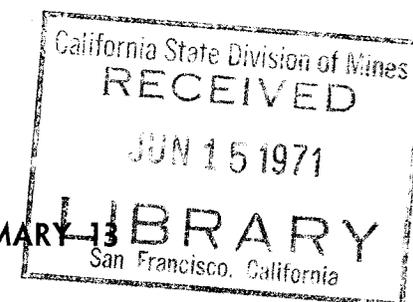




MINERAL INDUSTRY OF MICHIGAN, 1969

1971

ANNUAL STATISTICAL SUMMARY
Geological Survey Division



COVER PHOTO — The Michigan Vitrified Tile Company plant at Corunna showing several of their beehive kilns (left background) and four-inch common drain tile stockpile (right foreground). This plant, in operation since 1945, manufactures a variety of tile products that are in demand throughout the state.



...the State Geological Survey, shall make an annual report to the Governor, setting forth in detail the mineral statistics for the year; with the progress and development of ... mining and smelting industries.

—Compiled Laws Mich. 1948 s.319.202



Geological Survey Division

ANNUAL STATISTICAL SUMMARY 13

Mineral Industry of Michigan 1969

By
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Industry Economist
and

Richard J. Bishop
Statistical Clerk

Bureau of Mines, Minneapolis, Minnesota

Prepared in cooperation with
Bureau of Mines

United States Department of the Interior

1971

STATE OF MICHIGAN
WILLIAM G. MILLIKEN, *Governor*
DEPARTMENT OF NATURAL RESOURCES
RALPH A. MACMULLAN, *Director*
GEOLOGICAL SURVEY DIVISION
ARTHUR E. SLAUGHTER, *State Geologist and Chief*

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FOREWORD

Official statistics concerning Michigan's 1969 mineral output is included in the eighteen page center section of this report, a preprint of the Michigan Chapter in the current U. S. Bureau of Mines Mineral Yearbook. This report summarizes some 19 mineral commodities produced in the State under the heading of metals, nonmetals, and fuels.

Items which are included in this Bureau's chapter are reports on legislation, employment, late developments, and other information of value to industrialists, educators, and others concerned with Michigan's mineral resources. As in past years, the Michigan Geological Survey has added to the chapter a cover, photo plates, resource maps, and a resource bibliography, which this year is the clay and shale resources of the State.

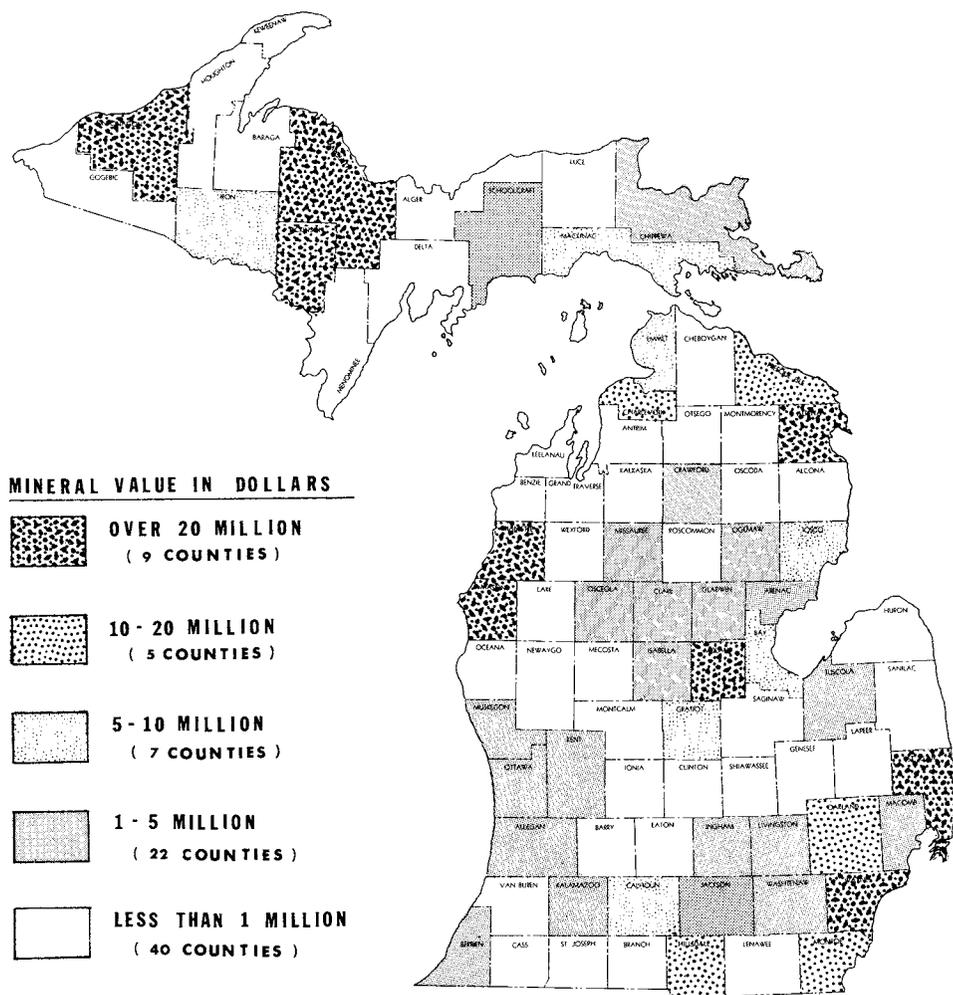
The Geological Survey again wishes to thank the mineral operators in supplying the necessary mineral data. Because of their generous cooperation, these yearly mineral summaries continue to be possible.

Lansing, Michigan
March, 1971

Harry O. Sorensen, Geologist
R. Thomas Segall, Geologist
Geological Survey Division
Dept. of Natural Resources

MICHIGAN MINERAL VALUE

1969



MINERAL VALUE IN DOLLARS

OVER 20 MILLION
(9 COUNTIES)

10 - 20 MILLION
(5 COUNTIES)

5 - 10 MILLION
(7 COUNTIES)

1 - 5 MILLION
(22 COUNTIES)

LESS THAN 1 MILLION
(40 COUNTIES)

COMMODITY	LEADING COUNTY	COMMODITY	LEADING COUNTY
CEMENT	ALPENA	NATURAL GAS	ST. CLAIR
CLAY	ALPENA	NATURAL SALINE	MIDLAND
COPPER	ONTONAGON	PEAT	LAPEER
GYPSUM	IOSCO	PETROLEUM	HILLSDALE
IRON ORE	MARQUETTE	SALT	WAYNE
LIME	WAYNE	SAND & GRAVEL	OAKLAND
MARL	KALAMAZOO	STONE	PRESQUE ISLE

The Mineral Industry of Michigan

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division of the Michigan Department of Natural Resources, for collecting information on all minerals except fuels.

By Donald F. Klyce¹ and Richard J. Bishop²

In 1969 the value of mineral production in Michigan continued its upward trend and totaled \$668.2 million, 7 percent above the 1968 record high.

Thirteen mineral commodities showed an increase in value. Many of the gains in value were substantial with the most significant increases reported for copper, iron ore, magnesium compounds, sand and gravel, and stone. Most of the losses in value of production were minor, with the exception of natural gas and natural gas liquids.

Nonmetals, as a group, increased in value nearly 4 percent and accounted for 55 percent of the value of State mineral

production. Its principal component, construction materials, registered a gain of about 3 percent, and chemicals, recovered mostly from natural salines, increased 7 percent. Metallic minerals, which accounted for 36 percent of the mineral value, gained more than 14 percent. All types of mineral fuels (natural gas, natural gas liquids, peat, and petroleum) showed a decline in value; and as a group the value of production was nearly 6 percent less than in 1968.

¹ Industry economist, Bureau of Mines, Minneapolis, Minn.

² Statistical clerk, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Michigan¹

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....thousand 376-pound barrels...	31,375	\$99,158	30,373	\$98,425
Masonry.....thousand 280-pound barrels...	2,006	5,527	1,904	5,473
Clays.....thousand short tons...	2,599	2,906	2,667	3,037
Copper (recoverable content of ores, etc.).....short tons...	74,805	62,607	75,226	71,516
Gypsum.....thousand short tons...	1,405	5,196	1,327	5,384
Iron ore (usable).....thousand long tons, gross weight...	12,699	148,890	14,058	169,756
Lime.....thousand short tons...	1,630	19,870	1,589	20,372
Magnesium compounds.....short tons, MgO equivalent...	266,406	25,087	328,047	30,604
Natural gas.....million cubic feet...	40,480	10,160	36,163	9,294
Natural gas liquids:				
Natural gasoline.....thousand 42-gallon barrels...	1,066	3,177	921	2,481
LP gases.....do.....	1,384	3,432	1,197	2,561
Peat.....short tons...	237,513	2,919	186,278	2,724
Petroleum (crude).....thousand 42-gallon barrels...	12,974	38,287	12,213	37,494
Salt.....thousand short tons...	4,893	44,481	4,819	45,961
Sand and gravel.....do.....	56,663	54,979	58,092	58,968
Silver (recoverable content of ores, etc.).....thousand troy ounces...	473	1,014	1,009	1,807
Stone.....thousand short tons...	37,279	41,092	39,186	43,572
Value of items that cannot be disclosed: Bromine, calcium chloride, calcium-magnesium chloride, gem stones, iodine, and potassium salts.....	XX	58,293	XX	58,818
Total.....	XX	627,075	XX	668,247
Total 1967 constant dollars.....	XX	615,421	XX	642,176

² Preliminary. XX Not applicable.

¹ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

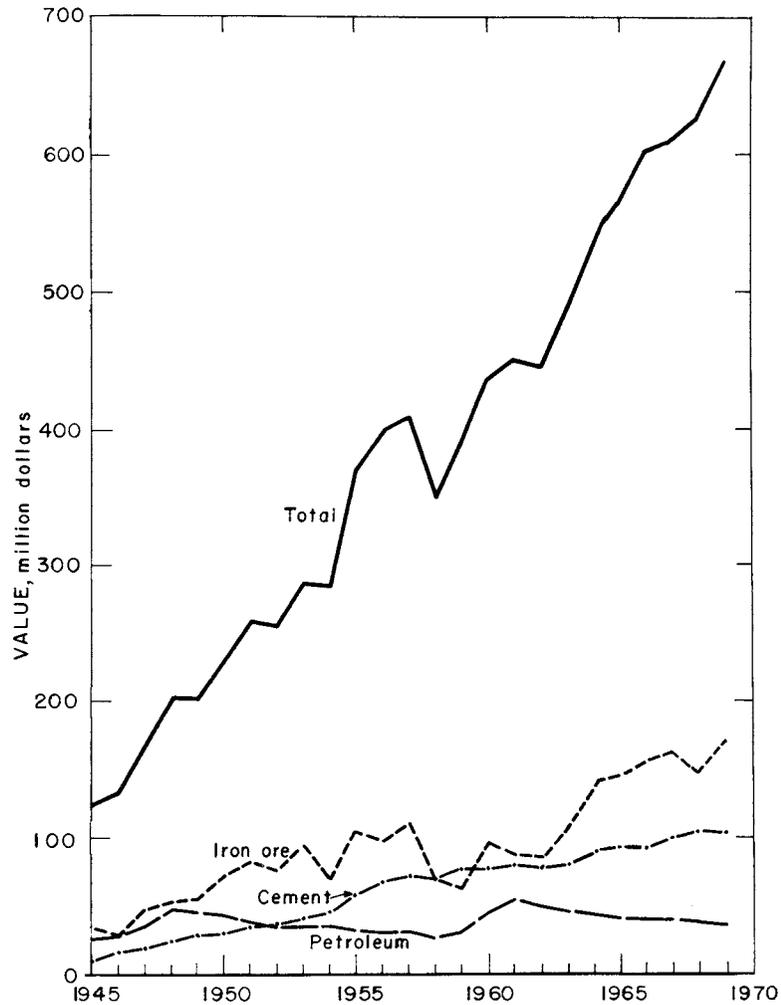


Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

Table 2.—Value of mineral production in Michigan, by counties¹
(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Alcona.....	\$117	\$225	Sand and gravel.
Alger.....	39	38	Do.
Allegan.....	1,020	² 972	Sand and gravel, petroleum, peat, stone, natural gas.
Alpena.....	W	W	Cement, stone, clays, sand and gravel.
Antrim.....	431	475	Clays, sand and gravel.
Arenac.....	¹ 1,037	1,005	Petroleum, stone, sand and gravel.
Baraga.....	105	99	Sand and gravel.
Barry.....	572	783	Sand and gravel, petroleum, stone.
Bay.....	10,230	9,851	Cement, petroleum, sand and gravel, lime.
Benzie.....	4	9	Sand and gravel.
Berrien.....	2,450	2,827	Sand and gravel, stone.
Branch.....	W	399	Do.
Calhoun.....	¹ 7,326	² 6,697	Petroleum, sand and gravel, stone, natural gas.
Cass.....	224	452	Sand and gravel, stone, petroleum.
Charlevoix.....	8,923	11,761	Cement, stone, sand and gravel.
Cheboygan.....	123	125	Sand and gravel, stone.
Chippewa.....	W	W	Stone, sand and gravel.
Clare.....	539	W	Petroleum, sand and gravel, natural gas.
Clinton.....	539	710	Sand and gravel, clays.
Crawford.....	1,049	² 1,405	Petroleum, sand and gravel, natural gas.
Delta.....	165	205	Sand and gravel, stone.
Dickinson.....	23,819	26,663	Iron ore, sand and gravel, stone.
Eaton.....	652	887	Sand and gravel, stone, clays, peat, petroleum.
Emmet.....	8,956	8,275	Cement, stone, sand and gravel.
Genesee.....	¹ 544	645	Sand and gravel, petroleum.
Gladwin.....	¹ 993	1,011	Petroleum, sand and gravel.
Gogebic.....	197	W	Sand and gravel.
Grand Traverse.....	274	189	Do.
Gratiot.....	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale.....	10,801	² 9,525	Petroleum, sand and gravel, stone, natural gas.
Houghton.....	3,015	210	Sand and gravel, stone.
Huron.....	886	970	Stone, sand and gravel, lime, petroleum.
Ingham.....	1,177	1,240	Sand and gravel, peat.
Ionia.....	260	483	Sand and gravel.
Iosco.....	4,836	5,011	Gypsum, sand and gravel.
Iron.....	11,344	9,565	Iron ore, sand and gravel.
Isabella.....	¹ 1,087	² 1,136	Petroleum, sand and gravel, natural gas.
Jackson.....	¹ 4,490	² 4,190	Petroleum, sand and gravel, stone, natural gas.
Kalamazoo.....	1,358	1,219	Sand and gravel, stone, peat.
Kalkaska.....	221	296	Petroleum, sand and gravel.
Kent.....	4,580	² 4,945	Sand and gravel, gypsum, petroleum, peat, natural gas.
Keweenaw.....	1,989	27	Sand and gravel.
Lake.....	W	626	Petroleum, sand and gravel.
Lapeer.....	2,112	² 1,479	Peat, petroleum, sand and gravel, salines, natural gas.
Leelanau.....	92	274	Sand and gravel, stone.
Lenawee.....	940	² 665	Sand and gravel, clays, petroleum, natural gas.
Livingston.....	3,819	3,738	Sand and gravel, petroleum.
Luce.....	112	92	Sand and gravel.
Mackinac.....	W	W	Stone, sand and gravel.
Macomb.....	¹ 2,454	² 2,770	Sand and gravel, petroleum, natural gas.
Manistee.....	20,795	25,790	Salt, salines, sand and gravel.
Marquette.....	114,494	134,424	Iron ore, sand and gravel.
Mason.....	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta.....	¹ 1,026	² 910	Petroleum, sand and gravel, peat, natural gas.
Menominee.....	705	W	Lime, sand and gravel.
Midland.....	W	W	Salines, salt, petroleum, sand and gravel.
Missaukee.....	1,476	² 1,791	Petroleum, sand and gravel, natural gas.
Monroe.....	W	W	Cement, stone, clays, peat, petroleum.
Montcalm.....	W	² 636	Petroleum, sand and gravel, natural gas.
Montmorency.....	53	31	Sand and gravel.
Muskegon.....	² 2,348	2,267	Salt, sand and gravel, petroleum.
Newaygo.....	¹ 423	443	Sand and gravel, petroleum.
Oakland.....	10,458	12,006	Sand and gravel, peat, petroleum.
Oceana.....	¹ 381	507	Sand and gravel, petroleum.
Ogemaw.....	¹ 1,757	² 1,412	Petroleum, sand and gravel, natural gas.
Ontonagon.....	59,041	73,412	Copper, silver, sand and gravel.
Oscoda.....	¹ 1,907	² 2,384	Petroleum, sand and gravel, natural gas.
Oscoda.....	51	20	Sand and gravel, petroleum.
Otsego.....	W	² 212	Sand and gravel, petroleum, natural gas.
Ottawa.....	2,412	² 3,066	Do.
Presque Isle.....	W	W	Stone, sand and gravel, petroleum.
Roscommon.....	W	² 772	Petroleum, sand and gravel, natural gas.
Saginaw.....	¹ 636	655	Clays, sand and gravel, lime, petroleum.
St. Clair.....	¹ 15,765	² 17,773	Salt, cement, petroleum, peat, clays, sand and gravel, natural gas.
St. Joseph.....	W	282	Sand and gravel, peat, stone.
Sanilac.....	1,095	1,468	Peat, sand and gravel, lime.
Schoolcraft.....	W	W	Stone, sand and gravel.
Shiawassee.....	¹ 773	830	Sand and gravel, peat, clays, petroleum.

See footnotes at end of table.

Table 2.—Value of mineral production in Michigan, by counties¹—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Tuscola	\$2,690	\$1,906	Sand and gravel, petroleum, lime.
Van Buren	349	273	Sand and gravel, petroleum.
Washtenaw	2,357	1,479	Do.
Wayne	54,477	56,213	Cement, lime, salt, sand and gravel, salines, stone, clays, petroleum.
Wexford	122	114	Sand and gravel.
Undistributed ²	206,121	202,999	
Total ⁴	627,075	668,247	

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² Values for natural gas and natural gas liquids are not available on a county basis, but are included with "Undistributed."

³ Excludes value of natural gas.

⁴ Includes values for natural gas, natural gas liquids, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

⁵ Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

	1968	1969	Change, percent
Employment and labor force, annual average: ¹			
Total labor force.....thousands..	3,520.2	3,571.9	+1.5
Agricultural employment.....do.....	63.8	60.0	-6.0
Nonagricultural employment ²do.....	3,279.1	3,361.0	+2.5
Manufacturing.....do.....	1,154.8	1,170.3	+1.3
Motor vehicles and equipment.....do.....	378.3	388.0	+2.6
Construction.....do.....	103.7	114.2	+10.1
Mining.....do.....	12.8	12.8	-----
Primary metal products.....do.....	101.3	104.3	+3.0
Stone, clay, and glass products.....do.....	17.4	19.8	+13.8
All other.....do.....	2,007.8	2,063.7	+2.8
Payrolls, manufacturing.....millions..	\$10,740.6	\$11,518.2	+7.2
Personal income:			
Total.....do.....	\$32,119	\$34,574	+7.6
Per capita.....do.....	\$3,703	\$3,944	+6.5
Construction activity:			
Building permits: ³			
Valuation of authorized residential construction.....millions..	\$885.1	\$858.3	-3.0
Number of private and public residential units authorized.....	59,987	55,329	-7.8
Contract construction work performed.....millions..	\$2,350	\$2,729	+16.1
State highway department:			
Contracts awarded.....do.....	\$136.3	\$147.6	+8.3
Contract work performed.....do.....	126.7	128.4	+1.3
Portland cement shipments to and within Michigan thousand 376-pound barrels.....	16,158	16,459	+1.9
Farm marketing receipts.....millions..	\$849.5	\$873.6	+2.8
Mineral production.....do.....	\$627.1	\$668.2	+6.6
Raw steel production.....thousand tons..	9,218	10,036	+8.9
Utility production and consumption:			
Production of electric energy by electric utilities million kilowatt-hours.....	52,102	55,267	+6.1
Natural gas consumption.....million cubic feet..	703,782	779,278	+10.7
Export trade ⁴millions..	\$3,485	\$4,172	+19.7
Import trade ⁴do.....	\$3,238	\$3,676	+13.5

¹ Revised. ² Preliminary.

³ Adjusted to March 1969 benchmark levels.

⁴ Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

⁵ Based on a nationwide survey of 13,000 permit issuing places.

⁶ Includes Detroit Customs District.

Sources: Michigan Employment Security Division in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, State of Michigan Department of Highways, Farm Income Situation, American Iron & Steel Institute, Federal Power Commission, and U.S. Department of Commerce.

Table 4.—Worktime and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1968:								
Peat.....	167	187	31	293	-----	-----	-----	-----
Metal.....	5,181	296	1,549	12,393	1	400	32.36	1,850
Nonmetal.....	1,798	275	494	3,952	-----	84	21.25	635
Sand and gravel.....	2,569	215	554	4,789	-----	104	21.72	963
Stone.....	3,412	288	983	7,918	-----	75	9.47	1,134
Total ¹	13,127	274	3,611	29,344	1	663	22.63	1,330
1969: ²								
Peat.....	183	189	35	332	-----	1	3.01	84
Metal.....	5,170	268	1,393	11,147	5	310	28.26	4,159
Nonmetal.....	1,825	275	503	4,023	-----	96	23.86	475
Sand and gravel.....	2,635	219	577	4,968	3	100	20.73	4,924
Stone.....	3,435	289	993	7,941	2	59	7.68	1,980
Total ¹	13,250	264	3,501	28,412	10	566	20.27	3,114

² Preliminary.

³ Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement shipments reversed the upward trend which began in 1960 and were 3 percent less than in 1968. The value of shipments, however, declined less than 1 percent as the unit value (barrels) increased to \$3.24 from \$3.16 in the previous year. Masonry cement output declined 5 percent, but value dropped only 1 percent because of an increase in price of 12 cents per barrel to \$2.87. Portland cement was produced at nine plants in seven counties (Alpena, Bay, Charlevoix, Emmet, Monroe, St. Clair, and Wayne); masonry cement, as in 1968, was shipped from six of these plants. Annual finished portland cement capacity exceeded 39 million barrels. Yearend stocks of portland cement at mills were 4.3 million barrels compared with 3.9 million barrels in 1968. More than 96 percent of portland cement shipped was types I and II (general use and moderate heat); the remainder was principally type III (high-early-strength) and portland-pozzolan. More

than 49 percent of the portland cement and 63 percent of the masonry cement were shipped to consumers within the State. Out-of-State distribution went mostly to Wisconsin, Ohio, Illinois, Indiana, Minnesota, and New York.

Ready-mixed concrete companies purchased about three-fifths of the shipments with the remainder going principally to concrete product manufacturers (16 percent), highway contractors (13 percent), and building material dealers (9 percent). About 1.7 million barrels of cement, mostly portland, were shipped into Michigan. About three-fourths of these shipments originated in Ohio, with the remainder coming mostly from Indiana and Pennsylvania.

Raw materials used in portland cement manufacture included 7.9 million tons of limestone, about 2.3 million tons of clay or shale, as well as quantities of gypsum, sand, iron ore, slag, mill scale, air-entraining compounds, and grinding aids. Over 757 million kilowatt-hours of electricity

Table 5.—Finished portland cement produced, shipped, and in stock

(Thousand 376-pound barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills		Stocks at mills Dec. 31
			Quantity	Value	
1965	8	27,018	27,565	\$86,996	2,110
1966	8	28,848	28,171	87,413	3,219
1967	9	29,862	29,645	94,515	3,813
1968	9	31,195	31,375	99,158	3,911
1969	9	30,565	30,373	98,425	4,320

¹ Revised.

was used, of which 410 million was purchased and the remainder generated by the consumer. Shipments of portland cement were by truck (85 percent), water (10 percent), and rail (5 percent).

American Cement Corp. announced that site preparation had begun in Detroit on the \$75 million cement plant for its Peercless Division. The new plant, to be operational in 1971, with one 580-foot kiln, will have an annual capacity of 5 million barrels initially. When completed, the plant will be a three-kiln operation with a capacity of 12 million barrels. The first phase will replace the oldest of two existing Detroit plants. The other Detroit plant, as well as the Port Huron operation, will be discontinued when the entire program is completed.

Clays.—Miscellaneous clays and shale were mined at 15 pits in 10 counties. Clay for use in manufacturing pottery and stoneware, lightweight aggregate, and cement was in greater demand than in 1968, while lesser quantities were required for heavy clay products (brick, tile, and sewer pipe). Total clay production was about 3 percent greater than in 1968. About 88 percent of the clay or shale was used in cement manufacture, and the remainder was used for lightweight aggregate, heavy clay products, pottery, and stoneware. The largest production was reported from Alpena, Wayne, Monroe, Antrim, Saginaw, and St. Clair Counties. Construction Aggregates Corp. completed a \$2 million lightweight aggregate plant near Grand Haven. The 1,200-ton-per-day plant incorporates a Dwight-Lloyd sinter machine with a rated capacity of 50 tons per hour, reportedly the largest ever used for the production of lightweight aggregate.

Gem Stones.—Gem stones were found along Lake Superior beaches in the Upper Peninsula, as well as on Isle Royale. Agates, thomsonite, and other semiprecious stones, as well as specimens of native copper and hematite, were collected by hobbyists.

Gypsum.—Crude gypsum production declined nearly 6 percent, but value increased by nearly 4 percent. Underground mines were operated at Grand Rapids; the output was processed at adjoining plants for plaster, lath, and wall-board. In Iosco County, gypsum was produced at several quarries at Whittemore,

Tawas City, and Alabaster. Crude gypsum was sold for portland cement retarder and also supplied building material plants at National City, Detroit, and in Ohio and Wisconsin. Gypsum materials were shipped by lake transport from company-owned port facilities at National City and Alabaster.

Lime.—Lime output declined by nearly 3 percent, but value increased by the same amount because of higher prices. An increased demand for lime was reported for use in sugar refining, water purification, paper manufacture, sewage treatment, and chemical manufacture. Lime for metallurgical use declined slightly, while demand for lime for alkali production decreased substantially. Lime plants were operated in eight counties. Plants in Wayne County produced 78 percent of the State total and supplied steel mills and chemical plants in the Detroit area. About 51 percent of the lime output was used by the producers, and the remainder was sold. Only 7 percent was shipped out of the State. About 287,000 tons of lime, mostly quicklime, was shipped into Michigan, with 225,000 tons coming from Ohio. Lime regenerated at paper mills and water purification plants is not included in the total State production.

Natural Salines.—Bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash were extracted from natural well brines at chemical plants in Gratiot, Lapeer, Manistee, Mason, Midland, and Wayne Counties. Total value of output was 7 percent larger than in 1968. Record highs for production of bromine, calcium compounds, and iodine were established in 1969. Standard Lime & Refractories Co., a division of Martin Marietta Corp., started production of high-purity, lightburn magnesia products at Manistee. The new facility is part of an \$8 million expansion program underway at the Manistee plant.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Iosco, Kent, and Wayne Counties. The material was used for building plaster.

Salt.—Salt was recovered from natural and artificial brines at plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties and produced from an underground mine at Detroit. Production declined less than 2 percent, and

value was more than 3 percent higher than in 1968. Michigan salt was widely distributed with the largest shipments going to contiguous States.

Sand and Gravel.—Production of sand and gravel increased nearly 3 percent and was valued at \$59 million, more than 7 percent higher than in 1968. Michigan ranked second nationally in sand and gravel output. In 1969, sand and gravel demand increased 11 percent for building use and 9 percent for industrial use (molding, glass, engine, etc.), while demand for paving use and for fill material

declined about 1 and 5 percent, respectively. Nearly every county in Michigan reported sand and gravel production. In each of 11 counties, output exceeded 1 million tons. These counties provided nearly three-fifths of the State production. Five of these counties make up metropolitan Detroit and produced nearly 23 million tons. Most of the sand and gravel was moved by truck (91 percent); the remainder was shipped by rail (6 percent) and water (3 percent). Production was reported from 415 commercial and 119 Government-and-contractor operations.

Table 6.—Sand and gravel sold or used by producers, by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	7,475	\$6,481	8,179	\$7,172
Paving.....	6,704	5,585	5,366	4,886
Fill.....	3,956	1,743	4,189	2,076
Molding.....	4,129	7,637	4,468	8,734
Other ¹	914	2,177	941	2,448
Total ²	23,178	23,623	23,143	25,315
Gravel:				
Building.....	6,425	9,727	7,291	11,087
Paving.....	18,666	16,915	19,647	17,637
Fill.....	393	293	325	247
Railroad ballast.....	W	W	173	260
Other.....	188	304	80	90
Total ²	25,672	27,239	27,518	29,321
Total sand and gravel.....	48,850	50,862	50,661	54,636
Government-and-contractor operations:				
Sand:				
Building.....			13	6
Paving.....	1,839	845	1,715	903
Fill.....	747	310	356	148
Other.....	151	58	135	63
Total ²	2,737	1,213	2,218	1,121
Gravel:				
Building.....	21	11	11	7
Paving.....	4,753	2,759	4,956	3,094
Fill.....	301	134	246	111
Other.....	1	(³)		
Total.....	5,076	2,904	5,213	3,212
Total sand and gravel ²	7,813	4,111	7,431	4,332
All operations:				
Sand.....	25,915	24,836	25,362	26,436
Gravel.....	30,748	30,143	32,730	32,532
Total.....	56,663	54,979	58,092	58,968

W Withheld to avoid disclosing individual confidential data; included with "Other."

¹ Includes chemical and railroad ballast (1968), abrasives, blast, enamel, engine, glass, pottery, porcelain, tile, and other construction and industrial sand.

² Data may not add to totals shown because of independent rounding.

³ Less than 1/2 unit.

Table 7.—Production of sand and gravel by counties
(Thousand short tons and thousand dollars)

County	1968		1969		County	1968		1969	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Aleona	230	\$117	391	\$225	Leelanau	148	\$92	250	W
Alger	63	39	64	38	Lenawee	1,122	915	709	\$656
Allegan	751	462	776	525	Livingston	3,593	3,816	3,435	3,736
Alpena	135	120	112	110	Luce	221	112	172	92
Antrim	92	W	95	W	Mackinac	205	98	196	102
Arenac	49	39	50	41	Macomb	2,838	2,423	3,202	2,747
Baraga	214	105	150	99	Manistee	W	W	W	W
Barry	537	531	797	740	Marquette	363	W	490	W
Bay	W	W	W	W	Mason	W	W	1,145	W
Benzie	12	4	17	9	Mecosta	324	W	331	W
Berrien	1,982	2,445	1,828	2,824	Menominee	407	W	400	238
Branch	455	W	332	398	Midland	327	W	272	W
Calhoun	760	W	481	335	Missaukee	5	3	88	68
Cass	245	203	580	436	Monroe	W	W	W	W
Charlevoix	114	W	113	W	Montcalm	328	W	487	266
Cheboygan	86	W	114	W	Montmorency	81	53	50	31
Chippewa	285	209	456	345	Muskegon	487	W	463	W
Clare	186	W	205	W	Newaygo	701	354	517	323
Clinton	601	W	773	W	Oakland	10,365	10,395	11,779	11,944
Crawford	30	19	21	24	Oceana	320	210	558	405
Delta	264	W	293	W	Ogemaw	1,099	937	773	567
Dickinson	143	W	104	W	Ontonagon	234	144	141	89
Eaton	402	313	730	589	Oscoda	221	176	374	316
Emmet	81	W	86	W	Otsego	91	46	29	15
Genesee	572	517	805	614	Ottawa	11	W	W	W
Gladwin	29	17	47	33	Presque Isle	2,479	2,184	2,729	2,835
Gogebic	276	197	163	W	Roscommon	565	W	470	W
Grand Traverse	548	274	253	189	Saginaw	W	W	308	W
Gratiot	326	297	425	395	St. Clair	141	75	109	55
Hillsdale	W	W	493	576	St. Joseph	538	W	301	276
Houghton	269	223	255	W	Sanilac	342	W	339	W
Huron	157	126	398	W	Schoolcraft	29	19	92	56
Ingham	1,378	1,175	1,575	1,237	Shiawassee	699	W	761	564
Ionia	425	260	575	483	Tuscola	2,950	W	1,525	W
Iosco	672	W	700	490	Van Buren	416	318	364	245
Iron	226	W	181	197	Washtenaw	1,942	2,306	1,548	1,461
Isabella	502	401	593	449	Wayne	2,686	4,477	2,696	4,978
Jackson	318	308	406	391	Wexford	158	122	143	114
Kalamazoo	1,110	1,304	941	1,163	Undistributed ¹	3,008	12,296	1,083	9,484
Kalkaska	17	9	19	11					
Kent	2,913	3,496	2,946	3,822					
Keweenaw	40	18	48	27					
Lake	W	W	35	20					
Lapeer	324	180	292	176					
Total ²	56,663	54,979	58,092	58,968					

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

¹ Includes production for which no county breakdown is available and data indicated by symbol W.

² Data may not add to totals shown because of independent rounding.

Stone.—The upward trend in stone production continued in 1969, with value up 6 percent and volume 5 percent larger than in 1968. Stone was quarried in 27 counties; five counties with production of 1 million tons or more contributed 91 percent of the State total. Nearly all the stone produced was crushed limestone and dolomite, chiefly from very large quarries and crushing plants in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties.

A large proportion of the material (73 percent) was shipped by boat from company-operated ports on Lakes Huron and Michigan to steel mills, cement and lime plants, and other consumers. In table 9, the distribution of crushed and broken

stone shipments by type of use is shown. Little change in pattern from 1968 was evident. Small quantities of dimension limestone and sandstone were produced for building use. Dimension limestone was quarried and milled in Eaton, Huron, Presque Isle, and Schoolcraft Counties; in Jackson County sandstone was produced and used as rubble; in Dickinson County granite was quarried and crushed for use as terrazzo and exposed aggregate; and in Houghton County basalt was quarried and crushed for road use. Marl was produced in 10 counties for agricultural use, with the bulk of the material being dipped from pits in Cass, Calhoun, and Kalamazoo Counties.

Table 8.—Dimension stone sold or used by producers, by kinds

Year	Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1965	5,286	\$76,989	6,396	\$42,760	11,682	\$119,749
1966	4,266	64,166	8,109	53,510	12,375	117,676
1967	3,241	61,150	2,770	16,890	6,011	77,840
1968	2,680	51,271	1,500	15,000	4,180	66,271
1969	4,242	58,954	1,000	10,000	5,242	68,954

Table 9.—Crushed and broken stone sold or used by producers, by kinds and uses¹
(Thousand short tons and thousand dollars)

Kind and use	1968		1969	
	Quantity	Value	Quantity	Value
Granite: Exposed aggregate	2	\$60	W	W
Limestone and dolomite:				
Concrete aggregate and roadstone:				
Concrete aggregate	3,490	4,035	3,372	\$3,574
Bituminous aggregate	1,023	1,352	1,268	1,652
Macadam aggregate	214	307	266	357
Dense graded road base stone	936	1,151	1,137	1,640
Surface treatment aggregate	334	485	378	513
Unspecified aggregate and roadstone	NA	NA	518	604
Total aggregate and roadstone ¹	5,997	7,329	6,940	8,340
Agricultural limestone	689	872	624	768
Cement	9,370	7,954	9,310	8,174
Flux	11,376	14,327	12,351	15,591
Lime	6,792	7,102	7,729	8,175
Railroad ballast	2,811	370	107	124
Other ²	2,612	2,878	2,005	2,197
Total ¹	37,116	40,827	39,067	43,368
Marl: Agricultural purposes	134	106	99	86
Traprock (basalt): Surface treatment aggregates	21	33	W	W
Grand total ¹	37,275	41,026	39,180	43,503

NA Not available. W Withheld to avoid disclosing individual company confidential data; included in "Grand total."

¹ Data may not add to totals shown because of independent rounding.

² Includes stone used for asphalt filler and other fillers or extenders; mine dusting (1968); chemical uses; dead-burned dolomite; poultry grit and mineral food; riprap and jetty stone; stone sand; terrazzo and exposed aggregate; and other uses.

Sulfur.—Byproduct sulfur was recovered from crude petroleum at oil refineries in Alma, Detroit, and Trenton. Shipments increased about 17 percent, but value of output declined by 10 percent because of lower prices.

Vermiculite.—Crude vermiculite, mined outside the State, was exfoliated at a plant in the Detroit area. It was sold for use in loose fill insulation, building plaster, concrete aggregate, and for agricultural and other uses.

METALS

Copper.—Production of copper, in terms of recoverable metal, increased slightly in 1969 but value increased 14 percent. The average weighted price for copper increased from 41.8 cents in 1968 to 47.5

cents per pound. The labor strike which began on August 21, 1968, at the Calumet Division, Universal Oil Products Co., continued into 1969. On April 8 the facilities of the Calumet Division in Upper Michigan were closed. The 104-year-old copper operation employed more than 1,000 miners, millmen, and smelter workers in the Houghton-Keweenaw area and accounted for more than half of the taxes in the area. The White Pine mine of White Pine Copper Co., in Ontonagon County, is now the only producer of primary copper in Michigan.

Iron Ore.—Iron ore shipments in 1969 were 11 percent higher than in 1968. Pellets accounted for 83 percent of the total shipments compared with 77 percent in 1968. The average weighted mine value for Michigan usable iron ore in 1969 was

Table 10.—Mine production of copper, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailing	Ore (thousand short tons)	Tailing (thousand short tons)	Short tons	Value (thousands)
1965	10	3	7,368	1,611	71,749	\$50,798
1966	10	3	8,000	1,851	73,449	53,133
1967	8	3	6,091	1,307	58,458	44,692
1968	4	--	8,027	-----	74,805	62,607
1969	1	--	8,200	-----	75,226	71,516

\$12.08 compared with \$11.72 the previous year. About 86 percent of the crude ore came from open pit mines, and the remainder came from five underground mines. The average iron content of usable ore produced was 60.99 percent natural, compared with 60.56 percent in 1968.

The Homer and Wauseca underground mines at Iron River, operated by The Hanna Mining Co., were closed permanently on June 27 after 58 years of operation and shipment of 31.5 million tons of ore. The Bristol underground mine at Crystal Falls, operated by Inland Steel Co.

was closed in July because of lessening demand for Bristol-type ore. The Bristol mine had produced 15 million tons of ore since its opening in 1892. The Chicago & Northwestern Railway Co. began operating its new \$16 million ore storage and loading facilities at Escanaba. A new ore shipping record of 6.9 million tons was established at the port in 1969, surpassing the previous high of 6.6 million tons in 1966. The lake shipping season for Michigan iron ore opened at Escanaba on April 6 and closed at the same port on December 24.

Table 11.—Crude iron ore data, in 1969, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To concentrators	
County:						
Dickinson	1,131	1,299	5,200	1,284	5,200	1,146
Iron	590	2,708	20,378	688	22,393	595
Marquette						
Total ¹	1,722	4,006	25,577	1,972	27,592	1,741
Range:						
Marquette	590	2,708	20,378	688	22,393	595
Menominee	1,131	1,299	5,200	1,284	5,200	1,146
Total ¹	1,722	4,006	25,577	1,972	27,592	1,741

^r Revised.¹ Data may not add to totals shown because of independent rounding.Table 12.—Usable iron ore¹ produced (direct-shipping and all forms of concentrate), by ranges

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total		
				Gross weight		Iron content (percent)
				Ore ²	Iron content	
1854-1964	330,807	270,514	248,710	850,031	NA	NA
1965	8,973	4,595	753	14,322	8,343	58.25
1966	9,589	4,620	113	14,322	8,432	58.87
1967	10,231	3,750	49	14,030	8,453	60.25
1968	10,086	3,684	-----	13,770	8,339	60.56
1969	10,048	3,369	-----	13,417	8,183	60.99
Total ²	379,734	290,531	249,626	919,892	NA	NA

NA Not available.

¹ Exclusive, after 1905, of iron ore containing 5 percent or more manganese.² Data may not add to totals shown because of independent rounding.³ Distribution by range partly estimated before 1906.

Table 13.—Iron ore shipped from mines

(Thousand long tons)

Year	Direct-shipping ore ¹	Concentrates			Total usable ore ²	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total ²		
1965	4,969	7,554	1,004	8,558	13,527	63.26
1966	4,272	8,690	1,415	10,106	14,377	70.28
1967	3,011	10,336	783	11,119	14,180	78.69
1968	2,353	9,786	560	10,346	12,699	81.47
1969	1,972	11,657	429	12,086	14,058	85.97

¹ Includes crushed, screened, and sized ore not further treated.² Data may not add to totals shown because of independent rounding.

Pig Iron and Steel.—Pig iron and steel were manufactured in the Detroit area by the Ford Motor Co. at Dearborn; National Steel Corp. at Ecorse; and McClouth Steel Corp. at Trenton. Pig iron shipments and value increased 4 and 6 percent, respectively, compared with 1968. Basic and foundry grades were produced, and a small quantity of low-phosphorus grade was shipped from stock. About 2.8 million tons of iron and manganese ores, mostly domestic, was consumed in agglomerating plants and blast and steel furnaces. The American Iron & Steel Institute reported Michigan steel production of 10.0 million tons, compared with 9.2 million tons in 1968.

Silver.—Silver was recovered from copper ore mined at the White Pine mine. Concentrate from a silver-recovery circuit in the White Pine mill was smelted separately for delivery to an outside smelter where the silver was recovered. Silver output more than doubled while value was 78 percent higher than in 1968.

MINERAL FUELS

Natural Gas and Natural Gas Products.—Natural gas was produced in 21 counties from both gas and oil wells, with 92 percent coming from five counties—Calhoun, Hillsdale, Jackson, Macomb, and St. Clair. Natural gas liquids were stripped from Michigan gas principally at the Albion-Scipio, Bell River Mills, Boyd, and Reed City gas plants. Additional natural gas liquids were stripped from out-of-State gas delivered by interstate pipeline to a plant in Washtenaw County.

Peat.—Although State output declined 22 percent in 1969, Michigan continued to be the largest producer of peat, accounting for 33 percent of the U.S. total. Peat was

produced in 13 counties; Sanilac County and Lapeer County accounted for 36 percent and 33 percent of the State total, respectively. Nearly 95 percent of the total output was used for general soil improvement, with the remainder being used as an ingredient for potting soils, for mushroom beds, and packing flowers, shrubs, etc. Over 77 percent of the sales was in packaged form. Reed-sedge peat accounted for 83 percent of the total sales, humus peat 12 percent, and moss peat 5 percent.

Petroleum.—Petroleum was produced in 47 counties. The largest output was from Calhoun, Jackson, and Hillsdale Counties (Albion-Pulaski-Scipio trend). In October, oil and gas discoveries near Gaylord and Traverse City indicated that a major oil and gas-producing area might develop in the Niagaran formation that extends 170 miles across the northern part of the lower peninsula from Alpena to Ludington. According to the Geological Survey Division, Michigan Department of Natural Resources, the statewide discovery-to-dry hole ratio for exploratory or new field wildcat wells was about 1 to 16 as compared with 1 to 12 in 1968. In St. Clair and Macomb Counties, where about 27 percent of the wildcats were drilled in 1969 (about 40 percent in 1968), the ratio was about 1 to 42 as compared with 1 to 16 in 1968. In the northern district, an area covering about 8,226 square miles, the success ratio was about 1 to 5 in 1969. About 38 percent of the exploratory wells bottomed out in Devonian age rocks, 37 percent in Silurian, 19 percent in Ordovician, and about 1 percent in Cambrian or older rocks. The remaining 5 percent was drilled in rocks younger than Devonian. There were eight new field discoveries and two new pool discoveries in 1969. One Precambrian test

was drilled in Wayne County in connection with a brine disposal well used in LPG storage operations. There were eight active refineries having an operating capac-

ity of 159,400 barrels per day. Two additional refineries were closed during the year. Their capacities are not included in the preceding figures.

Table 14.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1968		1969	
	Quantity ¹	Value ²	Quantity ¹	Value ²
Allegan	185	\$546	141	\$432
Arenac	253	746	231	708
Barry	12	35	12	37
Bay	309	911	285	876
Calhoun	2,325	6,862	2,067	6,344
Cass	1	3	1	3
Clare	562	1,659	539	1,654
Crawford	349	1,030	450	1,381
Eaton			(³)	1
Genesee	9	27	10	31
Gladwin	331	976	319	978
Gratiot	17	51	12	36
Hillsdale	3,511	10,362	2,915	8,949
Huron	2	5	2	6
Ionia	(³)	(³)		
Isabella	232	686	224	687
Jackson	1,401	4,135	1,223	3,755
Kalamazoo	72	212	93	285
Kent	76	224	74	227
Lake	56	166	197	606
Lapeer	70	208	71	219
Lenawee	(³)	1	(³)	1
Livingston	1	3	1	2
Macomb	10	31	7	23
Mason	70	207	57	175
Mecosta	276	814	222	682
Midland	206	607	200	615
Missaukee	499	1,473	561	1,723
Monroe	4	11	3	10
Montcalm	149	438	121	370
Muskegon	72	211	54	167
Newaygo	23	69	38	115
Oakland	1	3	(³)	1
Oceana	58	171	33	102
Ogemaw	278	820	275	845
Osceola	587	1,731	673	2,068
Oscoda	2	5	2	5
Otsego			13	39
Ottawa	77	227	75	231
Presque Isle			1	4
Roscommon	163	481	157	483
Saginaw	23	68	22	67
St. Clair	581	1,716	721	2,214
Shiawassee	12	34	10	31
Tuscola	71	209	67	205
Van Buren	11	31	9	28
Washtenaw	17	51	6	18
Wayne	11	31	19	57
Total ⁴	12,974	38,287	12,213	37,494

¹ Revised.

² Source: State of Michigan, Department of Natural Resources.

³ County values calculated by using State average value per barrel; \$2.95 for 1968 and \$3.07 for 1969.

⁴ Less than 1/2 unit.

⁵ Data may not add to totals shown because of independent rounding.

Table 15.—Oil and gas wells drilled in 1969

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage ¹
Allegan	1		1			3	5	8,132
Antrim						3	3	19,773
Arenac						1	1	3,058
Barry						1	1	4,703
Bay								2,730
Benzie						1	1	5,282
Branch						8	8	30,424
Calhoun	7	1	20			4	32	149,945
Cass						1	1	1,154
Cheboygan						1	1	4,495
Clare	2	1	3				6	25,664
Clinton						1	1	7,787
Crawford						1	1	7,241
Eaton				1		6	7	35,722
Genesee						1	1	3,143
Gladwin						1	1	3,962
Grand Traverse					1		1	6,922
Gratiot						7	7	21,137
Hillsdale			2			2	4	13,605
Ionia						1	1	6,400
Isabella	1			1			2	9,641
Jackson	1		2			5	8	34,753
Kalamazoo						2	2	4,760
Kalamazoo						2	2	14,290
Kent						1	1	359
Lake	15		8			3	26	66,133
Lapeer	1		2	1			4	12,230
Lenawee		1	1		1		2	4,591
Livingston		1	1				2	9,525
Macomb			1			18	19	62,000
Manistee						2	2	7,226
Mason	1		5			4	10	23,010
Mecosta	1		3			4	8	29,666
Missaukee	3		4			3	10	35,037
Montcalm						2	2	6,798
Muskegon			4			1	5	9,131
Newaygo	1		9			4	14	39,568
Oakland		2					2	8,679
Oceana			2	2		9	13	24,608
Ogemaw			1			1	1	4,272
Osceola	2		3			9	14	50,952
Otsego	1		1	1		2	5	32,997
Ottawa			1			2	3	6,737
Presque Isle			1	1		3	5	16,888
Saginaw						1	1	1,750
St. Clair	27		14		1	23	65	203,392
Shiawassee	1		1			1	3	5,979
Tuscola	1					1	2	5,825
Van Buren						1	1	2,771
Washtenaw			1			1	2	7,104
Wexford						1	1	4,045
Total	66	6	91	7	3	148	321	1,104,096

¹ Includes only wells drilled and completed for oil and gas.

² Old well drilled deeper.

Table 16.—Principal producers¹

Commodity and company	Address	Type of activity	County
Cement:			
Aetna Portland Cement Co., div. of Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Portland and masonry, wet process.	Bay.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	do.	Monroe.
Huron Cement Co., div. of National Gypsum Co.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Portland and masonry, dry process.	Alpena.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Portland, wet process.	Charlevoix.
Peerless Cement Co., div. of American Cement Corp.: Port Huron Plant.	900 Detroit Trade Center Detroit, Mich. 48226	Portland, wet process.	St. Clair.
Brennan Ave. Plant.		do.	Wayne.
Jefferson Ave. Plant.		Portland and masonry, wet process.	Do.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	do.	Emmet.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	do.	Wayne.
Clays and shale:			
Aetna Portland Cement Co., div. of Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Pit.	Saginaw.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	Pit.	Monroe.
Huron Cement Co., div. of National Gypsum Co.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Pit.	Alpena.
Light Weight Aggregate Corp.	12720 Farmington Rd. Livonia, Mich. 48150	Pit and plant.	Wayne.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Pit.	Antrim.
Peerless Cement Co., div. of American Cement Corp.	900 Detroit Trade Center Detroit, Mich. 48226	Pits.	St. Clair, Wayne.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Pit.	Antrim.
Coke:			
Industrial Chemicals Div. Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	Coke ovens.	Wayne.
Ford Motor Co.	The American Rd. Dearborn, Mich. 48121	do.	Do.
National Steel Corp. (Great Lakes Steel Div.)	2800 Grant Bldg. Pittsburgh, Pa. 15219	do.	Do.
Copper:			
White Pine Copper Co.	Box 427 White Pine, Mich. 49971	Mine and mill.	Ontonagon.
Gypsum:			
Georgia-Pacific Corp. Gypsum Division.	900 SW. 5th Portland, Oreg. 97204	Underground mine, and calcining and board plant.	Kent.
Grand Rapids Gypsum Co.	Box 1674 Grand Rapids, Mich. 49501	do.	Do.
Michigan Gypsum Co.	2840 Bay Rd. Saginaw, Mich. 48601	Open pit mine.	Iosco.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	Open pit mine and calcining and board plant.	Do.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Open pit mine.	Do.
		Calcining and board plant.	Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Cliffs Shaft.		Stockpile shipments.	Marquette.
Eagle Mills pellet plant.		Pelletizes ore from the Republic mine.	Do.
Empire.		Open pit mine, concentrator, and agglomerator.	Do.
Humboldt.		do.	Do.
Mather.		Underground mine. Ore treated at the Ore Improvement Plant and Pioneer Pellet Plant.	Do.
Ore improvement plant.		Processes Mather ore.	Do.
Pioneer pellet plant.		Pelletizes ore from the Mather mine.	Do.

See footnote at end of table.

Table 16.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
Cleveland-Cliffs Iron Co.—Continued Republic.	1460 Union Commerce Bldg. Cleveland, Ohio 44115	Open pit mine, concentrator. Part of the concentrates pelletized at the Eagle Mills plant.	Marquette.
Tilden.		Open pit mine.	Do.
The Hanna Mining Co.:			
Groveland.	100 Erieview Plaza Cleveland, Ohio 44114	Open pit mine, concentrator, and agglomerator.	Dickinson.
Homer.		Underground mine.	Iron.
Wauseca.		Stockpile shipments.	Do.
Inland Steel Co.:			
Bristol.	30 West Monroe St. Chicago, Ill. 60603	Underground mine.	Do.
Sherwood.		do.	Do.
Jones & Laughlin Steel Corp.: Tracy.	Michigan Ore Division Negaunee, Mich. 49866	do.	Marquette.
Iron and steel:			
Ford Motor Co.	The American Rd. Dearborn, Mich. 48121	Iron blast furnaces and open-hearth steel furnaces.	Wayne.
McLouth Steel Corp.	300 South Livernois Ave. Detroit, Mich. 48217	do.	Do.
National Steel Corp., Great Lakes Steel Div.	2800 Grant Bldg. Pittsburgh, Pa. 15219	do.	Do.
Lime:			
Detroit Lime Co., subsidiary of Edward C. Levy Co.	8800 Dix Ave. Detroit, Mich. 48209	Quicklime, shaft and rotary kilns.	Do.
The Dow Chemical Co.	Midland, Mich. 48640	Quicklime, 3 rotary kilns, continuous hydrator.	Mason.
Marblehead Lime Co.	300 West Washington St. Chicago, Ill. 60606	Quicklime, 2 rotary kilns.	Wayne.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Quicklime, 9 shaft kilns.	Do.
Peat:			
Anderson Peat Co.	2562 Graham Rd. Imlay City, Mich. 48444	Bog, processing plant.	Lapeer.
Fletcher & Rickard.	54001 Grand River Rd. New Hudson, Mich. 48165	do.	Oakland.
J. M. Huber Corp.	(Peat Department) Thornall St. Edison, N.J. 08817	do.	Sanilac.
Michigan Peat.	1 Decker Sq., Suite 325 Bala-Cynwyd, Pa. 19004	Bogs, processing plant.	St. Clair, Sanilac.
Scenic Lakes, Inc.	Box 566 East Lansing, Mich. 48823	Bog, processing plant.	Shiawassee.
Expanded Perlite:			
Georgia-Pacific Corp. Gypsum Division	900 SW. 5th Portland, Oreg. 97204	Processing plant.	Kent.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	do.	Iosco.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	do.	Wayne.
Petroleum refineries:			
Bay Refining Division, The Dow Chemical Co.	4868 Wilder Rd. Bay City, Mich. 48709		Bay.
Crystal Refining Co.	901 North Williams Carson City, Mich. 48811		Montcalm.
Lakeside Refining Co.	2705 East Cork Kalamazoo, Mich. 49001		Kalamazoo.
Leonard Refineries, Inc.:			
Alma Division.	East Superior St. Alma, Mich. 48801		Gratiot.
Roosevelt Oil & Refining Division.	Box 271 Pickard Ave. & A.A.R.R. Mount Pleasant, Mich. 48858		Isabella.
Marathon Oil Co.	1300 South Fort St. Detroit, Mich. 48217		Wayne.
Naph-Sol Refining Co.	1222 M-20, Box 630 Muskegon, Mich. 49443		Muskegon.
Osceola Refining Co.	Box 178 Reed City, Mich. 49677		Ogemaw.
Petroleum Specialties, Inc.	Box 448 Trenton, Mich. 48183		Wayne.
Socony Mobil Oil Co., Inc.	Box 477 Trenton, Mich. 48183		Do.
Salt and salines:			
American Salt Corp.	3142 Broadway Kansas City, Mo. 64111	Processing plant: Salt.	Midland.

See footnote at end of table.

Table 16.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Salt and salines—Continued			
Diamond Crystal Salt Co.	916 South Riverside St. Clair, Mich. 48079	Brine wells and processing plant: Salt.	St. Clair.
The Dow Chemical Co.:			
Ludington Plant	Midland, Mich. 48640	Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds.	Mason.
Midland Plant		Brine wells and processing plant: Bromine, calcium compounds, iodine, magnesium compounds, potash, salt.	Midland.
Harbison-Walker Refractories Co.			
Hardy Salt Co.	2 Gateway Center Pittsburgh, Pa. 15222 P.O. Drawer 449 St. Louis, Mo. 61366	Processing plant: Magnesium compounds.	Mason.
Hooker Chemical Corp.	Box 295 Montague, Mich. 49437	Processing plant: Salt.	Manistee.
International Salt Co.	Clarks Summit, Pa. 18411	Underground salt mine	Wayne.
Kaiser Aluminum & Chemical Corp.	900 17th St., NW. Washington, D.C. 20006	Processing plant: Magnesium compounds.	Midland.
Michigan Chemical Corp.:	321 East Ohio St. Chicago, Ill. 60611		
Manistee Plant		Processing plant: Bromine.	Do.
St. Louis Plant		Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds, salt.	Gratiot.
Morton Chemical Co., div. of Morton-Norwich Products, Inc.			
Morton Salt Co., div. of Morton-Norwich Products, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds.	Manistee.
Manistee Plant		Brine wells and processing plant: Salt.	Do.
St. Clair Plant		do.	St. Clair.
Pennwalt Corp.	3 Penn Center Philadelphia, Pa. 19102	Brine wells and processing plant: Salt.	Wayne.
Standard Lime & Refractories Co., div. of Martin Marietta Corp.	2000 First National Bank Bldg. Baltimore, Md. 21203	Brine wells and processing plant: Magnesium compounds.	Manistee.
Wilkinson Chemical Corp.	Mayville, Mich. 48744	Brine wells and processing plant: Calcium compounds.	Lapeer.
Wyandotte Chemicals Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Brine wells and processing plant: Calcium compounds and salt.	Wayne.
Sand and gravel:			
American Aggregates Corp.	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits and stationary plants.	Kalamazoo, Livingston, Macomb, Oakland.
Arrowhead Silica Corp., Manley Bros. Division	128 South 15th St. Chesterton, Ind. 46304	Pit and stationary plant.	Berrien.
J. V. Burkett Contractors Co., Inc.	St. Joseph, Mich. 49085	Pits and portable plant.	Kent, Newaygo.
Cole Brothers, Cole Brothers Contractors, Inc.	Route 3, Box 346 Battle Creek, Mich. 49017	Pits and stationary and portable plants.	Barry, Calhoun, Hillsdale, Ionia, Kalamazoo, St. Joseph.
Construction Aggregates Corp.	120 South LaSalle St. Chicago, Ill. 60603	Pit and stationary plants.	Ottawa.
R. E. Glancy, Inc.	1055 South Bay Dr. Tawas City, Mich. 48763	Pit and portable plant.	Iosco.
Grand Rapids Gravel Co.	2700 28th St., SW. Grand Rapids, Mich. 49509	Pits and stationary plants.	Kent.
Great Lakes Foundry Sand Co.	1217 Francis Palms Bldg. Detroit, Mich. 48201	Pit and stationary plant.	Tuscola.
Holloway Sand & Gravel Co.	29250 Wixom Rd., Box 247 Wixom, Mich. 48096	Pits and portable plants.	Genesee, Oakland, Ogemaw, Otsego.

See footnote at end of table.

Table 16.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Holly Sand & Gravel Plant, J. P. Burroughs & Sons, Inc.	16240 Tindall Rd. Davisburg, Mich. 48019	Pit and stationary plant.	Oakland.
Koenig Fuel & Supply Co.	1486 Gratiot Ave. Detroit, Mich. 48207	do.	Do.
Lyon Sand & Gravel Co., div. of E. C. Levy Co.	9300 Dix Dearborn, Mich. 48120	do.	Do.
Manley Sand Division, Martin Marietta Corp.	Rockton, Ill. 61072	do.	Berrien.
Mickelson Corp.	435 Granger Rd. Oxford, Mich. 48051	Pit, dredges, portable plant.	Oakland.
Molesworth Contracting Co.	321 Park Ave. Yale, Mich. 48097	Pits and portable plants.	Genesee, Lapeer, Macomb, St. Clair, Sanilac.
Natural Aggregates Corp.			
New Hudson Sand & Gravel, Inc., Texas Industries, Inc.	65545 Mound Rd. Romeo, Mich. 48065 Box H New Hudson, Mich. 48165	Pits, dredge, portable and stationary plants.	Livingston, Macomb, Oakland.
The Nugent Sand Co., Inc.	2875 Lincoln St. Muskegon, Mich. 49441	Pit and stationary plant.	Muskegon.
Ottawa Silica Co., Michigan Division.	Box 577 Ottawa, Ill. 61350	do.	Wayne.
Oxford Mining Co.	9820 Andersonville Rd. Davisburg, Mich. 48019	do.	Oakland.
Pickitt & Schreur, Inc.	Box 149 Allegan, Mich. 49010	Pits and portable plants.	Allegan, Calhoun, Clinton, Eaton, Ionia, Jackson, Kalamazoo, Kent, Missaukee, Ottawa.
Sand Products Corp.			
Sargent Sand Co.	2489 First National Bank Bldg. Detroit, Mich. 48226 2840 Bay Rd. Saginaw, Mich. 48604	Pit and stationary plants.	Manistee.
West Branch Concrete Products, Inc.	2250 Rau West Branch, Mich. 48661	Pit and stationary plant.	Bay, Mason, Saginaw, Tuscola.
Whittaker & Gooding Co.	5800 Cherry Hill Rd. Ypsilanti, Mich. 48197	do.	Ogemaw.
John G. Yerington	Route 2, Box 34 Benton Harbor, Mich. 49022	Pits and portable plants.	Washtenaw.
Silver:			
White Pine Copper Co.	Box 427 White Pine, Mich. 49971	Byproduct silver.	Barry, Berrien, Branch, Calhoun, Cass, Lenawee, Muskegon, Newaygo, Van Buren.
Smelters:			
Quincy Mining Co.	Hancock, Mich. 49930	Secondary smelter.	Ontonagon.
White Pine Copper Co.	Box 427 White Pine, Mich. 49971	Primary copper smelter.	Houghton. Ontonagon.
Stone:			
Granite: Caspian Construction Co.	Caspian, Mich. 49915	Quarry and stationary plant.	Dickinson.
Limestone and dolomite:			
Bethlehem Mines Corp.	701 East Third St. Bethlehem, Pa. 18016	do.	Chippewa.
Bethlehem Steel Corp.	2000 South Second Ave. Detroit, Mich. 48226	Quarry and portable plant.	Monroe.
Dundee Cement Co.	Box 317 Dundee, Mich. 48131	Quarry and stationary plant.	Do.
The France Stone Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	do.	Do.
Huron Cement Co., div. of National Gypsum Co.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	do.	Alpena.

See footnote at end of table.

Table 16.—Principal producers¹—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite—Continued			
Inland Lime & Stone Co.	Gulliver, Mich. 49840	Quarries and stationary plants.	Mackinac, Schoolcraft.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Quarry and stationary plant.	Charlevoix.
Michigan Foundation Quarry.	110 West Jefferson Ave. Trenton, Mich. 48183	do	Wayne.
The Michigan Stone Co.	Ottawa Lake, Mich. 49267	Quarries and stationary plants.	Monroe.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Quarry and stationary plant.	Emmet.
Presque Isle Corp.	Box 426 Alpena, Mich. 49707	do	Presque Isle.
United States Steel Corp. Michigan Limestone Operations.	Rogers City, Mich. 49779	Quarries and stationary plants.	Mackinac.
The Wallace Stone Co., div. of J. P. Burroughs & Son, Inc.	Bay Port, Mich. 48720	Quarry and stationary plant.	Huron.
Marl:			
Gerald Arnsman	Route 1 Hopkins, Mich. 49328	Pit	Allegan.
Case Brothers	Route 2, Box 136 Union City, Mich. 49094	Pit	Calhoun.
Darrell L. Hamilton	Route 3 Nashville, Mich. 49073	Pit	Barry.
Hayward Dry Marl	Route 2 Vicksburg, Mich. 49097	Pit	Kalamazoo.
Poehlman & Son	Route 2 Cassopolis, Mich. 49031	Pit	Cass.
Sandstone: Ray's Stone Quarry.	303 Natasawaepe St. Napoleon, Mich. 49261	Quarry and finishing plant.	Jackson.
Traprock (basalt): Houghton County Road Comm.	Hancock, Mich. 49930	Quarry and stationary plant.	Dickinson.
Recovered sulfur:			
Leonard Refineries, Inc., Alma Division.	East Superior St. Alma, Mich. 48801	Byproduct sulfur recovery.	Gratiot.
Marathon Oil Co.	1300 South Fort St. Detroit, Mich. 48217	do	Wayne.
Mobil Oil Co., Inc.	Box 477 Trenton, Mich. 48183	do	Do.
Exfoliated vermiculite: Zonolite Division	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Do.

¹ Data regarding producers of natural gas, natural gas liquids, and petroleum not available.

APPENDIX

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- I. Photographs of several mineral operations
 - II. Map of clay and shale resources
 - III. Bibliography of clay and shale resources
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PHOTO 1 — Michigan's newest gypsum mine is the Georgia-Pacific Gypsum Division KENTWOOD MINE, southeast Grand Rapids. Scheduled for production in 1971, this mine will produce crushed gypsum rock for the company's board plant in southwest part of the city.



PHOTO 4 — Cleveland-Cliff's REPUBLIC OPEN PIT MINE located at Republic on the Marquette Iron Range. Mining operations includes drilling, blasting, crushing; and then shipment to the mill for concentration and pelletizing operations.

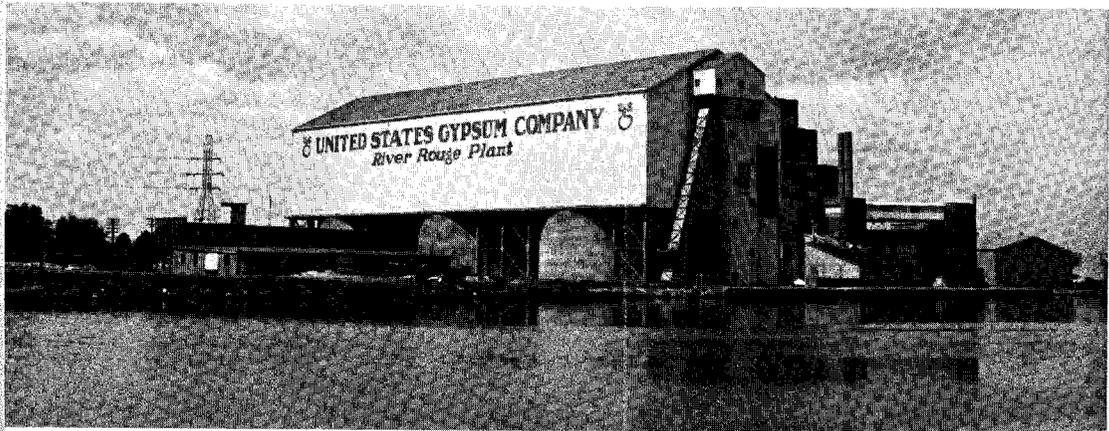


PHOTO 2 — UNITED STATES GYPSUM COMPANY product plant located on the River Rouge in Detroit. Since 1929, gypsum from Alabaster has been used in this plant for manufacture of plaster, wall board, and various other gypsum products used in building construction.



PHOTO 5 — FRANCE STONE COMPANY'S crushed stone operations at the recently acquired Monroe County Road Commission quarry located near Grape, Monroe County. Dolomitic limestone of the Detroit River Group is quarried and processed for aggregate use.



PHOTO 3 — UNITED STATES GYPSUM COMPANY processing and loading facilities at Alabaster. Gypsum quarried at this location is shipped by lake vessels to company's product plants and to Portland Cement plants.

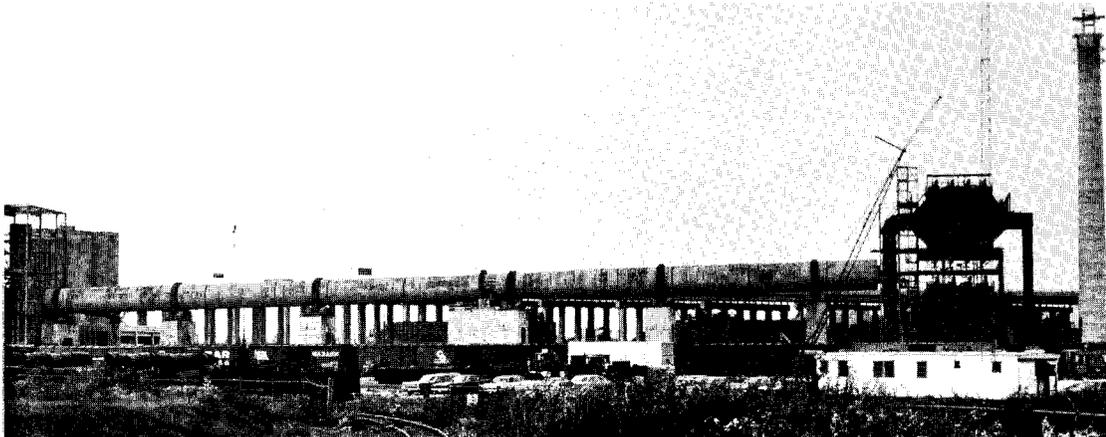
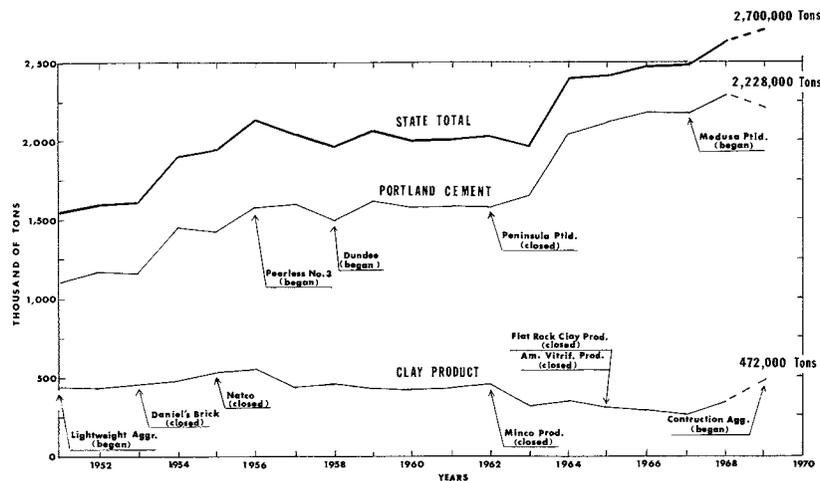
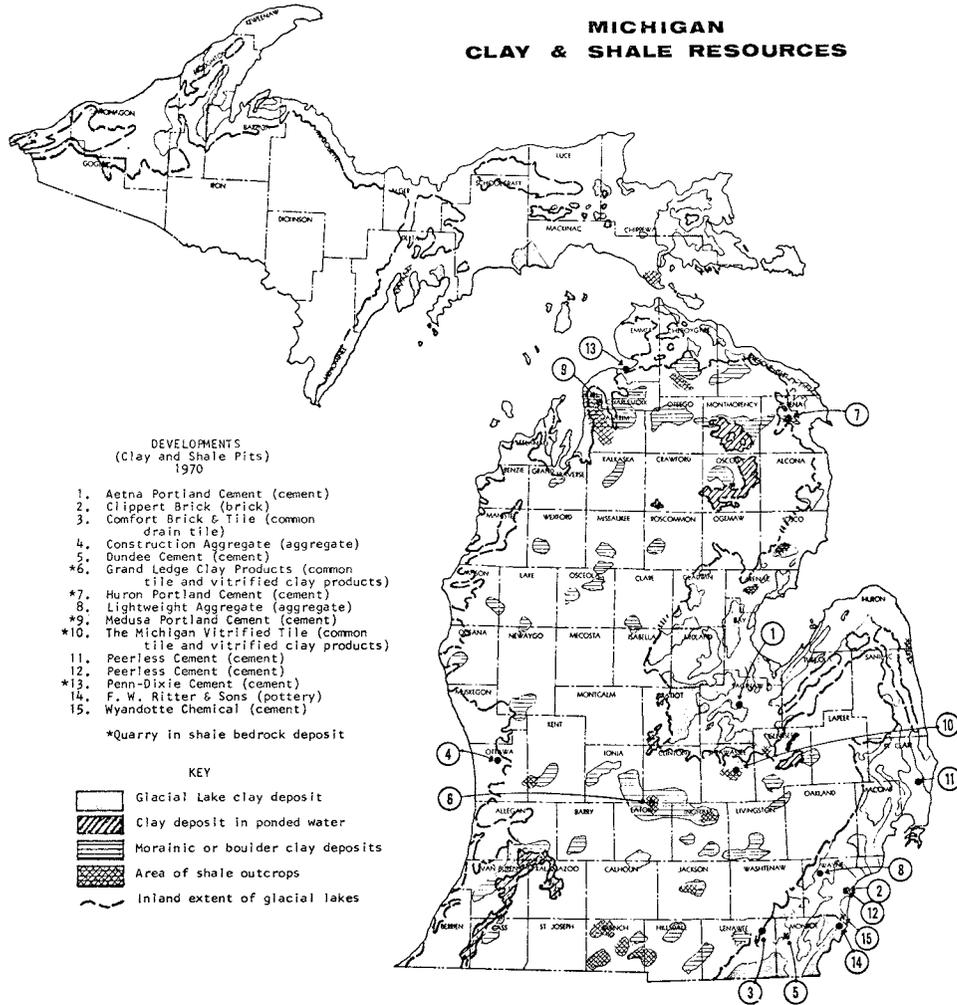


PHOTO 6 — This new kiln erection at the PEERLESS CEMENT COMPANY is part of a new \$30 million plant now under construction in Detroit. The initial capacity of 5 million barrels/year will ultimately be expanded to 12 million barrels/year and will eventually lead to the replacement of two existing Peerless operations, one at Port Huron and one at Detroit.

MICHIGAN CLAY & SHALE RESOURCES



SELECTED BIBLIOGRAPHY ON CLAYS & SHALES IN MICHIGAN

Michigan Geological Survey

- Brown, G. G., 1926, Clay and shale of Michigan and their uses: Pub. 36, 444 pp.
- Fall, D., 1903, Marls and clays in Michigan: v. 8, pt. 3, pp. 343-353.
- Kelly, W. A., 1936, The Pennsylvania System in Michigan: Pub. 40, pp. 149-219.
- Landes, K. K., Ehlers, G. M. and Stanley, G. M., 1945, Geology of Mackinac Straits Region: Pub. 44, 204 pp. (Point aux Chenes formation pp. 35-52).
- Martin, H. M., 1937, The centennial geological map of Michigan: Pub. 39, (pt. 1-Northern Peninsula and pt. 2-Southern Peninsula) scale 1:500,000.
-, 1955, Maps of the surface formations of the Southern Peninsula: Pub. 49, scale 1:500,000.
-, 1957, Map of the surface formations of the Northern Peninsula: Pub. 49, scale 1:500,000.
- Ries, Heinrich, 1900, Clays and shales of Michigan, their properties and uses: Vol. 8, pt. 1, 67 pp.
- Sorensen, Harry O., 1970, Clays and shale resources of Michigan: 6th forum on geology of industrial minerals: Miscellany 1, pp. 143-155.

U.S. Bureau of Mines

- Aase, James H., 1967, Lightweight aggregate expansion properties of selected Michigan shales: R. I. 7055, Dec. 1967, 23 pp.
- Miska, William S., 1969, Testing of Northern Michigan and Wisconsin glacial lake clays for utilization as iron ore binder: 31 pp. (open file report).

American Association of Petroleum Geologists

- Hale, Lucille, 1941, Study of sedimentation and stratigraphy of Lower Mississippian in western Michigan: Vol. 25, no. 4, April, 1941, pp. 713-723.
- Kelly, W. A., and Smith, G. Wendell, 1947, Stratigraphy and structure of Traverse Group in Afton-Onaway area, Michigan: Vol. 31, no. 3, March 1947, pp. 447-469.
- Monnett, V. Brown, 1948, Mississippian Marshall formation of Michigan: Vol. 32, no. 4, April 1948, pp. 629-688 (Coldwater Formation pp. 636-651).
- Tarbell, Eleanor, 1941, Antrim-Ellsworth, Coldwater shale formations in Michigan: Vol. 25, no. 4, April 1941, pp. 724-733.
- Warthin, A. S. Jr., and Cooper, G. A., 1943, Traverse rocks of Thunder Bay region: Vol. 27, no. 5, pp. 571-595.

Michigan Basin Geological Society Guide Books for Annual Field Trips

- 1949 The Traverse Group of the northern part of the Southern Peninsula of Michigan: W. A. Kelly, 32 pp.
- 1950 The Ordovician rocks of the Escanaba Stonington area: R. C. Hussey, 24 pp.
- 1970 Devonian strata of Alpena and Presque Isle counties, Michigan: G. M. Ehlers and R. V. Kesling, pp. 1-130.

U.S. National Museum

- Pohl, E. R., 1930, The Middle Devonian Traverse Group of rocks in Michigan, a summary of existing knowledge: Proc. U.S. National Museum, v. 76, art. 14, no. 2811, 34 p.

Many of the publications above are out of print, but are in many instances available for use in Michigan public and university libraries, and at the Lansing office of the Michigan Geological Survey.