

COVER PHOTO — One of several diamond core drilling sites on the Hendrick's dolomite outcrop belt traversing Schoolcraft, Mackinac, and Chippewa Counties. A cooperative diamond core drilling program was initiated in 1974 by the Institute of Minerals Research and the Michigan Geological Survey to evaluate high calcium limestone resources in this portion of the Eastern Upper Peninsula.

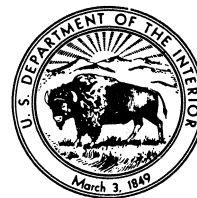
State of Michigan
Department of Natural Resources
Geological Survey Division

Preprint from the 1972
BUREAU OF MINES MINERALS YEARBOOK

The Mineral Industry of Michigan



UNITED STATES DEPARTMENT OF THE INTERIOR



UNITED STATES DEPARTMENT OF THE INTERIOR •
Rogers C. B. Mortort, Secretary
BUREAU OF MINES • Thomas V. Falkie, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals, Minerals, and Fuels; Volume II, Area Reports: Domestic; Volume III, Area Reports: International*. The separate volumes of the yearbook are sold by the Superintendent of Documents, Washington, D. C. 20402.

For sale by the Superintendent of Documents, U.S. Government
Printing Office Washington, D.C. 20402 -Price 30 cents

The Mineral Industry of Michigan

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

By Grace N. Broderick¹

In 1972 the mineral production of Michigan was valued at \$694.8 million, an increase of 8.4% over the \$640.6 million reported for 1971 and a 3.6% gain over the previous record high of \$670.7 million set in 1970. Iron ore continued to be the leading mineral commodity in terms of value, followed by cement, copper, and sand and gravel.

Nonmetallic minerals as a group retained dominance of the State's overall total mineral value, contributing 56%. Within this group, cement led in value, followed by sand and gravel, salt, stone, and magnesium compounds. Nationally, Michigan ranked first in production and value of gypsum production. It was the only domestic producer of iodine, and ranked second to Arkansas in bromine production, and second to California in production of sand and gravel. Other nonmetallic minerals produced were clays, gem stones, lime, and calcium-magnesium chloride.

¹Physical scientist, Division of Ferrous Metals-Mineral Supply.

Metallic minerals represented 36% of the total value of mineral production in 1972. Iron ore shipments were 12.7 million long tons compared with 11.8 million long tons in 1971, an increase of 7.3%. Production of 67,260 short tons of copper, in terms of recoverable metal, was 20.1% more than in 1971, when a lengthy strike at the White Pine operation curtailed production. Silver was recovered from copper ore at the White Pine mine.

Mineral fuels (natural gas, natural gas liquids, peat, and petroleum) provided 8% of the total value of mineral output. Michigan's oil and gas production is a relatively small part of total U.S. production, but over the years it has contributed significantly to the State's mineral industry.

Table 3.—Indicators of Michigan business activity

	1971	1972 ^p	Change, percent
Employment and labor force, annual average:			
Total labor force.....	thousands 3,621.0	3,665.0	+1.2
Unemployment.....	do 295.4	302.7	+2.5
Employment:			
Manufacturing.....	do 1,045.0	1,067.3	+2.1
Contract construction.....	do 111.9	108.5	-3.0
Mining.....	do 11.4	11.8	+3.5
Transportation and public utilities.....	do 148.3	145.1	-2.2
Wholesale and retail trade.....	do 608.0	609.9	+0.3
Finance, insurance, and real estate.....	do 116.3	118.7	+2.1
Services.....	do 481.5	441.7	-2.4
Government.....	do 504.9	520.6	+3.1
Personal income:			
Total.....	millions \$39,860	\$43,746	+9.8
Per capita.....	do \$4,430	\$4,817	+8.7
Construction activity:			
Valuation of nonresidential construction.....	millions \$514.0	\$586.7	+14.1
Number of private and public residential units authorized.....	do 72,948	71,213	-2.2
State highway departments: Contracts awarded.....	millions \$253.5	\$248.8	-1.9
Portland cement shipments to and within Michigan.....	thousand short tons 3,349	3,231	-3.5
Farm marketing receipts.....	millions \$1,021.7	\$1,102.0	+7.9
Mineral production value.....	do \$640.6	\$694.8	+8.5

^a Estimated. ^p Preliminary.

Sources: Survey of Current Business; Employment and Earnings; Farm Income Situation; Construction Review; Area Trends in Employment and Unemployment; Roads and Streets; and U.S. Bureau of Mines.

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

County	1971	1972	Minerals produced in 1972 in order of value
Alcona.....	\$135	\$49	Sand and gravel.
Alcona.....	69	52	Do.
Alcona.....	924	999	Sand and gravel, petroleum, natural gas, peat, stone.
Alcona.....	49,296	49,296	Cement, stone, clays, sand and gravel.
Antrim.....	W	W	Sand and gravel, clays, petroleum.
Arenac.....	\$1,254	1,195	Petroleum, stone, sand and gravel.
Baraga.....	51	W	Sand and gravel.
Baraga.....	W	W	Sand and gravel, petroleum, stone.
Bay.....	10,805	11,796	Cement, sand and gravel, petroleum, lime.
Benzie.....	18	W	Sand and gravel.
Berrien.....	W	3,058	Sand and gravel, stone.
Branch.....	W	Do.	Do.
Calhoun.....	5,061	5,546	Petroleum, natural gas, sand and gravel, stone.
Cass.....	W	W	Sand and gravel, stone.
Charlevoix.....	729	735	Cement, stone, sand and gravel.
Cheboygan.....	W	W	Stone, sand and gravel.
Chippewa.....	3,618	W	Do.
Clare.....	1,331	1,390	Petroleum, sand and gravel, natural gas.
Clinton.....	807	616	Sand and gravel, clays.
Crawford.....	W	W	Petroleum, natural gas, sand and gravel.
Delta.....	W	W	Sand and gravel, stone.
Dickinson.....	26,210	31,998	Iron ore, sand and gravel, stone.
Eaton.....	729	735	Stone, sand and gravel, clays, petroleum, peat.
Emmet.....	12,882	12,299	Cement, stone, clays, sand and gravel.
Genesee.....	975	700	Sand and gravel, petroleum.
Gladwin.....	912	875	Petroleum.
Gogebic.....	W	26	Sand and gravel.
Grand Traverse.....	W	620	Natural gas, petroleum, sand and gravel.
Gratiot.....	W	6,596	Magnesium compounds, salt, calcium-magnesium chloride, sand and gravel, petroleum, natural gas, bromine.
Hillsdale.....	W	10,085	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Houghton.....	W	296	Sand and gravel, stone, copper.
Huron.....	1,276	1,202	Stone, sand and gravel, lime, petroleum.
Ingham.....	1,917	5,548	Petroleum, natural gas, sand and gravel, natural gas liquids, peat.
Ionia.....	319	W	Sand and gravel.
Iosco.....	5,306	6,775	Gypsum, sand and gravel.
Iron.....	6,635	W	Iron ore, sand and gravel.
Isabella.....	W	649	Petroleum, sand and gravel.
Jackson.....	2,921	3,239	Petroleum, natural gas, sand and gravel, stone.
Kalamazoo.....	W	W	Sand and gravel, stone.
Kalamazoo.....	\$1,007	W	Petroleum, natural gas, sand and gravel.
Kalamazoo.....	5,106	5,497	Sand and gravel, gypsum, petroleum, peat, natural gas, stone.
Keweenaw.....	5	2	Sand and gravel.
Lake.....	630	483	Petroleum, sand and gravel.
Lapeer.....	1,231	1,812	Peat, sand and gravel, petroleum, calcium-magnesium chloride, natural gas.
Leelanau.....	609	W	Sand and gravel.
Lenawee.....	1,002	1,395	Sand and gravel, clays, natural gas.
Livingston.....	2,936	W	Sand and gravel.
Luce.....	W	W	Do.
Mackinac.....	W	W	Stone, sand and gravel.
Macomb.....	2,267	W	Sand and gravel, natural gas, petroleum.
Manistee.....	26,701	29,258	Magnesium compounds, salt, sand and gravel, bromine.
Marquette.....	128,064	142,951	Iron ore, sand and gravel, stone.
Mason.....	26,747	30,251	Magnesium compounds, calcium-magnesium chloride, lime, bromine, sand and gravel, petroleum.
Mecosta.....	W	393	Sand and gravel, petroleum, natural gas, peat.
Menominee.....	W	W	Lime, sand and gravel.
Midland.....	W	30,937	Bromine, calcium-magnesium chloride, magnesium compounds, salt, iodine, petroleum, sand and gravel.
Missaukee.....	W	2,167	Petroleum, natural gas, sand and gravel.
Monroe.....	W	24,362	Cement, stone, clays, peat, petroleum.
Montcalm.....	W	568	Petroleum, sand and gravel.
Montmorency.....	W	27	Sand and gravel.
Muskegon.....	W	2,646	Sand and gravel, salt, petroleum.
Newaygo.....	W	132	Sand and gravel, petroleum, natural gas.
Oakland.....	13,543	W	Sand and gravel, peat, petroleum.
Oscoda.....	401	385	Sand and gravel, petroleum.
Ogemaw.....	1,628	2,275	Petroleum, sand and gravel, natural gas.
Ontonagon.....	59,282	70,444	Copper, silver, stone, sand and gravel.
Oscoda.....	W	2,616	Petroleum, natural gas liquids, sand and gravel, natural gas.
Oscoda.....	40	10	Sand and gravel, petroleum.
Otsego.....	W	W	Petroleum, natural gas, sand and gravel.
Ottawa.....	3,763	4,379	Sand and gravel, clays, petroleum, natural gas.

See footnotes at end of table.

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

County	1971	1972	Minerals produced in 1972 in order of value
Presque Isle.....	W	\$21,528	Stone, sand and gravel, petroleum.
Roscommon.....	W	1,255	Petroleum, sand and gravel, natural gas.
Saginaw.....	\$809	766	Sand and gravel, lime, clays, petroleum.
St. Clair.....	18,923	26,669	Salt, cement, petroleum, natural gas, natural gas liquids, clays, sand and gravel.
St. Joseph.....	198	269	Sand and gravel, stone, peat.
Sanilac.....	1,935	1,546	Peat, sand and gravel, lime.
Schoolcraft.....	W	W	Stone, sand and gravel.
Shiawassee.....	486	764	Sand and gravel, peat, clays, petroleum.
Tuscola.....	W	W	Sand and gravel, petroleum, lime.
Van Buren.....	138	158	Sand and gravel, petroleum.
Washtenaw.....	2,503	W	Sand and gravel, natural gas liquids, petroleum.
Wayne.....	54,028	61,212	Cement, lime, salt, sand and gravel, stone, clays, petroleum.
Wexford.....	W	W	Sand and gravel, petroleum.
Undistributed.....	\$202,467	\$72,008	
Total.....	640,636	\$694,767	

^a Revised. ^W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
¹ Excludes value of bromine.
² Excludes value of natural gas.
³ 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.
⁴ Includes gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.
⁵ Data does not add to total shown because of independent rounding.

Table 1.—Mineral production in Michigan ¹

Mineral	1971		1972	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland.....	thousand short tons 6,108	\$104,665	5,901	\$111,410
Masonry.....	do 239	5,872	250	5,969
Clays.....	do 2,458	3,366	2,514	3,715
Copper (recoverable content of ores, etc.).....	short tons 56,005	58,245	67,250	68,874
Gem stones.....	do NA	8	NA	8
Gypsum.....	thousand short tons 1,433	5,585	1,650	7,267
Iron ore (usable).....	thousand long tons, gross weight 11,833	159,854	12,692	177,461
Lime.....	thousand short tons 1,444	20,549	1,509	22,768
Magnesium compounds.....	short tons, MgO equivalent 272,918	27,777	377,675	31,484
Natural gas.....	million cubic feet 25,662	6,776	34,221	10,506
Natural gas liquids:				
Natural gasoline.....	thousand 42-gallon barrels 553	1,513	395	1,097
LP gases.....	do 975	2,623	833	2,274
Peat.....	thousand short tons 202	2,497	219	2,190
Petroleum (crude).....	thousand 42-gallon barrels 11,893	38,859	12,990	41,556
Salt.....	thousand short tons 4,458	49,007	4,358	50,761
Sand and gravel.....	do 56,613	62,898	59,467	65,445
Silver (recoverable content of ores, etc.).....	thousand troy ounces 670	1,036	785	1,323
Stone.....	thousand short tons 40,705	49,240	39,754	50,317
Value of items that cannot be disclosed:				
Bromine, calcium-magnesium chloride, iodine.....	XX	40,266	XX	40,367
Total.....	XX	640,636	XX	694,767
Total 1967 constant dollars.....	XX	544,733	XX	\$777,976

¹ Preliminary. ^{NA} Not available. ^{XX} Not applicable.

² Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

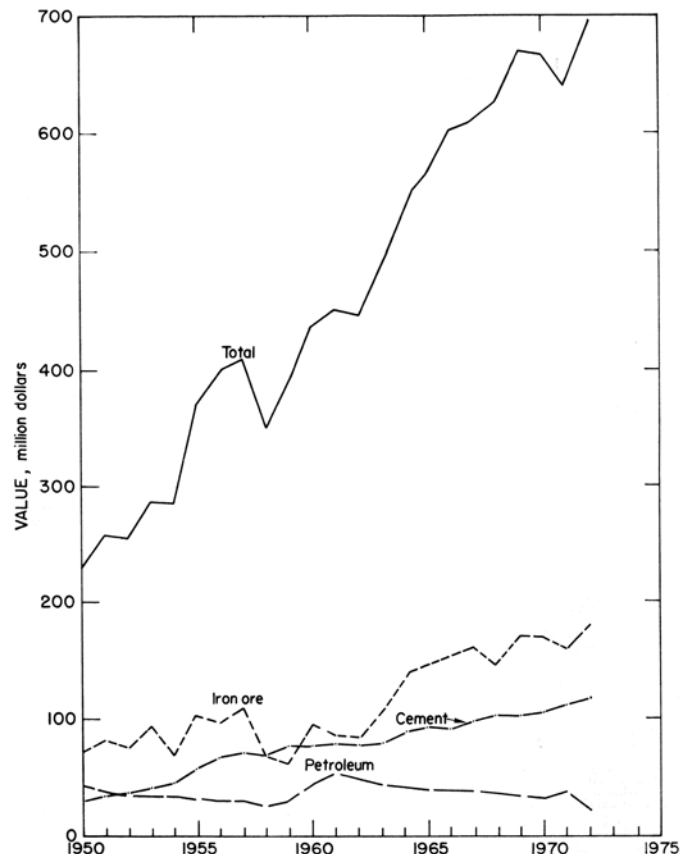


Figure 1.—Value of iron ore, petroleum, cement, and total value of mineral production in Michigan.

Value of oil production in Michigan in 1972 was \$41.6 million, an increase of nearly 7% over that of 1971. Gas production value increased 55% from \$6.8 million to \$10.5 million. Michigan continued as the principal producer of peat in the United States, accounting for 36% of the U.S. total. Peat was sold principally for soil improvement; none was sold as a fuel.

The dismantling of the Enrico Fermi plant, the world's first and largest nuclear breeder reactor, has begun. Located on Lake Erie, near Monroe, this experimental facility is being abandoned because its nuclear core, or bask fuel supply, was worn and the 22-company consortium (Power Reactor Development Co.) supporting the project declined to contribute the \$35 million to purchase a new one. The plant, built in 1963 at a cost of \$133 million, produced only 378 hours of power in its 9-year existence. The nuclear core, which belongs to the Atomic Energy Commission (AEC), has to be removed from the nuclear reactor and returned to the AEC's Savannah River plant at Aiken, S.C.

A summary compiled by the Locks Operation Office at the Soo Locks, Saulte Ste. Marie, showed that about 7% of all the iron ore from Lake Superior going through the locks was carried by the three largest freighters on the Great Lakes. Out of a total of 61,736,615 net tons of iron ore going through the locks, the *Steward J. Cort*, *Roger Blough*, and *Charles M. Beeghly* had carried 4,354,490 net tons of taconite pellets as of December 10, 1972.

The Locks Operation Office reported there are 131 U.S. and 92 Canadian flat-deck bulk carriers hauling bulk cargo on the Great Lakes, and 46 U.S. and 27 Canadian self-unloading bulk carriers. The flat-deck carriers chiefly transport iron ore and grain; the self-unloaders mainly carry iron ore and stone, plus some coal and other bulk cargo.

Legislation.—Michigan amended its 1970 Mine Reclamation Act (Act 92 of the Public Acts of 1970) by Act 123 of the Public Acts of 1972. The amended act extends the coverage of lands subjected to the mining of minerals from that of the earlier act, which included only lands subjected to the mining of metallic minerals. According to Act 123, "mineral" means coal, gypsum, stone, metallic ore or material mined for its metallic content and other similar solid material or substance to be excavated from natural deposits on or in the earth for commercial, industrial, or construction uses but does not include clay, gravel, marl, peat, or sand.

Employment.—Preliminary data for 1972 and final data for 1971 compiled by the U.S. Bureau of Mines on employment and injuries in the mineral industry, excluding the petroleum industry, are shown in table 4.

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
1971:								
Metal.....	4,013	311	1,247	9,976	--	251	25.16	1,517
Nonmetal.....	908	247	224	1,855	--	52	28.04	561
Sand and gravel.....	2,471	225	555	4,786	1	125	26.33	3,178
Stone.....	3,091	275	850	7,001	1	82	11.86	1,238
Total ¹	10,483	274	2,877	23,617	2	510	21.68	1,696
1972: ²								
Metal.....	3,975	336	1,334	10,672	4	263	25.02	2,863
Nonmetal.....	780	240	186	1,552	--	38	24.49	527
Sand and gravel.....	1,350	207	279	2,450	2	53	22.45	9,127
Stone.....	1,380	258	510	4,288	1	31	7.46	1,730
Total ¹	8,085	286	2,310	18,961	7	385	20.67	3,225

¹ Data may not add to totals shown because of independent rounding.
² In 1971 and earlier years, estimates were made of injury and employment data for those active operators who did not file reports; however, no estimates were made for active operators who did not report in 1972. Tabulations were made from data in file as of July 1, 1973 and are preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Metallic abrasive producers in 1972 were Abrasive Materials, Inc., at its Hillsdale plant, Hillsdale County; Cleveland Metal Abrasive Co., at its Howell plant, Livingston County; and Ervin Industries, Inc., at its Adrian plant, Lenawee County. The State ranked second to Ohio in the manufacture of metallic abrasives.

Bromine.—Bromine was recovered from well brines by The Dow Chemical Co. at its Ludington and Midland plants in Mason and Midland Counties, respectively; by Morton Chemical Co. at its Manistee plant, Manistee County; and by the Michigan Chemical Corp. at its St. Louis plant in Gratiot County. Output decreased 6.6% in quantity and 4.3% in value from 1971 figures.

Calcium-Magnesium Chloride.—Michigan Chemical Corp., Wilkinson Chemical Corp., and The Dow Chemical Co. recovered calcium-magnesium chloride from brine wells in Gratiot, Lapeer, Mason, and Midland Counties. Output decreased 3% in quantity but increased 6% in value.

Cement.—Portland cement shipments decreased 3.4%, but value of shipments increased 6.4%. Counties producing portland cement were Alpena, Bay, Charlevoix, Emmet, Monroe, St. Clair, and Wayne. Average mill value of portland cement increased to \$18.88 per ton from \$17.14 per ton in 1971. Yearend stocks of portland cement at mills were 763,454 tons compared with 619,748 tons in 1971. More than 93% of the portland cement shipped was Type I and II (general use and moderate heat); the remainder was principally Type III (high-early-strength). Consumption of portland cement in Michigan totaled 3,231,389 tons. It was consumed by ready-mix concrete companies (64%), concrete product manufacturers (16%), building material dealers (7%), and contractors and other users (13%).

Masonry cement shipments increased 4.8%, but value rose only 1.5%. Masonry cement was produced in Alpena, Bay, Emmet, and Wayne Counties. Average mill value of masonry cement was \$23.82 per ton compared with \$24.61 per ton in 1971. Yearend stocks

of masonry cement at mills were 61,709 tons compared with 49,499 tons in 1971. Masonry cement consumed in the State totaled 179,968 tons.

In 1972, Michigan continued to hold fourth place in the shipment of cement, being outranked only by California, Pennsylvania, and Texas, respectively in first, second, and third place. The leading producers in Michigan were Huron Cement Division of the National Gypsum Co., Peerless Cement Division of American Cement Corp., and Dundee Cement Co.

Peerless Cement Division closed its Port Huron plant at yearend. In October, Peerless suspended manufacturing operations at its Brennan Avenue plant in Detroit. Future plans are to incorporate the 16-year-old facility into the firm's new Detroit plant complex. Peerless' old Jefferson Avenue plant, purchased by Detroit Edison Co., was sold in June 1972 to Edward C. Levy Co. Doing business under the name Jefferson Marine Terminal, the firm produced cement by grinding clinker imported from Sweden and Canada.

The Medusa Portland Cement Co., known as such since 1916, changed its name on April 1, 1972, to Medusa Corp. The company was founded 80 years ago as the Sandusky Portland Cement Co. To permit the company's plant at Charlevoix to operate a longer season, clinker storage was built. Bag packing facilities have been added at Detroit to tap the market for masonry and package gray cement.

At the Dundee Cement Co.'s Dundee plant, four Koppers electrostatic precipitators were installed.

Huron Cement Division of National Gypsum Co. neared completion of a \$2.5 million air pollution control program at its Alpena plant. A corporate computer and communications center was established at Southfield.

Table 5.—Michigan: Portland cement statistics
(Short tons)

	1971	1972
Number of active plants.....	9	9
Production.....	6,015,096	6,180,940
Shipments from mills:		
Quantity.....	6,108,020	5,901,390
Value.....	\$104,665,357	\$111,409,545
Stocks at mills, Dec. 31.....	619,020	763,454

Table 6.—Michigan: Masonry cement statistics
(Short tons)

	1971	1972
Number of active plants..	4	5
Production.....	228,391	259,212
Shipments from mills:		
Quantity.....	238,597	250,161
Value.....	\$5,872,083	\$5,958,549
Stocks at mills, Dec. 31..	49,499	61,709

Clays.—Miscellaneous clays and shale were mined at 15 pits in 12 counties. Output of clay and shale increased 2.3% in quantity and 10.4% in value over that of 1971. Eighty-one percent of the clay or shale was used in cement manufacture in 1972, as compared with 78% used for this purpose in 1971. Other uses were for

lightweight aggregate and heavy clay products. The largest production was reported from Alpena, Wayne, Monroe, Ottawa, Emmet, St. Clair, and Saginaw Counties.

Gem Stones.—Semiprecious stones and mineral specimens continued to be collected. The State legislature passed a bill making chlorastrolite the official State gem.

Gypsum.—Michigan ranked first in the United States in quantity and value of crude gypsum produced in 1972. Production increased 15% to a record 1,650,000 tons, valued at \$7.3 million. The gypsum was produced from open pit mines in Iosco County by U.S. Gypsum Co., National Gypsum Co., and Michigan Gypsum Co., and from underground mines in Kent County by Georgia-Pacific Corp. and Grand Rapids Gypsum Co. Calcined gypsum, output of which increased 44% to a record 536,400 tons, was produced in Iosco County by National Gypsum Co., in Kent County by Georgia-Pacific Corp. and Grand Rapids Gypsum Co., and in Wayne County by U.S. Gypsum Co.

Georgia-Pacific Corp., in 1971, closed its Grand Rapids mine under the Butterworth Road plant and opened a new underground mine (the Kentwood mine at 3900 East Paris Avenue in Grand Rapids). Ore from the Kentwood mine is crushed underground and then transported to the Butterworth Road plant for processing.

Iodine.—The sole domestic producer, The Dow Chemical Co., continued to recover crude iodine from natural well brines at Midland. Production increased 2.9% over that of 1971, while value increased by 11.7%.

Lime.—Seven companies produced lime at 10 plants in 8 counties. Leading companies were BASF Wyandotte Corp., Marble-head Lime Co., Detroit Lime Co., and The Dow Chemical Co. C, Reiss Coal Co., located in Menominee County, closed down its operation in June. Output of lime increased 4.5% in quantity and 10.7% in value over that of the previous year. Plants in Wayne County produced 78% of the State total. Most of the State's production was quicklime, but a small tonnage of hydrated lime was manufactured. The lime was used for steel furnaces, alkalies, water purification, and other uses. Fifty percent of the output was used by producers, and the other 50% was sold. Only 3% was shipped to consumers outside the State, mostly in Ohio but also in Wisconsin, Indiana, and Pennsylvania. Total consumption of lime in Michigan was 1,654,096 tons.

Magnesium Compounds.—Michigan continued as the Nation's largest producer of magnesium compounds, accounting for nearly 52% of the U.S. total. Production increased 38.4% in quantity and 13.3% in value over the 1971 figures. Output came from Gratiot, Manistee, Mason, and Midland Counties.

Perlite.—Crude perlite, mined in the Western States, was expanded by National Gypsum Co. at its National City plant, Iosco County, by U.S. Gypsum Co. at its River Rouge plant, Wayne County, and by Harborlite

Corp. at its Vicksburg plant, Kalamazoo County; Georgia-Pacific Corp. discontinued expanding perlite at its Grand Rapids plant in Kent County. Most of the expanded perlite was used for plaster aggregate.

Salt.—Salt was produced from one rock salt mine in Wayne County, the only underground salt mine in the State, and from natural and artificial brines at plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties. Output was 2.2% less than that in 1971 and value 3.6% more.

Sand and Gravel.—Michigan ranked second only to California in production of sand and gravel in the United States. Tonnage increased 5% and was valued at \$65.4 million, an increase of 4% over the 1971 value. Nearly every county in Michigan reported sand and gravel production. In each of 10 counties, output exceeded 1 million tons. These counties provided almost 55% of the State production. Five of these counties make up metropolitan Detroit and produced over 23 million tons. About 92% of the sand and gravel was moved by truck, and the remainder was shipped by rail or water. Production was reported from 329 commercial and 66 Government-and-contractor operations.

Table 7.—Michigan: Sand and gravel sold or used by producers, by class of operation and use
(Thousand short tons and thousand dollars)

Class of operation and use	1971		1972	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building.....	8,568	7,952	7,862	7,571
Engine.....	39	104	28	73
Fill.....	3,184	1,619	2,610	1,684
Molding.....	3,435	7,063	2,909	6,694
Paving.....	6,773	6,610	8,772	8,960
Other uses ¹	1,406	3,608	2,363	4,534
Total ²	23,405	26,954	24,544	29,465
Gravel:				
Building.....	6,359	10,596	7,344	11,037
Engine.....	463	263	288	283
Paving.....	19,103	19,098	17,942	19,204
Railroad ballast.....	19	35	W	W
Miscellaneous.....	1,206	1,476	1,716	1,464
Other uses.....	799	624	2,849	2,191
Total ²	27,950	32,092	30,139	34,181
Government-and-contractor operations:				
Sand:				
Building.....	34	3	4	1
Fill.....	1,091	303	849	92
Paving.....	886	461	700	213
Other uses.....	183	79	109	69
Total ²	2,195	846	1,662	375
Gravel:				
Building.....	163	145	127	90
Fill.....	248	92	420	26
Paving.....	2,650	2,768	2,508	1,290
Other uses.....	1	(5)	68	18
Total ²	3,062	3,005	3,122	1,424
Total sand and gravel ²	56,613	62,898	59,467	65,445

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

¹ Includes abrasives, railroad ballast (1971), blast, enamel, foundry, glass, fire or furnace (1972), grinding and polishing, pottery, and other sands.

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

³ Less than 1/2 unit.

Stone.—Michigan, with production of 39.8 million tons, ranked eighth in the Nation's output of stone. Production (principally crushed limestone and dolomite) decreased 2.3% from that of 1971. Ninety-three percent of the production was reported from seven counties: Alpena, Chippewa, Mackinac, Monroe, Presque Isle, Schoolcraft, and Wayne.

A large proportion of the material 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 10, the distribution of crushed and broken stone shipments by type of use is shown.

The world's largest limestone quarry, the Calcite quarry, is located near Rogers City in Presque Isle County.

Since 1911, when Michigan Limestone and Chemical Co. first opened the quarry, about 600 million tons of stone have been removed. The operation, which now stretches roughly 18,000 acres along the shore of Lake Huron, was purchased by United States Steel Corp. in 1920 to meet its own needs for metallurgical stone, but the emergence of other uses for the high-calcium limestone attracted a growing list of commercial customers. A three-phase project to rehabilitate and modernize the original Calcite facilities, started at the close of the lake-shipping season during the winter of 1967-68, was completed in April 1971. The project, in addition to including equipment needed to produce the greater quantities of small-size limestone pellets required by the steel industry, boosted efficiency of the stone-processing systems and provided the opportunity to rearrange product stockpiling systems for a better balance of recovery and loadout operations. Average annual output is several millions of tons and involves eight basic sizes of stone, ranging from 8 by 5½ inches to 4-mesh by 0 fines.²

²Pit and Quarry. V. 65, No. 2, August 1972, pp. 76-85.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county
(Thousand short tons and thousand dollars)

County	1971			1972		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alcona.....	2	272	135	2	86	49
Alger.....	1	85	69	1	99	52
Alcona.....	7	755	497	5	902	542
Antrim.....	1	84	73	2	84	158
Baraga.....	2	168	81	2	W	W
Benzie.....	7	582	707	6	387	485
Berrien.....	1	18	18	1	W	W
Branch.....	7	1,438	2,558	12	1,483	W
Cass.....	2	W	W	3	249	W
Charlevoix.....	6	349	819	7	322	238
Cheboygan.....	6	66	50	4	39	21
Clare.....	2	W	W	4	91	32
Clinton.....	8	764	783	3	W	W
Crawford.....	1	W	W	1	48	28
Dickinson.....	2	W	W	3	W	186
Eaton.....	10	652	512	8	281	293
Emmet.....	2	74	65	3	225	148
Genesee.....	2	816	753	6	553	552
Gogebic.....	3	W	W	2	77	26
Grand Traverse.....	2	W	W	4	W	111
Gratiot.....	6	293	262	3	238	231
Hillsdale.....	4	107	56	5	W	W
Huron.....	4	W	W	6	301	191
Ingham.....	8	774	778	10	626	W
Ionia.....	3	338	319	3	294	W
Iron.....	3	W	W	2	153	159
Isabella.....	1	W	W	3	309	188
Jackson.....	2	W	W	3	350	262
Kalamazoo.....	11	1,003	1,459	6	836	1,244
Kalkaska.....	1	22	20	1	22	14
Kent.....	19	2,325	3,968	20	2,761	4,101
Keeweenaw.....	1	16	5	1	17	2
Lake.....	1	40	22	2	49	44
Lapeer.....	4	328	187	9	879	558
Lenawee.....	11	810	995	7	1,099	1,328
Livingston.....	6	2,576	2,936	6	2,798	W
Mackinac.....	5	W	W	7	188	72
Macomb.....	10	2,147	2,254	11	3,017	2,964
Manistee.....	4	W	W	4	399	4
Marquette.....	9	545	577	8	1,031	817
Mecosta.....	2	161	126	2	W	189
Menominee.....	3	95	90	5	127	114
Montcalm.....	3	W	W	8	430	226
Montmorency.....	1	49	2	1	69	27
Muskegon.....	4	461	1,095	5	W	W
Newaygo.....	2	W	W	6	185	92
Oakland.....	24	11,274	13,494	25	12,439	14,198
Oceana.....	2	271	159	4	257	221
Ogemaw.....	5	W	W	3	488	W
Ontonagon.....	1	84	1	1	W	W
Osceola.....	1	68	33	1	7	5
Otsego.....	2	W	W	3	74	49
Ottawa.....	16	2,875	3,188	12	3,229	3,852
Saginaw.....	2	W	W	3	367	W
Schoolcraft.....	1	62	3	1	62	3
Shiawassee.....	5	289	239	9	520	514
Tuscola.....	8	712	953	9	795	1,004
Van Buren.....	3	155	122	4	216	138
Washtenaw.....	9	2,188	2,487	8	1,816	2,285
Wayne.....	8	2,769	4,600	8	3,000	5,023
Various.....	25	8,934	7,544	9	6,441	4,794
Undistributed ³	63	8,502	8,272	61	8,157	17,019
Total ¹	388	56,613	62,898	395	59,467	65,445

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

² Includes production for which no county breakdown is available.

³ Includes Alpena, Arenac, Bay, Calhoun, Chippewa, Delta, Houghton, Iosco, Leelanau, Luce, Mason, Midland, Missaukee, Monroe (1971), Osceola, Presque Isle, Roscommon, St. Clair, St. Joseph, Sanilac and Washtenaw Counties.

⁴ Data may not add to totals shown because of independent rounding.

Small quantities of dimension stone have been produced in recent years for building purposes. Output in 1972 was 3,802 short tons valued at \$66,165.

Ottawa Silica Co., Michigan Division, continued to mine a high-purity quartzite sandstone at Rockwood, Wayne County. The deposit is the Sylvania Sandstone of the Detroit River Group. Silica sand has been mined at the Rock wood site since 1904. The operation was purchased in 1944 by the Ottawa Silica Co. Several thousand tons of high-quality silica is shipped annually from the nearly 700-acre site.³

The State of Michigan remained the leading producer of marl with production reported from nine counties. It was sold for agricultural purposes. The bulk of the material came from Allegan, Barry, Cass, Calhoun, and Kalamazoo Counties.

³Michigan Challenge. V. 11, No. 7, June-July 1971, pp. 29-30.

Table 9.—Michigan: Stone sold or used by producers, by kind
(Thousand short tons and thousand dollars)

Kind of stone	1971		1972	
	Quantity	Value	Quantity	Value
Dimension ¹	1	26	4	66
Crushed and broken:				
Limestone.....	32,229	35,077	31,301	35,360
Dolomite.....	7,275	11,267	7,499	12,104
Marl.....	119	111	79	81
Traprock.....	9	14	W	W
Other ²	1,072	2,745	870	2,707
Total ³	40,704	49,214	39,750	50,251
Grand total.....	40,705	49,240	39,754	50,317

W Withheld to avoid disclosing individual company confidential data; included with "Other."
¹ Includes limestone and dolomite. 1972 data also include sandstone.
² Includes granite, sandstone, quartz (1971), marble (1972) and miscellaneous stone.
³ Data may not add to totals shown because of independent rounding.

Table 10.—Michigan: Crushed and broken stone sold or used by producers, by use
(Thousand short tons and thousand dollars)

Use	1971		1972	
	Quantity	Value	Quantity	Value
Bituminous aggregate.....	736	921	W	1,213
Concrete aggregate.....	3,048	3,261	3,241	4,022
Dense graded road base stone.....	805	954	687	1,065
Surface treatment aggregate.....	342	494	W	181
Unspecified aggregate and roadstone.....	3,676	5,491	1,555	2,034
Agricultural limestone.....	495	529	468	566
Cement manufacture.....	8,637	7,250	7,184	6,428
Flux.....	10,740	14,392	11,446	15,944
Lime manufacture.....	7,345	8,117	9,604	10,926
Other soil conditioners.....	69	65	88	85
Riprap and jetty stone.....	595	696	353	629
Terrazzo.....	3	65	4	109
Other uses ¹	4,212	6,980	5,121	7,051
Total ²	40,704	49,214	39,750	50,251

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
¹ Includes chemical stone for alkali works, paper manufacture, poultry grit and mineral food, macadam aggregate, stone sand, railroad ballast, drain fields (1971), fill (1972), and unspecified uses.
² Data may not add to totals shown because of independent rounding.

Sulfur.—Byproduct sulfur was recovered from crude petroleum by Total Leonard, Inc. (Alma), Marathon Oil Co. (Detroit), and Mobil Oil Co., Inc. (Woodhaven). The latter facility discontinued refining operations at yearend. Shipments remained about the same as in 1971, but value declined by over 24%.

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, horticulture, concrete aggregate, plaster aggregate, and other uses.

METALS

Copper.—Production of copper, in terms of recoverable metal, was 20.1% more than in 1971 and its value was 18.2% higher; a lengthy strike had curtailed production in 1971. In addition to continued production from the White Pine mine of White Pine Copper Co., in Ontonagon County, a small amount of copper was produced by Mineral Recovery Corp. from tailings at the Champion mine in Houghton County.

The White Pine Copper Co., a subsidiary of the Copper Range Co., produces copper from sulfides mineralization in the Nonesuch Shale. Ore from the underground mine is extracted by the room-and-pillar system, using trackless equipment. Ore is moved from the working faces in 18-ton-capacity Wagner ore cars to pockets which are 1,200 feet or less from the face. Crushers are used at certain locations to reduce the ore before transporting it from the mine.

The concentrator employs rod mills followed by ball mills for grinding. Two flotation circuits are operated. One makes a copper concentrate which is high in silver. The company smelts the concentrates and fire refines the blister copper at the property. Products are ingots, wire bar, and semicontinuously cast cakes up to 23 feet in length.⁴

In late 1967 the rated capacity of the mill was increased to 25,000 tons per day from 17,500 tons per day. A reverberatory furnace, completed in December 1966, increased the maximum smelting capacity to 175 million pounds of copper annually.

The low sulfur content of the chalcocite ore has eased the burdens of keeping sulfur emissions below the primary and secondary ambient air standards established in the 1970 Clean Air Act.

Results of a Bureau of Mines study of three single-heading blasts in a long, straight haulageway at the White Pine copper mine were published in October 1971.⁵

Homestake Mining Co., which holds an option to lease the mineral rights on property owned by Universal Oil Products Co. (U.O.P.), announced it would investigate new methods of mining and milling the copper deposits in the Keweenaw Peninsula. Homestake Copper Co., a newly established, wholly owned subsidiary of Homestake Mining Co., will undertake the project. The first phase of the work will consist of dewatering the Centennial #6 mine, which has been closed since August 2, 1968, when economic conditions forced the Calumet Division of U.O.P. to cease production at that location. Geophysical and geochemical exploration will be undertaken on areas outside the prime Centennial mine target.

⁴Beall, J. V. Copper in the U.S.-A Position Survey. Min. Eng., v. 25, No. 4, April 1973, pp. 38-39.

⁵Olson, J. J., and L. R. Fletcher. Airblast-Over-pressure Levels From Confined Underground Production Blasts. BuMines RI 7574, 1971, 24 pp.

Table 11.—Michigan: Mine production (recoverable) of silver and copper

	1970	1971	1972
Mines producing: Lode.....	1	1	2
Material sold or treated:			
Copper ore.....thousand short tons..	7,638	6,891	8,250
Copper tailings.....do.....	--	--	40
Production (recoverable):			
Quantity:			
Silver.....troy ounces.....	891,579	670,052	785,100
Copper.....short tons.....	67,543	56,005	67,260
Value:			
Silver.....thousands.....	\$1,579	\$1,036	\$1,323
Copper.....do.....	77,945	58,245	68,874
Total.....do.....	79,524	59,281	70,197

Iron Ore.—Iron ore shipments in 1972 were 12.7 million long tons, an increase of 7.3% over the 11.8 million long tons shipped in 1971. The average weighted mine value for Michigan usable iron ore shipments in 1972 was \$13.98 compared with \$13.51 in 1971. Iron ore continued to be the leading commodity in the State in terms of total mineral value.

Production, measured as shipments, came from two underground mines (the Mather mine in Marquette County and the Sherwood mine in Iron County), four open pit mines (the Empire, Republic, and Tilden mines in Marquette County, and the Groveland mine in Dickinson County), and four mines that have been closed but continued to ship from stockpiles (the Cliffs Shaft and Humboldt mines in Marquette County and the Homer and Wauseca mines in Iron County).

Pellet production at Cleveland-Cliffs Iron Co.'s Empire mine passed the 25-million-ton production mark on October 4, 1972. The mine began production late in 1963 with a rated annual capacity of 1.6 million tons of pellets. Expansions in 1966 and 1967 increased the production capacity to its current 3.4 million tons of pellets per year. A new expansion, started this year and scheduled to be completed in 1975, will raise the annual productivity by 1.8 million tons of pellets.

Operating under the same name from 1907 to 1928, the Empire mine produced 768,000 tons of a hard, red siliceous hematite ore with less than 40% iron content. The Cleveland-Cliffs Iron Co. and its partners revived the mine in 1963 and developed the first iron mining and processing complex to successfully produce high-grade (64%) iron pellets from Michigan's low-grade ore. The facility was the first iron ore processing mill in the United States to use full autogenous grinding.

The Tilden project, an iron ore mining and pelletizing venture of Cleveland-Cliffs and five North American steel companies, got underway with plans to produce 4 million tons of pellets annually starting in mid-1974. Additional expansion, in two phases, would increase production to 12 million tons a year by mid-1978.

Cleveland-Cliffs has owned the Tilden mine since 1865. It contains a low-grade, fine-grained iron oxide (hematite) ore deposit which has been mined by open pit methods on a small scale since 1927. Development of a process to turn low-grade, fine-grained hematite ore into iron-ore pellets made the current project possible. In cooperation with the U.S. Bureau of Mines, new technology was developed involving fine grinding, selective flocculation, desliming, and selective froth flotation to produce a pellet containing 65% iron with less than 5% silica from the crude ore (36% iron content).

Water is an important requirement in the process, which needs 38 tons of water to produce 1 ton of iron ore pellets. To provide the water, Cleveland-Cliffs will dam the Middle Branch of the Escanaba River to create a 1,400 acre reservoir along a 6.5 mile stretch. The initial pelletizing plant at Tilden will circulate about 86,000 gallons of process water each minute, of which about

6,200 gallons per minute would be new or makeup water obtained from the reservoir; about 93% of the water would be reused continuously.

Table 12.—Michigan: Usable iron ore¹ produced (direct-shipping and all forms of concentrates), by range
(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebie range (Michigan part)	Total		
				Ore ²	Iron content	Iron content (percent)
1854-1967.....	359,600	283,479	249,625	892,705	NA	NA
1968.....	10,086	3,684	--	13,770	8,339	60.56
1969.....	10,048	3,369	--	13,417	8,183	60.99
1970.....	10,363	2,394	--	12,757	7,950	62.31
1971.....	9,495	2,424	--	11,919	7,384	61.95
1972.....	9,131	2,533	--	11,664	7,332	62.86
Total ³	408,723	297,883	249,625	956,232	NA	NA

¹ Revised. NA Not available.

² Exclusive, after 1905, of iron ore containing 5% or more manganese.

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

⁴ Distribution by range partly estimated before 1906.

Table 13.—Michigan: Iron ore shipped from mines
(Thousand long tons)

Year	Direct-shipping ore ¹	Concentrates and agglomerates, total	Total usable ore	Proportion of beneficiated ore to total usable ore (percent)
1968.....	2,353	10,346	12,699	81.5
1969.....	1,972	12,086	14,058	86.0
1970.....	1,512	11,588	13,100	88.5
1971.....	1,439	10,393	11,833	87.8
1972.....	727	11,965	12,692	94.3

¹ Includes crushed, screened, and sized ore not further treated.

² Data does not add to total shown because of independent rounding.

Partly to meet power needs for the Tilden project, the Upper Peninsula Generating Co. will construct two new units, almost doubling the output of its Presque Isle Station in Marquette. The Station presently consists of four units with a total output of 179 megawatts.

A land reclamation experiment on iron ore tailings at the Humboldt mine involved the planting of grasses, tree seedlings, and cuttings. The mine was closed at the end of 1970 by the Cleveland-Cliffs Iron Co., which had operated it for 18 years until it was commercially exhausted.

The Hanna Mining Co. added a sixth balling circuit to its pelletizing section at the Groveland mine. Its purpose is to help produce pellets with better structure and more uniform size.

Pig Iron and Steel.—Pig iron and steel were manufactured in the Detroit area. Pig iron shipments remained about the same but value increased 5.2%, as compared with the 1971 figures. According to the American Iron & Steel Institute, Michigan produced 9,380,000 short tons of steel in 1972 compared with 9,069,000 short tons in 1971.

The Steel Division of Ford Motor Co. began construction in 1971 of a new 390,000-square-foot hot strip steel rolling mill at the Rouge manufacturing complex in Dearborn; completion of the new mill is scheduled for 1974. The present hot strip mill, installed in 1935, was one of the first built in the United States, and is the oldest continuously running mill of its kind in this country. Additional expansion plans, with construction to begin early in 1973, include the installation of two new electric melting furnaces, additional soaking pits and annealing furnaces, a new recoil and oiling line, and new processing and shipping facilities.

A contract was awarded by the Michigan Seamless Tube Co. to the Swindell-Dressler Co. for the engineering and

construction of an electric steel plant in Jackson, Mich., scheduled for completion in 1974. The plant will use a centrifugal casting method to produce 25-foot-long steel bars.

The Hoover Ball & Bearing Co. of Ann Arbor, Mich., and Cefilac, a subsidiary of P  chiney Ugine Kuhlmann of France, are jointly investing more than \$15 million to build a new 100,000-square-foot plant near Bridgman, Lake Township, in southwest Michigan. The plant will be the first in the United States to convert scrap steel into wire products without the need for remelting. It is expected to be in operation by early 1974 with an annual capacity of 150,000 tons. The plant will use an electric-powered process.

Silver.—Silver was recovered from copper ore mined at the White Pine mine in Ontonagon County.

Concentrates from a silver-recovery circuit in the White Pine mill were shipped to an outside smelter for silver recovery. Output of silver in 1972 was 17.2% more than in 1971, while value was 27.7% more than in 1971.

MINERAL FUELS

Coke.—Three companies operated oven-coke plants in Michigan in 1972. Total production of 3,677,000 short tons represented a decrease from the 3,780,000 short tons produced in 1971. The majority of the coke was consumed by blast furnaces. Michigan ranked fifth among the States in coke production and fourth in coke consumption.

Following a successful test at its Semet-Solvay Division's Iron ton (Ohio) plant, Allied Chemical Corp. began installing the COALTEK system at its battery of 70 coke ovens in Detroit. The COALTEK unit preheats the coal and feeds it into the ovens via closed pipelines, eliminating the conventional charging cars and reducing air pollution.

Natural Gas.—Marketed production of natural gas increased substantially from 25,662 million cubic feet to 34,221 million cubic feet in 1972. Value in 1972 was \$10,506,000, a 55% increase over that of 1971. Increased production was primarily due to the the new Niagaran reef fields. Many of the gas discoveries were not put into production immediately because of a lack of pipeline facilities and condensate handling equipment. A no-flare order, put into effect by the Michigan Department of Natural Resources late in 1971, prevented waste of oil-well gas from the Niagaran reef wells. It also has helped to expedite the construction of gas gathering systems.

One of the State utilities, Consumers Power Co., and one of the major producing companies, Shell Oil Co., are building natural gas processing plants on side-by-side locations at Kalkaska. Consumers Power Co. is constructing a facility that will handle 125 million cubic feet of gas daily; the plant is near the west terminal of Michigan Consolidated's line which will carry both the gas and gas liquids. Shell Oil Co.'s facility is designed to

handle up to 350 million cubic feet of gas daily. The new plants are expected to be operational in early 1974. Shell Oil Co., however, is experiencing construction difficulties that may delay completion of its facility.

Compilations by the Gas Section, Public Utilities Division of the Michigan Public Service Commission showed gas imports of 906,684,020 thousand cubic feet in 1972, a slight decrease from the 909,209,140 thousand cubic feet imported in 1971. The largest wholesale supplier of gas to Michigan is the Michigan Wisconsin Pipe Line Co. Michigan presently uses about 1 trillion cubic feet of gas annually, about 95% of which is imported.

According to estimates of the American Gas Association (AGA), proved natural gas reserves in Michigan on December 31, 1972, were 1,296,815 million cubic feet, a gain of 280,333 million cubic feet.

Natural Gas Liquids.—Production of natural gas liquids decreased 19.6% from that of 1971, to 1,228,000 barrels. Of the total production, 395,000 barrels were natural gasoline and 833,000 barrels were liquefied petroleum (LP) gases. LP gases averaged \$2.73 per barrel compared with \$2.69 in 1971, and natural gasoline averaged \$2.78 per barrel compared with \$2.74 in 1971.

According to the AGA, proved reserves of natural gas liquids totaled 19,026,000 barrels at yearend 1972 compared with 12,584,000 barrels at yearend 1971.

Peat.—Michigan continued to lead the Nation in peat production, accounting for 36% of the U.S. total. Production, which decreased from 209,835 short tons in 1971 to 208,691 short tons in 1972, was obtained from 11 counties. Sixty-nine percent of the State total came from Lapeer and Sanilac Counties; other producing counties were Allegan, Eaton, Ingham, Kent, Mecosta, Monroe, Oakland, St. Joseph, and Shiawassee.

Sales totaled 219,251 short tons in 1972 as compared with 202,189 short tons in 1971. Reed-sedge peat accounted for 78.8% of the total sales; moss peat, 12.5%; and humus peat, 8.7%. Over 82% of the sales was in packaged form. Ninety-four 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, for packing flowers, etc.

Petroleum.—Michigan's annual oil production, having followed a declining trend since 1962, began to climb in 1971 and continued upward in 1972. Output in 1972 was 12,990,000 barrels valued at \$41.6 million. The State average value per barrel was \$3.20 for 1972, compared with \$3.27 in 1971. Increased oil production was directly related to the new Niagaran reef reservoirs.

Albion-Scipio, the great Trenton and Black River field, passed the 100-million-barrel mark in 1972, making it the first field in Michigan to achieve "giant" status. Production in this field amounted to 3,948,650 barrels in 1972, compared with 4,714,659 barrels in 1971.

Niagaran oil production exceeded the Trenton Trend in gross oil runs in 1972.⁶ About 5,245,930 barrels of the State's total oil and condensate runs were credited to "new Niagaran," accounting for 40% of the State's oil production. If the well to refinery facilities in or projected are placed into service in 1973, runs can easily be doubled next year.

Eighteen waterflood projects, having 462 injection wells, were in operation during the year. They accounted for 1,896,396 barrels of oil in 1972, or 14.6% of the total oil production in the State for the year.⁷

Reserves of crude oil, according to the American Petroleum Institute (API), were 62,002,000 barrels on December 31, 1972, an increase of 3,237,000 barrels over that of the previous year.

Total Leonard, Inc., a wholly owned subsidiary of Total Petroleum (North America) Ltd., put into operation in July its new platforming unit at Alma. This unit increased the refinery's capacity for production of high-octane gasoline by nearly 40%. Revamping of crude processing facilities was undertaken to provide raw material for the new Platformer as well as additional crude processing capacity.

Mobil Oil Co. Inc., discontinued refining operations at its 46,600-barrel-per-day refinery at Woodhaven in the Detroit area. The facility, built in 1929, was capable of producing substantially less home heating oil and gasoline per barrel of crude oil than more modern refineries.

Marathon Oil Co. converted its fluid catalytic cracking unit at Detroit to "riser" cracking, a recently developed technology that increases the yield of gasoline per barrel of feedstock.

⁶Oil and Gas News. V. 79, No. 17, Apr. 27, 1973, p. 7.

⁷Oil and Gas Compact Bulletin. V. 32, No. 1, June 1973, p. 29.

Petroleum and Natural Gas Exploration and Development.—Total well completions in Michigan, according to the API, increased from 302 wells in 1971 to 309 wells in 1972. Of the 309 wells drilled, 87 were completed as oil wells, 34 as gas wells, and 188 as dry holes. Overall success ratio was 39%; 30% of the exploratory wells were completed as oil and gas producers. The total footage drilled in new wells was 1,486,258 feet, of which 576,718 feet was in development completions and 909,540 feet was in exploratory completions.

Ingham County, which was almost ignored by oil and gas developers until 2 years ago, accounted for 16.8% of the well completions; this included 20 oil wells, 8 gas wells, and 24 dry holes. Kalkaska County was second with 41 well completions, which included 19 oil wells, 9 gas wells, and 13 dry holes. Otsego County was third with 40 well completions, of which 24 produced oil, none were gas wells, and 16 were dry holes.

Table 14.—Michigan: Crude oil production, by county
(Thousand 42-gallon barrels and thousand dollars)

County	1971		1972	
	Quantity	Value ¹	Quantity	Value ¹
Allegan	122	399	114	364
Antrim	231	755	(²)	642
Arenac	12	39	10	32
Barry	235	765	218	697
Bay	1,533	5,009	1,255	4,015
Calhoun	394	1,287	383	1,225
Clare	524	1,712	586	1,876
Crawford	68	222	3	11
Eaton	279	912	274	875
Genesee	3	10	69	221
Gladwin	7	23	3	9
Grand Traverse	2,356	7,698	(²)	6,456
Gratiot	(²)	1	(²)	(²)
Hillsdale	348	1,137	1,149	3,677
Huron	187	611	144	461
Ingham	849	2,774	688	2,202
Isabella	302	987	328	2,650
Jackson	58	190	53	169
Kalamazoo	186	608	137	439
Kent	81	265	95	304
Lake	(²)	1	3	8
Lapeer	4	13	3	8
Leelanau	29	95	54	205
Macomb	101	330	54	172
Mason	185	604	154	494
Meosco	545	1,781	572	1,829
Midland	2	7	2	5
Missaukee	123	402	107	342
Monroe	20	65	16	50
Montcalm	16	52	13	40
Muskegon	1	3	(²)	1
Newaygo	74	242	51	164
Oakland	346	1,130	411	1,316
Oceana	622	2,032	531	1,699
Ontonagon	2	7	1	5
Otsego	815	2,663	1,404	4,490
Ottawa	51	167	54	172
Presque Isle	(²)	1	(²)	1
Roscommon	209	683	287	919
St. Clair	873	2,852	900	2,880
Saginaw	21	69	18	59
Shiawassee	7	23	4	12
Tuscola	60	196	53	169
Van Buren	5	16	6	20
Washtenaw	5	16	3	11
Wayne	4	13	6	20
Wexford	--	--	(²)	(²)
Total ¹	11,893	38,859	12,990	41,556

¹ County values calculated by using State average value per barrel: \$3.27 for 1971 and \$3.20 for 1972.

² Less than 1/2 unit.

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

Source: State of Michigan, Department of Natural Resources.

Table 15.—Michigan: Oil and gas well drilling completions, by county, in 1972

County	Proved field wells ¹			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Allegan	1	--	--	--	--	2	3	5,021
Antrim	--	--	--	1	--	2	2	12,365
Arenac	--	--	--	--	--	2	2	6,960
Barry	--	--	--	--	--	4	4	16,944
Bay	--	--	--	--	--	2	2	6,946
Benzie	--	--	--	--	--	1	1	5,155
Berrien	--	--	--	--	--	2	2	1,438
Calhoun	1	2	7	--	4	2	16	57,392
Clinton	--	--	--	1	--	1	1	3,111
Crawford	1	--	--	1	1	5	7	37,698
Eaton	--	--	1	2	--	6	9	42,012
Gladwin	1	--	8	--	--	4	13	51,670
Grand Traverse	--	1	--	5	3	10	19	123,434
Gratiot	--	--	--	--	--	--	1	270
Hillsdale	--	--	3	--	--	4	7	28,053
Huron	--	--	--	--	--	2	2	15,595
Ingham	15	6	13	5	2	11	52	223,544
Ionia	--	--	--	--	--	2	2	7,557
Jackson	--	--	2	--	--	6	8	34,943
Kalamazoo	11	1	3	8	8	10	41	280,217
Kent	--	--	--	--	--	1	1	3,555
Lake	1	--	--	--	--	2	7	22,859
Lapeer	5	--	--	--	--	2	7	7,704
Leelanau	--	--	--	--	--	2	3	16,172
Livingston	--	1	--	--	--	7	9	28,822
Macomb	--	--	2	--	--	1	2	1,125
Manistee	--	--	--	--	1	1	2	15,832
Mason	1	--	1	3	--	4	4	14,603
Meosco	--	--	--	--	--	1	2	8,096
Missaukee	--	--	1	--	--	--	1	3,366
Montcalm	--	--	--	--	--	1	1	5,350
Montmorency	--	--	--	--	--	2	3	4,090
Muskegon	--	--	1	--	--	2	3	5,700
Oceana	--	2	1	--	--	--	3	4,879
Ontonagon	15	--	8	9	--	8	40	246,088
Ottawa	--	--	--	--	--	1	1	1,620
Presque Isle	--	--	--	--	--	3	3	10,319
St. Clair	--	--	7	--	1	9	17	51,686
Tuscola	--	--	1	--	--	1	1	7,941
Van Buren	--	--	--	--	--	--	1	1,322
Washtenaw	--	--	1	--	--	4	5	24,398
Wexford	--	--	--	--	1	3	4	25,501
Total	53	13	61	34	21	127	309	1,486,258

¹ Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

For the fourth straight year, Niagaran reef exploration continued to dominate oil and gas activity in the State. The new discoveries are opening previously untested basin areas. The present play actually started in 1968 with a well near Onaway in Presque Isle County. Exploration in 1972, according to the Geological Survey, Michigan Department of Natural Resources, was concentrated mainly in Grand Traverse, Kalamazoo, and Otsego Counties in the northern district and in the Ingham-Eaton-northeastern Calhoun region in the southern part of the basin. Most of the new reefs were found in the northern part of Lower Michigan. One of these discoveries, the Hamlin 13-19n-18w field in Mason

County, extended the Niagaran trend about 150 miles southwest of the Onaway field. In December, the first Niagaran reef discovery for Manistee County was completed.

The old "bread and butter" areas of the State were for the most part ignored in 1972. Gladwin County accounted for 13 Dundee completions, only one of which was completed as a producing well. Such historic Traverse province areas as Allegan, Kent, Ottawa, and Van Buren Counties accounted for only six completions, with only one of these a producer. Calhoun, Hillsdale, and Jackson Counties, in the Albion-Pulaski-Scipio trend area, accounted for only 20 Trenton completions, none of which were productive. In St. Clair and Macomb Counties, where a number of Niagaran reefs were found during the 1960's, only 26 wells were completed, only one of which was rated a commercial well.

Oil and gas lease sales on State-owned land were held for the first time since November 1969. In July, a record Michigan bonus of \$9,640,971 was paid for 426,369 acres in 11 counties in the northern part of the Lower Peninsula. The average lease price was \$22.61 per acre, compared with \$2.10 per acre in 1968 and \$11 per acre in 1969. In December, the second sale brought a bonus of \$523,157 for 167,428 acres, which gives an average price per acre of \$3.13.

Three major oil companies led the way in finding new fields in Michigan's Lower Peninsula. In the northern area, Shell Oil Co. led the way, followed by Amoco Production Co., a Standard affiliate; in the southern area, Mobil Oil Corp. was the leader. Independents contributed a number of new fields including the previously mentioned Hamlin 13-19n-18w, which extended the known Niagaran reef area for the first time as far west as Mason County.

Pipeline Construction.—Mobil Oil Co. Inc., received approval to build a pipeline to serve its expanding Ingham County oil operations. The oil is presently being moved from the various fields to refiners by truck. By building a pipeline system, involving 13 miles of 8-inch and 8 miles of 4-inch pipe, Mobil will be able to carry crude to Lakehead Pipe Line's 30-inch Canada-Wisconsin loop that extends northeast to Port Huron. At Stockbridge, where Mobil will make the tap for its new line, it also will have a switch to Michigan-Ohio's Mt. Pleasant-to-Toledo line. The two junctions will give Mobil crude movement to many intrastate and interstate markets, up to 25,000 barrels per day.

Shell Pipe Line Corp. has been authorized to build an 85-mile pipeline system to carry crude oil from Niagaran reef fields in Kalkaska, Crawford, and Otsego Counties. The first section of the system, a 26-mile section of 8-inch and 16-inch line, will deliver oil produced in Otsego County to Lakehead Pipeline Co.'s Lewiston station in northeast Crawford County. It will eliminate having to move large quantities of crude oil by truck. Capacity of the system when fully completed is expected to exceed

100,000 barrels per day, which is greater than the peak in the past of any Michigan oil production.

Michigan Wisconsin Pipe Line Co. received approval from the Federal Power Commission for a \$58.3 million pipeline system expansion. It will increase the capacity of its transmission system by building 187 miles of 36-inch loop line on its Louisiana main line system. Michigan Wisconsin Pipe Line Co. delivers more than half of its total yearly capacity to Michigan. During 1972, Michigan utilities received from the company over 430 billion cubic feet of gas.

Table 16—Principal producers ¹

Commodity and company	Address	Type of activity	County
Abrasives, metallics:			
Abrasive Materials, Inc. . . .	Box 291 Hillsdale, Mich. 49242	Plant	Hillsdale.
Cleveland Metal Abrasive Co.	887 East 67th St. Cleveland, Ohio 44103	do	Livingston.
Ervin Industries, Inc.	Box 1168 Ann Arbor, Mich. 48106	do	Lenawee.
Cement:			
Dundee Cement Co.	Box 122 Dundee, Mich. 48131	Portland, wet process . . .	Monroe.
Martin Marietta Cement, Great Lakes Div.	Box 8 Bay City, Mich. 48706	Portland and masonry, wet process.	Bay.
See footnote at end of table.			

Table 16.—Principal producers ¹—Continued

Commodity and company	Address	Type of activity	County
Cement—Continued			
Medusa Cement Co., Div.	Box 5668 Cleveland, Ohio 44101	Portland, wet process . . .	Charlevoix.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Portland and masonry, dry process.	Alpena.
Peerless Cement Co., div. of American Cement Corp.: Brennan Ave. Plant	2000 The Executive Plaza Detroit, Mich. 48226	Portland, wet process . . .	Wayne.
Detroit Plant		Portland and masonry, wet process.	Do.
Port Huron Plant		Portland, wet process . . .	St. Clair.
Penn-Dixie Cement Corp.	Box 307 Petoskey, Mich. 49770	Portland and masonry, wet process.	Emmet.
Wyandotte Cement Inc.	3505 Biddle Ave. Wyandotte, Mich. 48192	do	Wayne.
Clays and shale:			
Construction Aggregates Corp.	13600-104th Ave. Grand Haven, Mich. 49417	Pit and plant	Ottawa.
Dundee Cement Co.	Box 122 Dundee, Mich. 48131	Pit	Monroe.
Light Weight Aggregate Corp.	27611 Schoolcraft Rd. Livonia, Mich. 48150	Pit and plant	Wayne.
Martin Marietta Cement, Great Lakes Div.	Box 8 Bay City, Mich. 48706	Pit	Saginaw.
Medusa Cement Co., Div.	Box 5668 Cleveland, Ohio 44101	Pit	Antrim.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Pit	Alpena.
Peerless Cement Co., div. of American Cement Corp.	2000 The Executive Plaza Detroit, Mich. 48226	Pits	St. Clair and Wayne.
Penn-Dixie Cement Corp.	Box 307 Petoskey, Mich. 49770	Pit	Emmet.
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., subsidiary of Copper Range Co.	Box 427 White Pine, Mich. 49971	Mine and mill	Ontonagon.
Gypsum:			
Georgia-Pacific Corp. Gypsum Div.	900 SW. 5th Ave. 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.	2340 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.: Empire	1460 Union Commerce Bldg. Cleveland, Ohio 44115	Open pit mine, concentrator, and agglomerator.	Marquette.
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.
Republic		Open pit mine, concentrator, and agglomerator. Part of the concentrates pelletized at the Humboldt plant.	Do.
Tilden		Open pit mine and stockpile shipments.	Do.
See footnote at end of table.			

Table 16.—Principal producers ¹—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
The Hanna Mining Co., Groveland.	100 Erieview Plaza Cleveland, Ohio 44114	Open pit mine, concentrator, and agglomerator.	Dickinson.
Inland Steel Co.: Sherwood	30 West Monroe St. Chicago, Ill. 60603	Underground mine.	Iron.
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.	2020 Dow Center Midland, Mich. 48640	Quicklime, 3 rotary kilns, continuous hydrator.	Mason.
Marblehead Lime Co.	300 West Washington St. Chicago, Ill. 60605	Quicklime, 2 rotary kilns.	Wayne.
BASF Wyandotte Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Quicklime, 9 shaft kilns.	Do.
Peat:			
Anderson Peat Co.	332 Graham Rd. Imley 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 P.O. Box 312 Sandusky, Mich. 48471	do.	Sanilac.
Michigan Peat.	8 Executive Mall Valley Forge, Pa. 19481	Bogs, processing plant.	Do.
Seenic Lakes, Inc.	Box 926 East Lansing, Mich. 48823	Bog, processing plant.	Shiawassee.
Expanded perlite:			
Harborlite Corp.	P.O. Box 458 Escondido, Calif. 92025	Processing plant.	Kalamazoo.
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 Div., The Dow Chemical Co.	4868 Wilder Rd. Bay City, Mich. 48709	do.	Bay.
Crystal Refining Co.	901 North Williams Carson City, Mich. 48811	do.	Montcalm.
Lakeside Refining Co.	2705 East Cor. Kalamazoo, Mich. 49001	do.	Kalamazoo.
Total Leonard, Inc., Alma Division	East Superior St. Alma, Mich. 48801	do.	Gratiot.
Marathon Oil Co.	1300 South Fort St. Detroit, Mich. 48217	do.	Wayne.
Mobil Oil Co., Inc.	Box 477 Trenton, Mich. 48183	do.	Do.
Oscoda Refining Co.	Box 178 Reed City, Mich. 49677	do.	Ogemaw.
Salt and salines:			
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-magnesium compounds, magnesium compounds.	Mason.
Midland Plant.		Brine wells and processing plant: Bromine, calcium-magnesium compounds, iodine, magnesium compounds, salt.	Midland.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	Processing plant: Magnesium compounds.	Mason.
Hardy Salt Co.	P.O. Drawer 449 St. Louis, Mo. 61366	Processing plant: Salt.	Manistee.
Hooker Chemical Corp.	Box 295 Montague, Mich. 49437	Brine wells and processing plant: Salt.	Muskegon.
International Salt Co., Inc.	Clarke Summit, Pa. 18411	Underground salt mine.	Wayne.

See footnote at end of table.

FIBORN LIMESTONE MEMBER (BURNT BLUFF GROUP)

The Burnt Bluff Group is named after a cliff on the west side of Delta County's Garden Peninsula along Bay de Noc in Michigan's northern peninsula. From top to bottom it consists of three formations, namely; the Hendricks dolomite, containing the Fiborn member; the Byron dolomite, and the Lime Island dolomite. The Burnt Bluff Group is separated from the overlying high-purity Engadine Dolostone by the siliceous Manistique Group. At most places the Burnt Bluff limestone is siliceous or dolomitic, but in a few locations the relatively undolomitized Fiborn Limestone Member is a very pure high-calcium stone.



The most notable of these high-calcium limestone deposits are worked by Inland Lime and Stone Company, a Division of Inland Steel Company. They are located in two adjacent quarries in western Mackinac and eastern Schoolcraft Counties. The limestone is very low in silica and exceptionally low in sulfur and is, therefore, very much in demand as flux stone in the making of steel. It is also highly desirable in the manufacture of cement and much stone is shipped for chemical uses. Small deposits of the Fiborn limestone formerly yielded similar high-calcium stone from the abandoned Hendricks and Fiborn quarries further to the east in Mackinac County. There are undeveloped deposits of Fiborn limestone at Gould City in the Trout Lake vicinity, as well as suggested deposits at Gulliver, Stalwart, and near Pickford. A diamond core drilling program now in progress by the Institute of Mineral Research, Michigan Technological University, in cooperation with the Department of Natural Resources' Geological Survey Division (see cover photo), will help establish the commercial feasibility of these sites. A report of this investigation, with chemical analyses and geologic data, will be available on termination of the drilling program. This report should be published sometime next year.

Table 16.—Principal producers ¹—Continued

Commodity and company	Address	Type of activity	County
Salt and salines—Continued			
Martin Marietta Chemicals, Refractories Div.	Executive Plaza II Hunt Valley, Md. 21030	Brine wells and processing plant: Magnesium compounds.	Manistee.
Michigan Chemical Corp.: St. Louis Plant.	351 East Ohio St. Chicago, Ill. 60611	Brine wells and processing plant: Bromine, calcium-magnesium compounds, magnesium compounds, salt.	Gratiot.
Morton Chemical Co., div. Morton-Norwich Products, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	Brine wells and processing plant: Bromine, magnesium compounds.	Manistee.
Morton Salt Co., div. of Morton-Norwich Products, Inc.	do.	do.	Do.
Manistee Plant.	do.	Brine wells, and processing plant: Salt.	Do.
Port Huron Plant.	do.	do.	St. Clair.
Pennwalt Corp.	3 Penn Center Philadelphia, Pa. 19102	do.	Wayne.
Wilkinson Chemical Corp.	Mayville, Mich. 48744	Brine wells and processing plant: Calcium-magnesium compounds.	Lapeer.
BASF Wyandotte Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Brine wells and processing plant: Salt.	Wayne.
Sand and gravel:			
American Aggregates Corp.	Drawer 160 Greenville, Ohio 45331	Pits and stationary plants.	Kalamazoo, Livingston, Macomb, Oakland.
Construction Aggregates Corp.	120 South LaSalle St. Chicago, Ill. 60603	do.	Ottawa.
Grand Rapids Gravel Co.	2700-28th St., SW Grand Rapids, Mich. 49509	do.	Kent.
Holloway Sand & Gravel Co.	29250 Wixom Rd., Box 247 Wixom, Mich. 48096	Pits and portable plants.	Genesee, Oakland, Ogemaw, Otsego, Oakland.
Holly Sand & Gravel Div., J. P. Burroughs & Sons Inc., Aggregate Div.	Box 1468 Saginaw, Mich. 48605	Pit and stationary plant.	Ottawa.
McCormick Sand Corp.	P.O. Box 506 Muskegon, Mich. 49443	Stationary plant.	Ottawa.
Mickelson Corp.	435 Granger Rd. Oxford, Mich. 48051	Pit, dredges, portable plant.	Do.
Molesworth Contracting Co.	321 Park Ave. Yale, Mich. 48097	Pits and portable plants.	Lapeer, Macomb, St. Clair, Sanilac.
Natural Aggregates Corp.	55545 Mound Rd. Romeo, Mich. 48065	Pits, dredge, portable and stationary plants.	Livingston and Macomb.
New Hudson Sand & Gravel Inc.	Box 174 New Hudson, Mich. 48165	Pits and stationary plants.	Oakland.
Sargent Sand Co.	2540 Bay Rd. Saginaw, Mich. 48604	do.	Bay, Mason, Saginaw, Tuscola, Clinton, Ingham, Oakland.
Spartan Aggregates.	P.O. Box 25 Holt, Mich. 48842	do.	Ottawa.
Standard Sand Co.	P.O. Box 290 Grand Haven, Mich. 49417	Stationary plant.	Ottawa.
Silver: White Pine Copper Co. subsidiary of Copper Range Co.	Box 427 White Pine, Mich. 49971	Byproduct silver.	Ontonagon.
Smelters: White Pine Copper Co., subsidiary of Copper Range Co.	do.	Primary copper smelter.	Do.
Stone:			
Granite: Caspian Construction Co.	100 West Caspian Caspian, Mich. 49915	Quarry and stationary plant.	Dickinson.
Limestone and dolomite: Bethlehem Mines Corp., Bethlehem Steel Corp.	701 East Third St. Bethlehem, Pa. 18016	do.	Chippewa.
Cheney Limestone Co.	Box 6 Bellevue, Mich. 49021	do.	Eaton.
Detroit Edison Co.	2000 South Second Ave. Detroit, Mich. 48226	Quarry and portable plant.	Monroe.
Dundee Cement Co.	Box 122 Dundee, Mich. 48131	Quarry and stationary plant.	Do.

See footnote at end of table.

Table 16.—Principal producers ¹—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite:			
The France Stone Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	Quarry and stationary plant.	Monroe.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	-----do-----	Alpena.
Inland Lime & Stone Co., div. of Inland Steel Co.	Gulliver, Mich. 49840.....	Quarries and stationary plants.	Mackinac. Schoolcraft.
Medusa Cement Co., Div. Medusa Corp.	Box 5668 Cleveland, Ohio 44101	Quarry and stationary plant.	Charlevoix.
Michigan Foundation Quarry Co., Inc.	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 307 Petoskey, Mich. 49770	-----do-----	Emmet.
Presque Isle Corp.	Box 426 Alpena, Mich. 49707	-----do-----	Presque Isle.
United States Steel Limestone Operations, United States Steel Corp.	Rogers City, Mich. 49779..	-----do-----	Mackinac, Presque Isle.
Wallace Stone Co., div. of J. P. Bur- roughs & Son, Inc., Aggregate Div.	Box 1468 Saginaw, Mich. 48605	Quarry and stationary plant.	Huron.
Marl:			
Gerald Arnsman.....	Route 1 Hopkins, Mich. 49828	Pit.....	Allegan.
Case Brothers.....	Route 2, Box 136 Union City, Mich. 49094	-----do-----	Calhoun.
Hayward Dry Marl...	Route 2 Vicksburg, Mich. 49097	-----do-----	Kalamazoo.
Poehlman & Son.....	Route 2 Cassopolis, Mich. 49031	-----do-----	Cass.
Sandstone:			
Ottawa Silica Co.....	33620 Streicher Rd. Rockwood, Mich. 48173	Pit and stationary plant.	Wayne.
Napoleon Stone Quarry	331 Austin Rd. Napoleon, Mich. 49261	Quarry and finishing plant.	Jackson.
Jude Stone Quarry...	338 Austin Rd. Napoleon, Mich. 49261	-----do-----	Do.
Recovered sulfur:			
Total Leonard Inc., Alma Div.	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: Con- struction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant.....	Do.

¹ A number of oil and gas producing companies operate in Michigan and they are listed in several commercial directories.

☆ U.S. Government Printing Office: 1974—543—488/226



STATE OF MICHIGAN

WILLIAM G. MILLIKEN, *Governor*

DEPARTMENT OF NATURAL RESOURCES

DAVID H. JENKINS, *Acting Director*

GEOLOGICAL SURVEY DIVISION

ARTHUR E. SLAUGHTER, *State Geologist and Chief*

NATURAL RESOURCES COMMISSION

HILARY F. SNELL, *Chairman*, Grand Rapids, 1972-76

CARL T. JOHNSON, Grand Rapids, 1972-75

E. M. LAITALA, Hancock, 1971-74

DEAN PRIDGEON, Montmorency, 1974-75

HARRY H. WHITELEY, Rogers City, 1973-77

JOAN L. WOLFE, Belmont, 1973-76

CHARLES G. YOUNGLOVE, Allen Park, 1972-74

CHARLES J. GUNTHER, Lansing, *Executive Assistant Secretary*

... 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

Published by Authority of State of Michigan CL '48 s.319.202
Printed by Speaker-Hines and Thomas, Inc., Lansing, August 1974

Available from Publications Room, Dept. of Natural Resources, Lansing., Mich. 48926

SELECTED REFERENCES

Michigan Geological Survey Publications

Smith, Richard A. (1915), Limestones of Michigan: Publication 21, Geological Series 17 (pages 153-55, 206, 231? 234-36, 260-65, 296-99, and 306-07).

VerWiebe, Walter A. (1927), Geology of Chippewa County, Michigan: Unpublished Geological Survey report (pages 20-23).

Poindexter, O. Floyd (1936), Geology of Schoolcraft County, Michigan: Unpublished Geological Survey report (pages 27-34).

(1940), Dolomite Deposits of Mackinac and Chippewa Counties: Three unpublished Geological Survey maps with table of chemical analyses for selected sample locations.

University of Michigan Publications

Ehlers, George M. (1930), Stratigraphy of the Niagaran Series of the Northern Peninsula of Michigan: Papers on Paleontology No. 3, Museum of Paleontology, Ann Arbor, 1973 (pages 53-126).

Michigan Basin Geological Society

Ehlers, George M. and Kesling, Robert V. (1957), Silurian Rocks of the Northern Peninsula of Michigan, Annual Field Excursion Guidebook (pages 7-19).