grit. These clays are generally suitable for making common brick and tile. There are inexhaustible supplies of such clays in the eastern portion of the Southern Peninsula from Arenac County south to the Ohio boundary. Large areas of pink or reddish lake clays also occur in Chippewa and Ontonagon counties.

The morainic or boulder clays have been developed for the manufacture of common brick and tile at many places in the State but generally on a small scale. The lake clays in the vicinity of Springwells and West Detroit have been developed very extensively for making common brick. With the growth of the city in this direction the land has become so valuable for building purposes that the brick industry is being gradually forced into other localities. Important developments have also been made near Paines and West Saginaw, Saginaw County, and at numerous places in Lenawee, Monroe, and Macomb Counties.

In Ontonagon County some of the clays are of the slip variety and are suitable for glazing pottery. A deposit of slip clay occurs near Harriette, Wexford County.

Most of the surface clays in Michigan are low grade and generally the mining of such clays is merely incidental to the manufacturing of common brick and tile. Nearly all of the clay sold as clay in Michigan is slip clay. It is mined chiefly near Rockland, Ontonagon County, and shipped to potteries in Ohio and other States for glazing. The great distance of the beds from the centers of the pottery industry is a serious obstacle in promoting development. In some years a small amount of clay is sold for medicinal purposes.

During the past two years an investigation of the clay and shale resources has been made in co-operation with the University of Michigan. The results are to appear in a forthcoming report.

PRODUCTION OF CLAY IN MICHIGAN, 1910-1922

Year.	Slip clay.		Brick clay.		Miscellaneous clay.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons		Tons		Tons		Tons	
1910	1,363	$3,889	60	$105	1	$400	$1,424	$4,394
1911	1,744	5,090	18	32	2	150	1,764	5,272
1912	2,034	6,164	.....	.....	9	9	2,043	6,173
1913	1,710	6,504	.....	.....	.....	.....	1,710	6,504
1914	1,463	4,572	.....	.....	.....	.....	1,463	4,572
1915	1,198	3,805	*	*	*	*	3,142	5,605
1916	.....	10,509	.....	.....	.....	.....	3,454	193
1917	2,153	8,824	*	*	.....	.....	5,746	13,627
1918	1,236	4,639	*	*	*	*	2,359	6,373
1919	568	2,123	.....	.....	*	*	568	2,123
1920	505	2,249	.....	.....	4,561	9,046	5,066	11,295
1921	484	2,047	.....	.....	208	308	692	2,355
1922	*	.....	*	*	.....	.....	1,653	4,852
Total	.....	.....	.....	.....	.....	.....	.....	84,339

*Included in total.

POTTERY

The pottery industry in Michigan has made almost uninterrupted growth since 1899, and after 1908 the growth was rapid, increasing over 4,054 per cent in 12 years, the main increase being in the period 1916-1920. In 1899 the total value of the pottery output was $29,741; in 1908, $62,409; in 1919, $2,096,874; and $2,592,625 in 1920. The increases were largely due to the greatly increased output of porcelain electrical and sanitary supplies and porcelain and decorated ware. In 1921 production decreased to $1,781,923, a decrease of $810,702 or 25.1 per cent, and in 1922 there was a decrease to $1,337,000 or 33.3 per cent.

The products are chiefly porcelain electrical supplies, sanitary ware, decorated and white ware, "white granite" ware, and flower pots. Of eight firms, the Jeffrey-Dewitt Company of Detroit manufactures a variety of porcelain products—sanitary ware, insulators, spark plugs, tumbling jars, crucibles, etc. The Kalamazoo Manufacturing Company manufactures sanitary ware exclusively. In January 1919 the plant of the Kalamazoo Company, which was the largest in the United States devoted to the manufacture of sanitary ware, was destroyed by fire. But with orders for six months ahead the plant was promptly rebuilt. The Anton Hupprich Company of Detroit and the Ionia Pottery Company manufacture flower pots exclusively. The Mt. Clemens Pottery Company manufactures decorated ware, and the Pontiac Clay Pipe Novelty Company, clay pipes and novelty ware.

The clays used for the manufacture of flower pots are obtained from Michigan but those used for porcelain products, pipes, etc., are imported from other states and countries, for no deposits of china or ball clays are found in Michigan.

VALUE OF POTTERY PRODUCTS IN MICHIGAN, 1899-1922

Year.	Rank of State.	No. firms.	Red earthenware value.	Miscellaneous value.**	Total value.	Gain per cent.	Per cent of total product in U. S.
1899	18	4	$29,641	.....	$29,741	.....	.17
1900	17	4	34,317	.....	34,317	15.4	.17
1901	16	5	42,465	$2,400	44,865	30.2	.20
1902	14	4	44,098	39,000	83,098	87.4	.41
1903	19	4	42,007	6,000	48,007	—42.2	.19
1904	17	4	40,621	3,000	43,621	—9.1	.17
1905	17	5	*	7,000	45,961	4.5	.16
1906	17	6	43,510	7,600	51,110	11.2	.16
1907	16	6	54,474	7,100	61,574	18.5	.20
1908	16	6	54,659	7,750	62,409	1.5	.25
1909	13	5	60,939	34,500	95,439	52.9	.31
1910	13	6	94,450	13,300	112,697	18.1	.33
1911	13	6	80,580	*	130,490	15.8	.38
1912	10	6	99,555	* *	194,892	49.3	.53
1913	10	5	65,000	* *	222,133	20.8	.59
1914	9	5	106,452	*	265,194	33.0	.75
1915	8	6	112,863	*	521,989	96.7	1.40
1916	8	7	133,734	668,982	792,716	51.8	1.64
1917	8	8	*	13,722	1,187,981	49.9	2.12
1918	6	8	*	88,842	1,976,436	66.3	3.00
1919	.....	8	*	12,708	2,096,874	6.1	.....
1920	.....	8	*	16,848	2,592,625	23.5	.....
1921	.....	.....	138,055	1,643,868	1,781,923	—35.1	.....
1922	.....	.....	38,000	1,299,000	1,337,000	—33.3	.....
Total	.....	.....	.....	.....	.....	.....	.....

*Included in the total.
**1920 includes art pottery, clay pipes and filter stones, 1921 and 1922 includes white ware, sanitary ware, porcelain electric supplies, and other miscellaneous ware.

COAL*

Coal mining began in Michigan as early as 1835 but no records of production are available before 1860, when Michigan was credited with an output of 2,320 tons. Most of the coal in the early days was obtained from veins exposed or at shallow depth in the vicinity of Grand Ledge, Eaton County; Jackson, Jackson County; and Corunna, Shiawassee County. In 1870 production reached 28,150 tons; in 1880, 100,800 tons, and for the following two years it exceeded 100,000 tons annually. In 1883 a sharp decline began and in the following year the production fell to only 36,712 tons. It was not until 1897 that the production again exceeded the 100,000 ton mark. In that year the Saginaw and Bay County fields were opened and the production jumped to 223,592 tons. The industry continued to grow rapidly and four years later, in 1901, the production reached nearly one and a quarter million tons. The maximum output of 2,035,858 tons was reached in 1907. Following 1907 a rapid decline set in and continued until 1912, when production was only 1,201,230 tons. Production remained practically stationary until 1917, when it increased to 1,374,805 tons. The gain was due not only to the great demand but to better car service. The shortage of freight cars as well as of labor in 1916 was an important factor in keeping down production. The car situation in 1918 was improved but labor shortage was an important factor in limiting production.

To meet the unprecedented demand caused by the severe winter of 1917-18 and the general tie-up of coal shipments, some new mines were opened and some old ones reopened, in Saginaw and Shiawassee Counties. Production reached 1,468,818 tons. In November of 1918, however, Michigan coal was not in demand and the mines operated but half time.

The coal strike of 1919 closed most of the mines and those not affected by the strike order did not operate full time. Partial settlement of the strike caused the mines to be reopened early in July of 1919 and they operated full time until November 1, when all the mines went on strike. During 1919 two new shafts were opened, one two miles east of Corunna in Shiawassee County, and the other three miles west of Jackson, Jackson County; two mines suspended operations, and three were abandoned. Production in 1919 decreased to 996,545 tons valued at $3,864,228; and in 1920 production increased by 49.5 per cent to 1,489,765 tons valued at $7,346,000, the highest value attained by Michigan's annual coal output. In 1921 production again declined, 1,141,715 tons were mined, valued at $5,555,000, followed in 1922 by a further sharp decline to 929,390 tons mined, valued at $4,693,376. The price received per ton partly offset the decline from 1921 to 1922. The average price per ton in 1921 was $4.87 but increased in 1922 to $5.05. The mining cost decreased from an average of $4.43 in 1921 to an average of $3.85 in 1922. The average profit derived from these figures is $1.20 per ton in 1922 which is the highest reported profit from Michigan coal mines. The cost figures however do not include depreciation, interest on investment, etc., hence the profit factor is considerably less than indicated.

*For a more complete report on the coal industry in Michigan see Publication 19 Geol. Ser. 16 Mineral Resources of Michigan for 1914, pp. 247-270; also Vol. VIII, Pt. 2, Coal, by A. C. Lane,

PRODUCTION OF COAL IN MICHIGAN, 1860-1922, IN SHORT TONS

Year.	Quantity. Tons.	Year.	Quantity. Tons.	Year.	Quantity. Tons.	Year.	Quantity. Tons.	Year.	Quantity. Tons.
1860	2,320	1872	33,600	1884	36,712	1896	92,882	1908	1,835,019
1861	3,000	1873	56,000	1885	45,178	1897	223,592	1909	1,784,692
1862	5,000	1874	58,000	1886	60,434	1898	315,722	1910	1,534,967
1863	8,000	1875	62,500	1887	71,461	1899	624,708	1911	1,476,074
1864	12,000	1876	66,000	1888	81,407	1900	849,475	1912	1,164,973
1865	15,000	1877	69,197	1889	67,431	1901	1,241,241	1913	1,138,639
1866	20,000	1878	85,322	1890	74,977	1902	964,718	1914	1,283,030
1867	25,000	1879	82,015	1891	80,307	1903	1,367,619	1915	1,156,138
1868	28,000	1880	100,800	1892	77,990	1904	1,342,840	1916	1,180,360
1869	29,980	1881	112,000	1893	45,979	1905	1,473,211	1917	1,374,805
1870	28,150	1882	135,339	1894	70,022	1906	1,346,338	1918	1,464,818
1871	32,000	1883	71,296	1895	112,322	1907	2,035,858	1919	996,545
								1920	1,489,765
								1921	1,141,715
								1922	929,390

PRODUCTION, COST OF MINING, PROFITS, AND VALUE OF COAL IN MICHIGAN, 1900-1922

Year.	*Number active mines.	Average number employees per month.	**Average daily wage.	†Total tons of coal mined.	Total cost of coal mined.	Average cost per ton.	***Total tons of coal mined.	***Total value of coal mined.	***Average price received per ton.	‡Average profit. Ton.
1900	31	1,676	$2.34	871,388	$1,209,228	$1.387	849,475	$1,259,683	$1.483	$0.096
1901	30	1,847	2.44	1,016,496	1,442,415	1.419	1,241,241	1,753,064	1.412	.007
1902	32	1,616	2.75	899,967	1,284,342	1.427	964,718	1,653,192	1.714	.287
1903	34	3,014	2.91	1,601,984	2,529,027	1.579	1,367,619	2,707,527	1.979	.400
1904	33	2,733	3.01	1,408,375	2,266,098	1.609	1,342,840	2,424,935	1.806	.197
1905	38	2,776	2.96	1,413,307	2,244,434	1.588	1,473,211	2,512,697	1.705	.117
1906	38	2,106	2.40	1,367,385	2,090,489	1.529	1,346,338	2,427,404	1.803	.274
1907	37	2,897	3.24	1,911,201	3,162,837	1.655	2,035,858	3,660,833	1.798	.143
1908	38	3,115	3.02	1,842,778	3,089,759	1.677	1,835,019	3,322,904	1.811	.134
1909	36	2,907	2.93	1,736,573	2,865,083	1.650	1,784,692	3,199,351	1.793	.143
1910	34	2,471	3.07	1,462,276	2,626,342	1.796	1,534,967	2,930,771	1.909	.103
1911	32	2,539	3.39	1,389,585	2,623,244	1.887	1,476,074	2,791,461	1.891	.004
1912	26	1,886	3.19	1,160,768	2,170,076	1.869	1,201,230	2,399,451	1.989	.120
1913	24	2,076	3.49	1,138,163	2,250,559	1.977	1,231,786	2,455,227	1.993	.016
1914	23	2,146	3.35	1,153,869	2,285,281	1.99	1,283,030	2,559,786	1.99	.000
1915	20	1,942	3.45	1,069,798	1,929,386	1.77	1,156,138	2,372,797	2.05	.280
1916	18	1,794	3.57	1,076,215	2,049,812	1.90	1,180,360	2,653,182	2.25	.350
1917	22	1,938	4.25	1,393,180	3,148,148	2.27	1,374,805	4,426,314	3.22	.95
1918	25	2,117	5.56	1,520,883	5,195,944	3.41	1,468,818	5,615,097	3.83	.42
1919	22	2,711	6.25	971,603	3,329,815	4.43	996,545	3,864,228	3.87	.44
1920	18	2,064	7.47	1,373,616	5,548,782	4.07	1,489,765	7,346,000	4.93	.86
1921	15	1,911	7.96	1,125,156	4,982,258	4.43	1,141,715	5,555,000	4.87	.44
1922	14	2,166	.....	822,441	3,165,207	3.85	929,390	4,693,376	5.05	1.20

*Compiled and adapted, Ann. Rept. State Department of Labor and Industry.
**For year beginning December 1 and ending November 30.
***From Mineral Resources of United States, U. S. G. S.
†Does not include coal used for steam and heat.
‡Not including depreciation, interest on capital invested, etc.

LIMESTONE*

The growth of the limestone industry in Michigan from 1899 to 1903 was relatively slow but in 1904 a rapid growth began which continued until 1919 when the industry began to fluctuate, declining somewhat in 1919, increasing by over 36 per cent in 1920, but declining with the slump in the steel industry in 1921. In 1903 the value of limestone including lime was only $390,473. Ten years later the value, exclusive of lime, was $1,408,703, or more than three and one-half times greater. Large gains were made in each of the succeeding years and in 1918 the war demands and war-time inflation of prices forced the total value of limestone products exclusive of lime to $5,186,867. In 1919, however, production decreased to $3,797,522, the decrease being due mainly to a lessened demand for limestone for blast furnace flux, and a very great decrease in sales to alkali works. The industry recovered in 1920; the limestone sold reached a total value of $5,943,229, the largest in the history of the industry. The 1920 value represents an increase of 56.5 per cent over 1919 and of 148.7 per cent above the pre-war maximum.

In 1921 a restriction in the production of steel resulted in a greatly reduced production of limestone so that its value for that year decreased by 43 per cent from the figure for 1920. In 1922 this condition improved, the total value of limestone was $4,533,998, indicating a gain over 1921 of 25.3 per cent. This gain is not entirely due to increased consumption of the blast furnaces but includes increases in limestone produced for crushed stone used in railroad ballast and concrete, for use in alkali works and paper mills, and for use as fertilizer. The only marked decrease was in limestone used by the sugar factories.

Formerly it was supposed that Michigan possessed few deposits of limestone, especially adapted for flux and chemical purposes, but in recent years many large deposits of very pure high calcium limestone have been discovered in Presque Isle, Cheboygan, Alpena, Chippewa, Mackinac, and Schoolcraft Counties. Large deposits of high calcium limestone has been developed on an extensive scale near Rogers, Presque Isle County, and Rockport and Alpena, Alpena County. On account of its low silica content, the stone at Rogers and Rockport is especially adapted for fluxing and chemical purposes and it is successfully invading the markets formerly held by stone from other states.

Most of the high calcium limestone is located in Alpena, Presque Isle, Cheboygan, Emmet, and Charlevoix Counties in the northern part of the Southern Peninsula, and in Schoolcraft, Mackinac, and Chippewa Counties in the Northern Peninsula. Important deposits occur at Sibley, Wayne County, and at Bellevue, Eaton County. Undeveloped

*For a more complete report of the limestone resources of Michigan see Pub. 21, Geol. Ser. 17, Min. Res. of Mich. for 1915, pp. 103-312.

deposits occur on Heisterman's Island, Saginaw Bay; about three miles northeast of Omer, Arenac County; and about two miles northeast of Dundee, Monroe County. Deposits of uncertain commercial importance occur near the mouth of Portage River about six miles north of Jackson, and at Parma, Jackson County.

The reserves of high calcium limestone in the northern part of the State are practically inexhaustible.

Enormous deposits of very pure magnesian limestone or dolomite occur in the Northern Peninsula near the lake shore from Seul Choix Pt., Schoolcraft County, eastward to Point Detour, Chippewa County. This dolomite is adapted for lining open hearth furnaces and for paper making. Extensive areas of impure limestone suitable for concrete, road material, and ballast occur in the vicinity of the high grade limestone areas in the Northern Peninsula. Low grade magnesian limestone or dolomite occurs in abundance in many places in Monroe County, near Bayport, Huron County, and along the west shore of Green Bay and Little Bay de Noc, Menominee and Delta Counties.

PRODUCTION AND VALUE OF LIMESTONE IN MICHIGAN, BY USES, 1899-1922

Year.	Crushed stone.						For blast furnace flux.		To sugar factories.		To alkali works.	
	Road making.*		Railroad ballast.		Concrete.							
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1899	.....	.....	.....	.....	.....	.....	.....	$27,512	.....	.....	.....	.....
1900	.....	.....	.....	.....	.....	.....	.....	3,200	.....	.....	.....	.....
1901	.....	$31,605	.....	$18,200	.....	$75,643	.....	13,488	.....	.....	.....	.....
1902	.....	56,261	.....	40,810	.....	49,430	.....	32,246	.....	.....	.....	.....
1903	.....	61,342	.....	35,340	.....	48,504	.....	15,502	.....	.....	.....	.....
1904	.....	58,655	.....	57,100	.....	60,745	.....	62,586	.....	.....	.....	.....
1905	.....	112,113	.....	43,649	.....	107,396	.....	109,883	.....	.....	.....	.....
1906	.....	78,437	.....	103,442	.....	61,852	.....	81,517	.....	$224,356	.....	.....
1907	.....	131,708	.....	46,516	.....	97,762	.....	109,429	.....	22,234	.....	.....
1908	.....	182,510	.....	33,900	.....	73,200	.....	56,841	.....	32,594	.....	.....
1909	.....	132,902	.....	42,445	.....	112,829	.....	91,915	.....	25,845	.....	.....
1910	.....	110,184	.....	42,358	.....	178,318	.....	100,149	.....	69,647	.....	.....
1911	224,307	113,574	91,713	34,998	306,385	137,285	341,027	186,046	.....	65,141	.....	*
1912	603,553	295,449	54,327	28,368	185,423	97,298	295,941	137,812	.....	36,944	.....	$508,044
1913	532,311	266,316	116,000	48,400	292,616	145,965	1,202,817	494,495	.....	38,215	.....	329,961
1914	505,133	242,839	38,000	20,600	362,209	166,959	1,604,240	565,012	.....	69,477	.....	269,087
1915	482,262	194,970	60,159	19,640	398,948	217,304	2,254,984	763,029	.....	46,143	.....	481,759
1916	834,215	420,467	186,949	57,950	323,479	155,084	3,033,155	1,207,326	.....	41,709	.....	438,783
1917	726,937	344,970	182,375	90,560	418,403	244,648	3,575,178	1,633,965	.....	37,004	.....	787,760
1918	591,781	251,265	*	*	389,176	261,877	4,289,289	2,892,179	.....	*	.....	1,097,251
1919	548,463	321,777	*	*	508,107	273,085	3,585,440	1,857,686	.....	.....	.....	654,632
1920	688,090	460,369	154,050	122,960	884,820	578,039	4,800,400	2,963,095	.....	.....	.....	1,031,251
1921	.....	.....	37,090	28,752	1,265,690	889,937	2,422,950	1,275,860	.....	124,678	.....	543,994
1922	.....	.....	38,300	33,024	1,024,110	662,781	4,812,850	2,390,692	62,070	75,961	1,177,780	842,131
Total	.....	$3,876,713	.....	$949,012	.....	$4,705,851	.....	$17,071,465	.....	$909,948	.....	$6,076,557

*Included under concrete after 1920.

PRODUCTION AND VALUE OF LIMESTONE IN MICHIGAN, BY USES, 1899-1922—Concluded

Year.	To paper mills.		Fertilizer.		Other purposes.†		Number of plants.	Rank of state.	Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.		Value.	Tons.	Value.
1899	.....	.....	.....	.....	.....	$2,375	.....	.....	.....	$281,769
1900	.....	.....	.....	.....	.....	124,220	.....	12	.....	330,847
1901	.....	.....	.....	.....	.....	101,399	.....	12	.....	429,771
1902	.....	.....	.....	.....	.....	68,164	.....	13	.....	413,148
1903	.....	.....	.....	.....	.....	4,747	.....	14	.....	390,473
1904	.....	.....	.....	.....	.....	5,323	.....	10	.....	501,708
1905	.....	.....	.....	.....	.....	142,790	.....	12	.....	544,754
1906	.....	.....	.....	.....	.....	.....	.....	10	.....	656,269
1907	.....	.....	.....	.....	.....	278,297	.....	11	.....	760,333
1908	.....	.....	.....	.....	.....	253,990	.....	9	.....	669,017
1909	.....	.....	.....	.....	.....	327,571	.....	11	.....	750,589
1910	.....	.....	.....	.....	.....	299,305	.....	9	.....	842,126
1911	.....	$12,558	.....	$3,003	.....	440,857	.....	8	.....	1,005,751
1912	.....	8,150	.....	3,447	.....	13,596	.....	8	.....	1,139,560
1013	.....	10,723	.....	7,048	.....	395,874	.....	7	.....	1,408,703
1914	.....	8,307	10,907	11,104	.....	39,523	.....	8	.....	1,457,961
1915	.....	8,620	.....	9,746	.....	31,529	.....	7	.....	1,828,766
1916	.....	11,827	.....	11,088	.....	39,896	.....	6	.....	2,389,763
1917	.....	24,097	62,027	58,148	.....	97,129	.....	5	.....	3,320,895
1918	.....	25,153	160,016	150,604	.....	284,649	.....	3	.....	5,186,867
1919	.....	45,706	*	*	.....	678,936	18	5	.....	3,797,522
1920	.....	81,718	170,460	191,146	.....	514,651	24	5	.....	5,943,229
1921	.....	77,850	285,960	201,251	.....	245,400	24	6	.....	3,387,722
1922	50,520	79,438	218,360	211,192	259,440	235,895	.....	.....	7,646,550	4,533,998
Total	.....	$394,147	.....	$1,097,132	.....	$4,626,121	.....	.....	.....	$41,971,542

*Included in total.
†Includes rubble and limestone for glass, and sugar factories and, in 1919, railroad ballast and agricultural limestone.

LIME

From 1904 to 1914, the lime industry made little or no growth, the production in those years being respectively 63,601 tons and 66,507 tons. In 1915 the production increased to 81,359 tons but this was 1,749 tons less than the maximum reached in 1909. In 1916 there was only a slight increase, the production being 86,447 tons. But the 1917 production increased 57.2 per cent over 1916, reaching 135,920 tons and the value increased 132 per cent to $892,682. This increase in production and value caused Michigan to advance from thirteenth place to seventh in rank in State production. In the production of chemical lime Michigan ranked third in quantity and second in value and produced over 14 per cent of the chemical lime used in the country at 16 per cent of the value. Michigan held sixth place in the amount of lime consumed.

In 1918 production decreased slightly, 0.8 per cent, but increased in value. Production in 1919 increased 8.1 per cent in quantity and 16.5 per cent in value, and decreased somewhat in quantity but increased in value in 1920, reaching the maximum value of $1,386,760 in the latter year.

The business depression of 1921 plus high price of coal and the high freight rates which closed markets for lime, caused Michigan to suffer more than any other State from the general decrease in lime production. The average decrease for the United States was 29.1 per cent, ranging from a decrease of 9.4 per cent in Massachusetts to 65.8 per cent in Michigan. Michigan's production was 48,164 tons valued at $445,386, decreases of 92,649 tons (65.8 per cent) in quantity and of $941,374 or 67.8 per cent in value. The production was the lowest since 1905 and Michigan dropped in rank from eighth to fifteenth place. Lime burned was sold for building, chemical, tanning, metallurgical, and fertilizer purposes, and to paper mills, sugar factories, and dealers. The greatest decreases were in the sale of lime for chemical and metallurgical purposes and to paper mills. In 1920 of the 28 kilns operating eighteen burned wood, one coal and nine coke, but in 1921 wood was burned in the twenty-three kilns operating. Conditions were not much improved in 1922. A production of 53,635 tons valued at $484,945 was reported, an average price of $9.04. This was an increase over 1921 of 11.3 per cent in quantity and 11.2 per cent in value.

The absence of growth in the lime industry from 1904 to 1914 inclusive was due to several causes, chief of which were: (1) the growing scarcity of suitable wood fuel for burning lime, (2) the substitution of concrete for stone and lime-mortar in buildings, (3) the rapidly growing use of gypsum wall plasters and plaster substitutes and (4) the relatively great distance of suitable limestone deposits from markets. Formerly, because of the abundance of cheap wood fuel and the lack of transportation facilities for the transportation of such a bulky and unstable product as lime, lime-burning flourished in many communities where limestone was available, even though the stone produced a very inferior lime.

The growth of transportation facilities and the increasing scarcity of cheap wood fuel supplies, together with the cheapness of the product, combined to drive most of the local burners out of business, especially those using inferior or hard burning stone. At present no lime is burned south of Little Traverse and Thunder Bays.

The growth in 1915 and 1916 may be ascribed, though indirectly, to the war in Europe. The great increase in 1917 was due to the entrance of this country in the conflict early in 1917. A large amount of lime is used in the manufacture of many chemical materials used in the war. Very little of the lime produced in Michigan is used for building purposes, hence the lime industry in 1918 did not suffer the general depression due to the restriction of building trades, and the small decrease in production may be ascribed to the shortage of labor and of fuel and to the difficulties of transportation.

In 1919 the increase in production was for all uses of lime but particularly for building purposes. The slight decrease of 1920 was due to inability to supply the demand owing to shortage of labor and is shown in the production of lime for chemical works, for tanneries, and for metallurgy; and as stated above, the great decrease for 1921 was due to the closing of markets for the lime industry and the general depression throughout the United States. The continuance of this condition permitted but little increase in production and value of lime in 1922.

PRODUCTION AND VALUE OF LIME IN MICHIGAN, 1904-1922

Year.	Total lime burned.		Average price per ton.	No. of plants operating.	Rank of State production.
	Quantity. Tons.	Value.			
1904	63,601	$256,955	$4.04	.....	.....
1905	48,089	192,844	4.01	.....	.....
1906	68,133	281,465	4.13	13	.....
1907	65,822	276,534	4.20	12	16
1908	68,050	282,023	4.14	10	15
1909	83,108	354,135	4.26	12	13
1910	72,345	303,377	4.19	10	14
1911	80,709	352,608	4.37	14	14
1912	74,720	311,448	4.17	11	16
1913	77,088	331,852	4.05	10	14
1914	66,507	287,648	4.33	10	14
1915	81,359	349,979	4.29	10	15
1916	86,447	385,341	4.45	7	13
1917	135,920	892,682	6.72	7	7
1918	134,813	1,186,007	8.79	6	6
1919	145,783	1,381,534	9.48	7	6
1920	140,813	1,386,760	9.85	7	8
1921	48,164	445,386	9.24	6	15
1922	53,635	484,945	9.04	7	16

SAND-LIME BRICK

The manufacture of sand-lime brick was introduced into the United States in 1901, and the first plant located at Michigan City, Indiana. The industry was a "boom" and within three years nine plants were in operation. Plants were erected all over the country, the producers being convinced that sand-lime brick satisfactory for most purposes could be made more cheaply than clay brick. But since proper investigations of the character and supply of raw material, methods of manufacture, competition from clay brick, transportation facilities, and market conditions were not made and because the brick made was of poor quality, many failures resulted and the new industry suffered. The sand-lime brick industry is adapted to those regions where sand is abundant and good brick clay scarce. The superior quality of sand-lime brick now made by many companies is overcoming the early prejudice of contractors and competition from clay brick is being met successfully.

In Michigan, fortunately, most of the early plants were started in widely separated regions, and far from clay working industries or were located near large cities which furnished a ready market for a limited production. The industry in the State therefore did not suffer from as large a proportion of failures as in some other States and has maintained a relatively steady growth. Michigan quickly attained first rank as a producer of sand-lime brick and with the exception of one year has held that rank since 1904.

The growth of the industry has been in increased production rather than in the number of plants. In 1904 ten plants were in operation and produced only 10,440,000 bricks of all grades, valued at $69,765. In 1905, twelve plants produced 26,421,000 bricks, valued at $169,302. After 1905 the number of operating plants fluctuated between ten and thirteen but production and value greatly increased, until the maximum production of 72,004,000 bricks valued at $499,711 was reached in 1916. A sharp decline began in August of 1917 due to the car shortage and, because of war-time conditions was continued during 1918, production dropping to 47,998,000 bricks of all classes in 1917 and to 22,564,000 bricks in 1918, the lowest production since 1904.

In 1919 the industry rallied and increased 88.6 per cent in quantity and 158 per cent in value. The increase in quantity was from 22,564,000 to 42,570,000 or 20,006,000 bricks and in value from $198,633 to $513,094. The increase in quantity was due to the resumption of building operations and the relatively larger increase in value was due to the increased demand and to increased cost of production. The production of 1919 was less than the maximum of 1916 by 29,434,000 bricks. Michigan continued the leading State in marketing sand-lime brick and produced 29 per cent of the quantity at 30 per cent of the value for the United States.

Although in 1920 the total production of sand-lime brick for the United States increased, the production in Michigan decreased to 39,280,000 bricks of all classes, a decrease of 3,290,000 bricks or 7.7 per cent. The value of $670,744 was an increase of $127,650 or 24.8 per cent and is the highest value recorded. The industry in 1920 was handicapped by the shortage and inefficiency of labor and difficulties of transportation and in securing raw material. Despite the decreased production Michigan continued in first rank and produced 23 per cent of the total United States production at 26 per cent of the total value.

Since statistics for sand-lime brick were collected by the Bureau of the Census there has been considerable delay in securing production figures and details of the industry. In 1921 a production of 33,658,000 bricks of all classes valued at $403,929 is reported. The production value shows a decrease of $236,815 or 36.9 per cent when compared with the 1920 reports. In 1922 a production of 46,558,000 at $557,647 shows a gain of 38 per cent in value over the 1921 figure.

The production of front and fancy brick has fluctuated greatly. The production of front brick increased from 580,000 in 1904 to about 2,000,000 in 1907, then decreased in 1908 to about 900,000. The maximum production of 3,255,000 was attained in 1910. From 1911 to 1916 the production of front brick did not exceed 1,000,000 annually, falling off in 1916 to 888,000. Evidently front and fancy sand-lime brick as manufactured were not as satisfactory for outside work or could not be produced as cheaply as clay front brick. In 1917, however, the production of front brick increased to 1,019,000 valued at $8,477. Either new methods of moulding, producing a more shapely brick, or better methods of manufacture producing a less easily crumbled brick, accounted for the increased demand. But since 1918 the demand has decreased until there is but one producer; hence values may not be published.

Excepting 1906, when New York took first place, Michigan since 1904 has held first rank among the States both in the number of plants and in the value of the output of sand-lime brick. For a number of years Michigan has produced nearly or more than twice as many sand-lime bricks as any other State. The decided set back suffered by the sand-lime brick industry in common with other building industries in 1918 caused many operators to close their plants, so that of eleven firms reporting in 1917, but seven operated in 1918. The increase in building operations caused one plant to be reopened and in 1919 and 1920 eight operators reported production. Plants are located in Detroit, Flint, Grand Rapids, Menominee, Rives Junction, Rochester, Sebewaing, and Saginaw.

ANNUAL PRODUCTION AND VALUE OF SAND-LIME BRICK IN MICHIGAN AND UNITED STATES, 1904-1922

Year.	No. of operating firms reporting—Mich.	No. of operating firms reporting—U. S.	Michigan production. Common brick. Quantity (thousands).	Common brick. Value.	Front brick. Average price per thousand.	Front brick. Quantity (thousands).	Front brick. Value.	Fancy brick. Average price per thousand.	Fancy brick. Quantity (thousands)	Fancy brick. Value.	Total value Michigan.	Change per cent Michigan.	Total value United States.	Per cent of total production of U. S.	Rank. Production.	Rank. Value.
1904	10	57	9,886	$64,034	$6.64	580	$5,234	$9.02	19	$497	$69,765	.....	$463,128	15.6	1	1
1905	12	84	24,841	155,883	6.28	1,577	12,898	8.17	24	526	169,302	142.7	972,064	17.4	1	1
1906	11	87	27,281	162,879	5.97	1,796	12,022	6.69	7	20	174,921	3.3	1,170,005	15.0	1	2
1907	13	94	25,488	158,606	6.22	*2,000	14,284	7.17	.....	.....	172,840	−1.2	1,225,769	14.1	1	1
1908	10	87	21,997	131,827	5.99	*900	6,982	7.76	.....	.....	138,809	−19.7	1,029,699	13.5	1	1
1909	11	74	34,217	207,082	6.05	*1,600	11,144	6.97	.....	.....	218,226	57.2	1,150,580	19.0	1	1
1910	10	76	37,648	218,627	5.81	3,256	22,022	6.76	.....	.....	240,649	10.3	1,169,153	20.5	1	1
1911	10	66	32,889	192,224	5.84	2,726	17,777	6.52	.....	.....	210,001	−12.7	897,604	23.4	1	1
1912	11	71	48,129	307,106	6.38	1,163	9,926	8.27	.....	.....	316,732	50.8	1,200,228	26.4	1	1
1913	12	68	49,373	315,882	6.40	†	†	.....	†	†	321,245	1.7	1,238,325	25.9	1	1
1914	12	62	41,456	248,113	5.98	†	†	.....	†	†	255,784	−24.4	1,058,512	23.5	1	1
1915	11	56	46,513	281,009	6.04	†	†	.....	†	†	286,948	11.8	1,135,104	25.3	1	1
1916	12	53	71,116	491,866	6.92	888	7,845	8.83	.....	.....	499,711	74.14	1,474,073	33.8	1	1
1917	11	47	46,979	302,246	7.71	1,019	8,477	8.31	.....	.....	370,723	−25.8	1,420,330	26.1	1	1
1918	7	42	22,248	195,636	8.79	†	†	9.48	.....	.....	198,633	−46.4	883,929	22.5	1	1
1919	8	35	42,063	507,010	12.05	†	†	12.00	.....	.....	513,094	+86.7	1,705,163	28.6	1	1
1920	8	37	38,810	632,112	16.80	†	†	18.36	.....	.....	640,744	+26.0	2,490,283	23.1	1	1
1921	....	....	‡33,658	.....	.....	.....	.....	.....	.....	.....	403,929	−36.9	.....	.....	.....	.....
1922	8	....	‡46,558	557,647	11.97	.....	.....	.....	.....	.....	557,647	+38.0	.....	.....	.....	.....
Total	....	....	701,150	$5,189,789	.....	.....	.....	.....	.....	.....	$5,779,703	.....	.....	.....	.....	.....

*Estimated.
†Included in total.
‡Includes common and front brick.

SAND AND GRAVEL

The sand and gravel resources of Michigan are inexhaustible. The most important deposits occur in the form of ridges known as "hogbacks" or eskers, in irregular hills called kames, in outwash plains, deltas, and beach ridges,—features resulting from water action during the retreat of the Wisconsin or last ice sheet, which covered much of the region north of the Ohio and Missouri rivers. There are enormous deposits of gravel in a series of old beach ridges in Presque Isle and Alpena Counties but much of this gravel is composed chiefly of limestone and is of low grade.

Only a small portion of the sand and gravel deposits in the State has been developed. Most of the development has been in the southern half of the Southern Peninsula, particularly in the vicinity of the cities and near railroads, and also in river channels and along the shores of the Great Lakes, where cheap water transportation is available. Large pits are locally developed in building State award roads. The chief producing localities and counties in order of importance are: Detroit and St. Clair Rivers, and Kent, Washtenaw, Macomb, Ingham, Livingston, Manistee, Oakland, Berrien, Jackson, Kalamazoo, and Calhoun counties.

The composition of gravel varies greatly in different parts of the State. In the localities where the glacial drift is thin, the gravel generally contains a considerable or even a large percentage of pebbles derived from the underlying rocks. Where the drift is thick the gravel is composed chiefly of pebbles which have been carried considerable distances by ice and water, hence the pebbles are usually harder and more resistant rock material. In the limestone regions of Presque Isle and Alpena counties there is a broad belt of gravel ridges along the shore of Lake Huron. The gravel is composed chiefly of limestone pebbles largely derived from the underlying beds of limestone. Since many of the beds of limestone in these counties are relatively soft, much of the gravel is inferior grade. The Marshall formation underlies much of Jackson, Calhoun, and Kalamazoo and many of the deposits in these counties contain considerable amounts of soft friable sandstone derived from this formation. This tends to make some of the gravel unfit for road building and inferior for use in concrete aggregates. There are also large deposits of gravel in the belt of limestone along the north shore of Lake Michigan and Lake Huron. These deposits contain an abundance of limestone pebbles and, since the beds of limestone in this region are generally hard, it is presumable that the gravel is of better average quality than that in the areas of softer limestone in the northern part of the Southern Peninsula. However, no tests have been made to determine the better grades of gravel in these areas and belts.

Sand and gravel have been produced in greater quantities each year since 1918. In 1919 production was 3,772,535 tons valued at $1,994,143, and in 1920 4,386,522 tons at $2,867,466 were produced. In 1921 reports

total 5,515,253 tons valued at $2,916,917 and this was followed by a further increase in 1922 to a total production of 5,962,916 tons valued at $3,222,043, an increase over 1921 of 8.1 per cent in quantity and 10.46 per cent in value.

The production of molding sand increased from 96,554 tons in 1921 to 147,546 tons in 1922, or 52.8 per cent, and the 1922 value was greater by $15,286, or 59.7 per cent. Building sand increased from 823,791 tons at $416,432 in 1921 to 858,764 tons at $445,970 in 1922, an increase of 4.2 per cent in quantity and 7.1 per cent in value. Paving sand decreased from 754,011 tons in 1921 to 731,933 tons in 1922, but the value increased from $311,341 in 1921 to $342,499 in 1922, making a decrease of 2.9 per cent in quantity but an increase of one per cent in value. Railroad ballast increased from 249,588 tons at $59,752 in 1921 to 484,112 tons at $208,311 in 1922, an increase of 93.9 per cent in quantity and 248.6 per cent in value. Gravel for road building increased from 3,416,881 tons at $1,959,610 in 1921 to 3,507,567 tons at $1,992,232 in 1922, an increase of 2.65 per cent in quantity and of 1.66 per cent in value.

PRODUCTION AND VALUE OF SAND AND GRAVEL IN MICHIGAN, 1905-1922

Year.	Molding sand.		Building sand.		Engine sand.		Paving sand.		Filter sand.		Other sand.†	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons		Tons		Tons		Tons		Tons		Tons	
1905	19,382	$13,247	263,315	$148,065	.....	.....	.....	.....	.....	.....	50,187	$14,476
1906	61,387	26,108	403,199	127,937	4,000	$400	.....	.....	.....	.....	51,005	12,140
1907	54,172	24,190	451,646	157,150	1,534	153	.....	.....	.....	.....	173,724	12,187
1908	4,584	2,892	474,238	228,395	1,991	319	.....	.....	.....	.....	29,187	6,850
1909	53,226	20,756	1,090,419	327,247	12,415	1,493	.....	.....	.....	.....	295,612	50,953
1910	93,812	24,004	1,151,588	334,346	22,270	2,172	.....	.....	.....	.....	372,880	57,385
1911	68,878	17,901	833,729	247,997	25,392	4,447	152,144	$29,650	.....	.....	114,801	52,005
1912	152,433	40,145	902,556	294,115	18,575	4,774	68,453	16,898	.....	.....	130,624	54,746
1913	50,763	17,493	1,326,016	415,737	4,447	647	533,261	108,328	.....	.....	113,318	20,342
1914	53,400	36,533	1,088,650	360,152	6,357	1,066	320,322	74,866	.....	.....	115,291	107,392
1915	82,666	25,998	843,887	236,956	70,077	2,794	131,466	14,021	.....	.....	111,105	12,248
1916	117,200	31,978	1,234,280	350,138	*	*	154,413	38,068	.....	*	228,003	103,722
1917	147,256	52,686	782,305	433,546	4,096	1,103	136,214	49,669	.....	.....	94,227	41,267
1918	116,485	55,255	433,497	174,888	5,174	1,322	237,317	89,430	6,163	$3,048	135,502	28,301
1919	124,006	66,877	539,800	251,733	6,958	2,268	204,045	75,228	.....	.....	190,327	147,247
1920	239,439	179,754	789,495	482,081	5,547	2,943	460,438	254,723	.....	.....	213,851	28,879
1921	96,554	25,576	823,791	416,432	3,508	1,201	754,011	311,341	.....	.....	137,505	35,552
1922	147,546	40,862	858,764	445,970	*	*	731,933	342,499	.....	.....	61,887	152,424
Totals.	1,635,188	$702,305	14,291,175	$5,433,402	192,350	$27,102	3,884,017	$1,404,721	.....	.....	2,619,036	$1,138,115

*Included under other sand.
†Includes fire, furnace, blast glass and filter sand.

PRODUCTION AND VALUE OF SAND AND GRAVEL IN MICHIGAN, 1905-1922.—Concluded.

Year.	Railroad ballast.		Gravel.		Total.		Rank.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		Tons.		Tons.		Tons.	
1905			76,625	$32,321	414,509	$210,609	10	11
1906			72,598	25,614	597,789	197,699	12	13
1907			329,407	81,182	1,024,641	289,595	10	11
1908			312,262	94,081	842,591	370,365	8	9
1909			695,902	200,523	2,219,757	685,632	8	8
1910			1,197,791	364,841	2,862,738	816,337	7	8
1911			985,072	203,218	2,185,165	565,969	9	9
1912			1,409,180	407,925	2,681,821	818,603	9	10
1913			3,928,874	915,205	6,422,818	1,528,892	4	5
1914			2,140,359	530,338	3,757,979	1,148,771	8	8
1915	7,565	$781	2,457,094	671,970	3,776,726	1,036,739	7	7
1916			2,226,878	726,033	4,407,475	1,295,717	7	7
1917			2,292,374	1,011,182	3,814,445	1,641,748	7	6
1918	207,827	21,829	741,681	869,316	2,837,371	1,239,874	8	9
1919	161,552	18,314	2,639,483	1,378,929	3,772,535	1,944,143	6	7
1920	67,916	21,861	2,444,006	1,658,414	4,386,582	2,867,466	8	6
1921	233,816	61,672	2,416,881	1,959,610	5,515,253	2,916,917	.....	.....
1922	249,588	59,752	3,507,567	1,992,232	5,962,916	3,222,043	.....	.....
Totals	484,112	208,311	.....	$13,356,852	57,483,111	$22,132,219	.....	.....

GLASS SAND

Glass sand is extensively quarried near Rockwood, Wayne County, and near Steiner, Monroe County. The glass sand occurs in the Sylvania sandstone, Middle Monroe of the Silurian. The Sylvania underlies a belt which extends west from the mouth of Detroit River, then curves southwest across the southeast corner of Wayne County and through Monroe County and leaves Monroe County near the southwest corner. The belt is from three to five miles wide except in the southwest corner of Monroe County where it narrows to about one-half mile. The thickness of the Sylvania varies exceedingly. Along the Detroit River in Wayne County it is from 70 to 165 feet thick and here as elsewhere contains horizons of sandy dolomite. It thins irregularly to the southwest until near the Ohio line it is only about 35 feet.

The sandstone is exposed or is near the surface in three localities, viz. in the southwestern part of Whiteford Township (T. 8 S., R. 6 E.) and in the vicinity of Steiner, Monroe County, and Rockford, Wayne County. In Section 28 of the Whiteford township area, the overburden is locally ten feet or less in depth. It is exposed for a considerable distance in the bed of Raisin River near Steiner in the southwest quarter of section 2, T. 6 S., R. 8 E. At this place the rock is exposed* or covered by a few inches of soil on an area of 8 to 10 acres and on an area of 60 acres the overburden is reported to be nowhere more than two or three feet thick.

There are no natural exposures of the Sylvania in Wayne County but east of Rockwood in section 15, in the vicinity of the pits of the Rockwood Silica Company, the overburden is only from five to eight feet deep. Apparently there is an area of several hundred acres in the vicinity of Rockwood where the overburden does not exceed twenty feet.

Typically the sandstone is a remarkably pure, sparkling, snow-white aggregation of fine incoherent rounded quartz grains, very uniform in size and resembling granulated sugar. Lumps of it may be readily crumbled in the hands and when placed in water disintegrate rapidly. At the pits of the American Silica Company east of Rockwood, Wayne County, and of the National Silica Company, Ford Plate Glass Company, near Steiner, Monroe County, the sandstone is washed down by a stream of water from a hose. At the Rockwood pit, there is a stratum of hard dolomitic sandstone which requires blasting. The material after being crushed and washed is pumped into bins where it is allowed to drain.

Some years ago the Rockwood Silica Sand Company drilled a well just east of Rockwood (SE¼ SW¼, Sec. 10) to the depth of 122 feet penetrating 15 feet of clay, 15 feet of dolomite, and 92 feet of glass sand rock without reaching the bottom of it. A six inch casing was used to rock and below this a four inch casing through which steam under pressure of 60 pounds per

*W. H. Sherzer, Geology of Monroe County: Mich. Geol. Survey, Vol. VII, pt. 1, p. 54.

square inch was injected, forcing out water and sand. About a car load of sand per day was obtained in this way.

Glass sand pits known as "Toll Pits" were opened many years ago near Steiner, Monroe County. These properties later were taken over by the National Silica Company, which operated them up to 1916 when its plant was burned down. The property was then sold to the Ford Plate Glass Company of Toledo, and a new plant was built. The Whiteford area is undeveloped.

Immediately beneath the drift the sandstone is more or less colored to a depth varying from a few inches to several feet, by iron from percolating surface water. However, most of the sandstone is very free from iron and the washed product from some horizons contains only about .001 of one per cent of iron. In the quarry of the Rockwood Silica Company near Rockwood there are numerous masses of celestite, or strontium sulphate, and native sulphur, produced by the reduction of the celestite. The masses of celestite are most numerous near the horizon of the dolomitic sandstone. Washing removes practically all of the small amount of dolomitic cement in the incoherent sandstone and also removes most of the cement from the dolomitic portions. The sand as marketed is stated to contain over 99 per cent of silica.

The following analyses are of the crude unwashed sand from the pits of the National Silica Company at Steiner, Monroe County, and of the washed product from the pit of the American Silica Company at Rockwood, Wayne County:

ANALYSES OF GLASS SAND

	Crude Per Cent	*Washed Per Cent
Silica	96.50	99.70
Calcium carbonate	1.50	0.08
Magnesium carbonate	1.04	0.22
Iron Oxide	0.00	.....
Sulphuric acid, loss and undetermined	0.76	.....
Loss on ignition	0.20	.....

The very low percentage of iron makes the sand especially adapted for glass making, particularly for glass of the higher grades, such as plate and optical glass. Large quantities are used in the manufacture of plate glass. Experiments by the United States Bureau of Standards show that the purest grade of the Sylvania sand of Michigan is suitable for making optical glass and now all the sand used by the Government for this purpose comes from this State. It was found that from the deposits near Rockwood it is possible under careful supervision to obtain carload lots of glass sand which average 0.015 per cent iron oxide, and some analyses as low as 0.004 iron oxide are reported. Glass sand for optical purposes is also obtained at

*J. E. Clark, Analyst.

Ottawa, Ill,. and Hancock, Maryland, but analyses from the best of these deposits averaged 0.02 per cent iron oxide.

The washed sludge containing the fine grit is used for the ignition surfaces on match boxes. The Rockwood Silica Company was the only producer in 1922.

SANDSTONE

For many years before the close of the last century the quarrying of sandstone was an important industry in Michigan. There were numerous quarries, though generally small, in Hillsdale, Jackson, Calhoun, Ionia, Eaton, and Huron Counties. No records, however, were kept until near the close of the century. In 1899, the production was valued at $178,038, the largest recorded, except in 1902, when the value of the output was $188,073. A rapid decline, though intermittent, at first began in 1900, and continued until 1911, when the industry all but ceased, the value of the output being only $12,985.

The decline of the sandstone industry in Michigan may be ascribed to (1) the poor quality of much of the sandstone, (2) the substitution of concrete in construction work, and (3) the greater use of brick and artificial stone.

Quarries formerly were operated in the sandstone of the Coal Measures near Ionia and at other places in Ionia County, and at Grand Ledge, Eaton County, and at many places in the Marshall sandstone in Calhoun, Hillsdale, Jackson, and Huron Counties. Most of the sandstone in these formations upon exposure to the weather for a few years alters more or less uniformly or in spots and streaks to an unsightly yellow color. This is due to the fact that the cementing material, especially in the Marshall, contains a considerable amount of iron carbonate, which upon exposure to the weather is oxidized to limonite. The sandstone near Ionia, though soft and friable, is streaked and mottled with red, orange, and yellow and makes a pleasing appearance in building. Some of the stone wnen first quarried is reported to be so soft that great care must be used in handling to prevent breakage. After seasoning for some time the stone becomes sufficiently hard to work and strong enough for ordinary building purposes. The only quarry operating in the Marshall at the present time is at Grindstone City, Huron County, where the gritstones near the base of the formation are quarried for grindstones and scythestones. Formerly some rubble and riprap were produced incidentally to the quarrying of gritstone, at Eagle Mills by the Wallace Company of Port Austin.

The only quarry producing sawed and rough building block is near Jacobsville, Houghton County. Extensive quarrying operations have been carried on near Portage Entry for many years but now the Portage Entry Redstone Company is the only active operator. The sandstone is known as the

Jacobsville and is apparently the equivalent of the Lake Superior or Upper Cambrian sandstone. The "redstone" or "brownstone" of the Jacobsville is well cemented, permanent in color, and pleasing in appearance, but the great distance from markets is a serious obstacle to development.

Formerly much sandstone was quarried for foundations but concrete has largely displaced stone for such purposes because of the cheapness of concrete and the rapidity and the ease of handling. Front and fancy brick are relatively cheap and a variety of artistic effects are possible through their use. Because of this they have largely displaced stone as a building material, except for foundations. Artificial stone is now displacing natural stone for foundations, especially for outside work.

Apparently the sandstone industry will not soon regain its early importance.

In 1919 four plants were operated and production reached a value of $24,413. Uses of sandstone reported were: rough building stone, rubble, riprap, and road metal. In 1920 there were but two operators, hence production values may not be given. In 1921 sandstone for rough building material and road metal was produced to the value of $49,270.

In 1922 sandstone produced for building stone, rough blocks, rubble, and riprap totalled 7,220 tons valued at $6,280.

GRINDSTONES AND SCYTHESTONES

The lower part of the Marshall Formation which is exposed in flat lowlying benches along the shore of Lake Huron near the end of the "Thumb" contains the "grit" stone for which commercial sandstones are made. The surface material is stripped off and the stone cut by channelling machines into square blocks eight feet or more in thickness. The blocks are split by wedges into slabs which are loaded on cars by derricks and then taken to the mills for sawing into grindstones. The sandstone locally contains thin beds of conglomerate composed of small pebbles of white quartz. From the resemblance of the pebbles to peanuts, the stone is often called "peanut" conglomerate. The pebbles also occur scattered through the sandstone. Much waste stone results from the conglomerate and the scattered pebbles, the latter in places being sufficiently numerous to make the stone unsuitable for use.

The grindstones vary in size from small stones a foot in diameter to those seven feet in diameter having a 14 inch face, and weighing from 1¼ to 2 tons. The broken stone is sawed into various grades of scythestones.

Until after the war Michigan ranked third in the value of grindstones and scythestones produced, Ohio being first with a total value about six times larger than that of Michigan and West Virginia together, the nearest competitors. There were but two active quarries, both located in Huron County near the end of the "Thumb." But these ceased operations during the war.

The Wallace Company of Port Austin formerly operated a quarry at Eagle Mills and the Cleveland Stone Company a quarry at Grindstone City. The latter resumed operations in 1923 but the former probably has permanently abandoned its quarry operations.

MINERAL WATERS

Since 1902 there has been a steady decline in the mineral water industry in Michigan, despite annual fluctuations in amount and value of mineral and spring water produced. The principal factors affecting the production are local conditions affecting municipal water supplies, and general business conditions. When a municipal water supply becomes unpalatable or unsafe the vending of mineral waters becomes profitable, only to decline, however, when a filtration plant is installed or a new source of water supply is developed in a town.

The general business depressions of 1906, 1907, and 1914 caused the greatest decrease in production in Michigan. During the past few years the increased demand for soft drinks has for a few firms occasioned a temporary increase in the sale of mineral waters used in the manufacture of "prohibition beers." The production of 8,653,680 gallons valued at $275,763 in 1902 decreased to 884,893 gallons valued at $52,642 in 1913. From 1913 to 1919 production and value steadily increased, and reached a total of 1,570,906 gallons valued at $132,312. There were ten commercial springs.

In 1920 production decreased 22 per cent in quantity and 8 per cent in value, production figures being 1,227,485 gallons valued at $122,010. Michigan ranked ninth among the states in quantity and value of mineral waters sold for all purposes, and ranked seventh in the value of table waters sold. Michigan produced 3 per cent of the total United States production at 2.5 per cent of the total value. In 1921 production and value of mineral waters increased from 1,227,485 gallons valued at $122,010 to 1,344,900 gallons valued at $154,405, an increase of 117,415 gallons or 9.5 per cent in quantity and of $32,395 or 26.2 per cent in value. There were nine commercial springs in 1921. In 1922 with nine producing springs Michigan again was ninth in the production of mineral waters although there was a decline from the 1921 production of 1,344,900 gallons at $154,405 to 1,229,802 gallons at $150,237, or a decrease of 8.5 per cent in quantity and of 2.7 per cent in value.

PRODUCTION AND VALUE OF MINERAL WATERS IN MICHIGAN, 1900-1922

Year.	Rank.		No. of springs active.	Total.		Medicinal value.	Table value.	Average price per gal.
	Quantity.	Value.		Quantity gals.	Value.			
1900	6	4	28	3,398,996	$411,935	.....	.....	$0.121
1901	2	1	28	7,019,168	1,195,614	.....	.....	0.170
1902	1	9	28	8,653,690	275,763	.....	.....	0.032
1903	1	9	19	6,919,107	200,668	.....	.....	0.029
1904	7	13	19	3,385,675	118,422	.....	.....	0.035
1905	4	4	17	2,684,800	277,188	$38,900	$238,288	0.100
1906	13	23	19	902,528	73,357	.....	.....	0.081
1907	8	15	19	1,472,679	127,133	35,091	92,042	0.086
1908	8	16	24	2,004,433	88,910	5,955	82,915	0.044
1909	5	16	19	2,760,604	104,454	6,099	98,355	0.035
1910	9	17	17	1,454,020	69,538	100	69,438	0.048
1911	11	24	23	1,713,401	72,253	12,156	60,097	0.042
1912	12	19	17	1,420,465	75,611	777	74,834	0.053
1913	17	24	20	884,893	52,642	3,605	49,037	0.059
1914	16	20	22	931,343	70,310	12,252	58,058	0.075
1915	16	18	19	913,765	72,111	5,165	67,546	0.080
1916	17	13	18	996,875	108,867	.....	.....	0.109
1917	12	12	11	1,069,164	105,641	500	105,641	0.098
1918	10	8	9	1,216,882	129,592	*	128,809	0.103
1919	7	9	10	1,570,906	132,312	760	132,252	0.080
1920	11	9	9	1,227,485	122,010	1,485	120,525	0.099
1921	6	7	9	1,344,900	154,405	.....	.....	0.114
1922	8	8	9	1,229,802	50,237	.....	.....	0.122
Total	.....	.....	.....	55,175,581	$4,191,573	.....	.....	0.076

MARBLE

The Kona dolomite in the Marquette iron bearing district, and the Randville dolomite in the Menominee and Crystal Falls districts are locally metamorphosed into dolomitic marble. The marble varies from coarse to fine texture and in color from white to various tones of pink, blue, green, and brown. The marble generally contains so much interbedded slate and quartzite that few of the deposits offer commercial possibilities. Developments have been attempted but it appears that excessive waste from the interbedded slates and quartzites made operations unprofitable.

An old marble quarry in Sec. 26, T. 42 N., R. 28 W., Dickinson County, was operated by the Metronite Company of Milwaukee, Wisconsin, until the fall of 1916, when fire destroyed the plant. Operations were resumed again in 1917. The product is ground for paint filler, whiting, etc.

Verde antique marble has been produced in commercial quantities by the Michigan Verde Antique Marble Company some miles north and west of Ishpeming. The marble is in a bed of altered peridotite in which the rock has been altered to serpentine and dolomite. In some places the rock is said to be almost wholly dolomite but generally it is a dolomitic serpentine, the dolomite investing the rock in an intricate system of veins and stringers. The serpentine varies in color from light to dark green with olive tones but the dolomite is generally white. The rock is firm and hard and takes a high polish. The intricate and delicate veins of white dolomite give very beautiful effects in the polished slab. The marble appears equal or superior

to much of the verde antique now on the market; it is said to equal the best from Italian and Grecian quarries and can be provided in larger sections than that formerly imported from Europe.

Developments began in 1914 but lack of transportation facilities, labor shortage, etc., hindered operations. A spur line connecting the quarry with the Chicago and Northwestern railroad was completed and blocks of marble were shipped to Marquette where the company has a stone sawing mill. Marble will be cut and polished at this mill, the electric power being supplied by the city of Marquette. In 1920 and 1921 the company shipped broken pieces of green marble to eastern manufacturers of terrazzo, which is used as flooring. Lack of available cars prevented maximum shipments. The broken pieces were blasted from the face of the ledge some years ago and are of little value as marble, but make excellent terrazzo. Fine blocks of verde antique are reported to be in stock, and more shortly to be ready for the finishing plants.

Other projects have been started in the past six years to develop other deposits of marble in this region but the war and post-war business unrest prevented developments. In this locality there are, apparently, several undeveloped deposits of verde antique marble which are under favorable quarrying conditions. The cutting off of foreign sources of marble in 1914 led to the development and appreciation of American marbles; architects and builders are urging the use of American marbles and it is possible that quarrying of marble may become an important industry near Ishpeming.

GRAPHITE

The Northern Graphite Company of L'Anse and the Detroit Graphite Company of Detroit have opened quarries in graphite slate nine miles southeast of L'Anse. The graphite rock, which is reported to contain from 32 to 35 per cent of graphite, is ground and used for paint. The production is intermittent, the quarries being operated only as the crude supply becomes depleted, enough being quarried in a year to supply the needs of the companies for several years.

No graphite was produced in 1918, 1919, 1920, 1921, or 1922.

MINERAL PAINTS

For some years certain iron ores in Iron County were mined and sold for paint manufacture but production ceased in 1915. The Detroit Graphite Company manufactures graphite paint from graphitic slate (see graphite) obtained near L'Anse, Baraga County. This company discontinued mining operations in 1917.

CELESTITE

Celestite or stronium sulphate ($SrSO_4$) occurs at several horizons in the Monroe formation in southeastern Michigan. Near Maybee, Monroe

County, it occurs in the Lower Monroe in scattered crystals and masses associated with native sulphur and occurs similarly in the Sylvania sandstone at Rockwood, Wayne County. Near Gibraltar, Wayne County, it occurs in disseminated crystals in Upper Monroe dolomites. In the glass sand pit of the Rockwood Silica Company the masses are numerous in places and some of them are large. The commercial recovery of the celestite has been but partially investigated. The masses are imbedded in a friable to incoherent sandstone and can be readily separated from it.

FELDSPAR

Deposits of potash feldspar are reported to occur near Republic, and in Sec. 22, T. 47 N., R. 29 W., Marquette County. A pegmatite dike occurs in coarse granite near the south quarter part of Sec. 8, T. 46 N., R. 41 W., Gogebic County.

According to the reports of the Commissioner of Mineral Statistics, for 1902 and 1903, the deposit near Republic is of red potash feldspar. A carload from this deposit was shipped to potters in East Liverpool, Ohio, and the material was reported to be satisfactory for the manufacture of porcelain. The following analysis of the material was made by an Ohio chemist.

Silica (SiO_2)	65.25
Alumina (Al_2O_3)	18.60
Iron Oxide (Fe_2O_3)	0.40
Lime ($CaCO_3$)	0.38
Magnesia (MgO)	0.23
Sodium Oxide (Na_2O)	1.99
Potassium Oxide (K_2O)	13.40

According to the report of the chemist there was but little free quartz in the sample. An attempt was made to develop the deposit in section 22 but apparently without success.

The pegmatite dike in Sec. 8, T. 46 N., R. 41 W. is very coarse. Many of the crystals are from four to six inches long, and some are fourteen inches in length. The feldspar appears to be pink orthoclase. The exposure is very small, being a rock knob 20 to 15 paces across and between 15 and 20 feet high. Exploration would be necessary to determine the extent of the dike. It is probable that other dikes occur in this locality.

TRAP ROCK

There are inexhaustible resources of trap rock in the western half of the Northern Peninsula, chiefly in the iron and copper bearing districts. Trap rock is quarried at Marquette and Negaunee, Marquette County. Large quantities of amygdaloidal trap are produced incidentally to the mining of copper. The trap rock from Marquette County is harder, tougher, and less altered than that from the copper mines. The inferior wearing qualities of the amygdaloidal trap, however, is partially compensated by superior cementing power.

Most of the quarry product and considerable amounts of fieldstone or "hardheads" are crushed for road material and concrete. In some years a small amount has been sold for riprap. The great distance from markets is a serious obstacle to the development of the trap rock industry of the State. Car and labor shortage is reported to be the chief cause of the decrease in 1918. The utilization of trap rock for roofing granules in 1921 caused the value of the rock produced to increase from $84,273 in 1920 to $173,620, an increase of $89,347 or 106 per cent.

PRODUCTION AND VALUE OF TRAP ROCK OR BASALT IN MICHIGAN, 1911-1922

Year.	No. of producers.	Crushed stone.				Total tons.	Total value.	Rank value.
		Roadmaking.		Concrete, etc.				
		Quantity.	Value.	Quantity.	Value.			
		Tons		Tons				
1911...	3	.....	.....	45,250	$38,429	.....	$51,000	8
1912...	5	21,805	$18,366	11,355	9,340	.....	36,206	8
1913...	5	24,920	23,369	*	*	.....	92,201	10
1914...	5	25,690	24,863	4,448	4,771	.....	34,406	12
1915...	6	28,262	29,764	18,775	22,047	.....	105,855	12
1916...	8	38,193	37,475	9,601	9,715	.....	83,072	12
1917...	4	50,420	64,098	*	*	.....	70,197	11
1918...	4	23,686	32,605	*	*	.....	53,269	11
1919...	1	.....	.....	.....	.....	.....	36,186	11
1920...	4	.....	.....	.....	.....	.....	84,273	10
1921...	6	17,640	22,174	.....	151,446	.....	173,620	12
1922...	.....	57,730	102,884	*	*	94,560	376,788	.....
.....	.....	.....	.....	.....	.....	.....	$1,200,373	.....

*Included in total.

QUARTZ

Quartz is mined near Ishpeming, Marquette County, and ground for wood filler and paint purposes by the Michigan Quartz Silica Company of Milwaukee, Wisconsin. Some of the ground product is used in making scouring polish. According to an analysis submitted by the company the quartz rock is practically pure silica, there being but a trace of impurities. Mills are located at Ishpeming and Milwaukee.

SLATE*

In the Northern Peninsula extensive deposits of black slate occur on the northwestern side of the Huron Mountains in Baraga County. The slate is very black, of fine texture, and uniform in quality. It appears to be of superior quality, and suitable for roofing and other purposes for which slate is adapted.

*See Pub. 16, Min. Res. of Mich. for 1913, pp. 92-95 for a more complete report.

From 1875 to 1878 and 1883 to 1888 a number of slate quarries were operated at and in the vicinity of Arvon. All of the companies failed because of poor methods and means of quarrying, the great distance from markets and lack of cheap transportation facilities.

PETROLEUM

The usual amount of exploration for petroleum and natural gas has been completed during the year. These explorations are by small companies who are content with one or two test wells. Those interested in the companies are most often a group of property owners in the vicinity of the test well. No encouraging showings of oil or gas have been reported with the exception of the Deerfield well in Lenawee County which is mentioned below.

Since the last published notice*.a second well has been completed by the Schoolcraft Development Company at Seul Choix Point, Schoolcraft County, Benjamin Gerow, Manistique, in charge. This well was continued far beyond the known oil bearing formations and penetrated the upper part of the Cambrian sandstone. No important oil showings were reported and with this test the company has abandoned operations. At Devil's Lake near Cement City the Prospect Hill Development Company, with R. R. Allerdyce in charge, has stopped operations. Very meager accounts of this well have been furnished by the company but the test was apparently completed in the upper part of the Dundee at 1,612 feet. The Thumb Oil & Gas Development Trust, J. C. Gaines in charge, completed a well near Burnside, Lapeer County, and furnished a complete set of samples which will serve as a standard of reference for the sub-surface geology of the Thumb district. No important showings of oil were obtained and the well was completed in the upper part of the Detroit River (Upper Monroe) formation at 2,627 feet. Press notices indicate that a well will be drilled near Manistee during the summer of 1924. A well completed near Deerfield, Lenawee County, by the W. K. Development Company has continued to furnish about four barrels of oil at each pumping although it has not been pumped regularly. One additional well near the producing location has been drilled by the Jackson County Oil and Gas Company, George Chrisman in charge. This well penetrated the oil horizon and obtained a showing of oil but has not been completed. The same company completed a well at Napoleon, Jackson County, at 1,876 feet, in the Detroit River (Upper Monroe) formation without obtaining any important showing of oil or gas. The Bay City Freezer, Paul W. Peterson in charge, drilled a well in the northeastern part of Bay City and furnished a set of samples which has served as a check on the drilling already done in the vicinity. This well was completed in the Lower Marshall at 1,003 feet. It was not drilled with the hope of finding oil or gas but gives an additional point of reference in regard to the underground

*Pub. 32, Mich. Geol. Surv. p. 103, 1922.

structure. Two other deep wells furnished important information, one at Sault Ste. Marie drilled by William Cater for the Cadillac Lumber and Chemical Company reached a depth of nearly 1,000 feet without penetrating the Cambrian formation in which it started, while one at Bay View drilled by A. Purcell for Charles Ditto penetrated the Traverse and Bell formations and was bottomed in the Dundee formation at 497 feet.

Rock samples from these wells which have been sent in by the various companies are on exhibition at the offices of this survey and are available at all times to anyone who is interested in deep drilling projects. The following records of samples submitted during the last two years and their correlation with formations in neighboring wells will offer some suggestions as to depths and drilling conditions.

The names of formations and also of the larger time-divisions as used in these records must be considered as tentative in most cases but because of the confusion which would be introduced by the use of a great number of query signs or other indications of uncertainty these have been quite generally omitted.

SEUL CHOIX (SCHOOLCRAFT COUNTY)

SCHOOLCRAFT DEVELOPMENT SYNDICATE WELL NO. 2

Location: ½ mile north from well No. 1 which was drilled at the SW corner of the NE ¼ of Sec. 21, T. 41 N., R. 13 W., Mueller Township.
Elevation: 642 feet (estimated) above sea level.
Samples furnished by Benjamin Gerow, Manistique.

	Thickness feet	Depth feet
Pleistocene: lacking		
Silurian*:		
Manistique Formation:		
Buff mixed with gray and white dolomite (cherty)	30	30
Buff cherty dolomite	10	40
Buff mixed with gray dolomite and white chert	110	150
Burnt Bluff Formation:		
Buff dolomite	25	175
Buff mixed with gray dolomite and white chert	25	200
Buff mixed with gray dolomite	50	250
Buff limestone	5	255
Buff and gray limestone	5	260
Gray dolomitic limestone	10	270
Bluish gray calcareous shale	5	275
Buff and gray shaly limestone	15	290
Gray shaly dolomitic limestone	5	295
Gray limestone	5	300
Gray and dark gray shaly limestone	5	305
Mayville Formation:		
Buff dolomite	35	340
Cream dolomite	15	355
Cream and light gray dolomite	5	360
Dark bluish gray shaly dolomite	5	365
Greenish gray plastic shale	5	370
Gray shaly dolomite	5	375
Cataract Formation:		
(Cabot Head Member):		
Reddish gray plastic shale	5	380
Gray and buff mixed shale and shaly dolomite with gypsum; some purple shale	50	430
Greenish gray shale	5	435
Greenish plastic shale	5	440
Greenish gray shale	10	450
Cataract Formation:		
(Manitoulin Member):		
Buff dolomite	15	465
Light gray shaly dolomite	20	485
Gray shaly dolomite	15	500
Ordovician:		
Queenston-Richmond Formation:		
Greenish gray shale	10	510
Red and greenish gray shale with gypsum	15	525
Greenish gray shale with gypsum	20	545
Gray shaly dolomite	10	555
Gray and brown shaly dolomite	30	585
Gray and brown shaly dolomite	30	615
Gray shaly dolomite	50	665
(?Lorraine):		
Dark shaly dolomite	30	695
Brown and gray shaly dolomite	50	745
Lorraine Formation:		
Bluish gray shale (dolomitic)	90	835
Dark gray dolomitic shale	155	990
Collingwood Formation:		
Dark brown limy shale	15	1005

*Silurian subdivisions according to Prof. G. M. Ehlers, Ann Arbor.

WELL NO. 2—Concluded.

	Thickness feet	Depth feet
"Trenton" Formation: (Black River):		
Brown to gray limestone	35	1040
Brownish gray dolomite	10	1050
Gray limestone	10	1060
Brownish gray limestone	2.5	1062.5
Gray shaly limestone	10	1072.5
Gray shaly limestone	10	1082.5
Dark gray shaly lime	22.5	1105
Buff gray dolomite	20	1125
Gray dolomite	20	1145
Dark gray shaly dolomite	15	1160
Gray dolomitic limestone	5	1165
Dark gray shaly dolomite	5	1170
Dark gray and brown shaly mixed limestone	25	1195
Brown and gray limestone	7.5	1202.5
Gray limestone	20	1222.5
Dark gray limestone	2.5	1225
Gray and brown limestone (fresh water)	5	1230
Mixed gray and light gray limestone	17.5	1247.5
Dark gray limestone	10	1257.5
Buff limestone	10	1267.5
Buff limestone becoming dolomitic	7.5	1275
Dark buff and gray dolomite	12.5	1287.5
Dark gray dolomite and quartz sand (Sand from St. Peter see below)	5	1292.5
St. Peter Formation:		
Pure white large grained quartz sand	10	1302.5
Same with green and rust colored grains and slightly dolomitic	5	1307.5
Same with finer quartz grains	17.5	1325
Ordovician and Cambrian, undivided:		
Beekmantown and Lake Superior Formations:		
Buff to reddish quartz and greenish slate particles slightly dolomitic	10	1335
Reddish quartz and greenish slate particles slightly dolomitic	2.5	1337.5
Same	5	1342.5
Same but coarser grains	5	1347.5
Buff dolomite with rust colored grains and dark slaty grains	20	1367.5
Dark reddish brown and dark buff dolomite (Fresh water at 1370)	5	1372.5
White sandstone with buff and slate colored grains	10	1382.5
White sandstone with dark shale particles; iron stains (from drill?)	7.5	1390
Coarse white sandstone, slightly dolomitic	2.5	1392.5
Coarse white sandstone with dark shale and dolomite particles	5	1397.5
Medium grained white sandstone	2.5	1400
Coarse white sandstone with dark shale and dolomite particles	12.5	1412.5
Medium grained white sandstone; slightly dolomitic	47.5	1460
Medium grained white sandstone with considerable gray dolomite	10	1470
Medium grained white sandstone, slightly dolomitic	12.5	1482.5
Medium grained white to gray sandstone; slightly dolomitic	17.5	1500
Coarse white sandstone	17.5	1517.5
Pink dolomitic sandstone	2.5	1520
White sandstone	5	1525
Pink dolomitic sandstone	2.5	1527.5
Sandstone pink tinted	32.5	1560
Cream colored sandstone gradually shading to pink with depth; slightly dolomitic	52.5	1612.5
Sandstone and gray dolomitic shale	12.5	1625
Fine grained gray sandstone, slightly dolomitic	85	1710

CEMENT CITY (LENAWEE COUNTY)

PROSPECT HILL DEVELOPMENT COMPANY WELL NO. 1

Location: Sec. 15, T. 5 S., R. 1 E. Woodstock Township. 1¾ miles north of Devils Lake station on D. T. & M. R. R. Old Turner Farm.
Elevation: 1061 feet above sea level.
Record from notes and samples submitted by R. R. Allerdyce, in charge of the drilling.

	Thickness feet	Depth feet
No record	1075	1075
Mississippian?		
Bedford Formation:		
Powdery gray shale	5	1080
Devonian:		
Antrim Formation:		
Black laminated shale	10	1090
No record	5	1099
Gray laminated shale	85	1180
No record	10	1190
Black laminated shale	175	1365
No record	45	1410
Traverse Formation:		
Siliceous dolomite		1410
Gray shaly limestone		1435
Buff limestone		1465
Gray shaly limestone		1495
Gray limy shale		1500
Gray shaly limestone		1505
Gray limy shale		1510–1515
Gray limy shale		1520–1540
Gray limestone		1555
Dundee Formation:		
Buff limestone		1560–1585
Buff to brown limestone; petroleum odor		1590–1612

BURNSIDE (LAPEER COUNTY)

THUMB OIL AND GAS DEVELOPMENT TRUST WELL NO. 1

Location: SW ¼ of the NW ¼, Section 15, T. 9 N., R. 12 E. Burnside Township.
Elevation: 803 feet above sea level.
Record from samples and driller's log furnished by J. C. Gaines.

	Thickness feet	Depth feet
Pleistocene:		
Reddish yellow boulder clay	8	8
Sand and gravel (water)	8	16
Plastic blue clay, sand, gravel	49	65
Sand and gravel (water)	20	85
Coarse sand	17	102
Coarse gravel	6	108
Mississippian:		
Lower Marshall Formation:		
Gray to buff sandstone	5	113
Conglomerate	2	115
Sandstone	1	116
Blue shale at top of sandstone with pebbles	4	120
Greenish gray shale with pebbles	5	125
Greenish gray sandstone; pebbles	10	135
Greenish gray sandstone	10	145
Coldwater Formation:		
Blue gray plastic shale	225	370
(Salt water at 370)		
Blue gray plastic shale	11	381
White to buff sandstone (water) (Richmondville member)	11	392
White to buff sandstone (Richmondville member)	27	419
Gray gritty shale	73	492
(Slight oil showings at 477-570)		
Dark gray shale	58	550
Dark gray shale (salt at 568)	153	703
(Slight oil showing 698-703)		
Light gray shaly sandstone	12	715
Dark gray shale	5	720
(Salt water at 720)		
Light drab sandstone	15	735
Dark gray shale	6	741
Gray shale	6	747
Gray shale	10	757
Light gray sandstone	5	762
Dark gray shale	6	768
Dark gray shale	119	887
Dark gray plastic shale	113	1000
Dark gray plastic shale	170	1170
(Limy streaks near 1085)		
Dark gray plastic shale	50	1220
Sunbury Formation:		
Very dark gray shale	70	1290
Berea Formation:		
Fine grained white quartz sand	30	1320
Fine grained white quartz sand	15	1335
Dark gray shale	10	1345
White quartz sand and some black shale	15	1360
Gray fine grained sandstone	10	1370
Mississippian?		
Bedford Formation:		
Dark and light gray shale mixed	100	1470
Devonian:		
Antrim Formation:		
Black shale	105	1575
Black shale	60	1635
Black shale	20	1655
Black shale	25	1680
Black shale	45	1725
Gray and black shale	10	1735
Gray shale	15	1750
Black shale	45	1795

WELL NO. 1—Concluded.

	Thickness Feet	Depth Feet
Traverse Formation:		
Gray plastic shale	5	1800
Gray shale	5	1805
Brown to gray limestone	20	1825
Gray calcareous shale	5	1830
Gray limestone	10	1840
Buff to brown limestone	15	1855
Dark gray calcareous shale	15	1870
Buff to gray fossiliferous limestone; some shale	5	1875
Dark gray calcareous shale	5	1880
Light gray plastic calcareous shale	5	1885
Buff limestone	25	1910
Dark gray shaly limestone	20	1930
Dark gray calcareous shale	15	1945
Buff gray shaly limestone	25	1970
Light gray plastic calcareous shale	50	2020
Dark gray calcareous shale	60	2080
Light gray plastic calcareous shale	5	2085
Dark gray calcareous shale	130	2215
Dundee Formation:		
Buff limestone and shale	35	2250
Buff limestone	80	2330
Buff limestone and shale	5	2335
Buff limestone; a few gray particles	5	2340
Gray limestone and dark gray shale	5	2345
Petroliferous limestone; pyrite, chert, and gummy residue	20	2365
Buff limestone	5	2370
Petroliferous limestone with pyrite, chert and gummy residue	5	2375
Brown limestone (steel fragments at 2386)	25	2400
Detroit River Formation:		
Brown dolomite (oil showing at 2425, water at 2415 and 2420)	35	2435
Brown dolomite, gummy residue and iron stain	28	2463
Brown dolomite with iron stain (oil showing)	5	2468
Brown dolomite	2	2470
Brown dolomite with anhydrite (oil showing at 2473)	10	2480
Limy dolomite, anhydrite	3	2483
Brown dolomite with anhydrite and some white chert (Rainbows at 2495, 2497)	14	2497
Gray dolomite with anhydrite and some chert	6	2503
Brown dolomite with anhydrite and some white chert (Rainbows at 2506, 2509)	21	2524
Brown dolomite, anhydrite, and chert	11	2535
Gray dolomite, anhydrite	4	2539
Brown dolomite, anhydrite. Rainbows at 2550, 2554	17	2556
Gray dolomite, anhydrite	3	2559
Brown limestone, anhydrite (Rainbows at 2562, 2566; gas at 2571)	12	2571
Brown dolomite, anhydrite	5	2576
Brown dolomite, some chert with salt, anhydrite, hydrogen sulphide, and petroleum residue	26	2602
Dolomitic limestone; brown with mineral waters as above	11	2613
Brown limy dolomite, mineral water as above	14	2627

NOTE: Anhydrite appears definitely at 2215 and continues to 2483 in small quantities but increasing until it is very noticeable below 2470.

NAPOLEON (JACKSON COUNTY)

JACKSON COUNTY OIL AND GAS WELL NO. 1

Location: SW ¼ of the SE ¼ Sec. 31, T. 3 S., R 2 E., Napoleon Township.
Elevation: 978 feet above sea level.
Record from samples from George Chrisman, in charge of drilling. Samples from surface to 1235 feet not submitted.

	Thickness feet	Depth feet
Pleistocene: No record.		
Mississippian	1235	1235
Devonian:		
Antrim Formation:		
Black shale		1235
Black shale		1400
Gray shale	50	1450
Brown to black shale	155	1605
Traverse Formation:		
Gray calcareous shale	20	1625
Brown dolomite and black shale	5	1630
Brown to gray dolomite	20	1650
Brownish gray shaly limestone	5	1655
Brown dolomitic limestone	3	1658
Brown limestone		1665
Gray shaly limestone		1675
Gray shaly limestone		1687
Gray shaly limestone		1715
Brown limestone		1720
Brown to gray shaly limestone		1730
Gray shaly limestone		1738
Gray shaly limestone		1750
Gray shaly limestone		1762
Dundee Formation:		
Gray shaly limestone		1770
Brown limestone		1780
Brown limestone		1792
Brown limestone		1800
Brown limestone		1810
Detroit River Formation:		
Brown dolomitic limestone		1819
Brown dolomitic limestone		1824
Brown dolomitic limestone		1860
Brown dolomitic limestone		1876

BAY CITY (BAY COUNTY)

BAY CITY FREEZER WELL

Location: NE ¼ of the SW ¼ Sec. 22, T. 14 N., R. 5 E. (Lot 10, C. E. Jennison's First Addition, Bay City.)
Elevation: 595 feet above sea level.
Driller's record to 260 feet. Samples submitted beyond that depth by Paul W. Petersen, Manager.

	Thickness feet	Depth feet
Pleistocene:		
Surface filling	2	2
Clay	81	83
Hardpan	2	85
Sand	2	87
Pennsylvanian:		
Saginaw Formation: Black shale	5	92
Dark sandy shale	7	99
Gray shale	1	100
Black shale	9	109
Black shale	2	111
White shale	3	114
Gray shale	1	115
Black shale	1	116
Coal	2	118
White shale	12	130
Gray shale	10	140
Blue shale	7	147
Coal	1	148
White sandy shale	10	158
White sandstone	32	190
Limestone	1	191
White sandstone	16	207
Coal	2	209
Gray shale	5	214
White sandstone	8	222
Gray sandy shale	2	224
Black slate	1	225
White shale	5	230
White sandstone	13	243
Gray shale	1	244
Gray sandstone	1	245
White sandstone	13	258
Gray shale	12	270
Gray sandy shale	15	285
Very dark gray shale	10	295
Light gray sandy shale	5	300
Dark gray shale	10	310
Very fine grained gray sandstone	5	315
Light gray sandy shale	15	330
Slate colored shale	10	340
Light gray plastic sandy shale	5	345
Gray plastic shale	5	350
Gray cherty shale	5	355
Gray shale	40	395
Black bituminous shale (almost coal)	5	400
Dark gray shale	70	470
Black carbonaceous shale (almost coal)	5	475
Dark gray shale	5	480
Gray calcareous shale (sandy)	5	485
Gray shale	5	490
Gray shale	35	525
Parma Formation:		
White sandstone	40	565
Mississippian:		
Michigan Formation:		
Drab dolomite	15	580
Quartz sand like Parma with dolomite grains	15	595
Dark drab dolomite with pyrite and quartz grains	20	615
Gray calcareous sandstone	15	630
Soft gray shale	10	640
Sandy calcareous gray shale	10	650
Green shale with gypsum	5	655
Gypsum	5	660
Green shale with gypsum	5	665

FREEZER WELL—Concluded.

	Thickness feet	Depth feet
Mississippian—Concluded.		
Gray shale with gypsum	10	675
Shaly gypsum	5	680
Dark gray shale with gypsum	5	685
Light gray fissile shale	5	690
Gray fissile shale with gypsum	5	695
Dark gray fissile shale with pink gypsum	5	700
Light gray fissile shale with white gypsum	5	705
Gray shaly dolomite	10	715
Dark gray plastic shale	25	740
Gray plastic shale	115	855
Gray shaly limestone	15	870
Gray plastic shale	5	875
Gray shaly limestone	5	880
Gray plastic shale	5	885
Gray shaly limestone	5	890
Gray plastic shale	5	895
Gray shaly limestone	15	910
Napoleon (Upper Marshall) Formation:		
Light gray sandy limestone	5	915
Fine grained gray sandstone; small amount of limestone in top (Gray plastic shale at 960)	45	960
Fine grained gray limestone	35	995
Lower Marshall Formation:		
Gray sandy shale	5	1000
Red sandy shale	3	1003

NOTE: Water 26′ from surface has strong salty taste, is clear, and has temperature of 52-53 degrees. Volume less than 30 gallons per minute.

SAULT STE. MARIE (CHIPPEWA COUNTY)

CADILLAC LUMBER AND CHEMICAL COMPANY WELL

Location: NE ¼ T. 41 N., R. 1 W. City of Sault Ste. Marie. Near River.
Elevation: About 600 feet above sea level.
Drilled in 1923 by William S. Cater, Chicago, contractor.

	Thickness feet	Depth feet
Pleistocene:		
Sand and gravel	91	91
Cambrian:		
Purple, hard sandstone with greenish white spots	24	115
Soft brick red sandstone	10	125
Hard very light buff colored sandstone with greenish tints	10	135
Purple hard sandstone with greenish white spots	40	175
Same but softer	10	185
Soft buff colored sandstone	10	195
Hard brick red sandstone with greenish white spots	10	205
Same but softer	20	225
Red and chocolate colored sandstone with greenish white spots	10	235
Brick red sandstone with greenish white spots	10	245
White sandstone with yellow stain from drill fragments and spots of chocolate colored sandstone	20	265
Hard purple sandstone with greenish white spots	60	325
Brick red sandstone with greenish white spots	30	355
Greenish white sandstone with chocolate colored spots	10	365
Purple sandstone with greenish white spots	10	375
Same but softer	10	385
Purple sandstone with greenish white spots	40	425
No record	90	515
Light buff colored sandstone with rare spots of greenish shaly material and chocolate colored sandstone	10	525
No record	60	585
Light buff colored sandstone	50	635
Purple sandstone with rust color (drill fragments)	110	745
Driller reports samples lost but that well was bottomed at 998 feet with the same series of sandstone all the way down	.....	998

BAY VIEW (EMMET COUNTY)

CHARLES DITTO WELL

Location: Near the SW corner of the NW ¼, Sec. 33, T. 35 N., R. 5 W. About 15 feet W. of the pumping station and 100 feet from the shore of Little Traverse Bay.
Elevation: 592 feet above sea level.
Drilled in 1922 by A. Purcell, contractor, and C. W. Brown, driller. Driller's log and samples from C. J. Ditto, Superintendent of the Bay View Camp Ground Association.

	Thickness feet	Depth feet
Pleistocene:		
Lake sand	7	7
Dark gray clay	5	12
Devonian:		
Traverse Formation:		
Dark gray limy shale	5	17
Dark gray limestone	23	40
Brown crystalline limestone	128	168
Dark gray limestone	8	176
Dark gray to brown limestone	96	272
Gray limestone	8	280
Brown limestone	88	368
Brown dolomitic limestone	8	376
Bell Formation:		
Gray limy shale	16	392
Bluish (light) gray shale	72	464
Gray limy shale	8	472
Dundee Formation:		
Brown crystalline limestone	25	497

At 482 there is a coarse grained pure quartz sand. The grains are well rounded, pitted, and frosted, and of uniform size.

TEMPERANCE (MONROE COUNTY)

ERIE OIL AND GAS COMPANY WELL NO. 1

Location: On the S. 53 A. of the E. ½ of the E. ½, Sec. 31, T. 8 S., R. 8 E., Bedford Twp.
Elevation: 590 feet above sea level.
Record from samples.
Samples furnished by R. B. Miller, Temperance.

	Thickness feet	Depth feet
Silurian:		
Bass Island Formation:		
Shaly dolomite, buff to gray	60	60
Gray limestone	140	200
Cream colored dolomite	40	240
Slate gray limestone	95	335
Buff gray limestone. Occasional fragments of anhydrite	80	415
Buff gray dolomite, anhydrite	50	465
Salina Formation:		
Cream colored dolomite	50	515
Cream colored limestone	20	535
Cream colored dolomite	30	565
Gray dolomite	90	655
Niagaran Series:		
White dolomite, grayish blue in lower half	85	740
Light gray dolomite	60	800
Gray dolomite	30	830
Light gray dolomite	40	870
Cataract Formation: (Cabot Head Member):		
Green shale, soft, fine grained	10	880
Cataract Formation: (Manitoulin Member):		
Gray dolomite	95	975
Buff dolomite	25	1000
Ordovician:		
Cincinnatian Series:		
Dark gray shale (Richmond?)	160	1160
Dark gray shale, soft, powdery (Lorraine?)	30	1190
Light gray shale, soft, powdery	80	1270
Gray-white shale, soft, powdery	150	1420
Gray shale	80	1500
Gray calcareous shale	40	1540
Gray shale finely laminated	40	1580
Black shale (dries gray) ("Utica")	110	1690
"Trenton" Formation (Black River):		
Gray buff limestone	65	1755

RIGA (LENAWEE COUNTY)

BLISSFIELD-RIGA AND OGDEN OIL AND GAS COMPANY

Location: N ½ of the SW ¼ Sec. 28, T. 8 S., R. 5 E., Riga Township. Ray Fachett farm, about 4 miles south of Riga.
Elevation: About 700 feet above sea level.
Samples furnished by Otto Wagner, Blissfield.

	Thickness feet	Depth feet
Pleistocene:		
No record	85?	85?
Devonian:		
Antrim Formation:		
Brownish black shale	75	160
Gray sandy shale	25	185
Brownish black shale	45	230
Traverse Formation:		
Brownish gray sandy shale	10	240
Buff dolomite and gray shale	60	300
Grayish white shale and gray limestone	15	315
Dundee Formation:		
Mixed dark and light gray fossiliferous limestone	35	350
Same with shale	70	420
Detroit River Formation:		
Buff dolomite	50	470
Buff dolomitic limestone increasingly sandy	90	560
Sylvania Formation:		
White sandstone	5	565
Silurian:		
Bass Island Formation and Salina Formation Undivided:		
Grayish buff dolomite	25	590
Slate gray and brown shale	16	606
Gray shale	84	690
Buff dolomite	60	750
Brownish gray dolomite	50	800
Buff dolomitic limestone	10	810
Brownish gray dolomitic limestone, some shale	190	1000
Buff dolomitic limestone	60	1060
Dark gray dolomitic limestone	40	1100
Brownish gray dolomite	60	1160
Gray dolomite	40	1200
Niagaran Series:		
White dolomite	175	1375
Light gray dolomite	25	1400
Gray dolomite	100	1500
Buff-white dolomite	15	1515
Cataract Formation: (Cabot Head Member):		
Green "gumbo" shale	10	1525
Greenish gray and brownish red shale	475	2000
Ordovician:		
Cincinnatian Series:		
Black shale (Utica?)	217	2217
Trenton Formation: (Black River):		
Gray and buff mixed limestone, a little shale	108	2325

NATURAL GAS

The production of natural gas reported for 1922 was 700,000 cubic feet valued at $350.00.

The production of natural gas is confined to the extreme southeastern part of the State, and a small area near Manistee in the northwestern part, where it is developed from shallow wells in the drift. Its development is usually accidental when a water well penetrates a gas pocket. The behavior of the small wells thus completed is erratic and they are subject to a rapid decline. The source of the gas is believed to be the Antrim formation which underlies the drift in each reported well. This formation is known to contain considerable quantities of bituminous matter included in the shale and in peculiar concretions of bituminous limestone which are often seen in outcrop as large spheroidal masses sometimes three or four feet through. These masses weathered from the shale mass have given the name of Kettle Point to an Ontario locality where the half buried concretions resemble overturned kettles. There is little hope of developing production within this formation because of its dense shaly texture. The accumulations under the capping of drift clay are probably due to a fractured condition of the formation and a favorable combination of the angle of dip, which is in this case somewhat greater than normal, and the angle of the plane of erosion.

SUMMARY TABLE OF THE PRODUCTION AND VALUE OF MINERAL PRODUCTS IN MICHIGAN, 1918-1922.

Mineral Products.	1918.		1919	1919	1920		1921		1922	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Brick and tile products, number of brick	98,747,000	$1,708,736	200,359,000	$3,699,929	187,415,000	$3,979,691	193,730,000	$2,417,309	748,608,890	$3,915,318
Brick, sand-lime, number of brick	22,564,000	198,633	42,063,000	513,094	38,810,000	640,744	33,658,000	403,929	45,558	557,647
Bromine; pounds	1,605,696	855,841	1,736,633	1,179,834	1,046,165	692,100	.....	(a)	.....	(a)
Calcium chloride; tons	20,615	394,200	21,668	256,091	49,937	1,905,013	18,683	431,402	.....	(a)
Cement, Portland; bbls. made, value cement shipped	3,554,872	6,078,167	4,675,244	8,468,196	4,891,457	10,939,633	5,777,533	10,300,289	6,243,805	11,145,573
Clay, tons	2,359	6,373	568	2,123	5,066	11,295	.....	2,355	1,653	4,852
Coal, tons	1,464,818	5,615,097	996,545	3,864,228	1,489,765	7,346,000	1,141,715	5,555,000	929,390	4,693,000
Coke, tons; value sales	.....	.....	.....	.....	1,485,833	15,731,994	835,973	4,704,141	1,142,059	9,229,083
Copper, lbs	226,224,305	55,120,307	179,082,970	33,696,537	161,343,880	29,220,990	100,918,001	16,873,992	121,386,726	†16,387,208
Glass sand	(c)	(c)	(c)	(c)	(c)	(c)	.....	(c)	.....	(c)
Graphite	.....	(f)	.....	(f)	.....	(f)	.....	(f)	.....	(f)
Grindstones, tons	.....	(a)	.....	(a)	.....	(a)	.....	(a)	.....	(f)
Gypsum, tons mined; value gypsum products sold	286,768	1,761,149	339,125	2,390,367	382,212	3,521,028	408,224	3,312,096	471,355	2,843,117
*Iron ore, shipments long tons, value f. o. b. mine	17,495,377	64,977,830	12,816,304	47,945,800	18,470,354	83,319,770	5,230,669	19,970,694	12,433,729	43,760,509
Iron, pig, long tons made; value pig iron shipped	489,816	(b) 17,823,684	416,277	(b) 13,418,185	513,920	(b) 16,812,062	243,433	b5,955,205	595,647	(b) 14,791,041
Lime, tons made	134,813	1,186,007	145,783	1,381,534	140,813	1,386,760	48,164	445,386	53,635	484,945
Limestone	.....	5,186,867	.....	3,797,522	.....	5,943,229	.....	3,387,722	.....	4,533,998
Mineral paints	.....	.....	.....	.....	.....	.....	.....	(f)	.....	(f)
Mineral and spring waters, gallons sold	1,248,082	129,592	1,570,906	132,312	1,227,485	122,010	1,344,900	154,405	1,229,802	150,237
Natural gas, M. cu. ft	1,173	1,045	1,098	911	.....	(e) 500	400	300	700	350
Petroleum	.....	(a)	.....	(a)	.....	.....	.....	(f)	.....	(f)
Pottery	.....	1,976,436	.....	2,096,874	.....	2,592,625	.....	1,781,923	.....	1,337,000
Potash (Pure K_2O) tons produced; value potash sold	404	100,647	166	48,581	56	18,312	.....	(f)	.....	(f)
Precious stones	.....	(a)	.....	(a)	.....	(a)	.....	(f)	.....	(f)
Quartz	.....	(a)	.....	(a)	.....	(a)	.....	(a)	.....	(a)
Salt, bbls	17,165,178	9,048,650	17,800,564	9,456,138	16,163,679	10,698,674	10,196,179	7,439,445	14,322,057	8,693,604
Sand and gravel, tons	2,837,371	1,242,794	3,772,535	1,944,143	4,386,582	2,867,466	5,515,253	2,916,917	5,962,916	3,222,043
Sandstone	.....	(a)	19,640	24,413	.....	(a)	.....	(a)	.....	(a)
Silver, fine oz. Troy	473,342	504,480	425,610	477,054	510,601	518,326	310,727	310,727	361,912	361,912
Stone, crushed	.....	.....	.....	.....	.....	.....	1,381,250	1,025,463	.....	(g)
Traprock	.....	53,269	.....	.....	.....	.....	.....	173,620	94,560	376,778
Miscellaneous	.....	247,204	.....	36,186	.....	84,273	.....	292,880	.....	627,860
				60,242	.....	161,822	.....		.....	
Total	.....	$156,393,324	.....	$121,482,109	.....	$181,702,225	.....	$81,872,995	.....	$112,325,034

* Figures from State Tax Commission.
† Estimated at $ .135 per pound, the average price.
a. Included under miscellaneous.
b. Excluded from total; covered by iron ore.
c. Included under sand and gravel.
d. Copper sales.
e. Estimated.
f. No production.
g. Included in limestone.

APPENDIX

DIRECTORY OF THE PRODUCERS OF NON-METALLIC MINERALS IN MICHIGAN, 1922.

BRICK AND TILE MANUFACTURERS, 1922

Operator.	Office.	Works.
Allegan County:		
Allegan Brick Works (Fish & Fish)	Allegan	Allegan.
Barry County:		
Leonard Bros. & Co.	Delton	Delton.
Chippewa County:		
Thornton Bros. Brick Co	Grand Rapids	Rudyard.
Genesee County:		
Atlas Clay Products Co	Atlas	Atlas.
L. J. & C. E. Scholl	Clio	Clio.
Gratoit County:		
Ashley Tile Co	Ahsley	Ashley.
Kennett Co	North Star	North Star.
North Star Tile Co	North Star	North Star.
Riverside Brick and Tile Yard	Sumner	Sumner.
Ingham County:		
Clippert Spaulding Co	Lansing	Lansing.
Jackson County:		
Michigan State Industries	Jackson	Jackson.
American Vitrified Products Co	Akron, Ohio (15 Broad St.)	Jackson.
Lenawee County:		
Albert A. Comfort	Tecumseh	Tecumseh.
Midland County:		
Robt. W. D. Fish	Coleman	Coleman.
Saginaw County:		
Miller City Tile Co	Saginaw	Saginaw.
Saginaw Clay Products Co	Paines	Saginaw.
National Plate Glass Co	Saginaw	Saginaw.
Thomas Day	Saginaw	Saginaw.
Shiawassee County:		
New Corunna Brick Co	Corunna	Corunna.
Van Buren County:		
Hartford Brick & Tile Co	Hartford	Hartford.
Wayne County:		
Anton Hupprich	4645 51st St., Detroit	Detroit.
Jacob Daniel Brick Co	291 Clippert Ave., Detroit	Springwells.
John S. Haggerty	1815 Dime Bk. Bldg., Detroit	Detroit.
Pewabic Pottery & Tile Co	10125 Jefferson Ave., Detroit	Detroit.
Bunte Bros. Tile Co	Flat Rock	Flat Rock.
Clippert Brick Co	Springwells	Springwells.
Wm. Clippert Brick Co	Western Ave. & M. C. R. R. Detroit	Detroit.
Porath Bros	305 Free Press Bldg., Detroit	Springwells.
Walker & Frank Co	8810 Dix Ave., Detroit	Detroit.
Mercer-Bryan-Larkins Brick Co	Miller Rd. and Lonyo Road., Detroit	Springwells.

SAND-LIME BRICK PRODUCERS, 1922

Operator.	Office.	Works.
Genesee County:		
Flint Sandstone Brick Co	Flint	Flint.
Huron County:		
Sebewaing Sandstone Brick Co	Sebewaing	Sebewaing.
Jackson County:		
Jackson-Lansing Brick Co	Rives Junction	Rives Junction.
Kent County:		
Grande Brick Co	Kalamazoo Ave., Gd. Rapids	Grand Rapids.
Menominee County:		
Menominee Brick Co	Menominee	Menominee.
Oakland County:		
Rochester Brick and Sand Co	Rochester	Rochester.
Saginaw County:		
Saginaw Brick Co	321 N. Hamilton St., Saginaw	Saginaw.
Wayne County:		
Michigan Pressed Brick Co	Cor. Lawton Ave. at M. C. R. R., Detroit	Detroit.
Fairview Brick Co	Foot of Jean St., Detroit	Detroit.
Detroit Sand-Lime Brick Co	Detroit	Detroit.

CEMENT PRODUCERS, 1922

Operator.	Office.	Works.
Huron Portland Cement Co	1525 Ford Bldg., Detroit	Alpena.
Alpha Portland Cement Co	140 S. Dearborn St., Chicago	Bellevue.
Peninsular Portland Cement Co	Cooley Block, Jackson	Cement City.
Michigan Portland Cement Co	Chelsea	Four Mile Lake.
Wolverine Portland Cement Co	Coldwater	Coldwater & Quincy.
Aetna Portland Cement Co	412 Union Trust Bldg., Detroit	Fenton.
Newaygo Portland Cement Co	Grand Rapids	Newaygo.
Peerless Portland Cement Co	Union City	Union City.
Wyandotte Portland Cement Co	1525 Ford Bldg., Detroit	Wyandotte.
New Egyptian Portland Cement Co	Fenton	Fenton.
Petoskey Portland Cement Co	Petoskey	Petoskey.
Acme Concrete Products Co	Cement City	Cement City.

LIST OF MICHIGAN COAL MINES, LOCATION BY COUNTY, NAMES OF MANAGERS AND SUPERINTENDENTS

Name of Mine.	County.	Manager.	Address.	Superintendent.	Address.
Robert Gage Coal Co. No. 7	Bay	Chas. Coryell	Bay City	Wm. A. Jones	Bay City.
Beaver Coal Company	Bay	Chas. Coryell	Bay City	Wm. A. Jones	Bay City.
Wolverine Coal Mining Co. No. 2	Bay	R. M. Randall	Saginaw	Alex Liddle	Bay City.
What Cheer Coal Mining Co. No. 1	Bay	A. N. Fancher	Bay City	Alex Jeffreys	Bay City.
B. S. K. Coal Mining Co	Calhoun	W. A. Knapp	Albion	W. C. Sellers	Albion.
Russell Mine	Clinton				
Reed Mine	Eaton				
Rogert Gage Coal Co. No. 3	Saginaw	Chas. Coryell	Bay City	Wm. A. Jones	Bay City.
Robert Gage Coal Co. No. 8	Saginaw	Chas. Coryell	Bay City	Wm. A. Jones	Bay City.
Bliss Coal Mining Co	Saginaw	C. E. Linton	Saginaw	J. T. Phillips	Saginaw. Swan Creek.
Banner Coal Mining Co	Saginaw	Wm. B. Carmichael	Saginaw. Swan Creek	Richard Jenkins	Saginaw. Swan Creek.
Community Coal Co	Saginaw	Alex Jeffreys	Bay City	Wm. Follis	Bay City.
Consolidated Coal Co. (Riverside Coal Co. No. 2)	Saginaw	R. M. Randall	Saginaw	Alex Liddle	Bay City.
Consolidated Coal Co. (Shiawassee Coal Co.)	Saginaw	R. M. Randall	Saginaw	Alex Liddle	Bay City.
Consolidated Coal Co. (Uncle Henry Coal Co. No. 2)	Saginaw	R. M. Randall	Saginaw	Alex Liddle	Bay City.
Akron Coal Mining Co. No. 2	Tuscola	Chas. Handy	Bay City, W. S.	Chas. Period	Akron.

CLAY MINERS, 1922

Operator.	Office.	Works.
Ontonagon County:		
Thos. Edmond Estate	Rockland	Rockland.
F. A. Jeffs	Rockland	Rockland.
Robinson Clay Product Co	1010 E. Market St., Akron, Ohio	Rockland.
Wayne County:		
Clippert Brick Co	1960 Mich. Ave., Detroit	Springwells.

COKE PRODUCERS, 1922

Operator.	Address.	Location of Plant.	No. of ovens.	County.
Michigan Alkali Co	Wyandotte	Plant No. 2	30	Wayne.
Cement-Solvay Co	Syracuse, N. Y.	Detroit	175	Wayne.
Ford Motor Co	Detroit	River Rouge	120	Wayne.

GRAPHITE PRODUCERS, 1917*

Operator.	Office.	Quarry.
Detroit Graphite Co	10, 12th Street, Detroit	L'Anse.
Northern Graphite Co	L'Anse	L'Anse.

*No graphite produced in 1919, 1920, 1921.

GRINDSTONE AND SCYTHESTONE PRODUCERS, 1922

Operator.	Office.	Quarry.
Huron County:		
Cleveland Stone Co	Cleveland, Ohio	Grindstone City.
The Wallace Company	Port Austin	Eagle Mills.
Cleveland Stone Company	Cleveland, Ohio	Port Austin.

PRODUCERS OF GYPSUM PRODUCTS, 1922

Operator.	Office.	Name of plant.	Location of mine.
United States Gypsum Co	Chicago, Ill	Alabaster	Alabaster.
United States Gypsum Co	Chicago, Ill	Midland	Grand Rapids,
Acme Cement Plaster Co	St. Louis, Mo	Mill No. 5	Beverly.
Alabastine (Mich. Gypsum Co.)	Grand Rapids		Grand Rapids.
American Cement Plaster Co	Lawrence, Kansas	Grand Rapids	Grand Rapids.
Grand Rapids Plaster Co	427 Michigan Trust Bldg., Gd. Rapids	Grandville	Grandville.

LIMESTONE AND LIME PRODUCERS, 1922

Operator.	Office.	Quarry.
Alger County:		
County Road Commissioners	Munising	Eben.
Alpena County:		
Michigan Alkali Co	Wyandotte	
Great Lakes Stone & Lime Co	Alpena	Rockport.
Charlevoix County:		
Northern Lime Co. (Lime)	Petoskey	Bay Shore.
Cheboygan County:		
Campbell Stone Co. (also lime)	Indian River	Afton.
Cheboygan Limestone Products Co.	Mackinaw City	Mill Creek.
Ross Stone Co	Afton	Afton.
Chippewa County:		
Scott Quarry Co	Sault Ste. Marie	Trout Lake.
Delta County:		
Delta Contracting Co	Escanaba	Escanaba (Hyde).
Richler Bros	Gladstone	Pine Ridge.
Berkman, Andrew J	Gladstone, R. F. D. 1	Gladstone, R. F. D. 1, Escanaba Twp.
Dickinson County:		
Metronite Co., The	Milwaukee, Wis	Felch.
Emmet County:		
Antrim Lime Co. (also lime)	912 Mich. Trust Bldg., Grand Rapids	Petoskey.
Northern Lime Co. (also lime)	Petoskey	Petoskey.
Petoskey Portland Cement Co	Petoskey	Petoskey.
Huron County:		
Wallace Stone Co	Bayport	3 miles E. of Bayport.
Mackinac County:		
Ozark Stone Quarry	Ozark	Ozark.
Union Carbide Co	42d St. Bldg., New York City	Hendricks Quarry
Fiborn Limestone Co	Sault Ste. Marie, Ontario, Canada	Fiborn Quarry.
Menominee County:		
Menominee County Road Commrs	Menominee	
Spencer, Henry	Menominee	Menominee.
Monroe County:		
The France Stone Co	1800 Second National Bank Bldg., Toledo, Ohio	Monroe.
Morris, Sam W	Monroe	Monroe, S. part of city.
Augerer & Gutman	Hammond Bldg., Detroit	Schofield.
Presque Isle County:		
Michigan Limestone & Chemical Co	55 Liberty St., New York, or Rogers City, Mich	Calcite.
Schoolcraft County:		
The White Marble Lime Co	Manistique	Blaney, Manistique, and Marblehead.
Delta Contracting Co	Escanaba	Manistique.
Wayne County:		
Solvay Process Co	Syracuse, N. Y.	Trenton and Sibley.
Dunbar & Sullivan Dredging Co	Detroit or River Rouge	Mouth of Detroit River.

MINERAL AND SPRING WATER PRODUCERS, 1922

Operator.	Office.	Spring.
Eastman Springs Beverage Co	Benton Harbor	Eastmans.
Arctic Spring Water Co	412 Ottawa Ave., Grand Rapids	Arctic.
Ogemaw Spring Water Co	Bay City	Ogemaw.
Ponce de Leon Co	Grand Rapids	Ponce de Leon.
Sharkey, Chas	Mt. Clemens	Victory.
Magnetic Spring Water Co	Saginaw, W. S.	Andrew's Magnetic Mineral.
Charbeneau, Jno. H	Mt. Clemens	Maple Leaf Springs.
Preussel, Frank W	No. 47 Crocker Ave., Mt. Clemens	Panacea.
Silver Springs Water Co	Detroit	Northville.
Deep Springs Co	Northville	Deep Springs.
Artesian Water Co	Detroit	Detroit.
Magnetic Mineral Water Co	Grand Rapids	Grand Rapids.

PIG IRON PRODUCERS, 1922

Operator.	Office.	Name of furnace.	Location of furnace.
Mitchell-Diggins Iron Co	Cadillac	Cadillac	Cadillac.
Detroit Furnace Co	1069 Jefferson Ave., Detroit	Detroit	Detroit.
Detroit Iron & Steel Co	149 Jefferson Ave., Detroit	A. & B.	Detroit.
East Jordan Furance Co	East Jordan		East Jordan.
Cleveland Cliffs Iron Co	Cleveland, Ohio	Pioneer No. 1	Gladstone.
Cleveland Cliffs Iron Co	Cleveland, Ohio	Pioneer No. 2	Near Marquette.
Antrim Iron Co	Anrtim	Antrim	Antrim.
Stephenson Charcoal Iron Co		Stephenson	Wells.
Charcoal Iron Co. of America	Detroit	Boyne City	Boyne City.
Charcoal Iron Co. of America	Detroit	Manistique	Manistique.
Charcoal Iron Co., of America	Detroit	Newberry	Newberry.
Ford Blast Furance Co	Dearborn	Ford Blast	Dearborn.

POTTERY PRODUCERS, 1922

Operator.	Office.	Works.
Macomb County:		
Mt. Clemens Pottery Co	Mt. Clemens	Mt. Clemens.
Monroe County:		
South Rockwood Pottery Co	South Rockwood	South Rockwood.
Oakland County:		
Pontiac Clay Pipe & Novelty Co		
Wayne County:		
Becker Bros. Flower Pot Co	4645 51st St., Detroit	Detroit.
Hygeia Filter Co	338 Denton Ave., Detroit	Detroit.
Meaker Spark Plug Co	7939 Lafayette Ave., Detroit	Detroit.
Pewabic Pottery & Tile Co	2161 Jefferson Ave., Detroit	Detroit.

QUARTZ PRODUCERS, 1922

Operator.	Office.	Mine.
Marquette County:		
Michigan Quartz Silica Co	Milwaukee, Wis	Ishpeming.

SALT PRODUCERS, 1922

Operator.	Office.	Works.
Bay County:		
Hine Lumber Co	Sta. A, Bay City	W. Bay City.
Bigelow Cooper Co	Bay City	Bay City.
Manistee County:		
The Buckley & Douglas Lbr. Co	381 River St., Mansitee	Manistee.
Sands Salt & Lbr. Co., Louis	Manistee	Manistee.
Mason County:		
Morton Salt Co	Ludington	Ludington.
Stearns Salt & Lbr. Co	Ludington	Ludington.
Midland County:		
The Dow Chemical Co. (bromine)	Midland	Midland.
Saginaw County:		
Mershon, Eddy, Parker & Co	Saginaw	Saginaw.
Bliss & VanAuken Lbr. Co	Saginaw, W. S.	Saginaw.
Saginaw Salt Products Co	Saginaw, W. S.	Saginaw.
Estate of Edward Germain	Holland Ave. near Genesee St., Saginaw, W. S.	Saginaw.
National Plate Glass Co	Saginaw, W. S.	Saginaw, W. S.
Strable Lumber & Salt Co	Saginaw	Saginaw
Saginaw Chemical Co	Saginaw	Saginaw.
St. Clair County:		
Michigan Salt Works	Marine City	Marine City.
Morton Salt Co	717 Ry. Ex., Chicago, Ill	Port Huron.
Diamond Crystal Salt Co	St. Clair	St. Clair.
Wayne County:		
Inland Delray Salt Co	Detroit	Delray.
Solvay Process Co	Detroit	Delray.
Detroit Rock Salt Co	Scranton, Pa	Detroit.
Mulkey Salt Co	610 Equity Bldg., Detroit	Oakwood.
Worcester Salt Co	168 Duane St., New York, City	Ecorse.
Michigan Alkali Company	Wyandotte	Wyandotte.
Pennsylvania Salt Mfg. Co	115 Chestnut St., Philadelphia	Wyandotte.

SANDSTONE PRODUCERS, 1922

Operator.	Office.	Quarry.
Dickinson County:		
Miench, Anton	Iron Mountain	Iron Mountain.
Huron County:		
Cleveland Stone Company	Cleveland, Ohio	Grindstone.
Marquette County:		
Marquette Trap Rock Company	Marquette	Marquette.

SAND AND GRAVEL PRODUCERS REPORTING IN 1922

Operator.	Office.	Pit.
Alcona County:		
Federal Sand & Gravel Co	301 ½ Federal Ave., Saginaw	Greenbush.
Alpena County:		
Federal Sand & Gravel Co	301 ½ Federal Ave., Saginaw	Lachine.
Antrim County:		
Floyd E. Moore	Central Lake	Eastport.
Barry County:		
Chas. Woolston	Hastings, R. F. D. No. 2	Hastings.
S. J. Palmiter	Bellevue, R. F. D. No. 4	Maple Grove.
Bay County:		
Geo. A. Whitney	Bentley	Bentley.
Benzie County:		
Hubbell Sand Company	Manistee, 7th and Fairview	Elberta.
Berrien County:		
Ireland & Lester	Benton Harbor	Benton Harbor.
Kerlikowsek Brothers	St. Joseph	Riverside.
Branch County:		
Ed. Corey	Bronson	Matteson Lake.
Calhoun County:		
Floyd I. VanSickle	Albion	Albion.
Brownlee Park Gravel & Material Co	R. F. D. No. 1, Box 83, Battle Creek	Battle Credk.
Michigan Railway Company	Jackson	Near Albion.
Genesee County:		
Morehouse Brothers	Fenton	Fenton.
Ford Sales Company	Flint	Otisville.
E. Bowles	Linden	Argentine.
Bayer-Brice Gravel Co	701 Genseee Co. Sav. Bank Bldg., Flint	Flint.
Genesee Gravel Co	1409 Ford Bldg., Detroit	Mt. Morris.
Otisville Gravel Co	Saginaw	Otisville.
Gratiot County:		
A. E. Tomlinson	Sumner	Sumner.
Hillsdale County:		
Charles Coler	Camden	Camden.
Huron County:		
Carey-Conley Company	No. 405 Bearinger Bldg., Saginaw	Port Austin.
Ingham County:		
Central Michigan Gravel Co	Lansing	Lansing-Benton Harbor.
Heller Brothers	Lansing	Lansing.
Hoyt Woodman	Lansing	Lansing.
Hugh Campbell & Son	1516 6th St., Bay City	Mason.
Charles Couch	Mason	Mason.
A. E. Sheltraw	Saginaw, W. S.	Mason.
Ionia County:		
J. I. Hazelitt	Star Route, Ionia	Palo.
Glick's Gravel Co	R. F. D. No. 3, Ionia	Saranac.
Jackson County:		
Jackson Gravel Company	Jackson	Jackson.
Kalamazoo County:		
County Road Commissioners	Kalamazoo	Kalamazoo.
Nelson Concrete Culvert Co	Portage Street, Kalamazoo	Kalamazoo.
Isaac Quick	Kalamazoo	Kalamazoo.

SAND AND GRAVEL PRODUCERS REPORTING IN 1922—Continued

Operator.	Office.	Pit.
Kent County:		
Batjes Fuel & Bldg. Mat. Co	38 Pearl St., Grand Rapids	Grand Rapids.
Richard J. Slater	R. F. D. No. 1, Ada	Cascade.
Rufus Overholt & Son	Byron Center	Sutton.
G. W. Bunker	Grand Rapids	Grand Rapids.
Grand Rapids Gravel Co	320 Franklin St. S. W., Grand Rapids	Grandville Rd.
Harrison Land Co., Ltd	1023 4th St., Grand Rapids	Grand Rapids
Valley City Stone and Gravel Co	19 W. Broadway, Grand Rapids	Grand Rapids.
Walker Ave. Gravel Pit	1518 Walker Ave., Grand Rapids	Grand Rapids.
Wyoming Sand & Gravel Co	R. F. D. No. 8, Grand Rapids	Grand Rapids.
John N. Coalter	Kent City	Kent City.
S. G. Greaves, High Ridge Gravel Co	Rockford	Rockford.
Lapeer County:		
John F. Smith	Goodrich	Hadley.
Lenawee County:		
Frank Lowe	Hudson	Hudson.
Geo. Evans	No. Morenci	No. Morenci.
R. P. Gillespie Estate	Tecumseh	Tecumseh.
Tecumseh Gravel Co	Tecumseh	Tecumseh.
Livingston County:		
Grand River Washed Sand & Gravel Co.	Ann Arbor	Ann Arbor.
Ohio & Mich. Sand & Gravel Co	1021 Nichols Bldg., Toledo, O.	Chilson.
Macomb County:		
Detroit Gravel & Ballast Co	807 Detroit Savings Bank Bldg., Detroit	Armada.
Peters Brothers	Mt. Clemens, Mich	Clinton River.
Lake Side Ice and Coal Co	Mt. Clemens	Mt. Clemens.
H. Jacob Wacker	Mt. Clemens	Mt. Clemens.
Detroit Sand & Gravel Co	3812 Nall, Detroit	Utica.
Manistee County:		
Hubbell Sand Co	Manistee	Manistee.
Marquette County:		
Champion Gravel Co	Marquette	Champion.
Mason County:		
Hubbell Sand Co	Nabustee	Ludington.
Mecosta County:		
Midland Gravel Co	Midland	Millbrook.
Menominee County:		
Board County Road Commissioners	Menominee	Various places.
Montcalm County:		
Alexander Kenny	Pierson	Pierson.
Muskegon County:		
Muskegon Co. Highway Dept	Court House, Muskegon	Slocum.
Oakland County:		
Julius Porath	745 Griswold, Detroit	Oxford.
United Fuel and Supply Co	Free Press Bldg., Detroit	Oxford.
Standard Gravel Co	Pontiac	New Hudson.
Detroit-Oxford Gravel & Stone Co	Oxford	Oxford.
Boice Brothers	R. F. D. No. 7, Pontiac	Pontiac.
Rochester Sand & Brick Co	1001 Smith Bldg., Detroit	Rochester.
Oceana County:		
Twp. Board of Newfield	Hesperia	Hesperia.
Ogemaw County:		
Crescent Gravel Company	Reed City	Reed City.
Hersey Gravel Company	Hersey	Hersey.
Ottawa County:		
Michigan Materials Co	Muskegon	Dredge, Bass River.
I. Van Welden & Co	609 Fulton St., Grand Haven	Grand Haven.

SAND AND GRAVEL PRODUCERS REPORTING IN 1922—Concluded

Operator.	Office.	Pit.
Saginaw County:		
Valley Sand Company	612 Webster St., Bay City	Saginaw River.
St. Clair County:		
Superior Sand & Gravel Co	726 Dime Bk. Bldg., Detroit	St. Clair River.
C. A. Westrick & Son	Marine City	Marine City.
Reynolds & Bailey	Marysville	Marysville.
Warner R. Thompson Co	Ponds Hill, Port Huron	Vassar.
Sanilac County:		
William Dawson	Sandusky	Sandusky.
Tuscola County:		
Tom Hile	R. F. D. No. 2, Caro	Near Caro.
Cass City Sand & Gravel Co	Cass City	Cass City.
Tuscola Sand & Gravel Co	Cass City	Cass City.
Washtenaw County:		
Board of County Road Commrs	Ann Arbor, Box 124	Various places.
Finkbeiner Brothers	R. F. D., Saline	Saline.
Wayne County:		
Cadillac Sand & Gravel Co	1021 Nicholas Bldg., Toledo	Ann Arbor.
Birmingham Sand & Gravel Co	2690 E. Atwater St., Detroit	Detroit.
F. D. Gleason Coal Co	28 Campau Bldg., Detroit	Detroit.
W. J. Jacques Co	1222 Parkview Ave., Detroit	St. Clair River.
Ontario Gravel Freighting Co	228 Sandwich St., Windsor, Ont	St. Clair River.
Mich. Pressed Brick Co	4500 Lawton Ave., Detroit	Detroit.

TRAP ROCK PRODUCERS, 1922

Operator.	Office.	Quarry.
Dickinson County:		
County Road Commissioner	Iron Mountain	Mine rock from stockpile.
Marquette County:		
City of Negaunee	Negaunee	Negaunee.
Olivine Co	Marquette	Marquette.
Beaver Granulith Co	Negaunee	Negaunee.
City of Ishpeming	Ishpeming	Ishpeming.
Advance Industrial Supply Co	Chicago, Ill	Marquette.
City of Marquette	Marquette	Marquette.
Marquette Co. Road Commissioners	Marquette	Marquette.
Ontonagon County:		
Blumgren, J. E., Estate	Norway	Bergland.
Iron County:		
Iron Co. Road Commissioners	Crystal Falls	NW. of NE. Sec. 7 43-32.

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