	39, 902	----------	3, 022, 004	6, 043, 000	2. 00	1, 185	248	155		497	2, 085	172	1, 449

NEW MEXICO

Colfax	738, 341	13, 475	15, 935	----------	767, 751	$2, 170, 000	$2. 83	797	86	100	--------	152	1, 135	110	676
Lincoln and Socorro	4, 000	1, 805	----------	----------	5, 805	14, 000	2. 41	13	4	3	--------	3	23	194	252
McKinley	541, 182	31, 137	26, 193	----------	598, 512	1, 761, 000	2. 94	730	126	57	--------	139	1, 052	142	569
Rio Arriba	16, 183	1, 301	73	----------	17, 557	41, 000	2. 34	28	5	6	--------	7	46	198	382
Sandoval and Santa Fe	135, 078	9, 743	11, 353	----------	156, 174	588, 000	3. 77	367	57	21	--------	109	554	214	282
San Juan	----------	7, 023	----------	----------	7, 023	23, 000	3. 27	13	2	2	--------	3	20	162	351
Total, 1931	1, 434, 784	64, 484	53, 554	----------	1, 552, 822	4, 597, 000	2. 96	1, 948	280	189	--------	413	2, 830	145	549
Total, 1930	1, 850, 048	59, 627	59, 758	----------	1, 969, 433	6, 017, 000	3. 06	1, 956	290	226	--------	430	2, 902	176	679

NORTH CAROLINA

Total, 1931	1, 600	583	180	----------	2, 363	$9, 000	$3. 81	17	3	3	--------	9	32	83	74
Total, 1930	24, 464	1, 276	2, 760	----------	28, 500	100, 000	3. 51	45	5	5	--------	15	70	290	407

[4] The output is obtained chiefly from strip pits, in which the production per man is large.
[5] The output of this county is obtained from strip pits, in which the production per man is large.

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

NORTH DAKOTA (LIGNITE)

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
								Underground			Surface				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others	Total		
Adams	34,282	19,299	1,620		55,201	$101,000	$1.83	44	7	7		12	70	211	789
Bowman	4,682	15,482			20,164	28,000	1.39	21	4	4		6	35	233	576
Burke	168,754	15,448	60		184,262	251,000	1.36				31	30	61	108	[4] 3,021
Burleigh	175,521	19,972	500		195,993	270,000	1.38	24	4	2	20	29	79	185	[4] 2,481
Divide	60,475	15,225			75,700	111,000	1.47	11	2	1	16	18	48	141	[4] 1,577
Dunn		1,388			1,388	2,000	1.44	3			3		6	120	231
Grant	6,505	18,999			25,504	43,000	1.69	12	2	2	18	9	43	221	593
Hettinger	2,596	15,725			18,321	27,000	1.47	17	2	1	20	3	43	157	426
McLean	64,928	33,787	500		99,215	160,000	1.61	34	4	4	74	14	130	176	763
Mercer	365,252	39,624	10,733		415,609	565,000	1.36	210	31	10	32	43	326	180	1,275
Morton	11,000	15,628			26,628	47,000	1.77	31	2	1	6	11	51	153	522
Mountrail	300	8,013			8,313	15,000	1.80	19	2	1	8	6	36	132	231
Stark	12,778	20,540	3,430		36,748	42,000	1.14	53	0	10	3	11	86	88	427
Ward	239,100	86,179	60		325,339	441,000	1.36	100	14	9	32	45	200	173	[4] 1,627
Williams	969	25,253			26,222	45,000	1.72	50	3	2		15	70	136	375
Other counties (Golden Valley, McKenzie, and Oliver)		4,700			4,700	7,000	1.49	3			12	1	16	143	294
Total, 1931	1,147,142	355,262	16,903		1,519,307	2,155,000	1.42	632	86	54	275	253	1,300	166	1,169
Total, 1930	1,335,883	344,934	19,340		1,700,157	2,768,000	1.63	638	74	50	496		1,258	180	1,351

OHIO

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others (underground)	In strip pits	All others (surface)	Total	Average number of days worked	Average tons per man per year
Athens	2,485,125	20,600	19,679		2,525,404	$3,264,000	$1.29	3,262	301	386		435	4,384	139	576
Belmont	6,422,794	249,926	22,785		6,695,505	7,628,000	1.14	5,434	614	580		692	7,320	183	915
Carroll	204,582	61,035	5,790		271,407	353,000	1.30	266	45	27		35	373	199	728
Columbiana	126,081	55,112	525		181,718	294,000	1.62	183	32	14		25	254	177	715
Coshocton	71,814	34,640	1,138		107,592	140,000	1.30	153	16	16		28	213	132	505
Guernsey	1,359,679	113,952	6,300		1,479,931	1,812,000	1.22	1,042	190	148		129	1,509	220	981

Harrison	1,973,667	14,391	17,698		2,006,256	2,239,000	1.12	583	108	120	285	171	1,267	209	1,583
Hocking	420,033	46,236	1,540		467,809	598,000	1.28	676	62	69	2	114	923	125	507
Holmes		7,519			7,519	15,000	2.00	17	2	2		4	25	155	301
Jackson	41,006	33,115	2,729		76,850	128,000	1.67	129	16	12	4	23	184	128	418
Jefferson	2,879,337	389,504	13,153		3,281,994	4,370,000	1.33	2,490	355	285	25	370	3,525	197	931
Lawrence		53,705			53,705	101,000	1.88	99	15	7		17	138	136	389
Mahoning		65,193	445		65,638	146,000	2.22	121	13	12		17	163	158	403
Medina, Portage, Summit, and Wayne		24,191	1,255		25,446	67,000	2.63	39	5	4		15	63	128	404
Meigs	336,317	24,829			361,146	436,000	1.21	401	50	50		68	569	156	635
Morgan and Washington	319,295	930			320,225	430,000	1.34	587	64	78		67	796	139	402
Muskingum	404,826	61,597	5,010		471,433	615,000	1.30	316	28	26	56	29	455	218	1,036
Noble	378,020	5,351	6,280		389,651	472,000	1.21	238	42	60		22	362	201	1,076
Perry	521,298	27,539	200		549,037	682,000	1.24	717	75	64	5	95	956	144	574
Stark	97,014	208,702	1,248		306,964	608,000	1.98	292	37	36	8	56	429	208	716
Tuscarawas	424,630	265,637	1,387		691,654	897,000	1.30	727	92	69	15	120	1,023	148	676
Vinton	70,253	2,163	1,695		74,111	76,000	1.03	116	8	11		19	154	165	481
Total, 1931	18,535,771	1,766,367	108,857		20,410,995	25,371,000	1.24	17,888	2,170	2,076	400	2,551	25,085	174	814
Total, 1930	20,132,937	2,306,713	112,328		22,551,978	31,643,000	1.40	17,858	2,359	2,378	2,979		25,574	189	882

OKLAHOMA

Coal	51,470	1,926			53,396	$152,000	$2.85	71	7	4		7	89	171	600
Craig		13,932			13,932	29,000	2.08	19	4	1	4	8	36	157	387
Haskell	101,949	80	1,210		103,239	256,000	2.48	70	19	10	26	18	143	117	722
Latimer	59,395	1,088	1,726		62,209	158,000	2.54	125	10	6		25	166	148	375
LeFlore	405,322	8,143	2,452		415,917	1,072,000	2.58	826	126	152		165	1,269	103	328
Muskogee and Wagoner	107,891	2,600	245		110,736	228,000	2.06				120		120	93	[5] 923
Okmulgee	257,094	337	2,500		259,931	555,000	2.14	427	82	54		61	624	105	417
Pittsburg	664,616	21,441	10,637		696,694	1,699,000	2.44	1,308	234	184	2	148	1,876	120	371
Rogers	56,428	1,600			58,028	127,000	2.19				61	7	68	156	[5] 853
Tulsa	121,728	10,287	2,297		134,312	338,000	2.52	125	9	12	72	25	243	106	553
Total, 1931	1,825,893	61,434	21,067		1,908,394	4,614,000	2.42	2,971	491	423	285	464	4,634	115	412
Total, 1930	2,691,404	63,692	38,858		2,793,954	7,768,000	2.78	3,445	639	460	880		5,424	148	515

PENNSYLVANIA (BITUMINOUS)

Allegheny	12,088,399	2,037,159	77,766		14,203,324	$20,342,000	$1.43	9,329	1,167	1,289	50	1,237	13,072	206	1,087
Armstrong	2,781,495	87,267	975		2,869,737	3,873,000	1.35	2,887	270	324		432	3,913	145	733
Beaver	7,120	78,759	74		85,953	177,000	2.06	115	14	14		22	165	179	521
Bedford	202,654	151,718	5,347		359,719	676,000	1.88	520	65	46		89	720	127	500
Blair	115,154	132,675	2,412	3,394	253,635	498,000	1.96	437	44	38		56	575	165	441
Bradford and Lycoming	28,180	7,863			36,043	98,000	2.72	62	9	4		9	84	217	429
Butler	534,495	135,690	796		670,981	1,004,000	1.50	1,129	110	99		133	1,471	125	456
Cambria	11,752,312	1,327,885	117,075	38,676	13,235,948	23,826,000	1.80	13,587	1,561	1,109		1,748	18,005	161	735

For footnotes see p. 479.

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

PENNSYLVANIA (BITUMINOUS)—Continued

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
								Underground			Surface				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others	Total		
Center	536, 121	48, 938	342		585, 401	$949, 000	$1. 62	1, 027	72	53		115	1, 267	136	462
Clarion	1, 103, 789	39, 686	269		1, 143, 744	1, 950, 000	1. 70	1, 187	93	76		127	1, 483	206	771
Clearfield	3, 025, 316	72, 038	4, 232		3, 101, 586	4, 747, 000	1. 53	4, 519	394	371	8	466	5, 758	141	539
Clinton	51, 937	14, 641	490		67, 068	101, 000	1. 51	102	8	6		20	136	209	493
Elk	877, 289	17, 000	13, 696		907, 985	1, 370, 000	1. 51	1, 133	94	91		133	1, 451	159	626
Fayette	12, 761, 064	194, 787	164, 905	817, 299	13, 938, 055	23, 672, 000	1. 70	8, 808	1, 961	2, 708	67	2, 205	15, 749	157	885
Greene	3, 633, 639	20, 828	23, 478		3, 677, 945	5, 904, 000	1. 61	1, 682	381	597		459	3, 119	192	1, 179
Huntingdon	511, 372	18, 697	10, 476		540, 545	1, 081, 000	2. 00	655	91	65		99	910	197	594
Indiana	6, 464, 769	245, 914	23, 684	68, 717	6, 803, 084	10, 524, 000	1. 55	5, 860	578	664		852	7, 954	173	855
Jefferson	1, 963, 808	40, 121	11, 014		2, 014, 943	2, 954, 000	1. 47	1, 873	189	234	14	242	2, 552	174	790
Lawrence	146, 501	44, 127	12, 774		203, 402	526, 000	2. 59	273	35	50		38	396	214	514
Mercer	171, 245	51, 542	9, 623		232, 410	584, 000	2. 51	323	51	46		58	478	185	486
Somerset	7, 163, 018	145, 000	93, 408		7, 401, 426	11, 779, 000	1. 59	6, 898	822	718	5	1, 144	9, 587	164	772
Tioga	129, 634	59, 754	4, 916		194, 304	565, 000	2. 91	390	24	33		66	513	163	379
Washington	13, 286, 147	290, 122	39, 914		13, 616, 183	20, 053, 000	1. 47	10, 139	1, 377	1, 219	50	1, 311	14, 096	174	966
Westmoreland	10, 347, 495	549, 375	121, 193	343, 818	11, 361, 881	17, 483, 000	1. 54	8, 873	1, 279	1, 216		1, 685	13, 053	165	870
Other counties (Cameron, Fulton, McKean, and Venango)	147, 959	4, 862	575		153, 396	324, 000	2. 11	146	23	24		26	219	217	700
Total, 1931	89, 830, 912	5, 816, 448	739, 434	1, 271, 904	97, 658, 698	155, 060, 000	1. 59	81, 954	10, 712	11, 094	194	12, 772	116, 726	169	837
Total, 1930	113, 885, 163	6, 880, 568	944, 138	2, 752, 918	124, 462, 787	213, 584, 000	1. 72	89, 452	12, 690	13, 506	14, 502		130, 150	198	956

SOUTH DAKOTA (LIGNITE)

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value total	Average per ton	Miners, loaders, and shot firers	Haulage and track	All others (underground)	In strip pits	All others (surface)	Total	Average number of days worked	Average tons per man per year
Corson and Ziebach	217	776			993	$2, 000	$2. 01				6		6	48	166
Dewey	6, 806	11, 994			18, 800	44, 000	2. 34				21	3	24	145	783
Harding		1, 030			1, 030	2, 000	1. 94	2	1	1	1		5	66	206
Meade		1, 116			1, 116	5, 000	4. 48	4	1	1		2	8	113	140
Perkins		5, 546			5, 546	11, 000	1. 98	5	1	1	6		13	162	427
Total, 1931	7, 023	20, 462			27, 485	64, 000	2. 33	11	3	3	34	5	56	127	491
Total, 1930	1, 330	11, 480			12, 810	31, 000	2. 42	23	4	4	12		43	109	298

TENNESSEE

Anderson	709,627	12,587	2,700	----------	724,914	$1,031,000	$1.42	678	95	81	--------	162	1,016	159	713
Campbell	1,040,808	29,251	10,112	----------	1,080,171	1,608,000	1.49	1,323	177	130	--------	245	1,875	150	576
Claiborne	935,168	16,168	3,600	----------	954,936	1,391,000	1.46	862	204	118	--------	178	1,362	169	701
Hamilton	7,661	16,297	142	----------	24,100	40,000	1.66	47	5	2	--------	12	66	120	365
Marion	302,160	2,192	----------	----------	304,352	563,000	1.85	464	20	19	--------	79	582	178	523
Morgan	343,646	1,057	7,767	25,390	377,860	495,000	1.31	331	79	110	--------	80	600	216	630
Other counties (Bledsoe, Cumberland, Fentress, Grundy, Overton, Putnam, Rhea, Scott, Sequatchie, Van Buren, and White)	1,203,450	28,272	14,960	8,533	1,255,215	1,814,000	1.45	1,413	174	121	--------	239	1,947	183	645
Total, 1931	4,542,520	105,824	39,281	33,923	4,721,548	6,942,000	1.47	5,118	754	581	--------	995	7,448	171	634
Total, 1930	4,892,501	136,669	54,754	46,504	5,130,428	8,417,000	1.64	5,015	824	757	939		7,535	196	681

TEXAS

Bituminous: Palo Pinto, Webb, and Wise	57,232	1,475	1,700	----------	60,407	$190,000	$3.15	319	43	26	--------	71	459	137	132
Total bituminous, 1931	57,232	1,475	1,700	----------	60,407	190,000	3.15	319	43	26	--------	71	459	137	132
Total bituminous, 1930	79,829	1,964	2,529	----------	84,322	323,000	3.83	336	45	33	--------	87	501	175	168
Lignite:															
Anderson and Henderson	347,231	431	3,510	----------	351,172	608,000	1.73	219	45	47	4	15	330	139	1,064
Bastrop, Bexar, and Milam	178,813	3	2,652	----------	181,468	122,000	.67	117	12	13	20	13	175	142	1,037
Houston and Leon	21,368	----------	500	----------	21,868	27,000	1.23	50	10	6	--------	9	75	83	292
Rains, Titus, and Wood	98,833	757	1,515	----------	101,105	123,000	1.22	77	14	6	--------	12	109	191	928
Total lignite, 1931	646,245	1,191	8,177	----------	655,613	880,000	1.34	463	81	72	24	49	689	142	952
Total lignite, 1930	726,288	13,347	9,915	----------	749,550	984,000	1.31	541	96	87	80		804	185	932
State total, 1931	703,477	2,666	9,877	----------	716,020	1,070,000	1.49	782	124	98	24	120	1,148	140	624
State total, 1930	806,117	15,311	12,444	----------	833,872	1,307,000	1.57	877	141	120	167		1,305	181	689

TABLE 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

UTAH

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Underground: Miners, loaders, and shot firers	Underground: Haulage and track	Underground: All others	Surface: In strip pits	Surface: All others	Total		
Carbon	2,896,553	35,935	3,080	7,435	2,943,003	$6,535,000	$2.22	1,608	398	249		613	2,868	139	1,026
Emery	261,792	9,703	601		272,096	635,000	2.33	147	26	7		40	220	107	1,237
Other counties (Grand, Iron, Kane, Sevier, Summit, and Uintah)	115,417	16,298	3,230		134,945	272,000	2.02	99	24	18		39	180	191	750
Total, 1931	3,273,762	61,936	6,911	7,435	3,350,044	7,442,000	2.22	1,854	448	274		692	3,268	140	[6] 1,025
Total, 1930	4,185,255	53,344	7,849	11,093	4,257,541	10,515,000	2.47	1,925	489	428		662	3,504	168	[6] 1,215

VIRGINIA

County	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Value: Total	Value: Average per ton	Underground: Miners, loaders, and shot firers	Underground: Haulage and track	Underground: All others	Surface: In strip pits	Surface: All others	Total	Average number of days worked	Average tons per man per year
Dickenson	1,027,917	17,286	516		1,045,719	$1,239,000	$1.18	547	123	99		152	921	197	1,135
Lee	1,873,179	21,662	2,364		1,897,205	2,609,000	1.38	1,298	308	210		306	2,122	182	894
Montgomery	123,009	5,018	772		128,799	396,000	3.07	255	35	50		86	426	153	302
Russell	987,285	17,338	4,150		1,008,773	1,454,000	1.44	701	173	91		229	1,194	169	845
Tazewell	2,198,711	11,195	5,050		2,214,956	3,259,000	1.47	1,330	309	463		313	2,415	197	917
Wise	3,129,543	29,913	24,689	164,121	3,348,266	4,938,000	1.47	2,280	611	730		518	4,139	155	809
Other counties (Pulaski and Scott)	52,611	506	1,845		54,962	165,000	3.00	68	18	21		33	140	219	393
Total, 1931	9,392,255	102,918	39,386	164,121	9,698,680	14,060,000	1.45	6,479	1,577	1,664		1,637	11,357	175	854
Total, 1930	10,414,384	96,153	35,947	360,893	10,907,377	17,520,000	1.61	6,422	1,691	1,857		1,739	11,709	200	932

WASHINGTON															
King	388,647	130,896	213		519,756	$1,442,000	$2.77	492	68	92		133	785	208	662
Kittitas	757,644	20,767	15,875		794,286	2,678,000	3.37	713	98	58		138	1,007	154	789
Lewis	44,185	19,513	2,211		65,909	146,000	2.22	89	13	12		31	145	140	455
Pierce	173,964	5,828	1,290	957	182,039	686,000	3.77	160	52	101		62	375	150	485
Thurston and Whatcom	258,507	20,536	5,428		284,471	848,000	2.98	238	29	18		65	350	160	813
Total, 1931	1,622,947	197,540	25,017	957	1,846,461	5,800,000	3.14	1,692	260	281		429	2,662	170	694
Total, 1930	2,089,015	163,002	33,983	15,928	2,301,928	7,439,000	3.23	1,681	289	410		421	2,801	205	822
WEST VIRGINIA															
Barbour	1,180,704	13,446	1,821		1,195,971	$1,211,000	$1.01	1,293	189	162		154	1,798	103	665
Boone	2,418,591	17,376	2,672		2,438,639	3,298,000	1.35	1,594	312	260		384	2,550	176	956
Braxton	54,653	13,877	1,250		69,780	75,000	1.07	81	10	8		14	113	194	518
Brooke	590,431	681,025	123		1,271,579	1,939,000	1.52	829	131	62	4	107	1,133	181	1,122
Clay	550,712	15,893	12,567		579,172	584,000	1.01	339	101	108		75	623	175	930
Fayette	10,587,835	139,317	34,575	128,353	10,890,080	17,662,000	1.62	6,877	1,814	1,305		1,559	11,555	191	942
Gilmer	8,876	3,111			11,987	13,000	1.08	15	6	1	3	4	29	132	413
Greenbrier	1,764,732	15,434	6,625		1,786,791	2,422,000	1.36	910	316	274		219	1,719	201	1,039
Hancock		13,798	25		13,823	28,000	2.03	23	4	2		4	33	207	419
Harrison	3,612,034	174,202	1,211		3,787,447	3,895,000	1.03	2,111	465	321		402	3,299	167	1,148
Kanawha	4,809,377	85,566	7,482		4,902,425	6,532,000	1.34	3,933	762	490		614	5,799	154	845
Lewis		11,400			11,400	14,300	1.23	12	1	1		3	17	180	671
Lincoln	16,379	250	5		16,634	15,000	.90	70	23	12		16	121	37	137
Logan	15,315,936	101,681	11,768		15,429,385	17,156,000	1.11	6,467	1,436	1,226		1,703	10,832	179	1,424
McDowell	16,214,815	196,333	123,475		16,534,623	23,499,000	1.42	9,166	2,262	2,686		3,605	17,719	158	933
Marion	6,699,013	156,132	35,879		6,891,024	8,010,000	1.16	2,981	568	688		560	4,797	197	1,437
Marshall	891,950	250,465	8,938		1,151,353	1,536,000	1.33	896	112	97		111	1,216	210	947
Mason	4,721	32,659	1,856		39,236	57,000	1.45	52	8	6		11	77	135	510
Mercer	3,347,928	35,166	3,490	11,180	3,397,764	4,506,000	1.33	1,910	491	376		677	3,454	178	984
Mineral	181,406	19,725	1,440		202,571	316,000	1.56	339	36	34		68	477	136	425
Mingo	3,936,057	40,908	1,291		3,978,256	4,294,000	1.08	1,999	671	537		565	3,772	158	1,055
Monongalia	5,449,290	106,632	2,956		5,558,878	4,946,000	.89	3,248	580	452		540	4,820	176	1,153
Nicholas	80,033	4,353	4,870		89,256	223,000	2.50	103	15	11		27	156	158	572
Ohio	1,442,258	171,322	3,775		1,617,355	1,884,000	1.16	1,284	123	90		152	1,649	223	981
Preston	903,462	16,526	7,911	49,811	977,710	1,321,000	1.35	1,210	209	140		187	1,746	125	560
Putnam	299,646	5,582	207		305,435	414,000	1.36	282	43	27		83	435	115	702
Raleigh	13,278,450	116,028	69,353		13,463,831	20,073,000	1.49	6,981	2,027	1,695		1,637	12,340	205	1,091
Randolph	349,803	12,939	8,590		371,332	454,000	1.22	389	53	83		88	613	132	606
Taylor	995,563	17,418			1,012,981	1,079,000	1.07	678	126	35		78	917	196	1,105
Tucker	651,874	6,671	41,032	847	700,424	1,178,000	1.68	589	115	74		103	881	183	795
Upshur	185,122	13,951	2,334		201,407	199,000	.99	167	29	21		38	255	182	790
Webster	607,154	34,699	2,838		644,691	982,000	1.52	486	107	65		98	756	184	853
Wyoming	1,769,157	19,641	17,212		1,806,010	2,767,000	1.53	874	319	310		267	1,770	201	1,020
Other counties (Grant and Wayne)	118,252	2,925	2,745		123,922	130,000	1.05	189	43	29		55	316	157	392
Total, 1931	98,316,214	2,546,451	420,316	190,191	101,473,172	132,762,000	1.31	58,377	13,507	11,688	7	14,208	97,787	176	1,038
Total, 1930	117,480,773	2,823,592	462,528	705,745	121,472,638	181,722,000	1.50	61,431	16,089	13,607		14,861	105,988	204	1,146

[a] The calculated output per man is affected by the practice of men going into certain mines to shoot and load coal on days when the tipples and mines as a whole are not in operation; also, by the use of loading machines.

Table 39.—*Production, value, men employed, days worked, and output per man per year at bituminous-coal mines in specified States and counties in 1931*—Continued

WYOMING

County	Net tons					Value		Number of employees						Average number of days worked	Average tons per man per year
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for power and heat	Made into coke at mines	Total quantity	Total	Average per ton	Underground			Surface		Total		
								Miners, loaders, and shot firers	Haulage and track	All others	In strip pits	All others			
Big Horn and Park		3,429	200		3,629	$13,000	$3.58	5	1	1		2	9	182	403
Campbell and Converse	75,808	11,004	8,103		94,915	97,000	1.02	12	1	1	25	3	42	130	[3] 2,260
Carbon	423,343	14,809	16,532		454,684	1,158,000	2.55	124	38	46		84	292	185	[3] 1,557
Hot Springs	220,779	8,948	33,559		263,286	829,000	3.15	373	113	85		105	676	103	389
Johnson		12,314	579		12,893	26,000	2.02	14	3	3		5	25	120	516
Lincoln	575,100	5,686	25,537		606,323	1,564,000	2.58	421	58	35		111	625	184	970
Sheridan	515,679	47,235	2,073		564,987	988,000	1.75	216	82	28		84	410	129	[3] 1,378
Sweetwater	2,850,393	30,755	67,098		2,948,246	7,204,000	2.44	1,635	333	244		403	2,615	162	1,127
Teton		974			974	4,000	4.11	3	1	1		2	7	81	139
Other counties (Fremont and Uinta)	29,299	10,132	4,318		43,749	113,000	2.58	35	6	5		12	58	146	754
Total, 1931	4,690,401	145,286	157,999		4,993,686	11,996,000	2.40	2,838	636	449	25	811	4,759	154	1,049
Total, 1930	5,779,128	120,303	188,702		6,088,133	15,133,000	2.49	3,007	750	559	900		5,216	188	1,167

See footnote on p. 475.

COAL PRODUCED AND CONSUMED IN ALASKA

TABLE 40.—*Coal produced and consumed in Alaska, 1927–1931*

Year	Produced in Alaska, chiefly subbituminous and lignite [1]		Imported from States, chiefly bituminous coal from Washington [2] (net tons)	Imported from foreign countries, chiefly bituminous coal from British Columbia [2] (net tons)	Total coal consumed (net tons)
	Net tons	Value			
1927	104,300	$548,000	39,437	30,492	174,229
1928	126,100	662,000	39,408	32,518	198,026
1929	100,600	528,000	36,693	27,073	164,366
1930	120,100	631,000	37,128	23,892	181,120
1931	105,900	556,000	30,772	17,796	154,468

[1] Compiled by the Alaska branch of the U. S. Geological Survey.
[2] Compiled from records of the Bureau of Foreign and Domestic Commerce.

DETAILED STATISTICS OF ANTHRACITE AND SEMI-ANTHRACITE OUTSIDE OF PENNSYLVANIA

Table 41 analyzes the production of anthracite and semianthracite from fields outside of Pennsylvania. Although statistics for these coals

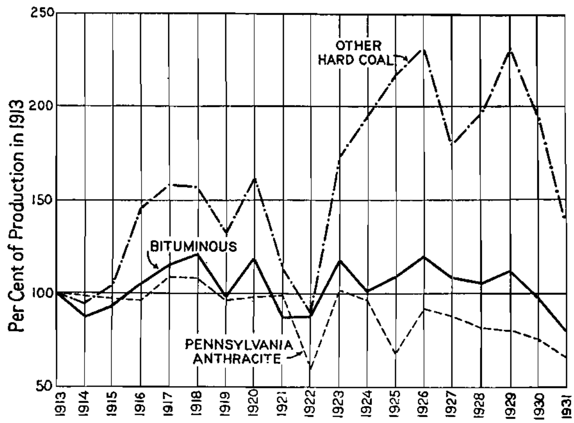

FIGURE 36.—Relative rates of growth of bituminous coal and Pennsylvania anthracite and other hard coal in the United States. Production data for 1913 are represented by 100, and the figures for all other years are expressed as percentages of the 1913 rate

are included with those for bituminous coal in the primary tables of this report they are shown here separately. For a detailed analysis of the hard-coal industry outside of Pennsylvania, see Coal in 1930, pages 721 to 726.

In 1931 production amounted to 507,140 tons compared with 708,221 tons in 1930, a decline of 28.4 per cent. Figure 36 illustrates the trend of this branch of the coal industry since 1913. The outstanding developments in the hard-coal industry outside of Pennsylvania in 1931 are given in Table 41.

TABLE 41.—*Production, value, men employed, days worked, and output per man per day at the principal hard-coal mines outside of Pennsylvania in 1931*

	Virginia	Arkansas, Colorado, and New Mexico	Total
Production:			
Loaded at mines for shipment net tons	175,320	303,506	478,826
Sold to local trade and used by employees do	5,524	14,115	19,639
Used at mines for power and heat do	2,617	6,058	8,675
Total do	183,461	323,679	507,140
Value:			
Total	$560,000	$1,314,000	$1,874,000
Average per ton	$3.05	$4.06	$3.70
Number of employees:			
Underground—			
Miners, loaders, and shot firers	310	1,196	1,506
Haulage and track	51	218	269
All others	69	162	231
Surface	116	315	431
Total employees	546	1,891	2,437
Average number of days worked	176	89	108
Average production per man per day tons	1.91	1.93	1.92

Part 2.—PENNSYLVANIA ANTHRACITE

By F. E. Berquist, H. L. Bennit, and F. G. Tryon

REVIEW OF INDUSTRY IN 1931

In 1931 the Pennsylvania anthracite industry experienced one of the dullest years on record. The production for the year totaled 59,645,652 net tons, 14.0 per cent less than in 1930 and 19.2 per cent less than in 1929. Indeed, except in years when production was curtailed by protracted labor disturbances, the output for 1931 was lower than for any year since the turn of the century.

The causes for the decline in output are readily discernible. The general effects of the business depression were accentuated by increased pressure of competitive fuels and by extremely mild weather. The net loss ascribable to each of the three factors (the depression, competition, and the weather) can not be accurately determined. That the weather had an important influence, however, is clearly indicated by the records of the United States Weather Bureau. According to these reports temperatures in New England and the Middle Atlantic States for January, February, and March, although not as high in proportion as in the fall, were higher than average. Undoubtedly, many householders were left with a material carry-over at the beginning of the new coal year, and the summer of 1931 was one of unusual stagnation in the anthracite trade, with production extraordinarily low. Toward fall business improved to some extent in response to the anticipated needs of the heating season. The weather, however, continued abnormally warm; high temperatures prevailed in September, October, December, and particularly in November, making the fall of 1931 the warmest in New England for the past 44 years. Warm weather also characterized New York State during the fall, the average for November being the highest in 41 years. Since approximately 70 per cent of the output is used for heating homes these unseasonable temperatures had a marked effect in curtailing demand.

The part played by the depression in reducing anthracite production was also evident in 1931. In the past the anthracite industry has not been particularly sensitive to the swings of the business cycle. For example, in 1931 the Federal Reserve Board's index of production in manufacturing and mining fell 19.3 per cent short of the 1929 level, while the production of anthracite declined only 6.0 per cent. Similarly, neither the depression that followed the panic of 1907 nor the depression of 1914 disturbed the trend of anthracite production in any marked degree. Still more striking was the experience of the industry during the severe postwar reaction of 1921 when the output of hard coal actually exceeded that of the previous year. This record would seem to indicate that the state of general business has minor importance in the anthracite trade; however, the present recession is not altogether comparable with those of the immediate past, none of which lasted more than a year before the upswing was resumed. The present depression, on the other hand, began in the late fall of 1929, and at the close of 1931 signs of improvement were still lacking. No industry whose product is so widely used in the industrial sections of the Northeast as is anthracite could escape unscathed from a collapse of such magnitude. The requirements of the railroads, utilities, and manufacturing industries, which use considerable, though declining, tonnages of anthracite were curtailed, and the purchasing power of the domestic consumer was greatly reduced.

The third influence curtailing demand for anthracite has been the competition from other fuels in the past several years in what was formerly almost exclusively hard-coal territory. In 1931 this competition was increasingly felt. By-product coke for domestic use amounted to 8,376,652 tons, an increase of 6.2 per cent over 1930 and 33.9 per cent over 1928. The quantity of gas-house coke sold remained about the same, while the volume of fuel oil used for domestic purposes (although somewhat diminished) decreased much less than anthracite.

The net decrease in anthracite production compared with the preceding year was 9,739,185 tons. Marked declines were recorded for all months except March and April, in which the weather, although not severe, was cold enough to cause brisk consumption by householders. For other months the decreases ranged from 600,000 tons in June to 1,829,000 tons in August compared with the corresponding months in 1930. Of the total decrease for the year, 7,760,000 tons (79.7 per cent) were accounted for from July to December, inclusive. The production in July was 3,960,000 tons, the smallest for any month free of labor disturbances in more than a quarter of a century.

The decline in business in 1931 is especially apparent in the record of distribution to regions far distant from the mines. Receipts in New England totaled 7,064,000 tons, a decline of 15.8 per cent from 1930 and 21.8 per cent from 1929. Exports to Canada declined from 2,532,135 tons in 1930 to 1,772,284 tons in 1931 and were only slightly more than half the 1929 total. Loadings at Lake Erie ports decreased from 1,232,137 tons in 1930 to 761,069 tons in 1931 (38.2 per cent). Receipts at Duluth-Superior were 300,447 tons, a decline of 160,261 tons (34.8 per cent).

Allowing for withdrawals from producers' storage yards, the total consumption for 1931 is placed at 58,408,000 tons, a decline of 13.6 per cent from the 1930 total of 67,628,000 tons.

The decline in the average sales realization recorded during several preceding years continued in 1931. The average realization on breaker shipments was $5.35 per net ton compared with $5.52 for 1930. Substantial increases for pea and steam sizes were more than offset by decreases in the larger sizes. This change in the price structure is indicative of economy practiced by consumers and the increased use of automatic firing equipment which is being promoted by the anthracite interests to meet the growing competition of fuel oil and gas.

Stocks in the hands of producers at the end of December were larger by 417,000 tons (15.7 per cent) than at the beginning of the year. On the other hand, stocks held by retailers decreased, a decline of 13.5 per cent being reported by 550 representative retailers. Stocks at upper lake docks changed only slightly.

The decreased demand for anthracite resulted in a shrinkage in the number of breakers, washeries, and dredges active during the year. In addition to the closing of several collieries, there were other instances in which groups of old and inefficient breakers were replaced by single new centrally located plants. The number of active washeries and dredges also decreased. One-third of the dredges active in the Schuylkill region in 1930 were idle in 1931.

The average number of men employed for the year was 139,431, a decrease of 11,373, or 7.5 per cent, from 1930 and the lowest since 1894. The average number of days worked in 1931 was 181, a decrease of 27 from 1930 and 44 from 1929. The output per man per day increased from 2.21 tons in 1930 to 2.37 tons in 1931, a change which reflects the suspension of less-favored operations as well as general improvement at the active collieries. The annual output per man was 428 net tons in 1931 compared with 460 tons in 1930 and 487 tons in 1929.

STATISTICAL SUMMARY

The outstanding developments in the anthracite industry during the five years following the great strike of 1925–26 are summarized in Table 1A. The years 1927 to 1929 were marked by general business activity; 1930 and 1931 show the effects of the great depression, accentuated in 1931 by extraordinary weather. Pressure from competitive fuels was heavy throughout the period, and even in the years of industrial activity consumption of anthracite declined. These changing conditions are reflected in the statistical records of production, consumption, and distribution; of sales realization and sizes shipped; and of men employed, time worked, and time lost through strikes. Table 2A records monthly developments in 1931.

TABLE 1A.—*Salient statistics of Pennsylvania anthracite industry, 1927–1931*

	1927	1928	1929	1930		1931
Production:						
Loaded at mines for shipment—						
Breakers...net tons..	68,465,537	64,551,767	64,203,900	59,839,838		51,141,397
Washeries...do....	1,475,738	1,394,615	766,288	994,199		1,295,190
Dredges...do....	554,011	541,219	324,390	368,020		199,268
Sold to local trade and used by employees...net tons..	3,046,770	3,184,825	3,233,024	3,144,434		2,901,117
Used at collieries for power and heat...net tons..	6,553,508	5,675,643	5,300,593	5,038,346		3,985,786
Total...do....	80,095,564	75,348,069	73,828,195	69,384,837		[1] 59,645,652
Value at breaker, washery, or dredge..	$420,942,000	$393,638,000	$385,643,000	$354,574,000		$296,355,000
Average sales realization per net ton on breaker shipments:						
Stove...	$7.91	$7.79	$7.79	[2] $7.73	[2] $7.68	$7.37
Pea...	$5.27	$4.46	$4.16	[2] $4.13	[2] $4.18	$4.76
Total domestic...	$7.44	$7.22	$7.14	[2] $7.08	[2] $7.05	$6.87
Buckwheat No. 1...	$2.29	$2.46	$2.35	[2] $2.46	[2] $2.49	$2.79
Buckwheat No. 2...	$1.59	$1.65	$1.58	[2] $1.51	[2] $1.51	$1.52
Total steam...	$1.77	$1.89	$1.82	[2] $1.85	[2] $1.87	$2.00
All sizes...	$5.80	$5.70	$5.63	[2] $5.54	[2] $5.52	$5.35
Percentage by sizes in total breaker shipments:						
Broken...per cent..	1.0	0.7	0.6	0.5		0.3
Egg...do....	11.7	11.7	11.4	10.5		9.6
Stove...do....	25.9	25.6	25.8	25.7		23.6
Chestnut...do....	26.4	25.4	25.6	25.7		25.0
Pea...do....	6.2	7.8	8.1	8.2		10.3
Steam sizes...do....	28.8	28.8	28.5	29.4		31.2

[1] Total includes 122,894 tons of coal stored at collieries.

[2] The figures in the first column are so calculated as to be exactly comparable with 1929; those in the second column are affected by a change in status of a company that formerly sold its output direct and in 1930 was merged with a larger company selling through a separately incorporated sales company.

TABLE 1A.—*Salient statistics of Pennsylvania anthracite industry, 1927–1931*—Continued

	1927	1928	1929	1930	1931
Exports net tons	3,326,000	3,336,000	3,406,000	2,552,000	1,778,000
Imports do	119,000	385,000	487,000	675,000	638,000
Consumption (calculated) do	74,672,000	73,650,000	71,457,000	67,628,000	58,408,000
Average number of days worked	225	217	225	208	181
Man-days lost on account of strikes and lockouts	159,242	400,682	272,511	112,398	570,664
Number of men on strike during year	20,478	36,128	39,777	18,202	65,907
Average number of men employed	165,259	160,681	151,501	150,804	139,431
Output per man per day net tons	2.15	2.17	2.17	2.21	2.37
Output per man per year do	485	469	487	460	428
Quantity mined by cutting machines net tons	1,171,888	1,289,809	1,159,910	1,410,123	1,587,265
Quantity mined by stripping do	2,153,156	2,422,924	1,911,766	2,536,288	3,813,237
Distribution:					
Total receipts in New England [3] net tons	9,145,000	9,376,000	9,039,000	[4] 8,387,000	7,064,000
Exports to Canada do	3,238,564	3,296,487	3,376,303	2,532,135	1,772,284
Loaded into vessels at Lake Erie [5] net tons	1,918,389	1,420,882	1,321,328	1,232,137	761,069
Receipts at Duluth-Superior [6] do	981,194	652,095	401,249	460,708	300,447

[3] From records of the Massachusetts Department of Labor and Industries, division on the necessaries of life.
[4] Revised since last report.
[5] From records of the Ore and Coal Exchange.
[6] From records of the United States Engineer Office, Duluth, Minn.

TABLE 2A.—*Statistical summary of monthly developments in Pennsylvania anthracite industry in 1931*

[All tonnage figures represent thousand net tons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1931	Total, 1930
Production, including mine fuel, local sales, and dredge coal:														
Monthly total	6,183	5,400	4,754	5,709	5,013	4,552	3,960	4,324	4,362	6,561	4,149	4,679	59,646	69,385
Average per working day	237.8	229.8	182.8	228.4	200.5	175.1	152.3	166.3	174.5	252.3	180.4	180.0	196.5	228.6
Shipments, breakers and washeries only:[1] Monthly total, all sizes	5,662	4,923	4,367	5,273	4,629	3,977	3,459	3,810	3,778	5,818	3,718	4,210	53,624	60,867
Distribution:														
Lake loadings	------	10	9	27	129	160	144	131	76	28	47	------	761	1,232
Receipts at Duluth-Superior	------	------	------	------	54	85	69	58	25	9	------	------	300	461
Shipments from lake docks	73	41	53	44	74	41	38	84	68	83	68	53	720	(2)
New England receipts:														
By tide	182	128	106	206	215	145	148	121	145	205	164	174	1,939	2,216
By rail	532	524	345	453	424	361	352	378	401	549	423	383	5,125	6,171
Exports	232	178	88	134	168	163	123	113	136	176	140	127	1,778	2,552
Imports	72	66	46	21	43	57	62	34	45	57	58	77	638	675
Stocks at end of period shown:														
Producers' stocks	2,189	1,818	1,605	1,601	1,674	2,073	2,504	2,828	3,109	3,167	3,314	3,073	3,073	2,975
Retail stocks, 550 dealers	950	(2)	660	854	(2)	1,159	1,193	(2)	1,199	1,400	(2)	1,150	1,150	1,330
Upper lake docks	568	529	479	434	511	621	704	752	763	723	687	632	632	641
Prices at mines, average per net ton:[3]														
Company stove	$8.17	$8.17	$8.17	$7.00	$7.20	$7.40	$7.54	$7.80	$8.00	$8.00	$8.00	$8.00	$7.79	$8.07
Independent stove	$8.06	$8.01	$7.99	$7.00	$7.14	$7.29	$7.49	$7.70	$8.00	$7.60	$7.60	$7.60	$7.62	$7.98
Company buckwheat No. 1	$2.68	$2.68	$2.68	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.25	$3.11	$2.68
Independent buckwheat No. 1	$2.71	$2.89	$3.60	$3.76	$3.24	$3.15	$3.20	$3.25	$3.25	$3.25	$3.25	$3.25	$3.23	$2.73
Retail prices (average per net ton, 25 cities):[4]														
Stove	$15.12	$15.09	$15.09	$14.45	$14.22	$14.33	$14.61	$14.76	$14.97	$15.00	$15.00	$15.00	$14.80	$15.07
Chestnut	$14.88	$14.85	$14.85	$14.39	$14.19	$14.31	$14.59	$14.73	$14.93	$14.97	$14.96	$14.97	$14.72	$14.77
Employment at collieries: Index of men on pay rolls at 159 mines[5]	90.6	89.5	82.0	85.2	80.3	76.1	65.1	67.3	80.0	86.8	83.5	79.8	80.5	93.4

[1] As reported by the Anthracite Bureau of Information.
[2] No data.
[3] Quoted by trade journals in New York market.
[4] Bureau of Labor Statistics, white ash, sidewalk delivery.
[5] Bureau of Labor Statistics; index number: 1929 average=100.0.

CHANGE FROM GROSS TO NET TONS

All figures in this report are expressed in the net or short ton of 2,000 pounds in place of the gross or long ton of 2,240 pounds used in previous reports on the Pennsylvania anthracite industry. The change has long been advocated by the Bureau of Mines, and its adoption by the industry is a distinct forward step.

The change conforms to practice in the sale of bituminous coal and coke and eliminates much confusion in comparing mine prices of anthracite with retail prices of the same fuel, which usually have been quoted by the net ton. The issue of changing from a gross-ton to a net-ton basis for trading purposes has come to the fore intermittently for a number of years. The adoption of the net ton was finally agreed upon by the principal operators early in 1931, and it became effective with the announcement of spring quotations for April 1. This change was made legal as of September 1, 1931, in a bill passed by the Pennsylvania Legislature.

The net ton has therefore been used by the Bureau of Mines in compiling the record for 1931. The reader should note that all figures carried forward from earlier reports have been converted from the gross-ton basis as originally published to the net-ton basis and that, except when specifically stated to the contrary, the net ton will be used hereafter.

COMPETITION FROM OTHER FUELS

For over a decade the general trend of anthracite production has been downward. The decline has been due partly to a decrease in sales to railroads, electric utilities, water-gas plants, and manufacturing industries; moreover, anthracite has lost business in the household-fuel market. Table 3A traces the growth in supplies of other fuels used for domestic heating. While production of Pennsylvania anthracite decreased from 1924 to 1930, imports of foreign anthracite and supplies of fuel briquets, coke, domestic oil, and natural gas largely increased. In 1931 sales of natural gas and by-product coke for domestic heating continued to increase in spite of the depression, and sales of oil for heating houses fell only 4 per cent below the record established in 1930. For detailed analyses of the trend toward competitive fuels see the reports for 1926 to 1930, inclusive.

To meet competition the anthracite industry during 1931 intensified its efforts to improve methods of mining and preparation, to maintain quality and size standards, to extend merchandising service to dealers, and to promote generally the interests of the industry by careful consideration of the problems of marketing and the interest of the consumer. A discussion of these activities, which are coordinated through the Anthracite Institute, will be found in Coal in 1930, pages 734 to 740, and in reports for earlier years.

TABLE 3A.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1928–1931*

[Wherever available the figures represent the quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic purposes, the total production (or imports) is shown in order to indicate the trend of growth]

	1924	1928	1929	1930	1931
Solid fuels (net tons)					
Pennsylvania anthracite production:					
Shipments of domestic sizes	56, 576, 296	46, 218, 403	46, 141, 575	42, 508, 088	35, 437, 946
Shipments of buckwheat No. 1 [1]	9, 510, 508	8, 769, 923	8, 597, 053	8, 570, 032	7, 956, 978
Shipments of smaller steam sizes	11, 160, 695	11, 499, 274	10, 555, 951	10, 123, 937	9, 240, 931
Local sales	3, 043, 939	3, 184, 825	3, 233, 023	3, 144, 434	2, 901, 117
Total commercial production	80, 291, 438	69, 672, 425	68, 527, 602	64, 346, 491	55, 536, 972
Anthracite exported	4, 017, 785	3, 336, 272	3, 406, 369	2, 551, 659	1, 778, 308
Anthracite imported, chiefly from United Kingdom and Russia	117, 951	384, 707	487, 172	674, 812	637, 951
Fuel briquets produced	580, 470	947, 423	1, 212, 415	1, 028, 865	698, 316
Fuel briquets imported	38	71, 485	89, 458	73, 418	60, 950
By-product coke sold for domestic use	2, 812, 771	6, 254, 382	7, 376, 320	7, 886, 432	8, 376, 652
Beehive coke sold for domestic use	139, 886	78, 338	134, 703	141, 391	118, 665
Coke imported	82, 832	147, 701	119, 724	132, 674	103, 563
Gas-house coke sold	[2] 1, 400, 000	[2] 1, 450, 000	1, 400, 000	[2] 1, 300, 000	[2] 1, 300, 000
Petroleum coke produced [3]	761, 100	1, 426, 600	1, 820, 600	1, 940, 000	2, 032, 000
Anthracite and semianthracite produced outside of Pennsylvania	704, 513	712, 406	842, 313	708, 221	507, 140
Bituminous coal for domestic use	(4)	(4)	(4)	(4)	(4)
Oil (barrels) [5]					
Oil used for heating houses	[2] 5, 021, 000	14, 271, 000	19, 581, 000	[6] 25, 771, 000	24, 659, 000
Oil used for heating offices, hotels, apartments, schools, hospitals, and buildings other than houses	(7)	16, 427, 000	17, 820, 000	[6] 17, 508, 000	15, 731, 000
Gas (million cubic feet)					
Natural gas consumed for domestic use	285, 152	320, 877	359, 853	376, 407	380, 897
Manufactured gas sold for domestic purposes	(7)	(7)	[8] 285, 552	(7)	[8] 260, 520

[1] A considerable part of the buckwheat No. 1 is used for domestic purposes.
[2] Partly estimated.
[3] How much petroleum coke was used for house fuel prior to 1928 is not known. For that year 235,000 tons were reported to have been consumed for domestic heating, according to E. B. Swanson in Economic Paper 9, Bureau of Mines.
[4] Between 56,000,000 and 77,000,000 tons a year.
[5] Based on surveys by E. B. Swanson, U. S. Bureau of Mines.
[6] Revised since last report.
[7] Data not available.
[8] From Census of Manufactures.

PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the statistics of the weekly and monthly production of anthracite first published in the Bureau of Mines weekly coal reports. The weekly output is estimated from records of cars of anthracite loaded by the nine railroads that serve the region. In Table 4A the original weekly estimates have been adjusted to the annual total ascertained by direct canvass of the operators at the end of the year.

In the anthracite industry the theoretical working year, allowing for holidays and Sundays, is 303.5 days. The actual average number of days worked in 1931, however, was only 181.

Before 1927 the average daily production was remarkably uniform throughout the year. Since then, however, the daily average has fluctuated appreciably more from month to month; and in 1931 it ranged from 152,000 tons in July to 252,000 tons in October, as shown in Table 5A.

TABLE 4A.—*Estimated weekly production of anthracite in 1931, in net tons*

Week ended—	Weekly production	Number of working days	Daily average	Week ended—	Weekly production	Number of working days	Daily average
Jan. 3	[1] 286,000	[1] 2	[2] 219,400	July 11	777,000	6	129,500
Jan. 10	1,469,000	6	244,800	July 18	752,000	6	125,300
Jan. 17	1,560,000	6	260,000	July 25	882,000	6	147,000
Jan. 24	1,431,000	6	238,500	Aug. 1	1,289,000	6	214,800
Jan. 31	1,424,000	6	237,300	Aug. 8	798,000	6	133,000
Feb. 7	1,458,000	6	243,000	Aug. 15	772,000	6	128,700
Feb. 14	1,599,000	6	266,500	Aug. 22	931,000	6	155,200
Feb. 21	1,211,000	6	201,800	Aug. 29	1,391,000	6	231,800
Feb. 28	1,135,000	5.5	206,400	Sept. 5	1,179,000	6	196,500
Mar. 7	959,000	6	159,800	Sept. 12	877,000	5	175,400
Mar. 14	1,087,000	6	181,200	Sept. 19	894,000	6	149,000
Mar. 21	1,269,000	6	211,500	Sept. 26	1,082,000	6	180,300
Mar. 28	1,078,000	6	179,700	Oct. 3	1,268,000	6	211,300
Apr. 4	777,000	5	155,400	Oct. 10	1,290,000	6	215,000
Apr. 11	1,263,000	6	210,500	Oct. 17	1,587,000	6	264,500
Apr. 18	1,376,000	6	229,300	Oct. 24	1,711,000	6	285,200
Apr. 25	1,421,000	6	236,800	Oct. 31	1,309,000	5	261,800
May 2	1,699,000	6	283,200	Nov. 7	1,149,000	6	191,500
May 9	1,023,000	6	170,500	Nov. 14	1,245,000	5	249,000
May 16	876,000	6	146,000	Nov. 21	905,000	6	150,800
May 23	1,266,000	6	211,000	Nov. 28	643,000	5	128,600
May 30	1,386,000	5	277,200	Dec. 5	1,243,000	6	207,200
June 6	959,000	6	159,800	Dec. 12	1,248,000	6	208,000
June 13	852,000	6	142,000	Dec. 19	894,000	6	149,000
June 20	951,000	6	158,500	Dec. 26	706,000	5	141,200
June 27	1,264,000	6	210,700	Jan. 2, 1932	[1] 795,000	[1] 4	[2] 194,800
July 4	950,000	5	190,000				
					59,646,000	303.5	196,500

[1] Figures represent the output and number of working days in that part of the week included in the calendar year 1931. Figures of total production for the week of Jan. 3, 1931, are 1,097,000 tons, and for Jan. 2, 1932, 974,000 tons.

[2] Average daily production for the entire week and not for the working days that fell in the calendar year 1931.

TABLE 5A.—*Estimated monthly production of anthracite, 1928–1931* [1]

[Production figures represent thousands of net tons]

Month	1928			1929			1930			1931		
	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average	Monthly production	Number of working days	Daily average
January	5,587	25	223	7,068	26	272	6,996	26	269	6,183	26	238
February	5,481	24.5	224	6,425	23.5	273	6,120	23.5	260	5,400	23.5	230
March	5,398	27	200	4,859	26	187	4,524	26	174	4,754	26	183
April	6,784	24	283	6,205	25	248	4,887	25	196	5,709	25	228
May	7,977	26	307	6,077	26	234	5,911	26	227	5,013	25	201
June	5,205	26	200	4,883	25	195	5,152	25	206	4,552	26	175
July	4,394	25	176	4,810	26	185	5,624	26	216	3,960	26	152
August	6,759	27	250	5,735	27	212	6,153	26	237	4,324	26	166
September	5,927	24	247	6,543	24	273	5,261	25	210	4,362	25	175
October	8,400	26	323	8,026	26	309	7,531	26	301	6,561	26	252
November	7,322	24	305	5,820	24	243	5,176	23	199	4,140	23	180
December	6,114	25	245	7,377	25	295	6,050	26	233	4,679	26	180
	75,348	303.5	248	73,828	303.5	243	69,385	303.5	229	59,646	303.5	197

[1] Production is estimated from weekly car loadings as reported by the American Railway Association, and includes mine fuel, coal sold locally, dredge coal, and the output of the Bernice Basin in Sullivan County. In computing the average rates per working day, New Year's, Eight-Hour Day (Apr. 1), Memorial Day, Independence Day, Labor Day, Mitchell Day (Oct. 29), Thanksgiving Day, Christmas and, since the war, Armistice Day have been counted as holidays. Beginning with 1927, Washington's Birthday is counted as a half holiday. No allowance, however, has been made for church holy days, which are observed by many of the miners. Monthly statistics from 1905 to 1922 will be found in Coal in 1925, pp. 427–428.

PRODUCTION BY REGIONS

Table 6A shows the production divided between the Lehigh, Schuylkill, and Wyoming trade regions. The total production for all three in 1931, including colliery fuel, local sales, and dredge and washery coal, was 59,645,652 net tons, and the total value at the mines was $296,354,586. Compared with 1930 this is a decrease of 14 per cent in tonnage and 16.4 per cent in value. This decrease was shared by each region, on the basis of tonnage, as follows: Wyoming, 15.4 per cent; Schuylkill, 14.3 per cent; and Lehigh, 7.9 per cent. Although breaker and dredge output declined, production by washeries increased from 1,087,624 net tons in 1930 to 1,383,739 net tons in 1931 (27.2 per cent).

Of the total production, 52,635,855 tons (88.4 per cent) consisted of railroad shipments outside the anthracite region, and 2,901,117 tons consisted of local sales made within the region or in the vicinity of the river dredges and the mines of Sullivan County. The local sales also include a small but increasing tonnage dispatched by motor truck to points outside the anthracite region. The sum of these two items—55,536,972 net tons—constituted the "commercial production," which in 1931 was valued at $289,495,647, or $5.21 per ton compared with $5.39 per ton in 1930. In addition to shipments and local sales, 3,985,786 tons were used as colliery fuel in 1931. For cost-keeping purposes this tonnage is valued at $6,110,181.

TABLE 6A.—*Anthracite produced, by regions, 1930 and 1931*

Region	Shipments		Local sales		Colliery fuel		Total production	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
1930								
Lehigh:								
Breaker product	[2] 8,446,426	[2] $44,697,109	296,278	$1,500,232	647,338	$1,127,129	[2] 9,390,042	[2] $47,324,380
Washery product	(2)	(2)					(2)	(2)
Dredge product	60,219	60,434					60,219	60,434
	8,506,645	44,757,453	296,278	1,500,232	647,338	1,127,129	9,450,261	47,384,814
Schuylkill:								
Breaker product	18,092,919	91,852,454	787,732	3,737,680	1,627,164	2,528,010	20,507,815	98,118,144
Washery product	609,103	1,025,764	7,077	7,754	5,273	8,200	621,453	1,041,718
Dredge product	307,801	208,006	274,577	269,208	694	620	583,072	477,834
	19,009,823	93,086,224	1,069,386	4,014,642	1,633,131	2,536,830	21,712,340	99,637,696
Wyoming:								
Breaker product	33,257,026	193,745,002	1,757,642	7,997,669	2,677,325	3,751,619	37,691,993	205,494,290
Washery product	385,096	1,558,383	13,179	62,470	67,896	94,681	466,171	1,715,534
	33,642,122	195,303,385	1,770,821	8,060,139	2,745,221	3,846,300	38,158,164	207,209,824
Total breaker product (including Sullivan County)	59,839,838	330,569,211	2,849,601	13,285,702	4,964,483	7,423,758	67,653,922	351,278,671
Total washery product	994,199	2,584,147	20,256	70,224	73,169	102,881	1,087,624	2,757,252
Total dredge product	368,020	268,440	274,577	269,208	694	620	643,291	538,268
Grand total	61,202,057	333,421,798	3,144,434	13,625,134	5,038,346	7,527,259	69,384,837	354,574,191

[1] Value given is value at which coal left possession of producing company f.o.b. mines and does not include margins of separately incorporated sales companies.
[2] A small amount of washery product is included with breaker product to avoid disclosing individual operations.

TABLE 6A.—*Anthracite produced, by regions, 1930 and 1931*—Continued

Region	Shipments		Local sales		Colliery fuel		Total production	
	Net ton	Value	Net tons	Value	Net tons	Value	Net tons	Value
1931								
Lehigh:								
Breaker product	[2] 7,860,415		[2] 272,598	[2] $1,430,083	536,775	$863,023	[2] 8,669,788	
Washery product	(2)	$39,749,202	(2)	(2)	--------	--------	(2)	$42,042,308
Dredge product	33,014		--------	--------	--------	--------	33,014	
	7,893,429	39,749,202	272,598	1,430,083	536,775	863,023	8,702,802	42,042,308
Schuylkill:								
Breaker product	15,285,622	74,188,700	768,995	3,668,020	1,030,687	1,585,312	[3] 17,200,056	[3] 80,130,618
Washery product	963,233	1,979,538	11,599	32,694	6,137	9,400	980,969	2,021,632
Dredge product	166,254	98,326	259,426	242,935	56	100	425,736	341,361
	16,415,109	76,266,564	1,040,020	3,943,649	1,036,880	1,594,812	[3] 18,606,761	[3] 82,493,611
Wyoming:								
Breaker product	27,960,343	159,282,808	1,559,553	7,377,716	2,347,877	3,557,221	[4] 31,875,915	[4] 170,277,917
Washery product	331,957	1,062,124	19,979	96,809	50,834	77,151	402,770	1,236,084
	28,292,300	160,344,932	1,579,532	7,474,525	2,398,711	3,634,372	[4] 32,278,685	[4] 171,514,001
Total breaker product (including Sullivan County)	51,141,397	273,411,761	2,610,113	12,533,139	3,928,759	6,023,530	[5] 57,803,163	[5] 292,717,188
Total washery product	1,295,190	3,041,662	31,578	129,503	56,971	86,551	1,383,739	3,257,716
Total dredge product	199,268	136,647	259,426	242,935	56	100	458,750	379,682
Grand total	52,635,855	276,590,070	2,901,117	12,905,577	3,985,786	6,110,181	[5] 59,645,652	[5] 296,354,586

[2] A small amount of washery product is included with breaker product to avoid disclosing individual operations.
[3] Includes 114,752 tons of coal, with a value of $688,586, stored at collieries.
[4] Includes 8,142 tons of coal, with a value of $60,172, stored at collieries.
[5] Includes 122,894 tons of coal, with a value of $748,758, stored at collieries.

PRODUCTION BY FIELDS AND COUNTIES

The classification by trade regions—Lehigh, Schuylkill, and Wyoming—is most commonly used by the trade. It is paralleled by the organization of the United Mine Workers, in which district 1 corresponds to the Wyoming trade region, district 7 to the Lehigh region, and district 9 to the Schuylkill region. In studies of costs of production and reserves, however, a classification adopted by geologists is more useful because it corresponds more closely to the natural conditions that largely govern mining costs. The geologic classification recognizes four fields. The Northern field is identical with the Wyoming region. That part of the Southern field lying east of Tamaqua, known as the Panther Creek Valley, and the Eastern Middle field make up the Lehigh region. That part of the Southern field west of Tamaqua and the Western Middle field compose the Schuylkill region. The Bernice Basin in Sullivan County is sometimes grouped with the Northern field.

Table 7A shows the production by fields. For those interested in production by political units figures by counties are given in Table 10A.

TABLE 7A.—*Anthracite produced, by fields, 1927–1931, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which in 1931 amounted to about 530,000 tons. Data for 1913–1918 will be found in Coal in 1925, p. 517, and for 1919–1926 in Coal in 1930, p. 747]

	1927	1928	1929	1930	1931
Northern field: [1]					
Breakers	43, 539, 000	41, 185, 000	41, 679, 000	37, 756, 000	31, 933, 000
Washeries	624, 000	521, 000	412, 000	466, 000	403, 000
Total	44, 163, 000	41, 706, 000	42, 091, 000	38, 222, 000	32, 336, 000
Eastern Middle field:					
Breakers	6, 919, 000	6, 526, 000	6, 780, 000	[2] 6, 508, 000	[2] 6, 075, 000
Washeries	------------	------------	------------	(2)	(2)
Total	6, 919, 000	6, 526, 000	6, 780, 000	6, 508, 000	6, 075, 000
Western Middle field:					
Breakers	15, 314, 000	14, 457, 000	13, 575, 000	13, 918, 000	11, 912, 000
Washeries	932, 000	729, 000	270, 000	522, 000	916, 000
Dredges	393, 000	404, 000	224, 000	265, 000	161, 000
Total	16, 639, 000	15, 590, 000	14, 069, 000	14, 705, 000	12, 989, 000
Southern field:					
Breakers	11, 665, 000	10, 746, 000	10, 268, 000	9, 471, 000	7, 883, 000
Washeries	131, 000	241, 000	127, 000	100, 000	65, 000
Dredges	579, 000	539, 000	493, 000	379, 000	298, 000
Total	12, 375, 000	11, 526, 000	10, 888, 000	9, 950, 000	8, 246, 000
Grand total	80, 096, 000	75, 348, 000	73, 828, 000	69, 385, 000	59, 646, 000

[1] Includes Sullivan County, which in 1931 contributed 57,000 tons of breaker product.
[2] A small amount of washery product is included with the breaker product.

TABLE 8A.—*Anthracite produced, by counties, 1930 and 1931*

County	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value [1]
1930								
Carbon	1, 543, 000	$7, 496, 000	47, 000	$265, 000	72, 000	$169, 000	1, 662, 000	$7, 930, 000
Columbia	226, 000	1, 255, 000	29, 000	51, 000	24, 000	37, 000	279, 000	1, 343, 000
Dauphin	740, 000	3, 738, 000	168, 000	301, 000	100, 000	155, 000	1, 008, 000	4, 194, 000
Lackawanna	13, 550, 000	78, 360, 000	685, 000	3, 275, 000	906, 000	1, 295, 000	15, 141, 000	82, 930, 000
Luzerne	24, 297, 000	140, 527, 000	1, 270, 000	5, 678, 000	2, 242, 000	3, 202, 000	27, 809, 000	149, 407, 000
Northumberland	6, 330, 000	29, 885, 000	274, 000	986, 000	384, 000	578, 000	6, 988, 000	31, 449, 000
Schuylkill	14, 092, 000	70, 239, 000	592, 000	2, 885, 000	1, 265, 000	2, 027, 000	15, 949, 000	75, 151, 000
Sullivan	44, 000	275, 000	8, 000	50, 000	12, 000	17, 000	64, 000	342, 000
Susquehanna and Wayne	292, 000	1, 565, 000	12, 000	66, 000	34, 000	47, 000	338, 000	1, 678, 000
Berks, Cumberland, Lebanon, Montour, Northampton, and York [2]	88, 000	82, 000	59, 000	68, 000	---------	---------	147, 000	150, 000
	61, 202, 000	333, 422, 000	3, 144, 000	13, 625, 000	5, 039, 000	7, 527, 000	69, 385, 000	354, 574, 000
1931								
Carbon	1, 608, 385	7, 555, 010	48, 913	273, 563	72, 181	135, 488	1, 729, 479	7, 964, 061
Columbia	297, 827	1, 583, 602	29, 745	57, 529	18, 338	27, 211	345, 910	1, 668, 342
Dauphin	690, 894	3, 422, 748	199, 603	289, 859	72, 318	111, 300	970, 153	3, 850, 323
Lackawanna	11, 247, 075	63, 450, 101	634, 293	3, 160, 788	762, 210	1, 166, 557	12, 643, 578	67, 777, 446
Luzerne	20, 699, 691	116, 518, 867	1, 105, 320	5, 122, 420	1, 930, 170	2, 917, 389	23, 743, 323	124, 618, 848
Northumberland	5, 546, 136	24, 949, 794	228, 654	813, 899	179, 059	264, 884	6, 082, 612	26, 744, 967
Schuylkill	11, 966, 735	56, 323, 738	593, 639	3, 018, 255	883, 706	1, 385, 730	13, 422, 731	60, 673, 503
Sullivan	35, 017	229, 372	8, 967	57, 320	13, 420	17, 974	57, 404	304, 666
Susquehanna and Wayne	494, 403	2, 508, 818	9, 486	53, 594	54, 384	83, 648	558, 273	2, 646, 060
Berks, Cumberland, Lebanon, Northampton, and York [2]	49, 692	48, 020	42, 497	58, 350	---------	---------	92, 189	106, 370
	52, 635, 855	276, 590, 070	2, 901, 117	12, 905, 577	3, 985, 786	6, 110, 181	59, 645, 652	296, 354, 586

[1] Value given for shipments is value at which coal left possession of producing company f.o.b. mines and does not include margins of separately incorporated selling companies.
[2] Counties producing dredge coal only.

FRESH-MINED AND CULM-BANK COAL, BREAKER AND WASHERY PRODUCT

Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. As all contribute to the country's supply, it is important to consider them all to ascertain the total production. A full explanation of the method used in reconciling figures on production from the three sources is given in Coal in 1926, pages 562 and 563. No difficulty is experienced in separating the figures of production by dredges. It is difficult to draw a sharp line that can be maintained throughout the statistics of the industry, however, between the fresh-mined and the culm-bank coal.

As the best solution of this problem the individual breaker, washery, or dredge is taken as the unit in compiling the statistics. Producing companies are asked to supply separate statements for each breaker, washery, or dredge, which are totaled to form the primary tables of this report and show the total quantity of breaker product, washery product, and dredge product, with related figures of value, number of employees, and time worked.

The figures on breaker and washery product, however, do not exactly equal those for fresh-mined and culm-bank coal because of the practice sometimes adopted of putting culm-bank coal through a breaker, either directly from the bank or after preliminary treatment in a washery. To obtain accurate statistics of culm-bank coal each company is now asked to recapitulate its total production of fresh-mined and culm-bank coal. The results are shown in Tables 9A and 10A.

Of the 57,803,163 tons handled by breakers in 1931, only 530,424 tons were culm-bank coal. The fresh-mined coal totaled 57,272,739 tons. The washeries handled 1,383,739 tons, but including the 530,424 tons of bank coal run through the breakers the total produced from culm banks was 1,914,163 tons.

TABLE 9A.—*Comparison of anthracite production, 1930 and 1931, classified as fresh-mined, culm-bank, and river coal and as breaker, washery, and dredge product, in net tons*

[Data for 1923 to 1929 will be found in Coal in 1930, p. 750. See Coal in 1923, pp. 697–700, for interpretation of the records of fresh-mined and washery coal before 1923]

	1930			1931		
	Classified by source of coal	Classified by type of preparation plant	Difference	Classified by source of coal	Classified by type of preparation plant	Difference
Fresh-mined coal	67,462,383		+191,539	57,272,739		+530,424
Breaker product		67,653,922			57,803,163	
Culm-bank coal	[1] 1,279,163		−191,539	[1] 1,914,163		−530,424
Washery product		1,087,624			1,383,739	
River coal	643,291			458,750		
Dredge product		643,291			458,750	
Total	69,384,837	69,384,837		59,645,652	59,645,652	

[1] Includes 191,539 tons put through the breakers in 1930 and 530,424 tons in 1931.

Table 10A.—*Culm-bank coal put through breakers, by fields, 1927–1931, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total
1927	350,000	306,000	373,000	597,000	1,626,000
1928	86,000	97,000	313,000	270,000	766,000
1929	73,000	15,000	116,000	223,000	427,000
1930	75,000	7,000	58,000	52,000	192,000
1931	96,000	70,000	57,000	307,000	530,000

SHIPMENTS BY REGIONS AND SIZES

The yield of the profitable domestic sizes varies considerably in the different regions owing to the varying geological conditions encountered in mining. It will be noted from Tables 11A and 12A that for the breaker product the proportion of domestic sizes in 1931 was, by regions: Wyoming, 74 per cent; Lehigh, 65 per cent; and Schuylkill, 62 per cent. The average for all regions, including Sullivan County, was 68.8 per cent in 1931 compared with 70.6 per cent in 1930.

Table 11A.—*Anthracite shipped, by regions and sizes, in 1931*

[The figures of shipments from breakers include a considerable tonnage of culm-bank coal handled in the breakers]

Size	Breaker shipments: Lehigh region [1]	Breaker shipments: Schuylkill region	Breaker shipments: Wyoming region	Breaker shipments: Total (including Sullivan County)	Washery shipments	Dredge shipments	Grand total
Net tons							
Lump [2] and broken	14,618	61,994	96,757	173,369			173,369
Egg	500,556	1,224,693	3,168,055	4,897,490			4,897,490
Stove	1,726,694	3,109,468	7,195,903	12,042,884	18,627		12,061,511
Chestnut	1,945,759	3,545,353	7,288,163	12,793,068	105,145	(3)	12,898,213
Pea	903,286	1,529,289	2,827,003	5,265,797	141,331	[3] 235	5,407,363
Total domestic	5,090,913	9,470,797	20,575,881	35,172,608	265,103	235	35,437,946
Buckwheat No. 1	1,265,149	2,598,722	3,787,934	7,651,805	304,017	1,156	7,956,978
Buckwheat No. 2 (rice)	764,794	1,412,239	2,225,387	4,402,420	258,954	(4)	4,661,374
Buckwheat No. 3 (barley)	688,704	1,581,669	1,164,580	3,434,953	422,304	[4] 107,430	3,964,687
Boiler	50,387	6,055	30,772	87,214	15,326	7,010	109,550
Other, including buckwheat No. 4	468	216,140	175,789	392,397	29,486	83,437	505,320
Total steam	2,769,502	5,814,825	7,384,462	15,968,789	1,030,087	199,033	17,197,909
Grand total	7,860,415	15,285,622	27,960,343	51,141,397	1,295,190	199,268	52,635,855
Value							
Lump [2] and broken	$92,830	$418,984	$657,191	$1,169,005			$1,169,005
Egg	3,440,798	8,371,943	22,511,949	34,352,989			34,352,989
Stove	12,542,199	22,561,717	53,565,484	88,743,530	$127,767		88,871,297
Chestnut	13,923,093	25,287,457	52,883,013	92,190,448	611,167	(3)	92,801,615
Pea	4,270,120	6,953,555	13,825,487	25,079,220	634,573	[3] $802	25,714,595
Total domestic	34,269,040	63,593,656	143,443,124	241,535,192	1,373,507	802	242,909,501
Buckwheat No. 1	3,536,723	7,017,432	10,829,101	21,383,256	830,585	2,836	22,216,677
Buckwheat No. 2 (rice)	1,171,674	2,032,324	3,489,920	6,693,918	387,047	(4)	7,080,965
Buckwheat No. 3 (barley)	718,941	1,431,918	1,400,654	3,551,513	425,789	(5)	[6] 4,064,436
Boiler	14,260	1,668	8,938	24,866	8,376	4,089	37,331
Other, including buckwheat No. 4	243	111,702	111,071	223,016	16,358	(5)	[6] 281,160
Total steam	5,441,841	10,595,044	15,839,684	31,876,569	1,668,155	135,845	33,680,569
Grand total	39,710,881	74,188,700	159,282,808	273,411,761	3,041,662	136,647	276,590,070

[1] For the Lehigh region, a negligible amount of washery product is included with breaker product to avoid disclosing individual operations.
[2] The quantity of lump included is insignificant.
[3] A small amount of chestnut coal is included with pea.
[4] A small amount of buckwheat No. 2 is included with buckwheat No. 3.
[5] Certain dredge operators were unable to give separate figures on the value of their reported production of buckwheat No. 3 and No. 4.
[6] Includes estimates of the value of a small tonnage of dredge coal of these sizes.

TABLE 11A.—*Anthracite shipped, by regions and sizes, in 1931*—Continued

Size	Breaker shipments				Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Total (including Sullivan County)			
Average value per ton							
Lump [2] and broken	$6.35	$6.76	$6.79	$6.74			$6.74
Egg	6.87	6.84	7.11	7.01			7.01
Stove	7.26	7.26	7.44	7.37	$6.86		7.37
Chestnut	7.16	7.13	7.26	7.21	5.81	(3)	7.19
Pea	4.73	4.55	4.89	4.76	4.49	[3] $3.41	4.76
Total domestic	6.73	6.71	6.97	6.87	5.18	3.41	6.85
Buckwheat No. 1	2.80	2.70	2.86	2.79	2.73	2.45	2.79
Buckwheat No. 2 (rice)	1.53	1.44	1.57	1.52	1.49	(4)	1.52
Buckwheat No. 3 (barley)	1.04	.91	1.20	1.03	1.01	(5)	[6] 1.03
Boiler	.28	.28	.29	.29	.55	.58	.34
Other, including buckwheat No. 4	.52	.52	.63	.57	.55	(5)	[6] .56
Total steam	1.96	1.82	2.15	2.00	1.62	.68	1.96
Grand total	5.05	4.85	5.70	5.35	2.35	.69	5.25

[2] The quantity of lump included is insignificant.
[3] A small amount of chestnut coal is included with pea.
[4] A small amount of buckwheat No. 2 is included with buckwheat No. 3.
[5] Certain dredge operators were unable to give separate figures on the value of their reported production of buckwheat No. 3 and No. 4.
[6] Includes estimates of the value of a small tonnage of dredge coal of these sizes.

TRENDS IN SIZES SHIPPED

The total shipments of steam sizes, including dredge and washery coal, declined from 18,693,969 tons in 1930 to 17,197,909 tons in 1931, a decrease of 8 per cent. On the other hand, shipments of domestic sizes dropped 7,070,142 tons (16.6 per cent) from the previous year.

Within the group of domestic sizes the relative proportions of each size have been affected by changes from time to time in sizing standards. In view of certain revisions undertaken in 1925, the recommendation for further improvement of preparation standards in 1928, and constantly tightening inspection rules resulting in more and more accurate sizing uniformity, special interest attaches to a comparison between the relative proportions of the five principal domestic sizes in 1928, those in four preceding years, and those in 1929, 1930, and 1931. The following figures, abstracted from Table 12A, represent percentages of the total breaker shipments for the years given:

	1923	1924	1926	1927	1928	1929	1930	1931
Broken	5.0	2.7	1.6	1.0	0.7	0.6	0.5	0.3
Egg	15.7	14.5	13.5	11.7	11.7	11.4	10.5	9.6
Stove	19.6	22.2	25.1	25.9	25.6	25.8	25.7	23.6
Chestnut	25.6	26.5	27.1	26.4	25.4	25.6	25.7	25.0
Pea	8.0	8.3	5.5	6.2	7.8	8.1	8.2	10.3

TABLE 12A.—*Sizes of anthracite shipped from breakers, by regions, 1928–1931, in per cent of total*

[Note that shipments of dredge and washery coal are not included]

Size of coal	Percentage of total shipments							
	Lehigh region				Schuylkill region			
	1928	1929	1930	1931	1928	1929	1930	1931
Lump	-------	(1)	(1)	(1)	-------	(1)	(1)	(1)
Broken	0.2	0.2	0.2	0.2	0.6	0.8	0.6	0.4
Egg	8.0	7.5	7.1	6.4	8.9	8.9	8.6	8.0
Stove	23.7	24.8	24.6	22.2	22.5	22.7	22.2	20.4
Chestnut	26.6	26.4	26.3	24.9	24.1	24.5	24.4	23.2
Pea	9.2	9.2	8.9	11.3	8.6	8.3	8.7	10.0
Total domestic	67.7	68.1	67.1	65.0	64.7	65.2	64.5	62.0
Buckwheat No. 1	13.4	13.7	15.3	16.9	15.7	15.6	15.4	17.0
Buckwheat No. 2 (rice)	8.5	7.7	7.8	9.7	7.5	7.1	8.0	9.2
Buckwheat No. 3 (barley)	9.4	9.9	9.1	8.6	10.6	10.4	10.8	10.4
Boiler	-------	-------	-------	.7	(1)	.2	.3	(1)
Other	1.0	.6	.7	(1)	1.5	1.5	1.0	1.4
Total steam	32.3	31.9	32.9	35.0	35.3	34.8	35.5	38.0
	Wyoming region				Total, including Sullivan County			
Lump	-------	-------	-------	-------	-------	(1)	(1)	(1)
Broken	.7	.6	.5	.4	.7	.6	.5	.3
Egg	14.1	13.6	12.4	11.3	11.7	11.4	10.5	9.6
Stove	27.7	27.5	27.9	25.7	25.6	25.8	25.7	23.6
Chestnut	25.9	25.9	26.2	26.1	25.4	25.6	25.7	25.0
Pea	7.1	7.7	7.8	10.1	7.8	8.1	8.2	10.3
Total domestic	75.5	75.3	74.8	73.6	71.2	71.5	70.6	68.8
Buckwheat No. 1	11.9	12.0	13.0	13.5	13.2	13.2	14.0	14.9
Buckwheat No. 2 (rice)	7.8	7.3	7.2	8.0	7.8	7.3	7.6	8.6
Buckwheat No. 3 (barley)	4.3	4.6	4.2	4.2	6.8	7.0	6.8	6.7
Boiler	.1	.1	(1)	.1	.1	.1	.1	.2
Other	.4	.7	.8	.6	.9	.9	.9	.8
Total steam	24.5	24.7	25.2	26.4	28.8	28.5	29.4	31.2

1 Less than one-tenth of 1 per cent.

LOCAL SALES

Local sales (that is, tonnages sold within the anthracite region itself or trucked to points outside the region) totaled 2,901,117 net tons (4.9 per cent of the total output) in 1931 compared with 3,144,434 tons (4.5 per cent) in 1930. (See Table 13A.) Chestnut, pea, and smaller sizes contributed 93.8 per cent of the total local sales in 1931, while these sizes accounted for only 66.5 per cent of the rail shipments outside the region. The larger proportion of pea and smaller sizes sold locally is the principal explanation for the lower average value of local sales compared with the average value of shipments.

TABLE 13A.—*Sales of anthracite, made locally by operators of breakers, washeries, and dredges, 1931*

Size	Breakers and washeries		Dredges	
	Net tons	Per cent of total	Net tons	Per cent of total
Lump and broken	26,889	1.0	----------	----------
Egg	31,373	1.2	----------	----------
Stove	105,468	4.0	118	(1)
Chestnut	700,307	26.5	----------	----------
Pea	871,229	33.0	354	0.2
Buckwheat No. 1	388,776	14.7	2,666	1.0
Buckwheat No. 2	261,038	9.9	9,266	3.6
Buckwheat No. 3	201,689	7.6	5,874	2.3
Boiler	47,985	1.8	47,269	18.2
Other, including buckwheat No. 4	6,937	.3	[2] 193,879	74.7
	2,641,691	100.0	259,426	100.0

1 Less than one-tenth of 1 per cent. 2 Mainly unsized river coal.

TRENDS IN VALUES AND PRICES

SOURCES OF INFORMATION AND METHODS OF ANALYSIS

Margins of sales agents not included.—The valuation figures in this study represent value at the breaker or washery reported by the operating companies. In making its report the company is requested to "estimate value of the products not sold" and to "exclude selling expenses."

From this it will be seen that where a producing company sells its output to a separately organized sales company—the practice of many, including certain of the larger producers—the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal in question is placed on the general market. This fact should be borne in mind in considering the variations in value between different regions shown in the tables for the same sizes of coal. (See Table 14A.)

Estimates included in figures of value.—The reports are furnished in writing and signed by responsible officers of the mining companies. Complete reports on tonnage produced and physical operation of the mines have been received from all operators. A few companies did not reply on the value of the product, however, and estimates of these values have been made to round out the totals. The estimates represent only 13.2 per cent of the value shown in 1931 because, aside from a few extremely small producers, only one company failed to report. The values for this company, a producer in the Wyoming region, were estimated in 1931 as follows: The tonnage it reported of each size from broken to pea was multiplied by the company's average circular price for that size as quoted in the trade journals for the year. The tonnage reported for buckwheat No. 1 and for each smaller size was multiplied by the average sales realization obtained on that size by all other producers in the Wyoming region.

AVERAGE SALES REALIZATIONS

The average sales realizations on each size from 1928 to 1931 are given in Table 14A. To insure comparability the table is based on shipments of breaker coal only, the dredge and washery product being excluded.

The average realization on breaker shipments in 1931, all sizes combined, was $5.35 per net ton, the lowest obtained by anthracite operators since 1919.

Except for pea coal, average realizations on each of the domestic sizes have declined annually since 1926 and fell still further in 1931. The decrease from 1930 ranged from 4 cents a ton on chestnut to 31 cents on stove, while the average realization on pea increased 58 cents a ton. The marked increase in the value of the pea size was shared, although to a smaller extent, by buckwheat No. 1. The increase in the mine prices of these sizes, in contrast with the decline in chestnut and larger sizes, reflects the increased use of automatic coal-feeding devices which utilize the smaller sizes and enforced economy on the part of consumers involving substitution, in whole or in part, of smaller sizes for those that are larger and higher priced.

The average mine price of all steam sizes increased from $1.87 a ton in 1930 to $2 a ton in 1931, chiefly because of the higher price obtained for buckwheat No. 1. The average realizations on steam sizes, computed in a manner exactly comparable from year to year, have been as follows:

	1923	1924	1925	1926	1927	1928	1929	1930 [1]	1931
Buckwheat No. 1	$3.11	$2.63	$2.22	$2.25	$2.29	$2.46	$2.35	$2.49	$2.79
Buckwheat No. 2 (rice)	1.99	1.72	1.64	1.59	1.59	1.65	1.58	1.51	1.52
All steam sizes	2.36	2.01	1.79	1.73	1.77	1.89	1.82	1.87	2.00

[1] In 1930 one large producer was merged with another and larger producer, with a resulting change in method of reporting values. This is fully explained in footnote 2 under Table 14A.

TABLE 14A.—*Average sales realization per net ton on anthracite shipments from breakers, by regions and sizes, 1928–1931*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region				Schuylkill region			
	1928	1929	1930	1931	1928	1929	1930	1931
Lump	--------	(1)	(1)	(1)	--------	(1)	(1)	(1)
Broken	$7.18	[1] $7.11	[1] $6.86	[1] $6.35	$7.66	[1] $7.29	[1] $7.12	[1] $6.76
Egg	7.46	7.33	[2] 7.22	6.87	7.48	7.38	7.23	6.84
Stove	7.81	7.72	[2] 7.71	7.26	7.87	7.85	7.71	7.26
Chestnut	7.43	7.42	[2] 7.26	7.16	7.48	7.36	7.24	7.13
Pea	4.47	4.11	[2] 4.08	4.77	4.43	4.06	3.96	4.55
Total domestic	7.16	7.07	[2] 7.00	6.74	7.21	7.11	6.96	6.71
Buckwheat No. 1	2.44	2.33	[2] 2.47	2.80	2.37	2.23	2.32	2.70
Buckwheat No. 2 (rice)[3]	1.71	1.63	[2] 1.48	1.53	1.58	1.52	1.41	1.44
Buckwheat No. 3 (barley)	1.25	1.19	[2] 1.13	1.05	1.21	1.15	1.05	.91
Total steam [4]	1.83	1.77	[2] 1.81	1.97	1.78	1.68	1.66	1.82
Total, all sizes	5.44	5.38	[2] 5.29	5.07	5.29	5.22	5.08	4.85
	Wyoming region				**Total, including Sullivan County**			
Lump	--------	--------	--------	--------	--------	(1)	(1)	(1)
Broken	$7.04	$6.95	[2] $6.96	$6.79	$7.23	[1] $7.08	[1] $7.02	[1] $6.74
Egg	7.42	7.28	[2] 7.27	7.11	7.44	7.30	[2] 7.26	7.01
Stove	7.75	7.78	[2] 7.65	7.44	7.79	7.79	[2] 7.68	7.37
Chestnut	7.38	7.36	[2] 7.26	7.26	7.42	7.37	[2] 7.25	7.21
Pea	4.47	4.23	[2] 4.35	4.89	4.46	4.16	[2] 4.18	4.76
Total domestic	7.25	7.17	[2] 7.10	6.97	7.22	7.14	[2] 7.05	6.87
Buckwheat No. 1	2.52	2.43	[2] 2.60	2.86	2.46	2.35	[2] 2.49	2.79
Buckwheat No. 2 (rice)[3]	1.68	1.61	[2] 1.57	1.57	1.65	1.58	[2] 1.51	1.52
Buckwheat No. 3 (barley)	1.25	1.23	[2] 1.24	1.20	1.23	1.19	[2] 1.13	1.03
Total steam [4]	2.00	1.94	[2] 2.04	2.15	1.89	1.82	[2] 1.87	2.00
Total, all sizes	5.96	5.88	[2] 5.83	5.70	5.70	5.63	[2] 5.52	5.35

[1] An insignificant quantity of lump coal is included with the broken coal.
[2] In 1930 a producer in the Lehigh and Wyoming regions, which formerly sold its output direct, was merged with a larger producer selling through a separately incorporated sales company. As the values do not include margins of separately incorporated sales companies, the averages for 1930, as reported above, are not exactly comparable with those for other years. The effect of this change is fully discussed in Coal in 1930, pp. 759–761, which also gives the figures recalculated to the 1929 basis. The discrepancy is not serious.
[3] Includes bird's-eye.
[4] Includes all other steam sizes.

AVERAGE VALUES OF SHIPMENTS, LOCAL SALES, AND COLLIERY FUEL

Table 15A shows by regions the average value per ton for all shipments, all local sales, and colliery fuel in 1930 and 1931. The receipts from local sales average distinctly less than those from shipments, a difference mainly accounted for by the large proportion of the smaller sizes in the local sales. (See Table 13A.) In 1931 shipments brought $5.25 per net ton and local sales $4.45, or 80 cents less.

The figures in the following table include the sales of dredge and washery coal as well as breaker coal.

TABLE 15A.—*Average value per net ton of anthracite shipped, local sales, colliery fuel, and total production, by regions, 1930 and 1931* [1]

[Note that values in this table include washery and dredge coal; data for 1919–1929 will be found in Coal in 1930, p. 762]

Year and region	Shipments	Local sales	Colliery fuel	Total production	Year and region	Shipments	Local sales	Colliery fuel	Total production
1930					1931				
Lehigh	$5.26	$5.06	$1.74	$5.02	Lehigh	$5.04	$5.25	$1.61	$4.83
Schuylkill	4.89	3.75	1.55	4.59	Schuylkill	4.65	3.79	1.54	4.43
Wyoming	5.80	4.55	1.40	5.43	Wyoming	5.67	4.73	1.52	5.31
Total [2]	5.45	4.33	1.49	5.11	Total [2]	5.25	4.45	1.53	4.97

[1] Value given for shipments is value at which coal left possession of producing company f.o.b. mines and does not include margins of separately incorporated selling companies.
[2] Includes Sullivan County.

LABOR STATISTICS

The number of men and boys employed in the anthracite region in 1931 was 139,431, a drop of 11,373 from the number in 1930. (See Table 16A.) The total shrinkage in the last five years was 25,955 (15.7 per cent).

The average working time reached the unusually low ebb of 181 days, or approximately three-fifths of the theoretical potential working year of 303.5 days. In 1930 the average working time was 208 days and in 1929, 225 days.

Although relatively little time was lost through strikes in 1931 compared with years in which major labor difficulties arose, the loss was considerably greater than for any other year since the great strike of 1925–26. The total time lost on account of strikes was 570,664 man-days. (See Table 17A.) Most of this loss occurred during March and April in a series of unauthorized strikes designed to force equalization of working time at all collieries.

TABLE 16 A.—*Men employed and days worked in the anthracite field, by regions, in 1931*

Region	Average number of men employed								Average number of days worked
	Surface			Underground				Grand total	
	In strip pits	All others	Total surface	Miners and their laborers	Haulage and track	Other	Total underground		
Lehigh:									
Breaker product	1,148	4,486	5,634	8,628	1,363	3,264	13,255	18,889	181
Washery product		26	26					26	20
Dredge product		8	8					8	148
	1,148	4,520	5,668	8,628	1,363	3,264	13,255	18,923	180
Schuylkill:									
Breaker product	443	8,841	9,284	16,683	3,003	4,978	24,664	33,948	193
Washery product		404	404					404	265
Dredge product		238	238					238	125
	443	9,483	9,926	16,683	3,003	4,978	24,664	34,590	193
Wyoming:									
Breaker product	641	13,585	14,226	48,817	8,338	13,739	70,894	85,120	176
Washery product		213	213					213	208
	641	13,798	14,439	48,817	8,338	13,739	70,894	85,333	177
Sullivan County: Breaker product		118	118	307	70	90	467	585	65
Total breakers	2,232	27,030	[1]29,262	74,435	12,774	22,071	109,280	138,542	181
Total washeries		643	643					643	237
Total dredges		246	246					246	126
Grand total	2,232	27,919	30,151	74,435	12,774	22,071	109,280	139,431	181

[1] Includes a comparatively small number of washery employees who could not be separated from breaker employees.

TABLE 17A.—*Strikes, suspensions, and lockouts in the anthracite region in 1931*

[Data for 1923 to 1930 will be found in Coal in 1930, pp. 765–766]

	Lehigh	Schuylkill	Wyoming	Sullivan County	Total
Total number employed	18,923	34,590	85,333	585	139,431
Men on strike		7,466	58,441		65,907
Man-days lost on account of strike		61,094	509,570		570,664
Average days lost:					
Per man employed		1.8	6.0		4.1
Per man on strike		8.2	8.8		8.7

METHODS OF MINING

Although the total quantity of fresh-mined coal decreased from 67,462,383 net tons in 1930 to 57,272,739 tons in 1931, the tonnage cut by machines increased from 1,410,123 tons to 1,587,265 tons (12.6 per cent). (See Table 18A.) Machine-cut anthracite constituted, however, only 2.8 per cent of the total fresh-mined production.

Strip mining also contributed a larger tonnage to the total in 1931. (See Table 19A.) The number of power shovels in operation was 189, compared with 108 in 1930 and 98 in 1929. The production by stripping in 1931 was 50.3 per cent greater than in 1930 and virtually twice that in 1929.

TABLE 18A.—*Anthracite cut by machines, 1930 and 1931*

Region [1]	1930		1931			
	Number of cutting machines	Net tons cut by machines	Number of cutting machines		Net tons cut by machines	
			Permissible	All other types	Permissible	All other types
Schuylkill	8	54,396	4	3	7,804	15,024
Wyoming	167	1,350,127	121	65	653,524	874,913
Total (including Sullivan County)	185	1,410,123	125	78	661,328	925,937

[1] No machine cutting in Lehigh region.

TABLE 19A.—*Anthracite mined in strip pits, 1929–1931*

Region	1929		1930		1931	
	Number of power shovels	Net tons	Number of power shovels	Net tons	Number of power shovels	Net tons
Lehigh	39	951,050	31	1,125,533	75	1,648,582
Schuylkill	35	770,883	44	1,187,563	48	1,573,681
Wyoming	24	189,833	33	223,192	66	590,974
	98	1,911,766	108	2,536,288	189	3,813,237

DREDGE OPERATIONS

The production by dredges in 1931—458,750 net tons—was markedly lower than in any year since 1918. The annual output for 1919 to 1930 ranged from 623,329 net tons in 1921 to 1,015,708 tons in 1925. Most of the output was derived from the Susquehanna River and its tributaries, as shown in Table 20A. As "river coal" consists chiefly of sizes equivalent to buckwheat No. 3 and boiler and is sold mainly for steam raising, the prices obtained have averaged well under $1 a net ton since 1922.

Average receipts per net ton on all dredge coal sold, 1928–1931

1928	$0.88	1930	$0.84
1929	.88	1931	.83

In the winter, dredging is handicapped by cold weather. The seasonal nature of the industry is shown by Table 21A, which gives the number of employees in each month.

TABLE 20A.—*Anthracite produced by dredges, by rivers, 1930 and 1931*

River (including tributaries)	Number of dredges	Net tons	Value	River (including tributaries)	Number of dredges	Net tons	Value
1930				1931			
Lehigh	2	60,219	$60,434	Lehigh	1	33,014	$110,929
Schuylkill	13	138,236	118,374	Schuylkill	8	90,855	
Susquehanna	38	444,836	359,460	Susquehanna	26	334,881	268,753
	53	643,291	538,268		35	458,750	379,682

TABLE 21A.—*Number of employees on pay rolls of anthracite-dredge operations on the first day of each month, 1929–1931*

Month	1929	1930	1931	Month	1929	1930	1931
January	94	64	70	July	373	238	265
February	89	85	68	August	267	145	177
March	177	215	121	September	232	140	155
April	353	257	340	October	334	131	137
May	418	257	377	November	282	96	104
June	430	215	337	December	130	34	60

IMPORTS AND EXPORTS

Anthracite imports, after increasing sharply in recent years, declined 5.5 per cent in 1931. (See Table 22A.) An increase in imports from Russia, Germany, and Belgium was more than offset by a decrease in imports from the United Kingdom. Practically all of the imports were received (and presumably consumed) in New England, as indicated by Table 23A, and imports constituted 8.6 per cent of the total receipts in that area.

Practically all the anthracite exports go to Canada. (See Tables 24A and 25A.) These shipments have declined yearly, from an average of about 4,200,000 tons in 1920–1924 to 1,772,284 tons in 1931, a reduction of nearly 60 per cent.

TABLE 22A.—*Anthracite imported, by countries, 1930 and 1931, in net tons*

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

Country	1930	1931	Country	1930	1931
Belgium	4	14,325	Hungary	4	--------
Canada	6,450	2,483	Soviet Russia in Europe	193,131	243,029
France	1	--------	United Kingdom	460,209	342,154
Germany	15,010	35,960			
Hong Kong	3	--------		674,812	637,951

TABLE 23A.—*Anthracite imported, by customs district, 1930 and 1931, in net tons*

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

Customs district	1930	1931	Customs district	1930	1931
Buffalo	1,129	459	Oregon	4	--------
Connecticut	4,098	13,703	Rhode Island	96,713	122,595
Georgia	--------	560	St. Lawrence	21	--------
Hawaii	162	1,290	San Francisco	4	--------
Maine and New Hampshire	141,263	61,758	Vermont	36	--------
Massachusetts	416,386	412,527	Washington	58	--------
Montana-Idaho	50	--------			
New York	14,888	25,059		674,812	637,951

TABLE 24A.—*Anthracite exported, by countries, 1930 and 1931, in net tons*

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

Country	1930	1931
North America:		
Bermudas	3,384	1,629
Canada	2,532,135	1,772,284
Central America—		
Guatemala	85	54
Honduras	67	78
Nicaragua		21
Salvador	22	10
Mexico	802	469
Miquelon and St. Pierre Islands	441	268
Newfoundland and Labrador	5,131	2,848
West Indies—		
British—		
Barbados	28	
Jamaica	22	1
Other British	612	170
North America—Continued.		
West Indies—Continued.		
Cuba	7,707	62
Dominican Republic	22	78
Haiti	4	
Netherland	150	19
South America:		
Colombia	67	
Ecuador	54	
Surinam		314
Venezuela	25	
Europe:		
France		3
United Kingdom	2	
Africa: Mozambique	899	
	2,551,659	1,778,308

TABLE 25A.—*Anthracite exported, by customs districts and ports, 1930 and 1931, in net tons*

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

Customs district	1930	1931
North Atlantic:		
Massachusetts	177	41
New York	61,106	58,160
Philadelphia	18,716	34,925
Maryland	283	
South Atlantic:		
Florida	585	87
Mobile		314
New Orleans	67	115
Mexican border:		
Arizona	175	87
El Paso	566	274
San Antonio	7	47
Pacific coast:		
San Francisco	22	4
Los Angeles	7	
San Diego	31	19
Lake Erie Ports: Ohio [1]	30,126	10,764
Rail gateways on Canadian border:		
Eastern—		
Maine and New Hampshire	38	78
Vermont	5,490	3,861
St. Lawrence	928,969	645,338
Rochester [2]	129,279	108,527
Buffalo	1,360,101	909,551
Michigan	5,572	1,522
Western—		
Duluth, Superior, and International Falls	2,826	2,529
Dakota	7,516	2,065
	2,551,659	1,778,308

[1] Chiefly Buffalo and Erie.

[2] Rail, car ferry, and Lake Ontario.

PHOSPHATE ROCK[1]

By B. L. Johnson[2]

CONTENTS

STATISTICAL SUMMARY

Summary of statistics for phosphate rock in the United States, 1929–31, in long tons

	1929	1930	1931
Mined	3,821,840	3,951,353	2,577,535
Sold or used by producers:			
Florida:			
Land pebble	[1] 3,015,874	[1] 3,166,318	1,990,806
Soft rock	(1)	(1)	13,436
Hard rock	72,424	81,753	57,224
Total, Florida	3,088,298	3,248,071	2,061,466
Tennessee (brown and blue rock)	633,939	611,045	343,622
Idaho	35,899	59,932	60,978
Montana	40	6,005	67,893
Wyoming	2,679	1,339	1,000
Total, United States	3,760,855	3,926,392	2,534,959
Imports	44,899	32,658	13,496
Exports	1,142,746	1,225,722	951,305
Consumption, apparent	2,663,008	2,733,328	1,597,150
Stocks in producers' hands, Dec. 31:			
Florida	690,200	800,000	733,400
Tennessee	168,200	168,000	207,650
Otber	2,130	740	1,920
Total stocks	860,530	[2] 968,740	942,970

[1] Small quantity of soft rock included with land pebble.
[2] Revised figures.

DOMESTIC PRODUCTION AND SALES

The total reduction in quantity of phosphate rock mined in the United States in 1931 was 1,373,818 long tons compared with 1930. The Western States nearly doubled their production during 1931, but

[1] Work on manuscript completed September 1932.
[2] Statistics on domestic industry prepared by B. H. Stoddard and data on imports and exports compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

this increased contribution was too small to offset the large decreases in Florida and Tennessee. These conditions were reflected in sales.

Phosphate rock mined in the United States, 1927–31, by States, in long tons

Year	Florida	Tennessee	Western States	Total
1927	2, 543, 708	432, 610	48, 831	3, 025, 149
1928	2, 905, 826	573, 601	43, 803	3, 523, 230
1929	3, 125, 941	653, 265	42, 634	3, 821, 840
1930	3, 261, 539	618, 341	71, 473	3, 951, 353
1931	2, 076, 803	370, 070	130, 662	2, 577, 535

Phosphate rock sold or used by producers in the United States, 1927–31

Year	Long tons	Value	Year	Long tons	Value
1927	3, 170, 699	$11, 253, 352	1930	3, 926, 392	$13, 996, 830
1928	3, 501, 406	12, 443, 179	1931	2, 534, 959	9, 288, 485
1929	3, 760, 855	13, 153, 259			

REVIEW BY STATES

FLORIDA

In Florida, the leading phosphate rock-producing State, the decline of 36.5 percent in total output in 1931 was due mainly to the 37 percent reduction in the land-pebble industry, which furnished 96.6 percent of the State total. The hard-rock industry registered a reduction of 30 percent.

Florida phosphate rock sold or used by producers, 1927–31

Year	Hard rock			Soft rock		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1927	131, 254	$525, 016	$4. 00			
1928	95, 918	383, 672	4. 00			
1929	72, 424	267, 218	3. 69	(1)	(1)	(1)
1930	81, 753	517, 229	6. 33	(1)	(1)	(1)
1931	57, 224	380, 540	6. 65	13, 436	$65, 118	$4. 85

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1927	2, 506, 166	$8, 121, 146	$3. 24	2, 637, 420	$8, 646, 162	$3. 28
1928	2, 787, 528	9, 040, 350	3. 24	2, 883, 446	9, 424, 022	3. 27
1929	[1] 3, 015, 874	[1] 9, 633, 856	[1] 3. 19	3, 088, 298	9, 901, 074	3. 21
1930	[1] 3, 166, 318	[1] 10, 273, 076	[1] 3. 24	3, 248, 071	10, 790, 305	3. 32
1931	1, 990, 806	6, 756, 428	3. 39	2, 061, 466	7, 202, 086	3. 49

[1] Soft rock included with land pebble.

Land-pebble phosphate rock.—The land-pebble phosphate-rock industry sustained a greater drop in marketed production in 1931 than in any year since 1921 and the second greatest in its history; the decrease exceeded a million tons (more than any annual commercial production before 1909). In 1931, as in 1930, seven companies were operating in the land-pebble field.

Hard-rock phosphate.—Production of Florida hard rock, which has had a general downward trend since 1907, dropped in 1931 to a new postwar low only a little higher than production in the lean years 1915 to 1917 when foreign markets were virtually cut off by war conditions. The hard-rock phosphate deposits worked in 1931 are near Hernando, Inverness, and Dunnellon, in northwestern peninsular Florida, about 100 miles north of the land-pebble field. Three companies reported production; two of them—the Mutual Mining Co. and J. Buttgenbach & Co.—discontinued mining early in the year after exhausting the deposits on which they were working, but C. & J. Camp operated the Felicia mine throughout the year. Sales of hard rock were made on the domestic market, but nearly three quarters of the total production was exported.

Two companies operating in Citrus County in 1931 dried, pulverized, and sold for use as fertilizer filler and for direct application to soil the finely divided waste-pond phosphatic debris from hard-rock phosphate-washing operations. The American Phosphate Corporation, Dunnellon, utilized waste from washing hard-rock phosphate of the Felicia mine near Dunnellon. This company, the successor (Nov. 19, 1930) of the Natural Products Corporation, was later (Sept. 18, 1931) succeeded by the Colloidal Phosphate Sales Co., Dunnellon. For 6 months in 1931 Connell and Schultz, Inverness, operated on waste-pond phosphates about 2 miles south of Hernando.

TENNESSEE

Tennessee, which ranks next to Florida as a producing State, experienced in 1931 an even larger proportionate decline in marketed production than Florida. Although the quantity sold did not reach the low levels of 1921 and 1922 the value was lower than in any year since 1916.

Tennessee phosphate rock [1] sold or used by producers, 1927–31

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1927	481,769	$2,318,785	$4.81	1930	611,045	$2,938,525	$4.81
1928	577,095	2,856,850	4.95	1931	343,622	1,545,607	4.50
1929	633,939	3,097,104	4.89				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.

The phosphate-rock deposits worked in Tennessee in recent years are in the west-central part of the State. By far the greater part of the present production comes from brown-rock deposits; the remainder is blue rock. In 1931 only eight companies in Tennessee mined brown phosphate rock. One of these—American Agricultural Chemical Co.—operating the Loveless mine at Kleburne Siding, Spring Hill, stopped mining at the property in May 1931; the last shipment was made June 30, 1931, and the plant is reported to have been abandoned later and sold as second-hand material. In 1931, as in other recent years, there was but one producer of blue rock.

WESTERN STATES

While Florida and Tennessee were making next to the greatest annual decline in marketed production of phosphate rock in their history, the Western States continued the rapid growth induced by the newly created demand for phosphate rock for manufacture of triple superphosphate in British Columbia. In 1931 they nearly doubled their commercial production, and the total for the group (Idaho, Montana, and Wyoming) established a new high record. Prior to 1931 the Western States furnished annually only about 1 to 2 percent of the total marketed production of phosphate rock in the United States, but in 1931 they supplied 5 percent of the total.

The number of phosphate rock-producing companies in the Western States increased from 5 in 1930 to 7—3 in Idaho, 3 in Montana, and 1 in Wyoming—in 1931, but the increase in total output was due chiefly to greatly increased production from 1 mine in Montana.

The larger part of the production in the Western States in 1931 was shipped to the Consolidated Mining & Smelting Co. of Canada, Ltd., near Trail, British Columbia, chiefly for manufacture of triple superphosphate. The next largest quantity—that from the Anaconda Copper Mining Co. phosphate mine at Conda, Idaho—was shipped to the company plant at Anaconda, Mont., where it was made principally into treble superphosphate and phosphoric acid; small quantities were also used for direct application to soil as plant food and in pig-iron blast furnaces. The rest of the production in the Western States was ground for direct application to soil as plant food or for use as fertilizer filler.

Western States phosphate rock sold or used by producers, 1927–31

Year	Idaho			Montana			Wyoming			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average		Total	Average
1927	45,260	$259,405	$5.73				6,250	$29,000	$4.64	51,510	$288,405	$5.60
1928	37,477	147,908	3.95				3,388	14,399	4.25	40,865	162,307	3.97
1929	35,899	141,931	3.95	40	$400	$10.00	2,679	12,750	4.76	38,618	155,081	4.02
1930	59,932	234,543	3.91	6,005	27,457	4.57	1,339	6,000	4.48	67,276	268,000	3.98
1931	60,978	234,781	3.85	67,893	301,511	4.44	1,000	4,500	4.50	129,871	540,792	4.16

IDAHO

In 1931 Idaho was the second largest phosphate rock-producing State of the West. Its phosphate-rock production came from two districts, Conda and Paris, and was shipped chiefly to Anaconda, Mont., and Trail, British Columbia. Smaller quantities were shipped to California for use as fertilizer filler.

The Anaconda Copper Mining Co. operated its No. 1 mine in the Conda district and shipped the product to its plant at Anaconda, Mont.

Two companies operated in the Paris district—the Solar Development Co., Ltd., of Trail, British Columbia, and the Agricultural Potassium Phosphate Co., Ltd., of San Pedro, Calif.—the latter a new producer operating the Bear Lake mine near Paris. The Star phosphate property at Paris was operated continuously throughout the year by the Solar Development Co.,[3] and shipments were made to Tadanac, British Columbia. Development, which was continued throughout the year, comprised 251.5 feet of sinking with 2,486.5 feet of drifting, crosscutting, and raising and showed that the beds were disturbed throughout the area, necessitating extra development and irregular stopes. Where the beds were undisturbed the grade was good, but the areas were too small to permit low mining costs.

MONTANA

Production of phosphate rock in Montana in 1931 came almost entirely from the Anderson phosphate mine near Garrison, operated by William Anderson, successor to the Montana Phosphate Products Co. Except for a few tons of ground rock from the Red Hill mine of Dissett Bros. near Philipsburg the output of the State went to British Columbia. A new operator, the Northwestern Improvement Co., started development work at the Elliston mine near Elliston and at the Douglas Creek mine near Hall; a test shipment of a few tons of phosphate rock was made to the British Columbia plant of the Consolidated Mining & Smelting Co. of Canada, Ltd.

The Solar Development Co.[4] did some development work on the Boetzkes leases, an area comprising 1,288 acres adjoining the Anderson property, Garrison, on the north and held in the name of the Garrison Montana Phosphate Co., subsidiary of the Solar Development Co. Surface trenching on the outcrop indicated continuation of the Anderson phosphate bed over a length of 1,500 feet, averaging more than 3 feet in width of 74 percent tricalcium phosphate. Diamond drilling, however, showed impoverishment of the bed in depth and going north, leaving a triangular section of limited tonnage but fairly accessible. A lease on a royalty basis was also acquired on an area known as the Janney lease, adjoining the Anderson property on the south, and a preliminary survey was made.

A crusher, ball mill, and concentrator are reported to have been installed during 1931 on the property of the Washington Phosphate & Silver Co. near Maxville, Mont.

WYOMING

In 1931, as in recent years, the Cokeville Phosphate Co. of Cokeville was the only producer of phosphate rock in Wyoming.

DISTRIBUTION OF SALES BY USES

Figures compiled from estimates by the producing companies, indicating the distribution of sales of phosphate rock by major uses in the United States for the past two years, are given in the following table.

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[3] Consolidated Mining & Smelting Co. of Canada, Ltd., Twenty-Sixth Ann. Rept., for 12 months ended Dec. 31, 1931.

[4] See footnote 3.

Phosphate rock sold by producers in the United States for major uses, 1930 and 1931, in long tons

Use	1930	1931	Use	1930	1931
Superphosphates	2,379,757	1,335,236	Stock and poultry feed	4,478	2,572
Phosphates, phosphoric acid, and ferrophosphorus	[1] 281,805	232,908	Undistributed	2,214	6,430
Direct application to soil	41,593	21,597		2,745,298	1,629,925
Fertilizer filler	35,451	31,182			

[1] Includes quantities used for phosphorus and for phosphorizing pig iron.

IMPORTS

Relatively small quantities of phosphatic materials are imported into the United States. Less phosphate rock was imported in 1931 than in any of several preceding years. Except for a small quantity from Russia, imports in 1931 came entirely from French Oceania.

Phosphate rock, crude, imported into the United States, 1927–31, by countries

Country	1927		1928		1929		1930		1931	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	116	$3,222	104	$3,284	741	$14,144	830	$16,278		
Cuba			11,752	141,544	6,000	73,972	6,360	72,797		
France			(1)	5						
Germany	45	1,115								
Japan	2	44								
Morocco, French	10,641	48,635	20,572	103,199	16,400	96,102	6,000	30,000		
Netherlands					160	2,060				
Oceania: French	17,391	239,855	13,371	183,170	19,348	261,411	19,417	257,742	12,985	$161,219
Soviet Russia in Europe							51	360	511	1,298
West Indies: Netherland			13	36	2,250	21,482				
	28,195	292,871	45,812	431,238	44,899	469,171	32,658	377,177	13,496	162,517

[1] Less than 1 ton.

Phosphatic fertilizers (other than crude phosphate rock) imported for consumption in the United States, 1927–31

Fertilizer	1927		1928		1929		1930		1931	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	54,586	$1,540,897	82,460	$2,566,686	55,877	$1,624,483	59,680	$1,474,500	48,979	$1,080,348
Guano	23,321	898,205	22,584	1,046,834	45,905	2,202,709	40,431	1,655,886	13,849	503,861
Slag, basic, ground or unground	1,625	18,945	2,822	31,879	3,998	54,456	3,913	54,463	1,464	15,903

EXPORTS

The year 1931 interrupted the upward trend of exports which had been general since 1921, as a decline of 274,417 long tons was registered. This decline would have been even greater had it not been for the notable increase in high-grade hard rock exported from Montana and Idaho which, as indicated in the table showing exports by customs districts, resulted in a net increase in exports of high-grade phosphate rock despite a sharp decline in overseas shipments. Exports of land pebble, as well as hard rock, from Florida, were greatly reduced, shipments to Europe being especially affected. Details on destinations of exports are given in the second table following.

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1927–31

Year	Long tons	Value	Year	Long tons	Value
1927	918, 211	$4, 731, 562	1930	1, 225, 722	$5, 630, 547
1928	898, 764	4, 453, 101	1931	951, 305	4, 277, 070
1929	1, 142, 746	5, 386, 919			

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1927–31, by countries

HIGH-GRADE ROCK

Country	1927		1928		1929		1930		1931	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia							946	$10, 406		
Belgium	11, 950	$81, 820	9, 000	$63, 000	7, 100	$48, 700	14, 930	97, 145	17, 625	$114, 562
Canada	1, 145	6, 747	3, 559	26, 488	3, 140	25, 517	2, 187	21, 237	66, 993	359, 396
France	1, 050	7, 350								
Germany	94, 725	653, 495	49, 318	331, 419	21, 936	153, 831	15, 652	107, 539	12, 325	83, 649
Lithuania							8, 400	54, 600	4, 200	27, 300
Mexico					3	43				
Netherlands	3, 550	24, 850	11, 425	79, 975	10, 465	72, 605	4, 125	28, 087	4, 150	29, 050
Nicaragua	4	20								
Norway	4, 200	29, 400	2, 100	14, 700	2, 200	15, 400				
Panama							2	43		
Poland and Danzig	12, 150	85, 050	3, 600	25, 200	9, 500	66, 500				
Sweden			10, 700	74, 900	13, 130	90, 435	19, 750	128, 375		
	128, 774	888, 732	89, 702	615, 682	67, 474	473, 031	65, 992	447, 432	105, 293	613, 957

LAND PEBBLE AND OTHER

Country	1927 Long tons	1927 Value	1928 Long tons	1928 Value	1929 Long tons	1929 Value	1930 Long tons	1930 Value	1931 Long tons	1931 Value
Australia	27, 332	$165, 492								
Belgium	20, 716	104, 186	25, 492	$128, 313	29, 102	$141, 765	16, 705	$85, 522	4, 403	$16, 211
British South Africa	10, 380	59, 685								
Canada	17, 848	104, 173	18, 666	119, 519	25, 244	192, 222	45, 561	303, 410	54, 519	260, 029
China					3, 599	12, 597				
Cuba	21, 754	106, 773	12, 157	65, 108	17, 196	77, 702	9, 901	54, 449		
Czechoslovakia			3, 000	15, 300						
Denmark	43, 755	193, 224	15, 947	73, 721	35, 287	161, 660	28, 991	126, 991	25, 006	112, 537
Estonia					3, 600	12, 600				
Finland	9, 269	50, 426								
France					2, 200	6, 622	1, 502	4, 806		
Germany	125, 661	693, 367	166, 931	803, 549	246, 748	1, 110, 183	281, 547	1, 216, 147	172, 728	697, 167
India (British)							1, 403	5, 261		
Irish Free State							10, 456	44, 653	3, 300	12, 243
Italy	87, 612	409, 193	96, 256	513, 526	122, 224	589, 656	96, 169	464, 181	62, 327	289, 906
Japan	131, 137	480, 780	183, 815	656, 839	230, 548	827, 316	287, 372	1, 051, 927	220, 389	830, 486
Latvia	12, 139	63, 198	12, 206	62, 885	16, 228	75, 957	4, 150	20, 211		
Lithuania			3, 994	24, 963	7, 510	44, 060	3, 142	8, 852		
Mexico			1	14	2	41	44	725	50	210
Netherlands	127, 981	606, 491	129, 035	636, 641	162, 224	787, 384	164, 562	760, 487	166, 029	755, 876
Norway									402	2, 312
Poland and Danzig	25, 204	155, 943	22, 337	128, 097	39, 129	217, 644	36, 999	203, 053	12, 035	70, 237
Salvador					32	1, 765				
Soviet Russia in Europe					4, 000	23, 000				
Spain	72, 363	369, 350	76, 051	369, 328	76, 818	374, 946	64, 984	321, 162	77, 962	366, 066
Sweden	29, 794	175, 466	29, 160	178, 921	32, 325	161, 631	52, 853	277, 052	31, 047	175, 471
United Kingdom	26, 492	105, 083	7, 739	29, 020	9, 677	38, 744	29, 615	114, 768	9, 201	41, 292
Yugoslavia and Albania			6, 275	31, 675	11, 579	56, 393	23, 774	119, 458	6, 614	33, 070
	789, 437	3, 842, 830	809, 062	3, 837, 419	1, 075, 272	4, 913, 888	1, 159, 730	5, 183, 115	846, 012	3, 663, 113

High-grade hard-rock phosphate exported from the United States, 1930 and 1931, by customs districts

Customs district	1930		1931	
	Long tons	Value	Long tons	Value
Buffalo	1,505	$13,299	1,121	$14,413
Florida	62,857	415,746	38,300	254,561
Michigan	252	5,673	64	557
Montana-Idaho	421	2,105	64,245	328,982
New Orleans	1	18		
New York	1	25		
Rochester			1,500	$15,000
St. Lawrence			63	444
Washington	955	$10,566		
	65,992	447,432	105,293	613,957

PRICES

Phosphate rock is sold mainly on contract, and prices governing such sales are not made public. Trade-journal quotations have not changed in recent years, indicating that there have been no substantial reductions in prices of crude rock at the mines, despite the sharp drop in prices of superphosphates in 1931. Engineering and Mining Journal quotations for Florida land-pebble rock for export and for domestic delivery, published in the chapter of this series for 1930, remained unchanged in 1931. Somewhat lower quotations were reported weekly throughout 1931 by the Oil, Paint and Drug Reporter, as follows:

Prices of Florida and Tennessee phosphate rock in 1931 [5]

[Per long ton f.o.b. mine]

Florida land pebble:	
68 percent minimum	$3.10–$3.25
70 percent	3.75– 3.90
72 percent	4.25– 4.35
75 percent basis, 74 percent minimum	5.25– 5.50
75 percent minimum	5.75
77 percent basis, 76 percent minimum	6.25
Florida hard rock:	
77 percent	$6.50
Tennessee brown rock:	
72 percent	5.00
75 percent	5.50

The average declared value of exports of Florida hard rock, as reported in the United States export trade statistics, was $6.65 per long ton in 1931 compared with $6.61 in 1930. The average for Florida land pebble declined from $4.47 in 1930 to $4.33 in 1931, but this change might readily be induced by a slight increase in the proportion of lower-grade rock. Average values of actual shipments of various types of phosphate rock from mines or plants, as computed from reports furnished to the Bureau of Mines by the producers, are shown in the following table.

[5] Oil, Paint and Drug Reporter weekly quotations for 1931; prices remained unchanged throughout year.

Average value f.o.b. mine shipping point per long ton of phosphate rock shipped, 1927–31

[From reports of producers]

Year	Florida		Tennessee[1]	Western States			
	Hard rock	Land pebble		Idaho	Montana	Wyoming	Total
1927	$4.00	$3.24	$4.81	$5.73		$4.64	$5.60
1928	4.00	3.24	4.95	3.95		4.25	3.97
1929	3.69	[2] 3.19	4.89	3.95	$10.00	4.76	4.02
1930	6.33	[2] 3.24	4.81	3.91	4.57	4.48	3.98
1931	6.65	3.39	4.50	3.85	4.44	4.50	4.16

[1] Chiefly brown rock. [2] Includes soft rock.

GENERAL CONDITIONS

In 1931 the phosphate-rock industry of the United States had the greatest setback since 1921. There were marked declines in total mine production, sales, imports, and consumption. The quantity and value of Florida output of both land pebble and hard rock decreased, and Tennessee production suffered similarly. Only Idaho and Montana increased in quantity and value of phosphate rock produced. Stocks of phosphate rock in Florida decreased, and although those in Tennessee increased there was a net decline in total stocks in producers' hands at the end of the year.

TECHNOLOGY

AGGLOMERATION AND TABLING OF LAND-PEBBLE PHOSPHATE-ROCK FINES

The Bureau of Mines in its studies on the possibilities of recovering the fine phosphatic material now allowed to go to waste in the land-pebble district has applied a method [6] for agglomerating and tabling phosphatic fines from land-pebble washers, which makes possible saving of fine phosphatic material in a commercial-grade concentrate and which has been successfully operated in a pilot plant by one of the larger companies.

The standard method of concentration in this field (washing) consists of wet screening at about 20-mesh to recover the plus 20-mesh material, the finer material going to waste. Lately some of the washers have introduced hydraulic classifiers, which the Bureau of Mines has shown [7] to be particularly desirable for the recovery of some coarser material formerly wasted, but even this treatment allows a loss of much of the finer phosphate. Ordinary tabling of the screen undersize material from washers after hydraulic classification recovers only 20 to 30 percent of the phosphate content in the form of a low-grade phosphatic product. If, however, the material is agitated for a few moments with 4 to 5 pounds of previously emulsified fuel oil (21° to 22° B.) and 1½ to 2 pounds of sodium oleate per ton of feed, the phosphate grains alone take up the oil and agglomerate; table concentration then recovers 93 to 98 percent of the bone phosphate of lime (B.P.L.) content of the mixture as a high-grade concentrate (over 76 percent B.P.L.).

[6] O'Meara, R. G., and Pamplin, J. W., Selective Oiling and Table Concentration of Phosphatic Sands in the Land-Pebble District of Florida: Rept. of Investigations 3195, Bureau of Mines, 1932, 6 pp.
[7] O'Meara, R. G., Added Recovery by Hydraulic Sizing of Fine Material in the Land-Pebble District of Florida: Rept. of Investigations 3139, Bureau of Mines, 1931, 5 pp.

BLAST-FURNACE TREATMENT OF LAND-PEBBLE PHOSPHATE ROCK

The blast-furnace plant of the Coronet Phosphate Co. in the land-pebble field, completed in 1931, was run experimentally in 1932 to produce pure phosphorus, some of which was sold and shipped.

MINING, WASHING, AND DRYING OF FLORIDA HARD-ROCK PHOSPHATE

Huttl [8] recently described operations at the Felicia mine of C. & J. Camp. The following description of the property is based upon his article.

The Felicia mine about 7 miles north of Inverness, Fla., is connected by a ½-mile spur with the Seaboard Air Line Railway at Felicia. The mine is an irregular pit 75 to 100 feet deep, partly water filled. The barren 25-foot overburden is stripped by hydraulic methods; two 6-inch monitors fed from a 10-inch main are utilized. Water is obtained from a 12-inch well, and centrifugal pumps deliver it to the hydraulic guns at 20C pounds pressure. The phosphate-bearing matrix above the ground-water level is removed by a ¾-cubic yard Bucyrus-Erie steam shovel mounted on a caterpillar truck. The phosphate-bearing matrix below the ground-water level is mined by a coal-fired Tampa-type dredge, equipped with a 40-foot boom and a 1½-cubic yard bucket. The matrix as mined is loaded on end-dump cars of 3 cubic yards capacity; these are hauled, by a 4-drum friction hoist and cable, over an inclined wooden trestle to the top of a washer at the edge of the pit. Here the matrix is dumped into a steel-lined feed bin fitted with a steel roll grizzly with 4-inch openings. The undersize passes to a 20-foot revolving trommel with 4-inch openings and the oversize to an Allis-Chalmers No. 1 roll crusher, the crushed product passing to the trommel. The oversize from this trommel drops onto an 8-foot picking table, from which the waste is hand picked. The phosphate rock and the undersize from the trommel pass to a 36-inch Ocala Iron Works roll crusher, and the product flows to a double-log washer. The washed rock goes to a 20-foot trommel with 1, ¾, and ⅜ inch openings. The oversize from this trommel passes to a 20-foot picking table; the picked product, with the trommel undersize, passes to the wet storage bin, from which it goes either to stock piles for rewashing and drying or to storage bins at the drying plant. The phosphate rock passes from the storage bins at the drying plant through a 30-inch Macon roll crusher, a set of Allis-Chalmers rolls spaced to produce a ⅜-inch product, and a 40-foot oil-fired Macon drier to loading bins.

FLORIDA HARD-ROCK WASTE-POND PHOSPHATES

The conversion of the finely divided phosphatic debris from hard-rock phosphate-washing operations into superphosphate is not economical owing, in general, to a high content of iron oxide, alumina, and silica and to a relatively low content of calcium phosphate. However, because of the fineness of the particles this debris has been used as a phosphate-bearing plant food for direct application to certain types of soil. The finer portion of the waste-pond material, deposited some distance from the point where the debris-laden water from the phosphate washers enters the ponds, is the portion used.

Several studies have been made recently [9] of the properties of this material. The color ranged from white to straw. The specific

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[8] Huttl, J. B., Mining and Processing Hard-Rock Phosphate: Eng. and Min. Jour., vol. 133, no. 6, June 1932, p. 336.

[9] Alexander, L. T., and Jacob, K. D., Mechanical Analysis of Finely Divided Natural Phosphates: U.S. Dept. Agr. Tech. Bull. 212, 1930, 24 pp.
Hill, W. L., Jacob, K. D., Alexander, L. T., and Marshall, H. L., Chemical and Physical Composition of Certain Finely Divided Natural Phosphates from Florida: Ind. and Eng. Chem., vol. 22, no. 12, 1930, pp. 1392–1396.
Jacob, K. D., Hill, W. L., and Holmes, R. S., The Colloidal Nature of Some Finely Divided Natural Phosphates: Colloid Symposium Annual, vol. 7, 1930, pp. 195–204.

gravity was 2.89 to 2.98, with an average of 2.93, considerably lower than that of the commercial grades of Florida land-pebble and hard-rock phosphate (3.00 to 3.09). The B.P.L. content of air-dried samples ranged from 40 to 55 percent and the oxides of iron and alumina from 15 to 18 percent. The fluorine-phosphoric acid ratio was much lower than in any other type of phosphate rock. The material examined contained very few particles coarser than 50 microns (0.05 mm) in diameter, and 70 to 90 percent by weight of the particles were finer than 5 microns (0.005 mm) in diameter. These finer particles contained about 70 percent colloidal material.

WORLD PRODUCTION

Decline in production of phosphate rock in 1931 was not confined to the United States. Reports from countries which in 1930 produced about 97 percent of the total output indicate that world production dropped in 1931 to about 7,400,000 metric tons, or 36 percent less than the output in 1930. There were decreases in most important producing countries for which figures are available, the largest being in the United States, 1,413,766 metric tons, and Tunisia, 1,178,000 tons.

In 1931 the United States was the leading producer; Tunisia was second, French Morocco third, Algeria fourth, and Nauru and Ocean Islands fifth.

World production of phosphate rock, 1927–31, by countries, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country	1927	1928	1929	1930	1931
Algeria	919,108	875,947	747,035	846,686	564,800
Angaur Island [1]	64,141	65,358	65,494	56,345	(2)
Australia:					
New South Wales	132	138	71	26	96
South Australia	761				523
Belgium	39,760	15,510	40,330	40,380	49,100
Canada	137	582	1,075	[3] 36	
China	12,000	(2)	(2)	(2)	(2)
Christmas Island (Straits Settlements) [4]	118,553	113,687	119,756	121,858	66,906
Egypt	279,389	200,563	215,311	313,478	257,011
Estonia	3,576	6,859	8,352	4,850	4,580
France	217,400	219,200	189,000	(2)	(2)
Germany: Prussia [3]	443				
India (British) [3]	613	818	22	308	111
Indo-China	20,700	19,629	18,772	30,300	12,871
Japan	75,386	58,776	14,573	27,713	(2)
Madagascar	6,480	8,450	13,441	11,150	8,000
Makatea Island [4]	135,666	136,306	242,990	176,075	111,422
Morocco, French	1,400,000	[5] 1,337,079	[5] 1,608,249	[5] 1,779,008	[5] 900,731
Nauru and Ocean Islands [6]	633,345	509,970	585,844	512,265	392,172
Netherland East Indies			3,172	1,258	110
Netherland West Indies: Curacao [4]	108,881	104,194	103,289	87,497	73,774
New Caledonia	9,000	7,000	(2)	(2)	(2)
Philippine Islands	705	1,550	1,492	(2)	260
Poland	17,614	20,311	39,294	40,000	(2)
Rumania			1,626	1,829	(2)
Russia [7]	56,460	121,711	[8] 45,000	(2)	(2)
Seychelles Islands [4]	11,329	15,408	12,789	15,977	4,730
Spain	4,202	7,897	7,626	5,400	7,734
Taiwan				57	(2)
Tunisia	3,075,000	2,789,000	2,511,000	3,326,000	2,148,000
United States (sold or used by producers)	3,221,589	3,557,604	3,821,217	3,989,411	2,575,645

[1] Exports during fiscal year ended Mar. 31 of year following that stated.
[2] Data not available.
[3] Apatite.
[4] Exports.
[5] Shipments, including exports as follows: 1928, 1,323,293 tons; 1929, 1,591,933 tons; 1930, 1,760,812 tons; 1931, 882,909 tons.
[6] Exports during fiscal year ended June 30 of year stated.
[7] Year ended Sept. 30.
[8] Powdered.

SUPERPHOSPHATES

STATISTICAL SUMMARY

Summary of statistics for superphosphate industry in the United States, 1930 and 1931, in long tons

		1930	1931
Production: [1]			
Bulk superphosphate	16 percent A.P.A.[2] basis	4,102,764	2,450,471
Base and mixed goods	16 percent A.P.A. only	(3)	[4] 61,563
Shipments: [1]			
Bulk superphosphates, to consumers	16 percent A.P.A. basis	1,299,338	920,237
Bulk superphosphates, to others	do	(3)	[4] 489,393
Base and mixed goods	16 percent A.P.A. only	(3)	[4] 381,281
Stocks (Dec. 31): [1]			
Bulk superphosphates	16 percent A.P.A. basis	1,320,469	1,172,788
Base and mixed goods	16 percent A.P.A. only	866,608	465,633
Exports of superphosphates [5]		111,659	81,587
Imports of superphosphates [5]		(6)	5,337
Sales of phosphate rock by producers for superphosphate production		2,379,757	1,335,236

[1] Bureau of Census Monthly Statistics Superphosphate Industry.
[2] Available phosphoric acid.
[3] Data not available in Bureau of Census reports.
[4] May to December, inclusive.
[5] Bureau of Foreign and Domestic Commerce.
[6] Not separately recorded prior to Jan. 1, 1931.

Superphosphates imported into the United States in 1931, by countries [1]

Country	Long tons	Value
Canada	74	$1,323
Cuba	3,000	44,117
Germany	126	4,990
Japan	1,968	29,082
Netherlands	169	1,282
	5,337	80,794

[1] Not separately recorded prior to Jan. 1, 1931.

Superphosphates (acid phosphates) exported from the United States, 1930 and 1931, by countries

Country	1930		1931	
	Long tons	Value	Long tons	Value
Canada	105,817	$1,424,069	78,852	$900,134
Cuba	3,669	70,039	2,661	36,684
Java and Madura	1,119	51,334		
Other	1,054	50,008	74	3,870
	111,659	1,595,450	81,587	940,688

CEMENT [1]

By B. W. Bagley

CONTENTS

GENERAL REVIEW

The final figures of production and shipments of portland cement in 1931 confirmed the estimates published by the Bureau of Mines in January 1932. These estimates, summarized from the monthly reports of producers, indicated a production of about 124,594,000 barrels and shipments of about 126,465,000 barrels and were within 0.7 and 0.5 percent, respectively, of the final figures for the year. The production of portland cement in 1931—125,429,071 barrels—showed a decrease of 22 percent compared with 1930. Each year beginning with 1929, when the first decrease since 1921 was recorded, the output has declined.

In 1931 the mills shipped 127,150,534 barrels of portland cement valued at $140,959,906, decreases from the preceding year of 20 percent in quantity and of more than 38 percent in gross value. The average factory value per barrel, in bulk, was $1.11, a decrease of 33 cents compared with 1930.

The stocks of finished portland cement at the mills reached a total of 24,177,159 barrels on December 31, 1931, a decrease of 7 percent from those at the end of 1930. According to estimates by the manufacturers, 7,035,000 barrels of clinker or unground cement were also on hand at the mills, compared with 8,809,000 barrels at the end of 1930.

Monthly production and shipments were at a much lower rate in 1931 than in 1930; both reached their maximum for the year in June. In the 4 years preceding 1931, August was the record month for production and shipments of portland cement. Shipments in December 1931 were less than for the corresponding month in any year since 1924.

At the end of October, when reserves of finished cement and clinker or unground cement were lowest, about 21,218,000 barrels of finished cement and 6,021,000 barrels of clinker were in stock at the mills.

[1] Work on manuscript completed April 1933.

The monthly average for the finished cement stocks for the year was more than 26,126,000 barrels and for the clinker stocks 9,941,000 barrels compared with 26,563,000 barrels and nearly 10,882,000 barrels, respectively, for 1930.

Both production and shipments of natural and puzzolan cements, including masonry cements of the natural-cement class, were 31 percent less in 1931 than in 1930.

CHIEF HYDRAULIC CEMENTS

The accompanying table gives statistics of output of portland and other (natural and puzzolan) hydraulic cements from 1927 to 1931. The quantity of these cements produced in the United States in 1931 decreased more than 22 percent compared with 1930; the shipments from the mills in 1931 decreased more than 20 percent in quantity and 38 percent in value.

Statistics of the output of alumina cement, representing the operations of only one manufacturer in the United States, are not included in this or other tables of this report.

Principal hydraulic cements produced and shipped in the United States, 1927–31

Year	Number of active plants	Production: Portland cement, barrels	Production: Masonry, natural, and puzzolan cements: Number of active plants	Production: Masonry, natural, and puzzolan cements: Barrels	Production: Total: Number of active plants	Production: Total: Barrels
1927	153	173, 206, 513	11	2, 123, 868	164	175, 330, 381
1928	156	176, 298, 846	11	2, 210, 404	167	178, 509, 250
1929	163	170, 646, 036	11	2, 209, 465	174	172, 855, 501
1930	163	161, 197, 228	11	1, 792, 083	174	162, 989, 311
1931	160	125, 429, 071	12	1, 241, 803	172	126, 670, 874

Year	Shipments: Portland cement: Barrels	Shipments: Portland cement: Value	Shipments: Masonry, natural, and puzzolan cement: Barrels	Shipments: Masonry, natural, and puzzolan cement: Value	Shipments: Total: Barrels	Shipments: Total: Value
1927	171, 864, 728	$278, 854, 647	2, 158, 323	$2, 881, 029	174, 023, 051	$281, 735, 676
1928	175, 838, 332	275, 972, 945	2, 213, 645	2, 910, 097	178, 051, 977	278, 883, 042
1929	169, 868, 322	252, 153, 789	2, 159, 130	2, 950, 717	172, 027, 452	255, 104, 506
1930	159, 059, 334	228, 779, 756	1, 787, 016	2, 469, 531	160, 846, 350	231, 249, 287
1931	127, 150, 534	140, 959, 906	1, 226, 850	1, 619, 920	128, 377, 384	142, 579, 826

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

Of the 35 States in which portland cement was manufactured in both 1930 and 1931, 8 increased production and 8 increased shipments in 1931 compared with 1930. All the commercial districts decreased production and shipments; the decreases in production ranged from 2 to 47 percent and in shipments from 3 to 34 percent. The net decrease for the country as a whole was 22 percent in production and 20 percent in shipments.

The output—125,429,071 barrels of 376 pounds net—is equivalent to 501,716,284 sacks, 21,054,165 long tons, or 23,580,665 short tons. In 1931 shipments exceeded production for the first time since 1922.

In the following table the statistics are arranged by States, so far as permissible, and by districts. The term "active plant" is applied to a mill or group of mills situated at one place and operated by one company. If a company has establishments at different places its mill or group of mills at each place is counted as a plant. The districts are groups of States related geographically and commercially.

Portland cement produced, shipped, and in stock in the United States, 1930 and 1931, by States and districts

	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Decrease, 1931 (percent)	1930		1931		Average factory value per barrel		Decrease in quantity, 1931 (percent)	Barrels		Increase or decrease, 1931 (percent)
	1930	1931	1930	1931		Barrels	Value	Barrels	Value	1930	1931		1930 (revised)	1931	
STATE															
Alabama	6	6	4,821,141	4,446,902	8	4,689,516	$5,829,818	4,476,400	$5,283,085	$1.24	$1.18	5	653,684	624,186	−5
California	12	10	10,124,219	7,740,168	24	10,438,479	15,241,089	7,496,080	11,557,442	1.46	1.54	28	859,324	1,103,412	+28
Illinois	4	4	7,934,563	6,407,191	19	7,951,680	10,519,162	6,425,909	5,342,446	1.32	.83	19	1,178,037	1,159,319	−2
Iowa	6	5	7,088,108	5,804,462	18	7,035,252	10,107,584	5,790,087	5,453,320	1.44	.94	18	1,400,000	1,414,375	+1
Kansas	7	7	6,012,360	4,145,195	31	5,633,098	8,254,416	4,478,823	4,112,809	1.47	.92	20	1,174,773	841,145	−28
Michigan	14	14	11,510,895	6,132,768	47	10,817,994	14,897,439	7,168,720	6,984,725	1.38	.97	34	3,091,414	2,055,462	−34
Missouri	5	5	7,808,543	5,666,869	27	8,030,528	11,470,751	5,103,287	5,052,840	1.43	.99	36	803,852	1,367,434	+70
New York	10	10	10,372,742	9,486,659	9	10,256,086	15,380,703	9,833,048	10,638,666	1.50	1.08	4	1,640,005	1,293,616	−21
Ohio	10	10	8,632,062	6,068,958	30	8,185,077	11,956,038	6,211,789	6,146,302	1.46	.99	24	1,795,919	1,653,088	−8
Pennsylvania	27	27	37,843,662	28,510,231	25	37,968,647	52,712,176	28,412,975	30,952,302	1.39	1.09	25	5,890,777	5,988,033	+2
Tennessee	6	6	3,874,549	3,302,720	15	3,822,598	5,315,693	3,287,966	3,810,271	1.39	1.16	14	527,517	542,271	+3
Texas	9	9	6,781,502	6,189,137	9	6,792,346	10,782,444	6,265,016	8,280,913	1.59	1.32	8	801,922	726,043	−9
Other States [1]	47	47	38,392,882	31,527,811	18	37,438,033	56,312,443	32,200,434	37,344,785	1.50	1.16	14	6,081,398	5,408,775	−11
	163	160	161,197,228	125,429,071	22	159,059,334	228,779,756	127,150,534	140,959,906	1.44	1.11	20	25,898,622	24,177,159	−7
DISTRICT															
Eastern Pennsylvania, New Jersey, and Maryland	25	25	35,140,880	28,640,435	18	35,356,917	49,041,368	28,852,931	31,526,293	1.39	1.09	18	5,064,120	4,851,624	−4
New York and Maine	11	11	11,341,724	10,309,448	9	11,121,958	16,877,560	10,740,835	11,733,315	1.52	1.09	3	1,774,464	1,343,077	−24
Ohio, Western Pennsylvania, and West Virginia	19	19	17,620,488	11,563,606	34	17,068,119	24,395,914	11,548,414	11,715,773	1.43	1.01	32	3,555,614	3,570,806	+0.4
Michigan	14	14	11,510,895	6,132,768	47	10,817,994	14,897,439	7,168,720	6,984,725	1.38	.97	34	3,091,414	2,055,462	−34
Wisconsin, Illinois, Indiana, and Kentucky	11	11	20,232,671	15,174,044	25	19,571,759	26,995,982	15,938,258	14,607,735	1.38	.92	19	3,596,835	2,832,621	−21
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	19	19	12,880,818	12,306,864	4	12,728,652	17,664,733	12,310,474	15,285,223	1.39	1.24	3	1,799,033	1,795,423	−0.2
Eastern Missouri, Iowa, Minnesota, and South Dakota	12	11	16,693,905	12,967,590	22	16,886,039	24,061,001	12,272,390	11,966,314	1.42	.98	27	2,403,117	3,098,317	+29

Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	13	13	12, 510, 599	9, 181, 849	27	11, 880, 424	17, 704, 859	9, 633, 404	9, 435, 048	1. 49	. 98	19	2, 089, 303	1, 637, 748	−22
Texas	9	9	6, 781, 502	6, 189, 137	9	6, 792, 346	10, 782, 444	6, 265, 016	8, 280, 913	1. 59	1. 32	8	801, 922	726, 043	−9
Colorado, Montana, Utah, Wyoming, and Idaho	9	9	2, 268, 813	2, 215, 985	2	2, 375, 335	4, 657, 623	2, 060, 045	3, 299, 076	1. 96	1. 60	13	336, 269	492, 209	+46
California	12	10	10, 124, 219	7, 740, 168	24	10, 438, 479	15, 241, 089	7, 496, 080	11, 557, 442	1. 46	1. 54	28	859, 324	1, 103, 412	+28
Oregon and Washington	9	9	4, 090, 714	3, 007, 177	26	4, 021, 312	6, 459, 744	2, 863, 967	4, 568, 049	1. 61	1. 60	29	527, 207	670, 417	+27
	163	160	161, 197, 228	125, 429, 071	22	159, 059, 334	228, 779, 756	127, 150, 534	140, 959, 906	1. 44	1. 11	20	25, 898, 622	24, 177, 159	−7

[1] Includes Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

The following table, which shows production, shipments, and stocks of finished portland cement by districts and by months for 1931, has been compiled from monthly reports on the operation of all but 4 plants for the first half of the year and all but 3 plants for the latter half of the year; estimates have been included for these plants. The table also shows totals for the United States in 1930 compiled from reports for all but 4 plants in May, 3 in June and July, and 2 in the other months of the year; estimates have also been included for these plants. Although the figures may differ slightly from the totals shown by other tables, which are based on final annual reports from the producers, they reflect accurately fluctuations in the industry during the year. In December, January, and February, in the colder part of the United States, the production of portland cement is necessarily somewhat curtailed by the weather, as are also demand and hence shipments from the mills. Moreover, mills often close for repairs during the winter when the demand is lowest. As the quantity of clinker, or unground cement, produced and in reserve at the mills awaiting manufacture into finished cement is of interest, a table is given showing these statistics, compiled from estimates by the manufacturers.

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1931, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania, New Jersey, and Maryland	1,617	1,630	2,293	2,691	3,053	2,900	2,675	2,891	2,761	2,369	2,046	1,434
New York and Maine	420	151	437	832	1,106	1,230	1,192	1,375	1,292	1,110	686	458
Ohio, western Pennsylvania, and West Virginia	504	412	444	829	1,289	1,505	1,520	1,296	1,063	904	769	422
Michigan	45	109	72	524	722	919	983	832	743	602	385	197
Wisconsin, Illinois, Indiana, and Kentucky	804	427	797	1,231	1,913	1,757	1,877	1,818	1,623	1,337	894	707
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	646	836	942	1,268	1,418	1,312	1,319	1,193	1,069	1,009	733	572
Eastern Missouri, Iowa, Minnesota, and South Dakota	854	766	869	1,261	1,335	1,300	1,414	1,449	1,228	975	827	600
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	450	263	638	674	1,248	1,187	1,015	987	701	795	566	688
Texas	322	286	489	585	600	634	646	644	625	601	459	291
Colorado, Montana, Utah, Wyoming, and Idaho	123	160	192	233	296	298	219	209	171	117	97	59
California	624	709	830	793	703	745	670	552	529	698	555	474
Oregon and Washington	186	171	242	324	327	331	369	303	287	245	144	72
United States, 1931	6,595	5,920	8,245	11,245	14,010	14,118	13,899	13,549	12,092	10,762	8,161	5,974
1930	8,498	8,162	11,225	13,521	17,249	17,239	17,078	17,821	16,124	14,410	11,098	8,480
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	1,084	1,123	1,724	2,587	2,952	3,260	3,114	3,147	3,108	3,123	2,064	1,310
New York and Maine	206	182	381	769	1,137	1,360	1,436	1,556	1,500	1,231	661	321
Ohio, western Pennsylvania, and West Virginia	367	415	595	919	1,252	1,507	1,471	1,353	1,224	1,139	581	282
Michigan	220	219	286	529	825	1,030	1,147	1,065	807	616	267	153
Wisconsin, Illinois, Indiana, and Kentucky	354	416	526	1,260	1,743	2,220	2,275	2,316	1,995	1,662	761	375
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	679	768	1,061	1,343	1,428	1,463	1,210	1,082	1,032	1,050	763	432
Eastern Missouri, Iowa, Minnesota, and South Dakota	288	377	494	1,029	1,538	1,917	1,896	1,737	1,341	995	474	212
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	321	404	520	942	1,307	1,303	1,102	1,121	886	881	475	372
Texas	340	328	456	581	644	693	696	667	688	583	378	214
Colorado, Montana, Utah, Wyoming, and Idaho	50	82	126	184	298	278	229	232	224	185	85	43
California	643	602	770	733	710	737	624	595	593	662	527	370
Oregon and Washington	140	158	253	308	366	309	345	301	273	233	120	58
United States, 1931	4,692	5,074	7,192	11,184	14,200	16,077	15,545	15,172	13,671	12,360	7,156	4,142
1930	4,955	7,012	8,826	13,340	17,224	18,781	20,153	20,299	18,083	15,599	8,784	5,688

Summary of monthly estimates of portland cement produced, shipped, and in stock at mills in the United States in 1931, by districts, in thousands of barrels—Continued

District	January	February	March	April	May	June	July	August	September	October	November	December
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	5,546	6,054	6,622	6,725	6,824	6,465	6,026	5,769	5,422	4,668	4,649	4,852
New York and Maine	1,988	1,957	2,013	2,076	2,044	1,914	1,669	1,489	1,281	1,159	1,185	1,343
Ohio, western Pennsylvania, and West Virginia	3,709	3,705	3,565	3,476	3,513	3,511	3,559	3,505	3,344	3,122	3,310	3,571
Michigan	2,915	2,814	2,600	2,586	2,482	2,372	2,208	1,975	1,908	1,893	2,011	2,056
Wisconsin, Illinois, Indiana, and Kentucky	3,955	3,966	4,237	4,208	4,378	3,915	3,518	3,020	2,648	2,352	2,485	2,833
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,766	1,833	1,714	1,639	1,630	1,479	1,576	1,687	1,725	1,684	1,656	1,795
Eastern Missouri, Iowa, Minnesota, and South Dakota	3,069	3,458	3,833	4,064	3,862	3,244	2,762	2,474	2,361	2,372	2,710	3,098
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2,218	2,077	2,196	1,885	1,826	1,710	1,624	1,490	1,305	1,219	1,311	1,638
Texas	782	740	773	777	734	675	626	603	539	558	649	726
Colorado, Montana, Utah, Wyoming, and Idaho	410	486	552	600	609	629	609	585	541	474	485	492
California	831	938	998	1,110	1,103	1,113	1,158	1,114	1,050	1,086	1,114	1,103
Oregon and Washington	570	584	573	569	549	575	599	602	612	631	654	670
United States, 1931	27,759	28,612	29,676	29,715	29,554	27,602	25,934	24,313	22,736	21,218	[1] 22,219	24,177
1930	27,081	28,249	30,648	30,867	30,891	29,364	26,289	23,824	21,889	20,697	[1] 23,056	[1] 25,899

[1] Revised figures.

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1931, by districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December	Year
PRODUCTION													
Eastern Pennsylvania, New Jersey, and Maryland	1,878	1,947	2,489	2,699	3,004	2,660	2,537	2,514	2,417	2,089	1,922	1,622	27,778
New York and Maine	659	326	669	979	1,028	1,021	1,047	1,019	987	992	750	585	10,062
Ohio, western Pennsylvania, and West Virginia	724	580	623	897	1,188	1,271	1,339	1,123	822	741	747	480	10,535
Michigan	445	380	382	486	577	623	610	587	464	615	338	314	5,821
Wisconsin, Illinois, Indiana, and Kentucky	1,000	891	980	1,419	1,685	1,533	1,574	1,479	1,276	1,140	1,047	735	14,759
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	587	749	962	1,238	1,283	1,274	1,281	1,218	1,078	877	746	653	11,946
Eastern Missouri, Iowa, Minnesota, and South Dakota	898	896	1,137	1,256	1,318	1,145	1,159	1,302	1,168	924	798	621	12,622
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	550	388	716	648	1,125	1,143	935	817	691	814	578	725	9,130
Texas	315	292	430	565	496	702	675	633	576	583	479	339	6,085
Colorado, Montana, Utah, Wyoming, and Idaho	128	160	203	234	312	297	212	181	109	59	58	98	2,051
California	686	706	813	835	800	754	588	503	502	686	609	589	8,071
Oregon and Washington	259	158	182	284	343	256	289	288	324	305	187	79	2,954
United States, 1931	8,129	7,473	9,586	11,540	13,159	12,679	12,246	11,664	10,414	9,825	8,259	6,840	121,814
1930	10,504	10,008	13,045	15,025	16,607	15,895	15,069	15,244	14,577	13,895	11,639	9,484	160,992
STOCKS (END OF MONTH)													
Eastern Pennsylvania, New Jersey, and Maryland	1,329	1,665	1,893	1,934	1,923	1,731	1,593	1,237	936	688	601	799	
New York and Maine	902	1,078	1,314	1,470	1,403	1,212	940	600	315	209	276	406	
Ohio, western Pennsylvania, and West Virginia	1,290	1,464	1,645	1,710	1,634	1,402	1,262	1,100	868	702	708	689	
Michigan	1,271	1,542	1,852	1,820	1,679	1,415	1,049	823	555	571	524	641	
Wisconsin, Illinois, Indiana, and Kentucky	1,091	1,558	1,741	1,928	1,706	1,490	1,199	871	532	311	464	494	
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	966	872	897	865	737	709	685	715	720	597	611	695	
Eastern Missouri, Iowa, Minnesota, and South Dakota	584	727	1,006	1,021	1,027	930	710	587	545	478	462	452	
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	666	791	871	848	732	695	622	461	456	479	495	542	
Texas	339	348	300	288	193	270	310	310	274	266	289	341	
Colorado, Montana, Utah, Wyoming, and Idaho	276	276	287	286	280	280	285	258	187	127	88	128	
California	1,175	1,141	1,085	1,294	1,362	1,364	1,290	1,252	1,230	1,235	1,292	1,436	
Oregon and Washington	495	484	427	390	411	339	264	254	300	358	405	412	
United States, 1931	10,384	11,946	13,318	13,854	13,087	11,837	10,209	8,468	6,918	6,021	6,215	7,035	
1930	9,646	11,572	13,503	15,164	14,668	13,452	11,684	9,275	7,783	7,266	7,758	8,809	

Except in January, February, August, September, and October, when slight increases were recorded, producers' stocks of portland cement reported on hand at the mills decreased each month in 1931 compared with the corresponding month in 1930. Reserves at the end of 1931 decreased 7 percent from those at the end of 1930, the first decrease recorded in stocks at the end of any year since 1922. Stocks at the end of 1931 exceeded the average for the 5 preceding years (23,111,365 barrels) by more than 4 percent. The totals by States and districts are given in the preceding tables.

Producers' stocks of finished portland cement on hand at mills in the United States, December 31, 1927–31, in barrels

1927	22, 457, 382	1930	[2] 25, 898, 622
1928	22, 760, 103	1931	24, 177, 159
1929	23, 700, 533		

DOMESTIC CONSUMPTION

The total consumption of portland cement in the United States may be estimated by adding the imports to the shipments and subtracting the exports from the sum. Of course, at any time a variable but considerable quantity of cement is in transit, in warehouses at distributing points, and awaiting use at jobs, so that the estimate thus made is at best only approximate. Another fact that impairs the accuracy of the estimate is that the cement imported and exported is classed as hydraulic cement; hence, the records do not discriminate between portland and other cements and probably include some plaster also. Portland cement, however, constitutes by far the greater part of the exports. The apparent domestic consumption in 1931 decreased more than 20 percent compared with 1930. This decrease and that of 7 percent in 1930 compared with 1929 and of nearly 4 percent in 1929 compared with 1928 are the only decreases in apparent domestic consumption recorded since 1918.

Portland cement available for consumption in the United States, 1927–31, in barrels

Year	Shipments	Imports	Exports	Available for consumption
1927	171, 864, 728	2, 050, 180	816, 726	173, 098, 182
1928	175, 838, 332	2, 284, 085	824, 656	177, 297, 761
1929	169, 868, 322	1, 727, 900	885, 321	170, 710, 901
1930	159, 059, 334	975, 546	755, 778	159, 279, 102
1931	127, 150, 534	457, 238	429, 653	127, 178, 119

[1] Revised figures.

The only available gage of consumption of portland cement by States is the record of shipments into the several States by the manufacturers and is therefore merely approximate. The shipments of cement into a State during a year do not equal the consumption in that State during the same year, but shipments over a long period should afford a fair index of consumption. The simplest available common unit is the estimated consumption in barrels per capita, which is obtained by comparing the shipments into the several States with the population of those States. The following table shows such figures for 1930 and 1931. The estimates of population used in calculating the per capita consumption are those of the Bureau of the Census.

The official figures for exports of cement on page 549 differ from the exports reported by manufacturers in the following table, because cement forwarded from mills and destined for foreign countries and for Alaska, Hawaii, and Puerto Rico is reported by the shipper as exported, whether or not it leaves the country during the calendar year, whereas the Bureau of Foreign and Domestic Commerce export figures record the cement that actually leaves the country during the period specified. (Shipments to Alaska, Hawaii, and Puerto Rico appear on p. 549.) The exports for 1931 recorded by that bureau include all other hydraulic cement exported, whereas the table of per capita consumption relates only to portland cement.

The per capita consumption indicated by the table necessarily falls short of the total apparent consumption by the quantity of the imports. These increase the consumption in certain States near the Canadian border and the seaboard; in 1931 they increased the general average per capita consumption about 0.004 barrel.

In 19 States—10 east and 9 west of the Mississippi River—the per capita consumption in 1931 was 1 barrel or more. Two Southern States—Louisiana and South Carolina—are included in this class. Only the District of Columbia showed a per capita consumption of more than 2 barrels.

Increases in per capita consumption were recorded in 6 States and the District of Columbia in 1931; decreases were recorded in 42 States. In 1931, as in 1930, Louisiana showed the largest increase in per capita consumption, followed in order in 1931 by South Carolina, the District of Columbia, Nebraska, and South Dakota.

The increases in per capita consumption in 1931 ranged from 0.01 to 0.46 barrel, the decreases from 0.01 to 1.06 barrels. The general average per capita consumption for the United States was 1.02 barrels in 1931 compared with 1.29 in 1930. From 1914 to 1931 the average per capita consumption for the country ranged from a low of 0.64 barrel (in 1918) to a high of 1.46 barrels (in 1928).

Shipments of domestic portland cement from mills into States and per capita, 1930 and 1931, in barrels

State	1930		1931	
	Total	Per capita [1]	Total	Per capita
Alabama	1,273,632	0.48	1,250,778	0.47
Arizona [2]	462,560	1.06	438,135	.99
Arkansas	1,459,388	.79	1,223,213	.66
California	9,426,837	1.66	6,616,135	1.13
Colorado	843,983	.81	775,540	.74
Connecticut [2]	1,754,324	1.09	1,476,613	.91
Delaware [2]	373,672	1.57	347,423	1.45
District of Columbia [2]	1,078,729	2.22	1,249,676	2.55
Florida	1,056,549	.72	764,671	.51
Georgia	1,561,775	.54	1,714,033	.59
Idaho	311,800	.70	189,317	.42
Illinois	11,164,248	1.46	7,925,435	1.03
Indiana	4,927,894	1.52	3,880,234	1.19
Iowa	6,411,595	2.59	3,799,665	1.53
Kansas	2,398,123	1.27	2,131,790	1.13
Kentucky	1,695,202	.65	1,628,002	.62
Louisiana	2,892,404	1.38	3,906,467	1.84
Maine	835,795	1.05	527,376	.66
Maryland	2,555,386	1.57	2,013,929	1.22
Massachusetts [2]	3,090,962	.73	3,043,584	.71
Michigan	8,625,691	1.78	5,582,116	1.13
Minnesota	3,668,645	1.43	3,716,068	1.41
Mississippi [2]	619,649	.31	524,804	.26
Missouri	6,145,380	1.69	4,259,370	1.17
Montana	319,214	.59	263,119	.49
Nebraska	1,675,904	1.22	1,903,200	1.38
Nevada [2]	147,243	1.62	133,403	1.45
New Hampshire [2]	559,958	1.20	437,493	.94
New Jersey	6,536,136	1.62	5,065,654	1.23
New Mexico [2]	298,111	.70	264,507	.62
New York	20,147,426	1.60	19,755,653	1.55
North Carolina [2]	1,165,162	.37	1,015,225	.32
North Dakota [2]	337,888	.50	258,072	.38
Ohio	9,698,510	1.46	6,644,895	.99
Oklahoma	3,396,549	1.42	2,213,685	.91
Oregon	1,070,341	1.12	926,874	.96
Pennsylvania	13,795,600	1.43	7,922,885	.82
Rhode Island [2]	704,943	1.03	569,817	.82
South Carolina [2]	1,654,951	.95	2,250,646	1.29
South Dakota	540,867	.78	637,023	.91
Tennessee	2,410,519	.92	1,396,425	.53
Texas	6,417,951	1.10	5,684,691	.96
Utah	417,472	.82	311,212	.61
Vermont [2]	582,495	1.62	312,492	.87
Virginia	1,648,052	.68	1,596,041	.66
Washington	3,102,088	1.98	2,086,795	1.32
West Virginia	1,598,843	.92	1,421,369	.81
Wisconsin	4,974,591	1.69	3,977,652	1.34
Wyoming	178,873	.79	136,273	.60
Unspecified	15,865		235,182	
	158,029,775	1.29	126,404,657	1.02
Exports reported by manufacturers but not included above [3]	1,029,559		745,877	
Total shipped from cement plants	159,059,334		127,150,534	

[1] Per capita figures based on latest available estimates of population made by the Bureau of the Census.
[2] Non-cement-producing State.
[3] Includes shipments to Alaska, Hawaii, and Puerto Rico.

The following table, which shows the monthly shipments from portland-cement mills into States in 1931, has been compiled from monthly reports of producers but includes estimates of the distribution of shipments from three or four plants each month. Although the figures vary slightly from the totals shown in the other tables, which are based on final annual reports from the producers, they reflect the fluctuations in shipments during the year.

Portland cement shipped from mills into States in 1931, by months, in barrels [1]

Shipped to—	January	February	March	April	May	June
Alabama	88,798	103,610	175,601	219,593	183,572	138,369
Alaska	11	159	1,111	1,153	946	1,100
Arizona	36,015	36,834	53,821	47,083	42,634	41,110
Arkansas	61,067	49,848	74,768	183,121	187,370	177,846
California	580,888	532,384	691,790	653,624	628,900	646,220
Colorado	20,937	32,603	42,724	70,204	124,139	99,511
Connecticut	40,081	40,716	82,833	150,380	176,666	166,357
Delaware	10,916	15,566	14,473	32,856	47,276	51,926
District of Columbia	53,960	56,388	76,232	119,153	130,588	141,277
Florida	64,038	60,601	49,466	61,526	82,852	95,649
Georgia	83,687	81,500	151,326	182,817	156,532	183,317
Hawaii	24,971	28,265	24,602	20,849	25,580	22,996
Idaho	4,465	7,472	16,408	21,558	19,917	25,547
Illinois	195,146	227,023	279,580	717,468	882,739	1,069,134
Indiana	79,310	108,914	130,801	256,697	411,373	616,508
Iowa	30,333	73,262	121,769	309,768	611,996	779,351
Kansas	70,951	111,835	133,354	184,369	328,414	300,175
Kentucky	56,989	73,623	97,970	197,013	231,958	215,082
Louisiana	133,695	156,356	216,170	277,366	314,748	422,388
Maine	8,263	9,015	19,556	36,091	54,690	90,276
Maryland	48,532	71,391	103,592	181,752	199,360	230,317
Massachusetts	106,524	69,184	151,893	279,032	323,576	318,456
Michigan	174,367	170,815	200,479	395,559	659,977	842,129
Minnesota	46,987	62,726	106,842	268,765	468,010	625,439
Mississippi	37,644	31,532	29,594	53,159	82,827	82,243
Missouri	172,628	187,552	221,789	406,831	511,513	500,949
Montana	9,502	10,912	19,072	24,187	30,139	35,590
Nebraska	16,464	49,142	58,027	131,416	237,284	272,654
Nevada	2,455	6,231	9,804	11,722	10,999	11,041
New Hampshire	6,586	7,359	11,868	30,884	42,169	43,410
New Jersey	135,679	151,941	285,359	484,331	557,649	508,242
New Mexico	12,200	14,839	23,879	30,751	42,604	29,840
New York	653,705	622,266	1,035,782	1,527,913	2,013,197	2,498,158
North Carolina	30,352	42,771	92,639	123,303	146,249	163,922
North Dakota	2,737	5,790	17,176	35,616	43,024	55,251
Ohio	188,631	219,903	308,587	491,647	668,196	817,720
Oklahoma	115,140	125,682	136,628	244,250	301,925	290,304
Oregon	36,696	38,148	84,549	105,653	104,620	109,997
Pennsylvania	323,776	343,903	458,913	697,081	801,763	866,697
Puerto Rico	620	1,020	2,672	2,825	3,905	17,385
Rhode Island	13,249	11,454	25,935	73,310	81,320	66,438
South Carolina	170,545	208,443	214,460	234,756	256,625	224,825
South Dakota	6,533	21,300	28,631	56,775	77,241	110,088
Tennessee	69,456	60,601	91,664	151,183	158,104	162,661
Texas	327,904	309,196	428,923	524,419	597,840	586,255
Utah	6,075	13,991	28,086	31,633	30,513	43,516
Vermont	2,869	2,014	7,389	22,391	24,529	42,905
Virginia	61,804	81,003	118,992	162,050	183,752	193,085
Washington	110,948	129,223	174,642	211,323	276,386	226,264
West Virginia	52,512	56,430	70,953	92,214	128,383	184,176
Wisconsin	66,531	85,088	119,628	288,648	431,564	569,655
Wyoming	4,854	5,333	8,585	13,920	17,243	19,781
Unspecified	9,333	7,071	16,547	19,876	12,082	1,246
	4,668,359	5,030,228	7,147,934	11,151,864	14,167,458	16,034,778
Foreign countries	23,641	43,772	44,066	32,136	32,542	42,222
Total shipped from cement plants	4,692,000	5,074,000	7,192,000	11,184,000	14,200,000	16,077,000

[1] Includes estimated distribution from 3 plants for January and for May to December; from 4 plants for February to April.

Portland cement shipped from mills into States in 1931, by months, in barrels—Con.

Shipped to—	July	August	September	October	November	December
Alabama	90, 757	88, 251	60, 846	50, 940	26, 640	21, 963
Alaska	2, 716	1, 666	835	808	1, 634	25
Arizona	41, 979	37, 842	33, 835	27, 780	16, 951	15, 640
Arkansas	124, 724	102, 693	88, 785	81, 767	65, 442	17, 112
California	540, 476	521, 774	523, 744	580, 258	469, 082	322, 270
Colorado	73, 107	77, 569	87, 979	86, 048	38, 269	22, 047
Connecticut	166, 381	159, 855	159, 798	162, 540	115, 392	51, 564
Delaware	42, 710	30, 933	43, 222	27, 187	18, 165	11, 461
District of Columbia	126, 637	122, 153	125, 178	122, 498	95, 373	77, 875
Florida	106, 826	68, 905	51, 414	51, 252	37, 636	33, 081
Georgia	144, 400	191, 428	164, 838	162, 410	127, 940	83, 222
Hawaii	23, 770	20, 407	18, 544	21, 468	21, 443	12, 473
Idaho	22, 930	23, 842	19, 173	15, 481	9, 045	3, 286
Illinois	1, 054, 935	1, 063, 517	975, 734	856, 580	405, 403	193, 244
Indiana	682, 234	592, 825	466, 096	313, 599	137, 557	72, 495
Iowa	681, 197	563, 562	305, 343	209, 676	75, 128	34, 916
Kansas	198, 757	242, 108	173, 915	166, 235	85, 678	86, 455
Kentucky	202, 923	186, 726	174, 142	149, 282	91, 585	49, 417
Louisiana	505, 614	498, 824	555, 155	485, 188	259, 759	77, 914
Maine	86, 427	75, 516	59, 275	46, 894	24, 207	11, 145
Maryland	186, 573	161, 645	206, 115	291, 938	198, 274	133, 256
Massachusetts	377, 774	332, 816	392, 466	344, 866	229, 878	110, 738
Michigan	908, 045	787, 425	620, 928	461, 985	191, 085	119, 925
Minnesota	681, 655	668, 690	432, 521	242, 908	90, 893	35, 166
Mississippi	66, 519	67, 290	33, 326	23, 656	15, 502	5, 820
Missouri	439, 866	483, 764	438, 547	482, 444	226, 333	178, 052
Montana	32, 722	34, 859	30, 420	21, 927	9, 526	3, 697
Nebraska	281, 405	319, 336	264, 988	194, 514	51, 644	25, 655
Nevada	9, 774	9, 907	12, 735	18, 440	14, 728	12, 587
New Hampshire	63, 680	78, 995	59, 641	51, 874	30, 201	9, 272
New Jersey	519, 732	550, 716	599, 005	645, 068	397, 146	212, 095
New Mexico	21, 853	20, 056	21, 342	25, 380	11, 907	9, 934
New York	2, 415, 239	2, 548, 291	2, 316, 622	2, 096, 119	1, 223, 494	760, 928
North Carolina	126, 608	77, 320	61, 534	59, 103	54, 884	35, 452
North Dakota	31, 587	22, 552	19, 533	17, 110	6, 152	1, 258
Ohio	869, 396	700, 988	805, 284	749, 570	371, 566	194, 959
Oklahoma	226, 890	311, 923	140, 858	174, 121	123, 866	121, 420
Oregon	102, 903	93, 759	88, 543	91, 480	52, 625	16, 332
Pennsylvania	807, 513	869, 155	857, 987	781, 503	526, 424	298, 610
Puerto Rico	5, 595	4, 035	4, 037	4, 515	9, 238	8, 525
Rhode Island	57, 157	59, 797	63, 719	54, 139	35, 655	26, 601
South Carolina	151, 919	141, 224	186, 108	243, 408	165, 616	52, 483
South Dakota	101, 420	95, 711	86, 660	29, 736	14, 179	8, 749
Tennessee	110, 542	119, 876	144, 628	171, 232	128, 207	44, 322
Texas	588, 163	562, 895	601, 256	542, 920	368, 199	223, 504
Utah	42, 650	24, 194	26, 160	22, 669	12, 860	6, 861
Vermont	48, 958	56, 224	49, 250	32, 942	15, 714	5, 602
Virginia	178, 952	146, 156	151, 914	122, 618	116, 823	78, 200
Washington	265, 116	223, 760	188, 660	157, 064	71, 142	50, 654
West Virginia	179, 975	166, 437	160, 286	142, 876	83, 257	50, 176
Wisconsin	611, 166	712, 588	474, 841	389, 339	153, 150	73, 102
Wyoming	20, 863	15, 674	12, 405	10, 638	4, 891	2, 661
Unspecified	61, 210	11, 303	7, 030	9, 434		
	15, 512, 920	15, 149, 757	13, 647, 200	12, 325, 427	7, 127, 388	4, 114, 201
Foreign countries	32, 080	22, 243	23, 800	34, 573	28, 612	27, 799
Total shipped from cement plants	15, 545, 000	15, 172, 000	13, 671, 000	12, 360, 000	7, 156, 000	4, 142, 000

LOCAL SUPPLIES

The following table compares the shipments from the mills within a State or group of States with the estimated consumption (State receipts of mill shipments) and indicates the surplus or deficiency in the supply of cement locally available. Consumption in the States that do not produce cement is also indicated in the table on page 534. Data for 1916 to 1929 will be found in Mineral Resources of the United States for 1917 to 1929.

The surplus shown in the following table was distributed by years as follows: In 1930, to non-cement-producing States, 12,830,647 barrels; to foreign countries and to Alaska, Hawaii, and Puerto Rico, 1,029,559 barrels; and unspecified, 15,865 barrels. In 1931, to non-cement-producing States, 12,321,890 barrels; to foreign countries and to Alaska, Hawaii, and Puerto Rico, 745,877 barrels; and unspecified, 235,182 barrels. Of the surplus shipped to the 14 noncement-producing States, 68 percent in 1930 and 73 percent in 1931 were shipped to Massachusetts, Connecticut, North and South Carolina, and the District of Columbia.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1930 and 1931, in barrels

State or division	1930			1931		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	4, 689, 516	1, 273, 632	+3, 415, 884	4, 476, 400	1, 250, 778	+3, 225, 622
California	10, 438, 479	9, 426, 837	+1, 011, 642	7, 496, 080	6, 616, 135	+879, 945
Illinois	7, 951, 680	11, 164, 248	−3, 212, 568	6, 425, 909	7, 925, 435	−1, 499, 526
Iowa	7, 035, 252	6, 411, 595	+623, 657	5, 790, 087	3, 799, 665	+1, 990, 422
Kansas	5, 633, 098	2, 398, 123	+3, 234, 975	4, 478, 823	2, 131, 790	+2, 347, 033
Michigan	10, 817, 994	8, 625, 691	+2, 192, 303	7, 168, 720	5, 582, 116	+1, 586, 604
Missouri	8, 030, 528	6, 145, 380	+1, 885, 148	5, 103, 287	4, 259, 370	+843, 917
Ohio	8, 185, 077	9, 698, 510	−1, 513, 433	6, 211, 789	6, 644, 895	−433, 106
Pennsylvania	37, 968, 647	13, 795, 600	+24, 173, 047	28, 412, 975	7, 922, 885	+20, 490, 090
Tennessee	3, 822, 598	2, 410, 519	+1, 412, 079	3, 287, 966	1, 396, 425	+1, 891, 541
Texas	6, 792, 346	6, 417, 951	+374, 395	6, 265, 016	5, 684, 691	+580, 325
Colorado, Montana, Utah, Wyoming, and Idaho	2, 375, 335	2, 071, 342	+303, 993	2, 060, 045	1, 675, 461	+384, 584
Oregon and Washington	4, 021, 312	4, 172, 429	−151, 117	2, 863, 967	3, 013, 669	−149, 702
Georgia, Kentucky, Virginia, Florida, and Louisiana	5, 111, 463	8, 853, 982	−3, 742, 519	5, 376, 411	9, 609, 214	−4, 232, 803
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	18, 792, 739	20, 643, 838	−1, 851, 099	15, 215, 643	17, 551, 075	−2, 335, 432
Maryland, New Jersey, and West Virginia	6, 271, 312	10, 690, 365	−4, 419, 053	5, 776, 581	8, 500, 952	−2, 724, 371
New York and Maine	11, 121, 958	20, 083, 221	−9, 861, 263	10, 740, 835	20, 283, 029	−9, 542, 194
	159, 059, 334	145, 183, 263	+13, 876, 071	127, 150, 534	113, 847, 585	+13, 302, 949

PRICES

AT FACTORIES

The average selling value of portland cement f.o.b. at the factories, with the price of containers not included and with cash discounts deducted where allowed, as reported to the Bureau of Mines is shown in the table of shipments by States and districts during 1930 and 1931 (p. 526). The averages by districts ranged from $0.92 a barrel in the Wisconsin-Illinois-Indiana-Kentucky district to $1.60 a barrel in the Colorado-Montana-Utah-Wyoming-Idaho and in the Oregon-Washington districts in 1931 compared with a range from $1.38 a barrel in Michigan and in the Wisconsin-Illinois-Indiana-Kentucky district to $1.96 a barrel in the Colorado-Montana-Utah-Wyoming-Idaho district in 1930. The general average value for the country as a whole has decreased each year since 1923; it decreased 33 cents per barrel (nearly 23 percent) in 1931 as compared with 1930, and averages were lower in all the districts and in all the States shown in the table except California.

The average factory value of portland cement may be higher for certain States than it would be if the ordinary structural cement were the only kind considered. For these States certain special cements that command higher prices are included in the average. These special cements include the white portland cement made in Pennsylvania and the high-early-strength portland cements now manufactured in a number of the States. A plant in California, equipped for the manufacture of white portland cement, was under construction in 1931. Statistics of output of high-early-strength portland cement, masonry cements of the portland-cement class, and other special cements, are shown on page 544.

Average factory value per barrel in bulk of portland cement, 1927–31

1927	$1.62	1930	$1.44
1928	1.57	1931	1.11
1929	1.48		

AT MARKETS

As the annual per capita consumption of portland cement in the United States exceeds 1 barrel, the prices of such an essential building material have attracted particular interest. Considerable information is now available to show the position of cement prices among those of other structural materials and to explain the economic conditions that determine them. Data of interest in this connection are now compiled and published by the United States Department of Labor, Bureau of Labor Statistics.

Comparative prices of building materials in December 1930 and 1931 [1]

[Percentage of decrease from 1926 average]

	1930	1931
Building materials in general	15.6	26.7
Lime, building, at plant (composite price)	15.2	16.6
Plate glass, 3 to 5 feet, New York	17.1	17.1
Turpentine, New York	55.2	58.0
Brick, common, building, at plant (composite price)	9.4	12.8
Linseed oil, raw, New York	17.9	36.8
Douglas fir, No. 1, common, at mills	21.2	32.7
Yellow pine, flooring, at mills	27.9	41.7
Oak, plain, white, No. 1, common, Cincinnati	24.3	33.4
Portland cement, at plant (composite price)	9.4	25.4

[1] U.S. Department of Labor, Bureau of Labor Statistics, Wholesale Prices of Commodities: Rept. for December and year 1931, pp. 9-10.

MANUFACTURING CONDITIONS

PLANTS

In 1931 portland cement was manufactured at 158 plants and shipments were made from 160 plants compared with 161 producing and 163 shipping plants in 1930. Two plants that reported production in 1930 manufactured no cement in 1931; they shipped in 1931 from stock on hand.

Additional plants were reported under construction but not completed in Arkansas and California.

FUELS [3]

Compared with 1930 the proportion of cement burned by coal alone and that burned by oil decreased in 1931, and the proportion burned by natural gas increased. Of the portland cement produced in 1931, 74.2 percent was burned with coal alone compared with 76.7 percent in 1930, 4.8 percent was burned with oil alone compared with 4.2 percent in 1930, and 5.5 percent was burned with natural gas alone compared with 4.7 percent in 1930.

As summarized from the reports of the cement producers the following quantities of fuel were consumed at the portland-cement plants in the United States in 1931 in the production of 125,429,071 barrels of finished cement: Coal, 6,379,440 short tons; oil, 2,016,729 barrels (or 84,702,618 gallons); and natural gas, 31,380,951,676 cubic feet. Corresponding figures from the producers' reports for 1930 follow: Finished cement produced, 161,197,228 barrels; and fuels consumed in its manufacture—coal 8,561,595 short tons, oil 1,968,018 barrels (or 82,656,756 gallons), and natural gas 41,255,809,368 cubic feet. In the estimates of consumption of fuel per barrel of cement the production of finished cement alone is considered. In this connection it is of interest that the stock of clinker or unground cement at the mills at the end of 1931 (7,035,000 barrels, as shown in the tables on pages 531 and 542) is more than 20 percent below the stock of clinker at the mills at the end of 1930 (8,809,000 barrels).

Coal was reported as the only fuel used at 114 plants in the United States in 1931 compared with 120 plants in 1930. The apparent average consumption in 1931 was 126.3 pounds of coal per barrel of finished cement compared with 127.9 pounds of coal per barrel of finished cement in 1930. The 50 dry-process plants using coal as the only fuel in 1931 reported a total consumption of 3,082,898 short tons of coal in the manufacture of 48,699,627 barrels of finished cement, an average consumption of 126.6 pounds of coal per barrel of finished cement, compared with the consumption in 1930 at 55 dry-process plants (where coal was reported as the only fuel used) of 4,273,538 short tons of coal in the manufacture of 68,712,446 barrels of finished cement, an average consumption of 124.4 pounds of coal per barrel of finished cement.

Sixty-four wet-process plants reported the use of coal alone as fuel in 1931, with a total consumption of 2,795,351 short tons in the manufacture of 44,361,233 barrels of finished cement, an average consumption of 126.0 pounds of coal per barrel of finished cement. In 1930, 65 wet-process plants reported the use of coal alone as fuel, with a total consumption of 3,640,014 short tons of coal in the manufacture of 55,012,869 barrels of finished cement, an average consumption of 132.3 pounds of coal per barrel of finished cement.

Eleven plants in four States reported the use of oil alone as fuel in 1931, with a total consumption of 1,431,330 barrels in the manufacture of 6,053,845 barrels of finished cement, an average of 0.2364 barrel (9.9 gallons) per barrel of finished cement; in other words, 1 barrel of oil burned 4.2 barrels of cement. The average consumption of oil by the dry-process plants was 0.2587 barrel (10.9 gallons) per barrel of finished cement and by the wet-process plants 0.2298 barrel (9.6

[3] The data on fuels in 1930 and 1931 include a few estimates. They also include fuel for 1 plant in 1930 and 2 plants in 1931 which manufactured from purchased clinker only.

gallons) per barrel of finished cement. The use of oil in 1931 was reported at 10 additional plants which also used other fuel; 1 of these plants was east and 9 were west of the Mississippi River. Eleven plants reported the use of oil alone as fuel in 1930, with a total consumption of 1,702,303 barrels in the manufacture of 6,769,668 barrels of finished cement, an average of 0.2515 barrel (10.6 gallons) per barrel of finished cement; in other words, 1 barrel of oil burned nearly 4 barrels of cement. The average consumption of oil by the dry-process plants was 0.2454 barrel (10.3 gallons) per barrel of finished cement and by the wet-process plants 0.2534 barrel (10.6 gallons) per barrel of finished cement. The use of oil in 1930 was reported at 12 additional plants which also used other fuel; 1 of these plants was east and 11 were west of the Mississippi River.

Eleven plants reported natural gas as the only fuel used in 1931 compared with 10 plants in 1930. The average consumption in 1931 was 1,657.9 cubic feet of gas per barrel of finished cement; the corresponding figure for 1930 is 1,916.8 cubic feet. The use of natural gas was reported by 20 additional plants which also used other fuel in 1931 and by 18 additional plants which also used other fuel in 1930.

The following table shows the quantities of natural gas used at portland-cement plants in the United States in 1930 and 1931. So far as permissible the statistics are arranged by States.

Since 1927, the first year for which figures on the quantity of fuels consumed in the manufacture of portland cement were collected by the Bureau of Mines, the use of natural gas in the industry has steadily increased; its growth has been reflected by declines in the use of coal and oil. During 1931 natural gas was used as fuel at 31 plants in 11 States compared with 28 plants in 10 States in 1930; 15 plants in 5 States reported the use of natural gas in 1927.

In addition to the above fuels 1 plant reported the use of manufactured gas in 1930 and 1931, and 3 plants reported the use of petroleum coke in 1931. These 4 plants also reported the use of coal, and 1 of them also reported the use of natural gas.

Natural gas used at portland-cement plants in the United States, 1930 and 1931, by States, in cubic feet

State	1930	1931
Kansas	9,649,071,000	5,680,644,094
Texas	11,161,486,787	8,349,796,000
Other States [1]	20,445,251,581	17,350,511,582
	41,255,809,368	31,380,951,676

[1] 1930: Alabama, Arkansas, California, Colorado, Missouri, Nebraska, Oklahoma, and South Dakota; 1931: Iowa in addition.

Portland cement burned, 1930 and 1931, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (cubic feet)
1930						
Coal [1]	120	[2] 123,725,315	76.7	7,913,552		
Oil	11	[2] 6,769,668	4.2		1,702,303	
Natural gas	10	[2] 7,510,630	4.7			14,396,715,102
Coal and oil	2	} 23,191,615	} 14.4	} 648,043	} 265,715	} 26,859,094,266
Coal and natural gas	8					
Oil and natural gas	5					
Coal, oil, and natural gas	5					
	161	161,197,228	100.0	[3] 8,561,595	1,968,018	41,255,809,368
1931						
Coal [4]	114	[2] 93,060,860	74.2	5,878,249		
Oil	11	[2] 6,053,845	4.8		1,431,330	
Natural gas	11	[2] 6,826,843	5.5			11,318,235,168
Coal and oil	2	} 19,487,523	} 15.5	} 501,191	} 585,399	} 20,062,716,508
Coal and natural gas [5]	12					
Oil and natural gas	5					
Coal, oil, and natural gas	3					
	158	125,429,071	100.0	[6] 6,379,440	2,016,729	31,380,951,676

[1] In addition to the coal shown for this group, 1 plant reported the use of petroleum coke with coal, and 1 plant reported the use of manufactured gas with coal.
[2] Average consumption of fuel per barrel of cement produced was as follows: 1930—coal, 127.9 pounds; oil, 0.2515 barrel; natural gas, 1,916.8 cubic feet. 1931—coal, 126.3 pounds; oil, 0.2364 barrel; natural gas, 1,657.9 cubic feet.
[3] Includes 173,005 short tons of anthracite, 8,374,216 short tons of bituminous coal, and 14,374 short tons of lignite.
[4] In addition to the coal shown for this group, 2 plants reported the use of petroleum coke with coal, and 1 plant reported the use of manufactured gas with coal.
[5] In addition to the coal and natural gas included for this group, 1 plant reported the use of petroleum coke with coal and natural gas.
[6] Includes 146,375 short tons of anthracite and 6,233,065 short tons of bituminous coal.

The following table shows the total fuels used and the finished cement produced by the wet and dry processes in 1930 and 1931.

Portland cement burned and fuels used, 1930 and 1931, by processes

Process	Finished cement produced			Fuel consumed		
	Number of plants [1]	Barrels	Percent of total	Coal (short tons)	Oil (barrels)	Natural gas (cubic feet)
1930						
Wet	89½	73,554,129	45.6	[2] 3,757,680	1,339,940	25,118,630,719
Dry	71½	87,643,099	54.4	4,803,915	628,078	16,137,178,649
	161	161,197,228	100.0	[3] 8,561,595	1,968,018	41,255,809,368
1931						
Wet	89½	62,127,750	49.5	[4] 2,943,957	1,292,866	18,368,076,309
Dry	68½	63,301,321	50.5	3,435,483	723,863	13,012,875,367
	158	125,429,071	100.0	[5] 6,379,440	2,016,729	31,380,951,676

[1] A wet mill and a dry mill in 1 plant are each counted as half a plant.
[2] In addition to the coal shown for this group 1 plant reported the use of petroleum coke with coal, and 1 plant reported the use of manufactured gas with coal.
[3] Includes 173,005 short tons of anthracite, 8,374,216 short tons of bituminous coal, and 14,374 short tons of lignite.
[4] In addition to the coal shown for this group 1 plant reported the use of manufactured gas with coal, 2 plants reported the use of petroleum coke with coal, and 1 plant reported the use of petroleum coke with coal and natural gas.
[5] Includes 146,375 short tons of anthracite and 6,233,065 short tons of bituminous coal.

Estimated clinker (unground cement) produced and in stock at mills in the United States, 1930 and 1931, by processes, in barrels

Process	Number of plants [1]		Production		Stock (Dec. 31)	
	1930	1931	1930	1931	1930	1931
Wet	89½	88½	73,715,000	59,885,000	[2] 4,458,000	[3] 3,458,000
Dry	70½	67½	87,277,000	61,929,000	[4] 4,351,000	[5] 3,577,000
	160	156	160,992,000	121,814,000	[6] 8,809,000	[7] 7,035,000

[1] A wet mill and a dry mill in 1 plant are each counted as half a plant.
[2] Includes some stock at 1 plant which reported no manufacture of clinker in 1930.
[3] Includes some stock at 2 plants which reported no manufacture of clinker in 1931.
[4] Includes some stock at 2 plants which reported no manufacture of clinker in 1930.
[5] Includes some stock at 1 plant which reported no manufacture of clinker in 1931.
[6] Includes some stock at 3 plants which reported no manufacture of clinker in 1930.
[7] Includes some stock at 3 plants which reported no manufacture of clinker in 1931.

CAPACITY

The capacity at the end of 1931 for producing finished portland cement of the 160 shipping plants in 1931 and 5 plants inactive in 1931 but producing within the four previous years, according to manufacturers' reports supplemented by a few estimates, was 271,850,000 barrels per year. This total includes increased capacity due to extensions and improvements at old plants. No new plants were reported in 1931. The total production for 1931 was 46.1 percent of the indicated capacity, based on producers' reports, at the close of the year; the corresponding figure for 1930 was 59.7 percent.

Portland-cement-manufacturing capacity of the United States, 1930 and 1931, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1930	1931	1930	1931
Eastern Pennsylvania, New Jersey, and Maryland	56,019,000	56,380,000	62.7	50.8
New York and Maine	19,009,000	19,009,000	59.7	54.2
Ohio, western Pennsylvania, and West Virginia	28,652,000	28,863,000	61.5	40.1
Michigan	19,241,000	19,235,000	59.8	31.9
Wisconsin, Illinois, Indiana, and Kentucky	31,393,000	31,393,000	64.4	48.3
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	26,491,000	27,021,000	48.6	45.5
Eastern Missouri, Iowa, Minnesota, and South Dakota	24,242,000	24,242,000	68.9	53.5
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	17,883,000	18,330,000	70.0	50.1
Texas	10,359,000	10,579,000	65.5	58.5
Colorado, Montana, Utah, Wyoming, and Idaho	6,769,000	6,812,000	33.5	32.5
California	22,405,000	22,405,000	45.2	34.5
Oregon and Washington	7,581,000	7,581,000	54.0	39.7
	270,044,000	271,850,000	59.7	46.1

The following estimates of the relation between the production of finished portland cement and the manufacturing capacity of the industry for each month in 1931 and for the 12 months ended with each month, based on the monthly reports of the producers, indicate the seasonal changes in the utilization of capacity. These estimates include increases in production and capacity due to improvements at old plants.

Ratio (percent) of finished portland cement produced to manufacturing capacity, 1930 and 1931

	Monthly		12 months ended—			Monthly		12 months ended—	
	1930	1931	1930	1931		1930	1931	1930	1931
January	38.8	29.5	65.5	60.6	July	77.8	62.0	66.1	53.8
February	41.5	29.4	65.6	59.7	August	81.0	60.2	65.6	52.0
March	51.5	36.9	66.1	58.6	September	75.7	55.3	65.2	50.2
April	64.0	52.1	66.0	57.7	October	65.4	47.4	64.2	48.6
May	78.9	62.8	66.2	56.5	November	51.7	37.2	62.6	44.4
June	81.4	65.4	66.4	55.2	December	38.2	26.4	61.5	46.5

The following table gives statistics of capacity by the two general methods—the "wet" and the "dry"—used in the manufacture of portland cement at plants in the United States. The figures given are based on the estimated capacity of the wet and dry process plants for the manufacture of finished cement. The figures show that in 1931 the wet-process plants, representing 46.8 percent of the total manufacturing capacity of the United States, in turning out 49.5 percent of the finished cement produced in 1931, utilized 48.8 percent of the wet-process capacity. The dry-process plants, accredited with 53.2 percent of the total manufacturing capacity of the United States, in turning out 50.5 percent of the finished cement produced in 1931, utilized 43.8 percent of the dry-process capacity. Statistics of production of both clinker and finished cement, by processes, appear on pages 541 and 542.

Portland-cement-manufacturing capacity of the United States, 1930 and 1931, by processes

Process	Estimated capacity				Percent of capacity utilized		Percent of total finished cement produced	
	Barrels		Percent of total					
	1930	1931	1930	1931	1930	1931	1930	1931
Wet	121,354,000	127,270,000	44.9	46.8	60.6	48.8	45.6	49.5
Dry	148,690,000	144,580,000	55.1	53.2	58.9	43.8	54.4	50.5
	270,044,000	271,850,000	100.0	100.0	59.7	46.1	100.0	100.0

SPECIAL CEMENTS

A number of types of cement are being manufactured and put on the market in the United States in addition to the standard or "ordinary" portland cement. These have been developed in response to a demand for cement of certain pronounced qualities or characteristics, such as greater plasticity and high early strength. Such special cements as the white portland cement and plastic portland cement have long been produced and marketed in the United States and have been included in the statistics in Mineral Resources. The Bureau of Mines is not at liberty to publish figures of white portland cement separately. Alumina cement, a hydraulic cement noted especially for its attainment of high strength at early periods, has been manufactured in the United States for some years.

The producers have for some time reported "mixed" and "improved" cements, among the natural cements that are noted for their plasticity and are much used in masonry.

Figures on special cements in the United States in 1931 as reported by producers to the Bureau of Mines show the following:

High-early-strength portland cement produced in the United States in 1931, as reported by producers, amounted to 1,366,468 barrels and shipments from the mills to 1,422,633 barrels, valued at $2,278,236, an average value per barrel of $1.60. These statistics include the output of 16 plants located in 10 States; they may not represent complete data, as reports may be lacking from one or two plants manufacturing this type of cement.

Masonry cement of the portland-cement class reported by producers in 1931 amounted to 677,451 barrels and shipments from the mills to 632,173 barrels, valued at $1,041,486, an average value per barrel of $1.65. These statistics represent the output of 24 plants located in 12 States.

Miscellaneous special cements (including so-called "oil-well", "high-silica", and "stainless" portland cements and cement manufactured under the trade name "Super") produced in 1931 amounted to 429,822 barrels and shipments to 404,161 barrels, valued at $674,399, an average per barrel of $1.67.

Data on production and value of special cements in 1929 and 1930, classified on a slightly different basis, will be found in Mineral Resources of the United States, 1930, Part II, page 425.

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

The term "masonry cement" is used here to designate certain cements made, like natural cements, by grinding calcined calcareous rock and used largely in mortar for laying brick and stone, although other hydraulic cements are also suitable for masonry and are being manufactured in increasing quantities for this purpose.

Natural cement, including masonry cement of the natural-cement class, was produced at 9 plants, and shipments were made from 10 plants in 1931 situated as follows: Utica, Ill.; Speed, Ind.; Fort Scott, Kans.; Kosmosdale, Ky.; Austin and Mankato, Minn.; Brixment and Rosendale, N.Y.; Lisbon, Ohio; and Siegfried, Pa.

Two manufacturers (with 1 plant each, located, respectively, at Birmingham and at Graystone, Ala.) report an output of puzzolan or slag-lime cement, and in order that this output may be included in the cement totals for the United States without disclosure it is included with the statistics of natural cement.

The following table, which gives figures on the output of natural, masonry (natural), and puzzolan cements from 1927 to 1931, shows a production in 1931 of 1,241,803 barrels, a decrease of nearly 31 percent compared with 1930. Shipments of these cements from mills in 1931 decreased more than 31 percent in quantity and more than 34 percent in gross value compared with 1930. Stocks at the mills were 7.4 percent higher at the end of 1931 than at the end of 1930. The average factory value per barrel of the cement shipped from the mills in 1931 was $1.32 compared with $1.38 in 1930. These cements, like portland cement, are packed four sacks to the barrel; each sack holds about 1 cubic foot. The lower specific gravity of the nonportland cements accounts for their lighter weight per barrel; the barrels ordinarily range in weight from 240 to 320 pounds. For statistical purposes, the output has been expressed in terms of 376-pound barrels to correspond with the figures for portland cement.

Producers reported that 16,598 short tons of coal and 4,240 short tons of coke were consumed in 1931 in the manufacture of these cements; they also reported the use of small quantities of oil and gas having a total fuel value equivalent to approximately 112 short tons of coal. The fuel consumption in 1930 amounted to 32,121 short tons of coal; in addition, small quantities of oil and gas having a total fuel value equivalent to approximately 505 short tons of coal were reported as consumed.

At natural-cement plants in the United States where coal was reported as the only fuel used the average consumption in 1931 was 40 pounds of coal per barrel (376 pounds) of cement compared with an average consumption in 1930 of 45 pounds of coal per barrel of cement.

Natural, masonry (natural), and puzzolan cements produced, shipped, and in stock at mills in the United States, 1927–31

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels of 376 pounds	Barrels of 376 pounds	Value	Barrels of 376 pounds
1927	11	2,123,868	2,158,323	$2,881,029	143,854
1928	11	2,210,404	2,213,645	2,910,097	137,357
1929	11	2,209,465	2,159,130	2,950,717	194,207
1930	11	1,792,083	1,787,016	2,469,531	[1] 202,416
1931	12	1,241,803	1,226,850	1,619,920	217,369

[1] Revised figures.

FOREIGN TRADE IN CEMENT[4]

IMPORTS

The quantities given in the following tables include imports of hydraulic cement of all kinds.

Imports of hydraulic cement into the United States in 1931—457,238 barrels—decreased 53.1 percent from 1930 compared with 43.5 percent in 1930 from 1929. The decrease in imports by countries in 1931 was almost general. Cuba and Yugoslavia, however, from which no imports were recorded in 1930, and Japan, with an increase in imports amounting to nearly 25 percent, made appreciable additions to the total imports in 1931. Denmark, the United Kingdom, and Belgium were the leading sources of the imports in 1931. The imports, by countries, were approximately as follows: From Denmark, 185,000 barrels (more than 40 percent of the total imports); United Kingdom, 109,000 barrels; Belgium 99,000 barrels; and other countries, 64,000 barrels. There were only two districts, New York and Puerto Rico, into which more than 100,000 barrels were imported. The total

[4] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

quantity imported into these two districts and into the Massachusetts district was more than 87 percent of the total imports into the United States in 1931. The average of the values assigned to the imports, which are supposed to represent the values in the foreign countries from which the material is exported, including the cost of the containers or coverings, was $1.11 per barrel, a decrease of 5 cents compared with 1930.

The tariff act of 1922 contained the following paragraph on the importation of hydraulic cement:

Par. 1543. Cement: Roman, portland, and other hydraulic: *Provided*, That if any country, dependency, province, or other subdivision of government imposes a duty on such cement imported from the United States, an equal duty shall be imposed upon such cement coming into the United States from such country, dependency, province, or other subdivision of government.

The tariff act of 1930, which went into effect June 18, 1930, displacing the tariff act of 1922, contained the following paragraph on the importation of hydraulic cement:

Par. 205. Roman, portland, and other hydraulic cement or cement clinker, 6 cents per 100 pounds, including the weight of the container; white nonstaining portland cement, 8 cents per 100 pounds, including the weight of the container.

Roman, portland, and other hydraulic cements imported into the United States, 1930 and 1931, by countries

[General imports]

Country	1930		1931	
	Barrels	Value	Barrels	Value
Belgium	446, 736	$472, 045	99, 202	$114, 256
Canada	11, 936	18, 002	1, 378	2, 239
Cuba			6, 750	10, 138
Denmark	283, 457	351, 854	184, 967	195, 587
France	9, 537	19, 711	649	1, 485
French Indo-China			1	5
Germany	11, 235	24, 706	4, 978	9, 231
Italy	10	22		
Japan	11, 344	13, 761	39, 665	41, 559
Norway	25	39		
United Kingdom	201, 266	235, 673	109, 383	121, 675
Yugoslavia			10, 265	11, 743
	975, 546	1, 135, 813	457, 238	507, 91

Roman, portland, and other hydraulic cements imported into the United States, 1930 and 1931, by districts

[General imports]

District	1930		1931	
	Barrels	Value	Barrels	Value
Florida	3, 450	$3, 828	1, 213	$1, 853
Hawaii	11, 344	13, 761	39, 665	41, 559
Los Angeles	155, 234	120, 153	4, 983	9, 249
Maine and New Hampshire	2, 190	5, 820	336	1, 027
Maryland	180	213	4, 000	6, 000
Massachusetts	216, 490	274, 235	51, 842	58, 697
Michigan			8	24
New Orleans	4, 700	5, 620		
New York	202, 897	232, 999	200, 038	221, 595
Oregon	3, 000	3, 588		
Philadelphia	155, 047	178, 401	8, 797	10, 478
Puerto Rico	214, 549	290, 344	146, 333	157, 378
San Antonio	6, 300	6, 429		
San Francisco	127	326		
Vermont	38	96	23	58
	975, 546	1, 135, 813	457, 238	507,918

Roman, portland, and other hydraulic cements imported into the United States in 1931, by countries and districts

[General imports]

Country and district	Barrels	Value	Country and district	Barrels	Value
Belgium:			France: New York	649	$1,485
Florida	604	$990	French Indo-China: Los Angeles	1	5
Massachusetts	51,842	58,697	Germany: Los Angeles	4,978	9,231
New York	27,909	29,412	Japan: Hawaii	39,665	41,559
Puerto Rico	18,847	25,157	United Kingdom:		
	99,202	114,256	Florida	609	863
Canada:			New York	108,774	120,812
Maine and New Hampshire	336	1,027		109,383	121,675
Michigan	8	24	Yugoslavia:		
Puerto Rico	1,011	1,130	Los Angeles	4	13
Vermont	23	58	New York	1,464	1,252
	1,378	2,239	Philadelphia	8,797	10,478
Cuba:				10,265	11,743
Maryland	4,000	6,000		457,238	507,918
Puerto Rico	2,750	4,138			
	6,750	10,138			
Denmark:					
New York	61,242	68,634			
Puerto Rico	123,725	126,953			
	184,967	195,587			

In addition to the imports shown in the preceding tables, "white nonstaining portland cement" was recorded as "imported for consumption," as follows: 1930, 9,261 barrels, valued at $18,749, of which, beginning June 18, 1930, 5,321 barrels, valued at $11,103, were imported from France; 1931, 12,360 barrels, valued at $27,855, of which 12,320 barrels, valued at $27,786, were imported from France. The source of the 1930 imports, by countries, prior to June 18, 1930, is not recorded; the figures are included in those shown in the following table:

Hydraulic cement imported for consumption in the United States, 1927–31

Year	Barrels	Value	Year	Barrels	Value
1927	2,065,730	$3,007,103	1930	984,807	$1,154,562
1928	2,302,475	3,135,558	1931	469,598	535,773
1929	1,745,345	1,983,974			

EXPORTS

In 1931 the hydraulic cement exported to foreign countries and to the Philippine Islands and the Virgin Islands of the United States (most of it portland cement) decreased 43.2 percent in quantity and more than 50 percent in value compared with 1930. The quantity exported in 1931 was 0.3 percent of the total shipments of hydraulic cement from mills during the year and was the smallest since 1906.

The value of exports of domestic cement is the actual cost at the time of exportation in the ports of the United States whence they are exported, as declared by the shipper on the export declarations. The average value at the ports in 1931 was $2.84 a barrel compared with $3.25 in 1930.

The destinations of exports were approximately as follows: South America, 178,000 barrels; Central America, 88,000 barrels; Mexico, 39,000 barrels; Cuba, 36,000 barrels; other West Indies and Bermudas, 32,000 barrels; Canada, 28,000 barrels; and other countries, 29,000 barrels. The decrease in exports to these groups in 1931 compared with 1930 was general; the largest decrease recorded—over 69 percent—was in exports to Mexico, where additional capacity for the manufacture of cement was put into operation in 1931.

Although the United States is the major cement-producing country of the world, its export trade has never attained large proportions; since 1925 it has been under 1,000,000 barrels.

Hydraulic cement exported from the United States, 1930 and 1931, by countries

Country	1930		1931	
	Barrels	Value	Barrels	Value
North America:				
Canada	51,367	$204,913	27,512	$103,942
Central America:				
British Honduras	51	144	37	145
Costa Rica	491	2,128	395	2,487
Guatemala	1,890	7,155	1,697	6,043
Honduras	47,673	107,935	17,720	40,172
Nicaragua	2,941	9,795	1,440	4,875
Panama	122,796	305,449	66,591	133,178
Salvador	555	3,409	480	2,921
Mexico	126,803	370,612	39,191	128,170
Newfoundland and Labrador	770	2,371	21	163
West Indies:				
British:				
Barbados	12	78	28	182
Bermudas	6,988	17,174	7,996	14,061
Jamaica	384	2,711		
Trinidad and Tobago	5	32	5	32
Other British	16,826	35,915	4,623	8,786
Cuba	66,258	168,345	35,800	83,683
Dominican Republic	1,663	4,350	4,921	8,511
French	476	1,291	788	1,986
Haiti	8,477	14,633	5,171	8,233
Netherland	18,087	39,599	7,520	12,014
Virgin Islands of the United States	99	281	568	1,630
	474,612	1,298,320	222,504	561,214
South America:				
Argentina	55,620	296,231	36,886	180,574
Bolivia	4,083	11,024	7,160	16,843
Brazil	16,302	85,566	7,592	40,032
Chile	7,806	45,611	1,649	9,630
Colombia	33,692	72,674	44,160	71,173
Ecuador	1,080	5,224	712	4,122
Guiana:				
French	495	1,238	330	769
Surinam	54	338		
Peru	2,807	15,026	1,599	6,408
Uruguay	16,588	87,802	8,942	45,094
Venezuela	95,066	256,700	69,409	122,883
	233,593	877,434	178,439	497,528
Europe:				
Azores and Madeira Islands	12	84	40	260
Belgium	518	2,893	920	4,708
Denmark	40	263	25	165
France	2	12		
Germany	2,189	11,724	1,244	6,893
Greece	997	5,615	287	1,832
Irish Free State	299	1,721	139	847
Italy	47	167	5	25
Netherlands	606	3,602	358	2,061
Norway	680	4,175	390	2,467
Portugal	110	666		
Soviet Russia	83	1,109	38	273
Spain	10	75	10	64
Sweden	33	195		
United Kingdom	25,180	143,474	15,449	84,047
	30,806	175,775	18,905	103,642

Hydraulic cement exported from the United States, 1930 and 1931, by countries—Con.

Country	1930		1931	
	Barrels	Value	Barrels	Value
Asia:				
Arabia	300	$882	255	$1,237
China	980	6,063	600	3,649
East Indies:				
British:				
Ceylon	90	614		
India	2,910	17,450	3,372	20,915
Malaya	1,039	6,170	1,458	8,499
Netherland:				
Java and Madura	654	3,809	565	3,235
Other Netherland	686	4,909	95	577
Hong Kong	650	3,993	125	759
Japan	1,610	11,929	637	4,516
Palestine	1,502	9,069	1,534	9,105
Persia	13	56		
Philippine Islands	381	2,502	91	688
Soviet Russia	2	12		
Syria	259	1,553		
Other Asia			315	1,083
	11,076	69,011	9,047	54,263
Africa:				
British:				
Union of South	463	2,955	33	210
Other British South	16	78		
Portuguese:				
Mozambique	307	1,101	375	2,245
Other Portuguese	105	350		
	891	4,484	408	2,455
Oceania:				
British:				
Australia	2,183	13,580		
New Zealand	2,537	15,542	217	1,047
Other British	80	369	132	448
French			1	3
	4,800	29,491	350	1,498
	755,778	2,454,515	429,653	1,220,600

Domestic hydraulic cement shipped to Alaska, Hawaii, and Puerto Rico, 1930 and 1931

	1930		1931	
	Barrels	Value	Barrels	Value
Alaska	23,957	$63,970	14,270	$29,699
Hawaii	266,990	679,756	270,373	671,858
Puerto Rico	54,193	100,547	68,064	94,733
	345,140	844,273	352,707	796,290

Hydraulic cement exported from the United States, 1927–31

Year	Barrels	Value	Percent of total shipments from mills	Year	Barrels	Value	Percent of total shipments from mills
1927	816,726	$2,796,717	0.5	1930	755,778	$2,454,515	0.5
1928	824,656	2,938,702	.5	1931	429,653	1,220,600	.3
1929	885,321	3,083,217	.5				

WORLD PRODUCTION

The accompanying table, copied from the Statistical Year-Book of the League of Nations 1931–32,[5] gives data on the cement output of the world from 1926 to 1930. The figures are in thousands of metric tons (1 metric ton equals 2,204.6 pounds). The following is stated in the preface to the year book from which the data are copied:

Throughout this volume the sign "—" indicates that the figure is nil or negligible, ". . ." indicates that the figures are not yet published, and "." that information is not available or is nonexistent. Decimal figures are preceded in the tables by a full stop and not a comma.

Cement production in thousands of metric tons

Country	1926	1927	1928	1929	1930
Africa [1] [2]	.	206	230	360	. . .
Algeria	61	46	52	58	. . .
Belgian Congo	19	32	41	60	64
Egypt [1]	.	85	90	180	300
Morocco (French)	39	43	. . .	. . .	. . .
North America	29,802	31,501	32,195	31,431	29,550
Canada	1,382	1,598	1,750	1,950	1,752
United States	28,420	29,903	30,445	29,481	27,798
Carribbean (Mexico)	165	153	216	225	. . .
South America [1] [2]	.	413	560	· 730	780
Argentina	169	201	233	350	384
Brazil	17	68	170	. . .	. . .
Chile	.	96	111	145	161
Peru	49	48	. . .	. . .	. . .
Asia (excluding U.S.S.R.) [1]	4,700	5,000	5,200	[1] 5,700	. . .
India	382	485	568	570	573
Indo-China [3]	139	149	159	184	. . .
Japan	3,032	3,267	3,293	[1] 3,700	. . .
South Manchuria	668	635	[1] 643	[1] 687	. . .
Philippines	60	66	65	. . .	. . .
Turkey [1]	.	.	59	65	57
Other countries [1]	400	400	. . .	. . .	. . .
U.S.S.R.[4]	1,293	1,599	1,902	2,290	3,081
Europe (excluding U.S.S.R.) [1] [5]	25,200	28,100	30,900	33,300	31,600
Germany [6]	5,950	7,342	7,576	7,039	5,511
Austria	464	523	582	. . .	. . .
Belgium-Luxemburg [7]	2,460	2,630	3,046	3,248	3,050
Bulgaria	88	112	108	151	174
Denmark	569	643	779	799	799
Spain	1,183	1,453	1,542	1,820	1,839
Estonia	80	52	64	62	47
Finland	174	232	280	278	203
France	3,960	3,590	4,240	5,787	. . .
Greece	86	105	145	155	180
Hungary	323	417	426	403	329
Italy	2,833	2,787	3,077	3,497	3,482
Latvia	23	18	25	40	. . .
Norway	.	(269)	(318)	(319)	. . .
Poland	1,176	1,634	2,159	2,055	[1] 1,700
Portugal	.	.	62	74	82
Roumania	288	321	332	317	. . .
United Kingdom	3,841	4,399	4,400	4,766	5,111
Saar	—	57	137	167	161
Sweden	471	496	468	570	611
Switzerland	540	540	630	690	790
Czechoslovakia	(680)	(727)	(809)	. . .	. . .
Yugoslavia	646	713	808	. . .	. . .
Oceania [1] [8]	750	850	970	920	900
Australia	615	648	766	720	708
Total [5]	62,400	67,800	72,200	[1] 74,900	[1] 72,300

[1] Estimated.
[2] Africa, South America: According to the U.S. Department of Commerce, the estimated total production in 1927 for Africa was 450,000 tons and for South America 570,000 tons.
[3] Principal artificial cement works.
[4] 12 months ended September 30.
[5] Excluding Norway and Czechoslovakia.
[6] Works affiliated with the German Cement Association. The number of works not affiliated has considerably increased since 1929.
[7] Artificial cement. The production of natural cement in 1929 is estimated at 150,000 tons and that of slag cement at 266,000 tons.
[8] Includes a rough estimate for New Zealand.

SOURCES: National Official Statistics. U.S. Department of Commerce, Commerce Reports.
NOTE.—The table covers as far as possible the total of natural cements and artificial cements, portland or other. The sources omit, in many cases, to specify the kind of cement.

[5] Statistical Year-Book of the League of Nations 1931-32: Geneva, 1932, p. 128.

CEMENT PRODUCTION IN CANADA

According to the Dominion Bureau of Statistics the total mill output of portland cement in Canada in 1931 was 10,197,964 barrels. The shipments amounted to 10,161,658 barrels valued at $15,826,243 compared with 11,032,538 barrels valued at $17,713,067 in 1930, a decrease of 7.9 percent in quantity and of 10.7 percent in value. The average selling price over the whole Dominion, computed from the total quantity sold and the total value as given, was $1.56 per barrel in 1931 and $1.61 per barrel in 1930. The selling price in 1931, f.o.b. Canadian works, ranged from a low of $1.28 per barrel to a high of $2.60 per barrel.

The apparent consumption of cement in Canada in 1931 decreased 8.1 percent compared with 1930. Imports of portland cement in 1931 amounted to 38,392 barrels having an average value of $3.74 per barrel compared with an average of $3.97 per barrel in 1930. Exports of portland cement amounted to 114,064 barrels, valued at $124,267.

Summary statistics of the cement industry in Canada, 1930 and 1931 [1]

	1930		1931	
	Barrels	Value	Barrels	Value
Output	11,790,408		10,197,964	
Sold or used	11,032,538	$17,713,067	10,161,658	$15,826,243
Stocks, Dec. 31	2,246,621		2,259,298	
Imports:				
Portland	143,436	569,848	38,392	143,491
Manufactures		34,672		13,243
Exports	198,736	212,071	114,064	124,267
Apparent consumption	10,977,238		10,085,986	

[1] Dominion Bureau of Statistics.

Cement is produced in the Provinces of Quebec, Ontario, Manitoba, Alberta, and British Columbia. Twelve plants were represented in the output in 1931 and 11 plants in 1930. In 1931 mills in Quebec produced 49 percent of the total Canadian shipments; in Ontario, 34 percent; in Manitoba, 5 percent; in Alberta, 6 percent; and in British Columbia, 6 percent.

The Canadian cement plants in 1931 used 43 rotary kilns and 1 of the vertical type; these had a total daily capacity of 42,422 barrels. The industry consumed 2,489,147 tons of limestone and 56,677 tons of gypsum. Plants east of the Great Lakes used gypsum quarried either in Ontario or the Maritime Provinces, while western plants employed gypsum produced in Manitoba or British Columbia. One plant utilized shale from Jasper, Alberta. Both wet and dry processes were employed during the year, the latter predominating.

In 1931 the Canadian cement industry consumed for all purposes 288,851 short tons of Canadian bituminous coal, valued at $1,569,214, and 194,067 short tons of imported bituminous coal, valued at $958,076. The industry also used 1,096 tons of anthracite appraised at $4,000; 21,234 gallons of gasoline valued at $4,938; and 14,176 gallons of fuel and Diesel oil worth $1,843. Purchased electricity totaled 152,884,534 kilowatt-hours, valued at $741,790; in addition, 8,782,108 kilowatt-hours were generated for use by the industry.

Purchased power was used to operate 1,190 electric motors with a total rating of 70,472 horsepower; 72 electric motors with a rating of 2,954 horsepower were operated by power generated in the plants.

The Mines Branch of the Canada Department of Mines in an article on the cement industry in Canada states [6] the following:

The chief product is portland cement for the production of which there are 12 operating plants having an aggregate rated capacity of about 14,000,000 barrels. * * * In addition to the plants manufacturing portland cement, there is one plant in Nova Scotia capable of making cement from blast-furnace slag and one in Manitoba making puzzolan or natural rock cement.

The Canada Cement Co. took over, during 1929, the plant of National Cement Co. located in Montreal East so that now the Canada Cement Co. have a virtual monopoly of the cement production in Quebec and Ontario.

The production of cement in 1931 was about 73 percent of the total rated capacity (approximately 14,000,000 barrels) of the milling plants, as against 79 percent in 1930 and 82 percent in 1929, this latter the highest ever reported.

The average selling price per barrel, by Provinces, in 1931, computed from the quantity sold and the value as given follows: Quebec, \$1.44; Ontario, \$1.44; Manitoba, \$2.33; Alberta, \$2.05; and British Columbia, \$2.03.

The following table shows sales from mills in 1930 and 1931, by Provinces:

Cement sold by Canadian mills, 1930 and 1931, by Provinces [1]

Province	1930		1931	
	Barrels	Value	Barrels	Value
Quebec	4,865,609	\$7,031,528	4,942,323	\$7,092,895
Ontario	3,942,690	5,779,404	3,470,056	5,006,826
Manitoba	977,906	2,268,742	544,160	1,267,893
Alberta	525,289	1,144,160	626,483	1,286,080
British Columbia	721,044	1,489,233	578,636	1,172,549
Canada	11,032,538	17,713,067	10,161,658	15,826,243

[1] Dominion Bureau of Statistics.

[6] The Canadian Mineral Industry in 1931: Ottawa, 1932, p. 43.

CRUDE PETROLEUM AND PETROLEUM PRODUCTS[1]

By G. R. Hopkins and A. B. Coons[2]

CONTENTS

ILLUSTRATIONS

[1] Work on manuscript completed January 1933.

[2] Unless otherwise indicated, the tables of this report have been prepared by A. H. Redfield, A. T. Coumbe, Jr., E. W. Cochrane, M. N. Schellenger, A. L. Clapp, C. S. Evans, and E. M. Seeley of the Bureau of Mines. Current figures of imports, exports, and shipments were obtained by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce. The data for California were compiled at the San Francisco office of the Bureau of Mines by E. T. Knudsen.

GENERAL REVIEW

The improved statistical position of the oil industry was evidenced during 1931 chiefly by a further decline in crude production, material withdrawals from crude-oil storage, and an unexpected increase in the domestic demand for motor fuel. The financial condition of the oil industry was closely related to a decline in the average value of crude petroleum from $1.19 per barrel in 1930 to $0.65 in 1931 and to equally severe decreases in the prices of refined products. The apparent lack of response of the industry to its improved statistical position was due to many causes, most of them closely related to the unrestricted drilling campaign the first half of the year in the East Texas field. Although this field was not discovered until October 1930 enough drilling was done before the end of the year to show that it was to be an area of major importance. Although the development of a new field was, in a way, encouraging, it depressed the industry at the beginning of 1931. To add to the general feeling of pessimism was the knowledge that, because of the comparatively easy drilling and the large number of small, irregular leases, development would be extremely rapid. This forecast proved correct; by August production reached about 1,000,000 barrels daily, and prices had fallen as low as a few cents a barrel. Conditions became so critical that the Governor of Texas ordered the field closed on August 17. It was reopened September 5 under restrictions that kept the output within reasonable bounds. The effects of this shut-down were far-reaching, and prices for virtually all grades of crude oil east of California improved materially. Although the East Texas field naturally occupied the spotlight in 1931, considerable interest was displayed in the attempts of the Governor of Oklahoma to raise the price of crude oil to $1 a barrel by closing in all but the stripper wells. This move achieved partial success before it was abandoned on October 10.

Because of low prices drilling in the settled fields was at a very low ebb, and only 6,788 oil wells were completed in the United States compared with 11,640 in 1930. (See fig. 37.) Of the successful completions in 1931, 3,280 (48 percent) were in the East Texas field proper. The decline in field activity in 1931 was further indicated by a survey of the number of producing oil wells as of December 31, 1931, which showed 315,850 producing wells on that date, indicating that about 22,000 wells had been abandoned or shut in during the year.

Only Texas and New Mexico gained in output during 1931. The former retained its rank as the leading producing State, and New Mexico advanced from ninth position to sixth.

The refiners resisted the temptation to operate at full capacity in 1931, even though crude prices were at unprecedented low levels. This self-imposed restriction did not result from proration nor was it inspired by altruism, but evidenced growing realization of the necessity for regulating refinery operations to conform with probable demands for refined products. Crude runs to stills in 1931 totaled 894,608,000 barrels, a decline of 32,839,000 barrels (4 percent) from 1930. This decrease in crude throughput was somewhat less than was generally recommended, but was sufficient to reduce total stocks of refined oils from 251,680,000 barrels on hand January 1, 1931, to 247,936,000 barrels at the close of the year. (See fig. 38.) The relative importance of natural gasoline in the refining industry declined materially in 1931; only 35,116,000 barrels of natural gasoline were utilized at refineries in 1931 compared with 43,170,000 barrels in 1930. The domestic demand for motor fuel, the barometer upon

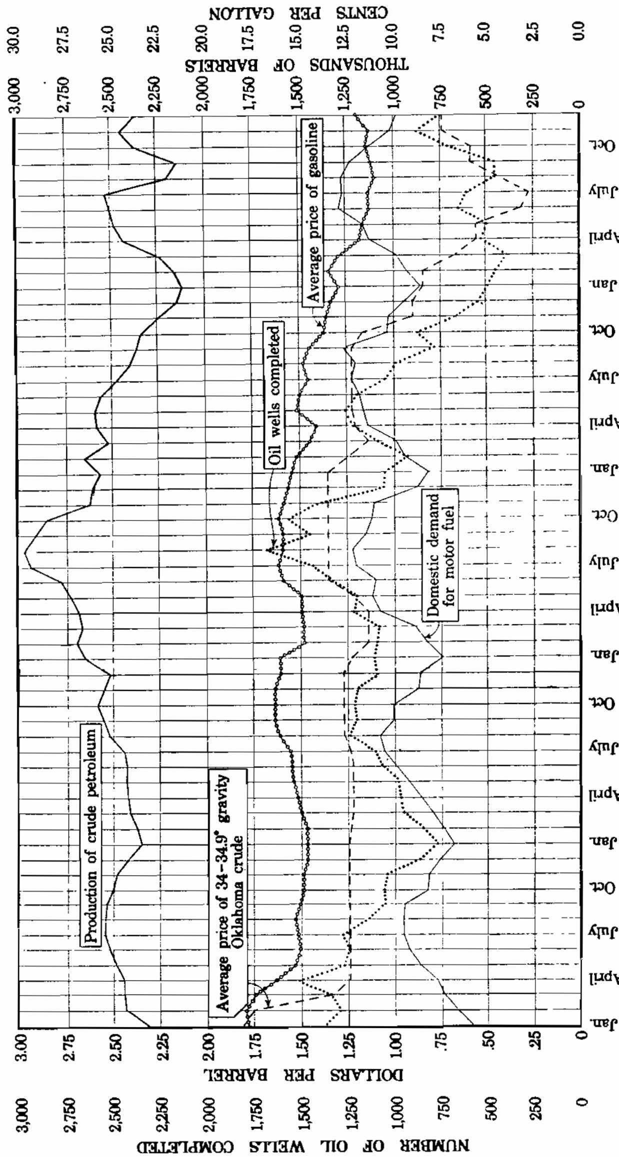

FIGURE 37.—Daily average production of crude petroleum, daily average domestic demand for motor fuel, total number of oil wells completed, average price of a selected grade of Oklahoma crude petroleum, and average tank-wagon price (excluding tax) of gasoline at 50 cities in the United States, 1927–31, by months.

which most refinery operations are based, exceeded expectations in 1931 and increased 2 percent over 1930. There was a small decrease in the number of motor vehicles registered, but this was more than offset by the increased utilization of vehicles kept in operation and by a material gain in the use of taxicabs, busses, and trucks, which have the highest average consumption per vehicle. On the other hand, exports of gasoline, which had increased annually through 1930, declined 19,859,000 barrels (30 percent) in 1931. This material

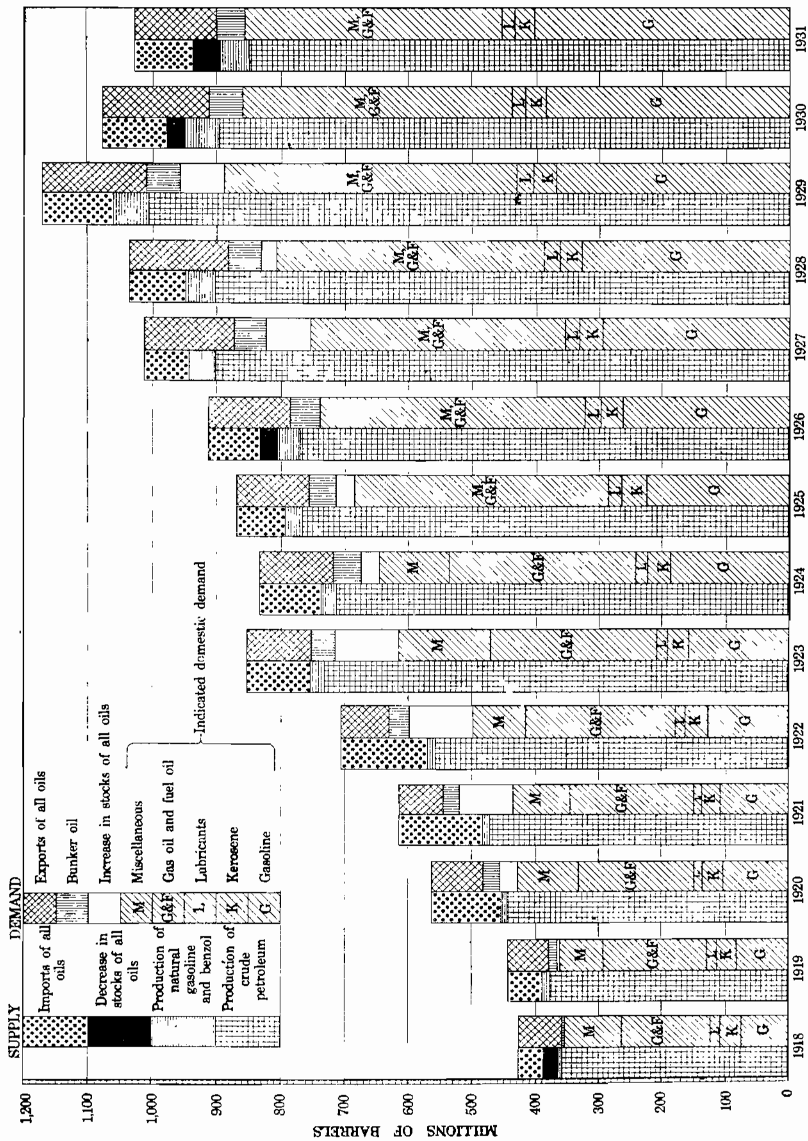

FIGURE 38.—Supply and demand of all oils, 1918–31.

decrease in exports more than offset the beneficial effects of the increased domestic demand and curtailed imports. Stocks of motor fuel increased slightly during the year; but the fluctuations in 1931 were much less than in 1930, forecasting abandonment of the practice of accumulating excessive stocks in the spring.

The statistics on the other so-called "major refined products"—kerosene, gas oil and fuel oil, and lubricants—were noticeably similar in 1931; all showed a decline in production, consumption, and stocks. The drop in production resulted primarily from the lower refinery yields, although the reduced throughput of crude also had a material effect; the decrease in consumption was due primarily to curtailed industrial activity, although the reduced consumption of lubricants indicated that motorists changed oil less frequently than in more prosperous years.

The severe decline in crude petroleum prices during 1931 was reflected in prices of refined products, particularly gasoline. The average refinery price per gallon for a representative grade of gasoline declined from 6.20 cents in 1930 to 3.54 cents in 1931, a decrease of about the same proportion as that recorded in the average value of crude oil. Considerable "distress" gasoline was sold for less than 2 cents per gallon in 1931, and the general market was so weakened that improvements in statistical position had practically no influence. The average service-station prices of gasoline, excluding the tax, have been calculated at about 16 cents per gallon in 1930 and 13 cents per gallon in 1931.

Potentials in the oil industry became relatively more important in 1931, as it became increasingly evident that shut-in production and idle refinery capacity influenced prices in the same manner as did actual stocks. The quantity of shut-in production in 1931 was much disputed, due principally to variation in the estimates for the East Texas field, but the total was undoubtedly several times the actual production throughout the year. The potential production of gasoline may be approximated from a study of refinery capacities. Such an analysis shows that, whereas the total capacity of the refineries and cracking plants increased in 1931, the gain was considerably below the average of the past decade, indicating a tendency to reduce the amount of idle equipment.

The changing aspects of engineering in the petroleum industry are discussed briefly in this report, as they are closely related to the economics of production and refining.

From 1924 to 1929 production engineers were concerned principally with increasing the volume and rate of output. The gas lift, operated so successfully at Seminole, was an outstanding device employed. The record-breaking output of crude petroleum in 1929 resulted from application of engineering principles to stimulate production. Meanwhile, the necessity for curtailing that output became increasingly apparent, and proration was devised as the most promising economic method of balancing supply and demand. The element of quantity was largely removed from the duties of engineers; their attention became directed toward producing the allowable output most efficiently and at lower cost. Most production engineers in the East Texas field in 1931 were concerned less with the maximum rate of production than with bottom-hole pressures, gas-oil ratios, water encroachment, and other factors that control waste and ultimate recovery in a prorated field. Unit operation, an essential part of most conservation programs, made only moderate progress in 1931, as the diversified ownership in the East Texas field was not conducive to application there. However, an enactment by Congress authorizing the Secretary of the Interior to enter into unit plans of development on public lands was a forward step.

The duties of the refinery engineers, like those of production engineers, have changed as attention has been diverted from quantity to quality and lower costs. Proration, so important to production engineers, has not yet been applied to refining, and the chief direct interest of refinery engineers in proration has been in its influence on the proportions of the various crude oils processed. The economic issue of chief interest to the refinery industry in 1931 was that of increasing the yield of gasoline enough to compensate for the loss due to reduced crude runs and decreased production of natural gasoline, as well as to the indeterminate decline in output that followed elimination of certain low antiknock fractions. To fulfill this program of producing better gasoline from less raw material refinery engineers perfected the cracking process. "Re-forming"—the cracking of naphthas to raise their octane rating—was used extensively in 1931 to aid in producing higher-quality gasoline. The increased use of crude oil as cracking stock reduced costs. Hydrogenation, another contribution of the refining industry to the conservation program, undoubtedly increased in importance in 1931 but remains a minor factor.

Second only to research on cracking in 1931 was that on lubricating oils. Here, yield had slight importance, as it has declined steadily in the last decade, and quality was the chief consideration. The quality of lubricating oils was improved in 1931 by developments in the process for manufacturing synthetic oils—oils changing but slightly in viscosity with temperature—and by further progress in the use of continuous pipe stills operating under vacuum. The development of vacuum units has economic importance because it has increased the number of crudes manufacturers of lubricating oils may use.

SUMMARY TABLES OF CRUDE PETROLEUM, REFINED PRODUCTS, AND NATURAL GASOLINE

Selected statistics of crude petroleum, refined products, and natural gasoline, 1920, 1925, and 1929–31

	1920	1925	1929	1930	1931
Crude petroleum:					
Domestic production ..... thousands of barrels [1]	442,929	763,743	1,007,323	898,011	851,081
World production ..... do.[1]	688,884	1,068,933	1,485,867	1,411,905	1,372,532
United States proportion of world production ..... percent	64	71	68	64	62
Imports ..... thousands of barrels [1]	106,175	61,824	78,933	62,129	47,250
Exports [2] ..... do.[1]	9,295	13,337	26,401	23,705	25,535
Stocks, end of period [3] ..... do.[1]	149,448	431,646	535,514	{ 408,809 / [4] 411,882 }	370,919
Runs to stills ..... do.[1]	433,915	739,920	987,708	927,447	894,608
Total value of domestic production at wells ..... thousands of dollars	1,360,745	1,284,960	1,280,417	1,070,200	550,630
Average price per barrel at wells	$3.07	$1.68	$1.27	$1.19	$0.65
Total producing oil wells in the United States, Dec. 31	[5] 258,600	306,100	328,200	331,070	315,850
Total oil wells completed in the United States during year	24,273	16,559	15,572	11,640	6,788
Refined products:					
Imports ..... thousands of barrels [1]	2,647	16,376	29,777	43,489	38,837
Exports [2] ..... do.[1]	70,281	100,497	136,719	132,794	98,859
Stocks, end of period [3] ..... do.[1]	60,397	120,492	151,692	{ 254,311 / [4] 251,680 }	247,936
Output of motor fuel ..... do.[1]	118,022	262,252	439,393	440,728	437,735
Yield of gasoline ..... percent	26.1	32.4	39.3	42.0	44.3
Completed refineries, end of year	415	510	412	435	473

See footnotes at end of table.

Selected statistics of crude petroleum, refined products, and natural gasoline, 1920, 1925, and 1929–31—Continued

	1920	1925	1929	1930	1931
Refined products—Continued					
Daily crude-oil capacity of refineries thousands of barrels [1]	1,889	2,853	3,766	3,943	4,012
Average tank-wagon price (excluding tax) of gasoline in 50 United States cities [5] cents per gallon	28.05	17.46	15.57	14.49	11.80
Natural gasoline:					
Production thousands of barrels [1]	9,161	26,307	52,271	52,631	43,617
Stocks, end of period do.[1]	([7])	[8] 326	2,291	2,377 [4] 3,100	2,818

[1] Of 42 U.S. gallons.
[2] Includes shipments to Alaska, Hawaii, and Puerto Rico.
[3] 1925 and 1929, California heavy crude and fuel oil included under crude petroleum; 1930 and 1931, California heavy crude and fuel oil included under refined products. Statistics of heavy crude and fuel oil in California not available before June 30, 1923.
[4] For comparison with 1931.
[5] Oct. 31.
[6] From American Petroleum Institute.
[7] Not available.
[8] At plants only—stocks of natural gasoline at refineries not segregated from refined products until Dec. 31, 1929.

Supply and demand of all oils, 1920, 1925, and 1929–31

[Thousands of barrels of 42 U.S. gallons]

	1920	1925	1929	1930	1931
New supply:					
Domestic production:					
Crude petroleum	442,929	763,743	1,007,323	898,011	851,081
Daily average	1,210	2,092	2,760	2,460	2,332
Natural gasoline	9,161	26,307	52,271	52,631	43,617
Benzol	1,771	1,857	3,055	2,689	1,826
Total production	453,861	791,907	1,062,649	953,331	896,524
Daily average	1,240	2,170	2,911	2,612	2,456
Imports:					
Crude petroleum	106,175	61,824	78,933	62,129	47,250
Refined products	2,647	16,376	29,777	43,489	38,837
Total new supply, all oils	562,683	870,107	1,171,359	1,058,949	982,611
Daily average	1,537	2,384	3,209	2,901	2,692
Increase in stocks, all oils	27,303	29,291	68,156	[1] 24,000	[1] 44,989
Demand:					
Total demand	535,380	840,816	1,103,203	1,082,949	1,027,600
Daily average	1,463	2,304	3,022	2,967	2,815
Exports: [2]					
Crude petroleum	9,295	13,337	26,401	23,705	25,535
Refined products	70,281	100,497	136,719	132,794	98,859
Domestic demand	455,804	726,982	940,083	926,450	903,206
Daily average	1,245	1,992	2,576	2,538	2,475
Excess of daily average domestic production over domestic demand	[3] 5	178	335	74	[3] 19
Stocks, end of period:					
Crude petroleum [4]	149,448	431,646	535,514	408,809 [5] 411,882	370,919
Natural gasoline	([6])	[7] 326	2,291	2,377 [5] 3,100	2,818
Refined products [4]	60,397	120,492	151,692	254,311 [5] 251,680	247,936
Grand total stocks, all oils	209,845	552,464	689,497	665,497 [5] 666,662	621,673
Days' supply [8]	143	240	228	224	221
Bunker oil (included in domestic demand)	26,335	42,827	52,278	50,773	43,714

[1] Decrease.
[2] Exports include benzol and shipments to Alaska, Hawaii, and Puerto Rico.
[3] Deficiency.
[4] 1925 and 1929, California heavy crude and fuel oil included under crude petroleum: 1930 and 1931, California heavy crude and fuel oil included under refined products. Statistics of heavy crude and fuel oil in California not available before June 30, 1923.
[5] For comparison with 1931.
[6] Figures not available.
[7] At plants only—stocks of natural gasoline at refineries not segregated from refined products until Dec. 31, 1929.
[8] Grand total stocks of all oils divided by daily average total demand.

Supply and demand of all oils in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
New supply:													
Domestic production:													
Crude petroleum	65,737	60,540	69,429	72,860	76,822	75,011	78,210	68,014	64,378	73,297	73,456	73,327	851,081
Daily average	2,121	2,162	2,240	2,429	2,478	2,500	2,523	2,194	2,146	2,364	2,449	2,365	2,332
Natural gasoline	4,207	3,698	4,114	3,888	3,879	3,583	3,569	3,224	3,107	3,381	3,450	3,517	43,617
Benzol	174	163	183	177	176	153	145	137	130	134	128	126	1,826
Total production	70,118	64,401	73,726	76,925	80,877	78,747	81,924	71,375	67,615	76,812	77,034	76,970	896,524
Daily average	2,262	2,300	2,378	2,564	2,609	2,625	2,643	2,302	2,254	2,478	2,568	2,483	2,456
Imports:													
Crude petroleum	4,353	4,789	3,715	4,162	4,512	3,978	3,588	2,702	3,426	4,106	3,604	4,315	47,250
Refined products	3,601	2,917	4,065	3,458	2,847	2,396	3,435	3,228	3,468	3,940	2,579	2,903	38,837
Total new supply, all oils	78,072	72,107	81,506	84,545	88,236	85,121	88,947	77,305	74,509	84,858	83,217	84,188	982,611
Daily average	2,518	2,575	2,629	2,818	2,846	2,837	2,869	2,494	2,484	2,737	2,774	2,716	2,692
Increase in stocks, all oils	[1] 4,445	[1] 3,953	[1] 1,486	[1] 358	447	[1] 3,970	[1] 3,736	[1] 14,679	[1] 13,052	[1] 6,310	3,179	3,374	[1] 44,989
Demand:													
Total demand	82,517	76,060	82,992	84,903	87,789	89,091	92,683	91,984	87,561	91,168	80,038	80,814	1,027,600
Daily average	2,662	2,716	2,677	2,830	2,832	2,970	2,990	2,967	2,919	2,941	2,668	2,607	2,815
Exports:[2]													
Crude petroleum	1,919	1,710	1,586	1,826	2,268	2,544	2,621	2,856	2,296	2,389	2,449	1,071	25,535
Refined products	10,091	8,000	7,244	8,163	9,719	7,753	9,135	8,713	7,817	8,056	8,067	6,101	98,859
Domestic demand	70,507	66,350	74,162	74,914	75,802	78,794	80,927	80,415	77,448	80,723	69,522	73,642	903,206
Daily average	2,274	2,370	2,392	2,497	2,445	2,626	2,611	2,594	2,582	2,604	2,317	2,376	2,475
Excess of daily average domestic production over domestic demand	[3] 12	[3] 70	[3] 14	67	164	[3] 1	32	[3] 292	[3] 328	[3] 126	251	107	[3] 19
Stocks, end of period:													
Crude petroleum [4]	409,227	405,199	401,515	400,439	398,972	397,304	395,195	381,356	370,822	367,171	368,585	370,919	370,919
Natural gasoline	3,252	3,288	3,699	4,017	4,029	4,020	3,711	3,214	3,088	2,577	2,586	2,818	2,818
Refined products [4]	249,738	249,777	251,564	251,964	253,866	251,573	250,255	249,912	247,520	245,372	247,128	247,936	247,936
Grand total stocks, all oils	662,217	658,264	656,778	656,420	656,867	652,897	649,161	634,482	621,430	615,120	618,299	621,673	621,673
Days' supply [5]	249	242	245	232	232	220	217	214	213	209	232	238	221
Bunker oil (included above in domestic demand)	3,544	3,622	3,666	4,044	4,286	4,053	3,839	3,442	3,068	3,643	3,060	3,447	43,714

[1] Decrease.
[2] Exports include benzol and shipments to Alaska, Hawaii, and Puerto Rico.
[3] Deficiency.
[4] California heavy crude and fuel oil included under refined products.
[5] Grand total stocks of all oils divided by daily average total demand.

Runs to stills and production at refineries of the various refined products in 1931, by months

[Thousands of barrels of 42 U.S. gallons except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Runs to stills:													
Crude petroleum	70,207	65,314	73,651	74,761	78,521	76,187	79,758	80,672	75,094	76,083	71,639	72,721	894,608
Natural gasoline [1]	3,238	3,091	3,081	2,877	3,097	2,909	2,691	2,542	2,754	3,181	2,959	2,696	35,116
	73,445	68,405	76,732	77,638	81,618	79,096	82,449	83,214	77,848	79,264	74,598	75,417	929,724
Production:													
Gasoline	32,161	30,818	34,688	36,151	38,419	36,624	37,873	38,425	37,016	38,080	35,692	35,563	431,510
Kerosene	3,560	3,171	3,676	3,397	3,389	3,404	3,696	3,685	3,239	3,701	3,815	3,713	42,446
Gas oil and distillate fuel oils	7,372	6,327	8,112	7,683	7,226	6,764	7,070	7,139	6,713	6,669	6,346	6,461	83,882
Residual fuel oils	21,026	19,447	21,183	21,880	21,566	21,472	21,541	21,780	20,736	21,346	20,632	20,476	253,085
Lubricants	2,441	2,036	2,293	2,316	2,264	2,088	2,337	2,306	2,143	2,267	2,164	2,049	26,704
Wax ... thousands of pounds	42,560	38,640	37,520	33,040	35,840	34,160	37,800	37,520	42,000	46,200	46,760	45,360	477,400
Coke ... thousands of short tons	159.0	150.8	170.4	168.4	178.4	179.6	172.6	177.9	180.0	159.2	168.0	167.7	2,032.0
Asphalt ... do	147.3	165.8	190.2	247.8	304.0	314.7	314.0	311.5	325.8	314.2	209.6	131.6	2,976.5
Road oil	102	115	114	169	529	700	1,115	980	682	452	135	84	5,177
Still gas ... millions of cubic feet [2]	10,755	10,157	11,692	12,004	12,809	12,923	13,941	14,346	13,680	14,326	13,695	13,758	154,086
Other finished products	265	272	306	370	379	401	494	395	413	321	287	247	4,150
Unfinished oils	[3] 618	[3] 395	[4] 5	[4] 1,386	[3] 466	[4] 11	[3] 88	[3] 265	[4] 1,150	[4] 1,548	[4] 1,516	[3] 415	[4] 3,369
Shortage	1,456	1,477	1,406	1,724	1,478	1,605	1,949	1,843	1,721	1,685	1,479	1,247	19,070
	73,445	68,405	76,732	77,638	81,618	79,096	82,449	83,214	77,848	79,264	74,598	75,417	929,724

[1] Includes quantities blended at refineries and run through pipe lines in California.
[2] For equivalents of still gas in barrels see p. 658.
[3] Excess of gross unfinished oils produced over gross unfinished oils rerun.
[4] Excess of gross unfinished oils rerun over gross unfinished oils produced.

Crude production, crude runs to stills, and refinery capacity in 1931, by States

State	Crude production		Crude runs to stills		Refinery capacity, Jan. 1, 1932	
	Quantity (thousands of barrels)	Percent of total	Quantity (thousands of barrels)	Percent of total	Total operating (thousands of barrels)	Percent of total
Arkansas	14,791	1.7	9,096	1.0	41	1.1
California	188,830	22.2	173,008	19.3	822	22.7
Colorado	1,545	.2	1,098	.1	6	.2
Georgia			[1] 16,077	1.8	5	.1
Illinois	5,039	.6	34,146	3.8	128	3.5
Indiana	840	.1	56,002	6.3	171	4.7
Iowa			(2)			
Kansas	37,018	4.4	[2] 39,113	4.4	140	3.9
Kentucky	6,456	.8	6,944	.8	26	.7
Louisiana	21,804	2.6	50,815	5.7	186	5.1
Maryland			(1)		50	1.4
Massachusetts			[3] 14,544	1.6	48	1.3
Michigan	3,789	.4	3,629	.4	15	.4
Missouri			(2)		19	.5
Montana	2,830	.3	2,110	.2	17	.5
New Jersey			71,962	8.0	310	8.6
New Mexico	[4] 15,234	1.8	[5] 2,509	.3	5	.1
New York	3,363	.4	11,471	1.3	40	1.1
Ohio	5,327	.6	25,267	2.8	101	2.8
Oklahoma	180,574	21.2	65,937	7.4	285	7.9
Pennsylvania	11,892	1.4	75,869	8.5	247	6.8
Rhode Island			(3)		12	.3
South Carolina			(1)		6	.2
Tennessee	6				(6)	
Texas	332,437	39.1	217,356	24.3	804	22.2
Utah	(4)		(5)		6	.2
Virginia			(1)		2	.1
West Virginia	4,472	.5	4,693	.5	18	.5
Wyoming	14,834	1.7	12,962	1.5	112	3.1
	851,081	100.0	894,608	100.0	3,622	100.0

[1] Georgia includes Maryland, South Carolina, and Virginia.
[2] Kansas includes Iowa and Missouri.
[3] Massachusetts includes Rhode Island.
[4] New Mexico includes Alaska and Utah.
[5] New Mexico includes Utah.
[6] Less than 500.

Summary of percentage yields of refined products, 1920, 1925, and 1929–31

[Computed on total crude runs to stills]

	1920	1925	1929	1930	1931
Gasoline [1]	26.8	35.1	44.0	46.6	48.2
Do [2]	26.1	32.4	39.3	42.0	44.3
Kerosene	12.7	8.1	5.7	5.3	4.7
Gas oil and distillate fuel oils	48.6	49.3	45.5	8.8	9.4
Residual fuel oil			[3] 43.4	31.4	28.3
Lubricants	5.7	4.2	3.5	3.7	3.0
Wax	(4)	.3	.2	.2	.2
Coke	(4)	.7	1.0	1.0	1.2
Asphalt	(4)	2.0	1.9	2.0	1.8
Road oil	(4)	(4)	(4)	.6	.6
Still gas	(4)	(4)	(4)	(4)	4.3
Other finished products	(4)	1.1	1.0	1.4	.5
Shortage	4.3	3.1	3.6	4.0	2.1

[1] Based on total gasoline production.
[2] Based on total gasoline production less natural gasoline used.
[3] On new basis in which certain duplications were omitted from production.
[4] Figures not available.

Comparative analyses of the major refined products, 1920, 1925, and 1929–31

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

	1920	1925	1929	1930	1931
Motor fuel:					
Production	118,022	262,252	439,393	440,728	437,735
Imports	964	3,813	8,834	16,927	13,621
Exports	15,678	31,684	62,059	65,575	45,716
Stocks, end of period	11,009	38,918	43,261	40,541 [1] 40,098	42,320
Domestic demand	102,937	226,329	375,999	394,800	403,418
Kerosene:					
Production	55,240	59,689	55,940	49,208	42,446
Imports	([2])	19	208	200	11
Exports	20,878	21,212	20,022	16,884	12,712
Stocks, end of period	9,359	7,121	9,095	6,883	5,332
Domestic demand	[3] 33,082	39,969	36,032	34,736	31,296
Gas oil and fuel oil:					
Production	210,987	364,991	428,219	372,498	336,967
Imports	([2])	12,245	20,545	26,080	24,998
Exports	22,080	36,088	39,151	36,450	29,231
Stocks, end of period [4]	19,938	24,681	39,762	137,790	135,856
Domestic demand	[3] 185,972	([2])	([2])	([2])	([2])
Lubricants:					
Production	24,938	31,055	34,359	34,201	26,704
Imports	([2])	37	39	25	32
Exports	9,643	9,678	10,860	9,935	8,128
Stocks, end of period	3,822	7,253	8,269	10,971	9,511
Domestic demand	[3] 14,742	20,581	23,609	21,589	20,068
Wax (thousands of pounds):					
Production	541,204	590,577	630,074	547,680	477,400
Imports	7,629	14,588	40,860	30,402	37,835
Exports	375,276	334,179	319,324	292,973	290,527
Stocks, end of period	195,368	116,391	189,592	232,592	180,843
Domestic demand	200,651	244,301	274,572	242,109	276,457

[1] For comparison with 1931.
[2] Figures not available.
[3] Exclusive of imports.
[4] 1925 and 1929, east of California; 1930 and 1931, California heavy crude and fuel oil included.

Stocks of crude petroleum, natural gasoline, and refined products at the end of the year, 1920, 1925, and 1929–31

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

	1920	1925	1929	1930	1931
Crude petroleum:					
East of California:					
At refineries [1]	27,211	29,607	46,307	41,136	36,546
Pipe line and tank farm	94,919	264,245	334,891	320,740	286,057
Producers'	3,586	7,560	6,198	6,608	6,202
Total, east of California	125,716	301,412	387,396	368,484	328,805
California:					
Light	(2)	44,451	41,049	40,325 [3] 43,398	42,114
Heavy [4]	(2)	85,783	107,069	(4)	(4)
Total, California	23,732	130,234	148,118	----------	----------
Total crude petroleum [4]	149,448	431,646	535,514	408,809 [3] 411,882	370,919
Natural gasoline	(2)	[5] 326	2,291	2,377 [3] 3,100	2,818
Refined products:					
Gasoline [6]	11,009	38,918	43,261	40,541 [3] 40,098	42,320
Kerosene	9,359	7,121	9,095	6,883	5,332
Gas oil and distillate fuel oil	(2)	(2)	(2)	16,390	18,526
Residual fuel oil	(2)	(2)	(2)	124,038 [3] 121,400	117,330
Total, gas oil and fuel oil	19,938	24,681	39,762	140,428 [3] 137,790	135,856
Lubricants	3,822	7,253	8,269	10,971	9,511
Wax .... thousands of pounds	195,368	116,391	189,592	232,592	180,843
Coke .... thousands of short tons	31.5	238.4	745.4	1,069.1	1,511.6
Asphalt .... do	81.1	159.4	263.2	307.8	301.8
Road oil	9,569 (road oil and other finished products)	1,009 (road oil and other finished products)	111	189 [3] 234	333
Other finished products			699	530 [3] 575	785
Unfinished oils	1,119	38,922	44,551	46,793 [3] 47,153	43,784
Total refined products [7]	60,397	120,492	151,692	254,311 [3] 251,680	247,936
Grand total	209,845	552,464	689,497	665,497 [3] 666,662	621,673

[1] Includes foreign crude held by importers.
[2] Figures not available.
[3] For comparison with 1931.
[4] 1925 and 1929, California heavy crude and fuel oil included under crude petroleum; 1930 and 1931, California heavy crude and fuel oil included under refined products as residual fuel oil. Statistics of heavy crude and fuel oil in California begin with June 30, 1923.
[5] At plants only—stocks of natural gasoline at refineries not segregated from unfinished oils until Dec. 31, 1929.
[6] 1925 and 1929–31, includes stocks of motor blends (not available in 1920); 1931, includes gasoline pipe-line stock.
[7] Includes equivalents for wax, coke, and asphalt in barrels.

Production of crude petroleum by districts and States and daily average production in principal fields and States in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

TOTAL PRODUCTION

	January	February	March	April	May	June	July	August	September	October	November	December	Total	Value at wells [1]
Appalachian:														
New York	251	241	264	269	268	286	275	257	299	324	291	338	3, 363	6, 800
Pennsylvania	936	850	924	935	942	937	935	941	1, 087	1, 204	1, 072	1, 129	11, 892	23, 550
West Virginia	379	346	376	376	373	380	365	347	381	415	352	382	4, 472	7, 070
East and southeast Ohio	391	356	389	375	368	364	313	290	345	355	322	344	4, 212	4, 600
Kentucky	551	525	688	515	477	486	478	461	555	591	615	514	6, 456	5, 295
Tennessee	------	2	------	1	1	------	1	------	------	------	1	------	6	5
Total, Appalachian	2, 508	2, 320	2, 641	2, 471	2, 429	2, 453	2, 367	2, 296	2, 667	2, 889	2, 653	2, 707	30, 401	47, 320
Lima-Indiana:														
Northwestern Ohio	105	91	93	93	93	100	98	82	95	98	78	89	1, 115	1, 010
Northeastern Indiana	4	4	3	3	4	3	2	3	3	3	3	2	37	20
Michigan	267	231	291	263	260	240	287	281	357	405	430	477	3, 789	2, 840
Total, Lima-Indiana	376	326	387	359	357	343	387	366	455	506	511	568	4, 941	3, 870
Illinois-Indiana:														
Southwest Indiana	70	66	58	66	66	75	72	64	67	67	64	68	803	730
Illinois	411	376	374	378	384	456	463	439	437	444	430	447	5, 039	4, 500
Total, Illinois-Indiana	481	442	432	444	450	531	535	503	504	511	494	515	5, 842	5, 230
Mid-Continent:														
Kansas	3, 102	3, 030	3, 299	3, 195	3, 244	2, 999	2, 862	2, 825	3, 105	3, 114	3, 060	3, 183	37, 018	25, 500
Oklahoma	15, 044	14, 160	17, 088	17, 437	18, 026	17, 683	16, 233	9, 117	8, 414	13, 724	16, 649	16, 999	180, 574	119, 200
Texas, exclusive of coastal Texas and west Texas	8, 789	8, 177	11, 122	15, 645	18, 266	18, 983	23, 955	21, 578	19, 066	21, 317	20, 045	18, 938	205, 881	102, 060
West Texas	7, 770	6, 908	7, 304	6, 782	6, 664	6, 465	6, 269	6, 341	6, 048	6, 178	5, 971	5, 824	78, 524	37, 270
Southeast New Mexico	1, 128	1, 031	1, 198	1, 154	1, 368	1, 229	1, 257	1, 275	1, 238	1, 284	1, 273	1, 269	14, 704	6, 040
Arkansas	1, 535	1, 369	1, 435	1, 378	1, 360	1, 291	1, 140	1, 112	1, 102	1, 094	1, 020	955	14, 791	7, 200
Northern Louisiana	1, 246	1, 189	1, 211	1, 140	1, 155	1, 028	918	897	883	902	845	830	12, 244	7, 850
Total, Mid-Continent	38, 614	35, 864	42, 657	46, 731	50, 083	49, 678	52, 634	43, 145	39, 856	47, 613	48, 863	47, 998	543, 736	305, 120
Gulf coast:														
Texas Gulf coast	4, 655	4, 190	4, 421	4, 478	4, 495	3, 979	3, 894	3, 692	3, 512	3, 615	3, 578	3, 523	48, 032	31, 620
Louisiana Gulf coast	855	817	780	822	813	678	652	693	687	978	867	918	9, 560	6, 370
Total, Gulf coast	5, 510	5, 007	5, 201	5, 300	5, 308	4, 657	4, 546	4, 385	4, 199	4, 593	4, 445	4, 441	57, 592	37, 990

[1] Thousands of dollars.

Production of crude petroleum by districts and States and daily average production in principal fields and States in 1931, by months—Con.

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total	Value at wells [1]
Rocky Mountain:														
Montana	252	242	255	250	258	249	233	218	242	242	181	208	2, 830	2, 730
Wyoming	1, 325	1, 237	1, 324	1, 331	1, 327	1, 262	1, 236	1, 254	1, 119	1, 102	1, 152	1, 165	14, 834	11, 120
Colorado	137	123	134	128	129	138	136	125	112	143	114	126	1, 545	825
Northwest New Mexico	48	48	33	41	31	58	42	52	42	45	45	38	523	450
Utah and Alaska				1	1	1	1	1	1	1			7	15
Total, Rocky Mountain	1, 762	1, 650	1, 746	1, 751	1, 746	1, 708	1, 648	1, 650	1, 516	1, 533	1, 492	1, 537	19, 739	15, 140
California	16, 486	14, 931	16, 365	15, 804	16, 449	15, 641	16, 093	15, 669	15, 181	15, 652	14, 998	15, 561	188, 830	135, 960
Total, United States: 1931	65, 737	60, 540	69, 429	72, 860	76, 822	75, 011	78, 210	68, 014	64, 378	73, 297	73, 456	73, 327	851, 081	550, 630
1930	79, 633	74, 290	78, 226	77, 483	80, 528	77, 060	76, 922	74, 831	71, 216	72, 893	67, 957	66, 972	898, 011	1, 070, 200
Total, Ohio	496	447	482	468	461	464	411	372	440	453	400	433	5, 327	5, 610
Total, Indiana	74	70	61	69	70	78	74	67	70	70	67	70	840	750
Total, Texas	21, 214	19, 275	22, 847	26, 905	29, 425	29, 427	34, 118	31, 611	28, 626	31, 110	29, 594	28, 285	332, 437	170, 950
Total, Louisiana	2, 101	2, 006	1, 991	1, 962	1, 968	1, 706	1, 570	1, 590	1, 570	1, 880	1, 712	1, 748	21, 804	14, 220
Total, New Mexico	1, 176	1, 079	1, 231	1, 195	1, 399	1, 287	1, 299	1, 327	1, 280	1, 329	1, 318	1, 307	15, 227	6, 490
DAILY AVERAGE PRODUCTION														
California	532	533	528	527	531	521	519	505	506	505	500	502	517	
Kettleman Hills	22	27	26	26	39	58	73	63	62	60	60	60	48	
Long Beach	93	95	90	88	86	80	78	76	79	76	75	76	83	
Santa Fe Springs	72	71	71	72	72	65	63	62	62	61	62	64	66	
Kansas	100	108	106	107	105	100	92	91	104	100	102	103	101	
New Mexico	38	39	40	40	45	43	42	43	43	43	44	42	42	
Hobbs	30	30	32	33	39	36	36	37	36	36	38	37	35	
Oklahoma	485	506	551	581	581	589	524	294	280	443	555	548	495	
Oklahoma City	82	98	140	172	177	193	154	24	22	116	178	167	127	
Seminole	156	145	157	153	152	146	136	75	61	101	151	142	131	
Texas	684	688	737	897	949	981	1, 101	1, 020	954	1, 004	987	912	911	
East Texas	3	26	98	259	315	363	528	446	360	417	407	362	300	
Gulf coast	150	150	143	149	145	133	126	119	117	117	119	114	132	
West Texas	251	247	236	226	215	216	202	205	202	199	199	188	215	
Wyoming	43	44	43	44	43	42	40	40	37	35	38	38	41	
Salt Creek	26	26	26	26	25	25	24	23	23	22	22	22	24	
Other States	239	244	235	233	224	224	205	201	222	234	223	220	225	
Unites States: 1931	2, 121	2, 162	2, 240	2, 429	2, 478	2, 500	2, 523	2, 194	2, 146	2, 364	2, 449	2, 365	2, 332	
1930	2, 569	2, 653	2, 523	2, 583	2, 598	2, 569	2, 481	2, 414	2, 374	2, 351	2, 265	2, 160	2, 460	

[1] Thousands of dollars.

CRUDE PETROLEUM

DOMESTIC PRODUCTION

GENERAL STATEMENT

The daily average production of crude petroleum in 1931 was at its lowest level in January and at its peak in July. The daily average production in July 1931 was 2,523,000 barrels compared with daily

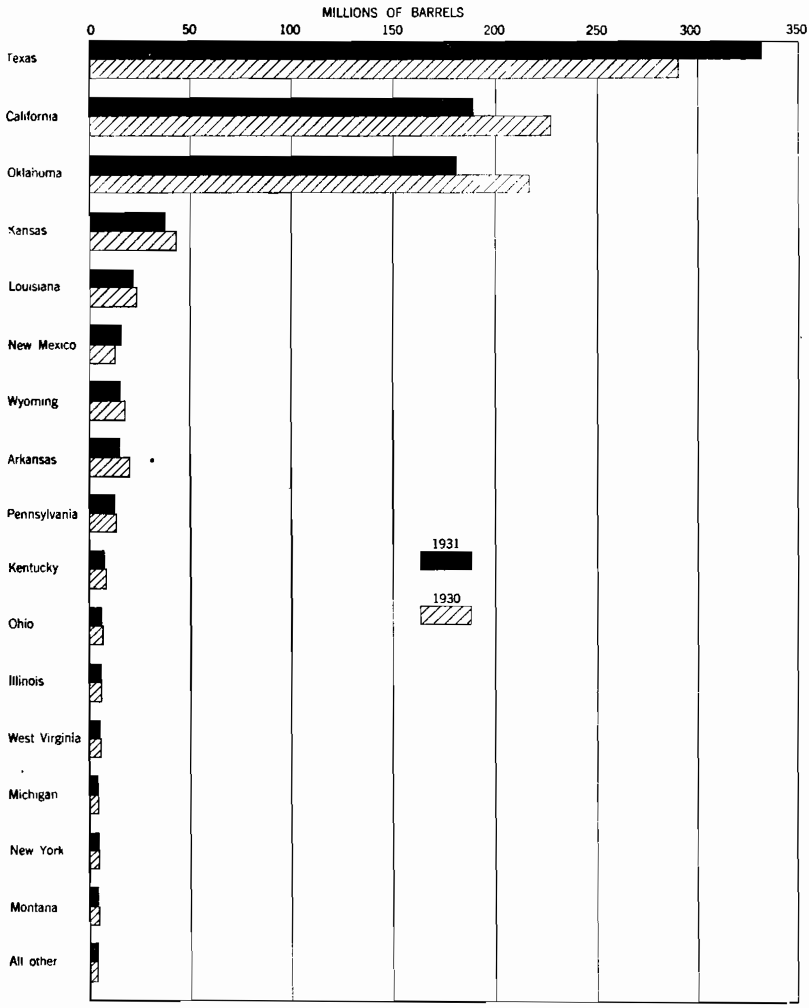

FIGURE 39.—Production of crude petroleum, 1930 and 1931, by States.

average of 2,653,000 barrels in February 1930, the high month of that year. Daily average production in 1931 increased steadily from January to early in August; this growth resulted largely from the rapid development of the East Texas field and from increases in the allowable output at Oklahoma City.

The inauguration of proration in the East Texas field after the shutdown, the closing in of the flush wells of Oklahoma in August and September, and the general depressing effect of low prices caused the output to decline in September and October. However, this curtailment was short-lived, as improved prices and the lifting of the shut-down in Oklahoma were followed by increased production in November and December.

Texas easily retained first place among the producing States with an output of 332,437,000 barrels, an increase of 14 percent over 1930 and the largest annual total ever recorded by any State. (See fig. 39.) Texas also had the distinction in 1931 of being the first State in which the daily average output exceeded 1,000,000 barrels; this occurred first about July 20. California retained its rank as the second most m portant producing State, although its margin over Oklahoma, in third place, was reduced in 1931. The only State exclusive of Texas that increased production was New Mexico, where the yield rose from 10,189,000 barrels in 1930 to 15,227,000 barrels, enough to allow the State to rise from ninth place in 1930 to sixth in 1931. Comparatively few other producing States changed their rank in 1931; Arkansas fell from sixth to eighth and Pennsylvania from eighth to ninth.

The Mid-Continent district was the only one of the eight major districts that increased production in 1931. The total output in that district was 543,736,000 barrels (64 percent of the total for the United States compared with 59 percent in 1930). The increased production in the Mid-Continent was due almost entirely to increases in the East Texas, Oklahoma City, and Hobbs fields. The production of Pennsylvania-grade crude declined in 1931 for the first time in several years. The output of this crude was 21,893,000 barrels, approximately half coming from the Bradford district. The production of grade A crude in the Gulf coast district declined materially in 1931, whereas that of the lighter grade B crude increased slightly.

Production of crude petroleum, 1859–1931, by States

[Thousands of barrels of 42 U.S. gallons]

	1859–1927	1928	1929	1930	1931	Total, 1859–1931	Percentage of total production
Arkansas	[1] 281, 558	32, 096	24, 917	19, 702	14, 791	373, 064	2. 7
California	2, 746, 021	231, 811	292, 534	227, 329	188, 830	3, 686, 525	26. 3
Colorado	19, 112	2, 774	2, 358	1, 656	1, 545	27, 445	. 2
Illinois	379, 790	6, 462	6, 319	5, 736	5, 039	403, 346	2. 9
Indiana	114, 735	1, 052	981	994	840	118, 602	. 8
Kansas	[2] 466, 735	38, 596	42, 813	41, 638	37, 018	626, 800	4. 5
Kentucky	[3] 89, 422	7, 359	7, 775	7, 389	6, 456	118, 401	. 8
Louisiana	378, 485	21, 847	20, 554	23, 272	21, 804	465, 962	3. 3
Michigan	[4] 537	594	4, 528	3, 911	3, 789	13, 359	. 1
Montana	27, 075	4, 015	3, 980	3, 349	2, 830	41, 249	. 3
New Mexico	[5] 4, 050	943	1, 830	10, 189	15, 227	32, 239	. 2
New York	[6] 65, 775	2, 603	3, 377	3, 647	3, 363	78, 765	. 6
Ohio	528, 592	7, 015	6, 743	6, 486	5, 327	554, 163	4. 0
Oklahoma	[2] 2, 276, 847	249, 857	255, 004	216, 486	180, 574	3, 178, 768	22. 7
Pennsylvania	[6] 806, 853	9, 956	11, 820	12, 803	11, 892	853, 324	6. 1
Tennessee	[3] 217	46	19	21	6	309	---------
Texas	1, 523, 132	257, 320	296, 876	290, 457	332, 437	2, 700, 222	19. 3
West Virginia	355, 904	5, 661	5, 574	5, 071	4, 472	376, 682	2. 7
Wyoming	276, 610	21, 461	19, 314	17, 868	14, 834	350, 087	2. 5
Other	[7] 225	[8] 6	[8] 7	[8] 7	[8] 7	252	---------
Total production	10, 341, 675	901, 474	1, 007, 323	898, 011	851, 081	13, 999, 564	100. 0
Total value at wells (thousands of dollars)	14, 266, 397	1, 054, 880	1, 280, 417	1, 070, 200	550, 630	18, 222, 524	---------
Average value per barrel	$1. 38	$1. 17	$1. 27	$1. 19	$0. 65	$1. 30	---------

[1] 1920 included under "Other."
[2] Oklahoma included with Kansas in 1905 and 1906.
[3] Tennessee included with Kentucky, 1883 to 1907, inclusive.
[4] 1900-19, inclusive, included under "Other."
[5] 1913 and 1919 to 1923, inclusive, included under "Other."
[6] Early production of New York included with Pennsylvania.
[7] Alaska, Arkansas in 1920, Michigan prior to 1925, Missouri and New Mexico prior to 1924, and Utah.
[8] Alaska and Utah.

DETAILED STATISTICS BY STATES

Arkansas.—Depressed conditions within the oil industry were particularly evident in Arkansas in 1931, and drilling was virtually at a standstill. Only 19 oil wells were completed in the State compared with 46 in 1930 and 1,202 in 1925, the peak year.

No proration was applied in Arkansas, but the drastic decline in drilling and material gain in the number of oil wells abandoned as unprofitable to operate under the reduced prices resulted in a decrease in output from 19,702,000 barrels in 1930 to 14,791,000 barrels in 1931. The output of all fields except the comparatively new Urbana dropped. Most of the oil wells completed were in the Urbana field; its output accordingly rose from 236,000 barrels in 1930 to 322,000 barrels in 1931.

Arkansas, like New Mexico and Wyoming, has depended on a single field for the major portion of its production, the Smackover field having yielded more than three fourths of the State's output for several years. Production at Smackover totaled 11,504,000 barrels from about 2,500 wells.

Prices of crude petroleum in Arkansas experienced practically the same general reductions as were posted in nearly all producing fields of the Mid-Continent. The average value per barrel at the wells was $0.49, compared with $0.88 in 1930.

The low prices provided little incentive for exploratory drilling, and no new discoveries of importance were made. The prospective field discovered in Miller County in 1930 was tested several times in 1931 but yielded only dry holes. The year witnessed drilling of the first deep test in the Smackover field. This well was in sec. 4, T. 16 S., R. 15 W., on top of the structure. Although it encountered several oil shows below the regular producing formations at Smackover it entered solid rock salt close to 6,000 feet and was still in salt when it was closed down at 7,255 feet.

Production of crude petroleum in Arkansas, 1921, 1925, and 1929–31, by districts

[Thousands of barrels of 42 U.S. gallons]

Year	Bradley	Champagnolle	El Dorado	Irma	Lisbon	Mount Holly	Smackover	Stephens	Urbana	Total
1921			10,473							10,473
1925 [1]			4,247	334			72,144	673		77,398
1929	24	2,651	1,987	409	492	(2)	[2] 18,991	363		24,917
1930	19	1,486	1,424	380	399	34	15,405	319	236	19,702
1931	5	944	1,186	266	288	4	11,504	272	322	14,791

[1] Peak year.
[2] Mount Holly included with Smackover.

Production of crude petroleum in Arkansas in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Bradley	1	1	-----	1	2	-----	-----	-----	-----	-----	-----	-----	5	------	5
Champagnolle	146	92	91	88	85	78	56	68	66	60	58	56	944	------	944
El Dorado	116	98	103	93	98	91	82	100	103	103	98	104	1, 189	−3	1, 186
Irma	12	51	16	17	13	33	17	23	22	19	31	15	269	−3	266
Lisbon	29	25	28	34	36	32	31	14	15	16	15	14	289	−1	288
Mount Holly	2	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4	------	4
Smackover	1, 179	1, 040	1, 127	1, 068	1, 062	969	893	890	881	861	787	752	11, 509	−5	11, 504
Stephens	27	24	26	25	27	22	20	22	20	21	19	22	275	−3	272
Urbana	27	32	33	52	51	51	30	-----	-----	3	17	6	302	20	322
Total: 1931	1, 539	1, 365	1, 424	1, 378	1, 374	1, 276	1, 129	1, 117	1, 107	1, 083	1, 025	969	14, 786	5	14, 791
1930	1, 659	1, 682	1, 785	1, 732	1, 673	1, 674	1, 684	1, 643	1, 570	1, 569	1, 462	1, 543	19, 676	26	19, 702

California.—According to monthly figures of the American Petroleum Institute the production of crude petroleum in California in 1931 totaled 188,830,000 barrels, 17 percent less than in 1930. The annual total reported by the State Department of Natural Resources was 188,311,000 barrels, practically the same figure given by the American Petroleum Institute.

The history of the industry in California in 1931 was marked by numerous and vigorous efforts to curtail production, which were greatly intensified when prices dropped to very low levels in the latter part of March; however, price increases in June restored about half the March declines. Although the California producers never quite succeeded in reducing their production to the totals prescribed by proration committees they made commendable progress, which paved the way for further curtailment in 1932.

Low prices and the fact that the shut-in production of the State exceeded actual production reduced drilling to a minimum, and only 246 oil wells were completed in 1931 compared with 755 in 1930. The Playa del Rey field, with 66 successful completions, was the most active drilling area; the Long Beach field was second with 37 completions; in the Kettleman Hills field 23 oil wells were completed with the unusually high average daily initial output of 10,174 barrels.

Long Beach displaced Santa Fe Springs as the leading producing field in California. The Kettleman Hills field ranked fourth in production, but might easily have been first had the yield not been rigidly curtailed. The only other fields that gained materially in output in 1931 were Playa del Rey and Lost Hills-Belridge. The increase at Playa del Rey came from competitive drilling in the absence of much curtailment; that at Lost Hills-Belridge resulted chiefly from successful operations in the deeper zones.

Considerable success attended the efforts of California wildcatters in 1931. Three new fields were discovered: Gato Ridge, Santa Barbara County; Kettleman Hills Middle Dome, Kings County; and

San Miguelitos, Ventura County. The oil at Gato Ridge is heavy and the structure at San Miguelitos small; it is therefore improbable that these two fields will be developed speedily. The potentialities of the Middle Dome at Kettleman Hills were somewhat clouded, as the discovery well was still in poor mechanical condition at the close of 1931; however, because of the sharp dips the producing areas will probably be small and the wells very deep. Extensions to producing fields were discovered at Playa del Rey, Fruitvale, and West Coyote; deeper zones were found at Dominguez, Seal Beach, Ventura Avenue, and Elwood.

An important event of the year was the formation of the Kettleman North Dome Association (Kenda) to operate part of the north dome of Kettleman Hills on a unit plan. This proved so successful from an economic and technical standpoint that producers elsewhere are giving serious consideration to the possibility of forming similar organizations.

Production of crude petroleum in California, 1922, 1923, and 1929–31, by counties [1]

[Thousands of barrels of 42 U.S. gallons]

County	1922	1923	1929 [2]	1930	1931
Fresno	9,266	5,061	3,498	3,363	2,992
Kern	53,512	45,953	43,577	44,171	35,794
Kings	----------	----------	1,969	6,176	17,608
Los Angeles	37,726	158,665	182,444	114,533	85,382
Orange	31,049	46,475	25,862	23,114	17,564
San Luis Obispo	[3] 34	33	(4)	(4)	53
Santa Barbara	3,931	3,062	11,142	15,914	11,661
Santa Clara	16	[3] 16	[5] 38	[6] 75	[7] 12
Ventura	2,934	3,611	24,004	19,983	17,245
	138,468	262,876	292,534	227,329	188,311

[1] Division of Mines, Department of Natural Resources, California.
[2] Peak year.
[3] Includes San Mateo.
[4] Included under Santa Clara.
[5] Includes Colusa and San Luis Obispo.
[6] Includes Colusa, San Luis Obispo, and Tulare.
[7] Includes Tulare.

Production of crude petroleum in California in 1931, by districts and months [1]

[Thousands of barrels of 42 U.S. gallons]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Brea Olinda	330	292	331	302	310	292	300	294	292	298	291	294	3,626
Coalinga	275	245	266	253	263	259	262	236	232	235	225	228	2,979
Coyote	305	293	324	310	310	300	327	326	308	323	312	314	3,752
Dominguez	307	331	369	355	359	340	344	344	318	387	330	399	4,183
Elk Hills	459	411	453	446	453	409	367	378	368	399	389	394	4,926
Elwood	1,022	871	1,079	1,068	1,082	873	807	812	769	774	704	609	10,470
Huntington Beach	707	602	686	653	668	617	631	637	596	663	628	691	7,779
Inglewood	479	428	472	458	500	426	429	427	413	423	409	425	5,289
Kern River	336	312	331	339	350	317	320	330	309	313	299	301	3,857
Kettleman Hills	691	752	805	784	1,189	1,751	2,246	1,965	1,854	1,856	1,800	1,851	17,544
Long Beach	2,877	2,658	2,789	2,638	2,666	2,399	2,416	2,354	2,379	2,363	2,263	2,365	30,167
Lost Hills-Belridge	201	182	203	173	191	295	307	291	280	290	285	286	2,984
Midway-Sunset	1,651	1,493	1,632	1,618	1,650	1,523	1,556	1,548	1,481	1,544	1,484	1,548	18,728
Montebello	215	198	222	214	217	199	204	198	190	198	190	201	2,446
Mount Poso	236	210	233	228	245	254	268	280	273	266	256	260	3,009
Playa del Rey	1,103	914	973	921	902	800	757	699	668	711	648	663	9,759
Richfield	211	196	211	204	213	206	198	197	188	208	196	205	2,433
Rosecrans	140	134	124	114	116	105	103	101	102	105	102	98	1,344
Santa Fe Springs	2,223	1,995	2,204	2,149	2,233	1,964	1,964	1,931	1,871	1,896	1,873	1,970	24,273
Seal Beach	522	418	491	458	429	336	325	365	349	393	388	408	4,882
Torrance	182	168	187	190	193	173	182	183	179	189	178	188	2,192
Ventura Avenue	1,348	1,251	1,386	1,345	1,349	1,243	1,226	1,232	1,209	1,230	1,176	1,260	15,255
Other	666	577	594	584	561	560	554	541	553	588	572	603	6,953
Total: 1931	16,486	14,931	16,365	15,804	16,449	15,641	16,093	15,669	15,181	15,652	14,998	15,561	188,830
1930 [2]	21,898	20,805	19,624	18,696	18,970	17,951	18,749	18,717	17,933	18,192	18,058	17,736	227,329

[1] Monthly figures by districts from American Petroleum Institute.
[2] Total from Division of Mines, Department of Natural Resources, California; monthly figures prorated.

Colorado.—Production in Colorado declined, as the output of the Greasewood field was insufficient to offset the natural decline in the older districts. The total production for the year was 1,545,000 barrels compared with 1,656,000 barrels in 1930.

The interest of the oil industry in Colorado in 1931 was focused primarily on the new Greasewood field of Weld County, which appeared promising when discovered late in 1930. On the whole, the results at Greasewood in 1931 were disappointing, as the productive horizon—the Muddy sand—was found to be lenticular and relatively thin. A test drilled to the underlying Dakota found water. The total production of the field in 1931 was 173,000 barrels from four wells.

Most of the wildcatting was carried on near Greasewood (in the northeast corner of the State) and was generally unsuccessful; the only new discovery of importance was the Powder Wash gas field in northwestern Colorado.

Production of crude petroleum in Colorado, 1924, 1925, and 1929–31, by districts

[Thousands of barrels of 42 U.S. gallons]

Year	Boulder	Florence	Fort Collins [1]	Greasewood	Iles	Moffat	Rangely	Tow Creek	Total
1924	4	70	86	----------	----------	256	29	----------	445
1925	3	97	430	----------	17	605	32	42	1,226
1929	(2)	[3] 344	824	----------	546	436	[4] 35	173	2,358
1930	(2)	[3] 200	485	(5)	382	394	[6] 47	148	1,656
1931	(2)	[3] 135	355	173	391	321	[4] 49	121	1,545

[1] Includes Wellington.
[2] Included with Rangely.
[3] Includes Canon City.
[4] Includes Berthoud, Boulder, and Walden.
[5] Greasewood included with Rangely.
[6] Includes Berthoud, Boulder, Greasewood, and Walden.

Production of crude petroleum in Colorado in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Florence [1]	15	13	12	13	12	11	9	10	10	12	9	10	136	−1	135
Fort Collins [2]	36	29	32	30	31	29	30	23	29	28	27	32	356	−1	355
Greasewood	12	9	10	11	11	10	10	9	5	31	13	17	148	25	173
Iles	30	28	32	30	31	44	39	38	30	31	28	27	388	3	391
Moffat	28	30	30	28	26	25	26	25	21	24	22	24	309	12	321
Rangely [3]	2	2	3	3	3	7	9	6	5	3	3	3	49	------	49
Tow Creek	11	10	12	10	12	10	9	10	9	10	9	9	121	------	121
Total: 1931	134	121	131	125	126	136	132	121	109	139	111	122	1,507	38	1,545
1930	139	146	140	135	137	130	138	131	125	131	125	134	1,611	45	1,656

[1] Includes Canon City.
[2] Includes Wellington.
[3] Includes Berthoud, Boulder, and Walden.

Illinois.—Production in Illinois continued to reflect adverse economic conditions and declined 12 percent—from 5,736,000 barrels in 1930 to 5,039,000 barrels in 1931. This decrease was due largely to the natural decline in the older fields and to a material falling off in drilling. The average price at the well for Illinois crude was $0.89 per barrel in 1931 compared with $1.59 in 1930; this material decline caused Illinois producers to reduce new development work to a minimum. Only 13 oil wells were completed compared with 117 in 1930 and 314 in 1929. Another factor that tended to lower the output of crude petroleum in Illinois was the 25 percent curtailment plan inaugurated in 1930 which operated 5 months in 1931 compared with 4 months in 1930.

Production of crude petroleum in Illinois, 1905, 1908, and 1929–31, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1905	------	------	------	------	------	6	17	24	26	28	35	45	181
1908 [1]	2,704	2,572	2,825	3,250	3,224	3,082	2,693	2,809	2,675	2,710	2,480	2,662	33,686
1929	508	455	603	457	552	517	561	572	532	566	506	490	6,319
1930	487	478	532	511	540	513	531	523	409	428	378	406	5,736
1931	411	376	374	378	384	456	463	439	437	444	430	447	5,039

[1] Peak year.

Indiana.—Production in Indiana totaled 840,000 barrels compared with 994,000 barrels in 1930 and 11,339,000 barrels in 1904, the peak year. Drilling declined materially, although the decrease was relatively less than in Illinois. The average daily initial production of the new completions in Indiana was 43 barrels compared with 41 barrels in 1930; this increase tended to offset the natural decline of the old fields and the loss in output resulting from the abandonment of about 100 wells because of low prices. New development work was generally unsuccessful, although several wells in the Troy field, Perry County, were reported to have had exceptionally high initial yields.

Production of crude petroleum in Indiana, 1894, 1904, and 1929–31, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Southwestern Indiana:													
1929	83	81	77	76	78	71	72	75	71	78	78	78	918
1930	74	80	77	87	87	85	89	88	69	70	67	68	941
1931	70	66	58	66	66	75	72	64	67	67	64	68	803
Northeastern Indiana:													
1929	4	4	6	6	6	7	5	5	5	5	5	5	63
1930	4	4	4	5	6	5	5	4	5	5	3	3	53
1931	4	4	3	3	4	3	2	3	3	3	3	2	37
Total Indiana:													
1894	259	232	282	287	322	334	327	345	320	339	304	338	3,689
1904 [1]	726	671	801	802	872	933	1,006	1,084	1,119	1,143	1,133	1,049	11,339
1929	87	85	83	82	84	78	77	80	76	83	83	83	981
1930	78	84	81	92	93	90	94	92	74	75	70	71	994
1931	74	70	61	69	70	78	74	67	70	70	67	70	840

[1] Peak year.

Kansas.—Kansas declined 11 percent in production but retained fourth place among the producing States. The total output was 37,018,000 barrels, slightly above that in 1917, when the Eldorado field was at its peak. As in the majority of States, the decline in Kansas in 1931 was due to proration, decreased drilling, and the abandonment of many wells that became unprofitable to operate at reduced prices or had their pipe-line connections removed. Production in Kansas in 1931 showed little variation from month to month, although the potential output of the wells undoubtedly increased steadily. Conservation measures in the Kansas oil industry were administered by the Kansas Public Service Commission beginning with March 1931, and that body is generally credited with assisting the producers materially in retarding the development of flush areas while insisting that every district receive fair treatment as to market outlets.

Development work in Kansas was centered in what is generally called western Kansas but is actually central Kansas. The only active spot in eastern Kansas in 1931 was the Eastborough field near Wichita, where interest was revived by the discovery of a deep sand.

The producing areas in west or central Kansas may be divided roughly into two parts—McPherson County and the Barton-Ellsworth Arch in Barton, Ellsworth, Rice, Rush, Russell, and Stafford Counties. At the beginning of the year the chief producing fields of McPherson County were the Voshell and Ritz pools. Before the beginning of 1931 the former was considered large enough to overthrow all the State's curtailment plans if allowed to produce at capacity. It was therefore prorated to 20 percent of its potential until after the first of 1931, when a new gage of the wells disclosed that proration was unnecessary; however, it was easily the leading producing field of the State in 1931. A pool known as the "Canton field" was discovered in McPherson County in February 1931; later drilling showed that this was contiguous to the Ritz pool to the south and the Decker gas field to the north. The Ritz-Canton-Decker district was the most active area in the State, being credited with nearly half the oil wells completed in 1931. In general, the district contains two producing horizons (one of Mississippian age and a deeper zone in the Viola lime of Ordovician age). Geologically, the latter zone is one of the oldest producing formations in the country.

At least six new pools were discovered in 1931 in the area embraced by the Barton-Ellsworth Arch. In virtually all instances the discovery well was shut in, and no attempt was made to outline the field further. In general, these new discoveries exhibited marked similarity, being characterized by low gas pressure but comparatively high initial production on the pump or by swabbing. The oil is of uniformly high gravity, and the fields should be profitable despite the fact that they will probably be short-lived. Drilling in the far western counties was practically confined to gas developments in the Hugoton field. This field was extended during the year, and its reserves were increased; nevertheless, it was relatively quiet compared with the Decker gas field in McPherson County.

Production of crude petroleum in Kansas, 1916, 1917, and 1929–31, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1916	197	285	354	441	634	835	705	645	951	1,261	1,212	1,218	8,738
1917	2,200	1,740	2,499	2,323	2,366	2,682	3,010	3,611	4,101	4,116	4,304	3,584	36,536
1929	2,939	2,717	3,093	3,385	3,812	3,795	4,323	4,194	3,963	3,681	3,427	3,484	42,813
1930	3,149	3,103	3,477	3,520	3,948	4,087	3,618	3,414	3,439	3,432	3,252	3,199	41,638
1931	3,102	3,030	3,299	3,195	3,244	2,999	2,862	2,825	3,105	3,114	3,060	3,183	37,018

Production of crude petroleum in Kansas in 1931, by districts and months [1]

[Thousands of barrels of 42 U.S. gallons]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Anderson	41	37	43	44	45	43	34	34	32	33	32	33	451
Butler:													
Eldorado	200	171	195	183	189	183	197	182	170	201	186	188	2,245
Leon-Weaver	117	94	102	101	99	95	82	75	83	86	83	83	1,100
Other	270	309	294	233	203	189	138	194	187	140	128	210	2,495
Cowley	165	151	169	168	167	159	151	149	151	159	150	146	1,885
Ellis	8	6	11	11	11	10	8	32	30	37	38	36	238
Greenwood-Woodson:													
Seeley	189	161	165	157	154	149	138	142	135	150	134	136	1,810
Teeter	102	94	104	100	103	98	95	83	86	92	90	90	1,137
Virgil	139	133	141	129	135	130	112	116	119	117	112	112	1,495
Other	111	107	116	112	113	110	100	86	88	92	88	87	1,210
McPherson:													
Ritz-Canton	185	182	190	192	175	173	218	335	469	432	493	509	3,553
Voshell	522	605	572	499	553	503	478	446	378	361	309	320	5,546
Other	13	4	4	6	5	4	20	19	3	2	2	3	85
Rice	20	18	21	19	35	28	34	26	21	50	100	79	451
Russell	99	83	98	93	98	96	85	87	93	92	90	95	1,109
Sedgwick:													
Eastborough	245	225	222	190	170	164	129	161	163	176	165	239	2,249
Wright	251	230	238	211	210	198	168	169	160	155	139	143	2,272
Other	91	119	131	116	111	105	120	121	117	96	93	99	1,319
Sumner	248	220	225	219	224	216	211	197	172	145	147	124	2,348
Other	416	392	458	499	541	522	572	487	490	561	553	467	5,958
	3,432	3,341	3,499	3,282	3,341	3,175	3,090	3,141	3,147	3,177	3,132	3,199	38,956

[1] Monthly estimates by districts from Oil and Gas Journal.

Kentucky.—Production in Kentucky was 6,456,000 barrels, 13 percent less than in 1930. This decrease was due to a shut-down in western Kentucky fields and to a very material decline in drilling. The number of oil wells completed fell from 633 in 1930 to 179 in 1931. The only area in which drilling kept pace with, or exceeded, that in 1930 was Hart County, or more specifically the part of the Le Grande pool which is in that county.

Production of petroleum in Kentucky, 1909, 1919, and 1929–31, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1909	60	56	63	56	57	54	55	55	54	46	42	41	639
1919 [1]	576	658	765	859	851	913	891	799	815	773	704	674	9,278
1929	585	511	560	584	636	547	710	676	722	810	724	710	7,775
1930	665	604	625	643	663	609	676	610	621	608	524	541	7,389
1931	551	525	688	515	477	486	478	461	555	591	615	514	6,456

[1] Peak year.

Louisiana—Northern.—Production in northern Louisiana fields totaled 12,244,000 barrels, 16 percent lower than in 1930. The decline was due chiefly to a drastic reduction in drilling, less than one-fourth as many oil wells being completed as in 1930.

The only field that increased production materially was Zwolle, Sabine Parish, where virtually all the drilling was done. Despite an unusually high percentage of dry holes the output of Zwolle rose from 1,801,000 barrels in 1930 to 2,538,000 barrels in 1931, a gain of 41 percent. Haynesville was the only other field to increase its output; this resulted from the continuation of a repressuring program inaugurated in 1930.

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Wildcatting was curtailed in northern Louisiana; nevertheless, a number of wildcats were drilled on the outskirts of Zwolle and along the southeastern edge of the Sabine uplift. The Sabine wells were undoubtedly drilled in the hope of finding another field like East Texas.

Gulf coast.—Production in the Louisiana coastal fields increased from 8,610,000 barrels in 1930 to 9,560,000 barrels in 1931, marking the ninth successive year in which the output of this area has increased. The number of oil wells completed in coastal Louisiana declined, but the average initial output continued to be relatively high and more than compensated for the natural decline of the older wells. Five new fields—Choctaw, Iberville Parish; Leesville, Lafourche Parish; Cameron Meadows, Cameron Parish; Iowa, Calcasieu Parish; and Lake Washington, Plaquemines Parish—were added to the producing column, but their combined output was considerably less than that obtained from extensions and new deep sands at Hackberry, Lockport, Vinton, and other fields; however, the new fields were an important addition to the already impressive reserves in the coastal area.

The number of geophysical crews operating in the coastal areas of both Louisiana and Texas declined materially in 1931, due undoubtedly to the desire to curtail expenses, although it is probable that, except for the deeper domes, the territory has been explored rather thoroughly.

Production of crude petroleum in Louisiana, 1919, 1920, and 1929–31, by districts

[Thousands of barrels of 42 U.S. gallons]

District	1919	1920	1929	1930	1931
Gulf coast					
Anse la Butte			14	9	12
Bayou Bouillon			72	78	15
Black Bayou			(3)	177	477
Choctaw					104
Edgerly	361	379	245	161	109
Hackberry			1,783	1,213	1,399
Jennings	347	232	515	495	169
Lake Barre			46	388	1,021
Leesville					154
Lockport			1,369	1,131	1,906
Port Barre			33	970	450
Sorrento			110	30	53
Starks			170	206	260
Sulphur			1,374	1,362	567
Sweet Lake			93	193	459
Vinton	1,592	1,333	1,484	1,768	1,940
White Castle			(3)	300	329
Other	9	3	[7] 146	[8] 129	[9] 136
Total Gulf coast	2,309	1,947	7,454	8,610	9,560

District	1919	1920 [1]	1929	1930	1931
Northern					
Bellevue			255	233	93
Caddo	8,700	6,336	[2] 4,589	4,120	3,054
Cotton Valley			1,040	880	509
De Soto	1,200	(4)	276	247	192
Elm Grove			178	172	149
Haynesville			1,806	1,743	1,902
Holly				308	189
Homer	2,000	21,508	1,405	1,278	1,083
Pleasant Hill			(5)	178	115
Red River (Bull Bayou, Crichton)	2,900	[4] 5,923	987	838	713
Sarepta			(2)	[6] 888	[6] 259
Urania			2,155	1,976	1,448
Zwolle			[5] 409	1,801	2,536
Other	79				
Total northern	14,879	33,767	13,100	14,662	12,244
	17,188	35,714	20,554	23,272	21,804

1 Peak year.
2 Carterville and Sarepta included with Caddo.
3 Included under "Other."
4 De Soto included with Red River.
5 Pleasant Hill included with Zwolle.
6 Includes Carterville.
7 Bayou Blue, Black Bayou, Dog Lake, Lake Pelto, Welsh, and White Castle.
8 Bayou Blue, Caillou Island, Dog Lake, Lake Pelto, and Welsh.
9 Bayou Blue, Cameron Meadows, Iowa, Lake Pelto, Lake Washington, and Welsh.

Production of crude petroleum in Louisiana in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Gulf coast															
Black Bayou	31	26	23	46	47	38	46	46	42	43	40	41	469	8	477
Choctaw	-----	-----	-----	-----	-----	3	22	18	12	14	16	15	100	4	104
Edgerly	16	13	14	10	9	9	7	6	7	6	7	5	109	-----	109
Hackberry	134	96	85	79	72	51	44	57	102	177	234	251	1,382	17	1,399
Jennings	15	16	15	13	15	12	14	14	13	14	16	12	169	-----	169
Lake Barre	86	85	83	75	61	49	46	77	74	120	133	128	1,017	4	1,021
Leesville	-----	-----	2	4	13	4	5	35	24	18	14	34	153	1	154
Lockport	153	138	151	195	180	154	156	132	114	270	132	129	1,904	2	1,906
Port Barre	59	48	57	58	53	45	24	19	24	24	19	18	448	2	450
Sorrento	5	-----	-----	13	9	7	3	3	4	3	1	-----	48	5	53
Starks	19	22	24	23	24	24	22	20	21	21	21	19	260	-----	260
Sulphur	95	144	80	52	113	42	28	24	24	23	24	25	674	−107	567
Sweet Lake	40	27	35	29	42	53	46	49	31	45	29	29	455	4	459
Vinton	171	165	192	181	166	159	150	148	156	161	144	139	1,932	8	1,940
White Castle	31	28	28	41	52	18	23	24	23	28	17	14	327	2	329
Other [1]	3	7	6	4	7	4	2	18	6	8	10	48	123	40	163
Total Gulf coast: 1931	858	815	795	823	863	672	638	690	677	975	857	907	9,570	−10	9,560
1930	518	578	591	569	628	675	753	807	767	822	797	783	8,288	322	8,610
Northern															
Bellevue	20	17	17	18	13	8	1	-----	-----	-----	-----	-----	94	−1	93
Caddo	311	289	301	280	283	244	234	216	218	231	218	226	3,051	3	3,054
Cotton Valley	74	63	68	66	62	56	20	20	21	21	19	26	516	−7	509
De Soto	20	17	18	17	17	17	17	14	14	13	13	17	194	−2	192
Elm Grove	15	12	12	16	15	12	12	11	12	11	9	10	147	2	149
Haynesville	167	157	184	177	176	175	152	152	146	138	134	145	1,903	−1	1,902
Holly	28	20	18	17	16	15	14	14	12	13	11	11	189	-----	189
Homer	104	96	102	98	97	95	81	77	78	86	85	85	1,084	−1	1,083
Pleasant Hill	11	10	11	11	10	10	9	9	8	9	9	8	115	-----	115
Red River (Bull Bayou, Crichton)	68	60	67	62	63	60	60	57	56	56	53	52	714	−1	713
Sarepta [2]	40	33	28	27	24	23	15	17	15	13	12	13	260	−1	259
Urania	141	133	143	136	145	112	94	94	118	124	109	101	1,450	−2	1,448
Zwolle	238	297	239	217	240	212	207	205	189	179	167	142	2,532	6	2,538
Total northern: 1931	1,237	1,204	1,208	1,142	1,161	1,039	916	886	887	894	839	836	12,249	−5	12,244
1930	1,145	1,155	1,252	1,284	1,161	1,219	1,245	1,205	1,183	1,270	1,243	1,317	14,679	−17	14,662
Total Louisiana: 1931	2,095	2,019	2,003	1,965	2,024	1,711	1,554	1,576	1,564	1,869	1,696	1,743	21,819	−15	21,804
1930	1,663	1,733	1,843	1,853	1,789	1,894	1,998	2,012	1,950	2,092	2,040	2,100	22,967	305	23,272

[1] Anse la Butte, Bayou Blue, Bayou Bouillon, Cameron Meadows, Iowa, Lake Pelto, Lake Washington, and Welsh.
[2] Includes Carterville.

Michigan.—Michigan was affected by the general decline in drilling but the total output (3,789,000 barrels) was almost on a par with that in 1930 (3,911,000 barrels). The most important event of the year was the discovery of the east extension of the Mount Pleasant field, where a number of very prolific wells were completed in the Dundee sand between July and December. In spite of proration the total output of the Mount Pleasant field increased slightly and its relative importance as a producing factor in the State was considerably enhanced. The Leaton and Vernon pools northwest of Mount Pleasant proved to be small and lacked the large producing wells at Mount Pleasant. The older fields of Muskegon and Saginaw continued to decline. Drilling was at a standstill at Muskegon after the last deep test failed.

Production of crude petroleum in Michigan, 1927–31, by districts

[Thousands of barrels of 42 U.S. gallons]

Year	Leaton	Mount Pleasant	Muskegon	Otway	Saginaw	Vernon	Total
1927			(1)		[1] 439		439
1928		(2)	338		[2] 256		594
1929 [3]		1,394	3,019		115		4,528
1930		2,599	1,223		89		3,911
1931	[4] 300	2,608	577	[4] 1	59	[4] 244	3,789

[1] Muskegon included with Saginaw.
[2] Mount Pleasant included with Saginaw.
[3] Peak year.
[4] Department of Conservation, Michigan.

Production of crude petroleum in Michigan in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Leaton [1]	32	31	28	30	32	28	25	21	20	19	16	18	300		300
Mount Pleasant	166	138	192	170	157	155	194	157	249	301	334	401	2,614	−6	2,608
Muskegon	60	49	58	53	56	46	55	46	46	41	39	32	581	−4	577
Otway [1]												1	1		1
Saginaw	5	5	6	5	5	4	5	5	5	4	5	5	59		59
Vernon [1]	6	6	9	10	10	8	9	53	38	41	30	24	244		244
Total: 1931	269	229	293	268	260	241	288	282	358	406	424	481	3,799	−10	3,789
1930	420	394	378	360	336	337	356	300	251	251	253	267	3,903	8	3,911

[1] Department of Conservation, Michigan.

Montana.—Production in Montana totaled 2,830,000 barrels, a decline of slightly more than half a million barrels from 1930 due to slowing up of field operations, as only 13 oil wells were completed compared with 74 in 1930. The Border and Dry Creek fields were the only ones to gain in output in 1931. Drilling at Dry Creek had particular interest, as it disclosed the presence of a highly faulted structure upon which large wells could be offset by dry holes. In general, oil operations in the State were overshadowed by expansion of the natural-gas industry.

Production of crude petroleum in Montana, 1920, 1926, and 1929–31, by districts

[Thousands of barrels of 42 U.S. gallons]

Year	Border	Cat Creek	Dry Creek	Kevin-Sunburst	Pondera	Other	Total
1920		243				[1] 97	340
1926 [2]		1,015		6,630		82	7,727
1929		[3] 497		2,378	1,057	[4] 48	3,980
1930	120	418	15	1,998	739	[5] 59	3,349
1931	178	359	164	1,557	525	[5] 47	2,830

[1] Elk Basin.
[2] Peak year.
[3] Includes small amounts from Bannatyne and Devil's Basin.
[4] Elk Basin and Lake Basin.
[5] Bannatyne, Elk Basin, and Lake Basin.

Production of crude petroleum in Montana in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Border	14	21	20	15	18	16	13	12	12	12	10	15	178		178
Cat Creek	33	30	33	31	31	29	30	29	27	27	27	29	356	3	359
Dry Creek	14	18	26	21	16	14	12	11	9	9	7	6	163	1	164
Kevin-Sunburst	132	126	121	128	138	137	132	118	148	151	110	128	1,569	−12	1,557
Pondera	44	51	52	51	50	44	51	49	45	42	25	25	529	−4	525
Other [1]	6	5	3	3	4	3	4	3	3	3	2	4	43	4	47
Total: 1931	243	251	255	249	257	243	242	222	244	244	181	207	2,838	−8	2,830
1930	259	263	269	297	304	285	300	310	262	240	260	275	3,324	25	3,349

[1] Bannatyne, Elk Basin, and Lake Basin.

New Mexico.—Field activity was virtually at a standstill in New Mexico but the total output rose from 10,189,000 barrels in 1930 to 15,227,000 barrels in 1931. As a result of this 49 percent gain in output New Mexico advanced to sixth in rank as a producing State. The material gain in output in 1931, despite a virtual shut-down in field operations, was accomplished by drawing on the reserves of the Hobbs field. Although the daily potential production of the Hobbs field remained well over 1,000,000 barrels throughout the year, the actual daily production was usually restricted to around 35,000 barrels—the average approximate market demand. The fields in San Juan County in the northwest corner of the State were quiet throughout the year, and production declined. Continued efforts to prove a new deep sand in the Rattlesnake field were not successful.

Production of crude petroleum in New Mexico, 1925, 1926, and 1929–31, by districts

[Thousands of barrels of 42 U.S. gallons]

Year	Artesia	Hobbs	Hogback	Lea	Rattlesnake[1]	Total
1925	748	----------	187	----------	125	1,060
1926	1,016	----------	221	2	427	1,666
1929	323	(2)	120	[3] 899	488	1,830
1930	261	6,525	159	[4] 2,782	462	10,189
1931	426	12,788	176	[4] 1,490	347	15,227

[1] Includes Bloomfield in 1925; Bloomfield and Table Mesa in 1926; Hospah and Table Mesa in 1929; and Table Mesa in 1930 and 1931.
[2] Included with Lea.
[3] Includes Hobbs, Jal, Maljamar, and other pools in Lea County.
[4] Includes Jal, Maljamar, and other pools in Lea and Eddy Counties.

Production of crude petroleum in New Mexico in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Artesia	17	16	28	44	50	44	29	30	44	54	42	31	429	−3	426
Hobbs	943	832	984	997	1,173	1,085	1,123	1,142	1,095	1,140	1,128	1,130	12,772	16	12,788
Hogback	13	13	14	14	14	16	16	16	16	15	15	14	176	------	176
Lea	171	176	188	136	116	99	106	102	101	99	93	103	1,490	------	1,490
Rattlesnake[1]	35	35	19	27	17	42	26	36	26	30	30	24	347	------	347
Total: 1931	1,179	1,072	1,233	1,218	1,370	1,286	1,300	1,326	1,282	1,338	1,308	1,302	15,214	13	15,227
1930	362	303	335	364	569	732	1,331	1,265	1,228	1,239	1,161	1,209	10,098	91	10,189

[1] Includes Table Mesa.

New York.—Production in New York was 3,363,000 barrels, a decline of 8 percent from 1930, resulting principally from the curtailment efforts of the conservation board of the Pennsylvania Grade Crude-Oil Association. Proration was relaxed in the latter part of the year so that the output in December 1931 was considerably above that in December 1930. Virtually all the production in New York comes from the Bradford field, in which a substantial reserve has been built up by the "five-spot" method of water flooding; consequently, the amount produced depends largely upon the extent to which curtailment is exercised rather than upon the success attending new drilling.

Production of crude petroleum in New York, 1882, 1902, 1922, 1930, and 1931, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1882[1]	------	------	------	------	------	------	------	------	------	------	------	------	6,685
1902	------	------	------	------	------	------	------	------	------	------	------	------	1,120
1922	77	73	80	78	95	85	85	83	94	85	85	80	1,000
1930	314	327	369	373	392	326	275	213	263	285	248	262	3,647
1931	251	241	264	269	268	286	275	257	299	324	291	338	3,363

[1] Peak year.

Ohio.—The petroleum industry in Ohio (as in most of the Eastern States) was marked by a material decline in drilling, decreased production, virtually no wildcatting, and hence few new discoveries of importance. The total output was 5,327,000 barrels, a decline of 18 percent from 1930. The output in 1931 was undoubtedly influenced by activities of the producers' conservation board, although the late recovery which followed lifting of proration in most of the other States that produce Pennsylvania-grade crude was not evidenced in Ohio. The output in the central and eastern fields declined relatively more than in the Lima district of northwestern Ohio, yet the former continued to outrank the latter by far in production and general interest.

Production of crude petroleum in Ohio, 1896, 1906, 1916, 1930, and 1931, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Central and eastern Ohio:													
1896	322	282	293	291	287	279	274	270	255	271	252	290	3,366
1906	432	377	427	417	428	414	404	427	400	413	389	379	4,907
1916	356	345	385	371	402	423	390	409	376	389	386	377	4,609
1930	446	423	436	464	463	450	457	402	417	441	367	408	5,174
1931	391	356	389	375	368	364	313	290	345	355	322	344	4,212
Northwestern Ohio:													
1896	1,636	1,524	1,674	1,698	1,776	1,822	1,844	1,790	1,739	1,770	1,612	1,690	20,575
1906	912	803	861	854	884	870	854	832	752	798	743	718	9,881
1916	247	253	288	272	287	277	265	270	250	260	248	219	3,136
1930	101	112	109	120	123	120	121	107	109	108	86	96	1,312
1931	105	91	93	93	93	100	98	82	95	98	78	89	1,115
Total, Ohio:													
1896[1]	1,958	1,806	1,967	1,989	2,063	2,101	2,118	2,060	1,994	2,041	1,864	1,980	23,941
1906	1,344	1,180	1,288	1,271	1,312	1,284	1,258	1,259	1,152	1,211	1,132	1,097	14,788
1916	603	598	673	643	689	700	655	679	626	649	634	596	7,745
1930	547	535	545	584	586	570	578	509	526	549	453	504	6,486
1931	496	447	482	468	461	464	411	372	440	453	400	433	5,327

[1] Peak year.

Oklahoma.—The production of crude petroleum in Oklahoma totaled 180,574,000 barrels, a decline of 17 percent from 1930 and nearly 100,000,000 barrels below the peak attained in 1927.

Although the year was somewhat deficient in production and monetary return to the producers it had outstanding historical interest, chiefly because of the severe decline in crude prices, the consequent abandonment of many stripper wells, and the use of militia to enforce proration.

The price of 34° to 34.9° gravity oil in Oklahoma began the year at \$0.89 but fell to \$0.16 in July due to the decline of prices in East Texas. The generally unsatisfactory condition led to issuance of an executive order on August 4 under which all prorated wells in the State were shut down. The stated purpose of this shut-down was to reduce the supply enough to raise the price of average grades to \$1 per barrel. In spite of the fact that some Oklahoma consumers arranged to obtain crude supplies out of the State, principally from East Texas, the market strengthened so that on August 24 one major purchaser announced its willingness to pay \$1 for crude. However, the majority of the purchasers did not believe that price to be justified by economic conditions and kept their top quotation at \$0.70. The martial order was withdrawn on October 10.

Little wildcatting was undertaken in 1931, and few discoveries of importance were made. Seminole was inactive, and its production declined to 39 percent below 1930. Production in the Oklahoma City field increased 30 percent to a total of 44,823,000 barrels and would have been much larger if the field had not been prorated for 10 months and virtually closed in for the other 2. From the standpoint of drilling the Oklahoma City field was the most active area, as nearly half the 498 oil wells completed were located there. Due to water encroachment the Arbuckle lime horizon ceased to be a production factor in that field. On the other hand, the Wilcox sand on the west side of the structure yielded many sensational producers, very few of which have experienced water troubles. Other active areas in the State were Wewoka Townsite, which aroused considerable interest early in the year, and Chandler, Lincoln County, which developed a considerable potential but was restricted to 2,000 or 3,000 barrels actual daily production.

Production of crude petroleum in Oklahoma, 1907, 1917, 1927, 1930, and 1931, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1907	------	------	------	------	------	------	------	------	------	------	------	------	43, 524
1917	8, 564	7, 930	9, 475	8, 939	8, 963	8, 996	9, 564	9, 042	9, 013	9, 560	9, 143	8, 319	107, 508
1927 [1]	18, 596	19, 951	22, 341	21, 407	23, 400	23, 516	26, 810	26, 377	24, 424	24, 704	23, 767	22, 482	277, 775
1930	20, 276	17, 643	19, 361	19, 919	21, 204	19, 570	17, 967	17, 010	16, 553	16, 882	15, 095	15, 006	216, 486
1931	15, 044	14, 160	17, 088	17, 437	18, 026	17, 683	16, 233	9, 117	8, 414	13, 724	16, 649	16, 999	180, 574

[1] Peak year.

Production of crude petroleum in Oklahoma in 1931, by districts and months [1]

[Thousands of barrels of 42 U.S. gallons]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Allen	402	355	395	353	368	348	337	211	160	251	340	320	3, 840
Asher	299	247	257	239	249	237	216	108	66	139	172	129	2, 358
Bowlegs	384	352	433	432	457	431	421	206	143	290	414	429	4, 392
Bristow, Depew, etc	366	326	340	320	313	300	292	295	291	290	267	261	3, 661
Burbank	367	362	393	380	402	390	418	379	371	375	363	366	4, 566
Chandler	40	38	42	39	75	63	56	26	14	65	104	112	674
Carr City	395	357	389	380	409	380	385	140	34	225	555	613	4, 262
Cromwell	130	135	144	144	170	149	174	178	170	172	163	168	1, 897
Cushing-Shamrock	385	359	432	405	410	390	387	380	391	377	368	372	4, 656
Earlsboro	555	285	576	569	597	530	524	336	259	344	502	462	5, 539
East Earlsboro	569	512	579	540	513	505	504	198	64	287	465	461	5, 197
East Little River	317	269	273	198	173	157	149	116	84	110	107	70	2, 023
Glenn	204	166	180	202	169	162	169	150	144	128	134	130	1, 938
Healdton	321	298	327	300	355	338	353	354	344	352	337	346	4, 025
Henryetta, etc	182	156	168	160	174	156	162	156	149	152	143	143	1, 901
Hewitt	187	172	189	173	188	180	169	180	174	182	172	180	2, 146
Konawa	507	433	412	306	298	255	201	93	47	135	227	204	3, 118
Little River	684	632	768	718	788	723	666	436	281	437	654	635	7, 422
Mission	206	179	230	252	275	246	231	109	57	151	262	270	2, 468
Nowata County	81	143	150	143	146	140	178	178	150	156	151	152	1, 768
Oklahoma City	2, 623	2, 544	4, 173	4, 984	5, 049	5, 164	4, 969	700	322	3, 467	5, 263	5, 565	44, 823
Osage (outside Burbank)	588	526	561	550	601	560	631	534	523	600	565	563	6, 802
St. Louis-Pearson	650	568	722	702	691	676	659	503	395	481	628	603	7, 278
Seminole City	413	374	423	409	429	412	397	254	173	265	434	387	4, 370
Sholem-Alechem	394	360	409	405	434	414	427	242	244	419	410	422	4, 580
Tonkawa	152	148	190	172	170	158	169	166	171	171	161	164	1, 992
Washington County	69	135	159	156	155	147	149	149	121	125	121	121	1, 607
Wewoka	190	228	262	269	275	259	275	177	141	211	277	280	2, 844
Yale, Quay, etc	93	89	91	92	94	89	95	89	124	124	116	116	1, 212
Other	3, 098	2, 784	2, 961	2, 824	2, 907	2, 719	2, 657	2, 474	2, 340	2, 471	2, 556	2, 554	32, 345
	14, 851	13, 532	16, 628	16, 816	17, 334	16, 678	16, 420	9, 517	7, 947	12, 952	16, 431	16, 598	175, 704

[1] Monthly estimates by districts from Oil and Gas Journal.

Pennsylvania.—Production in Pennsylvania totaled 11,892,000 barrels compared with 12,803,000 barrels in 1930. This decline in annual production, the first since 1924, resulted chiefly from curtailment measures and from a material decrease in drilling following cuts in crude prices. As in New York, the output in Pennsylvania in 1931 was influenced by the curtailment program of the conservation board of the Pennsylvania Grade Crude Oil Association, which after an economic study decided that production in the Bradford field should be curtailed to 50 percent of the 1930 normal and that other fields should be curtailed to 70 percent of the 1930 normal. General adherence to this program reduced stocks materially and constituted a controlling factor in increased prices in November. The restrictions on production were then relaxed, development work increased, and the trend in storage was reversed.

Interest in natural gas, which had been spurred by the discovery of the Tioga field in 1930, was continued, and the number of gas wells completed was the highest in several years. On the other hand, the number of oil wells completed in Pennsylvania (including New York) totaled only 496 compared with 2,083 in 1930.

Data of the Department of Internal Affairs indicate that 18 counties produced crude petroleum in 1931. Of these, McKean County was by far the most important, as it yielded 71 percent of the State output.

Production of crude petroleum in Pennsylvania, 1891, 1901, 1911, 1930, and 1931, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1891[1]													31,424
1901													12,625
1911	697	638	723	701	765	704	668	705	662	690	623	672	8,248
1930	1,162	1,127	1,217	1,298	1,312	1,109	939	862	911	1,008	946	912	12,803
1931	936	850	924	935	942	937	935	941	1,087	1,204	1,072	1,129	11,892

[1] Peak year.

Production of crude petroleum and number of producing oil wells in Pennsylvania in 1931, by counties [1]

County	Production (thousands of barrels)	Total number of producing oil wells	County	Production (thousands of barrels)	Total number of producing oil wells
Allegheny	294	1,606	McKean	8,386	28,803
Armstrong	25	254	Mercer	15	381
Beaver	59	800	Potter	6	231
Butler	564	5,750	Venango	1,084	25,942
Clarion	169	2,554	Warren	303	6,310
Crawford	105	1,281	Washington	420	1,764
Elk	84	1,255	Westmoreland	(2)	
Forest	93	1,517			
Greene	208	766		11,844	79,881
Jefferson	6	157	Bureau of Mines	11,892	79,930
Lawrence	23	510			

[1] Department of Internal Affairs, Pennsylvania.
[2] Less than 500 barrels from gas wells.

Tennessee.—Production in Tennessee declined almost to the vanishing point and totaled only 6,000 barrels, less than for any year since 1916. As in 1930, no oil wells were completed. A small refinery, placed in operation in 1931, utilized the major portion of the output.

Production of crude petroleum in Tennessee, 1917, 1927, and 1929–31, by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1917	------	1	1	------	1	------	------	1	4	2	1	1	12
1927 [1]	5	4	3	4	5	4	5	9	5	6	6	4	60
1929	2	2	1	3	2	1	2	2	1	2	1	------	19
1930	2	1	1	1	2	1	3	3	1	1	3	2	21
1931	------	2	------	1	1	------	1	------	------	------	1	------	6

[1] Peak year.

Texas.—The Texas Panhandle was prorated most of the year and yielded only 21,851,000 barrels compared with 31,777,000 barrels in 1930. Although the potential of the district was considered to be over 100,000 barrels daily throughout the year it is doubtful if the 1930 total could have been exceeded in 1931, even with unrestricted flow. Field work fell to a low ebb in the Panhandle, and only 93 oil wells were brought in compared with 343 in 1930. As in 1930, more than two thirds of the oil wells completed were in Gray County. A few new producing areas were discovered in the Panhandle in 1931, but scarcely any of the later completions met expectations.

Production in north Texas, including the district commonly called "west central Texas", declined 33 percent in 1931. This material decrease resulted primarily from curtailed purchases by the pipe-line companies, although a severe decline in drilling naturally tended to lower the output. Because of economic conditions the expenses of the operating companies were reduced to a minimum, entailing the surrender of many leases and virtual cessation of exploratory work. As a result of this retrenchment very few wildcats were drilled in north Texas in 1931, and important discoveries were few.

The greater east Texas district, comprising the East Texas field proper, Boggy Creek, Van, and scattered pools in Panola, Nacogdoches, and other counties, was by far the most important producing area in the country in 1931. Production at Van was 15,598,000 barrels—more than double the 1930 output—but that field was eclipsed by the East Texas field proper, in Rusk, Gregg, Smith, and Upshur Counties. The discovery well was completed in October 1930, in Rusk County, in what is now called the "Joiner pool"; but the first large well was brought in near Kilgore, also in Rusk County, just before the end of 1930. Any doubt as to the possibilities of the area was dispelled when the field was extended into the Lathrop district, Gregg County, in the latter part of January 1931. A few months later the producing area was extended into Upshur and Smith Counties, virtually proving a total of 100,000 acres for production in four counties. From the standpoint of area the East Texas field far outranks all other known fields of the world. The prevalence of small, irregular leases, easy drilling, and the fact that only a few major companies had protected themselves with large blocks of acreage led to a competitive drilling campaign.

In spite of the number of restrictive orders from the Railroad Commission production increased rapidly and by the middle of August reached 1,000,000 barrels daily. As production mounted prices declined, and considerable oil was sold for as low as 5 cents per barrel. Conditions became so chaotic that on August 17 the Governor issued an order shutting down the field and called out the militia to enforce it. The shut-down lasted nearly three weeks, during which time surplus stocks were used up and a program was devised under which the field could be operated without demoralizing the entire crude-oil market. Under this program the daily output of each well was restricted to 225 barrels, which at first allowed a daily total of about 400,000 barrels for the field. Later, as more wells were completed, the daily allowable per well was progressively reduced and on December 31, 1931, was only 100 barrels. Inauguration of this curtailment program had an almost immediate effect on prices, which rose from $0.25 to $0.68 per barrel on August 22 and to $0.83 on November 2. Little, if any, limitation was placed on drilling, and the number of producing wells rose rapidly. At the end of the year there were about 3,600 wells in the East Texas field proper, and about 15 new wells were being brought in daily. The total production of the East Texas field in 1931 was 109,561,000 barrels, far more than any other producing field in 1931.

Production in the fields of central Texas, including those along and near the Balcones fault zone, declined 27 percent from 1930. The only important increase was in the Pettus field, Bee County. Darst Creek, which was very active in 1930, showed a material decline in production, as did the nearby fields, Luling and Salt Flat. Drilling and exploratory work in the central Texas district declined in 1931, although wildcatting was quite active in the Pettus area throughout the year.

Production in coastal Texas decreased from 61,066,000 barrels in 1930 to 48,032,000 barrels in 1931. This decline was due partly to a falling off in field development, although voluntary curtailment by the comparatively few large companies which control most of the production probably had a more far-reaching effect.

Unlike other important producing districts the Texas Gulf coast comprises several dozen fields with a considerable production but lacks an outstanding field. The Spindletop field has come closest to dominating production in the Gulf coast but in late years has declined greatly in importance. The leading field in the Texas Gulf coast in 1931 was Refugio, but that only yielded 9,274,000 barrels, less than 20 percent of the total output. Barbers Hill continued active and again ranked second as a producing field in the district.

Geophysical prospecting fell to a low ebb in the coastal district in 1931, and no pronounced domes were discovered. However, drilling on domes located before 1931 resulted in the opening of four new fields: Rabb Ridge, Fort Bend County; McFaddin, Refugio County; Manvel, Brazoria County; and Conroe, Montgomery County. Of these, only Rabb Ridge developed substantial production in 1931. The Conroe field, discovered late in the year, was destined to become important in 1932.

The west Texas district lost its position as the leading producing area in Texas in 1931, when its output declined to 78,524,000 barrels from 108,730,000 barrels in 1930. This material decline resulted from proration in the Yates and Penn pools; from decreases in the Hendricks, Crane-Upton, and other pools; and from a sharp decline in drilling. The Yates pool, the largest field in the district and famed for its high potential (nearly 5,000,000 barrels daily in 1931), declined in output from 41,338,000 barrels in 1930 to 28,226,000 barrels in 1931 as the proration allowable was progressively reduced. The Hendricks field continued to decline, due to virtual cessation of drilling and the water encroachment. The Big Lake field, noted for its well producing from below 8,000 feet, again increased in output. Undoubtedly, this gain resulted from increased output from the deep zone, as production in the 3,000-foot zone has been declining for several years. Petroleum engineering continued to be an important factor in the operation of the deep wells at Big Lake in 1931, as methods were developed by which the production of oil was increased but the output of gas, for which there is little market in the area, was lowered. Drilling in virtually all west Texas fields was greatly curtailed, and only 170 oil wells were completed compared with 495 in 1930. Ward County was the most active area; Pecos County, the leader in 1930 with 141 completed oil wells, had only 21. West Texas was almost completely eclipsed by east Texas; in fact, large amounts of equipment, including refineries, tanks, and drilling rigs, were moved from west Texas to east Texas.

Southwest Texas, comprising principally the fields near Laredo, had a production of 5,002,000 barrels, the highest annual total since the district became a commercial producer in 1922. The number of oil wells completed in 1931 was less than half the 1930 total; hence, the probable explanation of the increase in output is that the district was virtually free from proration.

Production of crude petroleum in Texas, 1901, 1911, 1921, 1930, and 1931

[Thousands of barrels of 42 U.S. gallons]

District and field	1901	1911	1921	1930	1931
Gulf coast:					
Barbers Hill	-	-	(1)	7,441	7,651
Batson	-	1,023	495	418	330
Big Creek	-	-	-	1,390	858
Blue Ridge	-	-	326	644	378
Boling	-	-	-	378	269
Clay Creek	-	-	-	-	553
Corpus Christi	-	-	-	(2)	152
Damon Mound	-	-	666	224	282
Dayton	-	4	40	406	202
Esperson	-	-	-	819	712
Fannette	-	-	-	350	180
Goose Creek	-	-	[1] 4,640	1,690	1,460
Hankamer	-	-	-	546	798
High Island	-	-	-	331	255
Hull	-	-	8,150	3,128	2,264
Humble	-	2,426	3,004	5,859	3,022
Kingsville	-	-	-	41	29
Lost Lake	-	-	-	209	96
Markham	-	562	49	98	218
Moss Bluff	-	-	-	(2)	154
Nash	-	-	-	110	187
Orange	-	-	470	790	618
Orchard	-	-	-	636	495
Pierce Junction	-	-	1,239	3,847	2,831
Port Neches	-	-	-	672	503
Rabb Ridge	-	-	-	-	808
Raccoon Bend	-	-	-	3,893	2,704
Refugio	-	-	-	11,485	9,274
Saratoga	-	926	1,129	380	360

[1] Barbers Hill included with Goose Creek.
[2] Included under "Other."

Production of crude petroleum in Texas, 1901, 1911, 1921, 1930, and 1931—Contd.

District and field	1901	1911	1921	1930	1931
Gulf coast—Continued.					
Sourlake		1,365	1,802	806	675
South Liberty				1,503	694
Spindletop	3,593	966	344	6,176	3,301
Sugarland				4,274	4,216
West Columbia			12,081	1,827	1,310
Other		3	6	[3] 695	[4] 193
Total Gulf coast	3,593	7,275	34,441	61,066	48,032
East Texas:					
East Texas proper [5]					109,561
Boggy Creek				1,133	618
Van				7,330	15,598
Other		678	48	109	69
Total east Texas		678	48	8,572	125,846
Central Texas:					
Darst Creek				11,552	8,196
Luling				3,692	2,964
Lytton Springs				489	378
Mexia [6]	801	502	6,137	4,621	3,201
Pettus				1,730	2,360
Rockdale-Chapman			52	1,906	1,305
Salt Flat (Bruner)				7,305	4,372
Somerset-Medina			324	566	576
Other		3		12	19
Total central Texas	801	505	6,513	31,873	23,371
North Texas [7]		1,068	65,164	44,301	29,811
Panhandle [8]				31,777	21,851
Southwest Texas [9]				4,138	5,002
West Texas:					
Big Lake				7,050	9,444
Chalk-Roberts [10]				11,999	10,413
Crane-Upton				14,451	8,524
Ector				3,168	2,597
Fisher				532	270
Hendricks				26,404	15,510
Loving				663	1,237
Taylor-Link				1,389	502
Ward				931	1,152
World				693	550
Yates				41,338	28,226
Other				112	99
Total west Texas				108,730	78,524
Grand total	4,394	9,526	106,166	290,457	332,437

[3] Allen, Clay Creek, Corpus Christi, Moss Bluff, and Mykawa.
[4] Agua Dulce, Allen, Lucas, Manvel, Mykawa, and Saxet.
[5] Joiner, Kilgore, Lathrop, and other pools in Gregg, Rusk, Smith, and Upshur Counties.
[6] Corsicana, Nigger Creek, Powell, Richland, Wortham, and smaller field in Falls, Freestone, Limestone, and Navarro Counties.
[7] Districts in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[8] Carson, Gray, Hutchinson, Moore, Potter and Wheeler Counties.
[9] Duval, Jim Hogg, Live Oak, McMullen, Starr, Webb, and Zapata Counties.
[10] Includes Scurry and Westbrook.

Production of crude petroleum in Texas in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District and field	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	Total		
Gulf coast:															
Barbers Hill	658	584	566	786	849	643	580	516	512	588	690	609	7,581	70	7,651
Batson	31	28	30	29	28	27	22	22	34	27	22	29	329	1	330
Big Creek	90	77	95	98	90	77	72	64	54	53	47	42	859	−1	858
Blue Ridge	45	36	32	35	36	33	31	28	31	21	23	29	380	−2	378
Boling	29	22	23	22	22	27	24	21	20	20	17	20	267	2	269
Clay Creek	118	76	114	80	73			6	41	35	23	20	586	−33	553
Corpus Christi	2	2	7	7	11	18	16	15	15	19	18	22	152		152
Damon Mound	18	15	17	17	14	15	61	27	18	19	27	33	281	1	282
Dayton	24	15	19	18	14	19	18	17	17	14	15	12	202		202
Esperson	76	63	73	65	61	53	49	72	52	50	49	49	712		712
Fannette	21	20	16	14	15	15	12	15	13	14	14	12	181	−1	180
Goose Creek	137	124	130	125	132	121	120	121	110	115	109	113	1,457	3	1,460
Hankamer	72	68	75	77	79	60	69	60	56	63	60	60	799	−1	798
High Island	19	7	15	13	9	9	6	13	29	28	42	44	234	21	255
Hull	233	184	192	188	209	190	157	181	182	180	182	171	2,249	15	2,264
Humble	325	267	301	300	294	272	241	228	208	209	182	186	3,013	9	3,022
Kingsville	4	3	2	3	3	2	2	3	3	3	2	1	31	−2	29
Lost Lake	11	10	4	8	9	9		10	8	6	7	7	89	7	96
Markham	6	4	5	5	6	4	7	10	33	44	40	57	221	−3	218
Moss Bluff	13	11	14	16	9	9	7	17	13	16	12	14	151	3	154
Orange	69	58	56	59	58	51	45	43	43	46	49	47	624	−6	618
Orchard	76	59	55	51	28	35	35	36	39	28	29	25	496	−1	495
Pierce Junction	274	239	275	251	261	247	242	222	207	219	198	185	2,820	11	2,831
Port Neches	50	44	46	44	42	41	39	38	34	38	41	39	496	7	503
Rabb Ridge						47	78	78	66	69	184	276	798	10	808
Raccoon Bend	263	243	278	262	251	228	218	213	191	197	182	179	2,705	−1	2,704
Refugio	910	939	919	958	928	829	814	742	659	641	498	452	9,289	−15	9,274
Saratoga	23	25	31	32	39	37	35	29	31	30	30	24	366	−6	360
Sourlake	62	55	60	58	59	55	53	52	56	56	53	48	667	8	675
South Liberty	82	71	70	64	59	53	50	50	49	47	46	47	688	6	694
Spindletop	412	353	363	315	311	272	263	243	201	200	188	183	3,304	−3	3,301
Sugarland	376	337	372	352	358	333	372	370	343	349	331	321	4,214	2	4,216

West Columbia [1]	137	120	135	126	125	120	122	121	121	118	114	111	1,470	27	1,497
Other [2]	13	5	5	8	8	8	10	9	39	13	36	38	192	1	193
Total Gulf coast	4,679	4,164	4,395	4,486	4,490	3,959	3,870	3,692	3,528	3,575	3,560	3,505	47,903	129	48,032
East Texas:															
East Texas proper [3]	101	667	2,887	7,601	9,773	10,867	16,106	13,431	10,497	12,867	11,999	11,116	107,912	1,649	109,561
Boggy Creek	71	70	73	65	60	57	55	48	30	31	30	33	623	−5	618
Van	858	853	1,093	1,191	1,388	1,482	1,361	1,401	1,484	1,523	1,486	1,460	15,580	18	15,598
Other	6	6	7	5	6	6	5	5	5	6	6	6	69	--------	69
Total east Texas	1,036	1,596	4,060	8,862	11,227	12,412	17,527	14,885	12,016	14,427	13,521	12,615	124,184	1,662	125,846
Central Texas:															
Darst Creek	996	796	863	700	604	611	644	662	608	602	545	534	8,165	31	8,196
Luling	287	255	274	262	251	224	234	231	227	228	222	234	2,929	35	2,964
Lytton Springs	35	33	36	32	32	32	31	28	32	30	28	29	378	--------	378
Mexia [4]	365	316	339	299	302	276	247	210	210	219	211	211	3,205	−4	3,201
Pettus	247	214	215	208	213	189	189	172	166	177	168	175	2,333	27	2,360
Rockdale-Chapman	195	145	142	127	120	105	101	88	79	73	66	64	1,305	--------	1,305
Salt Flat (Bruner)	426	450	427	366	388	365	351	350	325	328	313	283	4,372	--------	4,372
Somerset-Medina	51	48	49	47	45	56	46	45	50	48	45	46	576	--------	576
Other	1	1	1	1	2	2	2	1	1	2	1	1	16	3	19
Total central Texas	2,603	2,258	2,346	2,042	1,957	1,860	1,845	1,787	1,698	1,707	1,599	1,577	23,279	92	23,371
North Texas [5]	2,702	2,291	2,585	2,474	2,525	2,580	2,428	2,371	2,538	2,557	2,414	2,420	29,885	−74	29,811
Panhandle [6]	1,850	1,533	1,624	1,719	2,126	1,883	1,804	1,862	2,013	2,097	1,768	1,700	21,979	−128	21,851
Southwest Texas [7]	415	372	406	396	402	364	387	359	386	474	504	537	5,002	--------	5,002
West Texas:															
Big Lake	825	836	870	763	601	838	809	770	748	749	856	779	9,444	--------	9,444
Chalk-Roberts [8]	874	740	815	963	981	934	892	935	881	835	782	795	10,427	−14	10,413
Crane-Upton	891	705	747	748	755	666	694	647	587	665	710	686	8,501	23	8,524
Ector	243	207	232	201	212	201	216	237	232	221	199	192	2,593	4	2,597
Fisher	22	22	23	21	18	18	23	26	25	25	23	24	270	--------	270
Hendricks	1,644	1,420	1,473	1,404	1,404	1,307	1,227	1,246	1,140	1,167	1,068	1,117	15,617	−107	15,510
Loving	93	89	114	99	106	106	85	109	118	111	102	102	1,234	3	1,237
Taylor-Link	63	53	51	50	46	39	35	32	38	32	33	30	502	--------	502
Ward	103	95	100	102	109	99	91	67	67	101	111	105	1,150	2	1,152
World	57	52	56	51	50	49	41	40	39	38	37	37	547	3	550
Yates	2,917	2,624	2,947	2,367	2,363	2,200	2,226	2,226	2,138	2,168	2,026	1,980	28,182	44	28,226
Other	7	4	5	2	8	4	3	14	14	15	13	10	99	--------	99
Total west Texas	7,739	6,847	7,433	6,771	6,653	6,461	6,342	6,340	6,027	6,127	5,960	5,857	78,566	−42	78,524
Total Texas: 1931	21,024	19,061	22,849	26,750	29,380	29,519	34,203	31,305	28,206	30,964	29,326	28,211	330,798	1,639	332,437
1930	24,604	23,262	25,458	25,056	25,971	25,081	25,687	25,149	23,162	23,815	21,718	20,931	289,894	563	290,457

[1] Includes 187,000 barrels produced in Nash.
[2] Agua Dulce, Allen, Lucas, Manvel, Mykawa, and Saxet.
[3] Joiner, Kilgore, Lathrop, and other pools in Gregg, Rusk, Smith, and Upshur Counties.
[4] Corsicana, Nigger Creek, Powell, Richland, Wortham, and smaller fields in Falls, Freestone, Limestone, and Navarro Counties.
[5] Districts in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north, and Runnels, Coleman, Brown, and Comanche Counties on the south.
[6] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[7] Duval, Jim Hogg, Live Oak, McMullen, Starr. Webb, and Zapata Counties.
[8] Includes Scurry and Westbrook.

West Virginia.—Natural decline of the producing wells, some voluntary curtailment, and a material decrease in field work were the chief factors contributing to the 12 percent decrease in the West Virginia output. The production was 4,472,000 barrels, the smallest annual total since 1892.

Production of crude petroleum in West Virginia, 1900, 1910, 1920, 1930, and 1931 by months

[Thousands of barrels of 42 U.S. gallons]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1900 [1]	1,264	1,148	1,318	1,288	1,400	1,389	1,431	1,440	1,354	1,464	1,356	1,344	16,196
1910	1,026	935	1,050	963	1,002	1,019	985	1,020	976	935	907	935	11,753
1920	684	619	772	660	663	701	679	694	679	680	663	755	8,249
1930	462	443	449	471	475	451	444	355	372	417	350	382	5,071
1931	379	346	376	376	373	380	365	347	381	415	352	382	4,472

[1] Peak year.

Wyoming.—Production in Wyoming continued to decline, and the output was 17 percent below that in 1930. The yield of Salt Creek, the principal field, fell 16 percent. Gains were recorded in a few fields, notably Grass Creek, where a repressuring program was begun; Frannie, which yielded its first commercial production; and Lost Soldier, where a new sand was developed. Oregon Basin, which ranked second in production in 1930, declined materially in 1931 after a pronounced drop in the demand for the heavy oil produced there.

Drilling reached a low ebb, and only 40 oil wells were completed in 1931. The majority of the new wells completed were in the Osage field, Weston County. Comparatively few new discoveries were made in Wyoming in 1931; the discoveries of deeper sands in the Big Muddy and Midway fields were regarded as most important.

Production of crude petroleum in Wyoming, 1913, 1923, and 1929–31, by districts

[Thousands of barrels of 42 U.S. gallons]

Year	Big Muddy	Byron-Grey-bull-Torch-light	Elk Basin	Frannie	Grass Creek	Hamil-ton Dome-Warm Springs	La Barge	Lance Creek	Lander-Dallas-Derby Dome	Lost Soldier	Mule Creek
1913		50							32		
1923 [1]	1,527	57	634		1,589	216		363	137	[2] 1,551	
1929	802	26	265		778	355	805	87	209	[3] 1,311	141
1930	711	49	264		729	300	747	60	252	[3] 1,271	29
1931	649	3	250	214	746	87	466	94	358	[3] 1,349	

Year	Oregon Basin	Osage	Pilot Butte	Poison Spider-South Casper	Rex Lake	Rock Creek	Salt Creek	Teapot	Other	Total
1913							2,297		28	2,407
1923		178	29			1,429	35,770	1,156	149	44,785
1929	1,540	166	18	[4] 446	36	842	11,377		110	19,314
1930	1,285	385	16	[4] 323	6	770	[5] 10,531		[6] 140	17,868
1931	393	419	14	[4] 199		682	8,834		[7] 77	14,834

[1] Peak year.
[2] Includes Ferris.
[3] Includes Ferris and Tensleep.
[4] Includes Simpson Ridge.
[5] Includes 11,000 barrels from East Teapot Dome.
[6] Frannie and other fields.
[7] Dutton Creek and other fields.

Production of crude petroleum in Wyoming in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

District	Petroleum transported from producing properties														
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
Big Muddy	58	53	59	59	57	54	54	52	51	52	48	51	648	1	649
Elk Basin	22	20	21	22	23	21	21	19	20	21	19	21	250	------	250
Frannie	22	22	25	23	17	14	2	1	4	4	35	45	214	------	214
Grass Creek	63	56	61	62	60	63	62	70	60	69	58	62	746	------	746
Hamilton Dome-Warm Springs	-----	-----	-----	-----	-----	3	2	2	1	23	40	16	87	------	87
La Barge	53	49	52	39	37	35	34	31	34	31	34	37	466	------	466
Lance Creek	5	5	6	5	7	8	9	18	11	8	7	6	95	−1	94
Lander-Dallas	25	31	28	33	32	33	31	27	26	28	24	32	350	8	358
Lost Soldier-Ferris-Tensleep	110	135	90	141	125	120	95	131	89	92	133	93	1,354	−5	1,349
Oregon Basin	48	37	43	44	64	41	38	54	24	7	2	-----	402	−9	393
Osage	41	39	39	40	40	33	38	34	23	14	26	37	404	15	419
Poison Spider-South Casper	9	14	20	27	31	27	31	28	5	2	2	2	198	1	199
Rock Creek	63	55	59	59	59	58	59	58	54	55	51	53	683	−1	682
Salt Creek	821	739	775	784	760	764	754	716	699	693	647	712	8,864	−30	8,834
Other [1]	6	1	1	2	2	18	11	4	19	3	2	12	81	13	94
Total: 1931	1,346	1,256	1,279	1,340	1,314	1,292	1,241	1,245	1,120	1,102	1,128	1,179	14,842	−8	14,834
1930	1,448	1,417	1,592	1,558	1,575	1,422	1,415	1,492	1,510	1,553	1,415	1,431	17,834	34	17,868

[1] Dutton Creek and other fields.

WORLD PRODUCTION

The total world production of crude petroleum was 1,372,532,000 barrels (189,475,000 metric tons), 39,373,000 barrels (3 percent) less than in 1930. This decline resulted from the decreased output in the United States, as the production in other countries showed a small gain. The ratio of production in the United States to the world total has declined steadily in recent years, as most foreign countries have been more desirous to exploit new discoveries. In 1931 the United States accounted for 62.0 percent of the total world production compared with 63.6 percent in 1930. (See fig. 40.)

Russia (U.S.S.R.) increased its output 30 percent and displaced Venezuela as the second-ranking producing country. Due to greatly curtailed operations production in Venezuela decreased 15 percent.

In 1930 Persia, Rumania, Netherland East Indies, Mexico, and Colombia ranked fourth to eighth, respectively. In 1931, Rumania and Persia changed places, but the other three countries retained their relative positions. Production in Mexico continued to decline, and the total in 1931 (33,039,000 barrels) was only 17 percent of that in 1921, the peak year. Of particular interest were the increases in Germany and Italy.

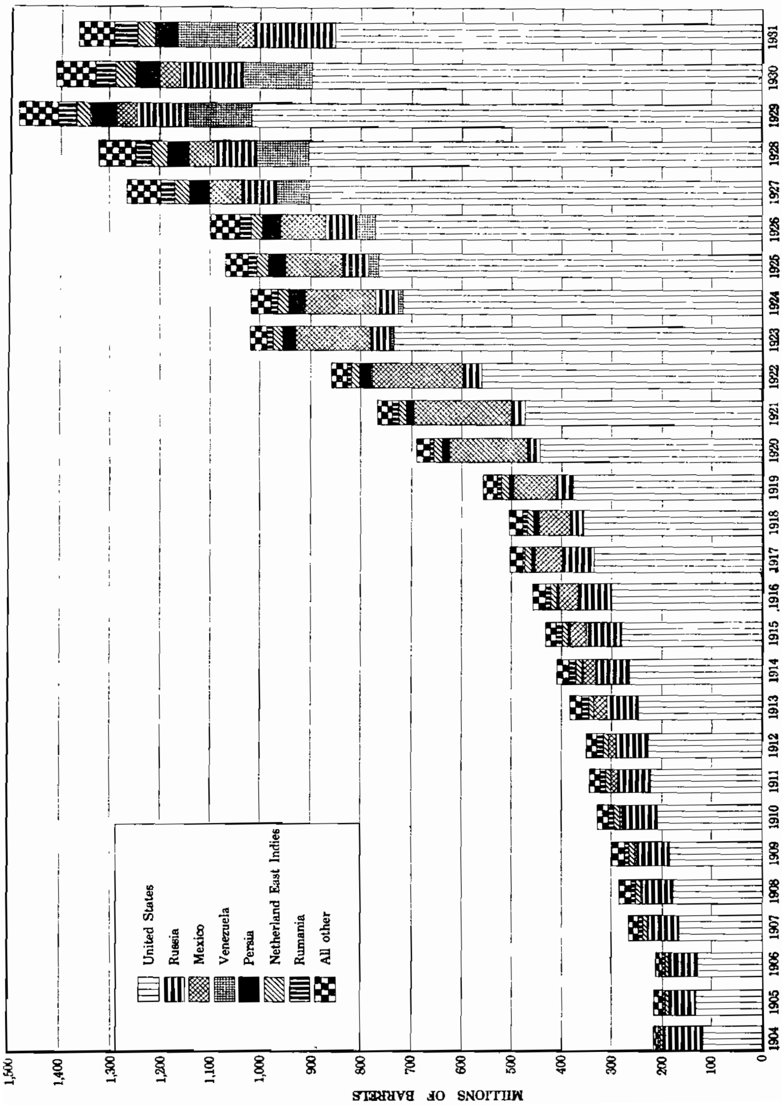

FIGURE 40.—World production of crude petroleum, 1904–31, by countries.

World production of petroleum, 1930, 1931, and total 1857–1931, by countries

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1930			1931			1857–1931	
	Thousands of barrels of 42 U.S. gallons [1]	Thousands of metric tons	Percentage of total by volume	Thousands of barrels of 42 U.S. gallons [1]	Thousands of metric tons	Percentage of total by volume	Thousands of barrels of 42 U.S. gallons [1]	Percentage of total by volume
United States	898,011	123,117	63.6	851,081	116,683	62.0	13,999,564	65.4
Russia (U.S.S.R.) [2] [3]	125,555	17,221	8.9	162,842	22,335	11.9	2,719,609	12.7
Venezuela	136,669	20,252	9.7	116,613	17,192	8.5	634,447	3.0
Rumania	42,759	5,792	3.0	49,127	6,655	3.6	431,657	2.0
Persia	45,833	6,035	3.3	44,376	5,843	3.2	433,905	2.0
Netherland East Indies	41,729	5,532	3.0	35,539	4,698	2.6	512,819	2.4
Mexico	39,530	5,904	2.8	33,039	4,941	2.4	1,632,456	7.6
Colombia	20,346	2,905	1.4	18,237	2,542	1.3	102,590	.5
Argentina	9,002	1,301	.6	11,709	1,689	.9	82,380	.4
Peru	12,449	1,656	.9	10,089	1,340	.7	130,975	.6
Trinidad	9,419	1,315	.7	9,744	1,371	.7	73,565	.3
India, British	8,887	1,226	.6	8,200	1,131	.6	216,438	1.0
Poland	4,904	663	.3	4,662	630	.3	227,825	1.1
British Borneo (Sarawak) [4]	4,907	707	.4	3,854	535	.3	49,921	
Sakhalin, Russian [3] [5]	1,805	267	.1	2,734	405	.2	7,156	
Japan (including Taiwan)	2,047	290	.2	2,050	291	.2	63,047	
Egypt	1,996	285	.1	2,038	289	.1	23,183	
Ecuador	1,553	221	.1	1,762	250	.1	7,235	
Germany	1,222	174		1,606	229		22,758	
Canada	1,522	186		1,543	195		31,540	1.0
Iraq	909	121		830	111		3,588	
France	523	76	.3	520	73	.4	6,460	
Czechoslovakia	157	23		134	20		1,379	
Italy	59	8		124	16		1,603	
Bolivia	56	7		25	3		81	
Other countries [6]	56	8		54	8		944	
	1,411,905	195,292	100.0	1,372,532	189,475	100.0	21,417,125	100.0

[1] 1 cubic meter of petroleum equals 6.29 barrels of 42 U.S. gallons.
[2] Exclusive of Sakhalin, which is shown separately.
[3] Figures for 1931 cover calendar year; those for 1930 the fiscal year ended Sept. 30.
[4] Includes a small production from Brunei.
[5] Production distributed as follows: 1931—Japanese concession 1,836,000 barrels, Russian operators 898,000 barrels; 1930—Japanese concession 1,305,000 barrels, Russian operators 500,000 barrels.
[6] Partly estimated.

CONSUMPTION

Prior to 1930 the trend in consumption of crude petroleum was upward, as increasing quantities were required to match the increased consumption of gasoline. In 1930, however, the consumption of gasoline failed to make its usual annual gain, and the yield of gasoline reached a point where less crude was required than in 1929. The statistical record for 1931 was similar to that for 1930, as the annual increase in the consumption of gasoline was smaller than ever and the steadily increasing yield of gasoline reduced the requirements for crude below those in 1928.

The total demand for crude oil in the United States in 1931 was 939,304,000 barrels, a decline of 40,472,000 barrels (4 percent) from 1930. Consumption at refineries accounted for 95 percent and exports for 3 percent of the total in 1931; consumption as fuel in the raw state, losses, and quantities not accounted for composed the remaining 2 percent. In 1925 consumption in the raw state, losses, etc., accounted for 11 percent of the total demand. The fact that this ratio dropped to 2 percent in 1931, a year of low crude prices, indicates a growing tendency to use crude oil as the raw material for refined products rather than as a fuel. The consumption of crude oil on the leases—that is, for drilling, pumping, etc.—was 1,628,000 barrels, a slight decrease from 1930. This decrease probably was due to the drop in field activity.

The major portion of the consumption of crude oil was in the last half of the year in contrast to 1930, when 52 percent of the crude runs were in the first 6 months. In view of the surplus of cheap east Texas crude available in 1931 it was greatly to the credit of the refining industry that crude runs were 8 percent below those in 1930 in the first half of 1931 and were only 1 percent greater in the second half.

Runs of foreign crude oil to stills continued to decline concomitantly with decreased imports. Total runs of foreign crude to stills were 46,937,000 barrels (5 percent of the total runs of all crude compared with 7 percent in 1930). The only district that showed a substantial decline in runs of domestic crude was California. Several districts processed more crude in 1931 than in any previous year.

Summary of demand for crude petroleum, 1925, 1927, and 1929–31

[Thousands of barrels of 42 U.S. gallons]

	1925	1927	1929	1930	1931
Production	763, 743	901, 129	1, 007, 323	898, 011	851, 081
Imports	61, 824	58, 383	78, 933	62, 129	47, 250
Changes in stocks east of California and in stocks of light crude in California	−17, 835	+64, 631	+35, 816	−19, 636	−40, 963
Total demand	843, 402	894, 881	1, 050, 440	979, 776	939, 294
Runs to stills	739, 920	828, 835	987, 708	927, 447	894, 608
Exports	13, 337	15, 844	26, 401	23, 705	25, 535
Consumed as fuel on producing properties	4, 286	2, 824	2, 021	1, 643	1, 628
Consumed as fuel in operation of pipe lines east of California	1, 825	2, 097	1, 840	1, 621	1, 866
Consumed as fuel, losses, etc	84, 034	45, 281	32, 470	25, 360	15, 657
Total demand	843, 402	894, 881	1, 050, 440	979, 776	939, 294

Runs to stills of crude petroleum in 1931, by districts and months

[Thousands of barrels of 42 U S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
East coast:													
Domestic	9,805	8,910	10,278	9,963	10,915	10,659	10,843	11,203	10,445	10,555	10,100	10,724	124,400
Foreign	4,259	3,559	4,136	3,640	3,949	3,652	3,640	3,181	4,036	3,891	3,187	3,260	44,390
Total East coast	14,064	12,469	14,414	13,603	14,864	14,311	14,483	14,384	14,481	14,446	13,287	13,984	168,790
Appalachian	2,626	2,741	3,130	2,880	2,999	2,932	3,276	3,357	3,367	3,264	2,951	2,849	36,372
Indiana, Illinois, Kentucky, etc	7,645	7,894	9,237	9,773	10,393	10,072	10,216	10,876	10,227	10,313	9,500	9,296	115,442
Oklahoma, Kansas, and Missouri	7,928	7,866	8,604	8,947	9,296	9,034	10,393	10,202	8,959	8,193	7,976	7,652	105,050
Texas inland	4,608	4,331	4,827	5,280	5,804	5,713	6,008	6,014	5,116	4,981	4,770	4,244	61,696
Texas Gulf coast:													
Domestic	13,283	11,897	12,932	13,258	13,424	12,804	12,759	12,831	12,033	13,207	12,970	13,543	154,941
Foreign	34	35	74	66	68	111	50	93	58	50	41	39	719
Total Texas Gulf coast	13,317	11,932	13,006	13,324	13,492	12,915	12,809	12,924	12,091	13,257	13,011	13,582	155,660
Louisiana Gulf coast:													
Domestic	2,779	2,538	2,889	2,673	3,301	3,362	3,683	3,672	3,141	3,231	3,331	3,594	38,194
Foreign	147	131	122	284	206	186	92	130	209	144	129	48	1,828
Total Louisiana Gulf coast	2,926	2,669	3,011	2,957	3,507	3,548	3,775	3,802	3,350	3,375	3,460	3,642	40,022
Arkansas and Louisiana inland	1,381	1,327	1,534	1,650	1,709	1,749	2,071	1,937	1,685	1,561	1,564	1,721	19,889
Rocky Mountain	1,285	1,350	1,496	1,765	1,834	1,734	1,807	1,754	1,600	1,445	1,386	1,224	18,679
California	14,427	12,735	14,392	14,582	14,623	14,179	14,920	15,422	14,218	15,248	13,735	14,527	173,008
Total domestic	65,767	61,589	69,319	70,771	74,298	72,238	75,976	77,268	70,791	71,998	68,282	69,374	847,671
Total foreign	4,440	3,725	4,332	3,990	4,223	3,949	3,782	3,404	4,303	4,085	3,357	3,347	46,937
Total United States:													
1931	70,207	65,314	73,651	74,761	78,521	76,187	79,758	80,672	75,094	76,083	71,639	72,721	894,608
1930	80,163	72,414	80,252	80,434	83,647	80,747	78,644	79,289	75,950	74,016	70,310	71,581	927,447

Indicated deliveries of crude petroleum (east of California) to domestic consumers in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July
Domestic petroleum, by fields of origin:							
Appalachian:							
Pennsylvania grade	1,747	1,641	1,741	1,932	1,686	1,987	2,097
Other (including Kentucky)	759	699	757	687	691	772	694
Lima-northeastern Indiana-Michigan	251	206	434	335	472	486	258
Illinois-southwestern Indiana	530	440	394	613	308	855	484
Mid-Continent:							
Northern Louisiana and Arkansas	3,544	3,156	3,043	2,722	2,702	2,771	2,796
West Texas-southeastern New Mexico	10,569	9,176	9,477	9,815	10,231	8,143	7,146
Other (Oklahoma, Kansas, north Texas, etc.)	28,465	27,848	33,234	34,943	36,921	38,195	42,018
Gulf coast:							
Grade A	1,851	2,154	2,298	2,088	1,671	2,220	2,327
Grade B	3,730	3,207	3,724	3,223	4,815	2,616	3,771
Rocky Mountain [1]	1,416	1,434	1,557	2,040	2,719	2,437	2,060
California							5
Total demand	52,862	49,961	56,659	58,398	62,216	60,482	63,656
Exports	1,067	1,062	933	1,353	1,543	1,858	1,962
Domestic demand	51,795	48,899	55,726	57,045	60,673	58,624	61,694
Foreign petroleum	3,152	4,740	4,283	3,992	4,673	3,924	3,853
Total: 1931	54,947	53,639	60,009	61,037	65,346	62,548	65,547
1930	63,679	55,450	63,546	63,686	65,902	63,652	62,427

	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Domestic petroleum, by fields of origin:						
Appalachian:						
Pennsylvania grade	2,200	2,160	2,153	1,986	1,860	23,190
Other (including Kentucky)	657	628	678	734	570	8,326
Lima-northeastern Indiana-Michigan	395	394	540	531	371	4,673
Illinois-southwestern Indiana	549	499	592	465	539	6,268
Mid-Continent:						
Northern Louisiana and Arkansas	1,747	2,436	2,093	2,831	2,987	32,828
West Texas-southeastern New Mexico	8,517	7,829	8,509	7,531	8,338	105,281
Other (Oklahoma, Kansas, north Texas, etc.)	42,728	38,081	40,388	36,927	35,966	435,714
Gulf coast:						
Grade A	1,557	1,723	1,194	1,467	1,363	21,913
Grade B	4,112	3,867	2,894	3,462	3,350	42,771
Rocky Mountain [1]	1,861	1,722	1,536	1,494	1,326	21,602
California						5
Total demand	64,323	59,339	60,577	57,428	56,670	702,571
Exports	1,970	1,823	1,989	1,528	602	17,690
Domestic demand	62,353	57,516	58,588	55,900	56,068	684,881
Foreign petroleum	3,238	3,406	4,456	3,478	3,414	46,609
Total: 1931	65,591	60,922	63,044	59,378	59,482	731,490
1930	62,257	62,792	59,085	56,101	57,983	736,560

[1] Includes Alaska.

STOCKS

Continued curtailment, as evidenced by a 5 percent decline in crude production in 1931 following a 11 percent decline the previous year, was reflected in crude stocks, which showed the largest withdrawal ever recorded. Stocks of refinable crude declined from 411,882,000 to 370,919,000 barrels, a drop of 40,963,000 barrels. (See fig. 41.) This figure may be considered to approximate the difference between (1) the decline in production plus imports and (2) the decrease in demand in 1931 plus (3) the withdrawal from stocks in 1930 (62,000,000 − 40,000,000 + 20,000,000).

Stocks of crude petroleum at refineries declined about 5,000,000 barrels in 1931, but the largest declines occurred in tank-farm stocks. One would logically expect this, as such stocks represent about 75 percent of the total crude stocks. Stocks of refinable crude in California decreased more than 1,000,000 barrels, to a total of 42,114,000 on December 31.

The relationship of stocks to prices was illustrated by Pennsylvania-grade crude. Stocks of this grade increased 9 percent in 1930, while prices declined 40 percent; in 1931 stocks decreased 16 percent, but prices declined only 14 percent. This showing is all the more remarkable in view of the drastic declines in crude prices elsewhere and the substantial drop in prices for lubricating oils.

The rapid development of the East Texas field exerted a marked influence on crude stocks, as it probably prevented a material withdrawal during the second quarter of the year. This statement is substantiated by the fact that in August, when the field was closed in for 2 weeks, stocks of Mid-Continent crude declined 9,932,000 barrels compared with a gain of 937,000 barrels in these stocks in July.

Producers' stocks, or stocks at wells, declined from 6,608,000 barrels on hand January 1 to 6,202,000 barrels on hand at the close of the year. This substantial reduction, which followed an increase of 410,000 barrels in 1930, was somewhat unexpected in view of the new storage facilities constructed in East Texas.

Stocks of crude petroleum in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
East of California:													
At refineries, by location of storage:													
East coast:													
Domestic	10,451	9,819	10,201	9,321	9,323	10,082	10,679	10,138	9,660	9,490	9,019	8,560	7,709
Foreign	2,816	3,828	3,966	3,437	3,597	3,601	3,811	3,361	2,964	2,983	2,551	2,666	3,694
Appalachian	2,505	2,564	2,549	2,481	2,358	2,308	2,296	2,225	2,176	2,190	2,076	1,942	1,956
Indiana, Illinois, Kentucky, etc	2,541	2,579	2,495	2,581	2,758	2,428	2,763	3,083	3,089	3,246	3,041	3,145	3,553
Oklahoma, Kansas, and Missouri	4,955	5,138	5,087	5,146	5,507	5,546	5,613	5,200	5,144	5,044	5,049	5,155	5,537
Texas, inland	1,320	1,406	1,743	1,357	1,393	1,623	1,611	1,959	2,001	1,846	1,721	1,776	1,954
Texas Gulf coast:													
Domestic	7,763	7,440	6,900	7,502	7,220	7,075	6,574	7,212	6,808	6,592	6,366	7,112	6,453
Foreign	343	393	366	345	340	325	195	290	191	222	260	340	137
Louisiana Gulf coast:													
Domestic	5,242	5,453	5,678	5,591	5,750	5,719	4,891	4,486	3,878	3,973	3,682	2,878	2,427
Foreign	694	833	771	753	768	618	592	682	642	612	656	587	663
Arkansas and Louisiana inland	813	574	449	429	562	627	738	585	692	632	604	554	540
Rocky Mountain	1,693	1,758	1,822	1,843	1,837	1,937	1,971	1,786	1,680	1,591	1,680	1,851	1,923
Total at refineries	41,136	41,785	42,027	40,786	41,413	41,889	41,734	41,007	38,925	38,421	36,705	36,566	36,546
At refineries, by fields of origin:													
Appalachian:													
Pennsylvania grade	2,320	2,257	2,297	2,214	2,015	2,153	2,158	2,045	1,914	1,926	1,883	1,817	1,689
Other Appalachian (including Kentucky)	785	740	726	782	792	818	745	677	631	706	732	706	690
Lima-northeastern Indiana-Michigan	85	119	165	162	194	179	194	189	205	242	180	233	261
Illinois-southwestern Indiana	86	89	103	94	122	139	124	114	112	125	128	98	121
North Louisiana and Arkansas	4,483	3,836	3,591	3,605	3,772	3,336	2,914	2,423	2,588	2,691	2,548	1,882	1,734
West Texas and southeastern New Mexico	5,311	4,808	4,866	4,792	4,181	3,821	3,569	3,996	3,399	3,479	3,241	3,516	3,257
Oklahoma, Kansas, north Texas, etc	15,537	16,350	16,012	16,224	16,948	17,951	18,475	19,075	18,712	18,638	17,314	17,617	17,554
Gulf coast:													
Grade A	3,742	3,565	3,438	3,001	2,534	2,717	2,334	1,586	1,725	1,669	1,512	1,521	1,523
Grade B	3,241	3,209	3,904	3,534	4,313	4,232	4,599	4,783	4,162	3,537	4,020	3,905	3,482
Rocky Mountain	1,688	1,753	1,817	1,838	1,832	1,994	2,019	1,786	1,680	1,591	1,680	1,678	1,741
California	5	5	5	5	5	5	5						
Foreign	3,853	5,054	5,103	4,535	4,705	4,544	4,598	4,333	3,797	3,817	3,467	3,593	4,494
Total at refineries	41,136	41,785	42,027	40,786	41,413	41,889	41,734	41,007	38,925	38,421	36,705	36,566	36,546
Pipe-line and tank-farm stocks—by fields of origin:													
Appalachian:													
Pennsylvania grade	5,581	5,653	5,583	5,683	5,719	5,667	5,464	5,234	4,874	4,640	4,670	4,633	4,927
Other (including Kentucky)	911	949	973	1,043	1,048	990	956	944	920	947	999	1,061	1,188
Lima-northeastern Indiana-Michigan	1,453	1,547	1,620	1,578	1,575	1,476	1,320	1,456	1,412	1,437	1,466	1,387	1,560
Illinois-southwestern Indiana	10,252	10,205	10,194	10,249	10,044	10,168	9,856	9,920	9,866	9,862	9,783	9,834	9,790

North Louisiana and Arkansas	19,957	19,842	19,504	19,085	18,721	18,996	18,967	18,713	18,809	18,270	18,304	18,008	16,980
West Texas and southeastern New Mexico	45,414	44,219	42,857	42,088	40,833	38,956	38,756	38,785	38,490	37,849	36,999	36,417	35,460
Oklahoma, Kansas, north Texas, etc	193,768	191,662	189,344	187,267	187,902	189,671	191,023	191,653	182,741	175,267	174,220	176,576	179,536
Gulf coast:													
Grade A	6,629	6,736	6,106	5,863	5,809	5,430	4,984	4,780	4,430	4,093	4,408	4,191	4,118
Grade B	11,626	11,708	11,410	11,652	11,416	10,585	10,866	10,069	9,639	9,296	9,143	8,979	9,198
Rocky Mountain	25,149	25,447	25,630	25,758	25,486	24,342	23,616	23,456	23,350	23,240	23,154	23,135	23,300
Total pipe line and tank farm	320,740	317,968	313,221	310,266	308,553	306,281	305,808	305,010	294,531	284,901	283,146	284,221	286,057
Producers' stocks	6,608	6,321	6,523	6,556	6,470	6,262	5,832	5,553	5,600	5,612	5,801	6,021	6,202
Total crude stocks east of California	368,484	366,074	361,771	357,608	356,436	354,432	353,374	361,570	339,056	328,934	325,652	326,808	328,805
California: Light	43,398	43,153	43,428	43,907	44,003	44,540	43,930	43,625	42,300	41,888	41,519	41,777	42,114
Grand total: 1931	411,882	409,227	405,199	401,515	400,439	398,972	397,304	395,195	381,356	370.822	367,171	368,585	370,919
1930	428,445	427,739	431,357	430,662	429,933	427,958	425,503	425,767	422,622	417,195	416,206	413,768	408,809 [1] 411,882

[1] For comparison with 1931.

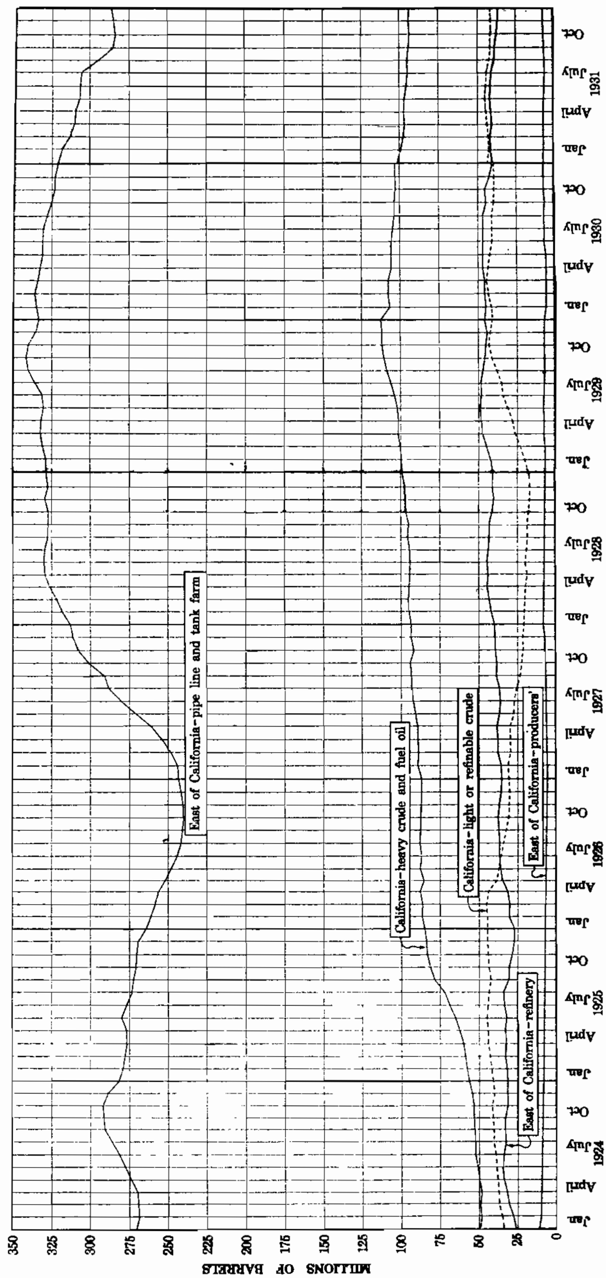

FIGURE 41.—Stocks of crude petroleum, 1924–31, by months.

DISTRIBUTION

RECEIPTS AND DELIVERIES BY STATES

Production in Arkansas plus receipts of East Texas crude totaled about 17,500,000 barrels in 1931. About 9,000,000 barrels were refined within the State, and 8,000,000 barrels were shipped to Louisiana. The remaining 500,000 barrels represent principally the difference between shipments to Texas and other States and withdrawals of about 800,000 barrels from stocks.

California is the most self-sufficient of the States as regards crude requirements, because its isolated position limits the distribution of refinable crude to consumption within the State and exports. Several years ago several small refineries were operating in Washington, but in 1931 the entire refining industry of the Pacific coast was centered in California with approximately 30 percent of the operating capacity in the general vicinity of San Francisco and the major portion of the remainder near Los Angeles. Crude runs to stills in California in 1931 were 173,008,000 barrels, exports to Japan and other countries totaled 7,845,000 barrels, and withdrawals of refinable crude from stocks were slightly over 1,000,000 barrels, leaving about 9,000,000 barrels for net transfers to fuel-oil stocks and losses.

In Colorado production plus withdrawals from stocks was slightly over 1,600,000 barrels. Activity at the few plants within the State increased, and about 1,100,000 barrels were run to stills compared with approximately 800,000 barrels in 1930. Tank-car shipments to Utah and Wyoming totaled slightly over 500,000 barrels.

Illinois is an important refining State. The total daily crude-oil capacity of its refineries at the close of 1931 was 129,200 barrels, and the actual throughput for the year was slightly over 34,000,000 barrels. Crude production in Illinois was approximately 5,000,000 barrels, receipts from Kentucky and Indiana were nearly 2,000,000 barrels, and receipts from the Mid-Continent district were about 28,000,000 barrels. The major portion of the difference between production plus receipts and refinery consumption consisted of deliveries to Ohio.

Only six refineries operated in Indiana in 1931, but the State ranked sixth in crude runs to stills. Indiana refineries are supplied almost entirely by pipe lines from the Mid-Continent field, as the major portion of the relatively small production of the State is shipped to Illinois.

Kansas is virtually self-sufficient in its crude-oil requirements, as production generally exceeds refinery consumption; however, appreciable amounts of crude are received from and shipped to Oklahoma. Production plus receipts from Oklahoma and a small amount from Texas was about 44,500,000 barrels. Crude runs to stills and shipments to Oklahoma totaled 38,000,000 barrels in 1931. The indicated surplus—6,500,000 barrels—represents principally deliveries into the several interstate lines connecting the producing fields of north Texas and Oklahoma, with refineries in Missouri, Illinois, and other States to the east.

The distribution of crude in Kentucky changed in 1931 as production decreased but runs to stills increased. The apparent deficiency in supply was balanced principally by increased receipts of Mid-Continent oil (1,800,000 barrels in 1930 and 2,300,000 barrels in 1931) and by a decline of about 1,500,000 barrels in shipments to Illinois and West Virginia.

Louisiana is an important crude-oil State because, in addition to being a producer, it acts as a connecting link in the movement of large quantities of Mid-Continent oil to the East coast. Large amounts are received from Oklahoma, Arkansas, and Texas by pipe lines, but some is reconsigned to the Atlantic seaboard. Pipe-line shipments of Oklahoma crude to Louisiana (one of the major movements in the past) declined materially in 1931 following the construction of lines to the East Texas field, a nearer and cheaper source of supply. Late in 1931 the Oklahoma-Louisiana movement was reversed, and material quantities of east Texas crude were delivered into Louisiana for shipment to Illinois and States farther east, via Arkansas and Oklahoma. Approximate data for the distribution of domestic crude oil in Louisiana in 1931 follow:

Receipts:	*Barrels*	Deliveries:	*Barrels*
Production	22,000,000	Runs to stills	49,000,000
Receipts from Arkansas	8,000,000	Exports	1,000,000
Receipts from Oklahoma	3,000,000	Deliveries to East coast	5,000,000
Receipts from Texas and withdrawals from stocks	28,000,000	Deliveries to Texas	6,000,000
Total	61,000,000	Total	61,000,000

About half the output of crude in Michigan is shipped out of the State. Crude runs to stills were about 3,600,000 barrels, an increase of 300,000 barrels over 1930. Receipts of Mid-Continent crude were practically the same as in 1930, hence the apparent deficiency in supply arising from the increase in runs at local refineries and the decline of about 100,000 barrels in production was balanced by a decrease in exports and by shipments to other States. Approximately 500,000 barrels of Michigan crude were used raw as fuel in 1931.

Although production in Montana has declined steadily since 1926 the yield is still more than enough to supply the 20 or more small refineries within the State. In 1931 production plus comparatively small receipts from Wyoming exceeded runs to stills by about 1,100,000 barrels. This quantity represents exports to Canada and tank-car shipments to Utah.

The importance of New Mexico as a producer of crude oil increased rapidly in 1931, but there was no corresponding expansion in refinery capacity. Crude runs at the comparatively few scattered plants and shipments to Utah were about 1,000,000 barrels in 1931. The remainder of the production, plus a small withdrawal from stocks, was moved to the Texas Gulf coast for consumption at refineries there or for shipment to the East coast.

There are only four refineries in New York, but their consumption of crude is several times the production of the State. Of the 11,471,000 barrels refined in New York in 1931 about 2,000,000 barrels were received by pipe line from the Mid-Continent and about 500,000 barrels from Pennsylvania. Most of the remainder was imports and receipts by tanker from the Gulf ports.

Ohio is a comparatively small producer of crude oil but is an important refining and transporting State. Its importance as a refining center increased rapidly in 1931, when crude runs to stills were 25,267,000 barrels (35 percent more than in 1930). Its importance in transportation arises chiefly from the fact that all the long trunk lines from the Mid-Continent to eastern refineries terminate in or cross the State. Receipts of Mid-Continent oil for use at refineries in the State were slightly over 19,000,000 barrels in 1931; receipts of Illinois and Michigan crude were nearly 2,000,000 barrels. All the production is refined within the State except for nearly a million barrels shipped to Pennsylvania.

Oklahoma ranks with Texas as a source of supply of crude for refineries in other States, as the difference between production and runs to stills for both States in 1931 was about 115,000,000 barrels. Data on the movements of crude from Oklahoma are difficult to obtain owing to the general practice of mixing Oklahoma and Texas crudes in most of the larger pipe-line systems. Because of this difficulty Oklahoma and Texas (exclusive of west Texas and coastal Texas) are regarded as one district in computing distribution.

In 1930 the principal movement of crude petroleum from Oklahoma and north Texas was northerly toward the Central and Eastern States, but the rapid growth in transportation facilities between the East Texas field and the Gulf in 1931 resulted in a southerly movement which was greater than that to the north. The quantity of crude transported from Oklahoma and Texas (exclusive of west Texas and the Gulf coast) for consumption at coastal refineries or for shipment by tanker was about 160,000,000 barrels. The northerly movement by pipe lines in 1931 totaled approximately 127,000,000 barrels, of which about 12,000,000 were retained for consumption in Kansas and Missouri.

Pennsylvania was the third-ranking State in consumption of crude at refineries in 1931. Total runs to stills of domestic crude in that year were 66,255,000 barrels, of which 50,871,000 barrels (77 percent) were refined in the few large refineries on the seaboard and 15,384,000 barrels (23 percent) were refined in the 30 or more refineries operating in the western part of the State. The chief movement of crude to the seaboard refiners was by tanker from the Gulf; in fact, the pipe-line movement to this group of refineries was less than 1,000,000 barrels in 1931. The production of about 11,900,000 barrels of Pennsylvania-grade crude near refineries in the western part of the State was augmented by receipts of nearly 4,000,000 barrels from West Virginia, Ohio, and New York but was depleted by approximately the same quantity shipped to New Jersey and New York. The difference between production and consumption in the western part of the State was supplied by pipe-line receipts of Mid-Continent and west Texas crudes plus an indeterminate amount of oil withdrawn from stocks.

Texas ranks first in the production, refining, and transportation of crude petroleum. The pipe lines are fairly well distributed over the State, but the principal movements of crude are from west Texas to the Gulf and from the East Texas field to the Gulf. The southward movement of Panhandle oil has declined in recent years, as has probably that of oil from north Texas. The total mileage of trunk lines in Texas increased in 1931, but the ton-mileage probably decreased because most of the new lines were laid between the East Texas field and the Gulf, a comparatively short distance. The refineries on the Atlantic seaboard depend chiefly for their crude on receipts by tankers from Texas ports; these shipments totaled about 112,000,000 barrels in 1931.

The consumption of crude at refineries in West Virginia exceeded production for the first time in 1931. The additional crude needed within the State was supplied by increased receipts of Mid-Continent crude and by a decrease in deliveries to Pennsylvania. Receipts from Kentucky continued small.

Production declined 17 percent in Wyoming in 1931 but was more than enough to supply the needs of refineries in the State. Shipments of Wyoming oil to Utah and Montana totaled 1,200,000 barrels in 1931; exports, consumption as fuel, and additions to stocks were about 500,000 barrels.

RECEIPTS OF DOMESTIC CRUDE PETROLEUM ON THE ATLANTIC SEABOARD

The Atlantic Coast States received 123,307,000 barrels of crude petroleum from other parts of the United States in 1931, a gain of 4,048,000 barrels (3 percent) compared with 1930. The Gulf coast ports continued to supply the larger share of the crude oil coming to the Atlantic coast refineries, furnishing 116,722,000 barrels (95 percent of the total) in 1931 compared with 111,581,000 barrels (94 percent) in 1930. Crude-oil shipments by pipe line to the Atlantic Coast States from the Mid-Continent, Illinois, and Appalachian districts were relatively unimportant, the Mid-Continent supplying less than 1 percent of the total and the Illinois and Appalachian districts about 5 percent. For the second consecutive year California failed to ship any crude oil to the Atlantic coast.

Receipts from domestic sources of crude oil at Atlantic coast points, 1927–31

[Thousands of barrels of 42 U.S. gallons]

Source	1927	1928	1929	1930	1931
Tankers from Gulf coast ports	85, 212	92, 745	99, 828	111, 581	116, 722
Tankers from California ports	10, 651	3, 330	667		
Pipe lines from the Mid-Continent district	11, 206	3, 121	1, 409	1, 732	740
Pipe lines from Illinois and Appalachian districts	4, 667	4, 552	5, 487	5, 946	5, 845
	111, 736	103, 748	107, 391	119, 259	123, 307

IMPORTS AND EXPORTS

Imports of crude petroleum continued to fall, amounting to 47,250,000 barrels in 1931 compared with 62,129,000 in 1930. Imports from Venezuela showed the largest decline, but that country continued to supply more than half the crude entering the United States. The average value of imported crude petroleum was $0.83 per barrel compared with $1.04 in 1930. This decrease, while material, was much less than the decline in average domestic price. Exports of crude increased 8 percent, or from 23,704,000 barrels in 1930 to 25,535,000 barrels in 1931—an outstanding performance in a year of material decline in foreign trade. In August exports of crude exceeded imports for the first time since 1912. Exports of crude to Canada, which comprise the major portion of such shipments, were 19,209,000 barrels, an increase of 1 percent over 1930.

Crude petroleum imported and exported in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total: Thousands of barrels	Total: Value (thousands of dollars)
Imports:														
By countries:														
Colombia	1,280	1,711	1,367	834	1,088	611	504	438	767	1,140	814	1,775	12,329	12,509
Mexico	245	522	240	773	1,085	1,300	827	493	515	860	994	353	8,207	6,062
Venezuela [1]	2,600	2,387	1,851	2,493	2,276	1,943	2,195	1,709	2,006	1,967	1,734	2,064	25,225	18,792
Other countries	228	169	257	62	63	124	62	62	138	139	62	123	1,489	1,858
	4,353	4,789	3,715	4,162	4,512	3,978	3,588	2,702	3,426	4,106	3,604	4,315	47,250	39,221
By ports of entry:														
Atlantic coast	4,109	4,462	3,548	3,978	4,320	3,908	3,177	2,624	3,321	3,868	3,321	4,315	44,951	37,578
Gulf coast	244	327	167	184	192	70	411	78	105	238	283	-----	2,299	1,643
Total: 1931	4,353	4,789	3,715	4,162	4,512	3,978	3,588	2,702	3,426	4,106	3,604	4,315	47,250	39,221
1930	5,450	4,321	4,827	5,781	4,984	5,767	5,877	5,059	5,808	5,061	4,467	4,727	62,129	64,872
Exports:														
By countries:														
Domestic crude oil:														
Canada	1,355	1,389	1,180	1,499	1,833	1,901	2,092	1,754	1,767	1,898	1,810	731	19,209	14,765
Cuba	80	71	52	53	71	80	80	-----	99	81	81	21	769	873
France	-----	-----	-----	-----	-----	66	134	138	-----	212	70	-----	620	538
Japan	350	147	352	155	316	338	212	595	226	196	402	317	3,606	3,518
Mexico	2	3	1	1	48	95	47	49	1	2	50	2	301	235
Netherland West Indies	-----	-----	-----	-----	-----	-----	-----	285	203	-----	-----	-----	488	247
Other countries	132	100	1	118	-----	64	56	35	-----	-----	36	-----	542	652
	1,919	1,710	1,586	1,826	2,268	2,544	2,621	2,856	2,296	2,389	2,449	1,071	25,535	20,828
By ports:														
Gulf coast [2]	120	171	52	297	479	684	996	1,101	880	983	902	21	6,686	5,157
Mexican border	2	2	1	1	1	1	1	12	-----	1	49	1	72	97
Northern border	945	888	880	1,055	1,063	1,173	965	857	943	1,005	578	580	10,932	8,197
Pacific coast	852	649	653	473	725	686	659	886	473	400	920	469	7,845	7,377
Total: 1931	1,919	1,710	1,586	1,826	2,268	2,544	2,621	2,856	2,296	2,389	2,449	1,071	25,535	20,828
1930	1,808	1,731	1,944	1,900	2,202	2,507	1,973	2,407	1,961	2,167	1,765	1,339	23,704	32,153
Excess of imports over exports	2,434	3,079	2,129	2,336	2,244	1,434	967	[3] 154	1,130	1,717	1,155	3,244	21,715	18,393

[1] Includes imports recorded by Bureau of Foreign and Domestic Commerce as from Netherland West Indies.
[2] Includes 691 barrels from Atlantic coast.
[3] Exports exceed imports.

PRICES AND VALUES

The total value of the crude petroleum produced in 1931 was \$550,630,000—little more than half of the 1930 total. The average value in 1931 was \$0.65 per barrel, the lowest since 1915 when Cushing field was at its height. This low average resulted principally from the price reduction late in 1930 and the more drastic reductions in the middle of 1931. The average value by States ranged from \$0.43 per barrel paid to producers in New Mexico to \$2.02 in New York.

In general, posted prices in 1931 showed a downward trend until August; this decline was followed by several increases, but the postings for nearly all grades were 20 percent lower at the end of the year than at the beginning. (See fig. 42.) The majority of the changes in posted prices in 1931 were induced by developments in the East Texas field. Several lower postings were made in most grades in the

Mid-Continent in the first quarter of the year before production in the East Texas field had passed the point at which it could be absorbed comfortably by the market. These undoubtedly anticipated the overproduction period that followed; the lower prices in the second quarter were brought on by the overproduction itself. Undercutting of prices in the East Texas field became so prevalent by midyear that the major purchasers withdrew their postings, and prices were reduced progressively until some producers accepted

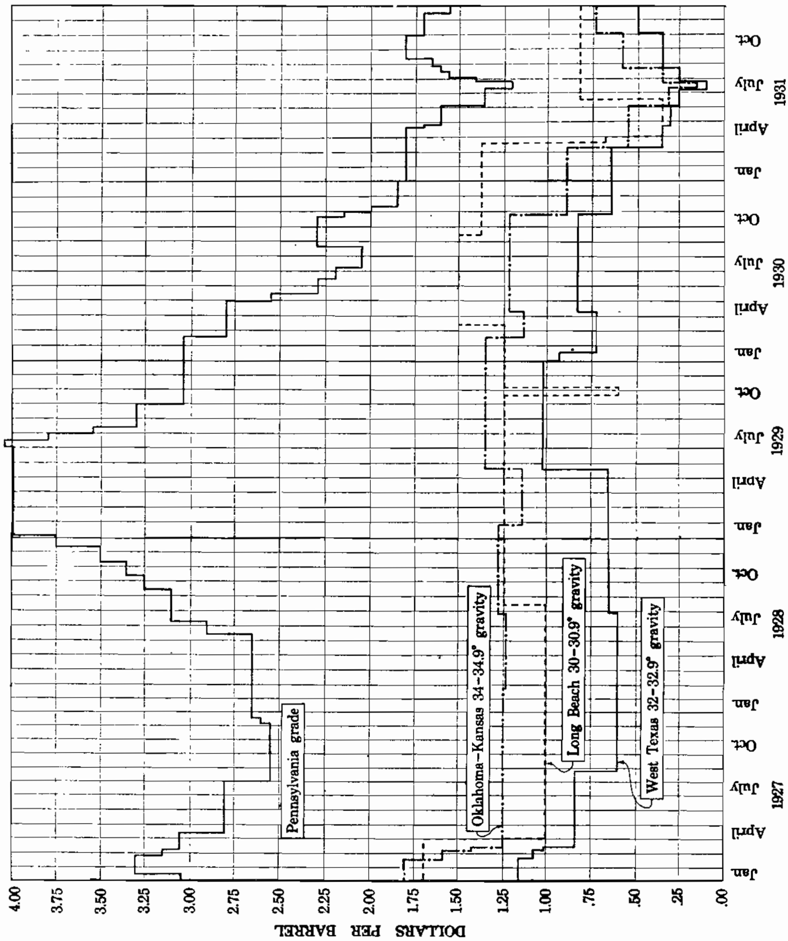

FIGURE 42.—Posted prices of selected grades of crude petroleum, 1927–31, by months.

2½ cents per barrel to obtain connections. Overproduction in the East Texas field tended to depress prices throughout the country, with the result that many so-called "marginal wells" were closed in. This curtailment in production and the protests of the harassed producers had a beneficial effect on prices, so that in some fields they were raised more than 100 percent late in July. The East Texas field was closed down completely on August 5, and the further restriction in supply led to general improvement in prices the latter part of August in most fields east of California. Later, the Governor of Oklahoma's campaign for "dollar oil" (under which the flush fields of that State were closed in), together with realization that production in the East Texas field would be kept under control, led to another general increase in posted prices early in November. Postings in California were somewhat affected by developments in east Texas, but local influences, such as the failure of some producers to curtail production, undoubtedly had more influence on prices in that State. Crude prices in California declined materially in March, but a large part of the decrease was restored in June when it became apparent that production could be held at or near the allowable suggested by the proration committees. The average price of all crudes in California in 1931 was $0.72 per barrel (more than the average for the country as a whole).

Value of crude petroleum at the wells, 1927–31, by States

[Totals in thousands of dollars; averages in dollars per barrel]

	1927		1928		1929		1930		1931	
	Total	Average	Total	Average	Total	Average	Total	Average	Total	Average
Arkansas	42,400	1.06	27,450	0.86	21,890	0.88	17,390	0.88	7,200	0.49
California	[1] 260,735	1.13	[1] 230,000	.99	[1] 321,367	1.10	[1] 271,699	1.20	135,960	.72
Colorado	3,400	1.20	2,750	.99	2,380	1.01	1,480	.89	825	.53
Illinois	11,700	1.67	9,980	1.54	10,430	1.65	9,100	1.59	4,500	.89
Indiana:										
Southwestern	1,200	1.65	1,470	1.53	1,520	1.66	1,540	1.64	730	.91
Northeastern	190	1.51	110	1.24	90	1.43	70	1.32	20	.54
Total Indiana	1,390	1.63	1,580	1.50	1,610	1.64	1,610	1.62	750	.89
Kansas	58,300	1.42	52,500	1.36	62,510	1.46	54,880	1.32	25,500	.69
Kentucky	11,220	1.67	11,850	1.61	13,220	1.70	11,080	1.50	5,295	.82
Louisiana:										
Gulf coast	6,110	1.21	8,150	1.16	9,150	1.23	9,200	1.07	6,370	.67
Northern	23,630	1.33	17,700	1.20	16,550	1.26	16,910	1.15	7,850	.64
Total Louisiana	29,740	1.30	25,850	1.18	25,700	1.25	26,110	1.12	14,220	.65
Michigan	832	1.90	920	1.55	6,140	1.36	5,160	1.32	2,840	.75
Montana	7,090	1.40	6,400	1.59	7,260	1.82	5,420	1.62	2,730	.96
New Mexico:										
Northwestern	1,680	1.37	1,280	1.36	2,170	1.19	900	1.45	450	.86
Southeastern							8,280	.87	6,040	.41
Total New Mexico	1,680	1.37	1,280	1.36	2,170	1.19	9,180	.90	6,490	.43
New York	7,110	3.17	8,750	3.36	13,170	3.90	9,850	2.70	6,800	2.02
Ohio:										
Central and eastern	11,900	2.02	11,950	2.20	13,200	2.51	10,020	1.94	4,600	1.09
Northwestern	3,070	1.80	2,520	1.59	2,570	1.73	1,940	1.48	1,010	.91
Total Ohio	14,970	1.97	14,470	2.06	15,770	2.34	11,960	1.84	5,610	1.05
Oklahoma	397,200	1.43	347,600	1.39	364,650	1.43	279,250	1.29	119,200	.66
Pennsylvania	29,150	3.06	32,550	3.27	44,800	3.79	33,410	2.61	23,550	1.98
Tennessee	90	1.50	70	1.52	30	1.58	26	1.24	5	.83
Texas:										
Gulf coast	61,119	1.30	47,120	1.19	59,930	1.21	63,650	1.04	31,620	.66
East Texas	([2])	------	([2])	------	([2])	------	([2])	------	50,430	.46
West Texas	41,327	.80	80,520	.65	110,780	.83	87,040	.80	37,270	.47
Rest of State	146,104	1.23	108,660	1.15	151,810	1.33	137,720	1.14	51,630	.54
Total Texas	248,550	1.14	236,300	.92	322,520	1.09	288,410	.99	170,950	.51
West Virginia	17,410	2.89	17,150	3.03	20,070	3.60	11,820	2.33	7,070	1.58
Wyoming	29,830	1.40	27,400	1.28	24,700	1.28	22,350	1.25	11,120	.75
Other [3]	33	4.71	30	5.00	30	4.29	15	2.14	15	2.14
United States	1,172,830	1.30	1,054,880	1.17	1,280,417	1.27	1,070,200	1.19	550,630	.65

[1] Division of Mines, Department of Natural Resources, California.
[2] Included with "Rest of State."
[3] Alaska and Utah.

Average monthly prices per barrel for selected grades of crude petroleum at wells in 1931

	Pennsylvania grade		Oklahoma-Kansas, 34°–34.9°	Gulf-coast grade B	Illinois	Lima, Ohio	Panhandle, Texas (Carson and Hutchinson Counties 35°–35.9°)	California (Long Beach, 30°–30.9°)	West Texas (Crane-Upton, etc., 30°–30.9°)
	Bradford	Southwest Pennsylvania							
January	$2.15	$1.80	$0.89	$0.69	$1.30	$1.10	$0.63	$1.38	$0.62
February	2.15	1.80	.89	.69	1.30	1.10	.57	1.38	.62
March	2.15	1.80	.65	.69	.88	.93	.45	1.10	.43
April	2.11	1.76	.55	.66	.80	.90	.37	.35	.33
May	2.00	1.60	.55	.60	.80	.90	.32	.35	.30
June	1.77	1.37	.31	.45	.56	.71	.23	.53	.25
July	1.67	1.27	.26	.36	.49	.64	.18	.81	.17
August	1.97	1.57	.42	.45	.64	.78	.32	.81	.28
September	2.20	1.75	.58	.55	.80	.90	.43	.81	.35
October	2.20	1.80	.58	.55	.80	.90	.43	.81	.35
November	2.00	1.70	.73	.70	.94	.99	.58	.81	.50
December	1.92	1.62	.73	.70	.95	1.00	.58	.81	.50
	2.02	1.65	.59	.59	.85	.90	.42	.83	.39

Posted price per barrel of petroleum, at wells in 1931, by grades, with dates of change

Date	Pennsylvania grade		Corning grade in Buckeye Pipe Line Co. lines [2]	Western Kentucky [3]	Lima, Ohio [3]	Illinois and Princeton, Ind.[3]	Midland, Mich.[4]
	Bradford and Allegany districts [1]	In Southwest Pennsylvania Pipe Line Co. lines [2]					
Jan. 1	$2.15	$1.80	$1.15	$1.15	$1.10	$1.30	$1.15
Mar. 6				.75	.90	.80	
Mar. 11			.80				
Mar. 13							.75
Apr. 23	2.00	1.70					
Apr. 27		1.60					
June 1							.52
June 2				.50	.70	.55	
June 3	1.75	1.35	.65				
July 11	1.60	1.20	.50	.35	.55	.40	.37
July 24				.50	.70	.55	
July 25							.57
July 28	1.80						
July 29		1.40	.65				
Aug. 3	1.95	1.55					
Aug. 17	2.00	1.60					
Aug. 18				.65	.85	.70	
Aug. 23							.73
Aug. 24				.75	.90	.80	
Aug. 29	2.10	1.65					
Sept. 1			.70				
Sept. 4			.75				
Sept. 12	2.25	1.80					
Sept. 16			.80				
Oct. 9							.55
Oct. 15	2.15						
Nov. 1	2.00	1.70					
Nov. 3				.90	1.00	.95	
Dec. 1			.85				
Dec. 16	1.85	1.55					
Average for year	2.02	1.65	.82	.78	.90	.85	.73

[1] The Tide Water Pipe Co. (Ltd.)
[2] The Joseph Seep Purchasing Agency.
[3] The Ohio Oil Co
[4] The Pure Oil Co.

Posted price per barrel of petroleum, at wells in 1931, by grades, with dates of change—Continued

Date	Kansas-Oklahoma; north and north-central Texas [5] 34°–34.9°	Kansas-Oklahoma; north and north-central Texas [5] 38°–38.9°	Panhandle, Texas (Carson and Hutchinson Counties, 35°-35.9°) [6]	West Texas, 30°–30.9° [6]	Hobbs, N.Mex., 35°–35.9° [6]	Darst, Tex. [6]	Southwest Texas, Mirando [6]
Jan. 1	$0.89	$1.01	$0.72	$0.62	$0.72	$0.90	$0.75
Jan. 14			.57				.69
Jan. 15	[7] .67	[7] .75					
Mar. 10	.55	.63	.40	[8] .35	[8] .40	.60	
Apr. 21			.32	.30	.32½	.53	.60
Apr. 23	[9] .45	[9] .53					
June 1	.31	.35					
June 3			.22	.25	.25	.37	.44
July 8	[9] .16	[9] .20	.12	.10	.10	.20	.35
July 11	(10)	(10)					
July 23	.35	.40					
July 24			[8] .27	.25	.25	.37	.44
Aug. 22	.58	.66	.43	.35	.35	.52	.60
Nov. 2	.73	.81	.58	.50	.50	.60	.75
Average for year	(11)	(12)	.42	.39	.42	.57	.61

Date	Van, Tex., 34°–34.9° [4]	East Texas, 38°–38.9° [13]	Gulf coast: Refugio, below 25° [6]	Gulf coast: Grade A [14]	Gulf coast: Grade B, below 25° [14]	North Louisiana, 34°–34.9° [15]	Smackover, Ark. [15]
Jan. 1	$0.89		$0.75	$0.80	$0.69	$0.89	$0.70
Jan. 14			.69				
Mar. 10	.55					.55	.45
Mar. 27		$0.63					
Apr. 21			.60	.70	.60		
May 26		.33					
June 1	.31						
June 3			.44	(16)	.44	.31	.25
June 20		[6] .20					
July 8			.31		.31		
July 10	.16						
July 11						.16	.15
July 24	.40		.40		.40	.36	.30
Aug. 13		.25					
Aug. 22		.68	.55		.55		
Aug. 24	.58					.58	.45
Nov. 2	.73	.83	.70		.70		
Nov. 4						.73	.55
Average for year	.60	.56	.59		.59	.59	.47

[4] The Pure Oil Co.
[5] The Texas Co.
[6] Humble Oil & Refining Co.
[7] North Texas only.
[8] Gravity scale discontinued.
[9] North and north central Texas only.
[10] Oklahoma-Kansas quoted same as north and north central Texas.
[11] Oklahoma-Kansas, $0.59; north Texas, $0.55; north central Texas, $0.58.
[12] Oklahoma-Kansas, $0.67; north Texas, $0.62; north central Texas, $0.66.
[13] Magnolia Petroleum Co.
[14] Gulf Pipe Line Co.
[15] Standard Oil Co. of Louisiana.
[16] Put on gravity basis with grade B.

Posted price per barrel of petroleum, at wells in 1931, by grades, with dates of change—Continued

Date	Salt Creek, Wyo. 36°–36.9° [18]	Sunburst, Mont.[3]	California [17]				
			Kettleman Hills 55° and above	Long Beach, 30°–30.9°	Midway-Sunset, 19°–19.9°	Playa del Rey, 22°–22.9° [19]	Santa Fe Springs, 33°–33.9°
Jan. 1	$0.95	$1.55	$1.65	$1.38	$0.70	$0.81	$1.48
Mar. 5	.59						
Mar. 20			(20)	.68	.55	.56	.68
Mar. 31				.35		(20)	.35
June 1	.33						
June 2		.85					
June 19				.81		.67	.83
July 9	.18						
July 10		.70					
July 24	.38						
July 25		.80					
Aug. 22	.62						
Aug. 24		.90					
Nov. 2	.77						
Nov. 3		1.00					
Average for year	.63	1.17		.83	.58		.86

[3] The Ohio Oil Co.
[17] Standard Oil Co. of California.
[18] The Midwest Refining Co.
[19] Subject to field gathering charge of 5 cents per barrel.
[20] Temporarily discontinued.

WELLS

Low prices and difficulty in obtaining pipe-line connections in certain "stripper" areas were reflected in a material decline in number of producing wells, the first ever recorded. The total number of producing wells on December 31, 1931, was 315,850, a loss of 15,220 from the previous year. Drilling fell to the lowest point in years, and only 6,788 oil wells were brought in compared with 11,640 in 1930 and 24,273 in 1920, the peak year. (See fig. 43.) These data indicate that about 22,000 oil wells were plugged, converted into gas wells, or permanently or temporarily disconnected from pipe lines in 1931.

Pennsylvania, with 79,930 producing oil wells on December 31, 1931, ranked far ahead of the other States in number of wells. Texas, which ranked first in production, ranked only third in number of wells. As is the case with gas wells, the majority of the producing oil wells are east of the Mississippi, yet the major portion of the output comes from west of the Mississippi because the average production of the wells west of the Mississippi, even under more severe proration, is many times that of the average well in the Eastern States. The average production per well per day for the United States as a whole has declined steadily in recent years, a reflection of stricter curtailment rather than of decrease in average size. The average initial potential of the oil wells completed in 1931 undoubtedly established a new record because 50 percent of them were in the East Texas field where nearly all the wells produced at the rate of two or three thousand barrels daily on short tests.

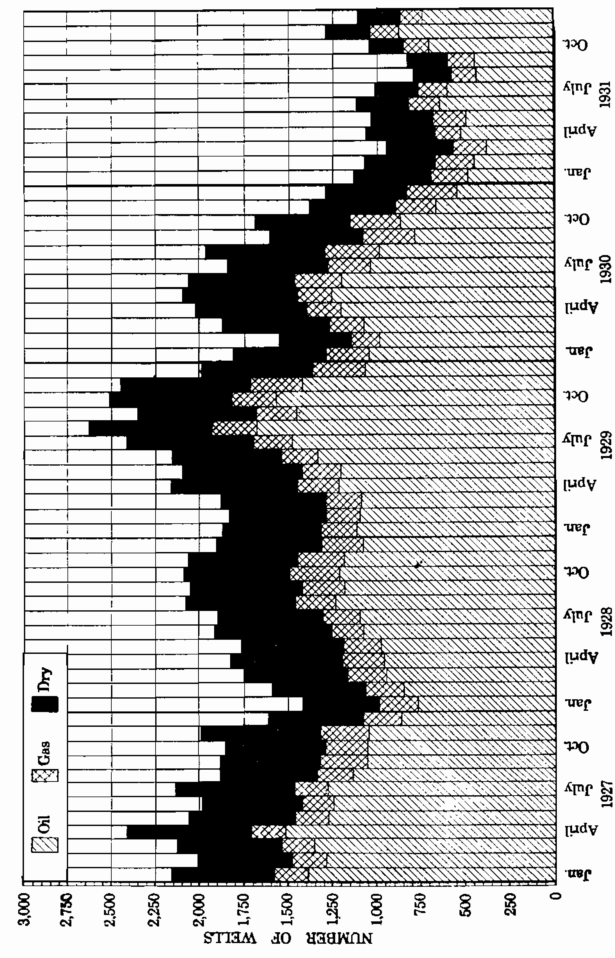

FIGURE 43.—Wells drilled, 1927–31, by months.

Oil and gas wells in 1931

State	Producing oil wells		Wells drilled [1]				
	Approximate number, Dec. 31, 1931	Average production per well per day (barrels)	Oil	Gas	Dry	Total	Estimated average daily initial production per well (barrels)
Arkansas	3,280	11.4	19	5	36	60	217
California	8,910	56.4	246	(2)	238	484	1,481
Colorado	200	19.2	10	5	12	27	277
Illinois	15,540	.9	13	1	25	39	8
Indiana:							
Southwestern	1,130	1.9	30	38	76	144	45
Northeastern	530	.2	5	9	4	18	30
Total Indiana	1,660	1.4	35	47	80	162	43
Kansas	19,120	5.2	229	112	129	470	633
Kentucky	12,420	1.3	179	116	125	420	68
Louisiana:							
Gulf coast	370	70.8	85	3	99	187	705
Northern	2,820	10.5	52	76	130	258	439
Total Louisiana	3,190	16.8	137	79	229	445	604
Michigan	630	16.3	49	30	48	127	795
Montana	1,420	5.5	13	36	47	96	26
New Mexico	430	93.7	26	11	21	58	3,101
New York	17,600	.5	(3)	(3)	(3)	(3)	(3)
Ohio:							
Central and eastern	20,530	.6	280	385	263	928	20
Northwestern	14,270	.2	34	90	24	148	28
Total Ohio	34,800	.4	314	475	287	1,076	21
Oklahoma	56,720	8.2	498	186	374	1,058	3,899
Pennsylvania	79,930	.4	[3] 496	[3] 210	[3] 131	[3] 837	[3] 2
Texas:							
Gulf coast	2,590	48.3	292	22	230	544	557
East Texas	3,540	169.7	3,363	13	252	3,628	[4] 729
West Texas	2,980	73.1	170	3	148	321	317
Rest of State	28,540	8.7	586	206	1,096	1,888	221
Total Texas	37,650	24.1	4,411	244	1,726	6,381	634
West Virginia	18,900	.6	73	379	83	535	4
Wyoming	3,410	11.7	40	9	22	71	269
Other	[5] 40	----------	----------	[6] 40	[5] 46	[6] 86	----------
	315,850	7.2	6,788	[2] 1,985	3,659	12,432	809

[1] For States east of California, Oil and Gas Journal; for California, American Petroleum Institute.
[2] California gas wells not reported.
[3] New York included with Pennsylvania.
[4] Based on 24-hour gage for the first half of the year and on gage averaging about 30 minutes for the last half of the year.
[5] Alaska, Tennessee, and Utah.
[6] Mississippi, Missouri, Tennessee, and Utah.

Wells drilled for oil and gas in the United States in 1931, by months

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Percentage
Oil	487	450	383	519	498	643	599	441	445	705	874	744	6,788	55
Gas [1]	202	218	182	152	178	179	160	135	147	142	161	129	1,985	16
Dry	441	397	381	393	355	294	255	218	233	199	253	240	3,659	29
Total: 1931	1,130	1,065	946	1,064	1,031	1,116	1,014	794	825	1,046	1,288	1,113	12,432	100
1930	[2] 1,813	1,559	1,870	2,014	[2] 2,110	2,074	[2] 1,847	[2] 1,969	1,612	[2] 1,697	1,382	[2] 1,293	[2] 21,240	------

[1] California dry gas wells not reported.
[2] Revised figures.

GRAVITY

No change in the extreme range of gravity of crude petroleum occurred in 1931; 6.8° for Casmalia (Calif.), crude continued to be the lowest on record and 65° crude for Rattlesnake (N.Mex.) crude the highest.

The average gravity of East Texas crude was the same as that of Oklahoma City crude (38.5°). The fact that these two important crudes were lighter than the average (about 33.5° in 1930) had considerable economic significance in 1931, as it undoubtedly increased the yield of gasoline.

Estimated average gravity of crude petroleum from selected fields in the United States in 1931

District or grade	°A.P.I.	Specific gravity
Arkansas:		
El Dorado	34.4	0.853
Smackover:		
Heavy	19.8	.935
Light	25.9	.899
California:		
Elwood	37.5	.837
Kettleman Hills:		
Heavy	38.0	.835
Light	60.0	.739
Long Beach	25.8	.900
Midway-Sunset	19.0	.940
Playa del Rey	22.5	.919
Santa Fe Springs	33.2	.859
Ventura Avenue	30.2	.875
Colorado:		
Florence	29.3	.880
Greasewood	42.0	.816
Illinois	31.5	.868
Kansas:		
Eastborough	42.0	.816
Ritz	34.0	.855
Voshell	41.5	.818
Wright	42.5	.813
Kentucky:		
Ohio County	35.0	.850
Somerset	37.6	.837
Louisiana:		
Gulf coast (salt domes):		
Cameron Meadows	40.9	.821
Choctaw	28.1	.887
Hackberry	21.0	.928
Iowa	40.9	.821
Lake Barre	28.0	.887
Lake Washington	18.0	.947
Lockport	24.8	.905
Vinton	18.6	.943
Northern:		
Caddo:		
Heavy	26.5	.896
Light	40.1	.825
Zwolle	39.6	.827
Michigan: Mount Pleasant	43.0	.811
Montana:		
Dry Creek	52.0	.771
Kevin-Sunburst	31.9	.866
New Mexico:		
Hobbs	35.0	0.850
Rattlesnake	65.0	.720
New York	43.5	.809
Ohio:		
Northwestern ("Lima")	36.6	.842
Corning	40.0	.825
Oklahoma:		
Burbank	37.6	.837
Chandler	38.8	.831
Oklahoma City	38.5	.835
Seminole City	39.0	.836
Sholem-Alechem	32.0	.866
Pennsylvania:		
Bradford	43.5	.809
Pennsylvania grade	40.0	.825
Texas:		
Gulf coast (salt domes):		
Barbers Hill	26.2	.897
Conroe	38.0	.835
Rabb Ridge	25.0	.904
Refugio	23.0	.916
Saxet	26.0	.898
Spindletop	26.0	.898
East and Central:		
Darst Creek	35.5	.847
East Texas	38.5	.832
Mexia	35.6	.847
Pettus	45.0	.802
Van	34.0	.855
North: Ranger	37.0	.840
Panhandle	35.8	.846
Southwest: Mirando	23.0	.916
West Texas:		
Hendricks	30.0	.876
Yates	30.0	.876
Wyoming:		
Hamilton Dome	25.2	.903
Lost Soldier	30.2	.875
Oregon Basin	22.0	.922
Osage	37.6	.837
Salt Creek	36.8	.841

PRODUCTION AND ROYALTIES FROM WELLS ON FEDERAL AND INDIAN LANDS

In spite of an increase in the output of crude petroleum on Government lands in the Kettleman Hills and Hobbs fields the total production on such lands declined from 33,449,606.86 barrels in 1930 to 28,833,120.70 in 1931. The average royalty (percentage) continued to decline, and the total royalty accruing to the Government was 3,822,201.48 barrels in 1931 compared with 4,331,835.71 barrels in 1930. The value of the royalty oil was influenced by the general decrease in crude prices and declined materially in 1931; however, the average was considerably higher than the average value of all the oil.

Activity on oil and gas lands within the various Indian reservations continued to decline; less land was leased, and less money was realized from bonuses and royalty than for many years. The total receipts in 1931 were $6,073,943, 45 percent less than in 1930.

Crude petroleum produced on Government lands in 1931, under the operation of the leasing act of Feb. 25, 1920

[From U.S. Geological Survey]

State and land office	Production (barrels)	Royalty	
		Barrels	Value
California:			
Los Angeles	2,429,304.08	194,999.76	$117,496.79
Sacramento (including Visalia), outside naval reserves	8,968,544.57	1,088,112.52	868,104.28
Sacramento (including Visalia), inside naval reserves	4,367,939.67	1,064,506.33	686,953.62
	15,765,788.32	2,347,618.61	1,672,554.69
Colorado: Denver	617,565.39	42,054.38	22,243.70
Louisiana: Baton Rouge	4,738.95	419.19	370.68
Montana:			
Billings	293,119.46	16,229.80	28,264.79
Great Falls	100,023.18	5,922.17	6,402.90
	393,142.64	22,151.97	34,667.69
New Mexico:			
Las Cruces	1,791,122.42	99,007.62	45,203.74
Santa Fe			
	1,791,122.42	99,007.62	45,203.74
Oklahoma: Guthrie	241,508.68	30,250.81	23,985.30
Utah: Salt Lake City	6,756.48	358.57	427.08
Wyoming:			
Buffalo	94,808.05	5,949.71	5,949.96
Cheyenne, outside naval reserves	9,418,829.02	1,236,649.48	1,062,914.43
Evanston	498,860.75	37,741.14	19,455.25
	10,012,497.82	1,280,340.33	1,088,319.64
	28,833,120.70	3,822,201.48	2,887,772.52

Royalty receipts from production of oil and gas and bonuses paid for sale of leases on Indian reservations, fiscal year ended June 30, 1931

[From Office of Indian Affairs]

Reservations	Oil and gas land leased during year (acres)	Receipts	
		Bonus from sale of leases	Royalty from production
Five Civilized Tribes:			
Oil	43,647	$271,164	$2,379,517
Gas			190,685
Blackfeet	7,791	1,441	
Cheyenne and Arapaho: Oil	14,448	64,385	
Chippewa: Oil	180	5,085	4,084
Crow	440		
Kiowa:			
Oil	43,473	174,078	5,605
Gas			2,588
Navajo (northern): Oil			79,561
Osage:			
Oil	16,519	[1] 107,749	1,999,040
Gas			622,515
Pawnee:			
Oil	2,297	22,994	39,245
Gas			5,052
Shawnee:			
Oil	1,654	23,081	45,296
Gas			2,737
Shoshone: Oil			9,016
Ute: Oil	4,720	11,825	7,200
	135,169	681,802	5,392,141

[1] Includes deferred payments.

REFINED PRODUCTS

DETAILED STATISTICS BY PRODUCTS

MOTOR FUEL AND GASOLINE

The statistics of motor fuel for 1931 show declines of 1, 20, and 30 percent, respectively, in production, imports, and exports but a gain of 2 percent in indicated domestic demand. New supply, or production plus imports, decreased 1 percent; total demand, or domestic demand plus exports, declined 2 percent. (See fig. 44.)

The total production of motor fuel was 437,735,000 barrels, 2,993,000 barrels less than in 1930. This first annual decline ever recorded in motor-fuel production was due to the fact that curtailment in crude runs to stills made necessary by economic conditions slightly outweighed an increase in the proportionate yield made possible by technical improvements. The adherence of the refining industry committee recommendations as to crude runs was the primary cause of the decline, as additional crude supplies could easily have been obtained even though production was restricted.

The problem of coordinating supply and demand in the petroleum industry has existed since its beginning but first gained official recognition in 1930 with the appointment of a volunteer committee on petroleum economics by the chairman of the Federal Oil Conservation Board. To the close of 1932 this committee and succeeding ones had submitted seven reports, each containing estimates of the probable demands for gasoline and recommendations as to the crude oil necessary to meet them. The predictions of gasoline demand have proved accurate within 4 percent, and these reports are highly regarded by the industry as yardsticks upon which to base refinery operation. Without them motor-fuel production would probably have increased in 1931.

The rapid increase in imports of gasoline in 1929 and 1930 had such economic significance that efforts were made to reduce them in 1931 in approximately the same ratio as crude production. This movement succeeded, and the comparatively few large companies involved curtailed their importations of gasoline 20 percent, or from 16,927,000 barrels in 1930 to 13,621,000 barrels in 1931.

Exports of gasoline, a major item of foreign trade, increased steadily throughout 1930, in which year they comprised 14 percent of the total demand. In 1931, however, the expansion of refining capacity in foreign countries, coupled with a probable decline in consumption due to the depression, resulted in a decrease of nearly 20,000,000 barrels (30 percent) in exports of motor fuel.

The domestic demand for motor fuel constituted a bright spot of the industry in 1931, as it increased when many had predicted a de-

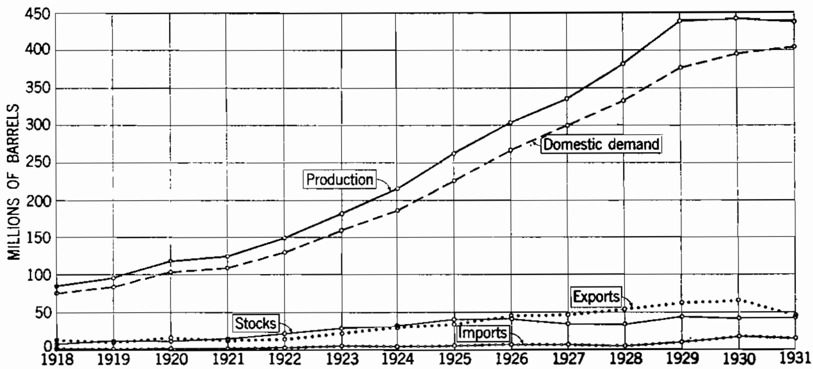

FIGURE 44.—Motor fuel; production, domestic demand, exports, imports, and stocks, 1918–31.

crease on account of the depression. The total domestic demand in 1931 was 403,418,000 barrels, an increase of 8,618,000 barrels (2 percent) over 1930. This increase may be attributed to a material gain in the use of taxicabs, busses, and commercial vehicles. This factor offset a small decline in the number of passenger vehicles. The increased demand in 1931 has been explained by the tendency of motorists to make longer or more frequent trips and by the generally favorable weather. Steady improvement in traveling conditions has tended to increase touring; furthermore, the desire to economize on train fares by traveling in automobiles has tended to overcome the decrease in week-end trips. The mild winter of 1931 undoubtedly helped to sustain the consumption of gasoline, although the fact that the winter of 1930 was also mild eliminates this factor when the two years are compared.

The trend in stocks of motor fuel is generally accepted as the best indicator of the success of the refining industry in balancing supply and demand, although the ease and speed with which crude oil and cracking stock may be converted into motor fuel have removed some of the importance of stocks as an economic barometer. In 1931 stocks of motor fuel rose from 40,098,000 barrels on hand January 1 to

42,320,000 barrels on hand at the close of the year, a net increase of 2,222,000 barrels. Compared with the decrease in motor-fuel stocks of 2,720,000 barrels in 1930 the 1931 record appears to be relatively poor. Actually, the record was better, as the fluctuation in days' supply was much less than in 1930, indicating that refiners no longer consider it necessary to accumulate excessive stocks early in the year.

Of the total motor-fuel stocks on hand December 31, 1931, 40,202,000 barrels were stored at refineries, 2,111,000 barrels in pipe lines, and 7,000 barrels at natural-gasoline plants. These data indicate that the gain in motor-fuel stocks in 1931 was due almost entirely to the increased quantity stored in lines and working tanks of the new gasoline pipe-line companies.

More consideration was given in 1931 to the relationship between stocks and demand—that is, days' supply—in the various refining districts. According to the following table, total stocks of gasoline on hand at refineries at the beginning and close of 1931 were equivalent to 33 and 34 days' supply, respectively. Although these data indicate little change in this relationship in 1931 for the country as a whole, some districts showed marked changes. For example, the days' supply of the East coast district fell from 33 to 24; that of the Indiana-Illinois district rose from 24 to 32. In terms of days' supply California held the largest gasoline stocks; however, it should be noted that the stocks for that district include terminal stocks, which were not reported for the other districts until 1932.

	Gasoline stocks at refineries at end of year [1]		Average daily refinery deliveries [1]		Days' supply on hand at end of year	
	Dec. 31, 1930	Dec. 31, 1931	1930	1931	1930	1931
East coast	5, 773	4, 589	173	193	33	24
Applaachian	1, 195	1, 426	41	47	29	30
Indiana, Illinois, Kentucky, etc.	4, 288	5, 706	179	180	24	32
Oklahoma, Kansas, and Missouri	3, 370	3, 452	174	166	19	21
Texas inland	1, 812	2, 420	76	86	24	28
Texas Gulf coast	4, 917	5, 778	203	205	24	28
Louisiana Gulf coast	1, 413	1, 253	58	49	24	26
Arkansas and Louisiana inland	225	149	22	24	10	6
Rocky Mountain	1, 752	1, 830	38	32	46	57
California	15, 141	13, 599	228	196	66	69
	39, 886	40, 202	1, 192	1, 178	33	34

[1] Thousands of barrels.

Comparative analyses of motor fuel in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Production	32, 698	31, 319	35, 235	36, 591	39, 009	37, 017	38, 432	39, 275	37, 461	38, 624	36, 030	36, 044	437, 735
Daily average	1, 055	1, 119	1, 137	1, 220	1, 258	1, 234	1, 240	1, 267	1, 249	1, 246	1, 201	1, 163	1, 199
Imports	1, 116	948	1, 607	1, 348	1, 050	964	1, 528	1, 244	1, 256	1, 181	586	793	13, 621
Daily average	36	34	52	45	34	32	49	40	42	38	20	26	37
Exports	4, 904	3, 606	2, 945	4, 187	4, 877	3, 264	4, 473	4, 210	3, 355	3, 461	3, 743	2, 691	45, 716
Daily average	158	129	95	140	157	109	144	136	112	112	125	87	125
Stocks, end of period	42, 604	45, 213	48, 340	48, 145	47, 223	43, 309	39, 558	36, 405	35, 105	36, 356	38, 696	42, 320	42, 320
Days' supply	42	43	44	38	36	31	28	26	26	29	34	39	34
Domestic demand	26, 404	26, 052	30, 770	33, 947	36, 104	38, 631	39, 238	39, 462	36, 662	35, 093	30, 533	30, 522	403, 418
Daily average:													
1931	852	930	993	1, 132	1, 165	1, 288	1, 266	1, 273	1, 222	1, 132	1, 018	985	1, 105
1930	821	945	992	1, 147	1, 173	1, 192	1, 232	1, 207	1, 260	1, 035	1, 029	942	1, 082

Motor-fuel production, or the production of gasoline at refineries, plus the relatively small quantity of natural gasoline and benzol that reach the consumer without being handled by refiners, increased fairly rapidly until 1930, when the total was only slightly above that for 1929. In 1931 the total output was 437,735,000 barrels, a decrease of less than 1 percent from 1930. In other words, the output of motor fuel during each of the three years 1929, 1930, and 1931 was virtually the same. Of the total production in 1931, 431,510,000 barrels (98.6 percent) were produced at refineries and 6,225,000 barrels (1.4 percent) were produced elsewhere. These data indicate an increase in the proportion made at refineries.

Production of motor fuel in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June
Gasoline produced at refineries:						
Straight run	15,604	15,325	17,766	18,632	19,778	19,454
Cracked	13,319	12,402	13,841	14,642	15,544	14,261
Natural gasoline blended	3,169	3,018	3,008	2,789	3,011	2,802
Natural gasoline run to stills via pipe lines in California	69	73	73	88	86	107
Total gasoline	32,161	30,818	34,688	36,151	38,419	36,624
Natural gasoline used elsewhere than at refineries:						
Blended at plants [1]	13	13	14	13	14	15
Exports and sales to jobbers	350	325	350	250	400	225
Benzol produced at byproduct coke plants	174	163	183	177	176	153
Total motor fuel, 1931	32,698	31,319	35,235	36,591	39,009	37,017
Daily average, 1931	1,055	1,119	1,137	1,220	1,258	1,234
Total motor fuel, 1930	36,380	33,893	37,644	38,126	39,270	37,360

	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Gasoline produced at refineries:							
Straight run	19,564	20,307	19,120	18,886	17,709	17,812	219,957
Cracked	15,618	15,576	15,142	16,013	15,024	15,055	176,437
Natural gasoline blended	2,586	2,475	2,599	3,021	2,878	2,618	33,974
Natural gasoline run to stills via pipe lines in California	105	67	155	160	81	78	1,142
Total gasoline	37,873	38,425	37,016	38,080	35,692	35,563	431,510
Natural gasoline used elsewhere than at refineries:							
Blended at plants [1]	14	13	13	12	10	5	149
Exports and sales to jobbers	400	700	302	398	200	350	4,250
Benzol produced at byproduct coke plants	145	137	130	134	128	126	1,826
Total motor fuel, 1931	38,432	39,275	37,461	38,624	36,030	36,044	437,735
Daily average, 1931	1,240	1,267	1,249	1,246	1,201	1,163	1,199
Total motor fuel, 1930	37,754	37,988	37,046	37,223	33,572	34,472	440,728

[1] East of California.

Production and stocks of gasoline in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	5, 647	5, 169	5, 699	5, 229	5, 809	5, 504	5, 915	5, 962	5, 911	6, 189	5, 954	6, 324	69, 312
Appalachian	1, 243	1, 241	1, 499	1, 380	1, 479	1, 424	1, 527	1, 592	1, 588	1, 606	1, 425	1, 463	17, 467
Indiana, Illinois, Kentucky, etc	4, 118	4, 273	4, 986	5, 618	6, 602	6, 075	5, 911	6, 544	5, 851	5, 994	5, 620	5, 521	67, 113
Oklahoma, Kansas, and Missouri	4, 621	4, 453	4, 962	5, 189	5, 455	5, 100	5, 872	5, 760	5, 322	5, 017	4, 752	4, 424	60, 927
Texas inland	2, 299	2, 162	2, 334	2, 698	2, 884	2, 845	3, 083	3, 149	2, 759	2, 894	2, 701	2, 430	32, 238
Texas Gulf coast	5, 941	5, 392	6, 032	6, 541	6, 494	6, 595	6, 346	6, 251	6, 137	7, 131	6, 519	6, 503	75, 882
Louisiana Gulf coast	1, 303	1, 286	1, 466	1, 418	1, 500	1, 347	1, 495	1, 707	1, 529	1, 688	1, 482	1, 626	17, 847
Arkansas and Louisiana inland	578	567	654	760	785	783	825	834	707	733	754	641	8, 621
Rocky Mountain	856	855	951	1, 094	1, 167	1, 063	1, 084	1, 035	959	949	953	876	11, 842
California	5, 555	5, 420	6, 105	6, 224	6, 244	5, 888	5, 815	5, 591	6, 253	5, 879	5, 532	5, 755	70, 261
Total, 1931	32, 161	30, 818	34, 688	36, 151	38, 419	36, 624	37, 873	38, 425	37, 016	38, 080	35, 692	35, 563	431, 510
Daily average, 1931	1, 037	1, 101	1, 119	1, 205	1, 239	1, 221	1, 222	1, 240	1, 234	1, 228	1, 190	1, 147	1, 182
Total, 1930	35, 776	33, 207	36, 885	37, 289	38, 519	36, 529	37, 240	37, 093	36, 495	36, 513	32, 867	33, 828	432, 241
Stocks, end of period:													*Dec. 31, 1930*
East coast	6, 868	7, 685	8, 876	8, 620	8, 086	7, 000	5, 715	4, 629	3, 897	3, 994	4, 277	4, 589	5, 773
Appalachian	1, 463	1, 748	2, 124	1, 980	1, 847	1, 634	1, 429	1, 277	1, 394	1, 389	1, 316	1, 426	1, 195
Indiana, Illinois, Kentucky, etc	4, 606	4, 948	5, 762	5, 974	6, 439	6, 080	5, 282	4, 708	4, 685	4, 710	5, 126	5, 706	4, 288
Oklahoma, Kansas, and Missouri	3, 477	3, 862	4, 266	4, 145	4, 376	3, 481	3, 013	2, 735	2, 919	3, 010	3, 243	3, 452	3, 370
Texas inland	1, 831	1, 872	1, 834	1, 950	2, 044	1, 835	1, 835	1, 957	2, 084	2, 044	2, 279	2, 420	1, 812
Texas Gulf coast	5, 060	4, 995	5, 814	5, 840	5, 596	5, 612	5, 084	4, 313	3, 547	4, 130	4, 845	5, 778	4, 917
Louisiana Gulf coast	1, 319	1, 725	1, 948	2, 231	2, 117	1, 400	834	664	626	696	986	1, 253	1, 413
Arkansas and Louisiana inland	213	209	183	183	186	131	165	180	244	142	190	149	225
Rocky Mountain	1, 813	1, 940	2, 003	2, 027	2, 064	1, 946	1, 651	1, 384	1, 395	1, 311	1, 545	1, 830	1, 752
California	15, 725	15, 940	15, 078	14, 651	13, 658	12, 947	13, 166	13, 022	12, 610	13, 189	12, 979	13, 599	15, 141
Total: 1931	42, 375	44, 924	47, 888	47, 601	46, 413	42, 066	38, 174	34, 869	33, 401	34, 615	36, 786	40, 202	[1]39, 886
1930	49, 712	53, 217	55, 228	54, 422	54, 096	50, 107	45, 715	41, 412	38, 182	38, 612	38, 692	40, 529	----------

[1] For comparison with 1931.

The upward trend in the percentage yield of gasoline, which has been an outstanding accomplishment of the refining industry since gasoline replaced kerosene as the principal refined product, was continued in 1931 when another new record was established. Based on the gasoline obtained from crude only the recovery in 1931 was 44.3 percent compared with 42 in 1930. This gain resulted primarily from continued growth in cracking, although the use of large quantities of high-gravity crude from the East Texas field undoubtedly had an appreciable effect. With refinery prices of gasoline at record low levels in 1931 the refiners had to modernize or go out of business; accordingly, part of the increased yield in 1931 should be credited to technical progress. In 1931 the percentage yield of gasoline increased quite rapidly from January through April but was fairly uniform during the remaining 8 months. As in 1930, the yield reached its maximum (45.9 percent) in October.

A majority of the refining districts reported a gain in gasoline yield; the largest increases were recorded in the East coast and Texas Gulf coast districts, both leaders in cracking activity. California, which had shown a rather rapid increase in gasoline yield (25 percent in 1927 to 34 percent in 1930), as cracking became increasingly popular, recorded virtually no change in 1931. The Rocky Mountain and Indiana-Illinois-Kentucky districts, in both of which cracking is carried to its final stages, continued to have the highest gasoline yields of all the districts. The yield in the East coast district rose from 35.2 percent in 1930 to 40.2 percent in 1931 as cracking increased and as East Texas crude replaced foreign and other heavier crudes.

Percentage yields of gasoline in 1931, by districts and months

	January	February	March	April	May	June	July	August	September	October	November	December	Average
Based on total gasoline production:													
East coast	40	41	40	38	39	38	41	41	41	43	45	45	41.1
Appalachian	47	45	48	48	49	49	47	47	47	49	48	51	48.0
Indiana, Illinois, Kentucky, etc	54	54	54	57	64	60	58	60	57	58	59	59	58.1
Oklahoma, Kansas, and Missouri	58	57	58	58	59	56	56	56	59	61	60	58	58.0
Texas inland	50	50	48	51	50	50	51	52	54	58	57	57	52.3
Texas Gulf coast	45	45	46	49	48	51	50	48	51	54	50	48	48.7
Louisiana Gulf coast	45	48	49	48	43	38	40	45	46	50	43	45	44.6
Arkansas and Louisiana inland	42	43	43	46	46	45	40	43	42	47	48	37	43.3
Rocky Mountain	67	63	64	62	64	61	60	59	60	66	69	72	63.4
California	39	43	42	43	43	42	39	36	44	39	40	40	40.6
United States: 1931	45.8	47.2	47.1	48.4	48.9	48.1	47.5	47.6	49.3	50.1	49.8	48.9	48.2
1930	44.6	45.9	46.0	46.4	46.0	45.2	47.4	46.8	48.1	49.3	46.7	47.3	46.6
Based on total gasoline production less natural gasoline used:													
East coast	38	40	39	38	38	38	40	41	40	42	44	44	40.2
Appalachian	45	44	47	46	48	47	45	46	46	48	46	50	46.6
Indiana, Illinois, Kentucky, etc	50	51	52	55	61	59	56	59	55	55	55	56	55.6
Oklahoma, Kansas, and Missouri	53	51	53	53	54	52	52	52	55	56	54	52	52.9
Texas inland	44	44	43	44	44	45	47	48	48	51	50	50	46.5
Texas Gulf coast	39	41	42	46	44	46	45	44	47	50	46	45	44.7
Louisiana Gulf coast	40	42	42	42	38	35	38	42	43	47	40	42	40.8
Arkansas and Louisiana inland	35	36	35	40	40	39	36	39	38	42	44	34	38.3
Rocky Mountain	56	57	57	57	58	55	54	53	52	57	61	64	56.6
California	32	34	35	36	35	34	34	31	38	32	34	34	34.1
United States: 1931	41.2	42.5	42.9	44.5	45.0	44.3	44.1	44.5	45.6	45.9	45.7	45.2	44.3
1930	40.3	41.3	41.6	41.9	42.0	41.1	42.5	42.1	42.8	44.2	41.7	42.2	42.0

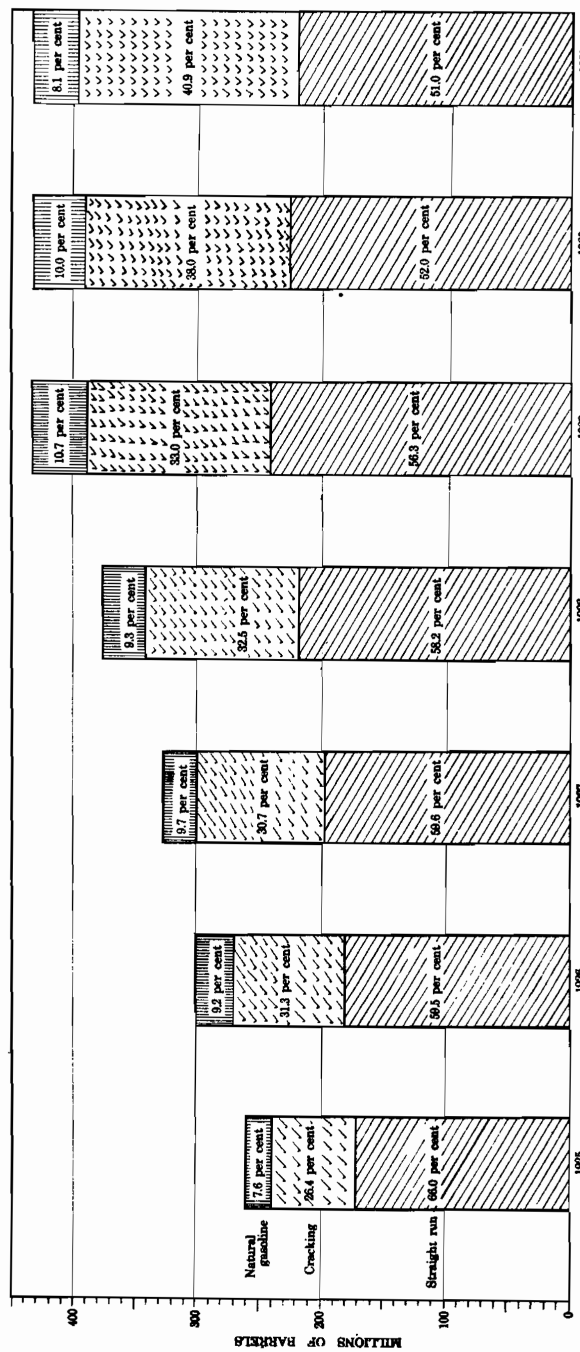

FIGURE 45.—Gasoline production by method of manufacture, 1925–31.

Production of gasoline by method of manufacture in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	1931 Quantity	1931 Percent [1]
Straight distillation:														
East coast	2,603	2,319	2,534	2,225	2,491	2,409	2,498	2,753	2,512	2,670	2,563	2,864	30,441	43.9
Appalachian	775	765	910	785	808	794	826	899	901	857	767	771	9,858	56.4
Indiana, Illinois, Kentucky, etc.	1,888	1,971	2,430	2,770	3,340	3,134	2,970	3,296	2,830	2,791	2,605	2,684	32,709	48.7
Oklahoma, Kansas, and Missouri	2,523	2,510	2,766	2,924	3,016	2,874	3,354	3,153	2,859	2,657	2,573	2,211	33,420	54.8
Texas inland	1,418	1,335	1,497	1,694	1,919	1,859	1,966	2,034	1,675	1,734	1,546	1,331	20,008	62.1
Texas Gulf coast	2,078	2,160	2,686	2,965	2,654	3,080	2,478	2,765	2,760	3,109	2,880	3,016	32,631	43.0
Louisiana Gulf coast	415	443	496	498	676	639	718	840	682	668	681	845	7,598	42.6
Arkansas and Louisiana inland	221	224	267	383	403	412	469	461	386	372	393	349	4,343	50.4
Rocky Mountain	365	378	432	508	545	490	529	481	436	398	417	387	5,366	45.3
California	3,318	3,220	3,748	3,880	3,926	3,763	3,756	3,625	4,079	3,630	3,284	3,354	43,583	62.0
Total straight run	15,604	15,325	17,766	18,632	19,778	19,454	19,564	20,307	19,120	18,886	17,709	17,812	219,957	51.0
Percent of total production	48.5	49.7	51.2	51.5	51.5	53.1	51.7	52.9	51.7	49.6	49.6	50.1	51.0	-------
Cracking:														
East coast	2,802	2,621	3,035	2,925	3,228	3,031	3,366	3,126	3,266	3,351	3,273	3,338	37,362	53.9
Appalachian	418	440	546	553	618	592	657	653	655	705	603	654	7,094	40.6
Indiana, Illinois, Kentucky, etc.	1,967	2,078	2,337	2,623	3,037	2,783	2,757	3,085	2,782	2,870	2,633	2,554	31,506	47.0
Oklahoma, Kansas, and Missouri	1,664	1,523	1,766	1,843	1,988	1,787	2,013	2,183	2,027	1,895	1,698	1,769	22,156	36.4
Texas inland	622	569	602	635	659	707	846	837	798	802	824	795	8,696	27.0
Texas Gulf coast	3,140	2,725	2,755	3,146	3,305	2,924	3,291	2,976	2,920	3,569	3,138	3,049	36,938	48.7
Louisiana Gulf coast	761	678	770	740	644	596	705	751	752	927	719	671	8,714	48.8
Arkansas and Louisiana inland	259	250	277	274	285	276	280	303	258	282	300	240	3,284	38.1
Rocky Mountain	359	386	423	493	520	470	454	446	399	431	433	396	5,210	44.0
California	1,327	1,132	1,330	1,410	1,260	1,095	1,249	1,216	1,285	1,181	1,403	1,589	15,477	22.0
Total cracked	13,319	12,402	13,841	14,642	15,544	14,261	15,618	15,576	15,142	16,013	15,024	15,055	176,437	40.9
Percent of total production	41.4	40.3	39.9	40.5	40.4	38.9	41.2	40.5	40.9	42.0	42.1	42.3	40.9	-------

By use of natural gasoline:														
East coast	242	229	130	79	90	64	51	83	133	168	118	122	1, 509	2. 2
Appalachian	50	36	43	42	53	38	44	40	32	44	55	38	515	3. 0
Indiana, Illinois, Kentucky, etc	263	224	219	225	225	158	184	163	239	333	382	283	2, 898	4. 3
Oklahoma, Kansas, and Missouri	434	420	430	422	451	439	505	424	436	465	481	444	5, 351	8. 8
Texas inland	259	258	235	369	306	279	271	278	286	358	331	304	3, 534	10. 9
Texas Gulf coast	723	507	591	430	535	591	577	510	457	453	501	438	6, 313	8. 3
Louisiana Gulf coast	127	165	200	183	180	112	72	116	95	93	82	110	1, 535	8. 6
Arkansas and Louisiana inland	98	93	110	100	97	95	76	70	63	79	61	52	994	11. 5
Rocky Mountain	132	91	96	93	102	103	101	108	124	120	103	93	1, 266	10. 7
California	910	1, 068	1, 027	934	1, 058	1, 030	810	750	889	1, 068	845	812	11, 201	16. 0
Total natural gasoline	3, 238	3, 091	3, 081	2, 877	3, 097	2, 909	2, 691	2, 542	2, 754	3, 181	2, 959	2, 696	35, 116	8. 1
Percent of total production	10. 1	10. 0	8. 9	8. 0	8. 1	8. 0	7. 1	6. 6	7. 4	8. 4	8. 3	7. 6	8. 1	--------

[1] Represents ratio of production by methods to the total production by districts.

Motor fuel is produced at refineries by three methods: (1) Straight-run distillation of crude, (2) cracking, and (3) blending natural gasoline. During the last decade the relative importance of methods (2) and (3) has increased at the expense of method (1), but in spite of these inroads the production of straight-run gasoline still accounts for about half the total output. (See fig. 45.)

The total production of gasoline at refineries in 1931 was 431,510,000 barrels, of which 219,957,000 barrels (51 percent) were produced by cracking and 35,116,000 barrels (8.1 percent) were natural gasoline. These data indicate declines of approximately 5,000,000 and 8,000,000 barrels for straight-run and natural gasoline, respectively, which were nearly compensated by a gain of about 12,000,000 barrels in the production of cracked gasoline. It was formerly held that in times of low crude prices, such as prevailed in 1931, it would be cheaper to produce gasoline by straight-run methods than by cracking.

In view of the steady reduction in cracking costs this theory may not be true at present. In any event it had little influence on refinery operations in 1931, as the superior antiknock qualities of cracked gasoline became generally recognized and as there was no market for the fuel oil that would have been produced as the result of processing additional crude by straight distillation.

In three districts—East coast, Texas Gulf coast, and Louisiana Gulf coast—the production of cracked gasoline exceeds that of straight-run gasoline. It is noteworthy that all three districts are on the seaboard and have a comparatively small number of large plants, proving a relationship between size, cracking activity, and location.

Gasoline was produced in 27 States in 1931; the States were the same as in 1930, except for the loss of Arizona.

Texas was again the leading gasoline-producing State, with California second and Oklahoma third. The margin between Texas and California increased in 1931, as production in Texas increased nearly 6,500,000 barrels and that in California fell nearly 14,000,000 barrels. Pennsylvania was the only other important gasoline-producing State with a large percentage increase in output in 1931.

States which individually produced more than 1 percent of the total output of crude petroleum in 1931 had a gasoline production equivalent to 72 percent of the total for the United States. In 1930 this ratio was 73 percent, indicating continuation of the tendency to expand refinery facilities near the consuming centers rather than in the crude-producing fields.

The transportation of gasoline by pipe line from refineries to large distributing centers was contemplated for many years and was seriously considered after the art of welding was perfected, but it was not until early in 1930 that the first long line was placed in operation. This line is owned by the Tuscarora Oil Co., Ltd., and extends from refineries of the Standard Oil Co. of New Jersey, the parent company, to a point in western Pennsylvania. The next long line placed in operation was that of the Great Lakes Pipe Line Co., which connects various refineries in Oklahoma and Kansas with Chicago, Milwaukee, St. Paul, and other important consuming centers. This line was constructed with new material, whereas the Tuscarora line is a converted crude-oil line. The Great Lakes system was placed in operation in February 1931. The next large system to be placed in operation was that of the Phillips Pipe Line Co., a subsidiary of the

Phillips Petroleum Co. This line extends from the Phillips refinery at Borger, in the Texas Panhandle, to St. Louis. On July 1, 1932, seven gasoline pipe-line systems were in operation with a total mileage of 3,662.

Production of gasoline in 1931, by States

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Arkansas	220	208	207	292	315	333	359	345	291	294	261	213	3, 338
California	5, 555	5, 420	6, 105	6, 224	6, 244	5, 888	5, 815	5, 591	6, 253	5, 879	5, 532	5, 755	70, 261
Colorado	42	46	65	74	62	57	71	72	67	67	68	70	761
Georgia, Rhode Island, South Carolina	210	198	206	145	133	117	115	114	128	111	119	128	1, 724
Illinois	1, 052	1, 074	1, 431	1, 778	1, 860	1, 865	1, 765	1, 801	1, 581	1, 545	1, 498	1, 460	18, 710
Indiana	2, 226	2, 304	2, 538	2, 846	3, 554	3, 020	3, 023	3, 457	2, 928	3, 052	2, 878	2, 782	34, 608
Kansas, Missouri, and Iowa	1, 767	1, 727	1, 983	1, 946	2, 099	1, 949	2, 180	2, 256	2, 109	1, 964	1, 878	1, 727	23, 585
Kentucky and Michigan	443	495	488	470	498	514	500	449	445	469	503	490	5, 764
Louisiana	1, 661	1, 645	1, 921	1, 894	1, 979	1, 797	1, 968	2, 196	1, 945	2, 127	1, 975	2, 054	23, 162
Maryland	424	341	371	299	377	388	387	407	412	442	445	483	4, 776
Massachusetts	433	426	373	428	481	452	498	455	472	461	465	450	5, 394
Montana	34	52	58	84	81	80	90	76	84	83	77	78	877
New Jersey	2, 096	1, 818	2, 208	2, 052	2, 317	2, 140	2, 308	2, 450	2, 406	2, 386	2, 367	2, 496	27, 044
New Mexico and Utah	134	122	123	142	153	142	152	135	137	80	137	136	1, 593
New York	387	345	376	374	412	402	387	408	422	439	431	402	4, 785
Ohio	842	858	1, 049	1, 012	1, 201	1, 150	1, 131	1, 396	1, 441	1, 429	1, 194	1, 264	13, 967
Oklahoma	2, 854	2, 726	2, 971	3, 235	3, 347	3, 151	3, 685	3, 504	3, 213	3, 053	2, 874	2, 697	37, 310
Pennsylvania	2, 711	2, 661	2, 950	2, 688	2, 885	2, 745	3, 017	2, 928	2, 910	3, 226	2, 901	3, 146	34, 768
Texas	8, 240	7, 554	8, 366	9, 239	9, 378	9, 440	9, 429	9, 400	8, 896	10, 025	9, 220	8, 933	108, 120
West Virginia	184	163	194	135	172	210	222	233	205	229	198	207	2, 352
Wyoming	646	635	705	794	871	784	771	752	671	719	671	592	8, 611
	32, 161	30, 818	34, 688	36, 151	38, 419	36, 624	37, 873	38, 425	37, 016	38, 080	35, 692	35, 563	431, 510

A comparatively small quantity of gasoline was transported through a converted crude-oil line in 1930, but the first official figures date from the beginning of 1931. These statistics show that only 162,000 barrels of motor fuel were delivered by pipe lines in January 1931, but by December 1,721,000 barrels were so delivered. The total quantity of motor fuel delivered from lines in 1931 was 12,766,000 barrels (3 percent of the domestic demand). Stocks of motor fuel held in gasoline lines or in working tanks adjacent thereto increased steadily throughout the year as more and more lines were placed in operation. The total shortage (58,000 barrels) incurred in the operation of gasoline lines indicates a relatively low percentage of loss—less than one half of 1 percent—by this method of transportation.

Shipments of motor fuel by pipe lines in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Motor fuel turned into lines	179	282	421	511	1, 122	1, 161	1, 420	1, 847	2, 110	1, 894	1, 851	1, 937	14, 735
Motor fuel delivered from lines	162	224	256	419	862	713	1, 270	1, 686	1, 926	1, 849	1, 678	1, 721	12, 766
Shortage	----	[1] 2	1	[1] 2	[1] 5	13	10	20	5	7	4	7	58
Stocks in lines and working tanks, end of period	217	277	441	535	800	1, 235	1, 375	1, 516	1, 695	1, 733	1, 902	2, 111	2, 111

[1] Overplus.

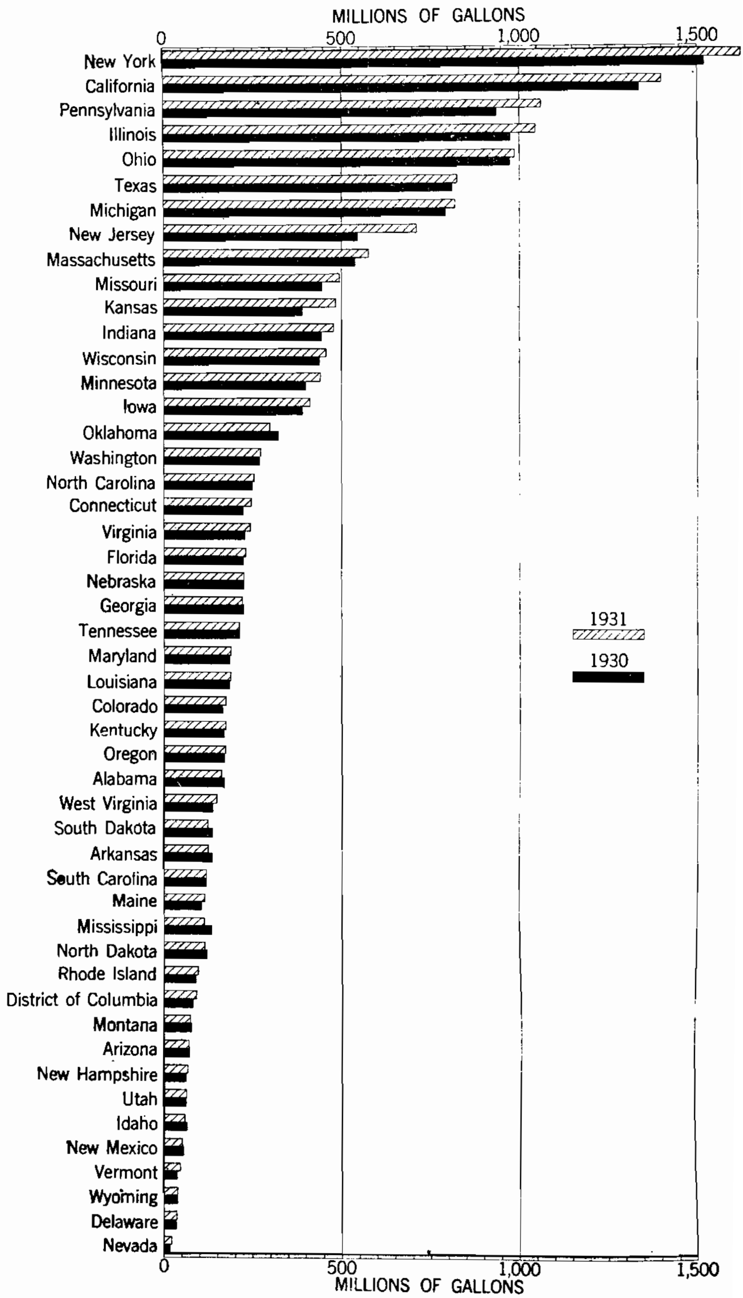

FIGURE 46.—Gasoline consumption, 1930 and 1931, by States.

Consumption of gasoline in 1931, by States and months [1]

[Thousands of gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total: Thousands of gallons	Total: Thousands of barrels
Alabama	12,575	11,501	12,979	13,949	14,626	14,376	15,403	14,608	13,803	14,026	13,102	11,724	162,672	3,873
Arizona	5,850	5,356	6,355	6,644	6,494	6,898	6,536	6,157	6,151	6,208	5,756	6,056	74,461	1,773
Arkansas	11,752	10,122	8,511	9,939	9,984	9,183	13,209	11,369	13,576	10,132	10,601	8,696	127,074	3,026
California	100,740	107,457	127,605	118,205	136,339	135,171	110,692	119,557	117,188	113,631	109,552	105,407	1,401,544	33,370
Colorado	12,037	11,488	12,434	15,124	15,707	17,342	20,654	18,448	15,078	14,986	12,638	10,558	176,494	4,202
Connecticut	14,924	13,372	15,989	19,487	22,328	23,921	25,691	25,879	23,948	23,416	20,237	19,735	248,927	5,927
Delaware	2,258	2,642	2,726	1,617	4,653	3,361	3,929	3,859	3,712	3,490	2,942	2,917	38,106	907
District of Columbia	6,489	6,046	6,994	7,881	8,236	8,437	8,581	8,390	8,126	8,508	7,892	7,913	93,493	2,226
Florida	22,365	21,396	22,420	20,226	19,183	17,974	19,769	15,780	16,557	18,218	17,645	20,455	231,988	5,523
Georgia	17,093	15,772	17,106	17,939	19,037	19,144	20,556	21,037	18,544	19,592	18,369	17,704	221,893	5,283
Idaho	2,961	2,919	3,923	4,935	5,629	6,556	6,392	6,892	6,198	5,679	4,436	3,233	59,753	1,423
Illinois	65,609	68,461	68,772	82,405	88,827	93,223	102,366	102,187	95,183	93,494	95,213	91,947	1,047,687	24,945
Indiana	31,976	29,697	32,604	42,176	43,379	44,938	49,414	48,492	44,205	42,449	37,014	35,127	481,471	11,464
Iowa	27,814	26,403	33,609	33,908	38,162	38,336	44,030	43,374	33,790	35,224	30,653	27,121	412,424	9,820
Kansas	26,815	24,559	25,441	30,182	40,763	54,622	66,026	71,833	46,865	38,585	32,251	27,541	485,483	11,559
Kentucky	12,396	11,131	12,037	14,202	15,408	15,851	17,253	17,321	16,467	16,060	14,785	13,292	176,203	4,195
Louisiana	13,928	13,125	14,069	15,620	15,920	16,577	16,664	17,291	16,803	17,396	15,498	15,064	187,955	4,475
Maine	4,460	3,864	4,830	7,716	11,213	12,351	14,936	15,874	13,249	11,627	9,014	7,065	116,199	2,767
Maryland	12,337	11,650	13,464	15,771	16,507	17,482	17,674	18,125	18,169	17,382	15,765	14,604	188,930	4,498
Massachusetts	33,836	30,736	37,962	48,045	50,282	54,534	59,988	61,009	54,409	53,803	47,103	45,490	577,197	13,743
Michigan	54,272	47,700	55,099	70,026	75,515	77,645	86,135	87,710	71,618	70,327	63,948	61,589	821,584	19,561
Minnesota	28,269	24,701	29,034	36,323	40,767	41,615	50,307	49,809	38,761	40,067	34,827	27,434	441,914	10,522
Mississippi	8,083	8,697	8,519	9,915	9,979	9,991	11,339	11,584	9,774	9,630	10,888	6,825	115,224	2,743
Missouri	31,848	36,661	31,141	42,858	41,981	45,431	50,280	48,488	43,249	43,372	37,460	39,803	492,572	11,728
Montana	4,159	4,092	5,639	8,276	7,407	7,915	8,140	8,447	6,239	6,945	4,719	3,667	75,645	1,801
Nebraska	16,334	17,695	17,307	17,284	19,751	21,735	23,995	24,787	18,976	19,880	16,689	13,767	228,200	5,433
Nevada	1,131	1,172	1,470	1,969	2,208	2,686	2,537	2,626	2,248	2,086	1,840	1,571	23,544	561
New Hampshire	2,959	2,787	3,310	4,558	6,062	6,956	8,700	9,089	7,505	6,736	5,249	4,394	68,305	1,626
New Jersey	46,434	43,241	50,701	59,047	62,235	65,691	72,273	67,146	65,830	64,441	58,177	55,912	711,128	16,932
New Mexico	3,594	3,422	3,797	4,341	4,512	5,162	5,551	5,285	4,551	4,410	4,094	3,503	52,222	1,243
New York	98,946	91,404	108,802	129,047	147,269	152,703	169,277	169,019	154,946	149,129	131,389	123,640	1,625,571	38,704
North Carolina	21,050	19,523	18,342	18,491	21,578	18,776	22,376	21,228	23,831	24,976	22,509	23,011	255,691	6,088
North Dakota	6,298	4,977	7,250	13,978	12,243	10,529	13,247	14,650	10,229	9,629	7,105	4,654	114,789	2,733
Ohio	63,371	66,749	69,168	82,462	90,615	90,349	99,113	98,874	87,171	86,548	78,273	72,116	984,809	23,448
Oklahoma	24,510	22,261	23,277	22,047	25,090	28,643	30,904	28,881	25,154	24,421	23,598	21,571	300,357	7,151
Oregon	10,323	11,007	12,674	15,082	18,274	18,390	16,769	17,716	16,034	14,752	12,346	11,183	174,550	4,156
Pennsylvania	81,217	61,407	73,009	66,751	96,022	96,580	103,283	104,435	102,953	101,436	91,712	83,797	1,062,602	25,300

[1] Compiled from reports of the American Petroleum Institute which cover "quantities of gasoline sold or offered for sale, as reported by wholesalers and dealers in the various States under provisions of the gasoline tax or inspection laws."

Consumption of gasoline in 1931, by States and months—Continued

[Thousands of gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total: Thousands of gallons	Total: Thousands of barrels
Rhode Island	6,006	5,227	7,182	7,273	9,071	9,405	10,435	10,674	8,905	8,597	7,551	7,831	98,157	2,337
South Carolina	8,987	8,489	9,741	10,158	10,196	10,498	10,911	11,169	10,730	10,718	9,852	9,790	121,239	2,887
South Dakota	8,906	7,634	12,793	12,669	12,756	13,534	15,418	12,674	10,794	11,129	9,054	7,153	134,514	3,203
Tennessee	15,215	14,201	16,051	17,068	18,276	20,378	18,377	20,111	20,074	19,274	18,078	17,266	214,369	5,104
Texas	61,059	54,653	62,513	66,550	72,106	77,273	80,127	80,555	69,486	70,948	68,512	62,325	826,107	19,669
Utah	3,800	3,566	4,609	5,598	5,312	6,283	7,384	5,906	5,429	4,985	4,838	3,465	61,175	1,457
Vermont	2,124	1,804	2,139	3,247	4,517	4,959	6,027	6,519	5,614	5,002	4,068	3,131	49,151	1,170
Virginia	15,658	14,443	16,268	19,531	20,952	22,282	23,690	24,245	23,340	22,955	20,738	20,049	244,151	5,813
Washington	18,912	16,433	18,349	29,202	17,854	26,233	27,277	24,447	27,307	24,438	22,488	19,668	272,608	6,491
West Virginia	8,060	7,810	8,296	11,165	12,677	13,580	14,950	14,979	14,907	14,086	12,488	10,983	143,981	3,428
Wisconsin	26,879	25,718	35,148	32,778	40,234	43,621	48,914	50,145	43,429	41,639	35,282	31,862	455,649	10,849
Wyoming	2,143	2,192	2,457	3,040	3,421	4,376	4,829	4,764	3,774	3,493	2,743	2,245	39,477	940
	1,118,762	1,057,363	1,193,915	1,346,705	1,491,557	1,563,496	1,682,328	1,683,444	1,514,879	1,479,955	1,340,981	1,245,854	16,719,239	398,077

According to reports of the American Petroleum Institute, the quantity of gasoline "sold or offered for sale, as reported by wholesalers and dealers in the various States under provisions of the gasoline tax or inspection laws" in 1931 totaled 16,719,239,000 gallons, or 398,077,000 barrels. This figure is somewhat below the Bureau's figure of indicated domestic demand as the latter includes various losses and the demand for special naphthas not used as motor fuel.

New York was the leading gasoline-consuming State in 1931, with California second and Pennsylvania third. (See fig. 46.) Of the 48 States and the District of Columbia, 36 gained in gasoline consump-

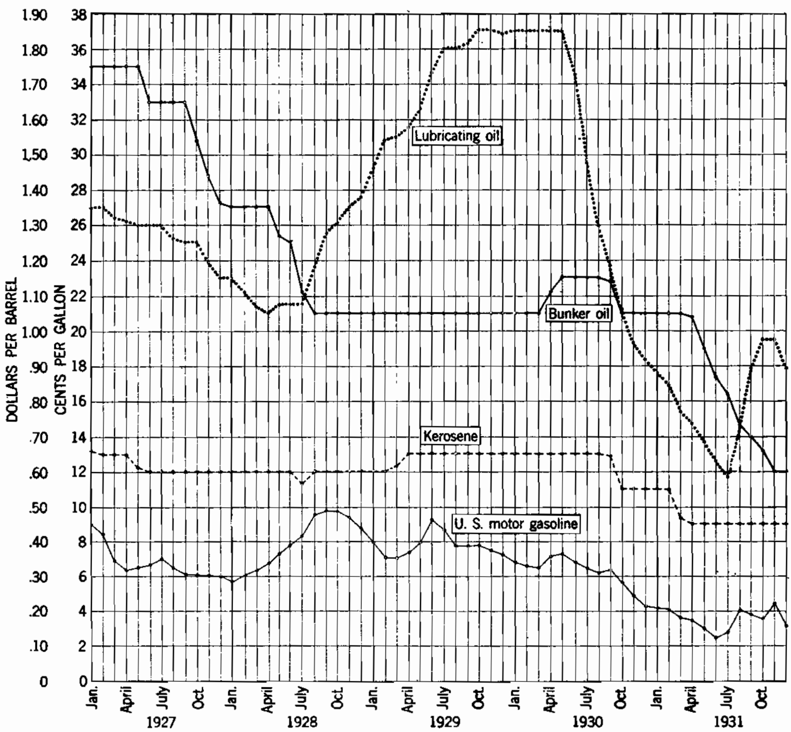

FIGURE 47.—Prices of refined products: Refinery price of United States motor gasoline, group 3; tank-wagon price of kerosene at Chicago; refinery price of grade C bunker oil at New York; and refinery price of 150-160 viscosity at 210° bright stock in Oklahoma, 1927-31, by months.

tion in 1931 over 1930 and 13 declined. The majority of those that dropped in consumption were in the South and Middle West. The largest increase in gasoline consumption in 1931, both quantitatively and on a percentage basis, was in New Jersey, the largest quantitative loss in 1931 was in Oklahoma and the largest percentage loss in Mississippi.

The average consumption per motor vehicle in 1931 was 596.9 gallons compared with 555.7 gallons in 1930. Gasoline consumption varies widely among the States, with the largest averages in the North Atlantic and Southern States.

The price of gasoline at refineries has declined steadily in recent years as the net result of a number of causes, such as cheaper crude, lower cost of manufacture, and keener competition. All these factors operated in 1931 to reduce quoted prices to record lows, or to points that would have been ruinous to the industry had its sole source of revenue been derived from selling gasoline wholesale. The major portion of the gasoline distributed to consumers is sold on contract; consequently, the real average refinery price of gasoline is unobtainable. The substitute generally used is the spot price of U.S. motor gasoline of 58° to 60° gravity in Oklahoma. In 1931 the average of the selected grades was 3.54 cents compared with 6.20 cents in 1930, a decline of 43 percent. (See fig. 47.) The range in 1931 was 2.25 cents per gallon in June to 5 cents per gallon in August. The June low reflected the overproduction of crude in the East Texas field; likewise, the August high was closely related to the shut-down of that field.

Refinery price of U.S. motor gasoline (58°–60° gravity, 437° F. end point) in Oklahoma in 1931, in cents per U.S. gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average, 1931
Average monthly prices	4.16	4.08	3.63	3.47	2.97	2.47	2.80	4.06	3.83	3.50	4.47	3.17	3.54

PRICE CHANGES BY WEEKS

Jan. 1 [2]	4.00	May 4	3.125	July 27	3.125	Oct. 19 [3]	3.75
Jan. 12	4.25	May 11	3.00	Aug. 3	3.25	Oct. 26	4.00
Feb. 9	4.125	May 18	2.875	Aug. 10	3.875	Nov. 2	4.25
Feb. 16	4.00	May 25	2.75	Aug. 17	4.25	Nov. 9	4.75
Feb. 23	3.875	June 8	2.50	Aug. 24	5.00	Nov. 23	4.25
Mar. 9	3.625	June 15	2.375	Sept. 8	4.25	Nov. 30	4.00
Mar. 16	3.50	June 22	2.25	Sept. 14	3.625	Dec. 7	3.375
Apr. 13	3.375	June 29	2.50	Sept. 21	2.875	Dec. 14	3.125
Apr. 20	3.625	July 6	2.625	Sept. 28	3.00	Dec. 21	2.625
Apr. 27	3.25	July 13	2.875	Oct. 12	3.625		

[1] From National Petroleum News.
[2] In effect on this date.
[3] Beginning Oct. 19, United States motor gasoline prices were based on octane rating; the quotations given from Oct. 19 to the end of the year are for gasoline below 57 octane number.

KEROSENE

The relative importance of kerosene in the refining industry continued to decline, and production in 1931 was about the same as in 1917. The production in 1931 totaled 42,446,000 barrels, a decrease of 6,762,000 barrels (14 percent) from 1930. (See fig. 48.) Part of this decrease was due to the decline in crude runs, but the major portion resulted from a decrease in yield from 5.3 percent in 1930 to 4.7 percent in 1931. Exports of kerosene suffered in common with those of other refined products, declining 25 percent in 1931. This loss in export trade in kerosene was due to increased production in foreign countries and to a drop in the purchasing power of China and other important customers for kerosene.

The indicated domestic demand for kerosene, which had declined slowly but steadily since 1925, decreased an additional 10 percent in 1931. Detailed data as to the consumption of kerosene are comparatively meager; however, its principal uses are as an illuminant, as a fuel in domestic cookstoves and heaters, and as tractor fuel. The consumption in all of these classes probably declined in 1931.

There are no State taxes on kerosene, but a number of States require reports of sales to be filed. The American Petroleum Institute supplied monthly statistics covering the quantities of kerosene inspected in nine States in 1931. These data indicate that the consumption of kerosene delined 13 percent in the nine States in 1931, a somewhat larger decrease than in the country as a whole. Minnesota was the chief kerosene-consuming State in the group and probably leads the country in average consumption per capita.

The decline in consumption of kerosene was reflected in market conditions and prices. The trade in kerosene in the Middle West was described in one of the trade papers as "dull with declining prices" until late in the year, when the demand increased and "prices were firmer." The prices cited were refinery prices, as tank-wagon prices

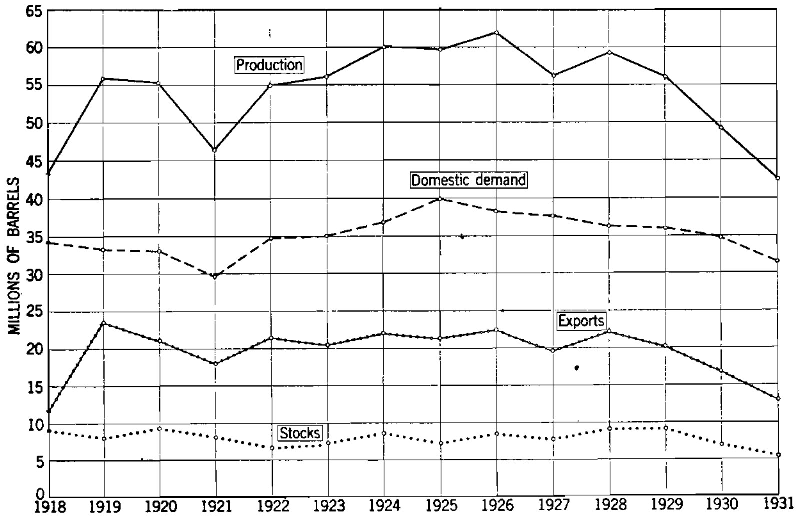

FIGURE 48.—Kerosene; production, domestic demand, exports, and stocks, 1918–31.

for kerosene declined in the spring and remained unchanged during the remainder of the year. (See fig. 47.)

About the only encouraging feature of the statistics for kerosene in 1931 concerns stocks at refineries. These stocks showed a net withdrawal of 1,613,000 barrels in 1931, and the total on hand at the end of the year (5,332,000 barrels) was the lowest reported since the statistics were first assembled in 1916.

Comparative analyses of kerosene, in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Production	3, 560	3, 171	3, 676	3, 397	3, 389	3, 404	3, 696	3, 685	3, 239	3, 701	3, 815	3, 713	42, 446
Daily average	115	113	119	113	109	113	119	119	108	119	127	120	116
Imports	1	------	1	2	------	2	2	2	------	1	------	-----	11
Exports	1, 292	985	1, 163	766	1, 162	741	1, 235	1, 144	1, 074	1, 294	1, 215	641	12, 712
Daily average	42	35	38	26	37	25	40	37	36	42	41	21	35
Stocks, end of period	6, 555	6, 477	6, 300	6, 129	5, 960	6, 521	6, 869	6, 734	6, 558	5, 924	5, 618	5, 332	5, 332
Domestic demand	2, 597	2, 264	2, 691	2, 804	2, 396	2, 104	2, 115	2, 678	2, 341	3, 042	2, 906	3, 358	31, 296
Daily average	84	81	87	93	77	70	68	86	78	98	97	108	86

Production and stocks of kerosene, in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Production:													
East coast	524	465	539	495	485	667	717	562	483	647	655	702	6,941
Appalachian	317	263	333	303	267	281	327	357	313	321	283	286	3,651
Indiana, Illinois, Kentucky, etc.	253	355	394	407	315	233	322	334	326	338	325	300	3,902
Oklahoma, Kansas, and Missouri	570	532	609	719	652	623	726	690	604	644	548	632	7,549
Texas inland	184	155	186	189	189	198	226	259	194	205	255	203	2,443
Texas Gulf coast	907	640	824	632	669	636	645	668	672	835	987	774	8,889
Louisiana Gulf coast	251	256	286	187	226	262	205	245	215	184	392	410	3,119
Arkansas and Louisiana inland	55	51	49	57	67	74	58	60	50	44	53	70	688
Rocky Mountain	68	76	76	70	90	77	103	86	52	62	69	54	883
California	431	378	380	338	429	353	367	424	330	421	248	282	4,381
Total, 1931	3,560	3,171	3,676	3,397	3,389	3,404	3,696	3,685	3,239	3,701	3,815	3,713	42,446
Daily average, 1931	115	113	119	113	109	113	119	119	108	119	127	120	116
Total, 1930	4,489	4,398	4,752	4,435	4,317	4,026	3,929	3,975	3,846	3,876	3,590	3,575	49,208
													Dec 31, 1930
Stocks, end of period:													
East coast	1,263	1,209	1,254	1,257	1,169	1,309	1,396	1,295	1,316	1,062	992	899	1,360
Appalachian	205	215	284	333	342	359	421	420	410	354	283	231	165
Indiana, Illinois, Kentucky, etc.	593	666	653	573	516	576	573	593	564	637	664	638	539
Oklahoma, Kansas, and Missouri	742	729	645	481	475	479	475	478	542	612	645	438	739
Texas inland	89	80	85	78	92	111	161	187	194	162	133	103	111
Texas Gulf coast	970	822	838	862	806	1,051	1,231	1,011	1,086	836	818	844	1,129
Louisiana Gulf coast	431	447	436	444	482	531	590	617	459	302	272	322	773
Arkansas and Louisiana inland	17	21	20	24	34	51	47	35	22	17	17	23	12
Rocky Mountain	286	300	253	251	258	264	304	327	318	333	354	352	276
California	2,004	2,040	1,889	1,881	1,839	1,839	1,731	1,755	1,655	1,609	1,440	1,482	1,841
Total: 1931	6,600	6,529	6,357	6,184	6,013	6,570	6,929	6,718	6,566	5,924	5,618	5,332	[1] 6,945
1930	8,571	8,565	8,455	8,068	8,384	8,352	8,319	8,030	7,771	7,633	7,379	6,883	-------

[1] For comparison with 1931.

Percentage yields of kerosene in 1931, by districts and months

	January	February	March	April	May	June	July	August	September	October	November	December	Average
East coast	4	4	4	4	3	5	5	4	3	4	5	5	4.1
Appalachian	12	10	11	11	9	10	10	11	9	10	10	10	10.0
Indiana, Illinois, Kentucky, etc.	3	4	4	4	3	2	3	3	3	3	3	3	3.4
Oklahoma, Kansas, and Missouri	7	7	7	8	7	7	7	7	7	8	7	8	7.2
Texas inland	4	4	4	4	3	3	4	4	4	4	5	5	4.0
Texas Gulf coast	7	5	6	5	5	5	5	5	6	6	8	6	5.7
Louisiana Gulf coast	9	10	9	6	6	7	5	6	6	5	11	11	7.8
Arkansas and Louisiana inland	4	4	3	3	4	4	3	3	3	3	3	4	3.5
Rocky Mountain	5	6	5	4	5	4	6	5	3	4	5	4	4.7
California	3	3	3	2	3	2	2	3	2	3	2	2	2.5
United States: 1931	5.1	4.9	5.0	4.6	4.3	4.5	4.6	4.6	4.3	4.9	5.3	5.1	4.7
1930	5.6	6.1	5.9	5.5	5.2	5.0	5.0	5.0	5.1	5.2	5.1	5.0	5.3

Consumption of kerosene in 1931, by States and months [1]

[Thousands of barrels of 42 U.S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Arkansas	36	28	29	35	36	20	23	21	30	24	28	25	335
Florida	74	57	63	49	42	38	33	35	38	46	51	49	575
Georgia	46	39	43	39	38	31	30	33	36	41	44	39	459
Kansas	70	72	93	90	88	101	103	102	73	67	66	55	980
Michigan	62	61	78	66	87	64	62	72	73	86	55	76	842
Minnesota	233	147	174	128	116	70	107	156	176	166	157	249	1,879
North Dakota	12	11	18	26	15	12	20	23	22	16	16	15	206
Oklahoma	61	59	56	72	66	62	67	54	52	49	56	55	709
South Dakota	20	22	43	22	22	21	16	16	13	18	16	17	246
	614	496	597	527	510	419	461	512	513	513	489	580	6,231

[1] From American Petroleum Institute.

Tank-wagon prices of kerosene at six representative cities in 1931, in cents per U.S. gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Average monthly prices:													
New York	12.0	12.0	12.0	12.0	12.0	12.0	12.0	11.8	11.0	10.7	9.0	9.0	11.29
Washington	10.7	10.7	10.7	10.5	10.0	9.8	9.7	9.7	10.3	10.7	10.7	10.7	10.34
Chicago	11.0	11.0	9.3	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.34
New Orleans	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	11.8	10.0	10.0	11.64
San Francisco	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.50
Denver	13.5	13.5	12.7	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.67
Average	12.5	12.5	12.0	11.9	11.8	11.8	11.8	11.8	11.7	11.7	11.1	11.1	11.80

	New York	Washington	Chicago	New Orleans	San Francisco	Denver
Dates of price changes:						
Jan. 1 [2]	12.0	10.7	11.0	12.0	15.5	13.5
Mar. 5			9.0			
Mar. 7						12.5
Apr. 23		10.0				
June 15		9.7				
Aug. 27	11.0					
Sept. 14		10.7				
Oct. 28	9.0					
Oct. 29				10.0		

[1] From National Petroleum News.
[2] In effect on this date.

GAS OIL AND DISTILLATE FUEL OILS AND RESIDUAL FUEL OILS

Until 1929 fuel oil, including the light fuel oils such as gas oil, represented quantitatively the most important refined product. In 1929 the percentage yield of gasoline exceeded that of fuel oil; in the next 2 years the margin between the two widened steadily so that in 1931 the yield of gas oil and fuel oil was 37.7 percent, whereas that of gasoline was 44.3 percent. This important change in refinery operations has resulted principally from increased cracking.

Since 1929 the statistics of gas oil and distillate fuel oils have been shown separately from those of residual fuel oil. At the time of writing the ratio for the two in refinery production is about 3 for residual fuel oil and 1 for gas oil and distillate fuel oil. (See fig. 49.)

In 1931 the output of gas oil and distillate fuel oil rose to 83,882,000 barrels from 81,551,000 in 1930, one of the very few instances of increased production at refineries in the year. The gain in output of gas oil and distillate fuel oil in 1931 was due principally to the increased demand for the distillate fuel oils in domestic heaters and for Diesel oil (gas oil) in Diesel engines. The use of gas oil at gas plants, the principal outlet, has declined in recent years due to competitive enriching methods.

The market for gas oil and distillate fuel oils was generally strong as the year opened but weakened rapidly with declining demand. In midsummer prices were less than half those on January 1. The increasing demand of the last quarter strengthened the market, but the recovery in prices was only about a third of the loss in the first 6

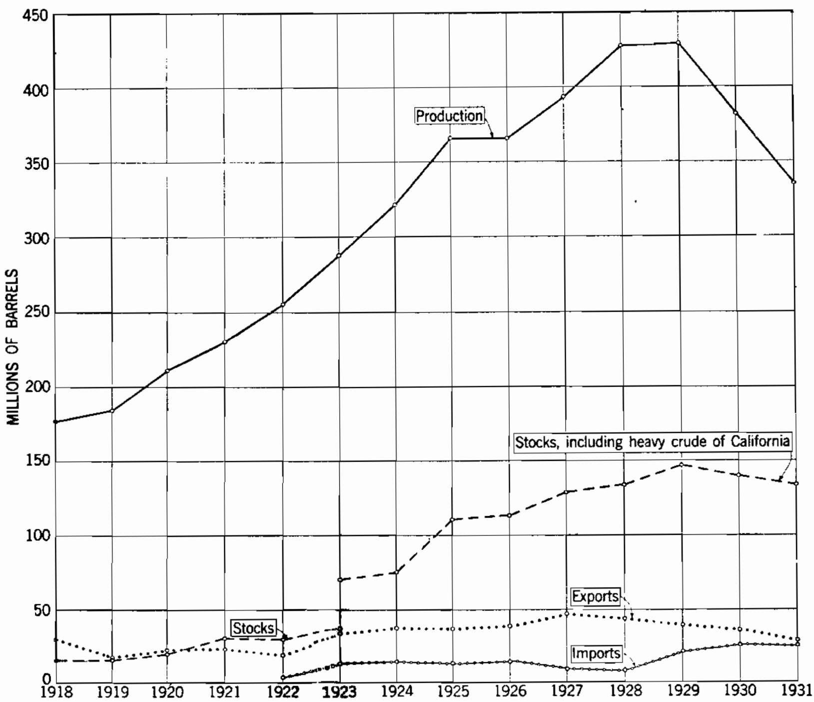

FIGURE 49.—Gas oil and fuel oil; production, imports, exports, and stocks east of California, 1918–31.

months of the year. The average refinery price of a representative grade of house-heating oil in the Mid-Continent area in 1931 was 1.91 cents per gallon; that of a representative gas oil was 1.59 cents.

In spite of the increasing amount of residual fuel oil diverted for use as cracking stock in the last decade, production increased steadily up to 1930 because the increased amount of crude processed more than balanced the decline in average yield. In 1930 and 1931 both the yield and crude runs were lower, and production fell materially. The demand for residual fuel oil declined but had much less effect on production than the curtailment in crude runs, which were made mainly to prevent overproduction of gasoline. The production of residual fuel oil in 1931 totaled 253,085,000 barrels, 13 percent less than in 1930. The percentage yield of residual fuel oil varies in the different districts, depending on the extent of cracking, the yield of lubricating oils, and the average gravity of the crude oil used. For example, the yield is low in the Appalachian district because most of the residual oil is utilized in lubricant manufacture and in the Indiana-Illinois district because of the tendency to recycle cracking stock to the limit—that is, to gasoline, coke, and gas. On the other hand, it is high in California because the crude used is below the average gravity and because cracking in that district has not progressed as far as in other districts; also, it is relatively high in the East coast district because of the relatively high percentage of low-gravity foreign crude used.

Imports of gas oil and fuel oil, which had been increasing rapidly, declined slightly in 1931. Exports of gas oil and fuel oil were outstandingly lower and in some months of 1931 were less than imports.

General market conditions for the heavier fuel oils in 1931 became steadily weaker throughout the year, with some signs of partial recovery in the fall in certain sections. (See fig. 47.) In general, bunker-fuel prices east of California declined 40 percent during 1931. The decline in California was relatively smaller because many wells in the low-gravity fields were kept shut in.

Comparative analyses of gas oil and distillate fuel oils and residual fuel oils in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
Gas oil and distillate fuel oils	7,372	6,327	8,112	7,683	7,226	6,764	7,070	7,139	6,713	6,669	6,346	6,461	83,882
Residual fuel oils	21,026	19,447	21,183	21,880	21,566	21,472	21,541	21,780	20,736	21,346	20,632	20,476	253,085
Imports	2,471	1,956	2,449	2,091	1,788	1,412	1,886	1,958	2,204	2,738	1,961	2,084	24,998
Daily average	80	70	79	70	58	47	61	63	73	88	65	67	68
Exports	2,981	2,556	2,261	2,231	2,675	2,633	2,699	2,259	2,494	2,285	2,208	1,949	29,231
Daily average	96	91	73	74	86	88	87	73	83	74	74	63	80
Stocks end of period:													
Gas oil and distillate fuel oils	14,450	13,695	14,064	14,912	16,820	17,985	19,304	20,757	21,752	20,887	20,469	18,526	18,526
Residual fuel oils [1]	19,527	18,464	18,041	18,942	19,759	20,606	22,035	23,588	23,482	23,996	24,965	24,056	24,056
California heavy crude and fuel oil	99,236	97,905	96,635	96,972	96,341	95,362	94,587	94,633	93,961	93,493	93,673	93,274	93,274
Total	133,213	130,064	128,740	130,826	132,920	133,953	135,926	138,978	139,195	138,376	139,107	135,856	135,856

[1] East of California.

Production and stocks of gas oil and distillate fuel oils in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	1,447	1,230	1,601	2,039	1,469	1,503	1,220	1,194	1,152	1,058	1,069	864	15,846
Appalachian	192	188	209	125	127	123	175	191	292	261	238	238	2,359
Indiana, Illinois, Kentucky, etc	842	787	947	897	758	769	816	792	718	841	914	899	9,980
Oklahoma, Kansas, and Missouri	892	807	1,029	977	831	862	1,103	1,033	857	827	790	758	10,766
Texas inland	237	198	230	274	292	233	297	292	234	263	257	213	3,020
Texas Gulf coast	1,343	1,293	1,861	1,468	1,439	1,243	1,116	1,489	1,291	1,128	1,220	1,362	16,253
Louisiana Gulf coast	307	288	254	313	269	252	277	324	272	343	302	346	3,547
Arkansas and Louisiana inland	151	80	109	182	142	150	183	160	125	131	152	156	1,721
Rocky Mountain	51	59	67	69	113	93	117	93	66	82	62	64	936
California	1,910	1,397	1,805	1,339	1,786	1,536	1,766	1,571	1,706	1,735	1,342	1,561	19,454
Total, 1931	7,372	6,327	8,112	7,683	7,226	6,764	7,070	7,139	6,713	6,669	6,346	6,461	83,882
Daily average, 1931	238	226	262	256	233	225	228	230	224	215	212	208	230
Total, 1930	6,669	6,079	6,232	6,305	7,139	6,953	6,726	6,831	7,051	7,167	7,182	7,217	81,551
Stocks, end of period:													*Dec. 31, 1930*
East coast	3,219	2,735	2,606	3,066	3,732	4,410	4,893	5,364	5,388	4,806	4,890	4,009	4,000
Appalachian	639	746	730	756	816	779	800	784	857	887	911	887	552
Indiana, Illinois, Kentucky, etc	1,198	1,021	939	1,097	1,201	1,509	1,780	2,066	2,266	2,523	2,515	2,272	1,443
Oklahoma, Kansas, and Missouri	1,913	1,976	2,032	2,198	2,515	2,812	3,072	3,029	3,033	2,810	2,758	2,421	1,957
Texas inland	383	363	366	416	577	606	735	857	842	783	725	703	449
Texas Gulf coast	2,453	2,284	2,405	2,473	2,805	2,634	2,586	3,008	3,355	2,933	3,134	2,919	3,165
Louisiana Gulf coast	374	338	428	460	365	419	332	470	536	616	522	613	365
Arkansas and Louisiana inland	145	139	160	197	202	228	287	286	250	188	187	167	166
Rocky Mountain	100	132	148	128	215	262	292	308	341	361	362	358	99
California	4,026	3,961	4,250	4,121	4,392	4,326	4,527	4,585	4,884	4,980	4,465	4,177	4,194
Total: 1931	14,450	13,695	14,064	14,912	16,820	17,985	19,304	20,757	21,752	20,887	20,469	18,526	16,390
1930	14,992	13,239	13,184	13,988	15,721	17,149	17,380	18,332	19,371	19,258	18,444	16,390	----------

Production and stocks of residual fuel oils in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	4, 929	4, 553	4, 791	4, 521	4, 341	4, 617	4, 431	4, 243	4, 692	4, 286	4, 334	4, 764	54, 502
Appalachian	359	385	361	368	329	284	275	352	425	312	227	203	3, 880
Indiana, Illinois, Kentucky, etc	1, 235	1, 316	1, 483	1, 374	1, 331	1, 284	1, 048	968	1, 069	1, 098	1, 313	1, 208	14, 727
Oklahoma, Kansas, and Missouri	1, 757	1, 560	1, 691	1, 647	1, 560	1, 623	1, 920	1, 721	1, 541	1, 384	1, 569	1, 393	19, 366
Texas inland	1, 816	1, 666	1, 697	1, 967	2, 185	2, 146	2, 127	2, 120	1, 716	1, 625	1, 562	1, 289	21, 916
Texas Gulf coast	3, 382	3, 001	3, 439	3, 425	3, 365	3, 545	3, 197	3, 564	3, 210	3, 768	3, 622	3, 377	40, 895
Louisiana Gulf coast	742	783	877	920	1, 056	996	1, 164	1, 120	1, 070	1, 061	917	907	11, 613
Arkansas and Louisiana inland	572	493	598	644	601	596	765	678	613	625	618	670	7, 473
Rocky Mountain	198	275	259	333	285	242	284	255	239	254	261	193	3, 078
California	6, 036	5, 415	5, 987	6, 681	6, 513	6, 139	6, 330	6, 759	6, 161	6, 933	6, 209	6, 472	75, 635
Total, 1931	21, 026	19, 447	21, 183	21, 880	21, 566	21, 472	21, 541	21, 780	20, 736	21, 346	20, 632	20, 476	253, 085
Daily average, 1931	678	695	683	729	696	716	695	703	691	689	688	661	693
Total, 1930	26, 173	25, 163	26, 004	25, 799	26, 588	23, 953	24, 422	23, 031	22, 813	22, 642	21, 872	22, 487	290, 947
Stocks, end of period:													*Dec. 31, 1930*
East coast	4, 689	4, 434	4, 500	4, 703	4, 863	4, 947	5, 497	5, 446	5, 090	4, 945	4, 848	4, 373	5, 020
Appalachian	569	498	505	527	506	523	599	612	701	735	687	699	627
Indiana, Illinois, Kentucky, etc	1, 664	1, 695	1, 660	2, 116	2, 200	2, 131	1, 936	2, 159	2, 372	2, 587	2, 808	2, 838	1, 923
Oklahoma, Kansas, and Missouri	2, 874	2, 884	2, 917	2, 878	2, 819	2, 967	3, 150	3, 433	3, 234	3, 026	2, 920	2, 572	3, 010
Texas inland	2, 749	2, 534	2, 481	2, 627	2, 860	3, 004	3, 361	3, 551	3, 497	3, 342	3, 405	3, 230	2, 919
Texas Gulf coast	4, 425	3, 889	3, 664	3, 771	4, 135	4, 529	4, 735	5, 337	5, 337	5, 811	6, 394	6, 291	4, 529
Louisiana Gulf coast	1, 151	1, 058	936	993	1, 133	1, 325	1, 532	1, 770	2, 011	2, 423	2, 811	2, 995	1, 123
Arkansas and Louisiana inland	614	739	721	657	628	609	647	710	681	595	586	630	532
Rocky Mountain	792	733	657	670	615	571	578	570	559	532	506	428	934
California [1]	99, 236	97, 905	96, 635	96, 972	96, 341	95, 362	94, 587	94, 633	93, 961	93, 493	93, 673	93, 274	100, 783
Total: 1931	118, 763	116, 369	114, 676	115, 914	116, 100	115, 968	116, 622	118, 221	117, 443	117, 489	118, 638	117, 330	[2] 121, 400
1930	128, 080	128, 894	127, 381	125, 579	126, 718	126, 785	126, 705	125, 560	125, 814	124, 565	125, 236	124, 038	----------

[1] Includes heavy crude.
[2] For comparison with 1931.

Percentage yields of gas oil and distillate fuel oils in 1931, by districts and months

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
East coast	10	10	11	15	10	11	8	8	8	7	8	6	9.4
Appalachian	7	7	7	4	4	4	5	6	9	8	8	8	6.5
Indiana, Illinois, Kentucky, etc	11	10	10	9	7	8	8	7	7	8	10	10	8.6
Oklahoma, Kansas, and Missouri	11	10	12	11	9	10	11	10	10	10	10	10	10.2
Texas inland	5	5	5	5	5	4	5	5	5	5	5	5	4.9
Texas Gulf coast	10	11	14	11	11	10	9	12	11	9	9	10	10.4
Louisiana Gulf coast	10	11	8	11	8	7	7	9	8	10	9	10	8.9
Arkansas and Louisiana inland	11	6	7	11	8	9	9	8	7	8	10	9	8.7
Rocky Mountain	4	4	4	4	6	5	6	5	4	6	4	5	5.0
California	13	11	13	9	12	11	12	10	12	11	10	11	11.2
United States: 1931	10.5	9.7	11.0	10.3	9.2	8.9	8.9	8.8	8.9	8.8	8.9	8.9	9.4
1930	8.3	8.4	7.8	7.8	8.5	8.6	8.6	8.6	9.3	9.7	10.2	10.1	8.8

Percentage yields of residual fuel oils in 1931, by districts and months

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
East coast	35	37	33	33	29	32	31	29	32	30	33	34	32.3
Appalachian	14	14	12	13	11	10	8	10	13	10	8	7	10.7
Indiana, Illinois, Kentucky, etc	16	17	16	14	13	13	10	9	10	11	14	13	12.8
Oklahoma, Kansas, and Missouri	22	20	20	18	17	18	18	17	17	17	20	18	18.4
Texas inland	39	38	35	37	38	38	35	35	34	33	33	30	35.5
Texas Gulf coast	25	25	26	26	25	27	25	28	27	28	28	25	26.3
Louisiana Gulf coast	25	29	29	31	30	28	31	29	32	31	27	25	29.0
Arkansas and Louisiana inland	41	37	39	39	35	34	37	35	36	40	40	39	37.6
Rocky Mountain	15	20	17	19	16	14	16	15	15	18	19	16	16.5
California	42	43	42	46	45	43	42	44	43	45	45	45	43.7
United States: 1931	29.9	29.8	28.8	29.3	27.5	28.2	27.0	27.0	27.6	28.1	28.8	28.2	28.3
1930	32.7	34.7	32.4	32.1	31.8	29.7	31.0	29.1	30.0	30.6	31.1	31.4	31.4

Prices of fuel oil at four selected points in 1931, in dollars per barrel of 42 U.S. gallons, and refinery prices of two grades of distillate fuel oil in 1931, in cents per U.S. gallon [1]

	January	February	March	April	May	June	July	August	September	October	November	December	Average
Average monthly prices:													
24°–26° gravity fuel oil at refineries in Oklahoma dollars per barrel	0.60	0.59	0.51	0.49	0.46	0.39	0.30	0.28	0.31	0.34	0.35	0.34	0.412
Grade C bunker oil in cargoes, Gulf coast dollars per barrel	.65	.65	.65	.61	.60	.58	.57	.46	.43	.40	.39	.40	.532
14°–18° gravity grade C bunker oil in cargoes, New York dollars per barrel	1.05	1.05	1.05	1.04	.95	.87	.82	.73	.70	.66	.60	.60	.841
14°–18° gravity bunker oil in cargoes, California dollars per barrel	.64	.64	.64	.61	.55	.55	.55	.55	.55	.55	.55	.55	.577
38°–40° straw distillate in Oklahoma cents per gallon	2.85	2.75	2.55	2.20	1.84	1.48	1.25	1.17	1.44	1.63	1.87	1.95	1.910
32°–36° straw gas oil in Oklahoma cents per gallon	2.35	2.25	2.06	1.91	1.41	1.15	.90	.83	1.21	1.29	1.38	1.27	1.590

	24°–26° gravity fuel oil at refineries, Oklahoma (dollars)	Grade C bunker oil in cargoes, Gulf coast (dollars)	14°–18° gravity grade C bunker oil in cargoes, New York (dollars)	14°–18° gravity bunker oil in cargoes, California (dollars)	38°–40° straw distillate, Oklahoma (cents)	32°–36° straw gas oil, Oklahoma (cents)
Price changes by weeks:						
Jan. 1 [2]	0.60	0.65	1.05	0.64	2.875	2.375
Jan. 26					2.75	2.25
Feb. 23	.55					
Mar. 9	.50				2.625	2.00
Mar. 16				.65	2.50	
Mar. 23					2.375	
Mar. 30		.62		.62	2.25	
Apr. 20	.475	.60			2.125	1.75
Apr. 27			.95	.55		
May 4					2.00	1.625
May 11					1.75	1.375
May 18	.45					1.25
June 8	.40		.85		1.50	
June 15	.375	.55				1.125
June 22	.35				1.25	1.00
June 29		.60				
July 6						.875
July 13	.275	.55	.80			
Aug. 3		.48			1.125	.75
Aug. 10		.45	.70			
Aug. 24					1.25	1.00
Aug. 31	.30				1.375	1.25
Sept. 8					1.50	
Sept. 14	.325					
Sept. 21		.40			1.375	1.125
Sept. 28					1.50	
Oct. 12					1.625	1.375
Oct. 19	.35		.60		1.75	
Oct. 26		.38				
Nov. 2					1.875	
Nov. 9		.40				
Dec. 7						1.25
Dec. 14					2.00	
Dec. 21	.325					

[1] From National Petroleum News.
[2] In effect on this date.

Railroads, steamships, manufacturing plants, commercial and domestic heating, and foreign trade all required less gas oil and fuel oil than in 1930. Deliveries of such oils totaled 356,537,000 barrels, 11 percent less than the 401,210,000 barrels reported for 1930. Corresponding deliveries in previous years were 423,573,000 barrels in 1929; 405,960,000 barrels in 1928; 388,138,000 barrels in 1927; and 378,651,000 barrels in 1926. Deliveries within the United States were 327,306,000 barrels, 10 percent below the 1930 total of 364,760,000 barrels, while exports and shipments to noncontiguous territories decreased 20 percent, or from 36,450,000 barrels in 1930 to 29,231,000 in 1931.

The general decline in the demand for gas oil and fuel oil was reflected in deliveries to virtually every industry. With nearly all types of manufacturing greatly reduced, due to prevailing economic conditions, fuel-oil requirements for industrial purposes naturally were less in 1931 than in 1930. Smelting and mining showed the greatest relative decrease in quantity of fuel oil used, consuming about a third less than in 1930. The logging and lumbering industry required approximately a quarter less fuel oil, while the automotive, cement and lime, ceramic, and food industries all showed about a 20 percent decline in demand compared with that in 1930.

The deliveries of light and heavy fuel oils for heating all types of buildings declined from 43,279,000 barrels in 1930 to 40,390,000 barrels in 1931, a decrease of nearly 7 percent. Deliveries for heating commercial buildings, such as schools, hospitals, and offices, dropped from 17,508,000 to 15,731,000 barrels (about 10 percent). This decline may be attributed to the difference in weather conditions during the respective years. One calculation of "degree-days" shows that the unusually mild weather in all sections of the country reduced the need for fuel in 1931 (based entirely on prevailing temperatures) 16 percent below 1930 requirements.

Deliveries of oil for domestic heating did not decline as much as those for commercial heating; the former dropped only 4 percent—from 25,771,000 barrels in 1930 to 24,659,000 barrels in 1931. The influence of weather conditions was offset to some extent by additional installations of oil burners in homes during 1931. At the close of the year 773,400 domestic oil burners were in use compared with 669,400 at the close of 1930, according to calculations by private authorities.

In the regional distribution of gas oil and fuel oil the Rocky Mountain area lost nearly 30 percent in 1931 compared with 1930, while deliveries declined approximately 20 percent in the Pacific Coast States. The South Central States and the South Atlantic States required about 10 percent less fuel oil in 1931 than in the previous year. The smaller losses compared with 1930 were in the New England States (5 percent) and the Middle Atlantic States (3 percent).

Distribution of gas oil and fuel oil, 1927–31, by States

[Thousands of barrels of 42 U.S. gallons]

State	1927	1928	1929	1930	1931
Alabama	406	376	671	520	983
Arizona	2,681	3,825	4,208	3,481	2,052
Arkansas	2,210	2,478	2,633	2,804	2,460
California	89,845	91,707	89,634	82,969	68,334
Colorado	884	628	446	368	388
Connecticut	2,594	2,200	2,598	2,559	2,223
Delaware	641	509	862	959	697
District of Columbia	972	1,024	1,202	1,251	984
Florida	7,397	5,646	5,970	6,984	5,836
Georgia	1,349	1,255	1,340	1,411	1,393
Idaho	30	34	47	41	39
Illinois	11,445	14,128	13,258	12,807	11,133
Indiana	4,268	4,972	5,581	4,961	5,028
Iowa	660	787	882	1,123	961
Kansas	4,816	5,654	5,717	4,662	5,438
Kentucky	403	371	426	570	476
Louisiana	18,207	17,526	19,576	14,893	12,130
Maine	1,273	763	1,211	1,301	1,186
Maryland	5,113	5,903	6,021	5,524	5,590
Massachusetts	11,976	11,240	12,520	11,741	11,788
Michigan	2,966	5,096	4,860	3,637	3,593
Minnesota	1,404	1,479	1,549	1,664	1,765
Mississippi	335	334	171	210	154
Missouri	5,296	4,516	4,751	4,490	4,222
Montana	2,825	2,163	2,207	1,693	1,001
Nebraska	671	637	810	852	802
Nevada	815	994	963	1,033	656
New Hampshire	154	112	161	223	576
New Jersey	19,677	20,039	22,458	22,927	21,407
New Mexico	387	419	370	434	224
New York	34,333	37,007	38,270	38,246	36,175
North Carolina	214	200	241	269	244
North Dakota	25	63	110	128	105
Ohio	3,871	4,807	4,835	4,472	4,584
Oklahoma	8,847	10,321	11,972	10,668	8,236
Oregon	5,270	6,878	6,589	7,234	6,603
Pennsylvania	14,504	16,222	19,908	18,482	19,708
Rhode Island	4,654	4,151	4,999	4,569	3,647
South Carolina	980	792	684	414	326
South Dakota	106	130	154	167	205
Tennessee	485	760	768	558	481
Texas	44,500	48,205	52,212	49,739	46,145
Utah	429	399	554	482	259
Vermont	141	214	341	185	185
Virginia	1,508	1,224	1,300	1,186	1,244
Washington	8,184	10,653	11,459	10,344	7,958
West Virginia	394	468	417	276	450
Wisconsin	1,411	1,474	1,640	1,573	1,393
Wyoming	2,716	2,449	2,443	2,010	1,626
	334,272	353,232	371,999	349,094	313,093

Distribution of gas oil and fuel oil, 1927–31, by uses

[Thousands of barrels of 42 U.S. gallons]

Uses	1927	1928	1929	1930	1931
Railroads	69,848	70,680	76,848	67,900	58,150
Steamships (including tankers)	88,215	89,942	92,870	94,152	83,559
Gas and electric power plants	30,021	30,902	31,511	26,769	24,490
Smelters and mines	6,831	6,898	7,050	5,936	3,627
Iron and steel products	18,336	19,429	20,209	15,210	12,855
Chemicals and allied industries	2,080	3,400	4,192	3,258	2,908
Automotive industries	1,687	3,628	3,224	2,225	1,784
Textiles and their products	4,852	4,586	4,722	4,475	5,684
Paper and wood pulp	3,131	2,793	2,993	2,236	1,834
Logging and lumbering	2,370	2,673	2,578	2,269	1,667
Cement and lime plants	5,051	5,224	3,351	3,008	2,435
Ceramic industries	3,270	2,996	2,376	1,993	1,598
Food industries	7,151	6,488	6,924	7,033	5,660
Other manufacturing	11,131	10,023	12,862	11,664	9,998
Commercial heating	15,751	16,427	17,820	17,508	15,731
Domestic heating	11,709	14,272	19,581	25,771	24,659
United States Navy, Army transports, etc	6,506	8,369	8,192	8,681	9,203
Used as fuel by oil companies	43,453	50,044	55,559	53,437	51,197
Miscellaneous uses	9,354	12,758	11,560	11,235	10,267
Total domestic deliveries	340,747	361,532	384,422	364,760	327,306
Exports and other shipments	47,391	44,428	39,151	36,450	29,231
	388,138	405,960	423,573	401,210	356,537

Distribution of gas oil and fuel oil in 1931, by States and principal uses

[Thousands of barrels of 42 U.S. gallons]

State	Rail-roads	Steam-ships	Gas and electric power plants	Smelt-ers and mines	Manu-fac-turing	Com-mercial and domes-tic heating	Oil-com-pany fuel	U.S. Navy and miscel-laneous	Total
Alabama	12	861	18	1	71	1	6	13	983
Arizona	6	-------	381	1,479	79	20	-------	87	2,052
Arkansas	1,911	82	31	-------	131	3	244	58	2,460
California	19,401	25,306	1,765	408	5,386	2,868	4,309	8,891	68,334
Colorado	130	-------	19	2	6	100	128	3	388
Connecticut	125	39	365	31	746	798	11	108	2,223
Delaware	-------	33	14	-------	512	77	61	-------	697
District of Columbia	-------	-------	377	-------	42	525	-------	40	984
Florida	671	1,603	2,170	344	469	139	36	404	5,836
Georgia	33	406	307	1	364	28	148	106	1,393
Idaho	5	-------	2	16	14	-------	-------	2	39
Illinois	278	24	1,602	64	3,068	2,835	2,100	1,162	11,133
Indiana	41	115	312	15	994	164	3,289	98	5,028
Iowa	46	-------	411	4	165	305	-------	30	961
Kansas	1,604	-------	305	10	208	84	2,807	420	5,438
Kentucky	15	9	12	4	66	53	306	11	476
Louisiana	2,262	6,336	375	-------	1,540	374	952	291	12,130
Maine	1	19	116	-------	895	117	14	24	1,186
Maryland	47	1,476	303	228	1,929	268	1,294	45	5,590
Massachusetts	145	1,735	1,808	-------	4,510	2,475	947	168	11,788
Michigan	31	81	657	4	2,146	491	151	32	3,593
Minnesota	29	-------	431	2	291	973	-------	39	1,765
Mississippi	3	5	53	-------	8	9	-------	76	154
Missouri	1,187	10	419	48	668	1,318	248	324	4,222
Montana	849	-------	4	31	2	28	73	14	1,001
Nebraska	76	-------	342	19	91	252	-------	22	802
Nevada	510	-------	22	27	14	8	-------	75	656
New Hampshire	-------	-------	150	-------	270	146	1	9	576
New Jersey	345	4,799	1,800	182	4,545	2,123	7,343	270	21,407
New Mexico	133	-------	52	1	3	16	16	3	224
New York	528	22,014	4,747	224	2,509	4,553	1,145	455	36,175
North Carolina	5	5	67	-------	49	20	1	97	244
North Dakota	1	-------	14	-------	9	79	-------	2	105
Ohio	62	12	61	11	2,813	244	1,035	346	4,584
Oklahoma	4,819	-------	144	22	75	15	3,042	119	8,236
Oregon	2,287	412	1,663	3	983	511	28	716	6,603
Pennsylvania	177	4,567	1,679	93	5,295	1,788	5,593	516	19,708
Rhode Island	16	101	305	-------	2,191	520	472	42	3,647
South Carolina	4	106	44	3	26	10	120	13	326
South Dakota	37	-------	82	-------	6	70	-------	10	205
Tennessee	183	197	30	-------	55	3	1	12	481
Texas	17,144	10,257	301	228	965	223	14,284	2,743	46,145
Utah	79	-------	4	10	4	5	156	1	259
Vermont	3	-------	31	3	16	129	3	-------	185
Virginia	14	597	270	3	134	77	51	98	1,244
Washington	1,711	2,350	166	84	1,494	693	57	1,403	7,958
West Virginia	11	1	6	10	130	3	285	4	450
Wisconsin	10	1	245	10	435	632	-------	60	1,393
Wyoming	1,163	-------	8	2	1	4	440	8	1,626
	58,150	83,559	24,490	3,627	46,423	26,177	51,197	19,470	313,093

Comparatively little change was recorded in fuel efficiency at petroleum refineries in 1931, when the calculated number of British thermal units required to refine a barrel of crude petroleum was 682,000 compared with 672,000 in 1930. Between 1925, the date of the first fuel survey, and 1929 there was a steady decline in the average fuel requirement per barrel of crude refined; for example, in 1925 the average was 829,000 B.t.u., but in 1929 it was 639,000 B.t.u., a decrease of 23 percent. In both 1930 and 1931 the average fuel requirement increased slightly, indicating that virtually all the technical improvements leading to fuel economy had been perfected or that recent refinery practice requires expenditure of more heat. Probably the latter reason is more important, as there is little doubt that the growth of cracking and re-forming (entailing relatively high temperatures) has caused more fuel to be burned.

The consumption of oil as refinery fuel declined 5 percent in 1931, but oil continued to be the chief fuel used at petroleum refineries. (See fig. 50). The rapid decline in the use of coal was continued in 1931, when that fuel supplied only 6 percent of the total heat utilized at refineries compared with 26 percent in 1925. The use of natural gas continued to decline due to the increasing competition of refinery gas and the fact that the prices of the other fuels probably showed relatively greater decreases in 1931. The consumption of refinery or "still" gas as refinery fuel was 149,924,000,000 cubic feet, an increase of 24 percent over 1930. Refinery gas supplied 34 percent of the total estimated quantity of heat evolved at refineries in 1931. If the present trend in fuel utilization continues, in 2 years refinery gas will exceed oil as the chief refinery fuel. In 1931, 529,000 short tons of petroleum coke, the least important refinery fuel, were used, a

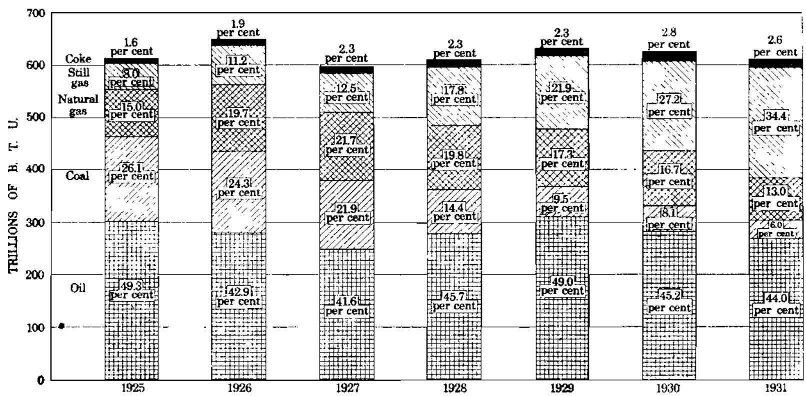

FIGURE 50.—Fuel used at refineries in. B.t.u. equivalent, 1925–31.

decline of 9 percent from the previous year and slightly more than one third the total indicated domestic demand.

The average theoretical amount of heat required to refine a barrel of crude decreased in approximately half of the refinery districts. The indicated improvement in fuel efficiency in the Indiana-Illinois-Kentucky district was particularly noteworthy, as it preserved the record for that district of steady reduction in the average fuel requirement since the first survey in 1925. The Louisiana Gulf coast district made the first large purchase of heat (steam) to be noted in these surveys in 1931, and as a result the average fuel requirement of that district declined materially.

Complete details of field consumption at refineries in 1931 have been published by the Bureau as Report of Investigations 3198.

Fuel used at refineries in the United States in 1931

	Oil [1] (thousands of barrels)	Coal (thousands of short tons)	Gas (millions of cubic feet) Natural	Gas (millions of cubic feet) Refinery	Coke (thousands of short tons)	Purchased electricity (thousands of kilowatt-hours)	Total B.t.u. (billions, approximate)	Crude run to stills (thousands of barrels)	B.t.u. per barrel of crude oil run
East coast	14,250	141		27,203	89	150,107	129,920	168,790	770,000
Appalachian	1,741	701	1,673	7,168	23	67,584	41,154	36,372	1,131,000
Indiana, Illinois, Kentucky, etc.	6,123	561	11	26,080	73	107,576	90,037	115,442	790,000
Oklahoma	3,409		7,510	10,677		89,561	43,288	65,938	657,000
Kansas and Missouri	2,737		3,336	6,146	24	39,790	29,250	39,112	748,000
Texas inland	2,461		7,391	4,985	11	87,470	29,836	61,696	484,000
Texas Gulf coast	7,730		17,917	41,248	282	97,321	131,399	155,660	844,000
Louisiana Gulf coast	797		5,265	7,009	14	67,812	20,543	40,024	513,000
Arkansas and Louisiana inland	533		5,486	3,275		13,575	13,543	19,888	681,000
Rocky Mountain	797	9	8,725	4,035	12	11,368	20,186	18,679	1,081,000
California	4,078		18,234	12,098	1	185,759	60,581	173,007	350,000
	44,656	1,412	75,548	149,924	529	917,923	609,737	894,608	682,000
Total B.t.u. (billions, approximate)	267,936	36,712	79,325	209,894	15,870		609,737		

[1] Includes acid sludge.

LUBRICANTS

The lubricating division of the industry experienced a generally unsatisfactory year, as both the domestic and foreign demand continued to decline and prices receded to below even the low points of 1930.

The demand for lubricating oils consists of three major divisions; (1) The consumption by motor vehicles, (2) the consumption in industrial establishments, and (3) exports. Exact separation of the first two classes of consumption is not possible, but it is believed that the break-down of the total demand in 1931 was about as follows: Motor vehicles, 11,500,000 barrels (41 percent); industrial, 8,568,000 barrels (30 percent); exports, 8,128,000 barrels (29 percent;) and total, 28,196,000 barrels. Compared with 1930 these data indicate a gain in the relative proportion consumed by motor vehicles at the expense of the other two classes. The decrease in the industrial consumption was caused primarily by recession of activity at manufacturing plants. The decline in consumption of motor oils was due to such factors as the reclamation of used oil, oil purifiers, and the tendency to drain the oil less frequently. The last-named factor appears to be gaining in relative importance because when the average age of the motor vehicles in operation increases, as it did in 1931, the desire to preserve the engine through the use of fresh oil becomes correspondingly less. On the other hand, old cars consume oil faster than new ones. Furthermore, the decline in prices of lubricating oil at service stations and the spread in distribution at chain stores have tended to retard the decline in consumption.

The statistical position of lubricants was improved, as output was reduced 22 percent while total demand declined 11 percent, with the result that stocks were reduced nearly 1,500,000 barrels. (See fig. 51).

Production in all the major refining districts declined in 1931. The East coast district continued to lead in quantity produced and the Appalachian district in percentage yield.

An analysis of the price record of several grades of lubricating oils in 1931 indicates that the market in the Mid-Continent area was weak until August and September, when prices recovered to about the levels of January 1. The prices of Pennsylvania grades fluctuated continously throughout 1931 but were generally higher at the end of the year than at the beginning. Although the average prices for most grades were lower than in 1930, there was a steadiness in prices that was lacking in 1930—a fact that may be accredited to the improvement in statistical position. (See fig. 47.)

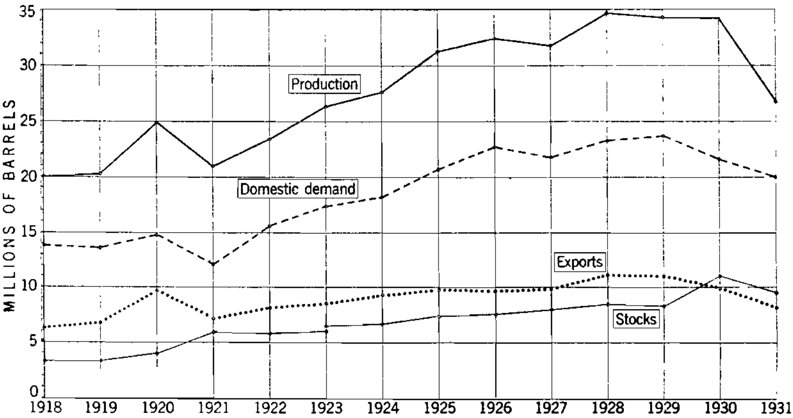

FIGURE 51.—Lubricants; production, domestic demand, exports, and stocks, 1918–31.

Comparative analyses of lubricants in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production	2,441	2,036	2,293	2,316	2,264	2,088	2,337	2,306	2,143	2,267	2,164	2,049	26,704
Daily average	79	73	74	77	73	70	75	74	71	73	72	66	73
Imports	3	2	3	3	3	4	1	4	2	1	3	3	32
Exports	687	556	551	716	741	833	535	863	662	740	647	597	8,128
Daily average	22	20	18	24	24	28	17	28	22	24	22	19	22
Stocks, end of period	11,013	10,911	10,710	10,463	10,119	9,763	9,597	9,289	9,224	9,113	9,422	9,511	9,511
Domestic demand	1,715	1,584	1,946	1,850	1,870	1,615	1,969	1,755	1,548	1,639	1,211	1,366	20,068
Daily average	55	57	63	62	60	54	64	57	52	53	40	44	55

Production and stocks of lubricants in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	801	650	628	692	597	638	732	687	640	744	656	702	8,167
Appalachian	365	314	398	410	346	370	427	400	399	393	384	355	4,561
Indiana, Illinois, Kentucky, etc	269	234	273	258	266	206	239	206	145	149	165	160	2,570
Oklahoma, Kansas, and Missouri	193	191	237	243	267	227	225	267	238	257	244	212	2,801
Texas inland	21	25	35	30	20	19	5	8	26	17	13	17	236
Texas Gulf coast	516	392	461	442	457	361	450	433	445	496	478	432	5,363
Louisiana Gulf coast	42	43	13	33	33	32	22	28	39	59	64	31	439
Arkansas and Louisiana inland	21	19	20	18	17	14	16	17	16	17	17	19	211
Rocky Mountain	39	31	48	49	40	39	28	17	15	11	21	28	366
California	174	137	180	141	221	182	193	243	180	124	122	93	1,990
Total, 1931	2,441	2,036	2,293	2,316	2,264	2,088	2,337	2,306	2,143	2,267	2,164	2,049	26,704
Daily average, 1931	79	73	74	77	73	70	75	74	71	73	72	66	73
Total, 1930	2,880	2,727	3,120	3,193	3,185	2,920	3,018	2,971	2,723	2,546	2,409	2,509	34,201
Stocks, end of period:													*Dec. 31, 1930*
East coast	3,548	3,489	3,399	3,284	3,167	2,998	3,081	3,121	3,092	3,010	3,084	3,099	3,475
Appalachian	1,433	1,344	1,313	1,269	1,180	1,121	1,056	1,005	982	1,005	1,099	1,145	1,350
Indiana, Illinois, Kentucky, etc	1,230	1,227	1,178	1,184	1,169	1,152	1,097	1,060	1,041	1,028	1,021	1,018	1,261
Oklahoma, Kansas, and Missouri	836	838	719	720	708	711	685	569	575	615	674	753	798
Texas inland	107	110	122	119	120	99	88	70	80	84	79	80	113
Texas Gulf coast	2,326	2,410	2,503	2,433	2,288	2,191	2,141	2,042	2,036	2,004	2,061	2,075	2,336
Louisiana Gulf coast	169	180	188	183	156	151	122	112	109	109	120	112	166
Arkansas and Louisiana inland	21	21	21	20	20	21	22	21	15	16	16	20	17
Rocky Mountain	229	211	205	220	237	253	250	244	242	238	243	250	225
California	1,036	994	973	961	975	966	968	999	990	1,004	1,025	959	1,086
Total: 1931	10,935	10,824	10,621	10,393	10,020	9,663	9,510	9,243	9,162	9,113	9,422	9,511	[1] 10,827
1930	8,956	9,289	9,561	9,549	9,498	9,742	9,953	10,161	10,257	10,502	10,536	10,971	----------

[1] For comparison with 1931.

Percentage yields of lubricants in 1931, by districts and months

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
East coast	6	5	4	5	4	4	5	5	4	5	5	5	4.8
Appalachian	14	11	13	14	12	13	13	12	12	12	13	12	12.5
Indiana, Illinois, Kentucky, etc	4	3	3	3	3	2	2	2	1	1	2	2	2.2
Oklahoma, Kansas, and Missouri	2	2	3	3	3	3	2	3	3	3	3	3	2.7
Texas inland		1	1	1					1				.4
Texas Gulf coast	4	3	4	3	3	3	4	3	4	4	4	3	3.4
Louisiana Gulf coast	1	2	4	1	1	1	1	1	1	2	2	1	1.1
Arkansas and Louisiana inland	2	1	1	1	1	1	1	1	1	1	1	1	1.1
Rocky Mountain	3	2	3	3	2	2	2	1	1	1	2	2	2.0
California	1	1	1	1	2	1	1	2	1	1	1	1	1.2
United States: 1931	3.5	3.1	3.1	3.1	2.9	2.7	2.9	3.0	2.9	3.0	3.0	2.8	3.0
1930	3.6	3.8	3.9	4.0	3.8	3.6	3.8	3.7	3.6	3.4	3.4	3.5	3.7

Refinery prices of five selected grades of lubricating oil in 1931, in cents per U.S. gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Average monthly prices:													
Oklahoma:													
200 viscosity, no. 4 color, neutral	9.3	9.3	8.9	8.5	8.5	8.3	8.3	8.3	8.5	9.0	9.2	9.0	8.74
150–160 viscosity at 210° bright stock 10–25 cold test	17.6	16.9	15.4	14.7	13.7	12.6	11.7	14.3	17.9	19.5	19.5	17.9	15.95
Pennsylvania:													
200 viscosity, no. 3 color, filtered, neutral, 420–425, flash	17.0	17.9	21.5	21.9	21.3	20.7	19.5	19.4	20.9	21.4	21.0	19.5	20.17
600 stream refined filterable	8.5	8.3	8.3	8.2	7.8	7.5	8.0	11.0	13.6	14.1	13.2	11.3	9.98
Gulf coast: 500 viscosity, no. 3½ color, unfiltered, neutral	10.0	10.0	10.0	10.0	9.7	9.4	9.0	9.0	9.0	9.0	9.2	9.3	9.45

	Oklahoma		Pennsylvania		Gulf coast
	200 viscosity, no. 4 color, neutral	150–160 viscosity at 210°, bright stock, 10–25 cold test	200 viscosity, no. 3 color, filtered, neutral, 420–425 flash	600 steam refined, filterable	500 viscosity, no. 3½ color, unfiltered, neutral
Price changes by weeks:					
Jan. 1 [2]	9.25	18.0	17.0	8.5	10.0
Jan. 19		17.0			
Feb. 9			17.5	8.25	
Feb. 16			18.5		
Feb. 23		16.5	19.0		
Mar. 2		15.5			
Mar. 9		16.0	22.0		
Mar. 16	8.5	15.0	22.5		
Mar. 30			22.0		
Apr. 13		14.5			
Apr. 20				8.0	
Apr. 27			21.5		
May 11		13.5		7.75	9.5
May 18			21.0		
May 25		13.0			
June 1				7.5	
June 8	8.25	12.5			
June 22			20.25		9.0
June 29		12.0	20.0		
July 6			19.5		
July 13		11.5			
July 20				8.5	
July 27			19.0	9.0	
Aug. 3		12.0		10.5	
Aug. 10		14.5		11.0	
Aug. 17			19.5	11.25	
Aug. 24		16.5	20.0	11.5	
Aug. 31			20.5	12.5	
Sept. 8			21.0	13.5	
Sept. 14		18.0		14.0	
Sept. 21	9.0	19.5			
Oct. 5			21.5	14.5	
Oct. 12				14.0	
Nov. 2	9.25			13.75	
Nov. 9			21.0	13.5	9.25
Nov. 23			20.5	12.25	
Nov. 30				12.0	
Dec. 7	9.0	17.5	20.0	11.5	
Dec. 14			19.5	11.25	
Dec. 21			18.5	10.75	

[1] From National Petroleum News.
[2] Prices in effect as of this date.

WAX

The trade in paraffin wax continued to be generally disappointing to the refiners. Undoubtedly the statistics of wax showed more improvement in 1931 than those of any other important refined product. For example, production was reduced 13 percent, exports about held their own (a notable feat in a year of material declines in foreign trade), stocks were reduced 22 percent, and domestic demand increased 14 percent, also an unusual event for 1931. (See fig. 52.) In general, the trend in stocks of wax has been inversely proportional to the movement of prices; however, in 1931 stocks were successively reduced in every month except May, but the downward trend in

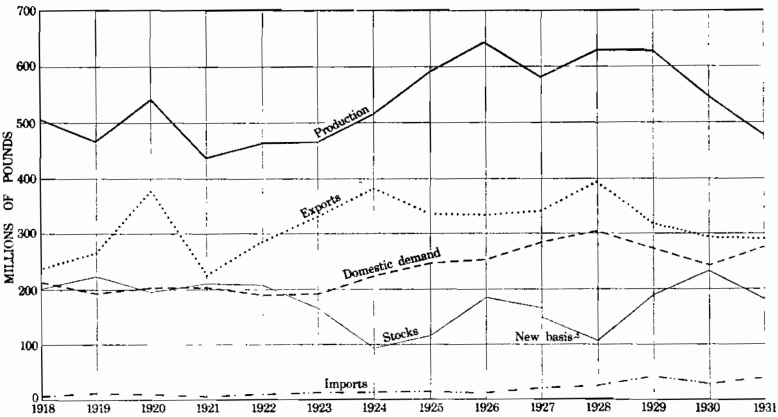

FIGURE 52.—Wax; production, domestic demand, imports, exports, and stocks, 1918–31.

prices did not cease until fall. This is a typical example in support of the growing belief that actual stocks on hand have lost much of their power to influence prices in favor of productive capacity.

The production of wax in 1931 totaled 477,400,000 pounds, of which 41 percent came from the East coast district and 20 percent from the Appalachian. The concentration of production in the Eastern States reflects the large quantity of paraffin-base crude used there in lubricant manufacture, although more wax is made in the East coast district from mixed-based crudes than from paraffin-base crudes.

Stocks of wax at the close of 1931 totaled 180,843,000 pounds, of which 41,858,000 pounds (23 percent) were refined wax and 138,985,000 pounds (77 percent) crude-scale wax. These data indicate an increase in the proportion of refined wax in storage; in fact, such stocks increased slightly in 1931 while stocks of crude scale declined about 53,000,000 pounds.

Comparative analyses of wax in 1931, by months

[Thousands of pounds]

	January	February	March	April	May	June
Production	42,560	38,640	37,520	33,040	35,840	34,160
Daily average	1,373	1,380	1,210	1,101	1,156	1,139
Imports	2,645	3,035	1,289	3,842	1,394	3,509
Daily average	85	108	42	128	45	117
Exports	22,063	23,503	30,470	21,373	17,586	20,391
Daily average	712	839	983	712	567	680
Stocks, end of period	233,044	229,414	208,620	205,105	205,803	200,836
Domestic demand	22,090	21,802	29,133	19,024	18,950	22,245
Daily average	732	779	940	634	611	742

	July	August	September	October	November	December	Total
Production	37,800	37,520	42,000	46,200	46,760	45,360	477,400
Daily average	1,219	1,210	1,400	1,490	1,559	1,463	1,308
Imports	2,537	3,026	1,671	2,684	5,775	6,428	37,835
Daily average	82	98	56	87	193	207	104
Exports	17,284	20,914	21,323	26,368	30,585	38,667	290,527
Daily average	557	675	711	851	1,020	1,247	796
Stocks, end of period	198,407	192,198	191,158	189,167	183,938	180,843	180,843
Domestic demand	25,482	25,841	23,388	24,507	27,179	16,216	276,457
Daily average	822	834	780	790	906	523	757

Production and stocks of wax in 1931, by districts and months

[Thousands of pounds]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	17,360	14,560	14,840	13,440	11,480	14,280	13,720	13,720	18,200	23,520	21,000	19,880	196,000
Appalachian	7,840	7,840	8,400	8,400	8,680	8,120	7,840	7,000	6,440	7,560	7,560	7,840	93,520
Indiana, Illinois, Kentucky, etc.	5,040	5,320	4,200	3,360	5,040	3,920	3,080	3,360	4,760	3,080	3,920	3,920	49,000
Oklahoma, Kansas, and Missouri	2,240	2,520	2,520	1,960	2,520	1,960	2,240	1,960	1,960	1,960	2,240	1,960	26,040
Texas inland	----	280	280	280	----	----	560	----	280	280	280	560	2,800
Texas Gulf coast	4,760	3,640	2,800	3,640	3,360	2,240	3,360	3,360	3,360	2,520	3,920	3,080	40,040
Louisiana Gulf coast	4,200	2,520	3,080	560	3,360	2,240	4,760	5,320	4,480	5,600	5,040	5,880	47,040
Rocky Mountain	1,120	1,960	1,400	1,400	1,400	1,400	2,240	2,800	2,520	1,680	2,800	2,240	22,960
Total	42,560	38,640	37,520	33,040	35,840	34,160	37,800	37,520	42,000	46,200	46,760	45,360	477,400
Daily average	1,373	1,380	1,210	1,101	1,156	1,139	1,219	1,210	1,400	1,490	1,559	1,463	1,308
Stocks, end of period:													
Crude scale:													*Dec. 31, 1930*
East coast	31,113	33,970	29,280	32,404	33,891	34,913	34,196	34,247	38,325	40,367	38,018	30,482	30,896
Appalachian	23,808	24,914	24,084	22,982	23,260	24,380	23,845	23,581	23,329	20,715	19,471	19,641	22,960
Indiana, Illinois, Kentucky, etc.	21,643	22,323	21,309	22,721	21,712	20,886	20,068	20,141	18,585	18,938	19,371	18,869	20,133
Oklahoma, Kansas, and Missouri	1,378	1,347	1,092	1,111	1,277	1,799	2,940	2,362	2,795	3,580	2,954	2,273	2,078
Texas inland	63	163	52	----	----	----	----	----	----	94	----	----	79
Texas Gulf coast	858	858	1,133	945	1,397	1,073	1,424	1,343	900	1,438	882	1,618	1,158
Louisiana Gulf coast	85,720	80,445	71,788	63,817	56,130	53,692	48,108	40,420	36,087	36,215	33,739	35,846	89,855
Rocky Mountain	25,187	24,636	24,765	24,097	23,901	23,839	24,867	25,901	26,724	27,107	28,663	30,256	24,781
Total	189,770	188,656	173,503	168,077	161,568	160,582	155,448	147,995	146,745	148,454	143,098	138,985	191,940
Refined:													
East coast	20,111	18,004	13,184	12,893	18,570	18,347	20,306	22,657	22,164	19,006	17,098	19,658	19,152
Appalachian	3,153	3,264	2,892	4,136	3,720	2,550	2,962	3,330	2,979	3,468	2,677	2,181	3,186
Indiana, Illinois, Kentucky, etc.	2,817	2,167	2,012	2,130	2,486	1,582	1,116	1,375	1,727	1,541	1,954	1,653	2,689
Oklahoma, Kansas, and Missouri	2,374	2,097	1,628	1,753	2,214	2,153	1,867	2,239	2,044	1,514	2,287	2,386	2,013
Texas inland	----	----	----	179	173	9	7	5	107	94	83	80	----
Texas Gulf coast	11,593	12,144	12,593	13,345	14,147	12,032	13,564	11,455	13,003	12,783	14,147	13,235	10,912
Louisiana Gulf coast	1,922	1,497	1,398	1,119	1,349	2,063	1,989	1,952	1,185	1,170	1,161	1,228	1,608
Rocky Mountain	1,304	1,585	1,410	1,473	1,576	1,518	1,148	1,190	1,204	1,137	1,433	1,437	1,092
Total	43,274	40,758	35,117	37,028	44,235	40,254	42,959	44,203	44,413	40,713	40,840	41,858	40,652
Total:													
East coast	51,224	51,974	42,464	45,297	52,461	53,260	54,502	56,904	60,489	59,373	55,116	50,140	50,048
Appalachian	26,961	28,178	26,976	27,118	26,980	26,930	26,807	26,911	26,308	24,183	22,148	21,822	26,146
Indiana, Illinois, Kentucky, etc.	24,460	24,490	23,321	24,851	24,198	22,468	21,184	21,516	20,312	20,479	21,325	20,522	22,822
Oklahoma, Kansas, and Missouri	3,752	3,444	2,720	2,864	3,491	3,952	4,807	4,601	4,839	5,094	5,241	4,659	4,091
Texas inland	63	163	52	179	173	9	7	5	107	198	83	80	79
Texas Gulf coast	12,451	13,002	13,726	14,290	15,544	13,105	14,988	12,798	13,903	14,211	15,029	14,853	12,070
Louisiana Gulf coast	87,642	81,942	73,186	64,936	57,479	55,755	50,097	42,372	37,272	37,385	34,900	37,074	91,463
Rocky Mountain	26,491	26,221	26,175	25,570	25,477	25,357	26,015	27,091	27,928	28,244	30,096	31,693	25,873
Total	233,044	229,414	208,620	205,105	205,803	200,836	198,407	192,198	191,158	189,167	183,938	180,843	232,592

Refinery price of 122 to 124 white crude scale wax at Pennsylvania refineries in 1931, in cents per pound [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Average montbly prices	2.36	2.26	2.25	2.20	2.10	1.97	2.00	1.89	1.90	2.00	2.03	2.13	2.09

PRICE CHANGES BY WEEKS

Jan. 1 [2]	2.375	Apr. 20	2.125	June 29	2.00	Sept. 14	1.90
Jan. 26	2.30	May 25	2.00	Aug. 3	1.90	Sept. 28	2.00
Feb. 9	2.25	June 8	1.95	Aug. 17	1.875	Nov. 23	2.125

[1] From National Petroleum News.
[2] In effect on tbis date.

PETROLEUM COKE

The output of coke at petroleum refineries continued to increase, the total being 2,032,000 short tons compared with 1,940,000 short

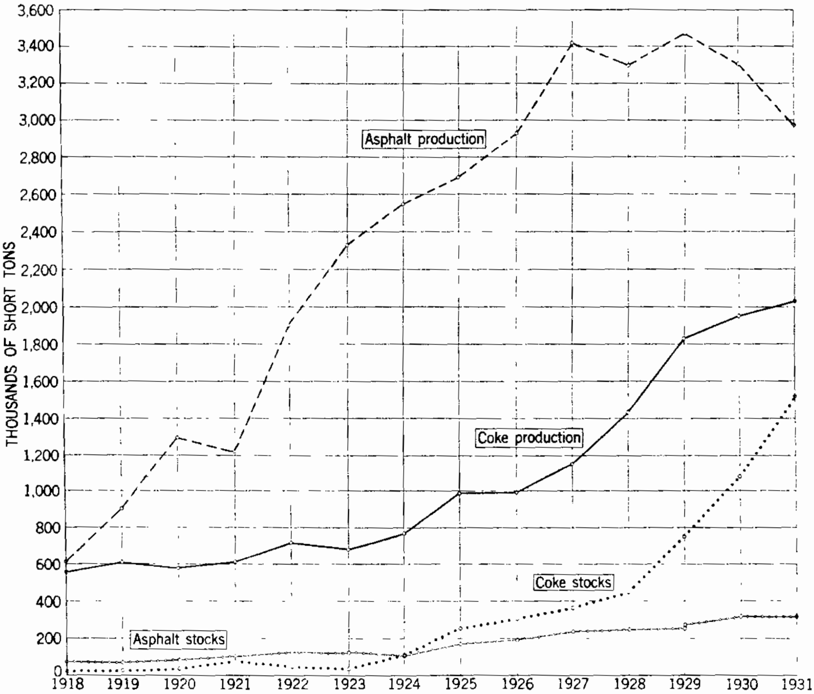

FIGURE 53.—Petroleum coke and asphalt; production and stocks, 1918–31.

tons in 1930. The gain resulted primarily from increased cracking. The indicated domestic demand for petroleum coke (1,533,600 short tons) increased over 1930 but not enough to prevent another material gain in stocks. (See fig. 53.) No petroleum coke is imported, and exports are negligible.

Complete data on the consumption of petroleum coke by industries in 1931 are not available. It is used principally as fuel at refineries and in homes. The use of coke at refineries has been retarded in recent years by the relative cheapness of fuel oil and still gas, both mechanically superior to coke. Refinery consumption in 1931 was 529,000 short tons compared with 580,000 short tons in 1930. Data on domestic consumption of coke in 1931 are lacking, but the fact that the total indicated demand increased whereas the consumption at refineries decreased would indicate that its use as domestic fuel is growing. The Indiana-Illinois district, which includes the populous Chicago area, is probably the leading district in domestic consumption; this conclusion is indicated by the fact that production in that district in 1931 represented more than one third of the total, but stocks held there were only one seventh of the total.

Comparative analyses of petroleum coke in 1931, by months

[Thousands of short tons]

	January	February	March	April	May	June	July
Production	159.0	150.8	170.4	168.4	178.4	179.6	172.6
Daily average	5.1	5.4	5.5	5.6	5.8	6.0	5.6
Exports	2.9	2.4	4.1	2.6	4.6	10.6	1.9
Stocks, end of period	1,032.3	1,052.6	1,089.1	1,157.8	1,250.3	1,315.4	1,390.7
Domestic demand	192.9	128.1	129.8	97.1	81.3	103.9	95.4
Daily average	6.2	4.6	4.2	3.2	2.6	3.5	3.1

	August	September	October	November	December	Total
Production	177.9	180.0	159.2	168.0	167.7	2,032.0
Daily average	5.7	6.0	5.1	5.6	5.4	5.6
Exports	4.2	5.0	9.7	4.6	3.3	55.9
Stocks, end of period	1,450.5	1,515.6	1,472.7	1,499.0	1,511.6	1,511.6
Domestic demand	113.9	109.9	192.4	137.1	151.8	1,533.6
Daily average	3.7	3.7	6.2	4.6	4.9	4.2

Production and stocks of petroleum coke in 1931, by districts and months

[Thousands of short tons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	12.7	12.3	10.8	10.6	11.8	11.2	11.0	9.6	11.0	12.0	12.3	9.2	134.5
Appalachian	2.2	2.4	2.4	2.0	3.5	3.3	2.9	2.8	4.9	3.5	3.7	3.5	37.1
Indiana, Illinois, Kentucky, etc.	52.3	51.6	54.7	58.4	63.9	65.5	63.0	70.2	67.4	57.3	62.3	57.7	724.3
Oklahoma, Kansas, and Missouri	24.1	25.5	27.6	30.8	29.0	29.8	33.1	40.0	39.6	32.2	30.4	31.2	373.3
Texas inland	8.4	7.3	9.9	10.4	12.4	10.0	11.6	12.5	12.4	11.6	11.8	10.8	129.1
Texas Gulf coast	37.5	34.3	41.6	34.5	33.1	39.4	33.9	25.3	24.3	22.5	28.8	35.3	390.5
Louisiana Gulf coast	10.0	7.0	11.2	10.6	11.0	8.4	5.7	5.9	5.5	6.8	5.9	4.9	92.9
Arkansas and Louisiana inland	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	2.4
Rocky Mountain	11.0	9.8	11.6	10.1	13.5	11.6	11.2	11.2	13.3	10.8	10.8	12.4	137.3
California	.6	.4	.4	.8	----------	.2	----------	.2	1.4	2.3	1.8	2.5	10.6
Total, 1931	159.0	150.8	170.4	168.4	178.4	179.6	172.6	177.9	180.0	159.2	168.0	167.7	2,032.0
Daily average, 1931	5.1	5.4	5.5	5.6	5.8	6.0	5.6	5.7	6.0	5.1	5.6	5.4	5.6
Total, 1930	145.5	139.6	160.6	150.6	175.7	163.0	161.2	172.1	170.2	177.3	158.1	166.1	1,940.0
Stocks, end of period:													*Dec. 31, 1930*
East coast	39.6	33.9	28.9	25.3	35.5	41.6	33.1	37.5	49.2	44.7	39.8	22.1	45.6
Appalachian	6.8	5.7	5.7	6.4	8.3	11.2	12.6	11.1	13.8	15.4	12.7	11.1	6.7
Indiana, Illinois, Kentucky, etc.	85.7	79.9	74.5	91.6	121.3	139.5	171.3	200.8	210.4	199.2	212.9	215.9	107.7
Oklahoma, Kansas, and Missouri	73.3	78.8	83.8	95.1	102.5	104.5	118.8	132.6	150.0	151.0	159.4	165.6	81.6
Texas inland	47.6	51.0	57.8	64.5	72.8	80.0	91.5	101.4	110.4	117.8	124.7	131.3	45.6
Texas Gulf coast	498.1	517.4	542.5	568.2	588.1	609.0	630.5	629.5	632.8	591.3	596.2	611.3	484.3
Louisiana Gulf coast	54.4	58.6	67.0	75.9	85.9	94.7	99.0	103.4	110.8	114.6	118.2	117.2	68.4
Arkansas and Louisiana inland	.2	.2	.2	.1	.3	.3	.3	.2	.3	.3	.3	.2	.2
Rocky Mountain	113.9	115.8	118.0	119.4	124.9	126.7	128.4	130.4	132.4	132.8	135.4	138.1	115.7
California	112.7	111.3	110.7	111.3	110.7	107.9	105.2	103.6	105.5	105.6	99.4	98.8	113.3
Total: 1931	1,032.3	1,052.6	1,089.1	1,157.8	1,250.3	1,315.4	1,390.7	1,450.5	1,515.6	1,472.7	1,499.0	1,511.6	1,069.1
1930	740.5	755.5	785.6	831.7	899.9	928.7	991.2	1,035.4	1,088.8	1,080.4	1,096.6	1,069.1	----------

ASPHALT

Decreased demand, domestic and foreign, for petroleum asphalt and increased imports of lake asphalt and grahamite reduced the output of asphalt at United States refineries 10 percent (from 3,308,000 short tons in 1930 to 2,976,500 tons in 1931). (See fig. 53.) Stocks of asphalt held at refineries at the beginning of 1931 totaled 307,800 tons, an increase of 17 percent over the 263,200 tons held at the beginning of 1930. By the end of 1931, however, refinery stocks of asphalt had been reduced to 301,800 tons. Exports to foreign countries decreased from 410,400 short tons in 1930 to 288,100 tons in 1931, while shipments of asphalt to Hawaii increased from 8,700 tons in 1930 to 10,000 tons in 1931 and shipments to Puerto Rico from 3,300 tons in 1930 to 6,300 tons in 1931. Imports of natural asphalt and bitumen, chiefly lake asphalt from Trinidad and Venezuela and grahamite or, rather, glance pitch from Cuba, increased 39 percent (from 53,197 short tons in 1930 to 73,672 tons in 1931). The indicated demand for petroleum asphalt in continental United States was 2,678,100 tons in 1931, a decrease of 6 percent from the 2,841,000 tons apparently consumed in 1930.

Of the 2,976,500 short tons of asphalt manufactured at petroleum refineries in 1931, 57 percent was made from foreign crude oil, imported chiefly from Venezuela, Colombia, and Mexico. Included in the 1931 total were 42,500 tons of other petroleum products blended with the asphalt to produce commercial varieties of the required hardness and consistency.

Forty-nine percent of the petroleum asphalt manufactured in the United States in 1931 came from refineries in the East coast district compared with 46 percent in 1930. Of the remaining 51 percent in 1931, 15 percent was produced in California, 15 percent in Indiana-Illinois, 13 percent in the Texas and Louisiana Gulf coasts, and 8 percent in the other districts. The decreases in asphalt production were general but were largest in the Indiana-Illinois and Louisiana Gulf coast districts.

In 1931, 63 percent of the annual output of asphalt was produced in the six months from May 1 to October 31 compared with an average of 60 percent for the corresponding period of the preceding five years. The highest daily output in 1931 was in September and the lowest in December.

Stocks of petroleum asphalt held at East coast refineries decreased 26 percent in 1931, and stocks held at refineries in the Louisiana Gulf coast decreased 31 percent. These decreases were largely offset by increases in asphalt inventories at refineries in California and in most inland refining districts.

Comparative analyses of asphalt in 1931, by months

[Thousands of short tons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production	147.3	165.8	190.2	247.8	304.0	314.7	314.0	311.5	325.8	314.2	209.6	131.6	2,976.5
Daily average	4.8	5.9	6.1	8.3	9.8	10.5	10.1	10.0	10.9	10.1	7.0	4.2	8.2
Exports	23.5	35.4	34.4	30.1	31.1	26.9	21.1	24.5	22.3	22.9	21.0	11.2	304.4
Stocks, end of period	295.0	331.5	354.1	360.0	379.8	389.6	343.4	314.9	287.5	275.9	276.8	301.8	301.8
Domestic demand	136.6	93.9	133.2	211.8	253.1	278.0	339.1	315.5	330.9	302.9	187.7	95.4	2,678.1
Daily average	4.4	3.4	4.3	7.1	8.2	9.3	10.9	10.2	11.0	9.8	6.3	3.1	7.3

Production and stocks of asphalt in 1931, by districts and months

[Thousands of short tons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East Coast	49.1	58.9	80.2	124.5	162.2	177.6	152.9	161.3	175.3	175.3	97.4	43.8	1,458.5
Appalachian	6.1	7.3	8.4	10.9	7.6	9.1	15.8	17.3	14.1	10.4	6.3	12.7	126.0
Indiana, Illinois, Kentucky, etc	29.1	36.3	30.4	32.9	38.5	38.4	44.9	46.7	38.0	45.9	35.3	23.1	439.5
Oklahoma, Kansas, and Missouri	3.6	-----	2.0	1.5	2.4	.7	3.3	.9	2.0	2.5	.9	2.9	22.7
Texas inland	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Texas Gulf coast	6.5	8.5	12.4	16.7	19.1	18.4	17.5	18.0	18.2	15.4	12.2	9.1	172.0
Louisiana Gulf coast	14.7	12.0	14.9	20.5	26.7	23.8	15.1	17.1	30.4	19.1	18.4	6.2	218.9
Arkansas and Louisiana inland	6.2	9.3	8.3	8.8	10.0	9.6	9.3	7.1	6.0	4.5	5.8	8.2	93.1
Rocky Mountain	-----	.2	.2	1.3	-----	.7	.3	.2	.9	1.8	-----	-----	5.6
California	32.0	33.3	33.4	30.7	37.5	36.4	54.9	42.9	40.9	39.3	33.3	25.6	440.2
Total, 1931	147.3	165.8	190.2	247.8	304.0	314.7	314.0	311.5	325.8	314.2	209.6	131.6	2,976.5
Daily average, 1931	4.8	5.9	6.1	8.3	9.8	10.5	10.1	10.0	10.9	10.1	7.0	4.2	8.2
Total, 1930	214.7	194.4	223.1	272.9	348.9	353.9	340.0	352.3	311.1	312.4	216.5	167.8	3,308.0
Stocks, end of period:													*Dec. 31, 1930*
East coast	99.5	128.2	138.5	145.2	152.6	160.5	119.4	109.3	93.6	97.7	88.5	87.5	118.3
Appalachian	12.1	17.3	20.8	24.3	23.7	22.3	22.0	20.5	16.0	11.3	12.9	20.1	9.7
Indiana, Illinois, Kentucky, etc	77.1	74.9	75.9	65.9	67.6	71.9	72.4	69.4	70.4	67.4	70.6	79.1	73.5
Oklahoma, Kansas, and Missouri	4.3	4.2	4.6	5.3	3.7	4.4	4.3	4.7	5.0	3.2	4.1	3.9	5.9
Texas inland	.1	.1	-----	.1	-----	-----	-----	.1	-----	-----	.1	.1	.1
Texas Gulf coast	7.6	6.7	9.0	7.4	6.7	9.1	7.4	7.9	9.1	8.7	10.6	11.3	7.5
Louisiana Gulf coast	48.3	37.6	36.2	37.9	45.8	38.2	33.0	27.0	26.9	23.7	29.5	28.9	41.7
Arkansas and Louisiana inland	.9	15.8	18.7	22.8	26.1	27.3	26.8	23.6	20.7	18.4	18.9	23.2	7.2
Rocky Mountain	3.8	4.0	4.0	4.8	3.8	3.6	3.4	2.7	2.3	3.0	2.5	2.3	3.9
California	41.3	42.7	46.4	46.3	49.8	52.3	54.7	49.7	43.5	42.5	39.1	45.4	40.0
Total: 1931	295.0	331.5	354.1	360.0	379.8	389.6	343.4	314.9	287.5	275.9	276.8	301.8	307.8
1930	285.9	288.7	302.2	294.1	316.8	312.0	310.7	316.8	269.6	267.1	294.7	307.8	-------

ROAD OIL

Greater use during 1931 of cheap, bituminous-type surfacing, especially in the construction of secondary roads, increased the use of road oil in the United States more than one fourth. Sales of petroleum oils for road surfacing increased from 5,578,000 barrels in 1930 to 7,170,000 barrels in 1931, a gain of 29 percent. Petroleum-refining companies manufactured 5,425,000 barrels of road oil in 1930 and 5,177,000 in 1931. Stocks of road oil held at refineries increased 99,000 barrels during 1931.

The manufacture of road oil by seaboard refineries of California, the East coast, and the Gulf coast decreased in 1931, while the output of road oil by inland refineries of the Indiana-Illinois, Oklahoma-Kansas, and Rocky Mountain districts gained both in quantity and relative importance.

More than nine tenths of the road oil manufactured in 1931 was made from domestic crude compared with five sixths in 1930. The quantity of road oil made from Venezuelan and Mexican raw material decreased from 906,000 barrels in 1930 to 470,000 in 1931. More than three fourths of the road oil of foreign origin was made in refineries of the Atlantic seaboard and the rest in Gulf coast refineries of Louisiana and Texas.

More than three fourths of the road oil was produced from May 1 to September 30 compared with 68 percent in the corresponding period of 1930. The leading month in 1931 was July, when production was 22 percent of the annual total.

Production and stocks of road oil in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	5	27	26	45	69	50	56	22	21	24	12	8	365
Appalachian	-----	-----	-----	5	56	58	40	16	14	19	-----	-----	208
Indiana, Illinois, Kentucky, etc	9	3	5	10	83	168	618	343	321	125	18	7	1,710
Oklahoma, Kansas, and Missouri	-----	-----	6	5	87	121	109	221	117	131	43	12	852
Texas Gulf coast	1	2	12	4	10	4	9	14	10	8	6	1	81
Louisiana Gulf coast	-----	-----	-----	-----	-----	-----	14	9	2	1	-----	-----	26
Arkansas and Louisiana inland	-----	-----	-----	2	6	20	16	18	11	9	-----	-----	82
Rocky Mountain	18	35	14	23	96	135	142	171	115	46	21	25	841
California	69	48	51	75	122	144	111	166	71	89	35	31	1,012
Total, 1931	102	115	114	169	529	700	1,115	980	682	452	135	84	5,177
Daily average	3	4	4	6	17	23	36	31	23	15	4	3	14
Total, 1930	293	259	257	316	487	811	910	887	613	292	166	134	5,425
Stocks, end of period:													*Dec. 31, 1930*
East coast	20	40	50	52	49	25	36	22	19	22	17	14	22
Appalachian	-----	-----	-----	5	42	35	37	29	22	29	13	10	-------
Indiana, Illinois, Kentucky, etc	3	-----	-----	1	53	77	307	95	86	43	41	12	4
Oklahoma, Kansas, and Missouri	7	5	10	8	73	77	45	53	47	61	81	88	15
Texas Gulf coast	10	10	17	8	10	8	7	8	8	7	12	11	9
Arkansas and Louisiana inland	-----	-----	-----	2	-----	7	12	6	6	5	-----	-----	-------
Rocky Mountain	77	112	125	133	179	166	114	83	62	51	66	89	59
California	167	174	169	173	166	146	133	150	116	131	148	109	125
	284	341	371	382	572	541	691	446	366	349	378	333	234

STILL GAS

One characteristic of modern refining methods is the large amount of "still" gas, often called "refinery gas," that is produced. The production of still gas received its greatest impetus with the advent of cracking; more recently it was augmented further by the introduction of re-forming to increase the octane number. In the past, much of the still gas produced was wasted (that is, not collected);

now, virtually all large plants and many small ones have vapor-recovery systems.

Still gas was formerly classed with miscellaneous products in statistics of the Bureau; but by 1931 it had become so important, quantitatively and economically, that it was decided to obtain separate data. These show a production of 154,086,000,000 cubic feet of still gas in 1931 which, on a B.t.u. basis, was equivalent to 38,630,000 barrels of fuel oil. The relative importance of this gas may be appreciated when it is considered that the output exceeds that of lubricating oils, is not far under that of kerosene, and from the standpoint of available B.t.u. outranks manufactured gas. The B.t.u. content of the average still gas produced in 1931 was 1,500 per cubic foot; the range was from 1,800 B.t.u. per cubic foot in the California district to 1,000 B.t.u. in the Arkansas-Louisiana inland district. The leading producers of still gas (Texas Gulf coast, East coast, and Indiana-Illinois-Kentucky districts) were also the leaders in cracking, proving the relationship between the growth in cracking and in still-gas production.

Still gas is utilized principally as refinery fuel, but increasing quantities are sold to public-utility companies. In 1931 the consumption of still gas as refinery fuel totaled 149,924,000,000 cubic feet compared with 121,321,000,000 cubic feet in 1930.

Production of still gas in 1931, by districts and months

[Millions of cubic feet]

	January	February	March	April	May	June	July
East coast	1,935	1,760	2,072	2,140	2,344	2,390	2,788
Appalachian	371	422	505	524	578	598	667
Indiana, Illinois, Kentucky, etc	1,547	1,635	1,869	2,243	2,468	2,584	2,670
Oklahoma, Kansas, and Missouri	923	869	964	1,026	1,134	1,147	1,347
Texas inland	360	305	351	398	432	380	430
Texas Gulf coast	3,306	3,135	3,644	3,537	3,740	3,710	3,820
Louisiana Gulf coast	543	498	591	580	577	568	551
Arkansas and Louisiana inland	54	42	43	45	59	49	55
Rocky Mountain	254	264	277	321	374	335	341
California	1,462	1,227	1,376	1,190	1,103	1,162	1,272
	10,755	10,157	11,692	12,004	12,809	12,923	13,941
Daily average	347	363	377	400	413	431	450
Total equivalent (thousands of barrels)	2,671	2,528	2,910	2,994	3,192	3,280	3,544

	August	September	October	November	December	Total	Total equivalent (thousands of barrels)
East coast	2,813	2,767	2,794	2,645	2,656	29,104	7,498
Appalachian	692	717	781	653	582	7,090	1,818
Indiana, Illinois, Kentucky, etc	2,946	2,726	2,866	2,709	2,614	28,877	7,138
Oklahoma, Kansas, and Missouri	1,428	1,413	1,316	1,230	1,156	13,953	3,501
Texas inland	404	387	401	380	379	4,607	1,089
Texas Gulf coast	3,607	3,356	3,760	3,562	3,772	42,949	10,316
Louisiana Gulf coast	630	620	667	629	612	7,066	1,464
Arkansas and Louisiana inland	50	59	47	52	55	610	105
Rocky Mountain	379	349	326	344	303	3,867	904
California	1,397	1,286	1,368	1,491	1,629	15,963	4,797
	14,346	13,680	14,326	13,695	13,758	154,086	38,630
Daily average	463	456	462	457	444	422	107
Total equivalent (thousands of barrels)	3,642	3,475	3,586	3,387	3,421	38,630	--------

MISCELLANEOUS PRODUCTS

The total production of "other finished products", or miscellaneous oils, at refineries, including all products other than gasoline, kerosene, gas oil, fuel oil, lubricants, wax, coke, asphalt, road oil, and still gas, amounted to 4,150,000 barrels in 1931. In 1930 the production of miscellaneous oils was reported as 7,754,000 barrels, but as this includes the equivalent of 5,377,000 barrels of still gas the comparable figure is 2,377,000 barrels.

Undoubtedly there has been a steady increase in the production of special refined products in recent years, although it is difficult to measure this growth, as a large proportion is manufactured outside of refineries and as some of the production is reported under gasoline, kerosene, etc. From a quantitative standpoint, special naphtha was the most important of the miscellaneous oils manufactured in 1931. This class includes principally dry cleaner's naphtha, painter's naphtha, and rubber solvents. The output of special naphthas in 1931 was reported as 1,033,000 barrels, but the actual output was probably several times that figure, as many refiners reported their output of special naphthas in 1931 in combination with that of blending naphtha; that is, as "gasoline."

Production and stocks of miscellaneous oils in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production:													
East coast	28	18	7	19	9	13	6	10	16	24	14	8	172
Appalachian	26	29	32	31	26	22	27	28	28	38	20	20	327
Indiana, Illinois, Kentucky, etc	28	48	11	51	72	73	87	89	58	51	53	66	687
Oklahoma, Kansas, and Missouri	23	15	27	13	12	6	3	39	75	33	12	9	267
Texas inland	4	2	8	8	8	7	9	12	7	5	8	9	87
Texas Gulf coast	1	1	3	3	3	1	2	3	1	1	1	1	21
Louisiana Gulf coast	28	30	17	13	12	11	4	8	4	4	4	4	139
Arkansas and Louisiana inland	9	12	31	24	29	13	25	22	17	34	22	22	260
Rocky Mountain	3	2	4	3	3	4	-----	4	3	5	----	3	34
California	115	115	166	205	205	251	331	180	204	126	153	105	2,156
Total, 1931 [1]	265	272	306	370	379	401	494	395	413	321	287	247	4,150
Daily average, 1931	9	10	10	12	12	13	16	13	14	10	10	8	11
Total, 1930 [1]	536	462	398	487	572	835	800	796	772	680	745	671	7,754
													Dec. 31, 1930
Stocks, end of period:													
East coast	34	43	62	73	62	63	59	73	72	68	58	81	19
Appalachian	65	76	79	63	52	51	50	64	60	56	61	67	73
Indiana, Illinois, Kentucky, etc	241	242	295	232	235	301	200	202	210	228	243	281	242
Oklahoma, Kansas, and Missouri	14	22	25	26	27	27	23	25	24	22	23	24	24
Texas inland	7	6	5	7	7	6	7	7	7	6	6	6	8
Texas Gulf coast	4	4	9	5	9	4	3	3	3	3	3	8	4
Louisiana	4	6	5	4	5	6	5	8	6	6	4	5	6
Arkansas and Louisiana inland	3	3	7	5	7	6	5	4	6	4	9	8	------
Rocky Mountain	26	31	29	32	35	36	38	43	46	44	44	49	29
California	180	162	179	179	191	187	215	232	211	228	263	256	170
Total: 1931	578	595	695	626	630	687	605	661	645	665	714	785	[2] 575
1930	556	552	535	552	525	485	447	478	554	591	501	530	------

[1] Totals for 1930 include still gas, the total production of which was equivalent on B.t.u. basis to 5,377,000 barrels. Beginning with 1931 monthly figures of still-gas production were reported separately from the production of miscellaneous products. See p. 658.

[2] For comparison with 1931.

Another important miscellaneous oil was petrolatum; production totaled 272,000 barrels, an increase of 11 percent over 1930. The production of absorption oil declined sharply, as new construction fell to a minimum and the low prices for natural gasoline forced the manufacturers to reduce costs to the point of revitalizing their absorption oil to the limit.

Stocks of miscellaneous oils are relatively unimportant; on December 31, 1931, total stocks were 785,000 barrels compared with 575,000 barrels in storage at the first of the year.

Production of miscellaneous oils in 1931, by districts

[Thousands of barrels of 42 U.S. gallons]

	Special naphthas	Petrolatum	Absorption oil	Medicinal oil	Black oil	Ink oil	Specialties	Other	Total
East coast		33		51		35	2	51	172
Appalachian	15	188			3			121	327
Indiana, Illinois, Kentucky, etc.	471	41			9		2	164	687
Oklahoma, Kansas, and Missouri	65	5	27					170	267
Texas inland			79					8	87
Texas Gulf coast		5					11	5	21
Louisiana Gulf coast								139	139
Arkansas and Louisiana inland	152				57	16		35	260
Rocky Mountain								34	34
California	330		26	36			437	1,327	2,156
Total: 1931	1,033	272	132	87	69	51	452	2,054	4,150
1930	226	246	239	128	(1)	(1)	(1)	1,538	2,377

1 Included with "Other."

UNFINISHED OILS

As the name implies, unfinished oils require further refining to convert them into marketable products. The most important unfinished oil is cracking stock, and the increase in cracking in recent years naturally has raised the general significance of the class; however, simplified practice at refineries whereby rerunning is reduced to a minimum has had an opposite effect. Stocks of unfinished oils totaled 43,784,000 barrels on December 31, 1931, compared with 47,153,000 on January 1; in other words, gross unfinished oils rerun exceeded gross unfinished oils produced by 3,369,000 barrels.

Production and stocks of unfinished oils in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production (net):													
East coast	[1] 176	[1] 510	[1] 34	[1] 932	353	[1] 481	[1] 511	[1] 279	[1] 327	[1] 498	[1] 859	[1] 548	[1] 4,802
Appalachian	[1] 76	82	33	[1] 34	67	47	100	4	[1] 80	[1] 64	59	[1] 77	52
Indiana, Illinois, Kentucky, etc.	271	128	408	274	[1] 7	175	27	384	634	693	243	311	3,541
Oklahoma, Kansas, and Missouri	[1] 428	126	[1] 242	[1] 207	15	74	[1] 6	[1] 88	[1] 275	[1] 457	[1] 298	[1] 100	[1] 1,886
Texas inland	[1] 3	82	261	108	128	128	90	[1] 24	11	[1] 94	[1] 126	16	586
Texas Gulf coast	755	416	[1] 378	[1] 135	318	[1] 346	182	[1] 229	[1] 539	[1] 1,006	[1] 599	335	[1] 1,226
Louisiana Gulf coast	56	[1] 101	19	[1] 149	237	406	298	111	[1] 129	[1] 201	37	182	766
Arkansas and Louisiana inland	[1] 38	48	16	[1] 110	[1] 33	[1] 3	36	15	42	[1] 100	[1] 129	51	[1] 205
Rocky Mountain	39	[1] 59	19	27	[1] 36	30	[1] 44	[1] 7	55	[1] 60	[1] 102	[1] 88	[1] 226
California	218	183	[1] 107	[1] 228	[1] 576	[1] 41	[1] 93	378	[1] 533	239	258	333	31
Total: 1931	618	395	[1] 5	[1] 1,386	466	[1] 11	88	265	[1] 1,150	[1] 1,548	[1] 1,516	415	[1] 3,369
1930	1,663	[1] 1,210	929	767	242	1,965	[1] 893	861	[1] 405	[1] 1,950	115	158	2,242
Stocks, end of period:													*Dec. 31, 1930*
East coast	9,356	9,488	9,771	9,247	9,837	9,360	9,285	8,916	8,746	8,423	7,756	7,286	9,447
Appalachian	1,362	1,444	1,477	1,443	1,510	1,557	1,657	1,661	1,572	1,508	1,567	1,490	1,438
Indiana, Illinois, Kentucky, etc.	4,816	5,024	5,215	5,122	5,070	5,224	5,220	5,461	6,003	6,224	6,144	6,277	4,853
Oklahoma, Kansas, and Missouri	2,873	2,919	2,894	3,054	3,114	3,209	3,234	3,289	3,106	3,121	3,146	3,224	2,993
Texas inland	1,336	1,418	1,135	1,243	1,371	1,499	1,440	1,416	1,427	1,333	1,207	1,223	1,339
Texas Gulf coast	14,337	14,345	14,303	13,760	13,841	13,666	13,570	13,431	12,988	11,888	11,237	11,494	13,357
Louisiana Gulf coast	2,230	1,895	1,805	1,656	1,893	2,124	2,307	2,418	2,036	1,754	1,651	1,833	2,484
Arkansas and Louisiana inland	610	658	674	564	531	528	679	694	736	636	507	558	648
Rocky Mountain	1,818	1,759	1,778	1,805	1,769	1,799	1,755	1,748	1,803	1,743	1,641	1,553	1,779
California	9,033	9,216	9,109	8,881	8,305	8,264	8,171	8,549	8,016	8,255	8,513	8,846	8,815
Total: 1931	47,771	48,166	48,161	46,775	47,241	47,230	47,318	47,583	46,433	44,885	43,369	43,784	[2] 47,153
1930	46,214	45,004	45,933	46,700	46,942	48,907	48,014	48,875	48,470	46,520	46,635	46,793	----------

[1] Negative quantity—represents net excess of unfinished oils rerun over unfinished oils produced.
[2] For comparison with 1931.

SHORTAGE

Shortage at refineries in 1931 was 19,070,000 barrels (2.1 percent of the crude runs) compared with 37,003,000 barrels (4.0 percent) in 1930. This decline indicates a material gain in efficiency at refineries but actually was due to a change in statistical methods whereby still gas, which hitherto comprised nearly one half of shortage, was shown as a separate product. Introduction of the new basis of reporting makes it difficult to ascertain the trend in actual shortage; however, it is probable that losses are being diminished steadily as more and more companies are reporting a volumetric gain in their operations.

Shortage in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
East coast	227	219	215	238	207	156	293	350	222	316	221	226	2,890
Appalachian	86	91	93	98	113	111	127	152	122	121	125	109	1,348
Indiana, Illinois, Kentucky, etc.	51	90	23	67	24	39	79	19	92	100	64	38	686
Oklahoma, Kansas, and Missouri	344	243	308	351	416	390	417	406	342	315	325	279	4,136
Texas inland	188	195	180	231	244	276	271	312	289	261	270	230	2,947
Texas Gulf coast	191	328	185	227	103	233	211	114	254	215	203	154	2,418
Louisiana Gulf coast	60	25	8	114	10	48	119	85	104	36	92	50	751
Arkansas and Louisiana inland	86	90	114	116	127	134	162	154	123	113	96	88	1,403
Rocky Mountain	28	47	26	51	17	9	43	46	53	68	61	25	474
California	195	149	254	231	217	209	227	205	120	140	22	48	2,017
Total, 1931	1,456	1,477	1,406	1,724	1,478	1,605	1,949	1,843	1,721	1,685	1,479	1,247	19,070
Daily average, 1931	47	53	45	57	48	54	63	59	57	54	49	40	52
Total, 1930	3,064	2,699	2,894	2,981	2,986	3,182	3,423	3,615	3,330	3,316	2,807	2,706	37,003

IMPORTS AND EXPORTS

Imports of gasoline, which have increased rapidly in recent years, declined 20 percent. Approximately 3 percent of the gasoline consumed in the United States in 1931 was foreign gasoline; but this proportion was much higher in the States along the Atlantic seaboard. Imports of gas oil and fuel oil also declined moderately. Although the quantity of fuel oil imported in 1931 greatly exceeded the total gasoline imports the value of the latter was far greater.

Exports of refined oils reflected the expansion in refinery facilities abroad and decreased 26 percent in 1931. Of the 98,859,000 barrels exported to foreign countries and shipped to noncontiguous territories 45,716,000 barrels (46 percent) were gasoline and benzol; 12,712,000 barrels (13 percent) were kerosene; 29,231,000 barrels (30 percent) were gas oil and fuel oil; 8,128,000 barrels (8 percent) were lubricants; and only 3,072,000 barrels (3 percent) were asphalt, wax, and miscellaneous oils. Exports of gasoline, which had increased steadily up to 1930, declined 28 percent in 1931. The decline in exports of gasoline was relatively greater than that in exports of the other major refined oils because besides a lower demand and increased competition in foreign refineries exporters of gasoline were faced with additional handicaps, such as special tariffs, taxes, monopolies granted to competitors, and substitute motor fuels. Exports of lubricating oils, second only to those of gasoline in value, declined 18 percent. This decrease resulted from the same general cause (a recession in industrial activity) that led to a decline in domestic demand, although the increased output of lubricating oils at foreign refineries may have exerted an appreciable influence. Exports of wax in 1931 were 290,527,000 pounds, only slightly below the 1930 total. Wax continued to be the only important refined product for which exports exceeded domestic demand.

The United Kingdom continued to be the chief customer of the United States for gasoline, lubricating oils, and wax and succeeded China as the principal market for kerosene. Japan continued to be the chief customer for gas oil and fuel oil.

Galveston, the customs port for the Houston refineries, ranked as the chief gasoline-exporting port in 1931, succeeding Los Angeles. New Orleans was the chief shipping center for kerosene in 1931, Los Angeles for gas oil and fuel oil, and New York for lubricating oils and wax.

Imports of refined products in 1931, by months

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total: Quantity	Total: Value (thousands of dollars)
Gasoline	1,116	948	1,607	1,348	1,050	964	1,528	1,244	1,256	1,181	586	793	13,621	35,069
Kerosene	1	(1)	1	2	(1)	2	2	2	(1)	1	-----	-----	11	69
Gas oil and fuel oil	2,471	1,956	2,449	2,091	1,788	1,412	1,886	1,958	2,204	2,738	1,961	2,084	24,998	16,215
Lubricants	3	2	3	3	3	4	1	4	2	1	3	3	32	564
Wax ..... thous. of pounds	2,645	3,035	1,289	3,842	1,394	3,509	2,537	3,026	1,671	2,684	5,775	6,428	37,835	1,371
Wax	9	11	4	14	5	13	9	11	6	9	21	23	135	1,371
Tops and other unfinished distillate	1	(1)	1	-----	1	1	9	9	(1)	10	8	(1)	40	232
Total: 1931	3,601	2,917	4,065	3,458	2,847	2,396	3,435	3,228	3,468	3,940	2,579	2,903	38,837	53,520
1930	3,806	3,224	3,714	3,214	3,603	4,028	4,040	4,329	3,614	3,800	2,807	3,310	43,489	80,244

[1] Less than 500 barrels.

Exports and shipments of refined products in 1931, by months

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

	January	February	March	April	May	June	July
Gasoline	4,832	3,589	2,942	4,116	4,862	3,191	4,330
Benzol	72	17	3	71	15	73	143
Kerosene	1,292	985	1,163	766	1,162	741	1,235
Gas oil and fuel oil	2,981	2,556	2,261	2,231	2,675	2,633	2,699
Lubricants	687	556	551	716	741	833	535
Wax, crude .... thousands of pounds	6,542	6,630	8,986	7,692	5,494	4,000	4,946
Wax, refined .... do	15,521	16,873	21,484	13,681	12,092	16,391	12,338
Wax, total .... do	22,063	23,503	30,470	21,373	17,586	20,391	17,284
Wax, total	79	84	109	76	63	73	62
Coke .... thousands of short tons	2.9	2.5	4.1	2.6	4.6	10.6	1.9
Coke	15	12	21	13	23	54	10
Asphalt .... thousands of short tons	23.5	35.4	34.4	30.1	31.1	26.9	21.1
Asphalt	129	195	189	166	172	148	116
Insulating or transformer oils [1]	5	3	3	3	4	4	6
Residuum and other petroleum products	1	1	1	3	2	2	2
Mineral spirits	3	5	4	5	4	5	3
Total: 1931	10,091	8,000	7,244	8,163	9,719	7,753	9,135
1930	12,042	10,123	12,688	12,482	9,468	14,332	11,040

[1] Included in lubricants.

Exports and shipments of refined products in 1931, by months—Continued

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

	August	September	October	November	December	Total: Quantity	Total: Value (thousands of dollars)
Gasoline	4,134	3,353	3,412	3,743	2,691	45,195	114,458
Benzol	76	2	49	(2)	(2)	521	3,795
Kerosene	1,144	1,074	1,294	1,215	641	12,712	35,852
Gas oil and fuel oil	2,259	2,494	2,285	2,208	1,949	29,231	26,334
Lubricants	863	662	740	647	597	8,128	65,131
Wax, crude .... thousands of pounds	6,429	7,354	7,499	11,912	13,097	90,581	2,132
Wax, refined .... do	14,485	13,969	18,869	18,673	25,570	199,946	6,296
Wax, total .... do	20,914	21,323	26,368	30,585	38,667	290,527	8,428
Wax, total	75	76	94	109	138	1,038	8,428
Coke .... thousands of short tons	4.2	5.0	9.7	4.6	3.3	56.0	395
Coke	21	26	49	24	17	285	395
Asphalt .... thousands of short tons	24.5	22.3	22.9	21.0	11.2	304.4	5,178
Asphalt	135	123	126	115	61	1,675	5,178
Insulating or transformer oils [1]	5	4	5	2	4	48	502
Residuum and other petroleum products	2	2	3	2	2	23	84
Mineral spirits	4	5	4	5	4	51	408
Total: 1931	8,713	7,817	8,056	8,067	6,101	98,859	260,565
1930	12,563	8,753	11,807	7,768	9,728	132,794	479,261

[1] Included in lubricants. [2] Less than 500 barrels.

Exports of the major refined products in 1931, by countries of destination

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

	Gasoline: Quantity	Gasoline: Value (thousands of dollars)	Kerosene: Quantity	Kerosene: Value (thousands of dollars)	Gas oil and fuel oil: Quantity	Gas oil and fuel oil: Value (thousands of dollars)	Lubricants: Quantity	Lubricants: Value (thousands of dollars)	Wax: Quantity (thousands of pounds)	Wax: Value (thousands of dollars)
Argentina	358	1,666	117	666	399	270	131	1,742	10,284	337
Australia	2,200	5,543	486	1,525	98	76	200	2,490	771	33
Belgium	1,787	3,737	160	263	288	413	591	2,722	7,395	222
Brazil	798	3,416	500	2,759	39	144	134	1,257	1,450	52
Canada	2,963	8,592	92	193	1,840	1,802	404	3,463	1,665	45
Chile	152	470	6	20	2,926	1,928	34	519	9,054	214
China, Hong Kong, and Kwantung	495	2,046	2,249	7,255	1,030	934	261	1,818	28,593	840
Colombia	6	31	1	6	24	47	6	113	9,332	318
Cuba	296	642	15	37	1,335	815	50	566	1,975	76
Denmark	1,166	2,358	501	807	656	712	196	1,078	1,197	36
Finland	188	379	113	178	-------	-------	11	160	493	18
France	6,132	12,010	544	948	371	425	1,402	9,240	1,621	62
Germany	984	2,121	396	630	1,686	1,421	837	5,489	18,088	522
Irish Free State	307	660	116	185	8	11	2	20	3,747	88
Italy	622	1,394	18	35	354	400	277	2,604	46,513	1,358
Japan	1,256	4,185	370	1,413	5,437	4,596	239	2,627	3,147	112
Mexico	418	1,356	45	148	1,138	907	49	526	6,497	202
Netherlands	1,832	3,995	1,142	1,774	816	983	174	1,206	15,230	450
Netherland West Indies	1,070	2,618	24	56	593	651	4	56	(1)	(1)
New Zealand	1,248	3,994	89	423	778	639	33	454	297	10
Norway	357	734	184	312	146	151	39	404	837	29
Panama	328	942	34	120	2,405	2,123	9	177	261	8
Philippine Islands	403	1,399	224	712	977	824	67	765	644	18
Spain	1,122	2,374	48	81	97	73	148	1,242	12,881	435
Sweden	1,362	2,703	249	433	174	239	98	1,023	4,648	128
Union of South Africa	709	2,119	173	893	1	4	70	1,159	5,472	192
United Kingdom	13,151	28,938	2,882	5,014	1,397	1,536	1,764	12,070	71,362	1,729
Uruguay	221	930	138	875	(1)	(1)	23	305	390	12
Other	1,856	7,949	1,618	7,035	1,575	1,842	796	8,527	26,640	879
	43,787	109,301	12,534	34,796	26,588	23,966	8,049	63,822	290,484	8,425

[1] Less than 500 barrels.

Exports of the major refined products in 1931, classified by shipping points

[Thousands of barrels of 42 U.S. gallons, except as otherwise indicated]

Customs district	Gasoline	Kerosene	Gas oil and fuel oil	Lubricants	Wax (thousands of pounds)
Atlantic coast:					
New York	796	1,266	257	2,557	157,277
Philadelphia	4,407	1,341	220	2,377	49,617
Maine [1]	557	19	3	52	10,690
Gulf coast:					
New Orleans	7,148	2,672	1,233	352	53,759
Sabine	4,201	1,597	1,898	900	11,375
Galveston	12,243	2,145	5,882	876	2,163
Florida; Mobile	37	11	7	6	----------
Mexican border:					
San Antonio	234	7	13	21	2,165
El Paso	80	14	96	2	173
Arizona	24	3	98	2	113
Pacific coast:					
Los Angeles	8,264	2,472	14,568	130	62
San Diego	43	10	45	2	(2)
San Francisco	3,756	886	1,995	391	1,334
Oregon; Washington; Alaska	32	10	58	16	62
Northern border:					
Dakota	65	8	19	61	18
Michigan	1,080	14	73	71	254
Buffalo	586	54	66	174	1,091
Montana [3]	234	5	57	59	331
	43,787	12,534	26,588	8,049	290,484

[1] Includes also Massachusetts, Rhode Island, Maryland, Virginia, and Puerto Rico.
[2] Less than 500 pounds.
[3] Includes also Duluth-Superior, Ohio, Rochester, St. Lawrence, and Vermont.

RECEIPTS OF DOMESTIC REFINED OILS ON ATLANTIC SEABOARD

Gasoline shipments into the Atlantic coast area from other parts of the United States were 69,385,000 barrels in 1931, a gain of 7,058,000 barrels (11 percent) over the 1930 total of 62,327,000 barrels. The gasoline shipments to the Atlantic Coast States in 1931 were more than twice the quantity reported for 1925, when 33,678,000 barrels were received from other sections of the country. The Gulf coast ports continued to be the main source of gasoline coming to the Atlantic Coast States, supplying 45,658,000 barrels (66 percent) in 1931 compared with 34,306,000 barrels (55 percent) in 1930. Tanker shipments of gasoline from California to the Atlantic coast dropped from 18,898,000 barrels (30 percent of the total) in 1930 to 13,791,000 (20 percent of the total) in 1931. The gasoline received on the Atlantic coast by tank cars from other districts amounted to 9,936,000 barrels, a total slightly larger than the 1930 shipments of 9,123,000 barrels, and 8,799,000 barrels more than the corresponding total in 1928.

Kerosene received in the Atlantic Coast States from other sections of the country totaled 4,862,000 barrels compared with 4,784,000 barrels in 1930. Tanker shipments from the Gulf coast constituted 94 percent of the 1931 total compared with 92 percent in 1930.

Other sections of the country supplied the Atlantic Coast States with 29,358,000 barrels of gas oil and fuel oil in 1931, as against 27,230,000 barrels in 1930. Tanker shipments from Gulf coast ports to the Atlantic coast amounted to 83 percent of the total in

1931, 75 percent in 1930, and 87 percent in 1925 (the year of their greatest relative importance). California shipments of gas oil and fuel oil into the Atlantic coast area in 1931 were the lowest since1925, being 1,107,000 barrels or about 4 percent of the total. Tank-car receipts of gas oil and fuel oil from other areas totaled 3,969,000 barrels (13 percent of the whole) in 1931 compared with 2,890,000 barrels (11 percent) in 1930 and 1,584,000 barrels (5 percent) in 1926, when such shipments were least important.

Receipts from domestic sources of the major refined products at Atlantic coast points, 1927–31

[Thousands of barrels of 42 U.S. gallons]

Product and source	1927	1928	1929	1930	1931
Gasoline:					
Tankers from Gulf coast ports	39, 304	43, 619	42, 808	34, 306	45, 658
Tankers from California ports	11, 346	16, 043	22, 397	18, 898	13, 791
Tank cars from other districts	3, 803	1, 137	3, 692	9, 123	9, 936
	54, 453	60, 799	68, 897	62, 327	69, 385
Kerosene:					
Tankers from Gulf coast ports	5, 931	5, 861	4, 669	4, 409	4, 568
Tankers from California ports	241			278	194
Tank cars from other districts	16	21	167	97	100
	6, 188	5, 882	4, 836	4, 784	4, 862
Gas oil and fuel oil:					
Tankers from Gulf coast ports	21, 509	14, 902	24, 041	20, 423	24, 282
Tankers from California ports	12, 873	2, 371	2, 623	3, 917	1, 107
Tank cars from other districts	2, 347	3, 122	2, 670	2, 890	3, 969
	36, 729	20, 395	29, 334	27, 230	29, 358

PANAMA CANAL SHIPMENTS

Shipments of crude petroleum and refined products from California through the Panama Canal to Atlantic and Gulf ports of the United States continued to decline and amounted to only 17,605,000 barrels in 1931 compared with a peak of 55,719,000 barrels in 1923. The decline in crude prices east of California in recent years has made it virtually impossible for California producers to compete in the crude market on the Atlantic seaboard, and no California crude has entered East coast ports since 1929. Declining margins in the gasoline market on the Atlantic seaboard had an adverse effect on the eastward coastwise movement of California gasoline in 1931, only 13,854,000 barrels being transported compared with 18,473,000 barrels in 1930; however, shipments of gasoline through the Canal continued to represent an increasing proportion of the total shipments, as it was uneconomic to transport much of the cheaper products that far.

California oil shipped through the Panama Canal to Atlantic and Gulf ports in the United States, in 1931, by months [1]

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Gasoline, naphtha, etc	1,189	1,116	1,643	1,292	1,016	1,234	921	854	1,552	669	1,106	1,262	13,854
Natural gasoline	136	260		73	336		216	152	75	146	281	73	1,748
Kerosene	46		42			48	28	30					194
Gas oil	363	198	192	185		95		286		93	94	95	1,708
Diesel oil							107						
Fuel oil	1	1											2
Lubricants	12	1	13	11	1	15	10	4	2		5	10	84
Asphalt	1	1	2	2	2	2	1	1	1		1	1	15
Total: 1931	1,748	1,577	1,892	1,563	1,355	1,394	1,283	1,327	1,630	908	1,487	1,441	17,605
1930	2,044	2,186	1,430	1,819	1,807	2,765	2,770	1,998	1,983	2,389	1,880	1,931	25,002

[1] Compiled by E. T. Knudsen, of the San Francisco office of the Bureau of Mines.

NATURAL GASOLINE

The restrictions on crude production in 1931 and the consequent decline in the quantity of natural gas produced and treated were reflected in the output of natural gasoline, which decreased 17 percent from 1930. As the total output of motor fuel declined only 1 percent in 1931 the proportion of natural gasoline in the average motor fuel decreased.

The low gasoline prices at refineries in 1931 were unprecedented. These low prices had vital concern to natural-gasoline manufacturers, as the prices paid them by refiners were correspondingly low. A further source of anxiety to manufacturers was the increased competition of products similar to natural gasoline made at refineries by cracking or by treating refinery gas. As a counterstep to the growing apathy of refiners toward the use of natural gasoline, some manufacturers, particularly those not affiliated with refining interests, intensified their efforts to distribute their product direct to consumers. This campaign may have borne some fruit, as the percentage of the total distribution of natural gasoline blended at refineries declined slightly in 1931; however, refiners still utilize over 80 percent of the total output of natural gasoline.

Details on the production, consumption, and stocks of natural gasoline may be found in Natural Gasoline in 1931, Mineral Resources of the United States, part II.

Production and distribution of natural gasoline in 1931, by months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Production	4,207	3,698	4,114	3,888	3,879	3,583	3,569	3,224	3,107	3,381	3,450	3,517	43,617
Decrease in all stocks	-----	-----	-----	-----	-----	9	309	497	126	511	-----	-----	282
	4,207	3,698	4,114	3,888	3,879	3,592	3,878	3,721	3,233	3,892	3,450	3,517	43,899
Blended at refineries	3,169	3,018	3,008	2,789	3,011	2,802	2,586	2,475	2,599	3,021	2,878	2,618	33,974
Blended at plants [1]	13	13	14	13	14	15	14	13	13	12	10	5	149
Run through pipe lines [2]	69	73	73	88	86	107	105	67	155	160	81	78	1,142
Exports and sales to jobbers	350	325	350	250	400	225	400	700	302	398	200	350	4,250
Increase in all stocks	152	36	411	318	12	-----	-----	-----	-----	-----	9	232	-----
Balance	454	233	258	430	356	443	773	466	164	301	272	234	4,384
	4,207	3,698	4,114	3,888	3,879	3,592	3,878	3,721	3,233	3,892	3,450	3,517	43,899

[1] East of California.
[2] To refineries in California.

Consumption and stocks of natural gasoline at refineries in 1931, by districts and months

[Thousands of barrels of 42 U.S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Consumption:													
East coast	242	229	130	79	90	64	51	83	133	168	118	122	1,509
Appalachian	50	36	43	42	53	38	44	40	32	44	55	38	515
Indiana, Illinois, Kentucky, etc	263	224	219	225	225	158	184	163	239	333	382	283	2,898
Oklahoma, Kansas, and Missouri	434	420	430	422	451	439	505	424	436	465	481	444	5,351
Texas inland	259	258	235	369	306	279	271	278	286	358	331	304	3,534
Texas Gulf coast	723	507	591	430	535	591	577	510	457	453	501	438	6,313
Louisiana Gulf coast	127	165	200	183	180	112	72	116	95	93	82	110	1,535
Arkansas and Louisiana inland	98	93	110	100	97	95	76	70	63	79	61	52	994
Rocky Mountain	132	91	96	93	102	103	101	108	124	120	103	93	1,266
California [1]	841	995	954	846	972	923	705	683	734	908	764	734	10,059
California [2]	69	73	73	88	86	107	105	67	155	160	81	78	1,142
Total: 1931	3,238	3,091	3,081	2,877	3,097	2,909	2,691	2,542	2,754	3,181	2,959	2,696	35,116
1930	3,490	3,333	3,484	3,600	3,367	3,361	3,786	3,729	4,024	3,824	3,569	3,603	43,170
													Dec. 31, 1930
Stocks, end of period:													
East coast	124	161	227	233	219	270	290	212	224	127	51	83	121
Appalachian	14	15	11	14	10	11	8	8	4	3	3	11	12
Indiana, Illinois, Kentucky, etc	56	65	41	32	19	51	32	25	46	62	44	47	39
Oklahoma, Kansas, and Missouri	35	66	79	65	47	17	28	26	14	29	31	29	7
Texas inland	13	12	7	21	16	8	11	8	8	8	6	5	28
Texas Gulf coast	326	293	302	254	288	213	100	130	207	175	147	273	226
Louisiana Gulf coast	-----	9	9	1	-----	7	7	9	6	3	6	2	-----
Arkansas and Louisiana inland	15	11	12	11	9	5	13	12	14	8	4	6	14
Rocky Mountain	-----	1	-----	-----	1	-----	-----	-----	-----	-----	1	1	1
California	2,063	1,963	2,127	2,380	2,424	2,578	2,367	2,062	1,951	1,638	1,652	1,716	2,074
Total: 1931	2,646	2,596	2,815	3,011	3,033	3,160	2,856	2,492	2,474	2,053	1,945	2,173	[3] 2,522
1930	1,912	2,161	2,239	2,237	2,417	2,384	2,596	2,261	2,000	1,797	1,784	1,799	-----

[1] Blended.
[2] Received by pipe lines.
[3] For comparison with 1931.

OIL SHALE

The oil-shale industry of the United States was inactive in 1931, as the low prices of crude and refined oils did not justify operation of the plants. The industry in foreign countries experienced a fairly satisfactory year in output, but profits were undoubtedly reduced by the world-wide slump in gasoline prices. The production of shale in the seven foreign countries reporting declined from 2,688,859 metric tons in 1930 to 2,394,925 metric tons in 1931 (11 percent). Production in Scotland, the leading country, declined 14 percent in 1931, but the outputs of Estonia, France, and Spain, which rank next in importance, held their own.

World production of oil shale, 1927–31, in metric tons

[Compiled by M. T. Latus, of the Bureau of Mines]

Country	1927	1928	1929	1930	1931
Australia:					
New South Wales				352	2,165
Tasmania	3,201	2,637	4,368	5,515	1,425
Estonia	397,609	446,117	517,653	497,955	499,495
France [1]	87,500	77,047	78,606	75,469	74,541
Germany (Bavaria)	430	670	603	544	418
Great Britain: Scotland	2,080,122	2,070,826	2,056,088	2,052,939	1,760,557
Italy	4,890	1,560	1,331	938	713
Russia [2]	9,434	562	(3)	(3)	(3)
Spain	54,337	54,110	54,900	55,147	55,611
Sweden [4]	2,178				(3)
United States	7,600	1,928	1,767		

[1] Includes some boghead coal
[2] Year ended Sept. 30.
[3] Data not available.
[4] Alum shale used for oil.

EQUIPMENT SURVEYS

REFINING ACTIVITY

The number of refineries reporting to the Bureau of Mines increased slightly in 1931, due to the construction of new plants in the East Texas field and elsewhere. The number of operating refineries ranged from 335 reporting for February to 363 for both August and September. The average daily crude-oil capacity of the operating refineries in 1931 was 3,744,000 barrels compared with 3,673,000 barrels in 1930. A steady increase in the crude-oil capacity of refineries and a decline in crude throughput have resulted recently in a rather rapid decrease in relative activity at refineries. For example, in 1925 the refineries operated at over 80 percent of their capacity, but in 1931 the average was only 65 percent and in one month (January) reached a low of 61 percent.

Comparative activity in the refining industry in 1931

	January	February	March	April	May	June	July	August	September	October	November	December	Average
Number of refineries reporting	336	335	342	349	356	352	360	363	363	357	357	344	351
Total rated capacity per day, thousands of barrels	3, 684	3, 693	3, 722	3, 744	3, 784	3, 778	3, 790	3, 776	3, 765	3, 762	3, 746	3, 688	3, 744
Daily average crude runs to stills, thousands of barrels	2, 265	2, 333	2, 376	2, 492	2, 533	2, 540	2, 573	2, 602	2, 503	2, 454	2, 388	2, 346	2, 451
Percentage of runs to capacity	61	63	64	67	67	67	68	69	66	65	64	64	65

CENSUS OF REFINERIES

In general, the crude-oil capacity of the refineries in the United States has gained steadily since 1918, when statistics were first assembled by the Bureau of Mines. The number of refineries increased in 1930 and 1931, but the total on January 1, 1932, was only slightly above that on January 1, 1920, indicating that the increased capacity has been achieved largely through modernization or enlargement of equipment at the long-established plants. The total capacity of all refineries on January 1, 1932, was 4,023,328 barrels; 90.1 percent was operative, 9.7 percent shut down, and 0.2 percent under construction.

The increase in refinery capacity during the past 10 years has not kept pace with the rapid gain in gasoline consumption, but because of the rapid rise in the percentage yield of gasoline the amount of idle equipment has grown steadily. This is illustrated by the trend in the ratio between crude runs to stills and operating capacity, which in 1929 was 78 percent but fell to 69 percent in 1930 and to 65 percent in 1931. In general, the construction of new refineries is governed by prices of refined oils; that is, by the prospects for profits. However, the majority of the new plants added in 1931 were built to take advantage of the cheap crude in the East Texas field or to provide an outlet for the production of fields which had lost their pipe-line connections. On January 1, 1932, the total capacity of the six plants under construction was only 8,720 barrels, the smallest since January 1, 1926. More complete information on petroleum refineries of the United States as of January 1, 1932, appears in Bureau of Mines Information Circular 6641.

Summary of refinery capacity in the United States, 1928–32, by years

	Number				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
Jan. 1, 1928	326	97	5	428	3, 036, 125	214, 255	22, 000	3, 272, 380
Jan. 1, 1929	341	72	14	427	3, 325, 890	183, 650	99, 000	3, 608, 540
Jan. 1, 1930	358	54	8	420	3, 634, 825	130, 760	37, 200	3, 802, 785
Jan. 1, 1931	346	89	10	445	3, 706, 610	236, 075	45, 000	3, 987, 685
Jan. 1, 1932	365	108	6	479	3, 624, 992	389, 616	8, 720	4, 023, 328

Refinery capacity, Jan. 1, 1932, by districts, States, and types of process

	Number				Capacity (barrels per day)			
	Operating	Shut-down	Building	Total	Operating	Shut-down	Building	Total
District:								
East coast	24	1		25	619,500	4,000		623,500
Appalachian	50	7		57	149,680	10,750		160,430
Indiana, Illinois, Kentucky, etc.	39	6	1	46	408,067	12,000	100	420,167
Oklahoma, Kansas, Missouri	55	17	1	73	444,800	57,250	120	502,170
Texas inland	70	36	1	107	266,565	113,500	1,400	381,465
Texas Gulf coast	14	3		17	542,000	16,000		558,000
Louisana Gulf coast	5	1	1	7	146,000	20,000	6,000	172,000
Arkansas and Louisana inland	13	4		17	80,800	24,100		104,900
Rocky Mountain	40	14	2	56	145,570	13,266	1,100	159,936
California	55	19		74	822,010	118,750		940,760
	365	108	6	479	3,624,992	389,616	8,720	4,023,328
State:								
Alabama			1	1			6,000	6,000
Arizona		1		1		1,000		1,000
Arkansas	8	1		9	41,000	5,500		46,500
California	55	19		74	822,010	118,750		940,760
Colorado	5			5	5,630			5,630
Georgia	1	1		2	5,000	4,000		9,000
Illinois	10	1		11	128,200	1,000		129,200
Indiana	6			6	171,050			171,050
Iowa		1		1		2,000		2,000
Kansas	14	2	1	17	140,000	14,000	120	154,120
Kentucky	8	2	1	11	26,100	6,500	100	32,700
Louisiana	10	4		14	185,800	38,600		224,400
Maryland	3			3	50,000			50,000
Massachusetts	2			2	48,000			48,000
Michigan	6	2		8	14,600	2,500		17,100
Missouri	2			2	19,500			19,500
Montana	12	8		20	16,500	10,580		27,080
New Jersey	7			7	310,000			310,000
New Mexico	7	1		8	5,300	100		5,400
New York	4			4	40,500			40,500
Ohio	14	1		15	101,122	2,000		103,122
Oklahoma	39	14		53	285,300	41,250		326,550
Pennsylvania	41	7		48	246,000	10,750		256,750
Rhode Island	2			2	11,500			11,500
South Carolina	1			1	6,000			6,000
Tennessee	1			1	75			75
Texas	84	39	1	124	808,565	129,500	1,400	939,465
Utah	1	2	1	4	6,000	800	1,000	7,800
Virginia	1			1	1,500			1,500
West Virginia	6			6	17,600			17,600
Wyoming	15	2	1	18	112,140	786	100	113,026
	365	108	6	479	3,624,992	389,616	8,720	4,023,328
Type of process:								
Skimming	208	86	5	299	1,027,712	327,516	8,620	1,363,848
Skimming and lube	23	3	1	27	299,050	11,400	100	310,550
Complete	85	5		90	1,956,230	7,900		1,964,130
Skimming and asphalt	13	2		15	154,500	21,500		176,000
Skimming, lube, and asphalt	4			4	38,500			38,500
Lube	3	5		8	3,700	3,800		7,500
Asphalt	8	3		11	28,500	9,000		37,500
Topping	20	4		24	116,500	8,500		125,000
Miscellaneous	1			1	300			300
	365	108	6	479	3,624,992	389,616	8,720	4,023,328

CENSUS OF CRACKING PLANTS

Although the total capacity of the equipment used for straight distillation has increased steadily in recent years the capacity of cracking plants has increased even more rapidly. In spite of the fact that 1931 was not a particularly opportune time for refiners to undertake an expansion program it is noteworthy that the total capacity being built at the close of the year was more than double that under construction on January 1, 1928, and several times as large as the capacity for straight distillation being built on that date. The following tables summarize the results of the last survey of cracking plants. More complete information may be found in Bureau of Mines Information Circular 6648.

Summary of cracking capacity, June 1, 1925–26, and Jan. 1, 1928–32

Date	Number of units	Charging capacity, barrels per day			
		Operating	Shut down	Building	Total
June 1, 1925	2,527	690,492	26,200	116,000	832,692
June 1, 1926	2,559	844,800	47,690	47,600	940,090
Jan. 1, 1928	2,334	1,013,000	253,000	22,000	1,288,000
Jan. 1, 1929	2,205	1,194,501	147,923	134,450	1,476,874
Jan. 1, 1930	2,002	1,419,200	139,840	149,900	1,708,940
Jan. 1, 1931	1,868	1,594,990	244,661	111,130	1,950,781
Jan. 1, 1932	1,348	1,603,809	394,585	48,587	2,046,981

Cracking capacity, Jan. 1, 1932, by districts and States

	Number of units	Charging capacity, barrels per day			
		Operating	Shut down	Building	Total
District:					
East coast	170	255,000	78,800	7,040	340,840
Appalachian	60	56,450	10,700		67,150
Indiana Illinois, Kentucky, etc	267	264,850	62,400	12,000	339,250
Oklahoma, Kansas, and Missouri	264	199,200	48,800	15,000	263,000
Texas inland	67	92,270	44,350		136,620
Texas Gulf coast	180	417,000	88,100	4,000	509,100
Louisiana Gulf coast	40	71,800	2,600	3,000	77,400
Arkansas and Louisiana inland	33	26,000	9,650		35,650
Rocky Mountain	189	36,289	29,985	7,547	73,821
California	78	184,950	19,200		204,150
	1,348	1,603,809	394,585	48,587	2,046,981
State:					
Alabama	1			3,000	3,000
Arkansas	21	10,500	6,250		16,750
California	78	184,950	19,200		204,150
Colorado	12	3,459	411		3,870
Georgia	2	3,600			3,600
Illinois	112	75,700	21,900		97,600
Indiana	129	132,050	40,500	12,000	184,550
Iowa	1		1,000		1,000
Kansas	91	79,500	30,050	12,500	122,050
Kentucky	8	10,000			10,000
Louisiana	51	87,300	6,000		93,300
Maryland	22	24,200	15,200		39,400
Massachusetts	16	22,300	8,000		30,300
Michigan	3	3,750			3,750
Missouri	26	15,500	4,500		20,000
Montana	4	2,800	2,000		4,800
New Jersey	48	93,300	15,200	7,040	115,540
New York	14	19,600			19,600
Ohio	28	62,100			62,100
Oklahoma	146	104,200	13,250	2,500	119,950
Pennsylvania	94	116,250	32,700		148,950
Rhode Island	3	6,000			6,000
South Carolina	8		14,400		14,400
Texas	247	509,270	132,450	4,000	645,720
Utah	33	6,400	3,800	1,000	11,200
West Virginia	10	7,450	4,000		11,450
Wyoming	140	23,630	23,774	6,547	53,951
	1,348	1,603,809	394,585	48,587	2,046,981

MILEAGE AND TONNAGE OF CRUDE-OIL PIPE LINES

The aggregate length of the oil pipe lines in the United States on May 1, 1931, was 111,660 miles, of which 58,020 miles (52 percent) were trunk lines and 53,640 miles (48 percent) gathering lines. The total tonnage of all the oil lines was 5,460,000 short tons, of which 77 percent was trunk lines. During the 5-year period May 1, 1926, to May 1, 1931, total mileage increased 24 percent, trunk lines 30 percent, and gathering lines 17 percent.

In 1931, as in 1926, Oklahoma was the leading State in mileage of gathering lines and Texas in mileage of trunk lines. The total mileage of gathering lines in Oklahoma rose from 10,960 in 1926 to 13,510 in 1931 (23 percent). The major portion of the increase resulted from new connections in the Seminole district during 1927 and 1928. The trunk-line mileage in Texas increased from 9,470 in 1926 to 18,880 in 1931 (99 percent). The new construction in Texas consisted principally of two developments, the building of lines from west Texas to the Gulf and the looping of facilities for relaying Mid-Continent crude across the State. The transportation of crude from the Mid-Continent area to Eastern and Central States by pipe lines, which was the principal movement prior to 1920 but which had been eclipsed by tanker transportation from California and the Gulf coast, increased in relative importance following the completion of several lines made necessary by refinery expansion in the Great Lakes area.

Mileage of crude-oil pipe lines, 1924,[1] May 1, 1926, and May 1, 1931, by States

State	1924 [1]			May 1, 1926			May 1, 1931		
	Trunk lines	Gathering lines	Total	Trunk lines	Gathering lines	Total	Trunk lines	Gathering lines	Total
Arkansas	591	645	1,236	830	940	1,770	820	840	1,660
California	3,078	1,461	4,539	3,210	1,800	5,010	3,780	1,820	5,600
Colorado		29	29	8	60	68	20	90	110
Illinois	1,937	1,218	3,155	1,800	1,170	2,970	3,020	1,140	4,160
Indiana	1,469	503	1,972	1,540	450	1,990	1,980	410	2,390
Iowa	77		77	77		77	98		98
Kansas	2,542	2,762	5,304	2,430	3,220	5,650	3,440	3,500	6,940
Kentucky	592	1,383	1,975	570	1,660	2,230	540	1,700	2,240
Louisiana	1,751	806	2,557	1,890	720	2,610	1,890	900	2,790
Maryland	36		36	33		33	33		33
Michigan	138		138	138		138	325	160	485
Missouri	2,485		2,485	2,490		2,490	4,170		4,170
Montana	93	20	113	130	20	150	60	215	275
Nebraska	377		377	404		404	404		404
New Jersey	476		476	480		480	190		190
New Mexico				70	20	90	150	350	500
New York	1,192	687	1,879	1,200	710	1,910	210	610	820
Ohio	2,623	6,192	8,815	2,690	6,320	9,010	2,580	5,780	8,360
Oklahoma	7,695	9,689	17,384	8,220	10,960	19,180	10,990	13,510	24,500
Pennsylvania	5,274	6,094	11,368	5,260	6,340	11,600	3,510	6,540	10,050
Tennessee		5	5		30	30		15	15
Texas	7,379	4,665	12,044	9,470	6,060	15,530	18,880	10,460	29,340
West Virginia	419	4,957	5,376	400	5,000	5,400	320	4,910	5,230
Wyoming	1,273	219	1,492	1,130	220	1,350	610	690	1,300
	41,497	41,335	82,832	44,470	45,700	90,170	58,020	53,640	111,660

[1] Compiled in the spring of 1924.

Most oil trunk lines use 6-inch, 8-inch, and 10-inch pipe, 8-inch pipe predominating. The most popular size used in gathering lines is 2-inch pipe. There is a pronounced tendency in the pipe-line industry to use larger pipe, as shown by an increase in the average diameter of trunk lines from 7.4 inches in 1926 to 8 inches in 1931. Other dominant trends in oil trunk-line practice were the augmented use of seamless pipe in place of lap-weld pipe, the almost universal replacement of screw joints by welded joints, and the increased attention given to protective coatings or to the general subject of corrosion.

Mileage and tonnage of crude-oil pipe lines, May 1, 1931, by sizes

Diameter of pipe, inches	Trunk lines		Gathering lines		Total	
	Miles	Short tons	Miles	Short tons	Miles	Short tons
2			21,450	204,000	21,450	204,000
3			9,970	198,000	9,970	198,000
Below 4	3,070	57,000			3,070	57,000
4	4,520	127,000	11,890	335,000	16,410	462,000
6	11,140	552,000	7,360	364,000	18,500	916,000
Above 6			2,970	180,000	2,970	180,000
8	26,290	1,956,000			26,290	1,956,000
10	8,270	875,000			8,270	875,000
12	4,700	608,000			4,700	608,000
Above 12	30	4,000			30	4,000
	58,020	4,179,000	53,640	1,281,000	111,660	5,460,000

STORAGE CAPACITIES FOR CRUDE PETROLEUM AND REFINED PRODUCTS

The tankage available for the storage of oil at tank farms and refineries in the United States totaled 1,002,745,000 barrels on May 1, 1931. Of this imposing total 705,013,000 barrels (70 percent) were for crude petroleum and 297,732,000 barrels (30 percent) for refined products. Compared with similar information as of May 1, 1926, these data indicate that the tankage for crude oil has increased 22 percent and that for refined oils 24 percent in the 5-year interval.

Between 1926 and 1931 only three flush fields—Seminole, West Texas, and East Texas—had all the important attributes conducive to the construction of extensive storage facilities. The construction of tankage in the West Texas and East Texas fields enabled Texas to take first place from California in total storage capacity.

There are four general types of tank bodies or shells: Steel, wooden, concrete, and earthen; of these, steel tanks are by far the most important. Wooden tanks are a negligible factor in the industry; earthen tanks have become steadily less important, as their use is not consistent with the best principles of conservation; and although concrete tanks showed a gain in capacity between 1926 and 1931 their use is still confined almost exclusively to California. On May 1, 1931, of more than 45,000 tanks in service 44,333 (98 percent) were tanks with steel shells. The capacity of these steel tanks was 878,136,000 barrels (88 percent of the total). There are many types of roofs used on tanks, but the most common is the cone-type steel roof, with wooden roofs second in importance.

Capacity of storage for crude petroleum, May 1, 1931, by States

[Thousands of barrels of 42 U.S. gallons]

State	At tank farms					In pipe lines	At refineries					Grand total
	Steel	Wooden	Earthen	Cement	Total		Steel	Wooden	Earthen	Cement	Total	
Arkansas	6,767		8,157		14,924	338	736				736	15,998
California	50,763	3	2	36,554	87,322	1,413	27,687		22,344	11,608	61,639	150,374
Colorado and New Mexico	1,862				1,862	82	5				5	1,949
Illinois	13,743				13,743	1,572	2,555				2,555	17,870
Indiana	1,873				1,873	737	1,620				1,620	4,230
Iowa, Nebraska, and Utah	1,061				1,061	301	459				459	1,821
Kansas	22,883	4			22,887	1,306	[1] 3,470				[1] 3,470	[1] 32,430
Kentucky and Tennessee	1,293	26			1,319	112	1,375				1,375	2,806
Louisiana	16,613	18	1,221		17,852	793	10,967				10,967	29,612
Maryland						4	1,896				1,896	1,900
Michigan	1,190				1,190	53	220				220	1,463
Missouri	2,880				2,880	1,887	(1)				(1)	(1)
Montana	2,120				2,120	30	576			1	577	2,727
New Jersey	732				732	44	10,566				10,566	11,342
New York	924	1			925	44	2,700				2,700	3,669
Ohio	13,612	39			13,651	929	1,246	4			1,250	15,830
Oklahoma	153,386		60		153,446	4,109	5,976				5,976	163,531
Pennsylvania	8,040	114			8,154	890	912			2	914	9,958
Texas	190,246	18	3,260	2,112	195,636	7,977	17,442	7			17,449	221,062
West Virginia	4,002	68			4,070	335	99				99	4,504
Wyoming	30,927				30,927	258	1,266				1,266	32,451
Other [2]							2,276			424	2,700	2,700
	524,917	291	12,700	38,666	576,574	23,214	94,049	11	22,344	12,035	128,439	728,227

[1] Missouri included with Kansas.
[2] Georgia, Massachusetts, Rhode Island, South Carolina, and Virginia.

Capacity of storage for refined products, May 1, 1931, by States

[Thousands of barrels of 42 U.S. gallons]

State	At refineries					Elsewhere					Grand total
	Steel	Wooden	Earthen	Concrete	Total	Steel	Wooden	Earthen	Concrete	Total	
Arkansas	1,731	8	279		2,018	295				295	2,313
California, Oregon, and Washington	57,067		1,850	35,476	94,393	6,168				6,168	100,561
Colorado	662				662						662
Illinois	10,763			46	10,809	41				41	10,850
Indiana	17,296				17,296						17,296
Kansas, Missouri, and Iowa	8,737				8,737						8,737
Kentucky and Tennessee	1,714				1,714	162				162	1,876
Louisiana	17,646	55		157	17,858	1,271				1,271	19,129
Maryland	3,937				3,937						3,937
Michigan	853				853	2,316				2,316	3,169
Montana	640				640						640
New Jersey	26,065				26,065	160				160	26,225
New Mexico and Utah	888				888						888
New York	2,750				2,750	266				266	3,016
Ohio	6,727				6,727	5				5	6,732
Oklahoma	21,370	139		40	21,549						21,549
Pennsylvania	6,086	10		212	6,308	1,390				1,390	7,698
Texas	59,544			23	59,567	2,176				2,176	61,743
West Virginia	1,233			65	1,298						1,298
Wisconsin						871				871	871
Wyoming	9,484		1	21	9,506						9,506
Other [1]	3,977			180	4,157	716			15	731	4,888
	259,170	[2] 212	2,130	36,220	297,732	15,837			15	15,852	313,584

[1] Alabama, Connecticut, Georgia, Maine, Massachusetts, Rhode Island, South Carolina, and Virginia.
[2] Includes 201 miscellaneous.