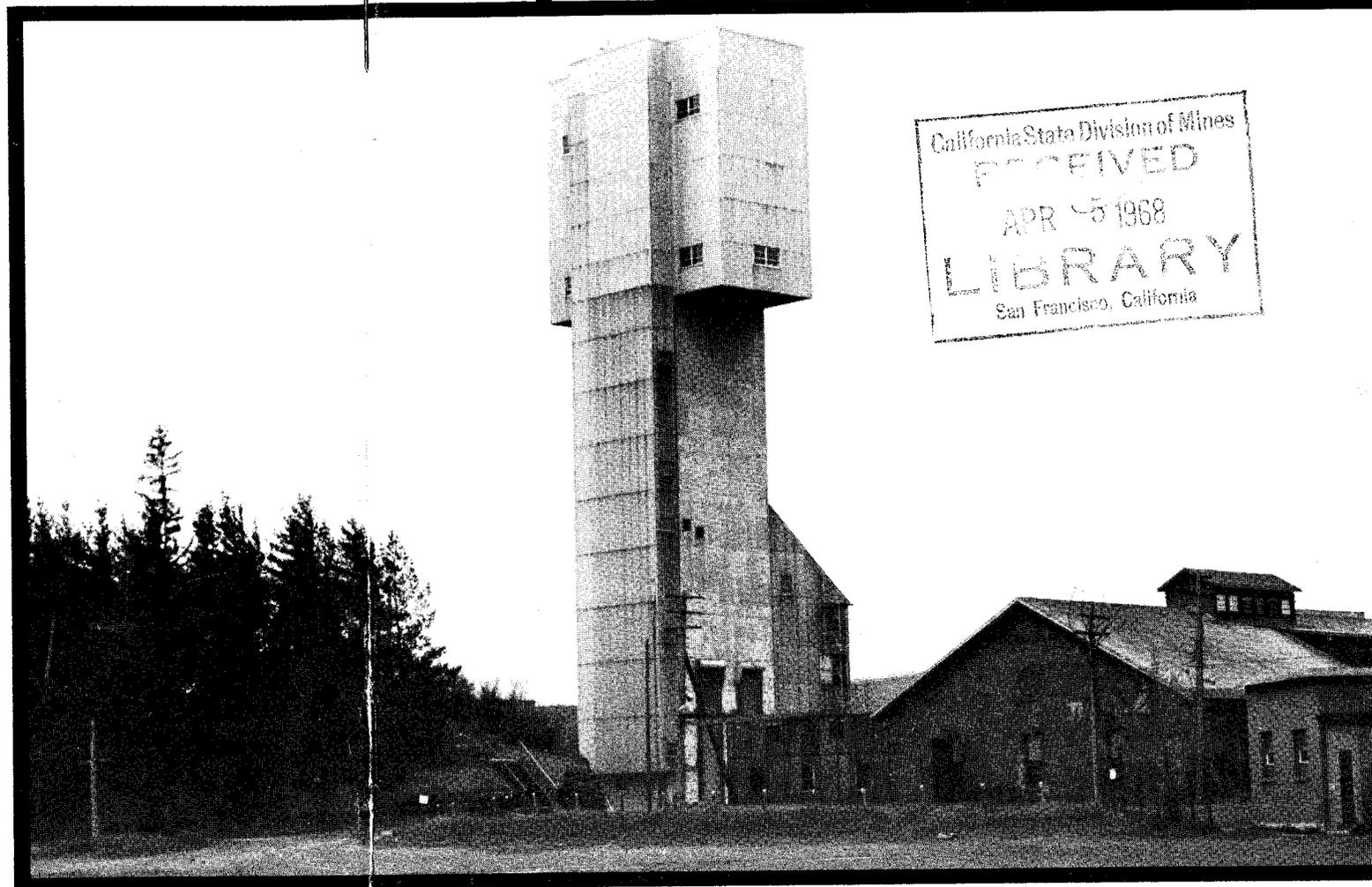


Cover photo shows headframe of the Cliffs Shaft mine at Negaunee. This great mine, operating longer than any other iron mine in the entire Lake Superior district, closed down for good on December 23, 1967.

# MINERAL INDUSTRY OF MICHIGAN, 1966



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ANNUAL STATISTICAL SUMMARY 7

Geological Survey





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ANNUAL STATISTICAL SUMMARY 7

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*... 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.319202

# Mineral Industry of Michigan 1966

By

Donald F. Klyce

Industry Economist

Bureau of Mines, Minneapolis, Minnesota

Prepared in cooperation with

Bureau of Mines

United States Department of the Interior

1968

STATE OF MICHIGAN  
GEORGE ROMNEY, *Governor*

DEPARTMENT OF CONSERVATION  
RALPH A. MACMULLAN, *Director*

GEOLOGICAL SURVEY DIVISION  
GERALD E. EDDY, *State Geologist and Chief*

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ROBERT J. FURLONG, *Executive Assistant & Secretary*

## FOREWORD

This publication summarizes the individual mineral commodities produced in Michigan during 1966. Included are statistics on production and value of the various commodities, statements on latest developments in the mineral industries, and information concerning shipments, and employment and injury experience.

Since 1962 the United States Bureau of Mines has provided the State Geological Survey with unbound and untrimmed copies of the Michigan preprint from their annual Mineral Yearbook. The Survey adds the cover, a map showing mineral value by counties, photos of mineral operations, and completes the assembly. A "Directory of Michigan Mineral Producers", prepared by the State Survey supplements this report.

Harry O. Sorensen, Geologist  
John R. Byerlay, Geologist

Mining & Economic Geology  
Geological Survey Division  
Department of Conservation

Lansing, Michigan  
January, 1968

Published by Authority of State of Michigan CL '48 s.319.202  
Printed by Speaker-Hines and Thomas, Inc., Lansing, 1968

Available from Publications Room, Dept. of Conservation, Lansing, Michigan 48926  
Price 15 cents + tax



# MICHIGAN MINERAL VALUE 1966

## 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 Conservation, for collecting information on all minerals except fuels.

By Donald F. Klyce <sup>1</sup>

In 1966 the value of mineral production in Michigan totaled \$602.1 million, exceeding \$600 million for the first time. Increased output of nearly every major mineral product, except petroleum, helped set this record.

Iron ore remained first in value, followed by cement, copper, and sand and gravel.

Nonmetals, chiefly construction materials (cement, clays, gypsum, lime, sand and

gravel, and stone) and chemicals recovered from natural salines (bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, potassium salts, and salt) accounted for more than 55 percent of the State's total mineral value. Value of copper, iron ore, and silver was 35 percent of the total, and mineral fuels made up the remainder.

<sup>1</sup> Industry economist, Bureau of Mines, Minneapolis, Minn.

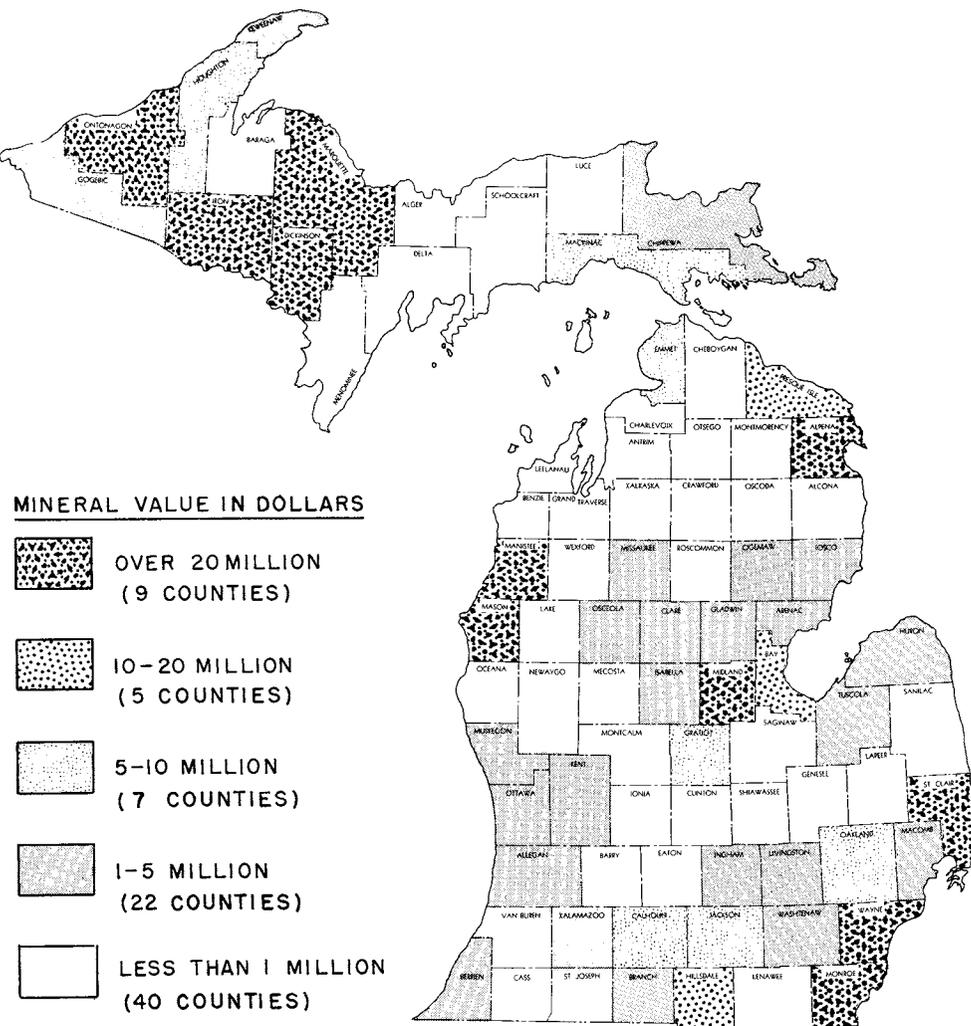


Table 1.—Mineral production in Michigan <sup>1</sup>

Mineral	1965		1966	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Portland..... thousand 376-pound barrels.....	27,565	\$86,996	28,171	\$87,413
Masonry..... thousand 280-pound barrels.....	2,108	5,373	2,032	5,221
Clays..... thousand short tons.....	2,402	2,580	2,450	2,620
Copper (recoverable content of ores, etc.)..... short tons.....	71,749	50,798	73,449	53,133
Gypsum..... thousand short tons.....	1,338	5,027	1,522	5,489
Iron ore (usable)..... thousand long tons, gross weight.....	13,527	145,482	14,377	157,377
Lime..... thousand short tons.....	1,095	13,057	1,701	20,016
Magnesium compounds..... thousand short tons.....	319,389	26,143	342,482	28,105
Natural gas..... million cubic feet.....	34,558	8,674	34,100	8,598
Natural gas liquids:				
Natural gasoline..... thousand gallons.....	9,054	607	15,703	1,099
LP gases..... do.....	76,299	3,815	79,719	4,385
Peat..... short tons.....	230,950	2,134	235,842	2,175
Petroleum (crude)..... thousand 42-gallon barrels.....	14,728	41,091	14,273	40,913
Salt..... thousand short tons.....	4,171	36,087	4,465	38,611
Sand and gravel..... do.....	53,168	47,176	55,123	49,521
Silver (recoverable content of ores, etc.)..... thousand troy ounces.....	458	592	483	625
Stone..... thousand short tons.....	34,713	36,438	37,864	40,380
Value of items that cannot be disclosed: Bromine, calcium chloride and calcium-magnesium chloride, gem stones, iodine, and potassium salts.....	XX	53,490	XX	56,446
<b>Total.....</b>	XX	565,560	XX	602,127

XX Not applicable.

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

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

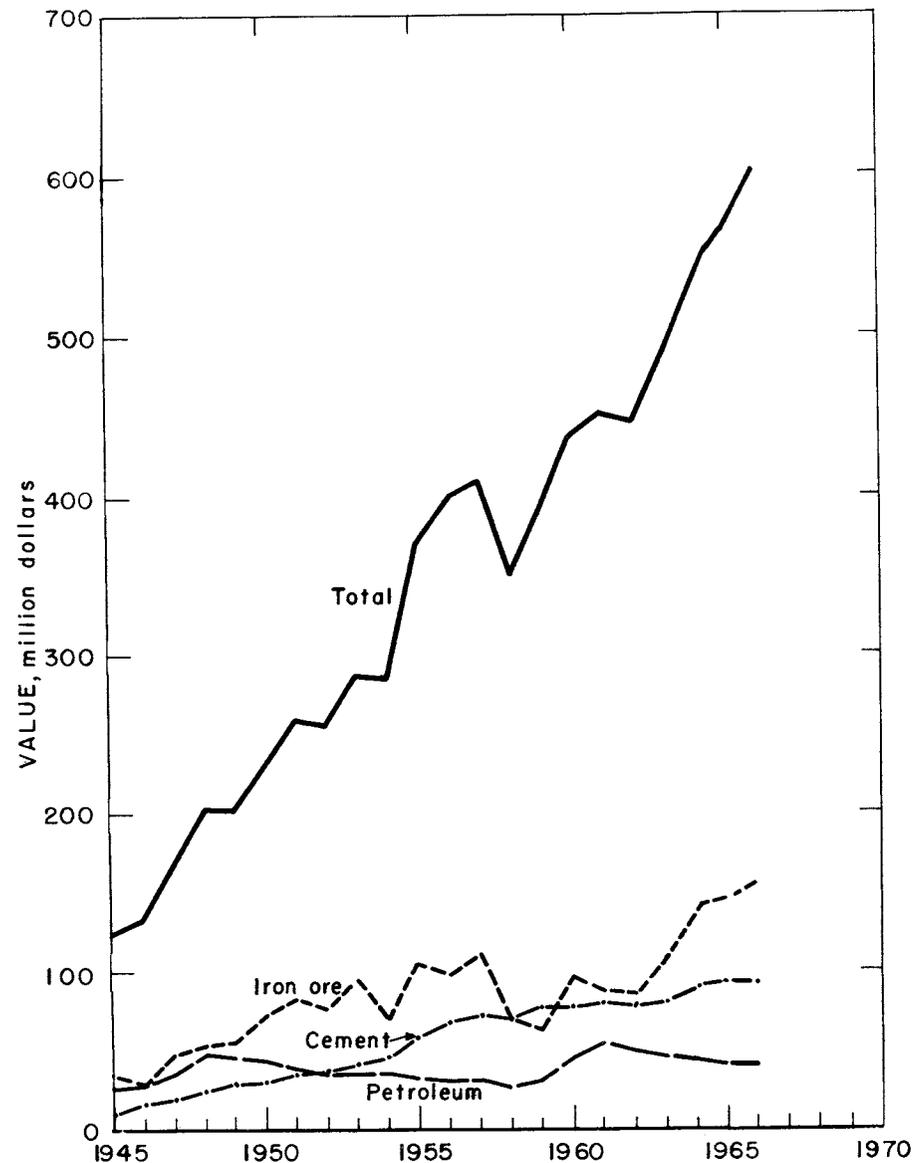


Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

Table 2.—Value of mineral production in constant 1957-59 dollars

(Millions)	
Year	Value <sup>1</sup>
1955	388
1956	397
1957	411
1958	353
1959	384
1960	427
1961	439
1962	436
1963	478
1964	528
1965	534
1966	<sup>p</sup> 562

<sup>p</sup> Preliminary.

<sup>1</sup> Data for 1955-64 revised.

Table 3.—Employment 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	Non-fatal	Frequency	Severity
<b>1965:</b>								
Metal	5,662	284	1,607	12,855	4	345	27.15	2,726
Nonmetal	1,548	265	410	3,310	---	31	9.37	1,244
Sand and gravel	2,547	222	567	4,822	2	35	18.04	3,342
Stone	3,414	292	998	7,997	---	61	7.63	467
Peat	189	159	30	270	---	3	11.11	148
Total	13,360	270	3,612	29,254	6	525	18.15	2,013
<b>1966: <sup>p</sup></b>								
Metal	5,980	296	1,767	14,126	7	484	34.76	4,613
Nonmetal	1,790	272	487	3,901	---	39	10.00	847
Sand and gravel	2,505	220	551	4,659	2	33	18.24	3,656
Stone	3,490	298	1,039	8,348	1	90	10.90	1,428
Peat	162	192	31	281	---	2	7.11	747
Total	13,927	278	3,875	31,315	10	698	22.61	3,126

<sup>p</sup> Preliminary.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Total shipments of portland and masonry cements exceeded 30 million barrels for the first time. Portland cement shipments were more than 2 percent higher than in 1965, while output of masonry cement declined slightly. Portland cement was produced at eight plants in six counties. Masonry cement was produced at seven of these plants. Total plant capacity was nearly 35.2 million barrels. Yearend stocks of portland cement at mills were nearly 3.3 million barrels, about 1.2 million barrels more than 1965. Nearly 96 percent of the portland cement shipped was of types I and II (general-use and moderate-heat); the remainder was type III (high-early-strength). More than 52 percent of the cement was shipped to consumers with-

in the State. Ohio, Illinois, Wisconsin, Indiana, Western New York, and Minnesota received most of the remainder. Ready-mixed concrete companies purchased 60 percent of the shipments with the remainder going principally to concrete product manufacturers, highway contractors, and building-material dealers.

Raw materials used in cement manufacture included 7.2 million tons of limestone, and 2.3 million tons of clay or shale, as well as gypsum, iron ore, sand, slag, mill scale, air-entraining compounds, and grinding aids.

About 708 million kilowatt-hours of electrical energy was used. The wet process was used at seven plants and the dry process at one.

Automation of the industry continued with computer controls planned at the new

**Table 4.—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	
1957-61 (average)	8	21,010	21,056	\$70,437	2,664
1962	9	23,070	22,632	73,267	3,354
1963	9	24,194	25,016	76,944	2,532
1964	9	26,802	26,745	84,316	2,737
1965	8	27,018	27,565	86,996	2,110
1966	8	28,848	28,171	87,413	3,264

<sup>1</sup> Revised.

Charlevoix plant of Medusa Portland Cement Co. and in operation at the Dundee Cement Co., Dundee, and at the Alpena plant of Huron Cement Co. (Division of National Gypsum Co.).

**Clays.**—Output of miscellaneous clay and shale from 12 pits in 10 counties was about 2 percent above that of 1965. About 89 percent of the production was used in cement manufacture. The remainder was used in manufacturing heavy clay products (sewer pipe and draitile), lightweight aggregates, and art pottery. The largest production was reported from operations in Alpena, Monroe, Saginaw, St. Clair, and Wayne Counties.

**Gem Stones.**—Gem stones were collected, principally in the upper peninsula, by hobbyists. Agates, thomsonite, and other semiprecious stones were found as well as specimens of native copper and hematite.

**Gypsum.**—Gypsum was produced from underground mines in Kent County and quarried in Iosco County. Output was 14 percent higher than 1965. Most of the ore was processed at plants in National City, Grand Rapids, and Detroit for use in wall-board, lath and plaster, and other building uses. Crude ore was also shipped to plants in other States. Uncalcined gypsum was sold as a cement retarder.

**Lime.**—Lime output was 55 percent higher than in 1965. Much of the increase was due to the operation of two new facilities in Wayne County, as well as the uninterrupted operation of the Wyandotte Chemicals Corp. plant, also in Wayne County, which was shut down for seven months in 1965 because of a strike. More than 58 percent of the lime manufactured was used by producers. About 94 percent of the lime was consumed in the State. Most of the lime manufactured was quicklime, and was used in chemical manufac-

ture, metallurgical operations (particularly basic-oxygen converters), water and sewage treatment, and paper and sugar manufacture. Data for lime regenerated at paper mills, water purification plants, and acetylene processors are excluded from total State production.

**Natural Salines.**—Bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash were extracted from natural well brines at processing plants in Gratiot, Lapeer, Mason, Manistee, Midland, and Wayne Counties. The value of chemicals produced from natural salines, excluding salt, was more than 6 percent higher than in 1965.

**Perlite.**—Crude ore, mined in Nevada and New Mexico, was expanded at plants in Iosco, Kent, and Wayne Counties. The output was used chiefly as lightweight aggregate and plaster.

**Salt.**—Salt was recovered from natural and artificial brines at processing plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties. In April, American Salt Corp. began operating a new plant in Midland County. One underground salt mine was operated in Detroit by International Salt Co., Inc. Salt output was about 7 percent higher than in 1965, and was sold principally for use in chemical manufacture, meat packing, ice control, water softening, and animal feed.

**Sand and Gravel.**—Sand and gravel production increased 4 percent to 55.1 million tons, the second highest in the Nation (after California) and a record high for the State. Sand and gravel for building use was up 6 percent over 1965, while paving and road material was nearly 3 percent higher. Industrial sand (foundry, molding, glass, grinding and polishing, and engine, etc.) output was about 12 percent greater than in 1965. Sand and gravel production

**Table 5.—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	1965		1966	
	Quantity	Value	Quantity	Value
<b>Commercial operations:</b>				
<b>Sand:</b>				
Building	6,469	\$4,726	6,350	\$5,093
Paving	5,377	4,697	5,469	4,645
Fill	3,265	1,484	3,639	1,659
Molding	3,298	5,903	3,611	6,735
Other <sup>1</sup>	917	2,014	868	2,002
<b>Total</b>	<b>19,326</b>	<b>18,824</b>	<b>19,937</b>	<b>20,134</b>
<b>Gravel:</b>				
Building	5,436	7,406	6,385	8,329
Paving	17,696	14,969	17,533	14,849
Railroad ballast	240	264	201	212
Fill	378	199	353	205
Other	347	397	56	70
<b>Total</b>	<b>24,097</b>	<b>23,235</b>	<b>24,528</b>	<b>23,665</b>
<b>Total sand and gravel</b>	<b>43,423</b>	<b>42,059</b>	<b>44,465</b>	<b>43,799</b>
<b>Government-and-contractor operations:</b>				
<b>Sand:</b>				
Building	74	33		
Paving	1,699	790	2,115	1,008
Fill	1,224	400	1,116	397
Other	102	41	114	42
<b>Total</b>	<b>3,099</b>	<b>1,264</b>	<b>3,345</b>	<b>1,447</b>
<b>Gravel:</b>				
Building	103	56	87	48
Paving	6,265	3,707	6,828	4,088
Fill	190	63	396	137
Other	88	27	2	2
<b>Total</b>	<b>6,646</b>	<b>3,853</b>	<b>7,313</b>	<b>4,275</b>
<b>Total sand and gravel</b>	<b>9,745</b>	<b>5,117</b>	<b>10,658</b>	<b>5,722</b>
<b>All operations:</b>				
Sand	22,425	20,088	23,282	21,581
Gravel	30,743	27,088	31,841	27,940
<b>Total</b>	<b>53,168</b>	<b>47,176</b>	<b>55,123</b>	<b>49,521</b>

<sup>1</sup> Includes sand for foundry, grinding and polishing (1965), abrasive, enamel, engine, glass, railroad ballast, other construction and industrial uses (1965-66), and fire or furnace and pottery, porcelain, and tile (1966).

was reported from all counties except Bay and Monroe. The Detroit metropolitan area (Livingston, Macomb, Oakland, Washtenaw, and Wayne Counties), produced nearly 20 million tons, more than a third of the State total. Production of more than 1 million tons was also reported from each of the following counties: Berrien, Branch, Genesee, Ingham, Kent, Mason, Ottawa, and Tuscola. More than 90 percent of the sand and gravel was processed. About 93 percent was moved by truck and the remainder by rail and water. Production was reported from 389 commercial operations and 191 Government-and-contractor operations.

Leading producers of sand and gravel, in alphabetical order, included the following:

American Aggregates Corp.  
Construction Aggregates Corp.  
Grand Rapids Gravel Co.  
Holloway Sand & Gravel Co., Inc.  
Holly Sand & Gravel Plant, J. P. Burroughs & Son, Inc.  
Michigan Silica Division, (Ottawa Silica Co.)  
Mickelson Corp.  
The Nugent Sand Co., Inc.  
Pickitt & Schreur, Inc.  
Sargent Sand Co.

**Stone.**—Total stone production increased 9 percent over that of 1965. Limestone ac-

Table 6.—Dimension stone sold or used by producers, by kinds

Year	Basalt		Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1962			7,798	\$51,603	15,223	\$65,406	23,021	\$117,009
1963			4,938	60,371	8,937	62,348	13,875	122,719
1964	150	\$150	5,383	68,711	8,306	62,030	13,839	130,891
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

Table 7.—Crushed and broken stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1965		1966	
	Quantity	Value	Quantity	Value
Basalt: Concrete aggregate and roadstone			5	\$6
Limestone:				
Riprap	100	\$151	109	173
Flux	12,550	14,447	13,391	15,789
Concrete aggregate and roadstone	5,614	6,540	6,479	7,748
Agriculture	609	1,069	669	1,040
Cement	8,999	7,303	9,443	7,736
Lime	4,514	3,814	5,560	5,125
Other <sup>1</sup>	2,183	2,904	2,053	2,495
Total	34,570	36,228	37,703	40,156
Marl: Agriculture	132	90	143	100
Grand total	34,702	36,318	37,852	40,262

<sup>1</sup> Includes limestone for dust for coal mines (1965), asphalt and miscellaneous filler, chemicals, mineral food, poultry grit, railroad ballast, stone sand, whitening or whitening substitutes, and other uses.

<sup>2</sup> Data do not add to total shown because of rounding.

counted for more than 99 percent of the total, and was quarried in 15 counties by 20 commercial producers and four county highway departments. Most of the output came from large quarries, in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties. About 78 percent of the stone was moved by water from company-operated ports on Lakes Huron and Michigan to steel mills, cement and lime plants, and other consumers.

Total crushed stone production was 9 percent greater than in 1965. Demand for fluxstone increased 7 percent, for concrete aggregate and roadstone 15 percent, for cement rock 5 percent, and for lime 23 percent. Major producers of limestone, in alphabetical order, included the following:

Drummond Dolomite, Inc.  
Dundee Cement Co.  
The France Stone Co.  
Huron Cement Co. (Division of National Gypsum Co.)  
Inland Lime & Stone Co. (Division of Inland Steel Co.)

The Michigan Stone Co.  
Penn-Dixie Cement Corp.  
Presque Isle Corp.

United States Steel Corp.  
The Wallace Stone Co. (Division of J. P. Burroughs & Son, Inc.)

Marl production was reported from 12 counties at 29 operations. The largest production came from Allegan, Barry, Calhoun, Cass, and Kalamazoo Counties.

Sandstone, used principally for building, was quarried and milled in Baraga and Jackson Counties.

**Sulfur.**—Byproduct sulfur was recovered from crude petroleum at Alma by Leonard Refineries, Inc., using the hydrofining process, and at Detroit by Marathon Oil Co. using the Parsons process.

**Vermiculite.**—Zonolite Division, W. R. Grace & Co. exfoliated crude vermiculite, mined in southern and western States, at its plant in Dearborn. The material was used for insulation, plaster and concrete aggregates, agricultural, and miscellaneous uses.

## METALS

Metals accounted for 35 percent of the total value of mineral production.

**Copper.**—Production of copper in terms of recoverable metal was 2 percent more than in 1965 and its value nearly 5 percent higher. The average weighted price increased to 36.2 cents per pound compared with 35.4 cents in 1965. During the year the average weekly price for domestic refinery copper, with few exceptions, moved in a narrow range around 36 cents per pound and at yearend was 36.2 cents.

Calumet & Hecla, Inc., operated eight mines, one reclamation plant, and one smelter in Houghton and Keweenaw Counties.

Copper Range Co. operated the Champion mine and the Freda mill in Houghton County. The mill concentrated ore from the mine and from the old Atlantic

Table 8.—Mine production of copper in 1966, by months, in terms of recoverable metal

Month	Short tons
January	6,275
February	5,875
March	6,639
April	6,275
May	6,615
June	6,425
July	5,355
August	6,085
September	5,605
October	6,240
November	6,055
December	6,005
Total	73,449

mine tailings. Quincy Mining Co. operated a reclamation plant and smelter in Houghton County. White Pine Copper Co. operated a mine, mill, and smelter in Ontonagon County.

The Bear Creek Mining Co. explored for possible copper deposits near Negaunee, on the Marquette Range.

Table 9.—Mine production of copper, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailing	Ore (short tons)	Tailing (short tons)	Short tons	Value
1957-61 (average)	11	3	6,054,732	1,992,236	59,667	\$35,593,560
1962	9	3	7,555,357	1,812,530	74,099	45,644,984
1963	10	3	7,211,387	2,226,129	75,262	46,361,392
1964	9	3	6,717,362	2,174,478	69,040	45,014,080
1965	10	3	7,367,571	1,611,378	71,749	50,798,292
1966	10	3	7,999,770	1,850,860	73,449	53,133,006

**Iron Ore.**—Shipments of usable iron ore totaled 14.4 million long tons, an increase of 850,000 tons over the 1965 total. Value of shipments increased by \$11.9 million. Concentrates comprised 70 percent of the shipments of usable ore compared with 63 percent in 1965. In 1966 pellets produced from low-grade ores, as well as from ore from the Mather B mine in Marquette County, increased to 60 percent of shipments from 56 percent in 1965. Shipments were made from 13 underground and 5 open pit mines. About 75 percent of the crude ore mined came from open pit operations. Average iron content of usable ore produced was 58.9 percent, natural. The average weighted mine value of Michigan iron ore, without respect to grade, was \$10.95 per long ton compared with \$10.76 in 1965.

Michigan iron ore was shipped to producers of pig iron and steel, except for a

small quantity used in manufacturing iron oxide pigments.

About 95 percent of the ore was shipped by rail to ore docks in Escanaba and Marquette and then by water to lower lake ports. The remainder was shipped by rail to the consuming districts. The lake shipping season for Michigan iron ores opened at Escanaba on March 31 and closed at the same port on December 23, the latest closing date on record. No ore was shipped from Ashland, Wis. because the port was closed late in 1965.

The Federal Bureau of Mines sampled selective low-grade iron ore resources.<sup>2</sup> An experimental all-rail shipment of iron ore pellets via a unit train from the Marquette Range and Ohio steel plant was made

<sup>2</sup> Heising, L. F., and D. W. Frommer. Lake Superior Iron Resources. Preliminary Samples and Metallurgical Evaluation of Selected Michigan-Wisconsin Iron Formations. Bureau of Mines Rept. of Inv. 6895, 1967, 31 pp.

Table 10.—Crude iron ore data, in 1966, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Under-ground	Open pit	Direct to consumers	To concentrators	
<b>County:</b>						
Dickinson.....	---	---	3,578	---	3,578	---
Gogebic.....	441	113	---	364	---	190
Iron.....	776	2,980	---	2,717	189	850
Marquette.....	1,015	3,479	14,670	1,191	17,281	692
<b>Total.....</b>	<b>2,232</b>	<b>6,572</b>	<b>18,248</b>	<b>4,272</b>	<b>21,048</b>	<b>1,731</b>
<b>Range:</b>						
Gogebic.....	441	113	---	364	---	190
Marquette.....	1,015	3,479	14,670	1,191	17,281	692
Menominee.....	776	2,980	3,578	2,717	3,767	850
<b>Total.....</b>	<b>2,232</b>	<b>6,572</b>	<b>18,248</b>	<b>4,272</b>	<b>21,048</b>	<b>1,731</b>

<sup>1</sup> Data do not add to total shown because of rounding.Table 11.—Usable iron ore<sup>1</sup> 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 <sup>2</sup>
1854-1956.....	289,298	240,884	236,187	766,369
1957.....	6,557	4,201	2,868	13,626
1958.....	4,111	2,896	1,397	8,404
1959.....	2,851	2,616	1,663	7,129
1960.....	6,619	4,079	2,169	12,866
1961.....	3,205	4,097	1,062	8,364
1962.....	4,563	3,460	1,237	9,259
1963.....	5,706	3,729	902	10,336
1964.....	7,898	4,551	1,227	13,676
1965.....	8,973	4,595	753	14,322
1966.....	9,589	4,620	113	14,322
<b>Total<sup>2</sup>.....</b>	<b>349,369</b>	<b>279,728</b>	<b>249,577</b>	<b>878,675</b>

<sup>1</sup> Exclusive, after 1905, of iron ore containing 5 percent or more manganese.<sup>2</sup> Data may not add to some totals shown because of rounding.<sup>3</sup> Distribution by range partly estimated before 1906.Table 12.—Usable iron ore shipped from mines, by ranges<sup>1</sup>

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total <sup>2</sup>
1957-61 (average).....	4,454	3,532	1,746	9,731
1962.....	4,479	3,462	1,480	9,422
1963.....	5,809	4,168	813	10,789
1964.....	7,909	4,560	1,403	13,871
1965.....	8,303	4,451	773	13,527
1966.....	9,686	4,327	364	14,377

<sup>1</sup> Exclusive of iron ore containing 5 percent or more manganese.<sup>2</sup> Data may not add to some totals shown because of rounding.

prior to the opening of the lake shipping season.

According to a study by the Michigan Department of Conservation,<sup>3</sup> the average mining cost per ton for underground mines was \$9.15 in 1966 compared with \$9.80 in 1965. Labor costs decreased to \$2.70 per ton compared with \$2.77 per ton in 1965, while taxes (excluding Federal income tax) decreased to \$0.33 per ton from \$0.41. Deferred costs per ton were \$0.50 in 1966 and \$0.55 in 1965. Other costs per ton in 1966 compared with 1965 were as fol-

Table 13.—Production of usable iron ore (Thousand long tons)

Year	Gross weight		Iron content (percent)
	Ore	Iron content	
1957.....	13,626	7,108	52.16
1958.....	8,404	4,460	53.07
1959.....	7,129	3,791	53.17
1960.....	12,866	6,920	53.78
1961.....	8,364	4,589	54.87
1962.....	9,259	5,160	55.73
1963.....	10,336	5,913	57.21
1964.....	13,676	7,923	57.93
1965.....	14,322	8,343	58.25
1966.....	14,322	8,432	58.87

Table 14.—Iron ore<sup>1</sup> shipped from mines

(Thousand long tons)

Year	Direct-shipping ore <sup>2</sup>	Concentrates			Total usable ore	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total		
1957-61 (average).....	7,865	692	1,175	1,867	9,731	19.18
1962.....	5,557	2,222	1,644	3,865	9,422	41.03
1963.....	4,852	4,364	1,574	5,938	10,789	55.03
1964.....	5,753	6,573	1,546	8,118	13,871	58.53
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

<sup>1</sup> Exclusive of ore containing 5 percent or more manganese.<sup>2</sup> Includes crushed, screened, and sized ore not further treated.

lows: General overhead, \$1.17 and \$1.42; transportation, \$3.02 and \$3.04; royalty, \$0.32 and \$0.31; and marketing, \$0.05 and \$0.09.

**Pig Iron and Steel.**—Pig iron and steel were manufactured in the Detroit area. Pig iron shipments and value were 6 percent and 5 percent higher, respectively, than in 1965. Basic, foundry, and low phosphorus grades were produced. According to the American Iron & Steel Institute, Michigan steel production was 10 million tons, about 3 percent larger than in 1965.

**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 electrolytic refineries where the silver was recovered. The amount of silver recovered was about 5 percent higher than in 1965. Silver contained in fire-refined copper was not recovered but was marketed as a constituent of lake copper.

#### MINERAL FUELS

**Natural Gas and Natural Gas Products.**—Natural gas production decreased in vol-

ume and value. Macomb and St. Clair Counties each supplied about a quarter of the State total while the Albion-Scipio trend fields in Calhoun, Hillsdale, and Jackson Counties accounted for nearly a third. The remainder, about 15 percent, came from fields in 20 counties.

At the end of 1966 there were 81 producible gas fields, of which 59 produced gas for commercial sale.

Total production of natural gasoline and liquid petroleum gases was about 12 percent higher than in 1965. Nearly all (99 percent) of the production came from processing plants in Hillsdale, Oscoda, St. Clair, and Washtenaw Counties. Gas processed in Washtenaw County was from out-of-State fields, delivered by interstate pipeline.

**Peat.**—Michigan again led the Nation in peat production with 39 percent of the U.S. output. Peat was produced in 15 counties with the largest production coming from Lapeer, Oakland, St. Clair, and

<sup>3</sup> Geological Survey Division, Michigan Department of Conservation. General Statistics Covering Cost and Production of Michigan Iron Mines. 1967, 6 pp.

Sanilac Counties. Peat was marketed principally as a soil conditioner. None was sold for fuel. Over three-quarters of the peat mined was reed-sedge. The remainder was moss and humus.

**Petroleum.**—Petroleum production again declined, about 500,000 barrels less than the 1965 figure. About half of the decrease occurred in the fields of the Albion-Pulaski-Scipio trend in Calhoun, Hillsdale, and Jackson Counties, although the area still accounted for about 61 percent of the State production. Petroleum was produced in 43 counties and natural gas in 25 counties. Eleven refineries had an operating capacity of 172,200 barrels a day.

During the year production came from 193 active oilfields and two reactivated fields, while three fields were abandoned. According to data compiled by the Geological Survey Division of the Michigan Department of Conservation, oil and gas field activity was below that of 1965. The most

active exploration and development areas were in St. Clair and Macomb Counties, also along the Albion-Pulaski-Scipio trend and in the general northwest quadrant of the Southern Peninsula. Most of the 11 new discoveries were made in the latter area. No large fields were found in 1966. The small areal extent of the new fields and the greater well spacing contributed to the decline in oil and gas field activity. Total drilling permits for oil and gas wells were 430 in 1966 compared with 494 in 1965. Of the 388 well completions in 1966, 186 were exploratory and 202 development wells. Of the exploratory wells, 175 were dry, eight yielded oil, and three yielded gas. Of the development wells, 111 were dry, 49 yielded oil, and 42 yielded gas.

An analysis of discovery wells by geologic system indicated that seven were in the Devonian, two in the Silurian, and one each in the Ordovician and Mississippian.

## REVIEW BY COUNTIES

Mineral production was reported from all counties in Michigan. Value of output increased in 54 counties and decreased in 19 counties. More than \$1 million in minerals was produced in each of 45 counties. Marquette County led in value of production, furnishing 19 percent of the State total.

**Allegan.**—Sand and gravel was produced at fixed plants near Allegan and Fennville. Portable plants were employed at several other sites throughout the county. Output declined to 719,000 tons from 877,000 tons in 1965 because of lower demands for paving and road materials. Marl was produced from pits near Allegan, Dorr, and Hopkins and sold for agricultural use. Moss and reed-sedge peat were dug from bogs near Middleville and Wayland and sold for soil improvement and for packing plants and shrubs.

Natural gas production declined 21 percent from 1965 to 245 million cubic feet, while petroleum output increased about 10 percent to 280,000 barrels. The largest gas production came from the Dorr and Hillards fields, while the greatest petroleum production came from the Wayland field.

**Alpena.**—Huron Cement Co. (Division of National Gypsum Co.) produced masonry

and portland cements at Alpena. The company produced shale and limestone for its own use at sites near the plant. About 374,000 tons of sand and gravel was produced, mostly for road construction and maintenance, at several commercial operations and by and for the county road commission.

**Antrim.**—Shale was mined near Ellsworth by Penn-Dixie Cement Corp. for manufacturing cement at its Petoskey plant. Sand and gravel was produced for use on county and State roads.

**Arenac.**—Petroleum production totaled 298,000 barrels, down 5,000 barrels from the previous year's total. The largest output was reported from the Deep River and Sterling fields. Crushed limestone and sand and gravel for road construction and maintenance were produced by county highway crews. Sand and gravel for building, fill, and road use was produced at the Eastman Gravel Pit, Standish.

**Baraga.**—Sandstone was quarried and milled at Arnheim for building use by Superior Natural Redstone Quarry. Sand and gravel for fill and road use was produced with portable plants at several sites in the county.

Table 15.—Value of mineral production in Michigan, by counties<sup>1</sup>

County	1965	1966	Minerals produced in 1966 in order of value
Alcona	\$141,000	\$203,000	Sand and gravel.
Alger	25,000	28,000	Do.
Allegan	1,284,132	<sup>2</sup> 1,184,491	Petroleum, sand and gravel, peat, stone, natural gas.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	204,696	336,034	Clays, sand and gravel.
Arenac	1,153,056	1,154,790	Petroleum, stone, sand and gravel.
Baraga	104,400	W	Sand and gravel, stone.
Barry	497,631	712,685	Sand and gravel, petroleum, stone.
Bay	10,342,073	10,855,213	Cement, petroleum, lime.
Benzie	30,000	57,000	Sand and gravel.
Berrien	1,376,055	2,064,741	Sand and gravel, stone, petroleum.
Branch	199,537	1,088,607	Sand and gravel, stone.
Calhoun	6,784,379	<sup>2</sup> 7,143,796	Petroleum, sand and gravel, stone, natural gas.
Cass	334,969	234,882	Sand and gravel, petroleum, stone.
Charlevoix	17,000	W	Sand and gravel.
Cheboygan	141,097	127,170	Stone, sand and gravel.
Chippewa	4,739,350	4,381,768	Do.
Clare	1,903,929	<sup>2</sup> 1,761,103	Petroleum, sand and gravel, natural gas.
Clinton	369,866	399,120	Sand and gravel, clays.
Crawford	269,202	<sup>2</sup> 331,157	Petroleum, sand and gravel, natural gas.
Delta	259,148	353,722	Sand and gravel, stone.
Dickinson	20,102,845	19,630,518	Iron ore, stone, sand and gravel.
Eaton	562,878	547,057	Stone, sand and gravel, clays, peat.
Emmet	7,285,985	6,104,336	Cement, stone, sand and gravel.
Genesee	652,164	755,485	Sand and gravel, petroleum.
Gladwin	W	W	Petroleum, sand and gravel.
Gogebic	6,587,762	3,020,680	Iron ore, sand and gravel.
Grand Traverse	W	96,000	Sand and gravel.
Gratiot	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale	14,235,692	<sup>2</sup> 13,656,957	Petroleum, sand and gravel, stone, natural gas.
Houghton <sup>3</sup>	7,829,391	9,390,415	Copper, sand and gravel, stone.
Huron	1,295,026	1,256,104	Stone, sand and gravel, lime, petroleum.
Ingham	1,221,912	1,259,650	Sand and gravel, peat.
Ionia	274,000	354,000	Sand and gravel.
Iosco	4,555,659	4,720,390	Gypsum, sand and gravel.
Iron	21,225,886	20,101,578	Iron ore, sand and gravel.
Isabella	1,729,101	<sup>2</sup> 1,398,765	Petroleum, sand and gravel, stone, natural gas.
Jackson	4,753,171	<sup>2</sup> 5,164,714	Do.
Kalamazoo	945,341	1,091,634	Sand and gravel, stone, peat.
Kalkaska	59,281	74,357	Petroleum, sand and gravel.
Kent	3,081,727	<sup>2</sup> 3,124,266	Sand and gravel, gypsum, petroleum, peat, natural gas.
Keweenaw	( <sup>4</sup> )	( <sup>4</sup> )	Copper, sand and gravel.
Lake	75,816	49,661	Petroleum, sand and gravel.
Lapeer	1,642,947	<sup>2</sup> 1,610,956	Peat, sand and gravel, salines, petroleum, natural gas.
Leelanau	53,000	113,000	Sand and gravel.
Lenawee	708,357	635,234	Sand and gravel, peat, clays, petroleum.
Livingston	3,743,000	<sup>2</sup> 3,561,000	Sand and gravel, natural gas.
Luce	90,000	25,000	Sand and gravel.
Mackinac	W	W	Stone, sand and gravel.
Macomb	1,950,236	<sup>2</sup> 2,305,800	Sand and gravel, petroleum, natural gas.
Manistee	19,964,216	20,425,526	Salt, salines, sand and gravel.
Marquette	99,075,859	115,647,036	Iron ore, sand and gravel.
Mason	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta	223,611	<sup>2</sup> 432,113	Petroleum, sand and gravel, peat, natural gas.
Menominee	1,063,482	889,822	Lime, sand and gravel.
Midland	W	W	Salines, salt, petroleum, sand and gravel, natural gas.
Missaukee	W	<sup>2</sup> 1,296,269	Petroleum, sand and gravel, natural gas.
Monroe	W	W	Cement, stone, clays, peat, petroleum.
Montcalm	968,561	<sup>2</sup> 950,187	Petroleum, sand and gravel, natural gas.
Montmorency	3,000	19,000	Sand and gravel.
Muskegon	2,166,691	2,271,854	Salt, sand and gravel, petroleum.
Newaygo	186,857	231,689	Sand and gravel, petroleum.
Oakland	8,083,304	8,595,441	Sand and gravel, peat, petroleum.
Oceana	660,047	522,515	Sand and gravel, petroleum.
Ogemaw	893,233	<sup>2</sup> 1,200,812	Petroleum, sand and gravel, natural gas.
Ontonagon	43,817,777	44,732,771	Copper, silver, sand and gravel.
Osceola	1,489,667	<sup>2</sup> 1,601,104	Petroleum, sand and gravel, natural gas.
Oscoda	23,688	124,667	Sand and gravel, petroleum.
Otsego	33,000	<sup>2</sup> 30,000	Sand and gravel, natural gas.
Ottawa	2,731,187	<sup>2</sup> 2,719,979	Sand and gravel, petroleum, stone, natural gas.
Presque Isle	W	W	Stone, sand and gravel.
Roscommon	675,618	<sup>2</sup> 697,755	Petroleum, sand and gravel, natural gas.
Saginaw	449,643	478,613	Clays, lime, petroleum, sand and gravel, natural gas.

See footnotes at end of table.

Table 15.—Value of mineral production in Michigan, by counties<sup>1</sup>—Continued

County	1965	1966	Minerals produced in 1966 in order of value
St. Clair.....	\$16,487,453	<sup>2</sup> \$16,498,116	Salt, cement, petroleum, peat, clays, sand and gravel, natural gas.
St. Joseph.....	269,746	261,939	Sand and gravel, peat, stone.
Sanilac.....	982,419	912,100	Peat, sand and gravel, lime.
Schoolcraft.....	2,000	W	Sand and gravel.
Shiawassee.....	569,152	671,837	Sand and gravel, clays, peat.
Tuscola.....	2,065,030	2,152,398	Sand and gravel, petroleum, lime, peat.
Van Buren.....	258,041	313,640	Sand and gravel, petroleum.
Washtenaw.....	1,564,849	<sup>3</sup> 1,279,249	Sand and gravel, petroleum, natural gas.
Wayne.....	40,047,759	<sup>2</sup> 50,556,371	Lime, cement, salt, sand and gravel, salines, stone, clays, petroleum, natural gas.
Wexford.....	106,000	<sup>2</sup> 147,000	Sand and gravel, natural gas.
Undistributed <sup>4</sup> .....	185,855,913	194,502,311	
Total.....	565,560,000	602,127,000	

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

<sup>1</sup> Values for natural gas and natural gas liquids are not available on a county basis, but are included with "Undistributed."

<sup>2</sup> Excludes value of natural gas.

<sup>3</sup> Includes value of mineral production in Keweenaw County.

<sup>4</sup> Value of mineral production is included in that of Houghton County.

<sup>5</sup> 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.

**Barry.**—Sand and gravel production was up 30 percent to 757,000 tons because of increased demand for building and road materials in the area. Marl was dipped from pits near Caledonia and Nashville and sold for agricultural use. About 13,000 barrels of petroleum were produced, most of it from the Hope field.

**Bay.**—Masonry and portland cements were manufactured at Bay City by Etna Portland Cement Co., Division of Martin Marietta Corp. Monitor Sugar Division, Robert Gage Coal Co. produced quicklime for use in sugar refining. About 338,000 barrels of petroleum was recovered from county oilfields. Largest production came from the Kawawlin and Essexville fields. Bay Refining, Division of The Dow Chemical Co., refined crude oil at Bay City.

**Berrien.**—Sand and gravel output totaled nearly 1.8 million tons, about 52 percent more than in 1965. The increase was derived from a greater demand for building, road materials, and industrial sand. In March the Sawyer plant of Manley Sand Division, Martin Marietta Corp., discontinued operation. The company reported their Bridgman plant would continue industrial sand production. Marl was produced from pits near Three Oaks and sold for agricultural use. A few barrels of petroleum was recovered from one well in the Pipestone field before it was abandoned in 1966.

**Branch.**—Sand and gravel output increased to nearly 1.7 million tons from

262,000 tons in 1965, due to greater demand for gravel for road construction and maintenance. Marl for agricultural use was obtained from pits near Kinderhook and Sherwood.

**Calhoun.**—The county held its position as second largest petroleum producer in the State. Output from fields in the Albion-Pulaski-Scipio trend was nearly 2.4 million barrels in 1966 compared with 2.3 million barrels in 1965. The output of 4 billion cubic feet of natural gas, about the same as in 1965, ranked the county fourth in the State in production of this commodity. Sand and gravel output increased to 777,000 tons from 733,000 tons in 1965. Most of the material was used for road construction and maintenance. Marl was obtained from pits near Burlington and Union City and sold for agricultural use.

**Cass.**—Sand and gravel output of 255,000 tons was reported from a fixed plant near Niles and portable plants operating in the Dowagiac, Edwardsburg, and Niles areas. Marl pits were operated near Cassopolis, Dowagiac, and Union and the output sold for agricultural use. A small amount (4,759 barrels) of petroleum was produced from the Jefferson field.

**Charlevoix.**—Construction continued on the 4-million-barrel plant of Medusa Portland Cement Co., scheduled for operation in mid-1967. The plant will have one of the industry's most advanced computer systems to control raw material blending, raw mill, kiln, cooler, and finish mills. About

127,000 tons of sand and gravel was produced for building, road use, and fill.

**Cheboygan.**—Limestone was quarried and crushed near Afton and sold for use in concrete aggregate, roadstone, agricultural limestone, and fluxstone. Sand and gravel output totaled 93,000 tons, down from 154,000 tons in 1965. Smaller requirements for road gravel by the State highway department caused most of the decline.

**Chippewa.**—Limestone was quarried and crushed on Drummond Island, in Lake Huron, by Drummond Dolomite, Inc. The output, from one of the largest quarries in the State, was shipped by water to consumers of fluxstone, concrete aggregate, roadstone, and agricultural limestone. About 355,000 tons of sand and gravel was produced, and was used mostly for roads.

**Clare.**—Petroleum production was 603,000 barrels, down from 651,000 barrels in 1965. Two-thirds of the petroleum came from the East Cranberry Lake and Hamilton fields. Natural gas output increased to 212 million cubic feet from 187 million in 1965, and come from the North Hamilton and Headquarters fields. Sand and gravel production for road use fell to 76,000 tons from 189,000 tons in 1965. State and county highway requirements decreased.

**Clinton.**—Clay was mined near Grand Ledge and used in manufacturing vitrified sewer pipe and other heavy clay products by Grand Ledge Clay Product Co. In the same area, operations of the American Vitrified Products Co. had been discontinued, and the plant was abandoned late in 1965. About 419,000 tons of sand and gravel was produced, primarily for building and road use.

**Crawford.**—Petroleum production increased to 87,000 barrels from 66,000 barrels in 1965. Natural gas output was 370 million cubic feet, an increase of 25 million cubic feet over the 1965 total. The Beaver Creek field yielded all the petroleum and gas production. Sand and gravel production, used mostly for road construction and maintenance, increased 23 percent to 113,000 tons.

**Delta.**—Limestone was quarried and crushed near Escanaba for use as roadstone and in concrete aggregate. Sand and gravel output increased to 511,000 tons from

372,000 tons in 1965, because of road building requirements. Delta Terminal Co. refined crude oil at Rapid River.

**Dickinson.**—The Hanna Mining Co. operated the Groveland open pit iron mine, concentrator, and pelletizing plant near Randville. The traveling grate pelletizing furnace at the operation was extensively remodeled. Limestone, quarried near Randville and Felch, was used principally for terrazzo, ornamental concrete, and roofing granules. About 80,000 tons of sand and gravel was produced, mostly in the Iron Mountain area, for building and road use.

**Eaton.**—Clay, used in manufacturing vitrified sewer pipe and other heavy clay products, was mined by the Grand Ledge Clay Product Co. Limestone was quarried by Cheney Limestone Co. near Bellevue for use in concrete aggregate, roadstone, agricultural limestone, and rubble. About 353,000 tons of sand and gravel was produced, mostly with portable plants at several sites in the county; principal use was for road construction and maintenance. Humus peat was produced near Charlotte and sold for soil conditioning.

**Emmet.**—Penn-Dixie Cement Corp. produced portland and masonry cements at Petoskey and, in the same area, quarried and crushed limestone for its own use. About 92,000 tons of sand and gravel for road use was produced under contract for the State highway department and by the county road commission.

**Genesee.**—Sand and gravel output was nearly 1.1 million tons, compared with 732,000 tons in 1965. Most of the increase was in gravel for road use. Five fixed plants and several portable plants were operated. About 3,000 barrels of petroleum was produced from the Otisville field.

**Gladwin.**—About 386,000 barrels of petroleum was produced, over half of which came from the Beverton, Bentley, and Buckeye fields. Road gravel was produced near Oberlin.

**Gogebic.**—Pickands Mather & Co. shipped iron ore from stockpiles at the Geneva and Peterson mines, as well as ore mined at the Peterson mine in January. The mine was closed January 29. The hoist was purchased by the White Pine Copper Co. and moved to the White Pine mine.

The Geneva mine was shut down in January 1965. These were the last operating iron mines on the Gogebic range. About 107,000 tons of sand and gravel was produced in the county, mostly for road use.

**Gratiot.**—Michigan Chemical Corp., at St. Louis, produced bromine, calcium chloride, calcium-magnesium chloride, and magnesium compounds from natural well brines. Also at St. Louis, Michigan Salt Co. produced salt from natural well brines. About 35,000 barrels of petroleum from the Sumner field and 2 million cubic feet of natural gas from the North Star field were produced. About 399,000 tons of sand and gravel was produced with stationary plants and dredges at Alma and Ithaca and with portable plants at several sites in the county. Leonard Refineries, Inc., operated a crude oil refinery at Alma, where byproduct sulfur was also recovered using the hydrofining process.

**Hillsdale.**—Petroleum production totaled nearly 4.6 million barrels, the largest in the State. About 4.5 billion cubic feet of natural gas was produced. The county ranked second in the production of natural gas liquids. Sand and gravel output was 559,000 tons compared with 339,000 tons in 1965. Production came from two fixed plants and several portable plants. Most of the increase was due to larger demand for road gravel. Marl was produced from pits near Allen and Mosherville for agricultural use.

**Houghton.**—Copper was produced by Calumet & Hecla, Inc., Copper Range Co., and Quincy Mining Co. Calumet & Hecla operated the Ahmeek group of mines in Houghton and Keweenaw Counties and the Tamarack reclamation plant and a smelter near Hubbell. The Seneca No. 2 mine was closed in July. In its annual report the company indicated that the Hills Creek copper deposit would require further geological work to determine the extent of the ore body before adopting a mining plan. The Copper Range Co. operated the Champion mine and Freda mill, where Champion ore as well as tailings from the old Atlantic mine were treated. Quincy Mining Co. operated a reclamation plant at Hubbell and a smelter at Hancock. The Limestone Mountain Co. quarried and crushed limestone for agricultural use near Pelkie. About 128,000 tons of sand and

gravel for building and road construction was produced by two companies and the county road commission. Portable plants were operated near Hancock and South Range.

**Huron.**—Michigan Sugar Co. produced lime for its own use in sugar refining at Sebewaing. The Wallace Stone Co. Division J. P. Burroughs & Son, Inc., quarried limestone for stone veneer, rubble, riprap, roadstone, concrete aggregate, railroad ballast, and agricultural use. About 216,000 tons of sand and gravel was produced compared with 738,000 tons in 1965. The decrease was due to smaller demand for State and county highway needs. Approximately 3,000 barrels of petroleum was produced from the Dwight and Grant fields.

**Ingham.**—Sand and gravel production totaled 1.6 million tons, up from 1.5 million tons in 1965. Most of the material was used for road construction and maintenance. Humus peat was dug from a bog near Lansing and sold for soil improvement. The Lansing Board of Power & Light recovered quicklime from calcium carbonate precipitated at the city water purification plant.

**Iosco.**—The county had the largest gypsum production in the State, all from open quarries. National Gypsum Co. operated a quarry and board plant at National City and port facility at Tawas City. At the plant, crude perlite, mined in the Southwest, was expanded for use in plaster. United States Gypsum Co. operated a quarry, processing plant, and port facility at Alabaster. Michigan Gypsum Co. opened a quarry about a mile southeast of their processing and crushing plant at Whittemore. About 120,000 tons of sand and gravel for road use was produced by and for the county road commission.

**Iron.**—The Hanna Mining Co. mined and shipped iron ore from the Hiawatha No. 2, Homer, and Wauseca underground mines. The Hiawatha No. 2 mine, opened in 1892, was closed the latter part of December because of depletion of ore reserves. A second screening unit to serve both the Homer and Wauseca mines began operation April 1. Inland Steel Co. operated the Bristol and Sherwood underground mines, and North Range Mining Co. operated the Book underground iron mine.

About 86,000 tons of sand and gravel for road use was produced.

**Isabella.**—About 280,000 barrels of petroleum, mostly from the Coldwater and Mount Pleasant fields, and nearly 5 million cubic feet of natural gas from the Fremont field were produced. Leonard Refineries, Inc., operated a refinery at Mount Pleasant. Sand and gravel output totaled 703,000 tons and was sold for building and road use. Marl for agricultural use was produced near Weidman.

**Jackson.**—Nearly 1.7 million barrels of petroleum and 2.1 billion cubic feet of natural gas were produced, slightly more than in 1965. Limestone was quarried and crushed at Parma for use as roadstone, concrete aggregate, and agricultural limestone. Sandstone was quarried and milled for building use in the Napoleon area. Sand and gravel production was 308,000 tons, and was used for building and road construction. Marl was obtained from pits near Horton and sold for agricultural use.

**Kalamazoo.**—The sand and gravel output of 917,000 tons was about the same as in 1965. Reed-sedge peat for soil conditioning was produced near Kalamazoo. Marl was dug from pits near Vicksburg and Paw Paw Lake and sold for agricultural use. Lakeside Refining Co. operated an oil refinery at Kalamazoo.

**Kalkaska.**—About 17,000 barrels of petroleum was produced, nearly all from the Beaver Creek field. The county road commission produced 68,000 tons of sand and gravel for road use and other purposes.

**Kent.**—Gypsum was produced from underground mines by Bestwall Gypsum Division of Georgia-Pacific Corp. and Grand Rapids Gypsum Co. The material was processed and manufactured into building products at company-owned plants in the Grand Rapids area. Perlite, mined in the Western States, was expanded for use in plaster at the Bestwall plant. Over 1.8 million tons of sand and gravel was produced compared with 2 million tons in 1965. Most of the decline was caused by lower demand for road materials. Humus, moss, and reed-sedge peat were dug from several bogs in the county and sold for soil improvement. About 101,000 barrels of petroleum and 15.5 million cubic feet of gas were produced. Most of the petroleum and all of the gas came from the Walker field.

**Lake.**—Nearly 15,000 barrels of petroleum was produced from five fields, with the major portion coming from the Luther field. The county road commission produced 16,000 tons of sand and gravel for road use and other purposes.

**Lapeer.**—Calcium-magnesium chloride was produced from natural well brines at Mayville by Wilkinson Chemical Corp. Nearly half of the State peat production came from bogs near Imlay City. The reed-sedge peat was sold both in bulk and packaged form for soil improvement and potting materials. About 457,000 tons of sand and gravel was produced for building and road use at sites throughout the county. The Rich field yielded about 33,000 barrels of petroleum and 25 million cubic feet of natural gas.

**Lenawee.**—Clay for manufacturing drain-tile was mined near Tecumseh. Reed-sedge peat was dug from a bog near Adrian and sold in packaged form for general soil conditioning. About 626,000 tons of sand and gravel was produced near Adrian and Tecumseh and used chiefly for building, road purposes, and railroad ballast. The Macon Creek and Medina fields yielded a small amount of petroleum (less than 1,000 barrels).

**Livingston.**—About 16.7 million cubic feet of natural gas was produced. Sand and gravel output totaled more than 3.3 million tons, most of it from the Brighton, Fenton, and Howell areas. Output was used for building, road purposes, railroad ballast, and fill. At the American Aggregates Corp. operation near Brighton, alterations were made to increase capacity and improve product quality. Included were an enlarged railroad dump hopper, raw material surge pile, reclamation system, and hydraulic separation facility.

**Mackinac.**—Large limestone quarries were operated by Inland Lime & Stone Co., Division of Inland Steel Co., near Port Inland and United States Steel Corp. near Cedarville. The Inland Lime & Stone Co. processing plant and port were located at Port Inland in adjacent Schoolcraft County. The crushed material was shipped from company-owned ports to consumers of fluxstone, roadstone, agricultural limestone, railroad ballast, and riprap, and cement, lime, and chemical manufacturers.

About 133,000 tons of sand and gravel was produced, mostly for road use.

**Macomb.**—About 2.9 million tons of sand and gravel was produced, compared with 2.4 million tons in 1965. Much of the material came from the Armada, Romeo, and Utica areas. Principal uses were for building and road construction.

Natural gas production was about 9 billion cubic feet, mostly from the Ray field. More than 3,000 barrels of petroleum was recovered from the Chesterfield and Ray fields.

**Manistee.**—Natural well brines were processed at several plants to recover bromine, calcium-magnesium chloride, and magnesium compounds. Salt was recovered from artificial brines. Chemical plants were operated in the Manistee area by Great Lakes Chemical Corp., Manistee Salt Works, Michigan Chemical Corp., Morton Chemical Co., Division of Morton International, Inc., Morton Salt Co., and Standard Lime & Refractories Co., Division of Martin Marietta Corp. At Filer City, Packaging Corp. of America produced quicklime for its own use in paper manufacturing by calcining carbonate sludge. Gravel for road use was produced at several sites, and molding sand was produced at Manistee.

**Marquette.**—Value of mineral production was nearly \$116 million, the highest in the State. Iron ore shipments were up nearly 17 percent. Open pit mines accounted for 62 percent of the total iron ore shipments.

Cleveland-Cliffs Iron Co. operated four underground and four open pit iron mines. The company operated the Pioneer pellet plant near Negaunee at full capacity during the year. The plant treats natural ore from the Mather underground mine. The company also operated the Empire mine complex near Palmer, which expanded its pellet capacity to 3.2 million tons per year.

Jones & Laughlin Steel Corp. operated the Tracy underground mine, and North Range Mining Co. operated the Champion underground mine.

About 880,000 tons of sand and gravel was produced, up from 787,000 tons in 1965. Most of the material was used for building, road construction, and fill.

**Mason.**—Bromine, calcium chloride, calcium-magnesium chloride, and magnesium compounds were recovered from natural

well brines at Ludington by The Dow Chemical Co. The company also produced quicklime. Harbison-Walker Refractories Co. produced refractory magnesia from purchased magnesium hydroxide.

Molding and glass sand was produced near Ludington, and road gravel was mined at several sites with portable plants.

About 127,000 barrels of petroleum was recovered from six fields. The Eden, Scottville, and Wiley fields yielded the major portion of county output.

**Mecosta.**—About 90,000 barrels of petroleum and 92 million cubic feet of natural gas were produced. The Hardy Dam and Paris fields accounted for most of the petroleum output. Natural gas was produced from seven fields.

About 303,000 tons of sand and gravel was produced, mostly for road use.

Reed-sedge peat was produced near Lakeview and sold in bulk and packaged form for soil improvement. Two marl pits which were operated near Mecosta in 1965 were idle during the year.

**Menominee.**—Quicklime and hydrated lime were produced at Menominee by Limestone Products Division of The C. Reiss Coal Co. The lime was sold for use in insecticides, paper and pulp manufacture, tanning, steelmaking (in basic-oxygen converters), water purification, and other purposes.

About 698,000 tons of sand and gravel was produced and used principally for road construction and maintenance.

**Midland.**—The Dow Chemical Co., at Midland, processed natural well brines and recovered bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds and potash. The company also extracted salt from artificial brines. In April, the American Salt Corp. began production of salt in its new plant at Midland. Kaiser Aluminum & Chemical Corp. produced refractory magnesia from purchased magnesium hydroxide. Sand and gravel for building, road use, and fill was produced near Midland.

About 225,000 barrels of petroleum and a small quantity of natural gas were produced from six fields. The Porter field had the largest petroleum output.

**Missaukee.**—About 444,000 barrels of petroleum and 673 million cubic feet of natural gas were produced from eight fields.

The largest petroleum production was from the Enterprise and McBain fields and natural gas from the East Norwich and Falmouth fields.

The county road commission contracted for 36,000 tons of road gravel.

**Monroe.**—Portland and masonry cements were produced by Dundee Cement Co. at Dundee. Clay and limestone were mined near the plant site for use in manufacturing cement. The company's large rotary kiln is now controlled by a digital computer, installed during the year.

Limestone was quarried and crushed at Monroe by The France Stone Co., and by The Michigan Stone Co. at Maybee and Ottawa Lake. The material was used for flux, roadstone, railroad ballast, and for agricultural use.

F. W. Ritter Sons Co. mined miscellaneous clay at South Rockwood for use in making art pottery and other clay products.

Reed-sedge and humus peat were dug from pits near Ida and Petersburg and used for potting soils and general soil improvement.

About 7,000 barrels of petroleum was produced from the Deerfield field.

**Montcalm.**—About 202,000 barrels of petroleum and 5.9 million cubic feet of natural gas were produced from 12 fields. Crystal Refining Co. refined crude oil at Carson City.

Sand and gravel output was about 790,000 tons compared with 733,000 tons in 1965. Most of the material was used for road construction and maintenance.

**Muskegon.**—Salt was extracted from artificial brines at Montague by Hooker Chemical Corp.

Union Carbide Corp., Olefins Division, produced hydrated lime as a byproduct of their acetylene-producing operations. Output was sold for mason's lime and treatment of sewage and industrial wastes. About 35,000 barrels of petroleum was produced from five fields. Naph-Sol Refining Co. refined crude oil at Muskegon. The Marathon Oil Co. refinery at Muskegon was abandoned.

About 528,000 tons of sand and gravel was produced for molding sand, building, road use, and fill.

**Newago.**—About 298,000 tons of sand and gravel was produced, mostly for road

use. About 24,000 barrels of petroleum was produced from several small fields. No natural gas production was reported in 1966.

**Oakland.**—Sand and gravel output, the largest in the State totaled 8.8 million tons, compared with 8.7 million tons in 1965. The material was used for building, railroad ballast, road construction, and fill.

Moss and humus peat were produced near New Hudson and Novi and sold in bulk for soil improvement.

About 1,000 barrels of petroleum was recovered from the Northville field.

**Oceana.**—About 82,000 barrels of petroleum was recovered from eight fields, with the largest production reported from the Pentwater, Stony Lake, and Elbridge fields.

About 464,000 tons of sand and gravel was produced, principally for building and road use.

**Ogemaw.**—About 278,000 barrels of petroleum and 627 million cubic feet of natural gas were produced. Most of the petroleum came from the West Branch and Rose City fields, and the gas came from the Rose City and Logan fields. Osceola Refining Co. refined crude oil at West Branch.

About 671,000 tons of sand and gravel was produced, compared with 222,000 tons in 1965. Demand for road material accounted for the increase.

**Ontonagon.**—White Pine Copper Co. a subsidiary of Copper Range Co., operated a mine, mill, and smelter at White Pine. In December, the new reverberatory furnace at the smelter was completed. Construction continued on the new 1,600 foot shaft, 5 miles from the original mine portals. The shaft had reached the ore horizon, and hoisting and surface facilities were near completion at yearend.

Sand and gravel output increased to 318,000 tons from 140,000 tons in 1965, because of demand for road materials.

**Osceola.**—Petroleum production totaled about 435,000 barrels, with the largest amount coming from the Reed City field, which lies in both Lake and Osceola Counties. About 291 million cubic feet of natural gas was produced, principally from the Middle Branch and Reed City fields.

Sand and gravel for fill, railroad ballast, building, and road construction was produced.

**Oscoda.**—Approximately 222,000 tons of sand and gravel was produced for county and State highway use.

Nearly 2,000 barrels of petroleum was recovered from the Mio field. About 12 million gallons of natural gas liquids were recovered at the Reed City plant.

**Ottawa.**—Sand and gravel output totaled 2.6 million tons, about the same as in 1965. Industrial sand (glass, molding, and engine) was produced, as well as large quantities of building and road materials.

A small quantity of marl was extracted from pits near Hudsonville and Jenison and sold for agricultural use.

About 133,000 barrels of petroleum and 151 million cubic feet of natural gas were recovered, principally from the Dennison, Fillmore, and Walker fields.

**Presque Isle.**—Limestone was produced at Rogers City by United States Steel Corp., and near Presque Isle by Presque Isle Corp. The crushed stone was shipped by water to steel mills, cement and lime plants, as well as users of concrete aggregate, roadstone, and agricultural limestone. Onaway Stone Co. produced limestone for building use at Onaway.

Sand and gravel production was 413,000 tons, down from 569,000 tons in 1965, because of smaller demand for building and road materials.

**Roscommon.**—About 177,000 barrels of petroleum and 714 million cubic feet of natural gas were produced from the East Norwich, Enterprise, Headquarters, and St. Helen fields.

About 296,000 tons of sand and gravel was produced, chiefly for road use.

**Saginaw.**—Clay was mined near Saginaw by Etna Portland Cement Co. Division, Martin Marietta Corp., for use in manufacturing cement at its plant in Bay City. Michigan Sugar Co. produced lime at Carrollton for sugar refining. About 132,000 tons of sand and gravel was produced by and for the county road commission for road use, fill, and other purposes.

About 26,000 barrels of petroleum was recovered from five fields. Birch Run field had the largest production.

**St. Clair.**—Portland and masonry cements were produced at Port Huron by Peerless Cement Co., Division of American Cement Corp. The company mined clay for its own use at Smiths Creek.

Salt was recovered from artificial brines by Diamond Crystal Salt Co. at St. Clair and Morton Salt Co. at Marysville.

Reed-sedge peat was produced near Capac and sold in bulk and packaged form for general soil improvement. Sand and gravel was produced, mostly for road use.

About 710,000 barrels of petroleum and 9.3 billion cubic feet of natural gas were produced. Major oilfields were Big, Boyd, and Peters. The largest gas production came from the Capac, Columbus, Boyd, and Peters fields. Gas production was the largest in the State. More than 34 million gallons of natural gas liquids were produced at the Boyd plant.

**St. Joseph.**—Marl and reed-sedge peat were produced near Three Rivers and Notawata.

About 346,000 tons of sand and gravel was produced, mostly in the Three Rivers and White Pigeon areas. The material was used principally for building, road construction, and fill.

**Sanilac.**—Lime was produced at Croswell by Michigan Sugar Co. for its own use. Moss and reed-sedge peat were dug from bogs near Minden City and Sandusky and sold chiefly for potting use and soil improvement. About 602,000 tons of sand and gravel was produced for building, road use, and fill.

**Shiawassee.**—Shale was mined at Corruna by Michigan Vitrified Tile Co. for use in manufacturing vitrified sewer pipe. Humus and reed-sedge peat were produced near Perry and Ovid, respectively, and sold for soil improvement and packing material for shrubs and plants. About 794,000 tons of sand and gravel was produced, compared with 684,000 tons in 1965. Output was used for building, road construction, and railroad ballast.

**Tuscola.**—About 80,000 barrels of petroleum was recovered from four fields, with the largest production reported from the Akron field. Moss peat was produced near Juniata and sold in bulk and packaged form for general soil improvement.

Sand and gravel output totaled 1.7 million tons, up from 1.5 million tons in 1965, and was used for building, road construction, and molding sand.

Lime was produced at Caro by Michigan Sugar Co. for sugar refining.

**Van Buren.**—About 330,000 tons of sand and gravel for road use, molding, and engine sand was produced. Petroleum output totaled about 11,000 barrels mostly from the Bloomingdale field.

**Washtenaw.**—Nearly 1.5 million tons of sand and gravel was produced, slightly less than in 1965. The material was used for building, road construction, and fill. About 28,000 barrels of petroleum and 177 million cubic feet of natural gas were recovered from the Lyndon and Northville fields.

**Wayne.**—In the Detroit metropolitan area lime was produced by Detroit Lime Co., a subsidiary of Edward C. Levy Co.; Industrial Chemicals Division, Allied Chemical Corp.; Marblehead Lime Co.; and Wyandotte Chemicals Corp. Portland and masonry cements were produced by Peerless Cement Co., Division of American Cement Corp., at two plants in Detroit; and by Wyandotte Chemicals Corp. at Wyandotte.

Salt was mined by International Salt Co., Inc., at Detroit, and recovered from artificial brines at Wyandotte by Pennsalt Chemicals Corp. and Wyandotte Chemicals

Corp. The latter company also produced calcium chloride. Sand and gravel output declined to about 3.2 million tons from nearly 4.4 million in 1965, reflecting a decline in building and road construction. In addition to building and road materials, industrial sand for a variety of uses was produced. Limestone for riprap and road use was quarried from the Sibley quarry at Trenton by Michigan Foundation Quarry Co., Inc. Clay was mined at Livonia by Light Weight Aggregate Corp. and at Allen Park by Peerless Cement Co. for their own use. Flat Rock Clay Products Co. did not operate its pit or plant in 1966.

About 1.2 billion cubic feet of natural gas and 18,000 barrels of petroleum were recovered from the Northville field. Socony Mobil Oil Co. refined crude oil at Trenton. Marathon Oil Co. recovered byproduct sulfur from crude oil at its Detroit refinery.

United States Gypsum Co. operated a calcining and board plant at Detroit. The crude ore was shipped by water from the company-owned port and quarries at Alabaster in Iosco County. The company also expanded perlite at the Detroit plant. Zonolite Division, W. R. Grace & Co. exfoliated vermiculite at a plant in Dearborn.

# PLATES

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Photographs of several mineral operations  
taken during 1967

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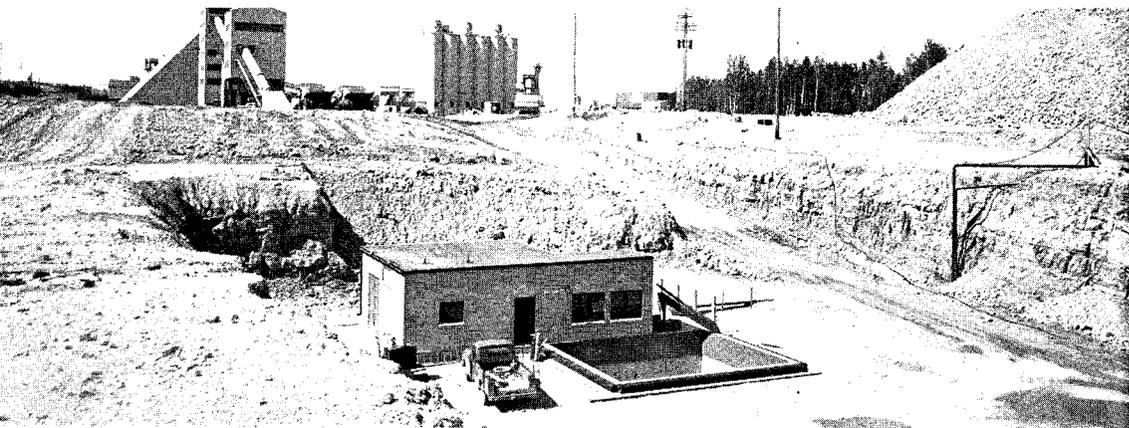


Photo 1—New \$25 million Medusa Portland Cement Co. operation at Charlevoix. Primary crusher in foreground and processing plant and cement storage silos in background.

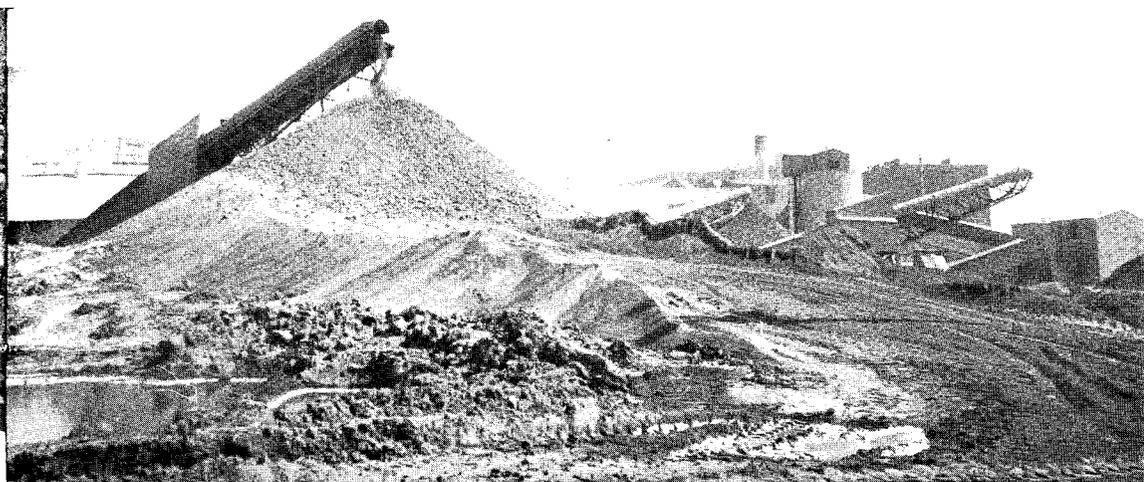


Photo 4—Iron ore stockpiles at Cleveland Cliffs' Pioneer Pellet Plant at Eagle Mills. Pellets are produced from the fine proportion of the natural ore mined at C.C.'s Mather Mine at Negaunee.



Photo 2—Inland Lime & Stone Co. dolomite quarry about two miles west of Port Inland in Schoolcraft County. The crushed stone is shipped from Port Inland on the north shore of Lake Michigan. Primary use is for flux in the iron and steel industry.

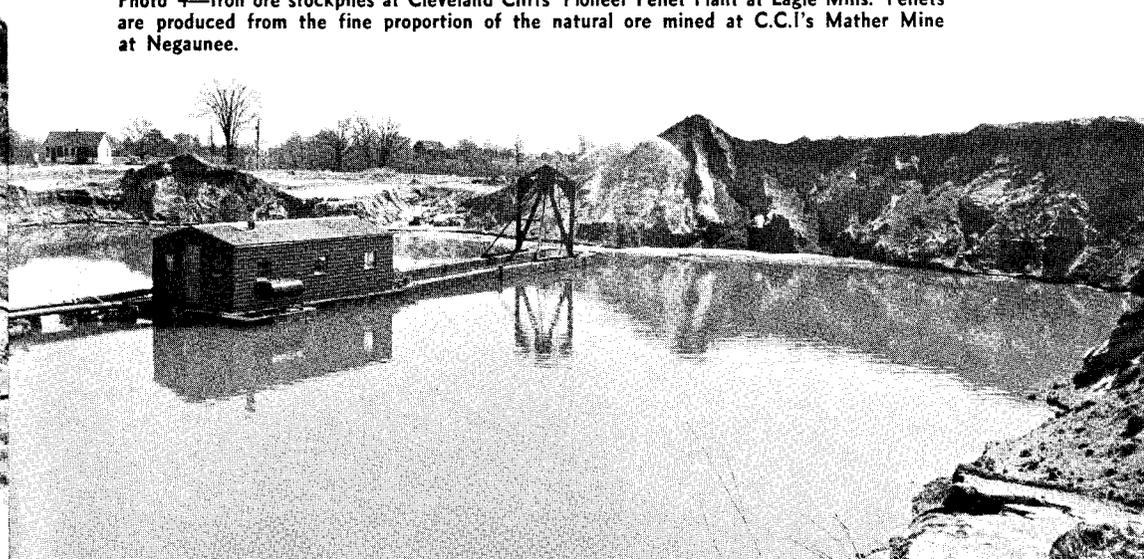


Photo 5—Mason Pit of Cheney Gravel Co. Gravel dredged many feet below water level helps meet demands in the Lansing area.



Photo 3—Rip-rap production by Howe & Howe Construction Co. in the Ozark Quarry, Mackinac County. These large boulders went into piers on Mackinac Island.



Photo 6—Green Thumb Peat Co. peat operation at Sandusky, Sanilac County. Almost all Michigan peat is marketed as a soil conditioner. Nurseries and golf course are major consumers.

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