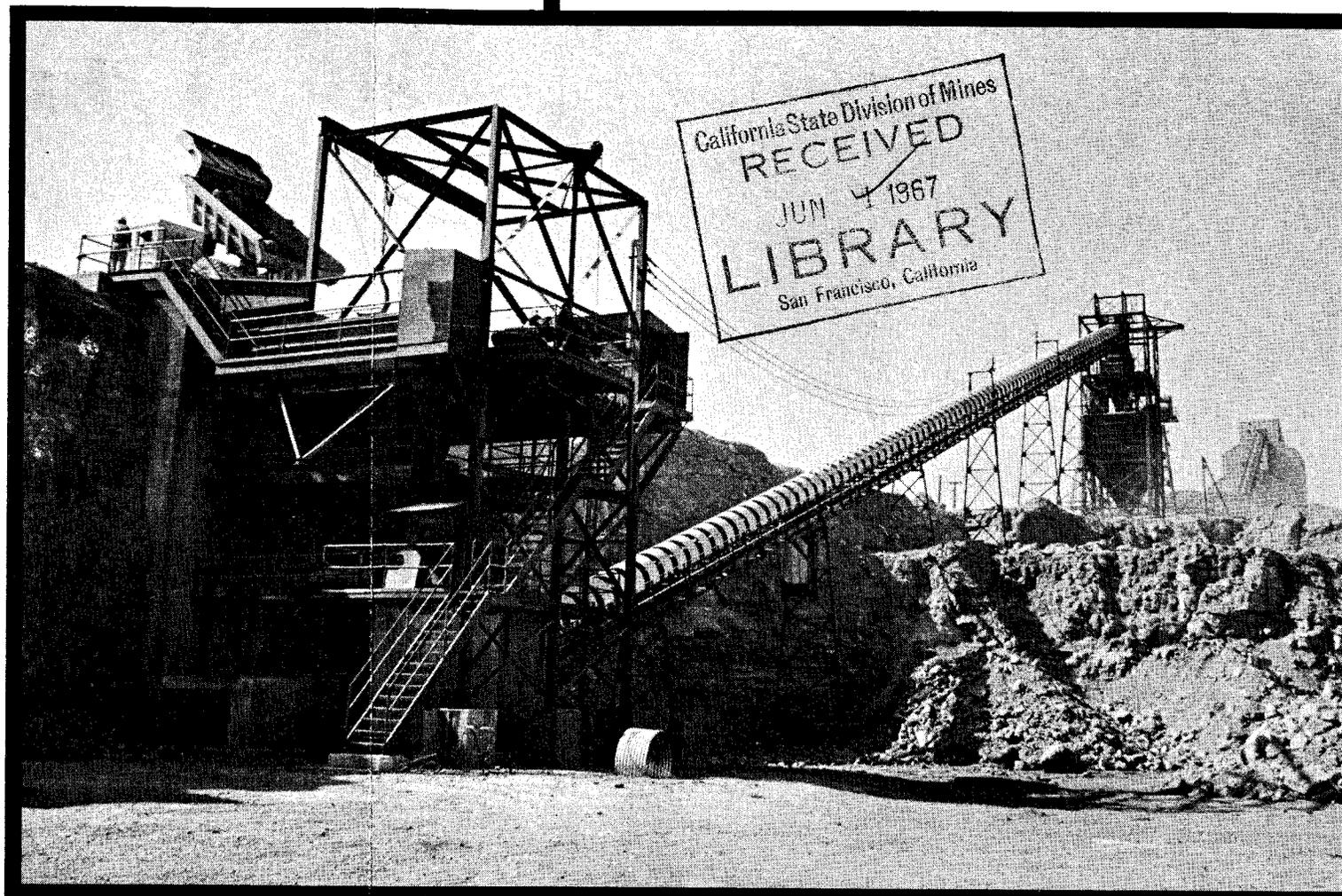


Cover photo shows new rock crusher and conveyor in quarry at one of the State's oldest limestone operations, The France Stone Company, Monroe, Michigan.

# MINERAL INDUSTRY OF MICHIGAN, 1965



1967

ANNUAL STATISTICAL SUMMARY 5  
Geological Survey



*. . . 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



Geological Survey

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ANNUAL STATISTICAL SUMMARY 5

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# Mineral Industry of Michigan 1965

By

Donald F. Klyce

Industry Economist

Bureau of Mines, Minneapolis, Minnesota

Prepared in cooperation with

Bureau of Mines

United States Department of the Interior

1967

STATE OF MICHIGAN  
GEORGE ROMNEY, *Governor*

DEPARTMENT OF CONSERVATION  
RALPH A. MACMULLAN, *Director*

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

COMMISSION OF CONSERVATION

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ROBERT J. FURLONG, *Executive Assistant & Secretary*

## FOREWORD

Production of mineral raw materials and mineral products attained an all-time high in Michigan during 1965. This record was not surprising because the insatiable demand for minerals in our industrialized society has been developing for a number of years.

To meet these present needs several new industries were being developed or were in operation during the year. These facilities include two lime plants in Detroit, two cement plants near Milan and Charlevoix, a salt plant at Midland, and sand plants at Bridgman, Ludington, and in Mackinac County. In addition, a number of established gravel, stone, and cement operations expanded or modernized.

This publication is similar in content and style to the immediate preceding issues of 1964 and 1963. The body of the report is a preprint of the Michigan chapter of the 1965 Minerals Yearbook compiled and issued by the U. S. Bureau of Mines in cooperation with the State Geological Survey. The map showing value of minerals by counties as added, as were the several photos at the rear.

This annual summary of the mineral industry of Michigan is supplemented by an Annual Directory of Michigan Mineral Operators available in accordance with the instructions appearing inside the rear cover.

Harry O. Sorensen  
John R. Byerlay  
Mining & Economic Geology  
Geological Survey Division  
Department of Conservation

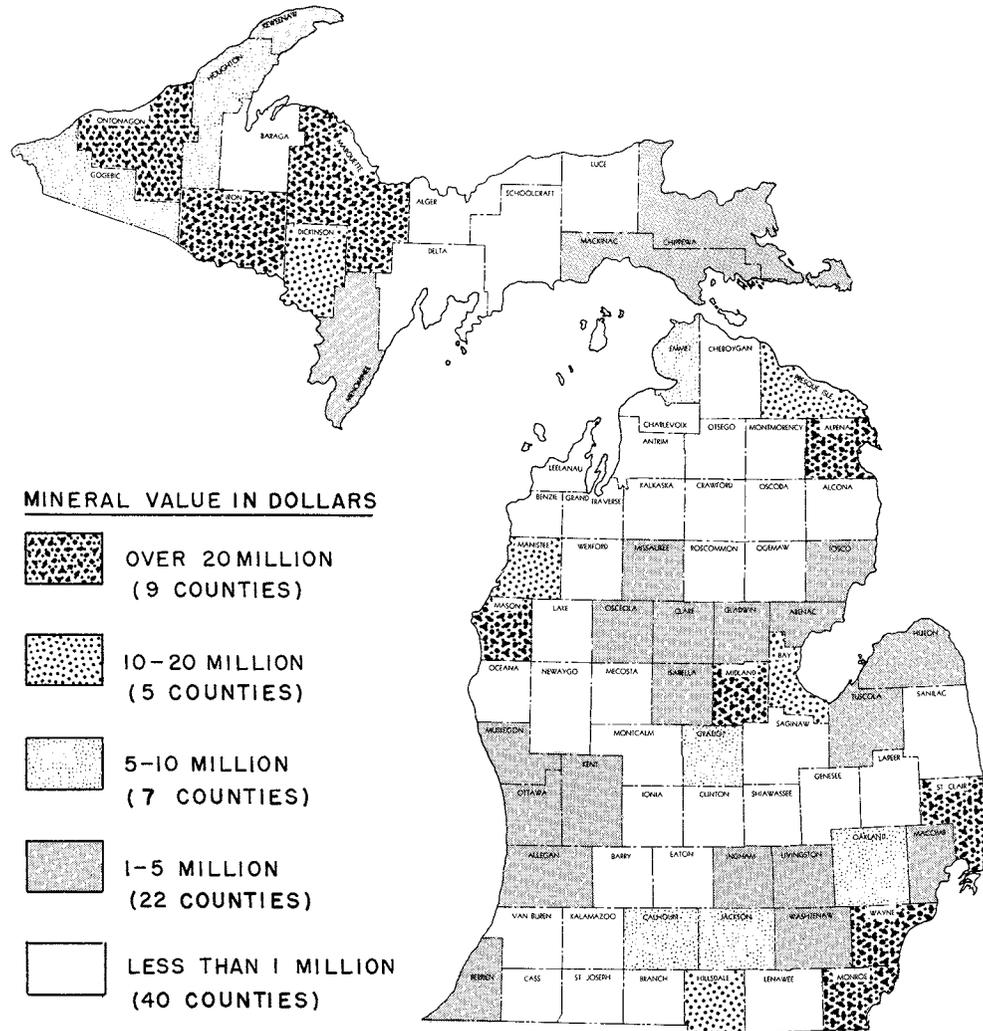
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# MICHIGAN MINERAL VALUE 1965



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

## The Mineral Industry of Michigan

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

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

The value of mineral production in Michigan reached \$565.6 million, 2 percent more than the record high set in 1964. Higher unit values for several mineral commodities combined with increased output of cement, copper, chemicals derived from well brines, and sand and gravel contributed to much of the increase. Petroleum production continued to decline, and lime output was curtailed by a labor strike at one of the major producers.

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

petroleum. Nonmetals, chiefly construction materials (cement, clays, gypsum, lime, sand and gravel, and stone) and natural saline minerals (bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, potassium salts, and salt from brine) again accounted for 55 percent of the State total mineral value. Metallic minerals increased to nearly 35 percent of the total value, while 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	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Portland..... thousand 376-pound barrels	26,745	\$84,316	27,565	\$86,996
Masonry..... thousand 280-pound barrels	1,865	4,954	2,108	5,373
Clays..... thousand short tons	2,385	2,592	2,402	2,580
Copper (recoverable content of ores, etc.)... short tons	69,040	45,014	71,749	50,798
Gypsum..... thousand short tons	1,421	5,263	1,338	5,027
Iron ore (usable)..... thousand long tons, gross weight	13,871	143,979	13,527	145,482
Lime..... thousand short tons	1,430	19,246	1,095	13,057
Magnesium compounds..... short tons	306,494	23,385	319,389	26,143
Natural gas..... million cubic feet	31,388	7,984	34,558	8,674
Natural gas liquids:				
Natural gasoline..... thousand gallons	W	W	9,054	607
LP gases..... do	W	W	76,299	3,815
Peat..... short tons	269,074	2,412	230,950	2,134
Petroleum (crude)..... thousand 42-gallon barrels	15,601	43,839	14,728	41,091
Salt..... thousand short tons	4,345	35,711	4,171	36,087
Sand and gravel..... do	51,921	44,405	53,168	47,176
Silver (recoverable content of ores, etc.)... thousand troy ounces	349	452	458	592
Stone..... thousand short tons	34,650	37,002	34,713	36,438
Value of items that cannot be disclosed: Bromine, calcium chloride, calcium-magnesium chloride, gem stones, iodine, potassium salts, and values indicated by symbol W.....	XX	\$ 54,278	XX	53,490
<b>Total.....</b>	XX	\$ 554,832	XX	565,560

<sup>1</sup> Revised. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

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

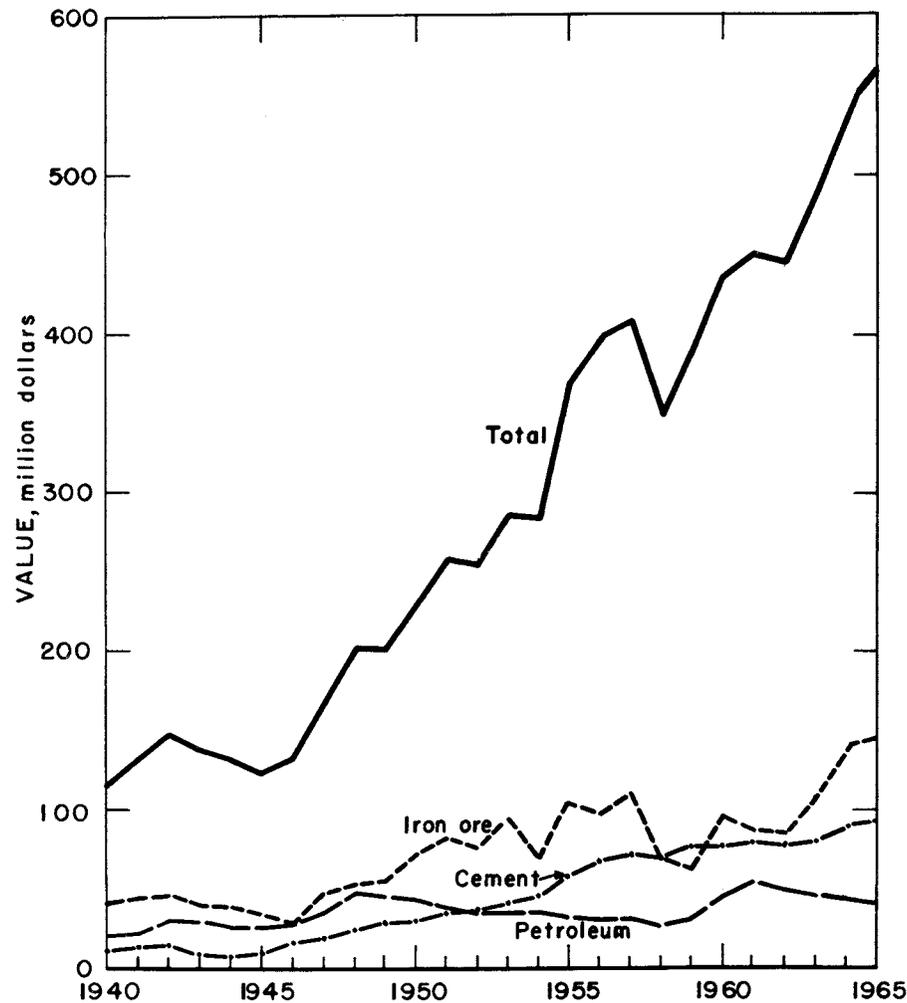


Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

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

Year	Value	Year	Value
1954	\$306	1960	\$431
1955	385	1961	444
1956	396	1962	440
1957	412	1963	484
1958	352	1964	535
1959	384	1965	540

† Revised. ♢ Preliminary.

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>1964:</b>								
Peat	291	186	54	495	1	12	24.26	267
Metal	5,470	277	1,514	12,125	1	321	26.56	1,893
Nonmetal	2,303	299	688	5,500	—	54	9.82	459
Sand and gravel	2,717	212	577	4,765	2	90	19.31	3,010
Stone	3,175	302	958	7,683	—	42	5.47	333
Total	13,956	272	3,791	30,568	3	519	17.08	1,391
<b>1965:♢</b>								
Peat	189	159	30	270	—	3	11.11	148
Metal	5,605	284	1,593	12,739	4	341	27.08	2,739
Nonmetal	2,120	278	589	4,718	—	43	9.11	269
Sand and gravel	2,715	212	577	4,765	2	90	19.31	3,897
Stone	3,315	292	968	7,767	—	54	6.95	453
Total	13,944	269	3,757	30,259	6	531	17.75	1,926

♢ Preliminary.

### REVIEW BY MINERAL COMMODITIES

#### NONMETALS

**Cement.**—Shipments of cement reached a new high of nearly 29.7 million barrels with both portland and masonry cements registering substantial gains. Portland cement was produced at eight plants in six counties. At six of these plants masonry cement was produced. Total finished portland cement capacity at these plants was nearly 34.5 million barrels. Yearend stocks of portland cement at mills were nearly 2.2 million barrels, 547,000 barrels less than in 1964. More than 95 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. Nearly 55 percent of the cement was shipped to consumers within the State. Western New York and the States of Ohio, Illinois, Wisconsin, Indiana, and Minnesota

received most of the remainder. Nearly 59 percent of the portland cement shipped was purchased by ready-mix concrete companies, with the remainder going principally to contractors, concrete product manufacturers, and building-material dealers.

Raw materials used in cement manufacture included 6.6 million tons of limestone, 2.1 million tons of clay and shale, as well as sand, gypsum, iron ore, mill scale, slag, grinding aids, and air-entraining compounds.

Over 650 million kilowatt-hours of electrical energy was used. The wet process was used at seven plants and the dry process at one. Major developments were the announcements by Martin Marietta Corp. of a \$30 million cement plant and quarry facility to be built near Milan, and by Medusa Portland Cement Co. of a cement

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	
1956-60 (average)	8	20,775	20,713	\$67,753	2,472
1961	9	21,661	21,948	75,172	2,737
1962	9	23,070	22,682	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	2,190

† Revised.

plant with annual capacity of 4 million barrels to be built at Charlevoix.

A strike at the Wyandotte Chemicals Corp. at Wyandotte, caused a shutdown of its cement plant from May 4 to December 31.

**Clays.**—According to reports from 14 mining operations in 10 counties, output of miscellaneous clay and shale was slightly greater than in 1964. About 88 percent of the total was used in manufacturing cement. The remainder was used in producing lightweight aggregate, vitrified and heavy clay products, and art pottery. The largest production was reported from Alpena County, followed by Wayne, Monroe, Saginaw, and St. Clair Counties.

**Gem Stones.**—Gem stones were collected principally in the upper peninsula, by hobbyists for personal collections and handmade jewelry. Native copper and hematite specimens as well as agates, thomsonite, and other semiprecious stones were found.

**Gypsum.**—Gypsum was quarried in Iosco County and mined from underground deposits in Kent County. Output was down about 6 percent from 1964. Plants at Detroit, Grand Rapids, and National City processed the crude ore for the manufacture of lath and plaster, wallboard, and other building uses. Crude ore was also shipped to plants in other States. Uncalcined gypsum was sold as a cement retarder.

**Lime.**—The output of lime was down more than 23 percent from that of 1964. A 7-month strike at Wyandotte Chemicals Corp. in Wyandotte caused a shutdown of their lime manufacturing facility and contributed substantially to the decline. Data for regenerated lime (produced by paper-mills, water purification plants, and acetylene processors) are excluded from the State total production. Wayne County again led in lime production. More than 83 percent of the lime manufactured was used by producers, and 97 percent was consumed within the State. Lime was used in paper and sugar manufacture, water and sewage treatment, and for chemical and metallurgical use. Nearly all of the lime produced was quicklime. The remainder was hydrated lime. The Detroit Lime Co. plant in River Rouge went into operation in November. A feature of the plant is a vertical lime kiln, reportedly the world's largest, with a capacity of 600 tons

of lime per day. Output of the new plant will be used for basic-oxygen steelmaking at plants in the Detroit area. Construction of the 700,000-ton-per-year-capacity lime plant of Marblehead Lime Co. at River Rouge in Wayne County continued during the year. Operation was scheduled for early 1966.

**Natural Salines.**—Natural well brines, processed at plants in Gratiot, Lapeer, Manistee, Mason, Midland, and Wayne Counties, yielded bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash. The value of chemicals, produced from natural salines, excluding salt, was 7 percent higher than in 1964.

**Perlite.**—Perlite was expanded from crude ore mined in western States at plants in Iosco, Kent, and Wayne Counties. The output was used chiefly as lightweight aggregate in plaster.

**Salt.**—Salt was recovered from natural and artificial brines in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties. One underground salt mine was operated in Detroit. Output was 4 percent smaller than in 1964, but because of a unit price increase of 43 cents per ton, value of production increased 1 percent. Salt was sold principally for use in chemical manufacture, meatpacking, ice control, water softening, and animal feed.

**Sand and Gravel.**—Output of sand and gravel totaled nearly 53.2 million tons, exceeding the record high established in 1964. The State remained second to California in sand and gravel production. An increased demand over that of 1964 was registered for all types of sand and gravel, except for fill material which recorded a slight decrease. The most notable increase was in industrial sand production which exceeded 1964 output by more than 500,000 tons. Most of the increase resulted from a greater demand for molding sand. Sand and gravel was produced in all counties except Monroe.

The Detroit metropolitan area (Livingston, Macomb, Oakland, Washtenaw, and Wayne Counties), producing over 20.6 million tons of sand and gravel, accounted for about 39 percent of State total production. Output of more than 1 million tons was also reported from each of the following counties: Berrien, Ingham, Kent, Otsego, and Tuscola. More than 92 per-

**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	1964		1965	
	Quantity	Value	Quantity	Value
<b>Commercial operations:</b>				
Sand:				
Building .....	5,754	\$4,169	6,469	\$4,726
Paving .....	5,135	4,274	5,377	4,697
Fill .....	3,204	1,412	3,265	1,484
Molding .....	2,819	5,085	3,298	5,903
Other <sup>1</sup> .....	694	1,620	917	2,014
Total .....	17,606	16,560	19,326	18,824
Gravel:				
Building .....	5,739	7,339	5,436	7,406
Paving .....	16,254	13,380	17,696	14,969
Railroad ballast .....	210	225	240	264
Fill .....	350	203	378	199
Other .....	418	457	347	397
Total .....	22,971	21,604	24,097	23,235
Total sand and gravel .....	40,577	38,164	43,423	42,059
<b>Government-and-contractor operations:</b>				
Sand:				
Building .....	107	48	74	33
Paving .....	1,659	744	1,699	790
Fill .....	1,215	394	1,224	400
Other .....	127	58	102	41
Total .....	3,108	1,244	3,099	1,264
Gravel:				
Building .....	196	76	103	56
Paving .....	7,641	4,764	6,265	3,707
Fill .....	347	141	190	63
Other .....	52	16	88	27
Total .....	8,236	4,997	6,646	3,853
Total sand and gravel .....	11,344	6,241	9,745	5,117
<b>All operations:</b>				
Sand .....	20,714	17,804	22,425	20,088
Gravel .....	31,207	26,601	30,743	27,088
Grand total .....	51,921	44,405	53,168	47,176

<sup>1</sup> Includes abrasive, engine, glass, grinding and polishing, railroad ballast, other construction and industrial uses (1964-65), and enamel and foundry sands (1965).

cent of the sand and gravel was processed. About 92 percent of the material was moved by truck, and the remainder by rail or water. Production was reported from 345 commercial operations and 187 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.  
Holly Sand & Gravel Plant, J. P. Burroughs & Son, Inc.  
Michigan Silica Co.  
The Nugent Sand Co., Inc.  
Pickitt & Schreur, Inc.

Sargent Sand Co.  
Straits Aggregate & Equipment Corp.  
I. L. Whitehead Co.

**Stone.**—Total stone output in 1965 was about the same as in 1964. Crushed limestone production of 34.6 million tons represented more than 99 percent of the stone production. It was quarried in 14 counties by 20 operators. Nearly 95 percent of the production came from large quarries, producing more than 1 million tons annually, in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties.

Nearly 27 million tons of crushed limestone was moved by water from company-operated ports on Lakes Huron and Michigan to industrial consumers, principally

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
1961			27,516	\$119,950	7,045	\$54,057	34,561	\$174,007
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

Table 7.—Crushed and broken stone sold or used by producers, by kinds and uses  
(Thousand short tons and thousand dollars)

Kind and use	1964		1965	
	Quantity	Value	Quantity	Value
Limestone:				
Riprap	W	W	100	\$151
Flux	12,969	\$14,792	12,550	14,447
Concrete aggregate and roadstone	4,593	5,464	5,614	6,540
Agriculture	679	1,147	609	1,069
Cement	9,273	7,610	8,999	7,303
Lime	2,956	2,709	4,514	3,814
Other <sup>1</sup>	4,048	5,065	2,183	2,904
Total	<sup>2</sup> 34,516	<sup>2</sup> 36,788	<sup>2</sup> 34,570	36,228
Marl: Agriculture	120	83	132	90
Grand total	34,636	36,871	34,702	36,318

W Withheld to avoid disclosing individual company confidential data; included with "Other."  
<sup>1</sup> Includes limestone for riprap (1964), asphalt and miscellaneous filler, chemicals, dust for coal mines, 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.

steel mills, and cement and lime plants. Total crushed stone production did not vary appreciably from 1964, but some changes in the consumption pattern were noted. Shipments of fluxstone and cement rock were both down 3 percent from those of 1964. Demand for roadstone and stone for lime manufacture were 22 percent and 53 percent, respectively, greater than in 1964. Major producers of limestone, in alphabetical order, included the following:

Drummond Dolomite, Inc.  
 Dundee Cement Co.  
 The France Stone Co.  
 Huron Portland Cement Co.  
 Inland Lime & Stone Co. (Div. 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 was produced at 35 operations in 14 counties. The largest output was re-

ported from Allegan, Barry, Calhoun, Cass, and Kalamazoo Counties. Dimension sandstone was quarried and milled in Baraga and Jackson Counties.

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

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

#### METALS

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

**Copper.**—Production of copper in terms of recoverable metal was 4 percent higher than in 1964. The value of output increased nearly 13 percent because the average weighted price rose to 35.4 cents per pound compared with 32.6 cents in

1964. The price, quoted by primary producers for delivered electrolytic copper at the beginning of 1965, was 34 cents per pound. The price of copper remained at 36 cents per pound from May 5 to November 12 and was 36 cents at yearend.

Calumet & Hecla, Inc., operated eight mines, one reclamation plant, and one smelter in Houghton and Keweenaw Counties. A labor strike which started on August 21 and lasted through October 31 interrupted copper production at the Calumet Division of Calumet & Hecla, Inc. Work was completed on the surface installations at the Kingston mine, and it was put into operation on July 6.

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

Table 8.—Mine production of copper in 1965, by months, in terms of recoverable metal

Month	Short tons
January	6,415
February	6,035
March	6,745
April	6,170
May	6,560
June	6,320
July	6,200
August	5,310
September	4,885
October	5,175
November	5,755
December	6,179
Total	71,749

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.

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
1956-60 (average)	11	3	5,918,166	2,014,499	57,923	\$37,623,580
1961	10	3	7,109,924	2,122,286	70,245	42,147,000
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	6,717,862	2,174,478	69,040	45,014,080
1965	10	3	7,367,571	1,611,378	71,749	50,798,292

**Iron Ore.**—Iron ore shipments totaled 13.5 million long tons, a decrease of 344,000 tons from those of 1964. Value of shipments, however, increased by \$1.5 million. Much of the gain was due to increased shipments of concentrates from low-grade ores. These accounted for 52 percent of total shipments compared with 47 percent in 1964. Fourteen underground and five open pit mines were active all or part of the year. About 73 percent of the crude ore mined came from open pit operations, the same proportion as in 1964. Average iron content of usable ore produced was 58.25 percent natural. The average weighted mine value of Michigan iron ore, without respect to grade, was \$10.76 per long ton, compared with \$10.38 in 1964.

Michigan iron ore was shipped to producers of pig iron and steel, except for a small quantity used in manufacturing iron oxide pigments.

About 93 percent of the ore was shipped by rail to ore docks in Ashland, Wis., and in Escanaba and Marquette, Mich. The ore was then shipped by water to lower lake ports. The remaining 7 percent was shipped by rail to the consuming districts. The lake shipping season for Michigan iron ores opened at Escanaba on April 6 and closed at the same port on December 19.

According to a study by the Michigan Department of Conservation,<sup>2</sup> the average mining cost per ton for underground mines was \$9.80 in 1965, compared with \$9.99 in 1964. Labor costs increased in 1965 to \$2.77 per ton from \$2.68, but taxes (excluding Federal income tax) decreased to \$0.41 per ton from \$0.49 in 1964. Deferred costs per ton were \$0.55 in 1965,

<sup>2</sup> Geological Survey Division, Michigan Department of Conservation. General Statistics Covering Costs and Production of Michigan Iron Mines. July, 1966, 12 pp.

**Table 10.—Crude iron ore data, in 1965, 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 con- centrators	
County:						
Dickinson			3,452		3,452	
Gogebic	460	753		773		441
Iron	627	2,980		2,832		776
Marquette	1,520	2,829	13,890	1,365	15,859	1,015
Total	<sup>1</sup> 2,608	6,562	17,342	<sup>1</sup> 4,969	19,311	2,232
Range:						
Gogebic	460	753		773		441
Marquette	1,520	2,829	13,890	1,365	15,859	1,015
Menominee	627	2,980	3,452	2,832	3,452	776
Total	<sup>1</sup> 2,608	6,562	17,342	<sup>1</sup> 4,969	19,311	2,232

<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>
1956	5,869	4,264	2,910	13,043
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
Total <sup>2</sup>	339,780	<sup>3</sup> 275,109	<sup>3</sup> 249,464	864,353

<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>
1961	4,141	3,881	1,362	9,384
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

<sup>1</sup> Exclusive of iron ore containing 5 percent or more manganese, natural.

<sup>2</sup> Data may not add to some totals shown because of rounding.

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

Year	Gross weight		Iron content (percent)	Year	Gross weight		Iron content (percent)
	Ore	Iron content			Ore	Iron content	
1946	8,689	4,502	51.82	1956	13,043	6,746	51.72
1947	12,577	6,441	51.21	1957	13,626	7,108	52.16
1948	13,102	6,737	51.42	1958	8,404	4,460	53.07
1949	11,199	5,747	51.32	1959	7,129	3,791	53.17
1950	12,691	6,508	51.28	1960	12,866	6,920	53.78
1951	13,704	6,962	50.80	1961	8,364	4,589	54.87
1952	11,810	6,030	51.06	1962	9,259	5,160	55.73
1953	13,813	7,039	50.96	1963	10,336	5,913	57.21
1954	10,751	5,494	51.10	1964	13,676	7,923	57.93
1955	12,311	6,359	51.66	1965	14,322	8,343	58.25

<sup>r</sup> Revised.

**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 concen- trates to total usable ore (percent)
		Agglom- erates	Other	Total		
1956-60 (average)	9,063	383	916	1,299	10,362	12.54
1961	6,041	1,580	1,764	3,344	9,384	35.63
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

<sup>1</sup> Exclusive of ore containing 5 percent or more manganese.

<sup>2</sup> Includes crushed, screened, and sized ore not further treated.

compared with \$0.56 in 1964. Other costs per ton in 1965 compared with 1964 were as follows: General overhead, \$1.42 from \$1.49; transportation, \$3.04 from \$3.05; royalty unchanged at \$0.31; and marketing \$0.09 from \$0.08.

**Pig Iron and Steel.**—Pig iron and steel were manufactured in the Detroit area. Pig iron shipments and value were slightly higher (1 percent) than those in 1964. Basic, foundry, and low-phosphorus grades were produced. According to the American Iron & Steel Institute, Michigan steel production was 9.7 million tons, about 3 percent greater than in 1964.

**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. 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 increased both in volume and value. The largest production, again, came from St. Clair County, which supplied more than 35 percent of the State total. The Albion-Scipio trend fields in Hillsdale, Calhoun, and Jackson Counties accounted for 29 percent, and Macomb County, another major producing area, accounted for 22 percent. The balance, 14 percent, came from fields in 21 counties.

At the end of 1965 there were 89 producible gas fields, of which 34 produced gas for commercial sale, compared with 83 total fields and 32 commercial fields in 1964.

Production of natural gasoline and liquid petroleum gases was 31 percent larger than in 1964.

Processing of natural gas for natural gas liquids was concentrated in St. Clair, Hillsdale, and Washtenaw Counties. These

counties accounted for 89 percent of the State total natural gas liquids. Gas processed in Washtenaw County was from out-of-State fields, delivered via interstate pipeline.

**Peat.**—Michigan was again the leading peat-producing State with over 38 percent of the national output. Peat was produced in 15 counties with 91 percent coming from Lapeer, Lenawee, Oakland, and Sanilac Counties. Peat was marketed principally as a soil conditioner. None was sold for fuel.

**Petroleum.**—Petroleum production declined about 873,000 barrels below the 1964 figure. Nearly half of this loss was reported from fields of the Albion-Pulaski-Scipio trend in Calhoun, Hillsdale, and Jackson Counties. However, this area still accounted for 60 percent of State production. According to data compiled by the Geological Survey Division of the Michigan Department of Conservation, no significant oil reserves were found or developed in 1965 that would offset the decline. Oilfield discoveries in 1965 increased the number of active fields to 187, up from 184 in 1964. During the year, five fields or pools were abandoned and one pool reactivated. At yearend, the number of producing wells was 4,036, compared with 4,151 at the end of 1964.

## REVIEW BY COUNTIES

Mineral production was reported from all counties in Michigan. Value of output increased in 36 counties and decreased in 47 counties. More than \$1 million in minerals was produced in each of 42 counties. Marquette County led in value of production.

**Allegan.**—Several commercial operators and Government agencies produced 877,000 tons of sand and gravel at plants near Allegan, Fennville, and Otsego. Most of the material was used in road construction with the remainder being used for fill and building construction. Marl, for agricultural use, was dipped from pits near Allegan and Martin.

Natural gas production declined about 29 percent to 310 million cubic feet, while petroleum output remained at the same level as in 1964. More than half of the output came from the Wayland field (147,000 barrels). Moss and reed-sedge peat

Most of the geophysical exploration was concentrated in the St. Clair-Macomb County area of eastern Michigan. Less gravimeter exploration was reported in 1965, but seismograph exploration exceeded that of previous years. Exploratory well completions were about 15 percent less than in 1964. Total exploratory and development well completions during 1965 were 378 compared with 506 in 1964.

Wells that reached total depth in Cambrian or older rocks were drilled mainly in the less shallow part of the basin. The deepest hole drilled during the year bottomed-out at 8,372 feet in the Treampealeau formation. Two Precambrian test holes were drilled, one on Harsen's Island, St. Clair County, and one in Berrien County. The Berrien County well was reported to have drilled over 1,000 feet of granite before reaching a total depth of 5,647 feet. The hole was drilled by a rotary rig with water as the primary drilling fluid.

Petroleum was produced in 42 counties. Eleven refineries had an operating capacity of 177,500 barrels per day.

Fluid injection was used in producing about 1.3 billion cubic feet of gas and 3.3 million barrels of petroleum. Nearly 45.4 million barrels of fluid, mostly brines, were injected through 341 wells. From the same fields, about 40.5 million barrels of fluid, nearly all brine, was produced.

were dug from bogs near Middleville and Wayland and sold for soil conditioning and for packing plants and shrubs.

**Alpena.**—Portland and masonry cements were produced at the world's largest cement plant by Huron Portland Cement Co., subsidiary of National Gypsum Co., at Alpena. During the year new dryers, a new raw-mix mill, and two new kilns were put into operation at the plant. This was one phase of a program designed to increase annual capacity to 24 million barrels per year by 1975. Clay and limestone for use at the cement plant were mined in the area. About 392,000 tons of sand and gravel was produced in the county, mostly for road construction. Output was from fixed and portable plants near Alpena and Ossineke.

**Antrim.**—Penn-Dixie Cement Corp. mined shale near Ellsworth for use in manufacturing cement at its Petoskey plant.

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

County	1964	1965	Minerals produced in 1965 in order of value
Alcona.....	\$178,000	\$141,000	Sand and gravel.
Alger.....	69,000	25,000	Do.
Allegan.....	1,347,433	<sup>2</sup> 1,284,132	Petroleum, sand and gravel, peat, stone, natural gas.
Alpena.....	W	W	Cement, stone, clays, sand and gravel.
Antrim.....	216,986	204,696	Clays, sand and gravel.
Arenac.....	1,247,038	1,153,056	Petroleum, stone, sand and gravel.
Baraga.....	44,850	104,400	Sand and gravel, stone.
Barry.....	443,214	497,631	Sand and gravel, petroleum, stone.
Bay.....	8,359,197	10,342,073	Cement, petroleum, lime, sand and gravel.
Benzie.....	13,000	30,000	Sand and gravel.
Berrien.....	1,072,741	1,376,055	Sand and gravel, stone.
Branch.....	102,920	199,537	Do.
Calhoun.....	6,782,895	<sup>2</sup> 6,784,379	Petroleum, sand and gravel, stone, natural gas.
Cass.....	270,749	334,969	Sand and gravel, petroleum, stone.
Charlevoix.....	42,000	17,000	Sand and gravel.
Cheboygan.....	202,189	141,097	Sand and gravel, stone.
Chippewa.....	3,324,830	4,739,350	Stone, sand and gravel.
Clare.....	1,736,725	<sup>2</sup> 1,903,929	Petroleum, sand and gravel, natural gas.
Clinton.....	319,604	369,366	Sand and gravel, clays.
Crawford.....	264,145	<sup>2</sup> 269,202	Petroleum, sand and gravel, natural gas.
Delta.....	170,146	259,148	Sand and gravel, stone.
Dickinson.....	17,808,288	20,102,845	Iron ore, stone, sand and gravel.
Eaton.....	505,861	562,878	Sand and gravel, stone, clays, peat.
Emmet.....	8,968,440	7,285,985	Cement, stone, sand and gravel.
Genesee.....	709,376	652,164	Sand and gravel, petroleum.
Gladwin.....	1,315,528	W	Petroleum, sand and gravel.
Gogebic.....	11,680,042	6,587,762	Iron ore, sand and gravel.
Grand Traverse.....	106,000	W	Sand and gravel.
Gratiot.....	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale.....	14,741,652	<sup>2</sup> 14,235,692	Petroleum, sand and gravel, stone, natural gas.
Houghton <sup>3</sup> .....	<sup>4</sup> 9,729,022	7,829,391	Copper, sand and gravel, stone.
Huron.....	978,621	<sup>2</sup> 1,295,026	Stone, sand and gravel, lime, petroleum, natural gas.
Ingham.....	972,096	1,221,912	Sand and gravel, peat.
Ionia.....	382,000	274,000	Sand and gravel.
Iosco.....	4,822,188	4,555,659	Gypsum, sand and gravel.
Iron.....	23,514,489	21,225,886	Iron ore, sand and gravel.
Isabella.....	1,742,337	1,729,101	Sand and gravel, petroleum, stone.
Jackson.....	5,844,547	<sup>2</sup> 4,753,171	Petroleum, sand and gravel, stone, natural gas.
Kalamazoo.....	1,250,698	945,341	Sand and gravel, stone, peat.
Kalkaska.....	72,043	<sup>2</sup> 59,281	Petroleum, sand and gravel, natural gas.
Kent.....	3,686,003	3,081,727	Sand and gravel, gypsum, petroleum, peat.
Keweenaw.....	( <sup>5</sup> )	( <sup>4</sup> )	Copper, sand and gravel.
Lake.....	110,968	75,816	Petroleum, sand and gravel.
Lapeer.....	1,682,723	1,642,947	Peat, sand and gravel, salines, petroleum.
Leelanau.....	51,000	53,000	Sand and gravel.
Lenawee.....	1,418,847	708,357	Sand and gravel, cement, peat, clays, petroleum.
Livingston.....	2,736,000	<sup>2</sup> 3,743,000	Sand and gravel, natural gas.
Luce.....	40,000	90,000	Sand and gravel.
Mackinac.....	W	W	Stone, sand and gravel.
Macomb.....	2,028,025	<sup>2</sup> 1,950,236	Sand and gravel, petroleum, natural gas.
Manistee.....	18,909,056	19,964,216	Salines, salt, sand and gravel.
Marquette.....	W	99,075,859	Iron ore, sand and gravel.
Mason.....	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta.....	248,123	<sup>2</sup> 223,611	Sand and gravel, petroleum, peat, stone, natural gas.
Menominee.....	781,177	1,063,482	Lime, sand and gravel.
Midland.....	W	W	Salines, salt, petroleum, sand and gravel, natural gas.
Missaukee.....	1,265,072	W	Petroleum, sand and gravel, natural gas.
Monroe.....	W	W	Cement, stone, clays, petroleum, peat.
Montcalm.....	1,077,159	<sup>2</sup> 968,561	Petroleum, sand and gravel, natural gas.
Montmorency.....	76,211	3,000	Sand and gravel.
Muskegon.....	1,915,869	<sup>2</sup> 2,166,691	Salt, sand and gravel, petroleum, natural gas.
Newaygo.....	170,608	<sup>2</sup> 186,857	Sand and gravel, petroleum, natural gas.
Oakland.....	7,393,223	8,083,304	Sand and gravel, peat, petroleum.
Oceana.....	855,040	660,047	Sand and gravel, petroleum.
Ogemaw.....	1,035,098	<sup>2</sup> 898,233	Petroleum, sand and gravel, natural gas.
Ontonagon.....	36,230,897	43,817,777	Copper, silver, sand and gravel.
Oscoda.....	887,699	<sup>2</sup> 1,489,667	Petroleum, sand and gravel, natural gas.
Oseola.....	28,055	23,688	Sand and gravel, petroleum.
Otsego.....	52,000	<sup>2</sup> 33,000	Sand and gravel, natural gas.
Ottawa.....	2,627,931	<sup>2</sup> 2,731,187	Sand and gravel, petroleum, stone, natural gas.
Presque Isle.....	W	W	Stone, sand and gravel.
Roscommon.....	714,813	<sup>2</sup> 675,618	Petroleum, sand and gravel, natural gas.
Saginaw.....	480,329	449,643	Clays, petroleum, lime, sand and gravel.
St. Clair.....	16,183,055	<sup>2</sup> 16,487,453	Salt, cement, petroleum, sand and gravel, clays, peat, natural gas.
St. Joseph.....	211,300	269,746	Sand and gravel, peat, stone.
Sanilac.....	1,148,822	982,419	Peat, sand and gravel, lime.
Schoolcraft.....	71,000	2,000	Sand and gravel.
Shiawassee.....	671,032	569,152	Sand and gravel, clays, peat.

See footnotes at end of table.

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

County	1964	1965	Minerals produced in 1965 in order of value
Tuscola.....	2,209,389	2,065,030	Sand and gravel, petroleum, lime, peat.
Van Buren.....	323,459	258,041	Sand and gravel, petroleum, stone.
Washtenaw.....	938,456	<sup>2</sup> 1,564,849	Sand and gravel, petroleum, natural gas.
Wayne.....	47,394,260	<sup>2</sup> 40,047,759	Cement, salt, lime, sand and gravel, clays, stone, salines, petroleum, natural gas.
Wexford.....	114,000	<sup>2</sup> 106,000	Sand and gravel, natural gas.
Undistributed <sup>3</sup>	<sup>4</sup> 267,714,411	185,855,913	
Total.....	<sup>5</sup> 554,832,000	565,560,000	

<sup>1</sup> Revised. W Withheld to avoid disclosing individual company confidential data.

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

<sup>3</sup> Excludes value of natural gas.

<sup>4</sup> Includes value of mineral production in Keweenaw County.

<sup>5</sup> Value of mineral production is included in that of Houghton County.

<sup>6</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.

About 103,000 tons of gravel for road use was produced for county and State highways.

**Arenac.**—About 303,000 barrels of petroleum was produced. The Deep River and Sterling fields produced the largest output. Crushed limestone and sand and gravel, primarily for road construction and maintenance, was produced at several sites in the county.

**Baraga.**—Superior Natural Redstone Quarry quarried and milled sandstone for building use at Arnheim. Sand and gravel, mainly for road use, was produced by county crews, under contract for the State highway department.

**Barry.**—Sand and gravel was produced at four fixed plants and at several sites with portable plants throughout the county. Output was 90,000 tons larger than the tonnage reported in 1964. The material was used for building, road construction, and other uses. Pits near Caledonia and Nashville yielded marl for agricultural use. A small quantity of petroleum was produced.

**Bay.**—Aetna Portland Cement Co., Division of Martin Marietta Corp., produced portland and masonry cements at Bay City. Quicklime for use in sugar refining was produced by the Monitor Sugar Division of Robert Gage Coal Co. About 334,000 barrels of petroleum was recovered from county oil fields, with the Kawkawlin field accounting for 75 percent of the total. Bay Refining, Division Dow Chemical Co., refined crude oil at Bay City. The Bay County Road Commission crews produced

98,000 tons of sand for road construction and maintenance.

**Berrien.**—County sand and gravel output was approximately 1.2 million tons. Industrial sand (primarily blast, engine, and molding) was mined at Bridgman by Arrowhead Silica Corp. and at Sawyer by Manley Sand Division, Martin Marietta Corp. Sand and gravel for building and paving was produced at pits with fixed and portable plants throughout the county. Marl for agricultural use was dug from two pits near Three Oaks.

**Branch.**—Pits near Kinderhook and Sherwood yielded marl for agricultural use. Sand and gravel for building, road construction, and other uses was produced from pits near Coldwater and Union City by commercial operators. State and county agencies used portable plants at several sites to obtain gravel for road use.

**Calhoun.**—Both petroleum and natural gas production was slightly higher than in 1964. The county maintained its position of second place in petroleum production, 2.3 million barrels, and fourth place in natural gas output, 4 billion cubic feet. Sand and gravel production of 733,000 tons was 15 percent greater than in 1964. Marl was obtained from pits near Burlington and Union City and sold for agricultural use.

**Cass.**—Nearly 20,000 tons of marl was dipped from pits near Cassopolis, Dowagiac, Edwardsburg, and Union. Output was sold for agricultural use. About 376,000 tons of sand and gravel was produced from fixed plants near Dowagiac and Niles and with portable plants at several sites.

Production of 5,000 barrels of petroleum was reported from the Jefferson field.

**Cheboygan.**—Limestone was quarried and crushed near Afton and sold for flux, concrete aggregate and roadstone, and agricultural use. About 154,000 tons of sand and gravel, down from 220,000 tons in 1964, was produced at several sites with portable plants. Most of the material was used for road construction and maintenance.

**Chippewa.**—Drummond Dolomite, Inc., operated one of the largest limestone quarries in the State on Drummond Island in Lake Huron. The material was used for flux, concrete aggregate and roadstone, and agricultural purposes. Sand and gravel output nearly doubled to 600,000 tons. Production was with portable plants in the Kinross and Soo areas.

**Clare.**—Petroleum output was 651,000 barrels compared with 614,000 in 1964. Although production was reported from 11 fields, more than 78 percent came from the Hamilton, Cranberry Lake, and East Cranberry Lake fields. Natural gas production declined slightly to 187 million cubic feet. Output of sand and gravel increased substantially to 189,000 tons.

**Clinton.**—Clay was mined at two sites near Grand Ledge and used in the manufacture of vitrified sewer pipe and other heavy clay products. Sand and gravel output totaled 451,000 tons, an increase of 90,000 tons over that of 1964. Principal uses were for building, road construction, and fill.

**Crawford.**—Petroleum production from the Beaver Creek field declined to 66,000 barrels from 85,000 in 1964, while natural gas output was 345 million cubic feet compared with 440 million in 1964. Sand and gravel production was 92,000 tons compared with 56,000 in 1964. Output was for building, paving, and fill.

**Delta.**—Limestone was quarried and crushed at Escanaba for use as concrete aggregate and roadstone. About 372,000 tons of sand and gravel, used mostly for building and road construction, was produced at several sites in the county.

**Dickinson.**—The Hanna Mining Co. operated its Groveland open pit iron mine, concentrator, and pelletizing plant near Randville. Shipments were 13 percent greater than in 1964. Limestone was quarried near Randville for use as terrazzo and

ornamental concrete and quarried near Felch for roofing granules and other uses. The Randville-Graceville quarry was operated the first quarter by the Superior Rock Products Co. and for the remainder of the year by the Great Lakes Select Stone Product Co. About 104,000 tons of sand and gravel was produced, principally for building and road use. The material was produced from pits near Iron Mountain and Norway.

**Eaton.**—Grand Ledge Clay Product Co. mined clay for its own use in manufacturing vitrified sewer pipe and other heavy clay products. About 362,000 tons of sand and gravel, compared with 324,000 tons in 1964, was produced mainly with portable plants at sites throughout the county. One stationary plant was operated near Charlotte. Most of the material was used for road construction and maintenance. Cheney Limestone Co. produced limestone near Bellevue for roadstone, agricultural use, and rubble. Reed-sedge peat was obtained from a bog near Charlotte and sold for soil improvement.

**Emmet.**—Penn-Dixie Cement Corp. operated a cement plant and limestone quarry at Petoskey. During the year, the expansion and improvement program begun in 1964 was completed. In addition to the new raw grinding mill and kiln, a computer control system was developed, reportedly the first industrial data logging system in this country using a computer for a wet-process cement plant. Raw material proportions are calculated to assure correct feed to the two kilns and the computer is used on-line to monitor raw mill, kiln, and cooler operations. A detailed article describing the plant operation was published.<sup>3</sup>

Sand and gravel for road use was produced by county crews and under contract for the State highway department.

**Genesee.**—Sand and gravel output totaled 732,000 tons, nearly 200,000 tons less than in 1964. Production came from five fixed plants and several portable plants. Most of the material was used for building and road construction. About 2,000 barrels of petroleum was recovered from the Otisville field.

**Gladwin.**—Nearly 439,000 barrels of petroleum was produced from 12 fields.

<sup>3</sup> Pit and Quarry. New Computer Control Concept Adapted to Penn-Dixie's Petoskey Wet process Plant. V. 68, No. 12, December 1965, pp. 78-91.

More than half of the output came from the Grout and North Buckeye fields. A small quantity of sand and gravel was produced near Gladwin for building and road construction.

**Gogebic.**—Pickands Mather & Co. produced direct-shipping iron ore from the Geneva and Peterson underground mines. The company discontinued mining activities at the Geneva mine in January and final shipments were completed later in the year. Competition from pellets and high-grade ores from other sources forced the shutdown of the mine. The Peterson mine, the last operating iron mine on the Gogebic range, was scheduled to close in February 1966.

About 346,000 tons of sand and gravel was produced, mainly with portable plants at sites throughout the county. The material was used for building, road construction, fill, and other purposes.

**Gratiot.**—Bromine, calcium chloride and calcium-magnesium chloride, and magnesium compounds were produced at St. Louis from natural well brines by Michigan Chemical Co. In the same area salt was extracted from natural well brines by Michigan Salt Co.

A crude oil refinery was operated at Alma by Leonard Refineries, Inc. At the refinery, byproduct sulfur was also recovered using the hydrofining process. About 46,000 barrels of petroleum was produced from the Sumner field. The North Star field yielded a small quantity of natural gas. Approximately 232,000 tons of sand and gravel was produced with fixed plants at Alma and Ithaca and with portable plants at several locations in the county. The material was used for building, paving, and other purposes.

**Hillsdale.**—Petroleum output of nearly 5 million barrels was the largest in the State and only 100,000 barrels less than in 1964. About 4.2 billion cubic feet of natural gas was produced. The county ranked second in the production of natural gas liquids, accounting for more than a third of the State total. A total of 339,000 tons of sand and gravel for road and building use, and fill was produced at a fixed plant in Jerome and with portable plants at several locations.

Marl, for agricultural use, was dipped from pits near Allen and Mosherville.

**Houghton.**—Copper was produced by Calumet & Hecla, Inc., Copper Range Co.,

and Quincy Mining Co. Calumet & Hecla operated the Ahmeek group of mines which included the No. 2 Centennial, No. 3 Centennial, No. 6 Osceola, No. 13 Osceola, the Kingston mines in Houghton County, the No. 4 Ahmeek Peninsula, Seneca, and the No. 3 Allouez mines in Keweenaw County. The company also operated the Tamarack reclamation plant and a smelter near Hubbell. Copper Range Co. operated the Champion mine and Freda mill which treated the Champion ore as well as the Atlantic tailings. Quincy Mining Co. operated a reclamation plant at Hubbell and a smelter at Hancock. The reclamation plant, operated with power purchased from Calumet & Hecla, Inc., was forced to close down for the duration of a 10-week strike at the latter company's operations.

The Limestone Mountain Co. reopened its quarry near Pelkie and produced limestone for roadstone and agricultural use.

Sand and gravel for building and paving was produced at Hancock and by the county road commission at several sites.

**Huron.**—Michigan Sugar Co. produced hydrated lime for its own use, in sugar refining, at Sebawaing. The Wallace Stone Co. (Division J. P. Burroughs & Son, Inc.) quarried and processed limestone at Bay Port. The output included rubble and house stone veneer, riprap, roadstone, railroad ballast, and agricultural limestone. About 738,000 tons of sand and gravel was produced, mostly for building and paving. A small quantity of natural gas and petroleum was recovered from county fields.

**Ingham.**—Sand and gravel output slightly exceeded 1.5 million tons, up from 1.1 million tons in 1964. Increased demand for road construction and maintenance materials was chiefly responsible for the gain. A small quantity of humus peat was dug from a bog near Lansing and sold in bulk for soil improvement. The Lansing Board of Water & Light recovered quicklime from calcium carbonate, precipitated at the city water purification plant.

**Iosco.**—National Gypsum Co. operated a gypsum quarry and board plant near National City and a port facility at Tawas City. At the plant, in addition to manufacturing building products, 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. The material was shipped to other company plants for

use in manufacturing wallboard and other building materials. Michigan Gypsum Co. operated a gypsum quarry south of Whittemore. The material was sold as a cement retarder. About 203,000 tons of gravel for road use was produced in the county, principally near Greenbush.

**Iron.**—The Hanna Mining Co. mined and shipped iron ore from the Hiawatha No. 2, Homer, and Wauseca underground mines. A crushing station and ore transfer system on the 16th level was completed to serve both the Homer and Wauseca mines. Inland Steel Co. operated the Bristol and Sherwood mines and installed new screening facilities which were operating by the end of the year. Output of these mines will be shipped as coarse ore and fines.

About 458,000 tons of sand and gravel, used mostly for fill and road construction, was produced in the county. The fill was produced and used by The Hanna Mining Co. for back-filling stopes in the company iron mines.

**Isabella.**—About 308,000 barrels of petroleum was produced from 10 fields with seven-eighths of the output coming from the Coldwater and Mt. Pleasant fields. Leonard Refineries, Inc., refined crude oil at Mount Pleasant.

Marl, for agricultural use, was dipped from a pit near Wiedman. About 904,000 tons of sand and gravel was produced and used mostly for road construction and repair. Operations were chiefly in the vicinity of Mount Pleasant.

**Jackson.**—About 1.6 million barrels of petroleum and 2 billion cubic feet of natural gas were produced from county fields of the Albion-Pulaski-Scipio trend. Oil output dropped about 300,000 barrels from that of 1964, while gas production remained about the same.

Limestone was quarried and crushed at Parma for use in concrete aggregate, roadstone, and agricultural application. Marl was produced near Horton for agricultural use. Output of sand and gravel totaled 371,000 tons, down more than 300,000 tons from that of 1964. The loss was due to less requirements of the county and State highway departments.

Sandstone was quarried and milled for building use in the Napoleon area. Output was 20 percent less than in 1964.

**Kalamazoo.**—Sand and gravel output, principally from the Kalamazoo area, totaled 916,000 tons, down 364,000 tons from that of 1964. The loss was due to smaller demand for road material. Marl and peat, both used for soil improvement, were produced at several sites in the county.

**Kalkaska.**—Petroleum and natural gas were produced from the Beaver Creek field, while a small quantity of petroleum was reported from the Excelsior field. About 49,000 tons of sand and gravel was produced for county and State highway use.

**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 western States, was expanded for use in plaster at the Bestwall plant. About 2,034,000 tons of sand and gravel, 652,000 tons less than in 1964, was produced, mostly in the Grand Rapids area. The decline in output reflected a lesser demand for both building and road materials. Peat was dug from several bogs in the county. Most of it was sold in bulk for soil improvement.

About 108,000 barrels of petroleum was produced, of which 90 percent came from the Walker field.

**Keweenaw.**—The county road commission produced 39,000 tons of sand and gravel for its own use. Value of copper produced by Calumet & Hecla, Inc., from No. 4 Ahmeek Peninsula, No. 3 Allouez, and Seneca mines is included with Houghton County.

**Lake.**—About 15,000 barrels of petroleum was produced. Most of it, over 13,000 barrels, came from the newly opened Luther Lake field. The county road commission produced about 42,000 tons of sand and gravel for county roads.

**Lapeer.**—Wilkinson Chemical Corp. produced calcium-magnesium chloride from natural well brines at Mayville. Half of the peat produced in the State came from bogs near Imlay City. The reed-sedge peat was sold in both bulk and packaged form for soil improvement, potting soils, and other horticultural uses. The peat operation of Hofman Peat Co. was acquired by J.M. Huber Corp. Most of the

463,000 tons of sand and gravel produced was used on county and State highways.

About 26,000 barrels of petroleum was recovered from the Rich field.

**Lenawee.**—Peninsular Portland Cement, Division of General Portland Cement Co. used its manufacturing facility at Cement City as a distribution center. No cement was manufactured during the year, although a small amount was shipped from stock. Comfort Brick & Tile Co. mined miscellaneous clay for use in manufacturing drain tile. Midwest Peat Co., Adrian, produced reed-sedge peat and sold it in packaged form for soil improvement. About 537,000 tons of sand and gravel was produced in the Adrian and Tecumseh areas for building, paving, railroad ballast, and fill. The Macon Creek field yielded a small quantity of petroleum.

**Mackinac.**—Limestone was quarried by Inland Lime & Stone Co., Division of Inland Steel Co., near Port Inland and at Cedarville by the United States Steel Corp. Both companies maintained large processing plants and port facilities for shipping the material to industrial consumers by water transport.

About 77,000 tons of sand and gravel, mostly road material and fill, was mined in the county.

**Macomb.**—About 2,445,000 tons of sand and gravel was produced, compared with 2,753,000 tons in 1964. The decrease was mainly due to lesser demand for road materials. Plants were operated near Armada, Macomb, Mount Clemens, Romeo, and Utica.

Natural gas production was 7.9 billion cubic feet compared with 5.3 billion in 1964. Most of the output came from the Ray field. The county ranked second in the State in natural gas production. About 4,000 barrels of petroleum was produced.

**Manistee.**—Bromine, calcium-magnesium chloride, and magnesium compounds were extracted from natural well brines. Salt was recovered from artificial brines. Chemical plants were operated in or near Manistee by Great Lakes Chemical Corp., Manistee Salt Works, Michigan Chemical Corp., Morton Chemical Co., Morton Salt Co., and Standard Lime & Refractories Co. (Division Martin Marietta Corp.). At Filer City, quicklime was produced by calcining calcium carbonate sludge by Packaging Corp. of America. The lime

was used in paper manufacture. About 559,000 tons of sand and gravel was produced—the gravel for building and road use and the sand for industrial use, mainly molding sand.

**Marquette.**—Value of mineral production in the county exceeded \$99 million and again was the highest in the State. County iron ore shipments were up 5 percent over those of 1964. The output of underground mines was up less than 1 percent and open pit mines 7 percent. Cleveland-Cliffs Iron Co. operated nine iron ore mines, five underground and four open pit mines. Expansion of the company's underground Mather mine began in June. Upon completion in 1966, production is expected to be at the rate of 2.4 million tons of crude ore per year. Some ore from the Mather mine was pelletized at the Pioneer Pellet Plant, which began operating in June. At the newly completed Empire mine complex near Palmer, a \$40 million program for expansion of pelletizing facilities was announced. Pellet output will be increased from 1.5 million 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.

Sand and gravel production totaled 787,000 tons. The output was used for road construction and maintenance, building, railroad ballast, and fill.

**Mason.**—Bromine, calcium chloride, calcium-magnesium chloride, and magnesium compounds were extracted from well brines at Ludington by The Dow Chemical Co. The company also produced quicklime in the same area. Harbison-Walker Refractories Co. produced refractory magnesia from purchased magnesium hydroxide.

Industrial sand, mainly molding and grinding and polishing sand, was produced near Ludington. Sand and gravel for road use was produced at several sites with portable plants.

Six fields produced 157,000 barrels of petroleum.

**Mecosta.**—About 23,000 barrels of petroleum was produced, largely from the Paris field. Natural gas production was reported from seven fields and totaled 75 million cubic feet. Peat was dug from a bog near Lakeview and marl from pits near Mecosta. Both products were used

for soil enrichment. About 273,000 tons of sand and gravel was produced, mainly for road construction, building use, and fill.

**Menominee.**—Quicklime and hydrated lime were produced at Menominee by Limestone Products Division of The C. Reiss Coal Co. (formerly Limestone Products Division of North Western-Hanna Fuel Co.). The material was sold for a variety of industrial uses including paper and pulp manufacture, tanning, water purification, and steelmaking. About 596,000 tons of sand and gravel was produced, 104,000 tons more than in 1964. Most of the material was used in road construction and maintenance.

**Midland.**—The Dow Chemical Co. produced a variety of chemical products at Midland from well brines, including bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash. The company extracted salt from artificial brines. Kaiser Aluminum & Chemical Corp. produced refractory magnesia from purchased magnesium hydroxide. Sand and gravel for road use and fill was produced near Midland. About 236,000 barrels of petroleum was produced from five fields and 12 million cubic feet of natural gas from the Mount Pleasant field.

**Missaukee.**—Petroleum output, 433,000 barrels, was slightly below that of 1964. Natural gas output decreased to 811 million cubic feet from 1.2 billion cubic feet in 1964. Largest production came from East Norwich, Enterprise, Falmouth, Forward, and McBain fields. A small quantity of road gravel was produced.

**Monroe.**—Portland and masonry cements, as well as clay and limestone, were produced at Dundee by Dundee Cement Co. Limestone was also quarried and crushed at Maybee, Monroe, and Ottawa Lake. It was used for flux, roadstone, railroad ballast, agricultural application, and riprap. Peat, for soil improvement, was dug from bogs near Ida and Petersburg. The Deerfield field yielded 8,000 barrels of petroleum. At South Rockwood, F. W. Ritter Sons Co. mined miscellaneous clay for use in making art pottery, flowerpots, and glazed products.

**Montcalm.**—About 239,000 barrels of petroleum was produced from 12 fields, and 43 million cubic feet of natural gas was produced, mainly from the Edmore

field. Crude oil was refined by Crystal Refining Co. at Carson City. Sand and gravel output totaled 733,000 tons, up from 569,000 tons in 1964. Most of the material was used for road construction and maintenance.

**Muskegon.**—Hooker Chemical Corp. extracted salt from artificial brines at Montague. Union Carbide Corp. produced hydrated lime as a byproduct at their acetylene producing operations. The lime was sold for use as mason's lime, soil stabilization, and sewage and industrial waste treatment.

About 11,000 barrels of petroleum and 6 million cubic feet of natural gas were produced. Crude oil was refined at Muskegon by Marathon Oil Co. and Naph-Sol Refining Co. About 575,000 tons of sand and gravel was produced. Output included considerable quantities of industrial sand, mainly engine and molding sand, as well as materials for building, road use, and fill.

**Newaygo.**—About 274,000 tons of sand and gravel was produced, most of it for road use. About 20,000 barrels of petroleum was produced from four fields. A small amount of natural gas was produced from the Ensley field.

**Oakland.**—The county maintained first place in sand and gravel production, with a total of nearly 8.7 million tons, compared with 8.1 million tons in 1964. The material was used mainly for building and road construction and fill in the Detroit area. Peat was dug from bogs near New Hudson and Novi and sold in bulk form for soil improvement. Gibbs Peat Co., near Clarkston, did not operate in 1965.

A small quantity of petroleum was recovered from the Northville field.

**Oceana.**—About 101,000 barrels of petroleum was produced from eight fields, compared with 170,000 barrels in 1964. The Pentwater, Eldridge, and Stony Lake fields contributed 95 percent of the total. About 730,000 tons of sand and gravel was produced, mostly for building and road use.

**Ogemaw.**—Petroleum production totaled 281,000 barrels and natural gas 553 million cubic feet. The Rose City, West Branch, and Logan fields contributed nearly all of the output. Osceola Refining Co. refined crude oil at West Branch. Most of 222,000

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

**Ontonagon.**—White Pine Copper Co. (subsidiary of Copper Range Co.) operated a mine, mill, and smelter at White Pine. Both copper and silver were produced. The company announced an expansion program to cost \$100 million in the next 6 years. The first phase was to be construction of a second reverberatory furnace with a maximum smelting capacity of 175 million pounds of copper annually. The company continued study of the long-wall mining method which will permit a larger recovery of ore. In addition to the original experimental panel, a second panel is being developed. In September, the company produced its billionth pound of copper. About 140,000 tons of sand and gravel for road use was produced, compared with 398,000 tons in 1964.

**Osceola.**—Petroleum production was 404,000 barrels compared with 265,000 barrels in 1964, while natural gas output totaled 161 million cubic feet compared with 219 million cubic feet in 1964. C. Stanley Hooker discontinued his marl operation near Tustin.

Sand and gravel production reached 553,000 tons compared with 224,000 in 1964. Requirements of the State highway department accounted for the increase.

**Ottawa.**—Sand and gravel output totaled 2.6 million tons, compared with 2.1 million tons in 1964. In addition to building and road materials, some molding and engine sand was produced. Pits near Hudsonville and Jenison yielded small amounts of marl for agricultural use.

Petroleum production declined to 176,000 barrels from 267,000 in 1964, while natural gas output increased to 178 million cubic feet from 170 million.

**Presque Isle.**—Limestone was quarried and crushed at Rogers City by United States Steel Corp., and by Presque Isle Corp. near Presque Isle. The material was shipped by water to steel mills, cement and lime plants, and other industrial consumers. It was also used for concrete aggregate, roadstone, and agricultural application. At Onaway, limestone was quarried and milled, mostly for building use. Sand and gravel production totaled 569,000 tons and was used for building, road construction, and railroad ballast.

**Roscommon.**—About 196,000 barrels of petroleum and 922 million cubic feet of natural gas were produced from the East Norwich, Enterprise, Headquarters, and St. Helen fields. Sand and gravel output totaled 231,000 tons compared with 349,000 tons in 1964. Most of the material was used for road construction and fill.

**Saginaw.**—Clay was mined near Saginaw from the Calvin No. 2 mine by Aetna Portland Cement Co. for its own use. Michigan Sugar Co. produced hydrated lime for use in sugar refining.

About 31,000 barrels of petroleum was produced from five fields, nearly the same quantity as in the previous year. A small amount of road gravel was produced for the State highway department.

**St. Clair.**—Portland and masonry cements were produced at Port Huron by Peerless Cement Co., Division of American Cement Corp. The company produced clay for its own use from a pit at Smiths Creek. Salt was recovered from artificial brines by Morton Salt Co. at Marysville and Diamond Crystal Salt Co. at St. Clair.

A bog near Capac yielded peat which was sold both in bulk and packaged form for soil improvement. About 371,000 tons of sand and gravel was produced for building, paving use, and fill. Petroleum production totaled 808,000 barrels and natural gas output totaled 12.4 billion cubic feet. Gas production was the largest of any county in the State.

**St. Joseph.**—Marl and peat, for soil enrichment, were dug from pits and a bog in the Three Rivers area and near Nottawa.

Sand and gravel production of 326,000 tons was 79,000 tons larger than in 1964. Output was mostly from pits in the Three Rivers and White Pigeon areas. The material was used for building and road construction, fill, and other purposes.

**Sanilac.**—Peat bogs near Minden City and Sandusky yielded moss and reed-sedge peat for horticultural use and soil improvement. The material was sold both in bulk and packaged form. Michigan Sugar Co. produced hydrated lime at Crosswell for use in sugar refining. About 645,000 tons of sand and gravel was produced for building and paving use and fill.

**Schoolcraft.**—At Port Inland, the Inland Lime & Stone Co., Division of Inland Steel Co. maintained a crushing and processing

plant as well as port facilities to handle the output of its large limestone quarry in adjoining Mackinac County. The Port Inland complex has processed and handled more than 100 million tons of limestone since operations began. The county road commission produced 5,000 tons of sand for its own use.

**Shiawassee.**—Clay was mined at Corunna for manufacturing vitrified sewer pipe. Peat was dug from a bog near Ovid and sold in bulk and packaged form for soil improvement. Sand and gravel production totaled 684,000 tons, compared with 720,000 in 1964. It was sold for railroad ballast and fill, as well as for building and paving use.

**Tuscola.**—Sand and gravel production reached nearly 1.5 million tons, compared with 1.9 million tons in 1964. Some of the large suppliers of road materials did not operate in the county in 1965. In addition to materials for building and road use, a considerable quantity of molding sand was produced. Michigan Sugar Co. produced hydrated lime at Caro for its own use. Moss peat was produced and sold in both bulk and packaged form for general soil improvement. About 74,000 barrels of petroleum was produced from four fields.

**Van Buren.**—Molding and engine sand was produced at South Haven. Road gravel was produced at several sites with portable plants. The Lime Lake pit near Paw Paw yielded marl for agricultural use. Four fields yielded 15,000 barrels of petroleum.

**Washtenaw.**—About 1.6 million tons of sand and gravel was produced, up from 921,000 tons in 1964. The increase was largely in building and road materials. About 28,000 barrels of petroleum and 191 million cubic feet of natural gas were produced from the Northville and Lyndon fields.

**Wayne.**—The county dropped to fifth place in value of mineral production from

third place in 1964. Output of several commodities was affected in the long labor strike at Wyandotte Chemicals Corp. Sand and gravel output totaled 4,367,000 tons, compared with 4,324,000 tons in 1964. Building and road materials as well as industrial sand were produced. Salt was mined in Detroit by International Salt Co., Inc., and recovered from artificial brines at Wyandotte by Pennsalt Chemicals Corp. and Wyandotte Chemicals Corp.

Portland and masonry cements were produced by Peerless Cement Co., Division of American Cement Corp., at two plants in Detroit. The company mined clay for cement from a pit in Allen Park. Wyandotte Chemicals Corp. produced portland cement at Wyandotte.

Flat Rock Clay Products Co. mined clay at Flat Rock for use in making drain tile, and Light Weight Aggregate Corp. mined clay at Livonia for its own use. Quicklime was produced in Detroit by Solvay Process Division of Allied Chemical Corp., at River Rouge by Detroit Lime Co. (subsidiary of Edward C. Levy Co.) and at Wyandotte by Wyandotte Chemicals Corp. The Marblehead Lime Co. plant under construction in the River Rouge area was scheduled for production early in 1966.

Calcium chloride was produced by Wyandotte Chemicals Corp. at Wyandotte for its own use and for sale.

United States Gypsum Co. operated a calcining and board plant at Detroit. The crude ore was shipped down lake from the company quarries and port in Alabaster, Iosco County. The company also expanded perlite at the Detroit plant. Zonolite Division, W. R. Grace & Co., exfoliated vermiculite at a plant in Dearborn. Marathon Oil Co. recovered byproduct sulfur from crude oil, using the Parsons process, at its Detroit refinery. Socony Mobil Oil Co. refined crude oil at Trenton.

About 21,000 barrels of petroleum and 708 million cubic feet of natural gas was recovered from the Northville field.

# PLATES

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Photographs of several mineral operations  
taken during 1966

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Photo 1—Michigan's largest diameter cement kiln being installed at new 4-million barrel plant of Medusa Portland Cement Company at Charlevoix.



Photo 4—Latest quarry opened up by the Michigan Gypsum Company in 1965 at their plant north of Turner in Iosco County.



Photo 2—New quarry opening at Medusa's Charlevoix operation. Deep hole in foreground will house primary crusher. The undulating bedding is typical of the Traverse Limestone in northern Michigan.



Photo 5—New lime plant of the Detroit Lime Company featuring a 600 ton per day vertical kiln claimed to be the largest of its kind in the world.

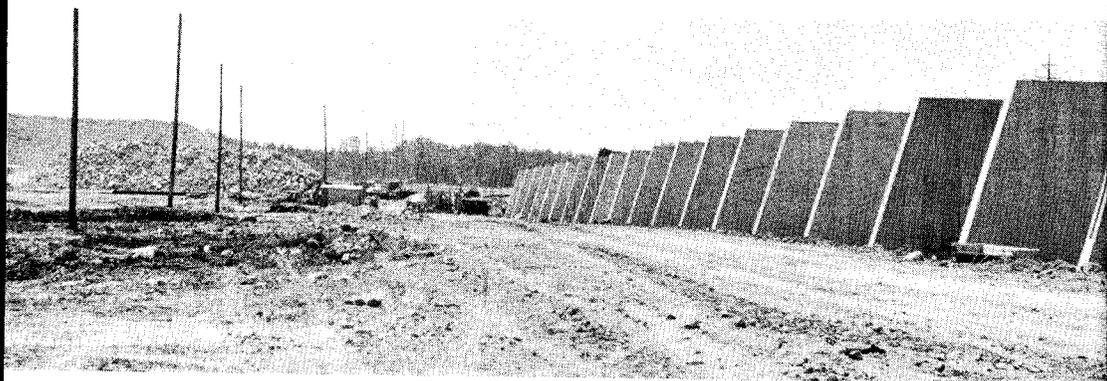


Photo 3—Quarried rock will be stored in bunkers to be erected in these foundations at the Charlevoix site.

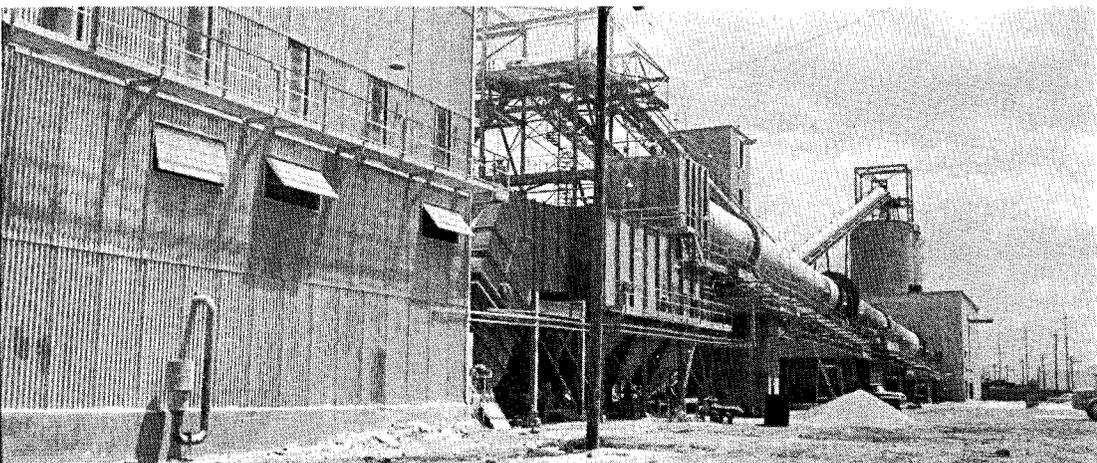


Photo 6—New twin-rotary lime kiln, Marblehead Lime Company, River Rouge. Most of the product of this new operation goes to the steel and chemical industries in the Detroit region.

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