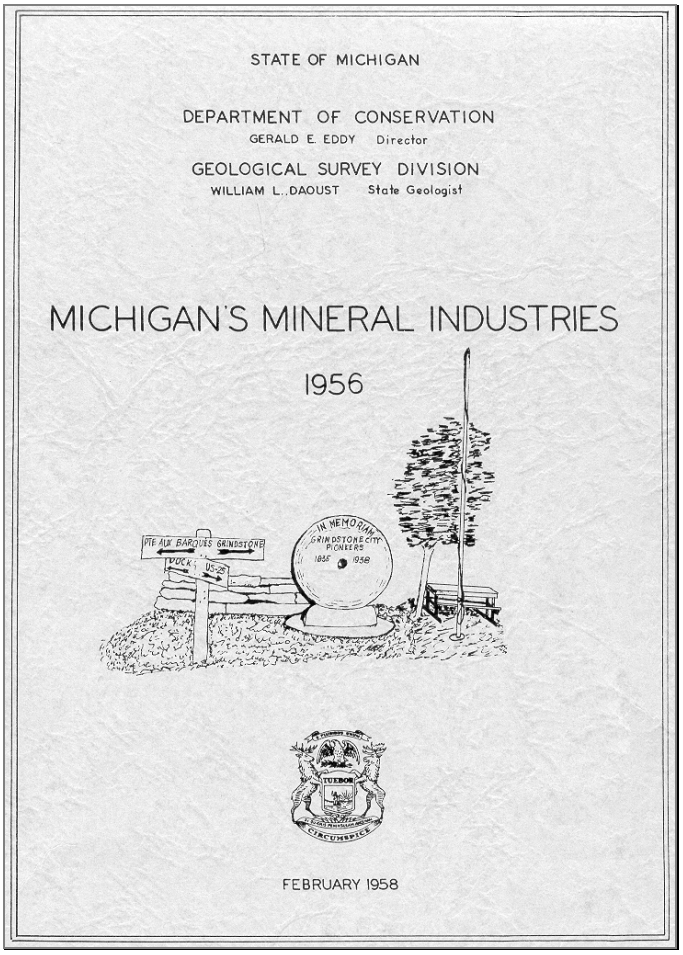

MICHIGAN MINERAL INDUSTRIES
1956

by

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FOREWORD

This report is a record of Michigan Mineral Industries for the calendar year 1956 compiled from statistical reports and information filed by the mineral producers of the state and in cooperation with the Bureau of Mines.

The estimated value of mineral production for 1957 was submitted by the United States Bureau of Mines on December 20, 1957. The section on developments in the mineral industries was prepared from office and field conferences with mineral producers, and from articles published in Pit and Quarry, Rock Products, Mining Journal, and other trade journals.

LATE DEVELOPMENTS IN MICHIGAN'S MINERAL INDUSTRIES

Since the close of 1956 a number of noteworthy events have been recorded in activities of Michigan's mineral industries. In mid-September, 1957, Calumet and Hecla decided, to reduce production of copper by suspending operation of some high cost mines. However, the company planned to absorb as many of the displaced employees as possible by increasing production of its higher grade properties. Although development work continued, about 500 men were laid off.

United States Metal Refining Company are operating six diamond drills in exploration of a large tract north of Wakefield, between the Gogebic Iron Range and the south shore of Lake Superior. The acreage is underlain by large potentially valuable copper-bearing formations.

Harry Hardenberg, Mining Geologist for the Geological Survey Division, estimated the 1957 iron ore reserve to be 154,208,852 tons a value of $93,815.000. This compares to 152,259,276 tons in 1956 valued at $90,716,500. Marquette Range has the largest

reserves, 64,463,706 tons; the Menominee Range has 1,000,000 — tons less than Marquette. The Gogebic Range has 26,209,049 tons and is the only range that showed a decline from 1956 estimate. The White Pine Copper Company valued at $11,000,000 was the largest Michigan copper property.

Cleveland Cliffs Iron Company's Mather mine on the Marquette Range constructed a tunnel under the large mine rescue training room at “B" shaft which is used for training mining rescue squads. The tunnel can be filled with smoke closely simulating conditions in an actual mine fire. The men receiving the training enter with oxygen apparatus and are taught such things as building a brattice from planks and poles placed near the mouth of the tunnel. (A brattice is a partition or wall used to prevent air circulation and thus smother a fire) The men receive best possible preparation for the hazardous job of fighting a real underground fire. During 1956 Cleveland-Cliffs moved-in a diamond drill one mile north of Cooks, a small town in eastern Delta County near the west line of the Schoolcraft County, less than ten miles from Lake Michigan. The company considers the drilling ”a wildcat exploration” as it is not near either the Menominee or Marquette range.

M. A. Hanna Company's new circular shaft is being sunk at a rate of about 8 feet (of completed shaft) per day as its project in the Mineral Hill area, Iron County, Michigan. The company is also erecting a new surface plant. Both projects are to save the Homer and Wauseca underground iron mines, by replacing existing facilities which will become inadequate as mining goes deeper. The new shaft will be 2,000 feet deep and will be ready for production in 1960.

Dannes Temple, a spokesman for the St. Lawrence Cement Company of Clarkston, Ontario, announced that a new multimillion-dollar cement plant is to be built near Dundee, Monroe County. St. Lawrence Cement Company is controlled by Holderbank Finance SA., a Swiss cement manufacturing group. It is reported that a 2000-acre site has been acquired by Senned Realties Corporation, a Delaware organisation in which the St. Lawrence firm has an interest. St Lawrence plans to ship a large part of the cement for the construction of the plant from its plants in Villeneuve, Quebec, and Clarkston, Ontario.

The Huron Portland Cement Company celebrated its Golden Anniversary during 1957. It was founded on January 29, 1907, in Detroit and now operates the largest single cement mill in the world at Alpena. In 1956, 24 kilns produced more than 25,000 barrels of cement a day at the Alpena Mill. Output was increased during 1957 when two large new kilns 5 equipped with preheaters, were put into production. In 1915 Huron instituted a method of shipping cement in bulk from its main plant at Alpena to its processing and distribution plants throughout the Great Lakes region. Today Huron ships its production from Alpena, in its own fleet of six vessels to Detroit, Duluth, Cleveland, Buffalo, Toledo, Saginaw, Oswego, Muskegon, Milwaukee, Green Bay, and Superior. A new storage plant on the St. Joseph River near Benton Harbor, Berrien County, is under construction. Desiring to have its own source of limestone Huron has bought the Wyandotte Chemical Corporations mile-wide limestone quarry at Alpena, which has supplied Huron for 50 years. The sale did not include ownership of the limestones-carrying fleet of Wyandotte Transportation Company, a subsidiary of the chemical firm.

Garner A. Beckitt, president of the Riverside Cement Company, San Francisco, California., announced late in 1957 that negotiations are underway for a merger of the Riverside Cement Company, the Hercules Cement Corporations Philadelphia, Pa., and the Peerless Cement Corporation, Detroit. The total annual capacity of the merged company will be approximately 18,500,000 bbl., making it one of the largest cement firms in the country. Under the plans, the combined company will have a new name. Properties and businesses now owned by the three corporations will operate as autonomous divisions of the combined company, but present brands and product names will not be changed.

An 11-week strike closed Penn-Dixie Cement plant at Petoskey, from mid-May to the end of July. Loss in production should reflect on 1957 cement output of The Michigan Portland cement industry.

U. S. Bureau of Mines reported that in 1956 the production of Portland cement for the nation was 6 percent greater than in 1955, reaching a high of 316,000,000 bbls. Shipments of Portland cement rose to 308,678,000 bbls., valued at $940,000,000, an average value of $3.05 per barrel.

Renaming ceremonies for two self-unloading vessels of the Bradley Transportation Line, operated by the Michigan Limestone Division of the United States Steel Corporation took place during the spring of 1957. The B. H. Taylor was rechristened the Rogers City in honor of the “Limestone Capitol of the World", and the A. F. Harvey became the Cedarville, in honor of the division's newest dolomite quarry.

The long abandoned Woolmith quarry, located about one mile northeast of Maybee, Monroe County, was dewatered late in 1956. Quarrying commenced the following year by Kramer and Sons to supply stone for Borin Aggregates of Detroit.

National Gypsum Company is proceeding with developments of its Tawas City gypsum quarry, anticipating production in the spring of 1958. Gyp-rock will be produced by open pit method. A year’s supply of rock will stockpiled at National City, and the remainder shipped to new plants in Ohio and Illinois.

The first two pipe lines used to transport brine between two countries were laid in November of 1957 from Canadian Brine, Ltd., just north of Ojibway, Ontario, to The Solvay Process Division plant on Zug Island, Wayne County. The twin 10-inch heavy iron pipes, 20 feet apart

and each a mile in length, will deliver brine amounting to a million tons of dry salt annually.

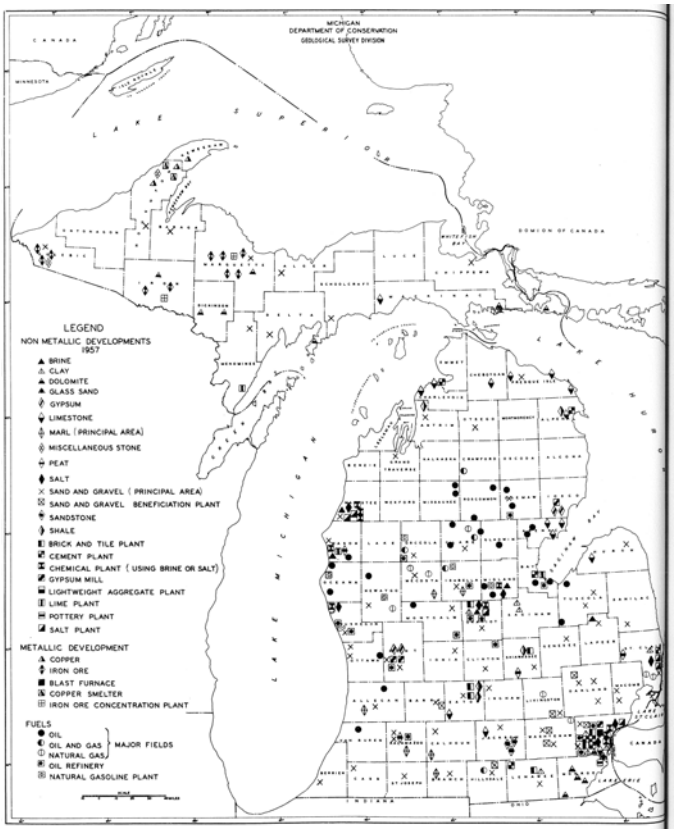
International Salt Company, Inc., Scranton, Pa. (owner and operator of the salt mine under Detroit) has been granted a 50-year lease by the state of Ohio for a $7,500,000 salt mine project under the water of Lake Erie. The company will sink a 2000-foot shaft on Whiskey Island where the company has purchased 16 acres and will tunnel from the bottom of the shaft to the salt deposit.

Michigan Chemical Industry, our sixth largest employer, provides jobs for nearly 40,000 persons, and continues to expand and to turn out innumerable varieties of chemical goods. Dow Chemical Company of Midland which employs 10,500 persons plans to build within the next two years a two-million dollar catalyst plant at Ludington, a petro-chemical plant in Bay City, and a half mile long new headquarters at Midland, Michigan Chemical Company plans a $21/2 million expansion, Parke Davis Company of Detroit is planning a new research unit at Ann Arbor and the Upjohn Company, of Kalamazoo, recently expanded operations in the state. The Ott Chemical Company is constructing a $300,000 unit in Dalton Township to produce intermediate chemicals. The American Agricultural Chemical Company of New York opened plants at Bay City and Kalamazoo. The American Nitrogen Corporation built in Traverse City, and Cowles Chemical Company of Cleveland acquired a site for a new plant near Monroe, Monroe County. Wyandotte Chemical Corporation scheduled an oxide products plant in Wyandotte for completion in 1957. The plant will process polyethers which are said to improve life and lower manufacturing costs of items using polyurethane foam plastic.

American Aggregates Corporation, at its Green Oaks, Livingston County plant, largest gravel operation, uses 20-inch diameter steel pipe to carry material from the large dredges to the desanding tables. The rate is 1,000 tons of gravel per hour. Annual production capacity of the plant exceeds 2,500,000 tons.

Six commercial sand and gravel plants employing heavy media separation and one plant using a new process "elastic fractionation" based on difference in elastic nodule of sound hard stone and the deleterious soft and absorbent stones, have now been established in Michigan in pits and deposits that were considered incapable of producing quality gravel suitable for specified highway concrete. These concerns are: American Aggregate Corp., Green Oaks, Livingston County; Bundy Hill Gravel Company, Somerset Center, Hillsdale County; Harry Pickett, Northville, Wayne County; Killians Gravel Company, Ann Arbor, Washtenaw County; Groverland Gravel Company, near Davisburg, Oakland County; Nashville Gravel Company, Nashville, Barry County; and Whittaker and Gooding Gravel Company ("elastic fractionation process"), near Dexter, Washtenaw County.

[Map Showing Locations of Rock and Mineral Developments and Mineral Industries]



MICHIGAN MINERAL PRODUCTION 1956

To appreciate Michigan's mineral resources it is necessary to have some knowledge of the geology of the State.

In Michigan rocks of the Precambrian, Paleozoic, and Cenozoic eras are found. No deposits of the Mesozoic are in the state. The Cenozoic era is represented only by deposits of the Pleistocene and recent epochs.

The Precambrian rocks are chiefly igneous and metamorphic although some sedimentary rocks are represented. These rocks are near or at the surface in the western part, of the Northern Peninsula.

The Paleozoic rocks of Michigan are sedimentary - sandstones, shales, limestones and dolomites, gypsum and salt. Paleozoic rocks are in the central part of the Southern Peninsula, and are flanked in circular fashion by older Paleozoic rocks, the oldest, the Cambrian, comes to the surface in the Northern Peninsula.

The youngest deposits, the Pleistocene, are known as glacial drift - gravels, sands, clays, and till, that cover the entire state. During 1956 Michigan's mineral production increased 9.5 percent over 1955 to an all time high. New production highs were established for bromine,

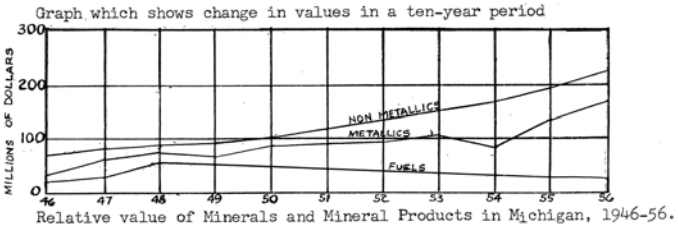
cement, sand and gravel, salt, clay and shale, magnesium compounds, and calcium-magnesium chloride. Non-metallic mineral production increased 13 percent and metallic mineral production increased 8 percent. The production of fuel, however, declined 3 percent.

In volume of mineral production in 1956 in the United States Michigan ranks: First in gypsum, salt, and marl; Second in iron ore, bromine, magnesium compounds, sand and gravel and stone; Third in peat; Fourth in Portland cement; Sixth in copper.

The following table gives the value of-Michigan mineral production in 1956:

	Value	Percent
Non-Metallics	$ 216,806,204	53.3
Metallics	157,219,225	38.7
Fuels	32,537,804	8.0
Total	$ 406,563,233	100.0

[Graph: Relative value of Minerals and Mineral Products in Michigan 1946-1956]



Relative value of Minerals and Mineral Products in Michigan, 1946-56.

METALLIC MINERALS

Iron Ore

Geological formation - Huronian. Iron production is principally from four counties - Dickinson, Gogebic, Iron, and Marquette. The most important iron-bearing zone is in the middle Huronian.

Shipments of iron ore, from 29 underground mines and 10 open pits totaled 12,536,302 long tons (2,240 lbs.) in 1956, a decrease of 11.4 percent from 1955. Work stoppages caused by steel and shipping strikes resulted in the decreased production. However, iron ore held top position in value of minerals produced.

Iron Ore Shipments by Ranges, 1956

	Number of Mines		Iron Ore Shipped (Long Tons)		
Range	Underground	Open Pit	Direct Shipping	Siliceous	Total
Marquette	11	6	5,394,774	294,239	5,689,013
Menominee	12	3	3,782,566	106,647	3,899,213
Gogebic	6	1	2,958,076	. . .	2,958,076
Total	29	10	12,135,416	400,886	12,536,302

The Republic Mine began commercial operation early in 1956. This mine is the second and largest low grade iron ore operation utilizing Michigan “Jasper Ore”. The mine is owned by the Marquette Iron Company, a union of the Cleveland-Cliffs Iron Company (which operates the property), Inland Steel Company, International Harvester Company, Jones and Laughlin Steel Corporation and the Wheeling Steel Corporation. Geared to an output of 550,000 tons per year, the Republic set-up follows the Humboldt Mine in this new activity in Northern Michigan iron ranges.

Working three shifts on a five-day week, the open pit operation supplies the mill with from 3,500 to 45,000 tons per day of 30 percent Jasper. Two tons of crude yields one ton of concentrate, 63 percent iron and 8 percent silica.

Republic features froth flotation treatment using an oil reagent from forest industries. Two units have 59 flotation cells.

The pelletizing plant located at Eagle Mills y also features new techniques: four Flying Saucer agglomerating discs and an updraft traveling grate that can turn out 2,000 tons of pellets per day. First shipments, about 4,500 tons of pellets were made by boat to the International Harvester Steel Plant at Chicago on October 3, 1956.

M. A. Hanna Company announced plans to sink a 26-foot diameter, concrete circular shaft to a depth of 2,000 feet on what is known as the Minckler farm property, at Mineral Hill on the Menominee Range, Iron County. A large surface plant including offices, change house, and shops will be constructed at the shaft. This project will not open a new property but is to be a joint plant to serve the Homer and Wauseca mines.

The Richmond mine, of the M. A. Hanna Company, located near Palmer, was closed permanently April 9, 1956. The Richmond Iron Company was incorporated in 1898 and operated the old Richmond mine until 1927 when a nearby property was opened and operated as the New Richmond until its abandonment.

Lake Superior and Ishpeming Railroad Company announced that they will construct an iron ore loading facility on Little Bay de Noc on Lake Michigan in the vicinity of Rapid River. The decision to establish this facility was largely due to the demand for iron ore at Chicago and the development and pelletization of low grade ores. The new dock will be a belt conveyor type to speed loading of boats and to minimize breakage in handling iron ore pellets.

Shipments and Value of Iron Ore, 1952-1956

Year	Shipments (Long Tons)	Value
1952	11,798,250	$ 83,942,523
1953	13,380,756	91,402,764
1954	9,722,882	69,226,417
1955	14,148,123	107,890,161
1956	12,536,302	105,688,087

Copper

Geological formation - Keweenawan. The production of copper in Michigan is entirely from rocks classified as Keweenawan. Copper is at many horizons throughout the Keweenawan series which extends from the Northern Peninsula south and westward into Wisconsin.

Production records begin in 1845, however, copper was mined at or near the surface prior to that time. Charred wood unearthed during an archaeological expedition to Isle Royale in Lake Superior was dated by radio-active

carbon 14 method in a University of Michigan laboratory. According to Dr. R. W. Drier, Professor of Metallurgical Engineering at Michigan College of Mining and Technology, evidence found indicated mining pits were opened on the island as early as 2000 B.C. The ancient miners heated copper-bearing rocks with fire, then poured water on the rocks to split them.

Michigan produced 123,280,235 pounds of copper during 1956, an increase of 23 percent in production and 37 percent in value over 1955. Thirteen copper mines in Houghton, Keweenaw, and Ontonagon counties produced approximately 93 percent of the total copper output. The remaining 7 percent was recovered by three reclamation plants in Houghton County from tailings or waste rejected by earlier mill operations. The 1956 copper production in Michigan was the largest since 1930 when 169,297,775 pounds were produced. The year of peak production was 1916 when 269,794,531 pounds were produced. The average price used in calculating the value of copper in 1956 was 41.8 cents per pound.

Number 13 shaft of the Calumet and Hecla, Inc., Osceola lode in the Keweenaw Peninsula was completely unwatered. Mining started on the lower levels and a substantial rate of production was in progress. Unwatering of the Number 6 shaft was completed late in 1956 and mining of copper was expected to begin about mid-1957.

The White Pine Copper Company authorized the purchase of two long conveyor systems to replace the long underground truck haulage. When the conveyor system is installed the trucks will carry the ore from the headings to the conveyors which in turn will deliver the ore to the underground crusher and to the surface.

Copper Production, 1956

County	Mines	Reclamation	Copper Production (Pounds) Mines	Reclamation	Total
Houghton	5	3	12,374,918	9,024,928	$ 21,399,846
Keweenaw	6	0	25,267,891		25,267,891
Ontonagon	2	0	76,612,498		76,612,498
Total	13	3	114,255,307	9,024,928	$ 123,280,235

Copper Production, 1952-1956

Year	Quantity (Pounds)	Value
1952	43,939,304	$ 10,820,054
1953	47,999,690	13,832,951
1954	44,786,803	13,298,994
1955	99,996,160	37,489,560
1956	123,280,235	51,531,138

FUELS

Petroleum

Geological formation - Marshall, Berea, Traverse, Dundee, Detroit River, Salina-Niagaran, Trenton. Petroleum production in Michigan is chiefly from Devonian rocks, however, some production is from Mississippian, Silurian, and Ordovician rocks.

Petroleum production in Michigan in 1956 decreased 5 percent in quantity and 5 percent in value below 1955. At the end of 1956, 4,191 producing wells were in 40 counties. Approximately 32 percent of the total output was from Arenac, Isabella, and Clare counties. More than a million barrels were produced in each county.

During the year 463 wells were completed (196 oil producers, 12 gas producers, 22? dry holes). Of these completions 165 were wildcats (12 oil producers, 1 gas producer, and 152 dry holes). The remaining 270 completions were field wells (184 oil producers, 11 gas producers, and 75 dry holes).

Fifteen refineries, in ten counties, processed more than 99 percent of the crude oil produced in Michigan during 1956. Michigan crude supplies nearly one third of the oil refined in the state. The combined normal daily capacity of all Michigan refineries is approximately 165,000 barrels.

Detailed information for oil and gas operations is recorded in the pamphlet “1956 Summary of Operation, Oil and Gas Fields", available from Michigan Geological Survey.

Petroleum Production and Accumulated Oil by Formation, 1956

Formation	Production (Barrels)	Per Cent	Accumulated (Barrels)	Per Cent
Marshall	1,678	.02	59,142	.01
Berea	24,356	.23	2,076,630	.52
Traverse	1,971,416	18.35	81,447,462	20.58
Dundee	5,638,662	52.50	288,264,025	72.82
Detroit River	2,993,221	27.87	23,016,730	5.82
Salina-Niagaran	8,207	.08	62,556	.01
Trenton	102,157	.95	943,893	.24
Total	10,739,697	100.00	395,870,446	100.00

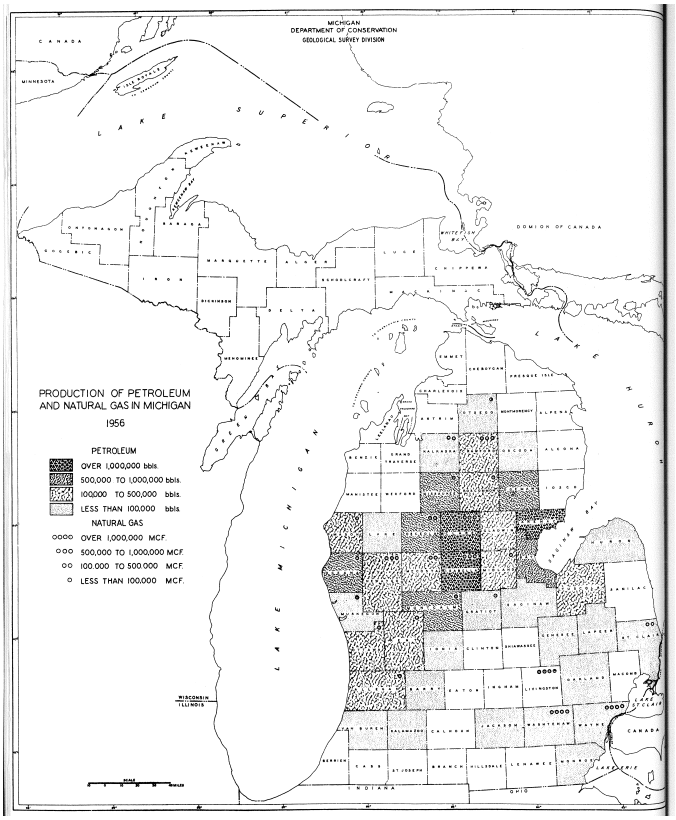
Petroleum and Natural Gas Production, 1952-1956

Year	Petroleum Barrels	Petroleum Value	Natural Gas M. cu. ft.	Natural Gas Value
1952	13,251,387	$ 36,176,306	8,677,737	$ 1,353,727
1953	12,284,510	35,644,982	7,089,985	1,246,106
1954	12,028,059	34,279,968	5,698,175	997,180
1955	11,265,832	32,074,018	6,787,697	1,187,846
1956	10,739,697	30,607,137	8,840,933	1,556,575

Natural Gas

Geological formation - Glacial drift, Michigan Stray-Marshall, Berea, Antrim, Traverse, Dundee, Detroit River, Richfield, Salina-Niagara, Trenton. Natural gas production increased 30 percent to 8,840,933,000 cubic feet in 1955. Of this amount 1.97 billion cubic feet was oil well gas. Natural gas was produced from 310 wells in 23 counties, Washtenaw, Wayne, and Livingston counties led with 50 percent of the state total.

[Map: Production of Petroleum & Natural Gas in Michigan]



Gas Production and Accumulated Gas by Formations - 1956

Formations	Production (M. cu. ft.)	Per Cent	Accumulated (M. cu. ft.)	Per Cent
Glacial Drift			8,020	.00
Michigan Stray)				
Marshall)	1,987,501	19.09	207,244,397	66.75
Berea	54,445	.64	10,234,100	3.30
Antrim	11,084	.13	127,494	.04
Traverse	13,376	.16	7,057,393	2.28
Dundee	451,343	5.33	38,599,555	12.45
Detroit River	202,188	2.39	737,999	.24
Richfield	1,323,335	15.62	10,011,179	3.23
Salina-Niagaran	2,713,634	32.04	22,848,937	7.37
Trenton	2,084,027	24.60	3,150,808	1.02
Unassigned			10,287,581	3.32
Total	8,840,933	100.00	310,307,463	100.00

Natural Gasoline

Michigan in 1956, produced a total of 3,740,916 gallons of natural gasoline and allied products valued at $374,092 from oil well gas, Crawford County, with 76 percent of the state total, ranked first among the six producing counties.

Natural Gasoline Production, 1952-1956

Year	Quantity(Gallons)	Value
1952	5,330,139	$ 533,014
1953	4,414,351	441,438
1954	3,898,312	389,831
1955	3,612,912	361,291
1956	3,740,916	374,092

NON-METALLIC MINERALS

Portland Cement

Portland cement is a chemical combination of lime, silica, alumina, iron oxide, and small amounts of other ingredients to which gypsum is added to regulate the set. Chief raw materials used in cement manufacturing in Michigan are limestone, shale, and clay. These raw materials are obtained from the Paleozoic limestones and shales and Pleistocene clays.

Portland cement was produced by eight cement plants in the state. Antrim shale from Alpena County and Ellsworth shale from Antrim County were used by the northern plants. All southern plants use local glacial or lake clays. The greater part of the limestone used was from the Traverse and Dundee formations quarried in the northern part of the Southern Peninsula. All gypsum was purchased as no cement company, owns gypsum deposits.

Raw Material Used in the Manufacture of Portland Cement, 1956

Raw Material	Short Tons
Limestone	5,436,431
Clay and shale	1,560,627
Gypsum	146,759

Shipments and value of Portland cement increased for the twelfth consecutive year. Nearly all plants operated at or near capacity during the year. Alpena County continued to be the leading producer; Wayne County ranked second. Portland cement was produced also in Bay, Emmet, Lenawee, and St. Clair counties.

The Huron Portland Cement Company, operating the largest plant of its kind in the world, expanded its facilities at Alpena to the extent that it can produce 10,000,000 barrels of Portland cement and masonry cement annually and furnish employment to more than 1,100 men. The company purchased Sportsman's Dock at Benton Harbor, Berrien County, as the site of a storage and handling plant. The site, on the St. Joseph River, is near the Chesapeake and Ohio Railroad right-of-way.

The new Peerless Cement Corporation cement plant in Detroit was completed and produced at the rate of 1,250,000 barrels annually. This output, added to the former 5,000,000 barrels volume of Peerless cement, gives the company nearly 30 percent of the state's total cement production. One of the most important features of the new plant is the 450-foot rotary kilns largest in the state. Automation of many processes permits a crew of only 70 workers to handle operation of 3 shifts, 7 days a week.

Portland Cement Shipments, 1952-1956

Year	Shipments (Barrels)	Value	Rank in U.S.	No. of Plants
1952	14,760,783	$ 36,819,041	5	7
1953	15,853,096	41,860,464	5	7
1954	18,106,975	50,460,566	5	7
1955	19,738,400	58,048,378	4	7
1956	21,880,222	67,798,262	4	8

Stone

Geological formation - Marshall, Traverse, Dundee-Rogers City, Detroit River, Bass Island, Engadine, Burnt Bluff, Keweenawan, Huronian.

The Precambrian and Paleozoic rocks of the state contain limestone and dolomite, however, the Paleozoic formations are much more important as a source of stone. Limestone and dolomite made up over 99

percent of Michigan stone production. Approximately 61 percent of the stone was quarried from the Rogers City Dundee, and Traverse limestone in Presque Isle, Cheboygan, Alpena, and Wayne Counties. The remaining 39 percent was from the Niagaran limestone and dolomites in Mackinac and Chippewa counties, the Bass Island and Detroit River dolomites in Monroe County, and the Bayport limestone from Huron, Eaton, Jackson and Arenac counties. Dimensional limestone was produced in Eaton, Huron, and Presque Isle counties.

Sandstone for rough construction, rubble, and flaggine stone was quarried from the Marshall sandstone of Mississippian age in Jackson and Calhoun counties.

Basalt from Precambrian rocks was crushed and used for road construction in Houghton and Gogebic counties.

Stone Production, 1956

Commodity	Quantity (Short tons)	Value
Limestone and dolomite:		
Crushed	24,586,940*	$ 23,832,728
Dimensional	33,117	110,159
Sandstone:		
Dimensional	10,930	91,360
Basalt:		
Crushed	71,500	101,750
Total	24,702,487	$ 24,135,997

*Does not include 9.2 million tons of limestone used in the manufacture of Portland cement and lime.

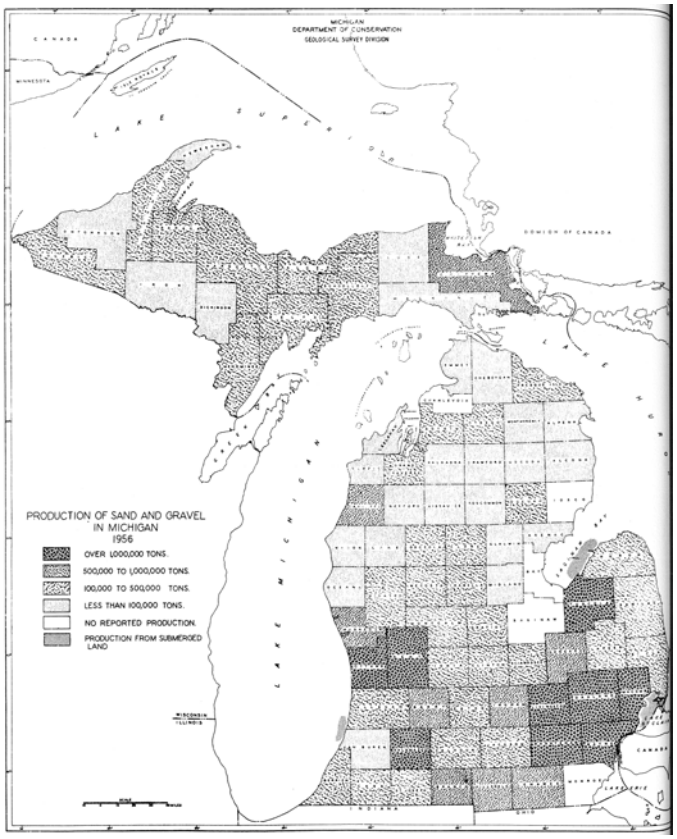
Uses of Crushed Limestone and Dolomite, 1956

Uses	Per Cent of total	Quantity (short tons)	Value
Flux	57.1	14,039,485	$ 12,865,578
Concrete & Road metal	22.2	5,442,797	5,923,492
Chemical*	17.1	4,206,961	3,909,681
Agricultural	2.2	538,439	657,919
Railroad ballast	.8	204,210	241,157
Other**	.6	155,048	234,901
Total	100.0	24,586,940	$ 23,832,728

*Includes alkali, calcium-carbide, sugar, glass and paper.
**Includes paint filler, putty filler, asphalt, dust for coal mines, mineral food, store sand, and others.

Work was in progress on a multi-million dollar crushing plant at the Wyandotte Chemical Corporation, Alpena Quarry site. Wyandotte limestone was used in the manufacture of Portland cement at the adjacent Huron Portland Cement Corporation plant and for the production of alkali at the company's Wyandotte, Wayne County plant.

[Map: Production of Sand and Gravel in Michigan 1956]



Production of Stone, 1952-1956

Year	Quantity (short tons)	Value	Rank in U.S.
1952	18,001,080	$ 15,590,573	4
1953	21,053,866	17,442,250	3
1954	19,461,818	17,526,743	3
1955	25,312,294	23,361,852	3
1956*	33,926,000	30,951,782	2

*Includes limestone used in the manufacture of cement and lime.

Sand and Gravel

Geological formation - Glacial Drift, Sylvania. Sand and gravel are obtained from glacial deposits - kames, eskers, outwash plains, delta of glacial streams, beach ridges, glacial drainage channels, beds of former glacial lakes and in less concentrated deposits in the glacial drift; from present-day beaches, river channels,, and lakes; or from sand dunes. Sand is also obtained from the Lower Devonian Sylvania sandstone, a very pure quartz sand very loosely cemented, with grains of uniform fineness.

Uses of Sand and Gravel, 1956

Uses	Quantity (short tons)	Value	Per cent of total
Structural sand	6,147,165	$ 4,711,015	14.6
Paving and road sand	5,967,383	4,354,606	14.2
Molding sand	1,753,195	1,875,766	4.2
Grinding and polishing sand	243,082	85,078	.6
Other sand*	935,066	1,393,254	2.2
Paving and road gravel	21,287,457	16,874,824	50.5
Structural gravel	5,227,460	5,393,908	12.3
Railroad ballast gravel	233,721	226,509	.6
Other gravel	355,417	230,993	.8
Total	42,149,946	$ 35,145,953	100.0

*Includes glass sand, engine sand, filter sand, railroad ballast sand, and other sand.

Production and use of sand and gravel reached a new high in 1956. Quantity increased 14 percent and value 19 percent, or 42,149,946 tons value at $35,145,953.

Sixty-five percent of the total sand and gravel output was used in road construction and 23 percent for structural purposes.

Production of sand and gravel was reported from 78 counties of Michigan. Approximately 59 percent of the total production was from nine counties in order of rank: Oakland, Livingston, Ottawa, Kent, Washtenaw, Wayne, Macomb, Tuscola, and Kalamazoo. About 47 percent of the state total was produced in Oakland County. Each of the other counties produced more than 1,000,000 tons. About 84 percent of the state's total was reported by commercial producers and the remaining 16 percent was noncommercial production by county road commissions and other governmental agencies.

Production of Sand and Gravel, 1952-1956

Year	Quantity (short tons)	Value	Rank in U.S.
1952	27,126,339	$ 21,050,125	2
1953	30,459,663	23,170,802	2
1954	32,035,729	25,458,503	2
1955	37,269,709	29,565,730	2
1956	42,149,946	35,145,953	2

Five commercial sand and gravel plants ranging in capacity from 100 to 300 tons per hour and employing heavy-media separation operated in the state at pits formerly considered incapable of producing premium-quality gravel suitable for specified highway concrete. These concerns are: American Aggregate Corp., Green Oaks, Livingston County; Bunday Hill Gravel Company, Somerset Center, Hillsdale County; Harry Pickitt, Northville, Wayne County; Killians Gravel Company, Ann Arbor, Washtenaw County; and Groveland Gravel Company, New Davisburg, Oakland County.

Salt

Geological formation - Marshall, Dundee, Detroit River, Salina.

Almost the entire Southern Peninsula of Michigan is underlain by great thicknesses of rock salt - one of the largest basins of salt deposition in the world. Artificial brines produced by dissolving salt from the Salina formation are recovered by six plants in Muskegon, St. Clair, and Wayne counties for production of evaporated salt and for use in chemical plants. Salina rock salt mined at Detroit is reached by a shaft approximately 19100 feet in depth. Evaporated salt is produced from natural brines drawn from the Marshall and Dundee formations at St. Louis, Gratiot County, and from artificial brines from the Detroit River formation at Manistee, Manistee County. Artificial brines from the Detroit River formation are used at the chemical plant in Midland, Midland County.

Approximately 63 percent of the salt was used by chemical plants in Wayne, Midland and Muskegon counties. Over 1.9 million tons of salt were used in soda ash plants, and 1.5 million tons were used for the manufacture of chlorine and other chemicals.

Approximately 15 percent of the total production was dried and evaporated salt.

Uses of Salt, 1956

Uses	Quantity (short tons)
Chemical	3,733,500
Highway, Dust and ice control	798,600
Livestock	223,500
Textile, hides, and packers	203,500
Food processing	200,600
Table and other household	161,100
Metallurgy	54,800
Water treatment	44,800
Refrigeration	2,200
Other	125,600
Total	5,548,200

The 1956 production and value of salt reached an all-time high - 5,548,178 short tons valued at $35,643,860 was due primarily to use of a larger quantity of brine by chemical plants, Wayne ranked first of the six counties producing salt - Gratiot, Manistee, Muskegon, St. Clair, and Wayne. Four companies in Wayne County reported a combined total of 4,141,061 tons or approximately 75 percent of the state's total output.

Salt Production, 1952-1956

Year	Quantity (short tons)	Value	Percent of U.S. total	Rank in U.S.
1952	4,778,347	$ 21,406,382	24.4	1
1953	5,127,387	22,171,988	24.7	1
1954	5,063,633	29,396,812	24.5	1
1955	4,975,442	31,668,351	21.9	1
1956	5,548,178	35,643,860	22.9	1

Clay and Shale

Geological formation - Glacial Drift, Saginaw, Ellsworth, Antrim. Shale is exposed or under shallow cover in widely scattered areas in Michigan. Formations from Ordovician to Pennsylvanian age contain shale. The surface clays of Michigan are of three classes - drift clays, lake clays, and residual clays.

Clay and shale are produced at widespread localities throughout the state. Antrim shale from Alpena County and Ellsworth shale from Antrim County quarries are used in the manufacture of Portland cement, Saginaw shale used by three plants for manufacture of tile in Eaton and Shiawassee counties. Other tile, brick, pottery, and light-weight aggregate plants and some southern Michigan cement plants use local surface clay deposits. Glacial lake clay, produced in Saginaw County, is sold for oil well drilling mud, for molding sand bond; for fungicide and insecticide base and for cosmetic "beauty packs".

A new record high for raw clay and shale was set by the 11 producing counties. Wayne County led in production and value with 35 percent of the state's total output, followed by Alpena, Saginaw, and St. Clair counties. Approximately 74 percent of all raw clay and shale produced was used by the Portland cement industry. The remaining 26 percent was used for the manufacture of a small quantity of prepared clays and for clay products - brick, tile, pottery, and lightweight aggregates.

Clay deposits furnish about 82 percent of the raw material for the manufacture of clay products and shale deposits the remaining 18 percent.

Production of Clay and Shale, and Clay Products, 1952-1956

Year	Raw Clay and Shale: Quantity (short tons)*	Raw Clay and Shale: Value**	Clay Products: Estimated Value
1952	1,580,123	$ 1,615,122	$ 4,534,000
1953	1,605,804	1,646,113	6,995,181
1954	1,890,950	1,940,408	7,331,998
1955	1,937,593	2,091,077	7,292,477
1956	2,110,030	2,401,051	6,951,866

*Sold or Used.

** Value of clay used in cement and heavy clay products not included in total value of state.

Gypsum

Geological formation - Michigan. Large quantities of gypsum are in the Michigan formation of the state. Gypsum is near the surface in the vicinity of Grand Rapids, Kent County, and in the southeastern portion of Iosco County. Throughout the remainder of its belt of occurrence the gypsum is concealed by varying thicknesses of glacial drift. Underlying the remainder of the basin deep wells show the gypsum to be largely replaced by anhydrite.

Gypsum is quarried at Alabaster and National City, Iosco County, and is mined in two mines at Grand Rapids, Kent County. The raw material is processed in gypsum mills at National City, Grand Rapids, and River Rouge, Wayne County. Principal uses for gypsum are in the manufacture of a variety of plaster, wallboard, and allied building materials and as a Portland cement retarder.

Since 1945 Michigan, producing about 18 percent of the national total, has ranked first in the production of crude gypsum. In 1956, Michigan produced 1,715,832 short tons of crude gypsum valued at $5,861,152.

Production of Gypsum, 1952-1956

Year	Quantity (short tons)	Value	Per Cent of U.S.	Rank in U.S.
1952	1,487,642	$ 4,200,418	18	1
1953	1,446,973	4,091,002	18	1
1954	1,693,279	5,035,550	-	1
1955	1,762,105	5,660,587	-	1
1956	1,715,832	5,861,152	-	1

National Gypsum Company, Buffalo, N.Y. proceeded with development of the Tawas City Gypsum Quarry, anticipating production in the spring of 1958. Stripping of the overburden was started in the fall of 1956. New machinery delivered at the site included 40-ton trucks, bulldozers, graders and drills. Construction of the Crusher Building was in progress.

Gypsum will be extracted by open pit method. A year's supply of the gypsum rock will be stock-piled at National City, and the remainder shipped to new plants in Ohio and Illinois. The company may dredge a 12,000 ft. channels 250 feet wide, in Lake Huron, near Tawas City, to permit loading of lake freighters.

Bestwall Gypsum Company, organized during 1956 at Ardmore, Pennsylvania, acquired and now operates the Certain-Teed Products Corp. Grand Rapids plant and mine. The name of the plant was officially changed to "Bestwall", July, 1, 1956.

Peat

Geological formation - Pleistocene. Peat deposits are very common in Michigan and practically every county in the state contains some peat. It is estimated by the United States Bureau of Mines that the glacial lakes and bogs of Michigan, Minnesota and Wisconsin contain 75 percent of the nation's total peat reserves. The quality of the peat varies greatly from bog to bog and within individual bogs. Much of the peat is very woody, some is sedgy and grassy, and some is pulpy. The United States Bureau of Soils publishes maps of the counties that have been surveyed for soils. These maps show peat areas. They may be obtained from the United States Bureau of Soils, Michigan State University, East Lansing. A report, "Peat, Origin, Uses and Distribution in Michigan", by Charles A. Davis, can be found in the Michigan Geological Survey Annual Report for 1906.

Peat production was reported in Lapeer, Shiawassee, Kalamazoo, and Mason counties in 1956. Michigan peat is used almost exclusively for horticultural purposes, marketed largely as a soil conditioner for lawns, golf courses, gardens, nurseries, and in greenhouses.

Production of Peat, 1952-1956

Year	Quantity (short tons)	Value	Per Cent of U.S.	Rank in U.S.
1952	36,020	$ 430,156	16.6	2
1953	25,439	257,176	12.5	4
1954	27,847	429,116	11.4	3
1955	30,000	465,000	11.0	3
1956	31,111	474,899	10.7	3

Marl

Geological Formation - Pleistocene.

The marl deposits of the state range considerable in extent as well as thickness depending in a large degree upon the character of the basin in which they develop and also upon the supply of calcareous material available to the inflowing water. Many of the larger and some of the smaller lakes of the state are floored throughout with marl of various degrees of thickness. In others, the marl may be a narrow rim or shelf around the margin which in places has developed a considerable thickness. The deposits of marl are limited in extent and thickness by the depression which confines them. They range in area from merely a fraction of an acre to several square miles in some localities and may contain thicknesses of 10 to 15 feet of marl but rarely is the thickness more than 30 feet.

All marl produced in the state is used for agricultural purposes. Commercial marl production was reported by 21 producers in 14 counties during 1956. Isabella County ranked first, followed by Kalamazoo, Calhoun, and Branch counties. These counties produced approximately 64 percent of the state output.

Production of Marl, 1952-1956

Year	Quantity (short tons)	Value	Rank in U.S.
1952	130,613	$ 119,705	1
1953	183,685	72,781	1
1954	106,668	37,724	1
1955	119,313	57,176	1
1956	157,246	94,821	1

Lime

Geological formation - Dundee, Burnt Bluff. Lime is either calcium oxide or the combined oxides of calcium and magnesium. It is obtained by heating limestone to a temperature at which the carbon dioxide is driven off. The stone is crushed, screened, and conveyed to rotary or vertical kilns where it is calcined at 2200° F into quick lime. Hydrated lime is produced by treating quick lime with water. Raw stone for the manufacture of lime was obtained from the high calcium Dundee limestone in Presque Isle County and from the Burnt Bluff limestone in Mackinac County.

Production of lime in Michigan increased approximately 6 per cent in production and 13 percent in value over 1955. Mason County continued to rank first in production, followed by Menominee and Bay Counties. Ninety-three percent of the lime sold and used was quick lime. The remaining 7 percent was treated with water to form hydrated lime. All lime produced was sold or used for chemical and industrial use.

Until the turn of the century, when the chemical industries began to grow rapidly, lime was used almost entirely in building and agriculture. Since then, progressively larger amounts have been employed in chemical tests and processes. All lime produced in the State is now sold or used for chemical purposes. Lime is used to soften and purify water, to make glass, petrochemicals, bleaches, pharmaceuticals, insecticides 9 sugar and leather, and as a causticizing agent in paper and pulp manufacturing. It is used as a flux in the purification of steel.

Bromine, Calcium-Magnesium Chloride, Magnesium Compounds, Potash

Geological formations - Marshall, Dundee, Sylvania, Detroit River. Brines are produced in Michigan from a number of formations. The Marshall sandstone is in rocks under the central part of the state. The Sylvania sandstone is a broad belt from the Manistee-Ludington area to Detroit. The Detroit River formation is under almost the entire Southern Peninsula. The Traverse, Dundee, Berea and Parma which contain brine are present throughout the Southern Peninsula. Drillings find brine in one or more rock formations practically anywhere in the Southern Peninsula.

Natural brines from the Marshall, Dundee and Sylvania formations are used by chemical companies of Midland and Gratiot counties; and brine from the Filer sandstone of the Detroit River formation was used in Mason and Manistee counties. These natural brines are source material for many chemicals and chemical compounds.

Elemental bromine was produced in 1956 by four companies in six plants in Gratiot, Manistee, Mason and Midland counties. Bromine compounds were produced by three companies in Gratiot, Manistee, and Midland counties. Magnesium compounds were produced by four companies in Gratiot, Manistee, Mason, and Midland counties. Calcium chlorides and calcium-magnesium chloride were produced by three companies in Gratiot, Lapeer, Mason, and Midland counties. Only one company (Dow Chemical Company, Midland) reported production of potassium salts from natural brines.

Most of the calcium-magnesium chloride sold was for stabilization of dirt roads and for dust control. Other important uses for calcium chloride are the "freeze-proofing" of coal, iron ore and other materials shipped in bulk in railroad cars or stockpiled in the open and for the freeze-proof curing of cement. Magnesium compounds have a variety of uses and are particularly important in the manufacture of fertilizers, oxychloride cement, rayon and rubber. Magnesium chloride is at present the principal raw material used in the production of metallic magnesium. Magnesium sulfates carbonate, oxide and hydroxide are used extensively in pharmaceuticals.

The value of the natural salines recovered from natural brines in 1956 by the chemical plants increased 11 percent over the 1955 value. The greatest increase in value was recorded by bromine, followed by calcium-magnesium chloride, magnesium compounds, and potash.

Production of Magnesium Compounds, 1951-1956

Year	Quantity (tons)	Value	Rank in U.S.
1951	*	*	1
1952	*	*	2
1953	43,190	$ 4,591,922	2
1954	39,096	4,628,756	2
1955	86,264	5,630,978	2
1956	87,977	5,931,741	2

*Data concealed

Standard Lime and Cement Company expanded the capacity of their Manistee plant. Included in the expansion was an additional rotary kiln, more thickeners and settling basins, reactors, and accompanying equipment. Loading facilities at the plant were improved and enlarged.

Michigan Chemical Corporation announced its entry into the rare earth field through the acquisition of the Assets of Saturnium Corporation. In its new activities, the company will continue rare earth research as well as place in operation pilot-plant procedures. The Saturnium research laboratory at California, Kentucky is being closed and its facilities moved to St. Louis, Michigan.

Water

Underground water is a source of water supply for small communities in the state but large cities, with a few exceptions, either utilize waters of the Great Lakes or of the rivers on whose shores they were founded. During the retreat of the continental glacier deposits of glacial drift - sand, clay, gravel, boulders - were laid down on the bed rock. Many Michigan cities, villages, and rural areas now obtain fresh water from the sands and gravel beds of the glacial drift, from sands and gravels deposited in the moraines arid outwash plains, or from the beaches and delta deposits of ancient glacial lakes and rivers. In other localities where the drift is relatively

thin fresh water is recovered from underlying porous bedrock formations. In some places, however, it has been necessary to pipe large volumes of water from the Great Lakes to industrial areas or cities where ground-water resources are inadequate or contain salty or brackish waters.

No data has been compiled on the gallons of water used for domestic, industrial, agricultural, scenic and recreational purposes and no dollar value has been assessed, however, best estimates available from the U. S. Department of Commerce are that 30,000 water wells are drilled in Michigan each year. Approximately one million water wells are in use for all purposes. Each citizen of modern society requires more than 1300 gallons daily to meet direct and indirect needs. Industry uses tremendous quantities for man's direct needs especially when we consider that for every 100 gallons of water a person uses directly, many times that amount is used for him by industry and service facilities. It takes 14,400 gallons of water to produce one ton of pig iron; 65,000 gallons to produce one ton of finished steel; 18 barrels of water to refine a barrel of oil; 15,000 gallons of water to make an automobile; 100 gallons of water to produce one slice of breakfast bacon.

Michigan is blessed with an abundance of water, however, since water resources are renewable (from rains and snows) and are transient (much water runs off to rivers, much is transpired to the air by plants) a great deal of information is required to adequately plan their development and uses. Appraisal of water resources is becoming more and more important to insure a lasting supply sufficient to meet needs of expanding industries as well as of an ever increasing population. This appraisal includes consideration of climate, surface, and sub-surface, land forms, land uses, stream flow and other seemingly remote bits of information. Hydrological conditions regarding rainfall, runoff, and percolation must be understood in developing a water supply.

Precipitation from the atmosphere of water evaporated from the earth's surface is the source of all water supply. Only a small part of the rain-snow fall on the land is converted by man to his use. With an average rainfall of 30 to 33 inches per year only about 5 inches become useful groundwater. The remainder runs off to streams on its way back to the sea. Of the precipitation that enters the ground, plants transpire an enormous amount, and rainfall is not concentrated where water is most needed in the industrial and irrigation areas.

Cities and areas plagued by water shortages grow in number every year. With adequate hydrological investigations, however, shortage in most communities can be met intelligently or avoided, by making an approximate analysis of the quantity and quality of water needed and by designing the systems on the basis of reliable information on the source of the water tote developed. Water can be provided in adequate quantity and quality in any part of the state if the funds are available to construct the necessary facilities.

GEM STONES

It is estimated by T. H. Miller, Deputy Director, United States Bureau of Mines that during 1956 some 50,000 "rock hounds" picked up stones and pebbles valued at more than $700,000 from the beaches, woods and fields of this country. Agates and thomsonite from the beaches of the Keweenaw Peninsula were the only reported gem stones collected in Michigan during the year. However, the following minerals and stones are frequently collected in the state, some when cut and polished are attractive enough to be classed as gem stones:

chlorastrolite	rose quartz	chalcedony
carnelian	datolite	epidote
prehnite	chalcocite	bornite
amethyst	chalcopyrite	domeykite
algodonite	whitneyite	natrolite
jaspilite	goethite	manganite
pyrolusite	psilomelane	verde antique
martite	grunerite	garnet
tourmaline	topaz	tremolite
actinolite	pyrite	calcite (dog-tooth spar)
celestite	gypsum	
Petoskey stone		

Value of Michigan's Minerals and Mineral Products, 1941-1956

Year	Value	Year	Value
1941	$ 135,492,921	1949	$ 207,607,694
1942	152,624,946	1950	238,474,008
1943	147,113,888	1951	257,529,882
1944	140,493,319	1952	267,089,423
1945	128,046,408	1953	287,693,135
1946	133,682,135	1954	286,549,922
1947	170,269,272	1955	371,356,604
1948	214,115,771	1956	406,563,233

TABLE I
MINERAL PRODUCTS OF MICHIGAN, 1956[1]

Product	Unit	Quantity	Value	Rank in U.S.(2)
Iron Ore	Long tons	12,536,302	$ 105,688,087	2
Cement	Barrels	21,880,222	67,798,262	4
Copper	Pounds	123,280,235	51,531,138	6
Natural Salines(3)	. . .	. . .	37,873,042	1
Salt	Short tons	5,548,178	35,643,860	1
Sand and Gravel	Short tons	42,149,946	35,145,953	2
Stone(4)	Short tons	33,926,000	30,951,782	2
Petroleum	Barrels	10,739,697	30,607,137	12
Clay Products	. . .	. . .	6,951,866	...
Gypsum	Short tons	1,715,832	5,861,152	1
Clay and shale	Short tons	2,110,030	2,401,051	9
Natural Gas	M. Cu. Ft.	8,840,933	1,556,575	16
Peat	Short tons	31,111	474,899	3
Natural Gasoline	Gallons	3,740,916	374,092	15
Marl	Short tons	157,246	94,821	1
Miscellaneous(5)			2,807,704	
Total			$ 406,563,233 (6)	

(1) Statistics compiled in co-operation with the United States Bureau of Mines.

(2) Based upon quantity.

(3) Includes bromine, magnesium compounds, calcium-magnesium chloride and potash.

(4) Includes 9,223,513 short tons of limestone valued at $6,815,785 used in the manufacture of cement and lime.

(5) Includes lime, silver, mineral pigments, and gem stones.

(6) Value of limestone used in the manufacture of cement and lime and value of clay and shale used in cement and clay products not included in state total.

TABLE II
MINERAL PRODUCTS OF MICHIGAN, 1955[1]

Product	Unit	Quantity	Value	Rank in U.S.(2)
Iron Ore	Long tons	14,148,123	$107,890,161	2
Portland cement	Barrels	19,738,400	58,048,378	4
Copper	Pounds	99,996,160	37,489,560	6
Petroleum	Barrels	11,265,832	32,074,018	12
Salt	Short tons	4,975,442	31,668,351	1
Sand and Gravel	Short tons	37,269,709	29,565,730	2
Stone (3)	Short tons	25,312,294	23,361,852	3
Clay Products	. . .	. . .	7,292,477	...
Gypsum	Short tons	1,762,105	5,660,587	1
Magnesium Compounds	Short tons	86,264	5,630,978	2
Clay and Shale, raw	Short tons	1,886,976	(4)	9
Natural Gas	M. cu. ft.	6,787,697	1,187,846	17
Peat	Short tons	30,000	465,000	3
Natural Gasoline	Gallons	3,612,912	361,291	15
Marl	Short tons	119,313	57,176	1
Miscellaneous (5)	. . .	. . .	30,603,139	...
Total			$371,356,604	

(1) Statistics compiled in co-operation with the United States Bureau of Mines.

(2) Based upon quantity.

(3) Limestone used in the manufacture of Portland cement and lime not included.

(4) Value of clay and shale used in clay products and cement industries not included in state total value; value of other clays included under miscellaneous.

(5) Includes bromine, calcium chloride, calcium-magnesium chloride, clay, lime, potassium salts, and gem stones (Agates, Datolite, Petoskey stone, Chlorastrolite, Jasper, and Thomsonite).

THE MINERAL INDUSTRY OF MICHIGAN IN 1957* (Preliminary)

The total value of-minerals produced in Michigan in 1957 was estimated at $393.2 million according to the Bureau of Mines, United States Department of the Interior. The decrease from the 1956 total of $394.5 million was less than one percent.

Although the value of copper production was reduced sharply because of a much lower unit price and gypsum production fell off, increased production of iron ore and cement and higher prices for sand and gravel and petroleum tended to equalize the losses.

Iron ore continued to rank first in value of minerals produced, followed by cement, sand and gravel, salt, copper, petroleum and stone.

METALS

Metallic minerals are mined in the upper Peninsula of Michigan. Copper is produced in Houghton, Keeweenaw and Ontonagon Counties and iron ore in Baraga, Dickinson, Gogebic, Iron, and Marquette Counties.

Metallic minerals accounted for 36 percent of the total value of the State mineral production in 1957.

Copper. - Copper production in Michigan in 1957, in terms of recoverable metal, was about 5 percent less, while value decreased 33 percent from 1956.

Because of the lower prices, Calumet & Hecla Inc. suspended operations in September at the Iroquois., Osceola No. 6 and No. 13 shafts, but continued development at the Osceola project. Production from other company mines and the reclamation plant was continued.

Copper Range Co. in addition to continuous operation of the Champion mine started reclamation of copper from the Redridge sands.

Quincy Mining Co. operated its reclamation plant and smelter continuously.

White Pine Copper Co. operated throughout the year except for a shutdown due to a strike that lasted from September 23 to October 28.

Silver production estimated at 430,000 fine ounces recoverable in 1957 is obtained only as a by-product when copper from the area is electrolytically refined. Production in 1956 was 380,000 fine ounces.

Average weighted price used for calculating the value of copper was 30 cents per pound in 1957 and 42 <»5 cents in 1956. After reaching a high of 48 cents per pound in March, 1956, copper prices began a downward trend. Copper opened 1957 at 36 cents and declined to a range of 25-27 cents towards the close of the year.

Iron and Manganese. - Although demand was down in 1957, production of iron ore was greater than in 1956 primarily because of labor strikes in 1956. The year 1957 ushered in a new milestone for Michigan iron ore mining in the commercial mining of Jasper iron ores (non-magnetic taconites) by the Cleveland Cliffs Co.

A small quantity of iron ore containing over 5 percent manganese, natural was mined in 1957.

Dates of first and last lake shipments of ore in 1957 from Michigan and Wisconsin ports were: Ashland - C&NW-Soo, April 28-November 23; Escanaba - C&NW, April 1-November 29; Marquette - DSSA, May 17-October 21; Marquette - LS&I, April 27 - November 26; Superior - GN, April 17-December 3; Superior - NP-Soo, April 21-October 30.

*Prepared December 20, 1957 by Donald F. Klyce, Commodity Industry Analyst, under the supervision of Samuel A. Gustavson, Chief, Minneapolis Field Office,' Division of Mineral Industries, Region V.

NONMETALS

Several of the important minerals produced in Michigan are classified as nonmetallics. These include cements clay, gypsum, lime, sand and gravel, stone, and salines derived from well brines. The salines are the source of raw materials in the production of several chemicals, notably bromine and magnesium compounds and common salt. The other nonmetallic minerals are used principally in the construction industry. Nonmetalllcs represented 55 percent of the value of the State's mineral production. Dollar-wise, about two thirds of the nonmetallics are used in the construction industry and one third in the chemical industry.

MINERAL FUELS

Mineral fuels (natural gas and natural gas products, peat and petroleum) accounted for 9 percent of the 1957 mineral output. Peat was utilized chiefly as a soil conditioner and none was sold as a fuel. No coal production was reported.

GENERALIZED COLUMNAR SECTION OF MICHIGAN

MICHIGAN GEOLOGICAL SURVEY DIVISION

SYSTEM, SERIES	FORMATION, GROUP	LITHOLOGY	THICKNESS	ECONOMIC PRODUCTS
RECENT				
PLEISTOCENE	GLACIAL DRIFT	SAND, GRAVEL, CLAY, boulders, marl	0-1000	SAND, GRAVEL, PEAT, MARL, FRESH WATER
"PERMO-CARBONIFEROUS"	"RED-BEDS"	SHALE, CLAY, SANDY SHALE, gypsum		
PENNSYLVANIAN	GRAND RIVER	SANDSTONE, sandy shale	80-95	BUILDING STONE, FRESH WATER
	SAGINAW	SHALE, SANDSTONE, limestone, coal	20-535	SHALE, COAL, FRESH WATER, BRINE, GAS
MISSISSIPPIAN	BAY PORT	LIMESTONE, SANDY OR CHERTY LIMESTONE, SANDSTONE	2-100	LIMESTONE, FRESH WATER
	MICHIGAN	SHALE, gypsum, anhydrite, sandstone	0-500	GYPSUM
	"MICHIGAN STRAY"	SANDSTONE	0-80	GAS
	MARSHALL	SANDSTONE, sandy shale	100-400	FRESH WATER, BRINE BUILDING STONE
	COLDWATER	SHALE, sandstone, limestone	500-1100	SHALE, FRESH WATER
	SUNBURY	SHALE	0-140	
	BEREA-BEDFORD	SANDSTONE, SHALE	0-325	GAS, OIL
	ELLSWORTH-ANTRIM	SHALE, limestone	100-950	SHALE, GAS
DEVONIAN	TRAVERSE	LIMESTONE, SHALE	100-800	LIMESTONE, OIL, GAS, FRESH WATER
	BELL	SHALE, Limestone	0-80	SHALE
	ROGERS CITY-DUNDEE	LIMESTONE	0-475	LIMESTONE, OIL, GAS, FRESH WATER
	DETROIT RIVER	DOLOMITE, limestone, salt anhydrite	150-1400	LIMESTONE, DOLOMITE, OIL, GAS, SALT, BRINE, FRESH WATER
	SYLVANIA	SANDSTONE, SANDY DOLOMITE	0-550	GLASS SAND, FRESH WATER
	BOIS BLANC	DOLOMITE, CHERTY DOLOMITE	0-1000	
SILURIAN	BASS ISLAND	DOLOMITE	50-570	DOLOMITE, FRESH WATER
	SALINA	SALT, DOLOMITE, Shale, anhydrite	50-4000	SALT, GAS, OIL
	NIAGARAN (Guelph-Lockport-Engadine) (Manistique-Burnt Bluff) (Cataract)	DOLOMITE, Limestone, shale	150-800	LIMESTONE, DOLOMITE, OIL, GAS, FRESH WATER
ORDOVICIAN	CINCINNATIAN (Richmond) (Maysville-Eden)	SHALE, LIMESTONE	250-800	
	TRENTON-BLACK RIVER	LIMESTONE, DOLOMITE	200-1000	OIL, GAS, LIMESTONE, FRESH WATER
	ST PETER	SANDSTONE	0-150	FRESH WATER
OZARKIAN OR CANADIAN	PRAIRIE DU CHIEN	DOLOMITE, Shale	0-410	
	HERMANSVILLE	DOLOMITE, SANDY DOLOMITE, sandstone	15-500	
CAMBRIAN	LAKE SUPERIOR (Munising) (Jacobsville)	SANDSTONE	500-2000	BUILDING STONE FRESH WATER
ALGONKIAN	KEWEENAW (Copper formations)	LAVA FLOWS, conglomerate, shale, sandstone	9800-35000	COPPER, SILVER, ROAD METAL, SEMI-PRECIOUS GEM STONES
	KILLARNEY GRANITE	GRANITE, GNEISS, diorite, syenite		
	HURONIAN (Iron formations)	SLATES, HEMATITE, SCHIST, QUARTZITE, GRANITE, marble, dolomite	2000+	IRON ORE, ROOFING SLATE, ROAD METAL, GRAPHITE MARBLE
ARCHEAN	LAURENTIAN	SCHIST, GNEISS, GRANITE		ROAD METAL, BUILDING STONE, VERDE ANTIQUE, TALC, GOLD
	KEEWATIN	SCHIST, GREENSTONE, SLATE		ROAD METAL