State of Michigan

# Mines and Mineral Statistics

BY

JAMES RUSSEL

COMMISSIONER OF MINERAL STATISTICS.

By Authority

MARQUETTE
PRESSES OF THE MINING JOURNAL CO., LIMITED
1900.

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## Charcoal Pig Iron

### Production in Michigan.

Pig iron is manufactured to a limited extent in this state, all of the furnaces using charcoal for fuel. The Pioneer furnace, at Gladstone, is so built that it can use coal or coke for fuel, if it is ever desired to change from charcoal, but it is not likely that such a step will be taken for many years, as the Cleveland-Cliffs Iron Company owns immense timber tracts accessible to the furnace, and also operates a chemical plant, from which large quantities of wood alcohol and gray acetate of lime are secured, as by-products, in the manufacture of the charcoal.

The production of charcoal pig iron by the furnaces of Michigan for the years 1898, 1899 and the first nine months of 1900, has been as follows:

| Furnace. | Location. | Tons 1898. | Tons 1899. | Tons—First 9 Mos. 1900. |
|---|---|---|---|---|
| Antrim Iron Co. | Mancelona | 27,398 | 36,073 | 21,651 |
| Elk Rapids Iron Co. | Elk Rapids | 18,362 | 25,134 | 18,447 |
| Excelsior Furnace | Ishpeming | 22,608 | ..... | ..... |
| Gaylord Iron Co. | Detroit | 10,541 | 5,473 | 8,266 |
| Peninsular Iron Co. | Detroit | 11,144 | 9,860 | 7,422 |
| Spring Lake Iron Co. | Fruitport | 22,054 | ..... | ..... |
| Pioneer Furnace | Gladstone | 38,800 | 31,546 | 29,194 |
| Carp River Furnace | Marquette | ..... | 2,326 | 10,388 |
| Totals | | 150,907 | 110,412 | |

The furnace of the Antrim Iron Company was in blast 9¾ months in 1898, continuously in 1899, and was out of blast 26 days in the first nine months of 1900.

The Excelsior furnace, at Ishpeming, was in blast 10½ months in 1898, and has not since been in operation.

The Weston furnace, at Manistique, went into blast during 1900.

The furnace of the Gaylord Iron Company, was in blast continuously during 1898, but was idle 6½ months in 1899.

The Pioneer furnace was out of blast two months in 1899, after three years and four months continuous running.

## Coal.

Coal has been mined to a limited extent for many years past, in this state; the earlier shafts being located at Jackson, Corunna, Williamston and Flushing. In the Jackson and Corunna districts the seams of coal averaged only two to three feet in thickness, with low percentages of fixed carbon, and the business never became an important one. Within the past few years the coal industry of Michigan has grown rapidly; new mines have been opened, and the area of the carboniferous beds of the state has been approximately determined by the State Geological Survey. The earlier work of the survey was nearly all devoted to the upper peninsula, which was, and probably will always remain, the principal mining section of the state. While there yet remains a vast amount of work to be done in the upper peninsula, it was felt by Dr. Alfred C. Lane, the present State Geologist, that the increasing mineral development of the lower part of Michigan demanded more attention from the bureau than has heretofore been given that part of the state; hence the work of the survey of late has been devoted mainly to the coal, salt, marl and sundry other mineral resources of the lower peninsula, greatly to the benefit of that section. The work of the State Geological Survey for the past two years has been of much practical value. as well as of theoretical and scientific interest, and during this time Dr. Lane and his assistants have devoted their attention almost exclusively to the coal and other minerals of the lower peninsula, with excellent results.

The area of the coal basin in Michigan is approximately 8,000 square miles, as now determined, and this figure is liable to be increased by more thorough exploration. There are places where the coal measures are cut out,

even near the center of the district, but in a general way it may be stated that the following counties are underlaid to greater or less extent by workable seams of coal; Ogemaw, Roscommon, Missaukee, Arenac, Glad win, Clare, Osceola, Huron, Bay, Isabella, Mecosta, Tuscola, Saginaw, Gratiot, Montcalm, Genesee, Shiawassee, Clinton, Ionia, Kent, Livingston, Ingham, Eaton and Jackson. Coal is not mined in all of the foregoing counties, the developments to date lying principally in the Saginaw Valley, in Bay and Saginaw counties. A start has also been made in other counties, and some of the old mines in Jackson and Eaton counties are still working.

The present-day development of coal mining may be said to date from 1897, as it was in that year that the first properties were opened in the Saginaw Valley. The development of the industry is shown by the following figures of production: In 1896 the coal output of the state was 83,150 tons; in 1897 it amounted to 188,638 tons; in 1808 had grown to 378,541 tons, and in 1899 reached the handsome total of 624,708 tons, worth nearly one million dollars at the pit's mouth. For the year 1900 the coal production of the state will closely crowd one million tons. No other state in the Union approached Michigan in the percentage of increase of coal production for 1899 over 1898.

The production of 1899 was raised by 23 mines, located in the seven counties of Saginaw, Bay, Jackson, Eaton, Huron, Genesee and Shiawassee. Saginaw county easily led, with a gross product of 455,607 tons, Bay following with 104,588 tons, and none of the other counties produced as much as 50,000 tons. The gross production of coal in the state of Michigan, to the end of the year 1899, has been 3,133,476 short tons. The total production of coal in the United States in the year 1899 amounted to 253,739,992 short tons, so there is plenty of room for the expansion of the coal mining industry of Michigan without unduly crowding the market. The largest coal producing states of the Union are Pennsylvania, Illinois, West Virginia and Ohio, in the order named, Pennsylvania having a commanding lead, and supplying about 55 per cent of the total coal output of the United States in 1899. In the production of coal in 1899 Michigan exceeded the following named states: Virginia, North Carolina, Georgia. North Dakota, Oregon and California. For 1900 it should also exceed Arkansas, Texas and Utah, and at the rate of progress maintained for the past three years, since the exploitation of the Saginaw Valley fields, will take its place, within five more years, among the larger producers of the Union.

In 1897 two new coal mines were opened in the state; in 1898 four new producers were added, and in 1899 six mines were added. Coal mining machines were first used in 1898, and with the introduction of air compressors and other modern appliances, the industry is rapidly developing from the extremely rudimentary and unsatisfactory form in which it existed so recently as four years ago.

The Saginaw county mines were much more regularly and effectively worked during 1899than those of any other county, averaging 274 days activity for the year, while the four Eaton county mines, at the other extreme, worked but 145 days in the year. Of the 1899 production, 16,237 tons were used at the mines, for power and heat; 34,191 tons were sold to local dealers, customers and employees, and 574,280 tons were loaded on cars for shipment. During the year 1900 the production has been materially larger than in the preceding year, and there has been great activity in the way of exploratory work, opening of new mines, and extension of mines already opened. The operators of the Saginaw Valley are awake to the necessity of adopting modern methods and the best machinery, if the coal industry of Michigan is to be made a profitable and extensive one, and the mine equipments are, as a rule, highly creditable to enterprises of such comparative youth.

The coal measures opened in the past three years in the northern portion of the Michigan field average a better grade than those originally developed in the vicinity of Jackson, Grand Ledge and Corunna. The mines at those points carried much sulphur, running from 2 to as high as 3½ per cent. The amount of fixed carbon ran as low as 40 per cent, and rarely went above 45 per cent, with a large quantity of volatile matter, and occasionally as much as 11 per cent ash.

The geographical location of the Michigan coal fields is excellent. The country is thickly settled, with flourishing agricultural, trade and manufacturing interests, which afford good home markets. The mines of the Saginaw Valley are located exceptionally well, having water transportation almost at their shafts, with unlimited markets to the north and west. The Michigan coal field is the only one which actually touches the chain of great lakes at any point.

The coal measures in Michigan rarely outcrop on surface, which has been one reason for their late development. Another cause for their tardy start is found in that the energies of the residents of the Saginaw Valley were so fully taken up with the pine log in years past that little attention was paid to anything else, except salt, which afforded a profitable means of using some of the great amount of fuel made by the waste from the sawmills. It is only of very recent years that fuel has not been a drug on the market in that part of the state, owing to the sawdust and slabs from the mills, but with the decline of the lumber industry, and the more careful utilization of the slabs and edgings, fuel has become of greater relative value.

One of the principal difficulties experienced in the development of Michigan coal mines is the excess of water. The coal basin is full of wet spots, and good pumps are required by most mines. For this reason, the mine that works the most steadily has the lowest pumping charges per ton, other things being equal. As a rule the roof of the coal beds is shale, and while this is solid when freshly cut, exposure to the atmosphere

causes a marked tendency to disintegration. Several mines have been wrecked by the collapsing of roofs, followed by flooding, and the matter of leaving strong pillars for roof supports is an important one, but these pillars cut out a great deal of coal, owing to the measures being thin. A little coal is found in Jackson and Eaton counties in comparatively dry ground, but as a rule the Michigan coal miner must tie his faith to good pumps.

The coal throughout practically the entire carboniferous district of the state occurs in nearly horizontal strata, the extreme dip, found only near faults in the formation, not exceeding 10 to 12 degrees. The seams now worked in the state run from 2 to 4 feet in thickness, though occasionally thicker. Borings in the vicinity of Saginaw and the mining town of St. Charles show as many as six coal horizons; an indication that this district will remain for some time the principal coal field of the state, and that it is capable of producing many times the present annual output.

The rooming system is in almost universal use, the long-walled system having been tried, but found illy adapted to the requirements of the district, much trouble being experienced from water, which found its way in freely through the cracks in the shale roofs. The rooming plan is wasteful of coal, because of the heavy pillars left to hold the roof, but seems unavoidable. The usual estimate of coal in a given area is 1,000 tons per acre per foot of thickness of the seam, which would give an average of fully 3,000 tons per acre, per seam, in the Saginaw Valley, and perhaps a larger amount.

There has been great activity in exploratory work in Saginaw and Bay counties in 1899 and 1900. Hundreds of thousands of acres have been leased, the royalties ranging from 4 to 15 cents per ton, with an average of about 6 to 10 cents, the royalty being commonly based on the thickness of the seam, and probably averaging about 4 to 5 per cent on the selling price of the coal. A great deal of drilling has been done, and the results of the drill holes are being carefully correlated, wherever obtainable, by Dr. Lane and his assistants. The mine operators have great faith in the work of the State Geological Survey, and the exchange of data between the practical miners and the theoretical geologists has proven of great mutual benefit. It is to be hoped that the result of the work done by the survey in the Saginaw Valley and elsewhere in the lower peninsula in 1899 and 1900 will bring to the support of that bureau a strong body of friends in the newly elected legislature. For many years the Geological Survey found almost its only supporters in the successive legislatures in members from the iron and copper districts of the northern peninsula. Lower peninsula law-makers were as a rule opposed to giving the survey anything more than a dole sufficient to enable it to eke out a precarious existence. It was because of inability to get the funds from the State Board of Auditors to print his valuable report, recently issued, that Dr. L. L. Hubbard resigned the office of state geologist. He is at present giving his services without charge, in looking after the office and work of the survey in Houghton. Now that the people of the lower peninsula have had a practical exposition of the value of the survey's work, not in the way of adding to geological lore, but in furnishing practical facts of immense cash value to that part of the state, friends should be raised up for the bureau and its officers, at Lansing.

The coal mines of the state have been placed under the supervision of the State Bureau of Labor, and Mr. Wm. Atwood, of St. Charles, a practical miner, has been appointed coal mine inspector. In the upper peninsula a mine inspector is appointed for each county, but in the lower peninsula the coal mining industry has as yet not reached a point where the mine inspection cannot be properly performed by a single official. The coal operators have manifested a commendable spirit of co-operation, and have carefully followed the advice of the inspector regarding requirements for working the mines with safety.

The mines of this state are fortunate in being immune from gases—the explosive fire-damp which causes such terrible accidents at collieries in many districts, and the deadly choke-damp, which overcomes and suffocates the unfortunate miner. The ventilation of the Michigan mines is good, as a rule.

The mining companies have had considerable trouble at times in securing experienced labor. The average worker on surface does not take kindly to the idea of earning his bread one to three hundred feet below the earth's crust, and out of reach of the sunshine. The principal trouble of the mines, however, has arisen from lack of cars. The railroad companies were not prepared for the rapid expansion of the coal business in Bay and Saginaw counties, and while they have kept adding to their equipment of rolling stock, have not succeeded in catching up with the productive capacity of the mines. A coal output of 4,000 to 6,000 tons daily, which would be held trivial in many of the older coal fields, is only relatively a small thing, and requires a great many cars for its proper disposal. The lack of cars has caused a considerable loss of time to both operators and employees, and has consequently not only prevented the making of possible profits, but has also added to the cost of production per ton. The railroad companies are doing justice neither to their customers or to themselves, by not making a greater effort to provide the cars requisite for the proper handling of this large and growing business.

The average number of employees in Michigan coal mines in 1899 was 1,402, including miners, engineers, tipple-men and laborers, this giving an average force of 56 men for each shaft. The working hours are eight per day and the average number of days worked per month was 22. The average daily wages paid employees of all classes was $2.04. Black powder has been used as an explosive, but the use of this is being reduced by the adoption of mining machines run by compressed air.

A coal miners' union was formed in June, 1899, and the relations between organized labor and employers have been uniformly pleasant. This is probably due in part to the just and generous treatment given their men by the operators, and partially to the class of labor employed, the operators uniting in bearing testimony to the intelligence, faithfulness and sobriety of their employees.

While the seams of coal so far discovered and opened in Michigan are all comparatively narrow, there is a thickness of hundreds of feet of coal measures in the central portion of the basin, and successive strata of coal have been found. Deeper mining will eventually be done, and the coal production of the state will be of no small size, if the present promise holds good. There are many places where the coal is cut out by surface erosion, and by dykes of sandstone and gravel, but the successive horizontal strata in the more promising portions of the coal basin will more than make up for the loss in productive area brought about by the reasons just stated. Allowing an average of 3,000 tons of coal per acre, which is two-thirds of the amount claimed in the Saginaw Valley, for an area of at least 8,000 square miles, it can be readily figured that the amount of coal in the basin is hot less than 15,000,000,000 tons—enough to supply the United States for 75 years, at the present rate of production of bituminous coal. The tendency of recent explorations is to enlarge the coal field, and to point to a greater number of successive strata in the central portion of the basin. In view of these facts the coal industry of Michigan is not to be lightly regarded.

The mining companies have adopted the "company doctor" plan so generally used in the iron and copper districts of the upper peninsula. The married employees are charged $1 per month, and the single men 50 cents, the payments being deducted from the monthly settlements of the men and turned over direct to the physicians under contract. A variation from the plan used in the upper peninsula is that each employee is allowed to select his own doctor. The system seems to work to the perfect satisfaction of all concerned.

At one or two points there are company stores, but these are located where the mines are some distance from the nearest town, and are operated as a convenience to employes rather than on the "pluck-me" system unfortunately so prevalent in coal mining districts of some of the other states.

As a rule the mining companies insure employees against accident. This provides for the maintenance of miners who are injured, and guards the operators against damage suits.

At many of the mines the operators have built houses for employees. These are rented at reasonable rates, and their occupancy by employees is not compulsory. As a rule the companies build only where it is necessary, to furnish dwellings for their workmen. The married men are the steadiest, and they demand homes.

The pay-days are bi-weekly, and wages are paid in cash or checks, throughout the district.

Safety lamps are not required, owing to the immunity of the mines from gas.

The shafts are vertical and range from 60 to 200 feet in depth, as a rule, and are usually 9x18 feet in size, inside of timbers, with two compartments, in which cages are operated in counterbalance.

The sand drift overlying the coal seams is sometimes hard to get through, especially when wet, and the shafts are all solidly timbered, to obviate crushing or warping from side pressure.

The percentage of accidents and fatalities is higher than in the iron and copper districts. This should not be, as the latter mines are much the deeper, and naturally the more dangerous. It is probable that the percentage of accidents to the number of employees will be reduced as the coal mining industry gets on a more firmly established footing.

Following is a summary of average results from a number of careful analyses of Saginaw Valley coal, made by the Solvay Process Company of Detroit and Syracuse:

| | |
|---|---|
| Moisture | 7.600 |
| Volatile carbonaceous matter | 37.895 |
| Fixed carbon | 50.730 |
| Ash | 3.770 |
| Sulphur | .990 |
| British thermal units | 12,521 |

As a result of comparative evaporative tests between Hocking Valley and Saginaw coals, made under the same boiler, under similar carefully prepared test conditions, the following results were obtained:

| | Hocking. | Saginaw. |
|---|---|---|
| Evaporation, per pound of coal, from and at 212 degrees Fahrenheit | 8.32 | 8.26 |
| Pounds of coal burned per square foot of grate surface, per hour | 24.50 | 25.50 |
| Water evaporated from and at 212 degrees Fahrenheit per square foot of heating surface per hour | 2.90 | 3.00 |
| Horse power developed | 133.20 | 137.90 |
| Percentage of moisture in coal | 5.00 | 5.50 |

The result of the foregoing test, made by so prominent and reliable a firm as the Solvay Process Company, must be taken as final. That the coal of the Saginaw Valley made such a fine showing when tested with the celebrated bituminous coal of the Hocking Valley, of Ohio, one of the most famous steam-coal districts of the country, is ample evidence that the fuel from the Saginaw Valley mines is all that is claimed for it, and is adapted to all ordinary uses as a steaming coal.

Beginning with Jackson county, where the oldest mines of the state are located, the mines are as follows:

### NEW HOPE.

Operated by the New Hope Mining Company, S. Jenkins, superintendendent, Jackson, Mich. The company is working a narrow seam and employs about 35 men. An analysis of a selected lump of coal from this mine gives the following results:

| | |
|---|---|
| Moisture | 5.93 |
| Volatile matter | 46.59 |
| Fixed carbon | 44.64 |
| Ash | 2.84 |
| | 100.00 |
| Volatile sulphur | 3.05 |
| Sulphur in ash | .02 |
| Total sulphur | 3.07 |

### ROBERT GAGE.

Owned and worked by Robert Gage, one of the pioneer coal mine operators of the state. Is located three miles west of Jackson, and was opened in the fall of 1900.

### TRUMBULL.

This is four miles out of Jackson, and a continuation of the seam worked in the old Woodville Mine. It was worked in 1899, but closed down in May, 1900.

### GRAND LEDGE.

This mine, operated by the Grand Ledge Coal Company, F. Boyle, superintendent, is located in the village of Grand Ledge, Eaton county. Seam thin, product small,

### BATES.

Owned and operated by O. L. Bates. Characteristics similar to those of the Grand Ledge Mine, near which it is located.

### ARNOLD.

Also in the Grand Ledge District, and a small producer. V. Allen, superintendent.

### PRATT.

Operated by Rufus Pratt, Grand Ledge.

### WILKINSON.

Operated by R. Wilkinson The northernmost of the Grand Ledge mines regularly worked. It has the thickest seam in the district, running about 2½ feet. The coal measures in the Grand Ledge District are of considerable depth, but the seams, so far as located, are of little thickness, and the coal mined so far is high in sulphur and low in fixed carbon, averaging about 46 per cent volatile matter, 46 per cent in fixed carbon and ash 7½ per cent. The sulphur, mostly easily volatilized, ranges around 3½ per cent. The mines of Grand Ledge, being evened in a hillside, are exceptionally free from water; otherwise their narrow seams of low grade coal would not permit working.

### CORUNNA.

The mine of the Corunna Coal Company, about five miles northeast of Owosso, is among the oldest in the state, and has been a comparatively small but steady producer for many years, having been very prudently worked. The fixed carbon runs above 50 per cent, and the sulphur about 1½ percent in the coal from this mine. Todd Kincaid, one of the veteran coal mining men of Michigan, is superintendent, and the postoffice address of the company is Owosso, Shiawassee county.

### OWOSSO.

This mine adjoins the Corunna, but is not so old. It is owned by the Owosso Coal Company, R. E. Travis, superintendent, with post-office address at Owosso. Its coal is about the same grade as that of the Corunna.

### MICHIGAN STANDARD.

This mine is located at Sebewaing, Huron County. The coal measures of Huron county are of very limited extent, being found only in the southwestern corner, adjoining Tuscola County, although several mines have been opened since the first mining in the district was done in 1873. Recent developments indicate that the coal measures extend in a southerly direction through Tuscola County, south of Sebewaing. The coal from this mine—and from the others in the immediate vicinity-is of intermediary grade between the coals of the Jackson and Saginaw districts. The seam is a wide one for Michigan, running fully four feet. The coal contains about 45 per cent of volatile matter, 5½ per cent of which is sulphur: 48 per cent of fixed carbon and about 7 per cent of ash. It is a good steaming coal, but subject to the usual drawbacks of all coal containing large quantities of sulphur. The mine is operated by the Michigan Standard Coal Company, X. B. Konkel, superintendent, Sebewaing, Mich.

### SEBEWAING.

This mine adjoins the Michigan Standard, but is abandoned and filled with water.

### SAGINAW BAY.

This mine is in the Sebewaing District, not far from the two preceding mines named, but was flooded, through breaks in the roof, and abandoned. The Sebewaing District is very wet, and the utmost care is required in leaving pillars ample for the support of the roof, which is treacherous.

### VERNE.

This property, closed down in August, 1900, is located in Saginaw County, and was operated by the Verne Coal Company, of which the officers are, H. C. Potter, Jr., president: S. T. Crapo, vice-president; H. T. Wickes, treasurer, and S. C. Higgins, secretary; Robert M. Randall, superintendent. There are two seams, not far apart, in this and some of the neighboring mines. The product is a coking coal, high in sulphur.

**COLCORD.**

Adjoining the Verne. Not working at present.

**GAGE.**

This is a new mine, in the St. Charles district, being located about two and a half miles southeast of the village of that name. Work was begun in June, 1900, and the property is now a shipper. The coal seam is of above the usual thickness, and of good grade, with a slate roof of 30 to 40 feet above the coal, allowing the mining of a greater proportion of the coal bed than is possible where the roof is weaker. The mine is operated by the Robert Gage Coal Company, with the following officers: President, Robert Gage: vice-president and general manager, Charles Coryell; secretary, E. J. Vance: treasurer, Frank W. Urch.

**ST. CHARLES.**

Located at St. Charles and worked by the St. Charles Coal Company. Has made extensive surface improvements during 1900, including the construction of 20 new dwellings for employees.

**SOMERS.**

The J. H. Somers Coal Company has two shafts, under the management of F. G. Benham, of St. Charles, and is a large producer of coal of good quality.

**NORTHERN.**

The Northern Coal & Transportation Company has two shafts, one at St. Charles and another at Jamestown, near Saginaw, the latter opened early in 1900. T. W. Davies, of Saginaw, is superintendent. This company has been quite active in exploratory work, and is developing good mines.

**MICHIGAN.**

The Michigan Coal Company, C. R. Campbell, superintendent, is one of the largest producers of the St. Charles district, raising 350 to 400 tons daily, when working to the mine's capacity.

**SAGINAW.**

This mine is operated by the Saginaw Coal Company, and has the same officers and superintendent as the Pere Marquette and Verne. The mine is located in the southern part of Saginaw, East Side, and is an important producer, mining fully as good a grade of steaming coal as is found anywhere in the state, the product carrying about 43 per cent of moisture and volatile matter; 55 per cent of fixed carbon and less than 3 per cent of ash. The sulphur runs only about one per cent, but the coal is not coking. The company has upwards of 500 employees, and for the 12 months ending Oct. 31, 1900. shipped 10,968 carloads of coal.

**PERE MARQUETTE.**

Operated by the Pere Marquette Coal Company, and having the same officers and manager as the Saginaw, the two companies being virtually worked as one property. The Pere Marquette has two shafts, one of which is immediately adjoining the Saginaw mine, while the other is a short distance to the west. The surface improvements at this property are among the finest in the district, and it has an excellent machinery plant. Its coal is of good grade, and the mine as a whole will compare very favorably with the better-class mines of the older and larger bituminous coal fields of Pennsylvania, Ohio and Illinois. Its management is a very progressive one, and fortunately has ample capital for the conduct of the business on a generous scale. The development and operation of mines like the Pere Marquette is decidedly beneficial to the coal industry of the state.

The Pere Marquette and Saginaw mines together have been producing steadily at the rate of 1,200 tons or better, daily, during a considerable part of the year 1900. The product of Pere Marquette shaft No. 2 was 16,000 tons of mine run coal, in October, 1900, raised with a force of about 250 men. This company is making strong efforts to extend the field in which business can be done by Michigan mines, and now has regular customers as far distant as Milwaukee.

**RIVERSIDE.**

A new mine, in James township, between Saginaw and St. Charles, with Alexander Zagelmeyer as general manager. The first sod was turned for the shaft on July 16, and the first cage of coal was hoisted on Sept. 17, 1900. The seam is about 3½ feet thick, and the property is a regular producer.

**CHAPPELL-FORDNEY.**

One of the new coal mines of the Saginaw district. It has been opened and is being managed by Richard Stanton, and is now mining and shipping,

**BARNARD.**

This is one of the newest properties of the Saginaw Valley, having been opened in 1900.

**WOLVERINE.**

A new property in Bay County, which has recently begun production, and is owned and worked by the Wolverine Coal Company.

**MONITOR.**

Located in Bay County, about seven miles west of West Bay City. Operated by the Monitor Coal Company, E. L. Mather, superintendent. A producer of a good steaming coal carrying considerable sulphur.

### BAY.

The Bay Coal Mining Company operates two shafts. The officers are as follows: President. M. L. Davies; vice-president, H. M. Gillett; treasurer, W. J. Cummings; secretary and general manager, Alexander Zagelmeyer. Shaft No. 1 is located in the vicinity of the Monitor, and is mining about 1,000 tons per week, from the same seam. Shaft No. 2, located in Frankenlust township, about 6 miles south of Bay City, was started in September, 1900, and struck coal in November, at a depth of nearly 150 feet. The vein is about 4 feet in average thickness. The entire product, slack and all, is taken by the North American Chemical Company of Bay City. The company is making permanent improvements, among which may be mentioned 25 new houses for employees, built during 1900.

### MICHIGAN COAL & MINING.

The Michigan Coal & Mining Company, J. A. Etzold, manager, operates a shaft in the western part of West Bay City.

### CENTRAL.

Operated by the Central Coal Mining Company and located very near the property of the Michigan Coal & Mining Company, in West Bay City. A second shaft will probably be sunk in 1901. W. A. Knapp is superintendent of the mine. The coal is of low grade, containing 4½ per cent moisture; 40 per cent volatile matter; 42 per cent fixed carbon and 12 to 13 per cent ash. The sulphur is very high, reaching nearly 7 per cent. The coal gave 6,717 calories, in a test by Dr. Lane.

### VALLEY.

The Valley Mine is located in Frankenlust township, about one mile southeast of Bay City, and is operated by the Valley Coal Mining Company, the officers being as follows: President, Charles H. Stiver; vice president, Ira J. Hiller; treasurer, Thomas R. Shaver; secretary and general manager, W. N. Sweeney; superintendent, J. H. Metcalf. A second shaft was started in June 1900, and a three-foot vein of coal reached at a depth of 125 feet in August. The product is a good steaming coal, and cokes well.

The Valley company is an enterprising one, and is now building what will be the largest pressed brick manufactory in the state, a deposit of clay well adapted to making the finer grades of brick having been located near the shaft. The trial run of the brick yard turned out upwards of 100,000 pressed brick, of excellent color, finish and strength.

### PITTSBURGH

The Pittsburg Coal Company is a new concern, formed exclusively of Pennsylvania people, which has opened a mine at Amelith, Frankenlust township, near the Valley property. The company controls about five square miles of good coal-bearing ground, located in a contiguous tract in Bay and Saginaw counties. The shaft is the largest in the coal fields of the state, being 9x20 feet in size. John C. Werner is general manager. The company is working vigorously and opening an excellent mine.

### HANDY.

The Handy Bros. Mining Company, C. W. Handy, superintendent, possesses one of the best mines of the Bay County District, the seam averaging materially thicker than to the southward, and the product being of coking variety, and a hot steaming coal. The mine, which is located in Bangor township, north of Bay City, is raising about 250 to 300 tons daily.

### WENONA.

This property, located on the bay shore, not far from the Handy, is owned by the Wenona Coal & Mining Company, with Frederick C. Norris, president; Geo. D. Jackson, vice president: W. J. Conway, secretary, and E. B. Foss, treasurer and general manager. It possesses a seam of about the same thickness and grade as the Handy. Extensive betterments, which will consider-ably increase the productive capacity of the mine, are now being made.

## Salt.

In the production of salt Michigan has long enjoyed a pre-eminent position, her only rival in the manufacture of this commodity being the state of New York, which has a very extensive saline industry at Syracuse and vicinity.

The salt producing territory of Michigan is divided into eight districts, by the state law. All salt is inspected by the State Salt Inspector and his assistants, for which inspection a charge of three mills per barrel is made, the income of the office from this source being sufficient to defray the expenses of inspection.

The fiscal year of the state salt bureau ends on Nov. 30th, hence the figures of the State of Michigan and of the United States Geological Survey are somewhat conflicting. As the state figures do not give estimates of the values of the annual salt output, for purposes of comparison with the salt business of the entire country, I have taken the following figures from the report of the Federal government:

SALT PRODUCTION AND VALUES.

| Year. | Michigan. Bbls. Made. | Value. | United States. Bbls. Made. |
|---|---|---|---|
| 1880 | 2,485,177 | $2.271,913 | 5,961,060 |
| 1882 | 3,037,317 | 2,126,122 | 6,412,373 |
| 1883 | 2,894,672 | 2,344,684 | 6,192,231 |
| 1884 | 3,161,806 | 2,392,536 | 6,514,937 |
| 1885 | 3,297,403 | 2,967,663 | 7,038,653 |
| 1886 | 3,677,257 | 2,426,689 | 7,707,081 |
| 1887 | 3,944,309 | 2,291,842 | 8,003,962 |
| 1888 | 3,866,228 | 2,261,743 | 8,055,881 |
| 1889 | 3,856,929 | 2,088,909 | 8,005,565 |
| 1890 | 3,837,632 | 2,302,579 | 8,876,991 |
| 1891 | 3,966,784 | 2,037,289 | 9,987,945 |
| 1892 | 3,829,478 | 2,046,963 | 11,698,800 |
| 1893 | 3,057,898 | 888,837 | 11,897,208 |
| 1894 | 3,341,425 | 1,243,619 | 12,968,417 |
| 1895 | 3,343,395 | 1,048,251 | 13,669,649 |
| 1896 | 3,164,238 | 718,408 | 13,850,726 |
| 1897 | 3,993,225 | 1,253,403 | 15,972,202 |
| 1898 | 5,263,564 | 1,628,081 | 17,612,634 |

For the fiscal year ending Nov. 30, 1899, the production of salt in Michigan was 4,732,669 barrels, according to the figures of the State Salt Bureau, which may be relied upon as exact.

The eight counties of the state which refine salt are known as districts. The number and name of these counties are as follows:

District No. 1. Saginaw county.
District No. 2. Bay county
District No. 3. St. Clair county.
District No. 4. Iosco county.
District No. 5. Midland county.
District No. 6. Manistee county.
District No. 7. Mason county.
District No. 8. Wayne county.

According to the last report of the State Salt Inspector, the number of concerns engaged in the manufacture of salt, and the production for the year ending November 30, 1899, were as follows:

Saginaw county had 15 producers with 15 steam salt blocks and 1,200 solar salt covers, with an annual capacity of 700,000 barrels, and made 424,432 barrels of salt for the year.

Bay county had 14. producers, with 13 steam salt blocks and one vacuum pan block, and an annual capacity of 800,000 barrels, the output for the year being 405,079 barrels.

St. Clair county had six producers, with four open pan blocks and three vacuum pan blocks. The annual capacity was 1,000,000 barrels, and the year's output was 432,929 barrels.

Iosco county had one salt company, having an annual capacity of 60,000 barrels from a steam block, and made 5,601 barrels.

Midland county had two producers, both with steam blocks, and an annual capacity of 50,000 barrels, the production for-the year being 26,700 barrels.

Manistee county had nine producers, operating 10 steam blocks and three vacuum pan blocks, with an annual capacity of 3,000,000 barrels, and an actual production of 2,205,182 barrels. This district is much the largest producer in the state.

Mason county had three producers, operating three steam blocks and two vacuum pan blocks, with an annual manufacturing capacity of one million barrels, and an actual output of 560,123 barrels.

Wayne county had five producers, operating five steam blocks and one vacuum pan block, with an annual capacity of one million barrels and an actual product of 672,623 barrels.

Summarized by counties, the salt production of the state for the year ending Nov. 30, 1899, was as follows:

| County. | Bbls. |
|---|---|
| Manistee | 2,205,182 |
| Wayne | 672,623 |
| Mason | 560,123 |
| St. Clair | 432,929 |
| Saginaw | 424,432 |
| Bay | 405,079 |
| Midland | 26,700 |
| Iosco | 5,601 |
| Total | 4,732,669 |

Divided by grades the production of the state was as follows:

| Grade | No. Bbls. |
|---|---|
| Medium No. 1 | 2,706,434 |
| Granulated No. 1 | 1,744,961 |
| Medium No. 2 | 18,712 |
| Granulated No. 2 | 26,210 |
| Packers' | 29,892 |
| Solar | 17,353 |
| Table | 189,107 |
| Total | 4,732,669 |

For the year covered, there were 57 firms engaged in the manufacture of salt, employing a total of 62 blocks and 1,200 solar salt covers, but one concern making solar salt during the year. The largest manufacturers were Buckley & Douglass, of the Manistee district, who made 675,308 barrels.

For the fiscal year 1899 the following named counties increased their production over the preceding year-by the number of barrels noted: Manistee, 650,176; Wayne, 125,530; Bay, 2,848; Mason, 2,285; Saginaw, 388. The following named counties showed decreased outputs: St. Clair, by 163,618 barrels; Iosco, by 52,757 barrels; Midland, by 5,099 barrels. The net result of the operations for the fiscal year 1899 shows a gain in production amounting to 560,753 barrels.

Despite the closing down of a number of salt blocks and the failure of owners to rebuild many of the blocks burned, the production of salt in this state is increasing rather than diminishing, contrary to the general impression that the industry is suffering a decline. The decline is in the profits, and not in the production. Salt has become a very cheap commodity, and the manufacturers still in the business are enabled to earn profits only by the exercise of the utmost economy, and the use of the most advanced methods in production and marketing.

According to the reports of the state bureau of inspection, which are more reliable than those of the United States Geological Survey, the total production of

salt by Michigan to Nov. 30, 1899, has amounted to no less than 86,675,398 barrels.

## Gold and Silver.

While Michigan does not rank with the leading producers of the precious metals, among the states of the union, the value of the gold and silver produced by the mines of this commonwealth is by no means insignificant. The gold production of the state has been practically all from Marquette County, and by far the greater part has come from one mine, the Ropes, located four and a half miles from Ishpeming. This mine was discovered, in the serpentine rocks north of Ishpeming, by Julius Ropes, nearly twenty years ago. The Ropes Gold & Silver Company was organized in 1882, and regular mining was begun on a well defined fissure vein of quartz lying in a schistose country rock. A five-stamp mill was built in 1883, and from year to year the mine was deepened, new machinery added—and assessments levied. The original cash capital was so small, and the assessments were each so trivial in amount, though levied with exasperating frequency, that the mine never had enough money at its command to do the things required to render it successful. A great deal of work was done, but the corporation reached the end of its tether in the summer of 1897, when all work was suspended and the property placed in the hands of a receiver. The first sale by the receiver was set aside by the court, on account of the successful bid being too small, and the mine was sold for a second time, and the last sale ratified by the court, to Corrigan, McKinney & Co., of Cleveland. This firm has probably managed to find enough gold and silver in the discarded amalgamating plates and in the dirt under the stamps and vanners, to replace the original price paid for the mine, and leave a profit. A cyaniding plant was put in operation during 1900, and the old tailings treated until freezing weather put a stop to the work. The cyaniding will be resumed in the spring of 1901, and it will probably take all of the coming season, and perhaps part of 1902, to complete treating the tailings. Messrs. Corrigan, McKinney & Co. have no statement to make regarding the returns of their operations, but it is known that their work has been profitable. The estimated value of the tailings is $2 per ton, and estimates of the amount of stamp-sand available run as high as 200,000 tons, which is probably very much too large. The plant of machinery is quite valuable, including a 65-stamp mill, hoists, a good air compressor, vanners and the usual outfit of skips, cables, blacksmith tools, etc. The mine and machinery will be left as by-products, after the cyaniding is completed at a profit. It is possible that the mine may be worked again by the new owners, but this point has not yet been decided. The future of the Ropes as a mine will probably depend upon the final results secured from the tailings, and a thorough examination of the mine. Corrigan, McKinney & Co. have been energetic and successful operators on the Lake Superior iron ranges for many years, and possess the capital and experience to work the Ropes vigorously if they should decide to do so. I am of the opinion that there are paying gold deposits in the Ishpeming District, and that this statement will eventually be fully proven by the opening of profitable mines.

During its period of activity the Ropes produced gold and silver to the value of $647.902.37, the gold forming approximately four-fifths of this amount. The returns secured by the present owners from the cyaniding process are not included in the foregoing figures. The mine is nearly 900 feet in depth and can be unwatered and put in working order in a few weeks.

About ten years ago the "Michigan" Mine was opened, three miles west of the Ropes, in the same serpentine group. From three small pockets, in a quartz vein running two to three feet in width, gold and silver were secured to the value of $17,699.36. The Michigan became a stock-jobbing enterprise, and was never given anything like the development warranted by the amount of gold taken from two shafts less than 100 feet in depth. There was also litigation over the property. This mine is worthy of a more careful and conscientious test than has ever been given it in the past.

The third gold producer of record, of the Ishpeming District, is the Fire Centre, which mined gold and silver to the value of $2,063.60.

In addition to the foregoing, there were a number of properties, some of which were owned by individuals and pools, and others by regularly organized, mining companies, on which more or less money was expended, though there were few on which more than two or three thousand dollars were spent. All of these showed gold, and from some of them several hundred dollars worth of gold and silver were taken, but the product went as "specimens" and did not replenish the coffers of the owners. Among these mines, or attempts at mines, were the Superior, Gitchee Gummee, Davis, Grayling, Gold Lake, and a score or so of others.

The Director of the Mint has kindly furnished me with the following figures, showing the value of the gold and silver taken from Michigan mines during the past thirteen years. The coining value of gold is the face value, but the coinage value of silver is subject to a discount averaging about 50 per cent:

| Year. | Gold. | Silver. |
|---|---|---|
| 1887 | $26,000 | $ 35,000 |
| 1888 | 42,000 | 84,000 |
| 1889 | 70,000 | 77,575 |
| 1890 | 90,000 | 71,111 |
| 1891 | 75,000 | 94,384 |
| 1892 | 70,000 | 84,816 |
| 1893 | 42,000 | 56,242 |
| 1894 | 44,444 | 45,410 |
| 1895 | 42,900 | 48,220 |
| 1896 | 37,200 | 76,283 |
| 1897 | 62,700 | 77,964 |
| 1898 | 100 | 41,891 |
| 1899 | 100 | 145,843 |

Notable features of the returns for the last two years are the falling off of gold production to merely nominal figures, and the great increase in the silver product

noted in 1899. The almost total disappearance of the gold output was caused by the closing down of the Ropes Mine, while the remarkable increase in the supply of silver is due to the increased amount of that metal saved from the copper. Even with the crude and wasteful methods formerly employed, and notwithstanding the vast amount of peculation on the part of the employees, from the miner in the stopes to the boys in the mills, the silver output of the Michigan mines has averaged more than one per cent of the value of the copper. With the introduction of electrolytic refining, recently tried by the Quincy and to be adopted by the Calumet & Hecla for certain grades of mineral, the production of silver is likely to increase from the older mines, while in the case of the Phœnix, Adventure, Mass, Michigan and other new or reopened copper mines known to be rich in silver, the necessary steps will be taken to secure the parting of the silver from the copper, which will still further augment the silver production of the state.

In the western or Porcupine Mountain end of the Keweenawan copper formation in Michigan, considerable silver has been found from time to time, and a promising silver boom was started about twenty-five years ago, in the so-called Iron River District, but did not develop staying powers. There was plenty of silver, but it could not be had without heavy initial outlay for mining development and equipment, and capital was too timid to risk the venture. There are also considerable deposits of argentiferous galena, mainly in Marquette County, in gash veins in the Huronian rocks, but no particular amount of capital or effort has ever been devoted to the silver-lead finds.

## Minor Minerals of Michigan.

I have collected a considerable amount of data relative to sundry metals and minerals found in this state, which have not been referred to in the foregoing chapters on the iron, copper, coal and other mineral industries of the first rank in Michigan, and .had intended treating of them in extenso, but as this work has already reached twice the length of any preceding report on Michigan minerals published since the establishment of the office nearly a quarter of a century ago, must content myself with a very brief summary, hoping to give the matter more space in the next volume of Mineral Statistics of Michigan.

### NICKEL.

The principal supply of the world of this useful metal is found in the vicinity of Sudbury, Ontario, about 300 miles due east of the Lake Superior copper district. Nickel is an important element in the new mineral "mohawkite", occurring in a fissure vein in the Mohawk Mine, detailed reference to which will be found in an article on that mine in the copper section of this book. A little nickel has also been found in a small fissure vein in the Baltic copper mine. The metal has been identified in the Ropes gold mine, and at other points in the territory north of Ishpeming, where there is a great variety of minerals to be found.

### ZINC.

The recent work of the Michigan Geological Survey in the Saginaw Valley coal district shows many traces of zinc, and the ores of zinc have also been found in limited quantities in drill borings in that district. Zinc is found in limestone formations, and the geological conditions in the Michigan coal measures are favorable to the existence of the metal, though whether or not it may be found in quantities of commercial importance is a question remaining to be settled by further developments. Zinc is found mainly in the form of a sulphide—sphalerite; as a carbonate—smithsonite; and as a silicate—calamine. There are also other ores, but they are of little commercial importance. The sulphide furnishes the bulk of the product obtained in this country, and comes in isometric crystals of varying sizes, known to miners as black jack, ruby jack and rosin jack, according to col or. Calamine, the silicate, is usually found as an efflorescence, near the surf ace, and while valuable, is of less frequent occurrence and is found in smaller masses than the zinc blende, or sulphide ore of zinc. Smithsonite, or zinc carbonate, termed "dry bone" by miners, is also of comparatively rare occurrence, and consequently of minor industrial importance.

### LEAD.

This important metal is found at many points in the upper peninsula of Michigan, principally in Marquette County, in the form of galenite, or sulphide of lead. This is a very heavy, rich ore, easily smelted, and decidedly valuable where found in workable quantities. The principal American sources of lead supply are in the limestones of the middle west, and in the auriferous, argentiferous and cupriferous ores of the Rocky Mountain states, where the lead is valuable, not only for itself, but also as a highly desirable flux for the reduction of sundry refractory ores of the precious metals. It has been found at many points in Marquette County, but has nowhere been developed to any important extent, and has never been regularly mined, with the exception of a short time at the Holyoke silver-lead mine, north of Negaunee, where a few tons were produced nearly forty years ago.

### MANGANESE.

One year with another, the Lake Superior iron mines of Michigan and Wisconsin produce about 200,000 tons of iron ore called manganiferous. the percentage of manganese in such ores running low as a rule, though some cargoes averaging about 17 per cent in manganese have been sent from, the Dexter iron mine, west of Ishpeming, where the ore lenses are so pockety that the production to date has been small. At the present time a fissure vein carrying impure pyrolusite in

considerable quantities is being reopened on the old Clark copper mining property, near Copper Harbor, Mich., further reference to which will be found under the title of Clark Mine in the copper section of this work.

### ANTIMONY.

Antimony in small quantities has been found in the gash veins in the granite lying to the north of the Marquette iron range, and in some of the fissure veins crossing the Keweenawan trap formation toward the end of Keweenaw Point. None of the discoveries have been of apparent commercial importance. The American production of antimony for 1898 was only 697 tons of stibnite, the sulphide ore, obtained from California, Nevada, Utah and Idaho, and so impure that it carried only 53 to 65 per cent metallic antimony.

### ARSENIC.

This element is found in various copper ores in Marquette and Keweenaw counties. Its only production commercially is from the mohawkite mined from a fissure vein in the Mohawk mine, Keweenaw County, mohawkite being a double arsenide of copper and nickel, carrying some cobalt—which is usually found closely associated with arsenic—and traces of iron. Owing to there being no American smelter adapted to refining arsenical-ores, the mohawkite, two cargoes of which have been shipped, are sent to Swansea, Wales, where future cargoes will probably continue to go, for reduction.

### COBALT.

This element, usually found in close association with arsenic, nickel and sulphur, is found to the extent of about 2 per cent in the mineral mohawkite. mined at the Mohawk copper mine, and traces have been found in galena and copper ores lying in the gash veins of the granite in Marquette County. American imports of oxide of cobalt for 1898 were 33,731 pounds, valued at $49,245, and used chiefly in the pottery trade. The mineral has been found in small quantities in Connecticut, New Jersey and California.

### PYRITE.

This is the sulphide of iron, carrying a trifle more than one half sulphur, by weight. Its principal value is in making sulphuric acid, and it is consumed in enormous quantities. Few people appreciate the great value of this commodity and the quantity consumed in the trades. It takes an average of about one pint of this acid—"oil of vitriol"—to refine a gallon of kerosene oil. It is the base from which nitric acid is made, and its uses are legion and rapidly increasing. The American production of sulphuric and sulphurous acids—the latter used mainly for bleaching—was probably not less than one million tons, worth $10 or more per ton, in 1899. Practically all of this enormous quantity was made from iron pyrites, much of which was imported. Pyrite is usually found in crystals of medium size, isometric and frequently cubical. It has a brassy color, and is known as "Frenchman's gold", or "Fool's gold", from its similarity to that metal in the eyes of the inexperienced; miners call it mundic. It is found quite freely in the iron measures and granite gash veins. Dr. Alfred C. Lane, state geologist, has been devoting some attention to the pyrite found quite plentifully in Huron County, in the lower peninsula of Michigan, and believes there are deposits of considerable commercial importance in that district. A shaft has been sunk near Bay Port, and gives a favorable showing. Detroit is rapidly becoming an important chemical manufacturing center, the salt deposits of the state favoring the building up of industries along this line in the eastern half of the lower peninsula, where cheap freight rates are procurable, and workable deposits of pyrite would probably find a good market in this state.

### SANDSTONE.

This important building stone is found at a number of points in Michigan. A fair quality of gray freestone, adapted to building purposes and weathering well, is quarried to some extent in Jackson County, and sandstone for building use is quarried in several other counties of the lower peninsula, to a, limited extent. The finest deposits of sandstone in the state, or for that matter in the United States, are found in the upper peninsula, in Marquette, Houghton and Baraga counties. There is a large quarry in the southern part of the city of Marquette, and other quarries are located on the western shore of Keweenaw Bay, in Baraga and Houghton counties, the principal point of activity being near Portage Entry. The demand for this stone has shown a considerable increase during 1899 and 1900, the industry having been much depressed for some years following 1893. Two varieties of this stone, of quite marked diversity in color, are produced, these being known as brownstone and redstone. A varietal form of brownstone known as "rain-drop" is an especially beautiful building stone. The sandstone from the local quarries is in extensive use in Marquette and Houghton counties, and is shipped to all parts of the United States where a strong and beautiful building stone is in demand. The Lake Superior colored sandstones are of exceptionally fine grain and great strength, hardening after continued exposure to the air. The oldest buildings constructed of this material show scarcely any sign of disintegration from the action of the elements, which usually impairs the value of the coarser sandstones in local use in many parts of the country, the ordinary varieties of sandstone having a tendency to flake and cleave from frost.

The quarry at Marquette is divided into two parts, one of which, the Burt quarry, is operated by Col. J. H. Jacobs, of Marquette. The other, or Furst-Jacobs quarry, is worked by the Portage Entry Quarries Company, which also operates a redstone quarry at Portage Entry, Houghton County. The Kerber-Jacobs Redstone Company and the Superior Red Sandstone Company

also work quarries in the Keweenaw Bay District. The latter is a new concern, incorporated Dec. 20, 1899, with a capitalization of $50,000, divided into 2,000 shares of the par value of $25 each, with Jeremiah Arn as manager. The company has recently concluded a highly successful first season's work. In addition to the quarries named, there are nearly a dozen others on which more or less work has been done, but which are now idle because of inferior quality of product, expense of production, poor shipping facilities, or lack of capital or experience. Sandstone is a bulky product, the market for which cannot be indefinitely expanded, and its production at a profit calls for considerable capital, experience and ability. Good transportation facilities are imperative, and the quarries located near water routes have a great advantage over those otherwise placed. The depth of the overburden of drift is also an important point, as this must all be removed. The quarries take out and ship stone during the season of navigation, and work greatly reduced forces during the winter, at the removal of the "stripping" overlying the stone, which is found in strata lying horizontally, or very nearly so. Power channelers and rock drills are used in all the important quarries, and the industry gives employment at good wages to several hundred men.

### SLATE.

Slate has not been quarried in Michigan for some years, but there are extensive deposits near Arvon, on Huron Bay, Baraga County, which were worked quite vigorously for a number of years. The Michigan Slate Company was organized in 1881, with a capitalization of $500,000, the late J. M. Turner, of Lansing, being manager, and operated the quarry near Arvon for about ten years, but without profit. A five-mile railway was 'built from the quarry to the bay, a $10,000 hotel erected, and considerable money spent for other improvements not actually necessary in the work. The chief difficulty met was in securing pieces of large size, but it is possible that the quarry might be made to pay if worked upon a more modest and economical basis. A bed of slate of promising quality was found in Section 14, Town 48 North, Range 34 East, near Covington, Baraga County, in 1898, and some layers of slate as large as 2x4 feet in size by a quarter inch in thickness were secured there.

### SAND.

There are ample deposits of sand, suited to building uses, in every county in the state, these being entirely too ample for the comfort of the farmer at some points. Much of this sand is adapted for use in making the coarser varieties of glassware, and at points there are large banks of fine-grained quartz sand, suitable for the better grades of glass. The best known bed of glass sand rock in the state is in the extreme southeastern corner of Monroe County. Attention was directed to this deposit by a number of the earlier geologists, and also by Dr. Hubbard in the later reports of the State Geological Survey. The stratum of sand rock outcrops for some distance in the bed of the river Raisin, near Raisinville, but to the southward is covered by drift. This rock was quarried, crushed and washed by Charles Toll, of Monroe, for a number of years after 1860, the product being sold to glass factories of Ohio, Pennsylvania and New York. The crudity of production forced suspension of work in 1873, though the quality of the sand has never been excelled, analyses showing it to be of surpassing purity, giving better than 99½ per cent pure silica, with mere traces of calcium and magnesium carbonates, and no iron whatever. The sand is very white, and a superior article in every respect.

The Toll quarry and ad joining lands have recently been acquired by the Michigan White Sand Company, of Maybee, Mich. W. H. Cowles is president and F. G-. Strong secretary of this corporation. The company has been experimenting with a process of dryrwashing, by which the sand is heated to 400 degrees Fahrenheit and separated into several grades by sifting. The management is much pleased with the results obtained, and is contemplating the erection of a plant capable of turning out 150 tons of graded sand daily.

### LIMESTONE.

This useful stone is found freely in nearly all parts of the lower peninsula and at a number of points in the upper peninsula, and ranges in quality from the coarse and scaly variety of common occurence to the hard and fine-grained dolomites, which are half marble. It is used at many points for a cheap building stone, mainly for foundations, and for lime burning, also for flux in iron furnaces.

### MARBLE.

Marble is found at several points in the upper peninsula, notably north of Ishpeming, and on the Menominee Iron Range, north of the mines. The Northern Michigan Marble Company opened a quarry of excellent grade in 1892, on Section 26, Town 42 North, Range 28 West, near Foster City, in the Felch Mountain District, on lands owned by Houghton County. The company was hard hit by the panic of 1893, which not only brought about a great slackening in building, but caused many people who did build to consider that brick was far more beautiful than marble, by reason of its lesser cost. The Northern Michigan Company is getting on its feet again, and the Houghton County board has manifested a proper spirit of encouragement to the company by remitting accrued royalties. Work at the quarry will be resumed next season.

Just north of Ishpeming, in the serpentine group, there is located some of the finest verde antique found anywhere upon earth. This mineral, which is a dolomite, is mined to a limited extent in Tennessee, and has also been found in Georgia, but practically the entire world's supply comes from Italy, where quarries have been worked for centuries, and are still productive. This stone is worth $4

to $8 per cubic foot, in finished form, and is used only in the richest interior work of costly buildings. The bed owned by the Deer Lake Company, of Ishpeming, in Section 30, Town 48 North, Range 27 West, is worthy of development. The stone therefrom is among the most beautiful found any where, and is compact and can be quarried in large pieces, at comparatively small cost. The stone is not inaccessible, being located within a short distance of rail and water communications, and would not be expensive to quarry.

### GRANITE.

The backbone of the western half of the upper peninsula of Michigan is granite. There are some fine qualities of this durable rock, in different colors. A large and apparently prosperous quarry has been developed at Amberg, Wisconsin, just south of the Menominee Iron Range, the principal product being Belgian blocks, for paving purposes.

### STAMP SAND.

During 1899 and 1900 a number of cargoes of waste sand from the stamps of the Tamarack mill have been taken by lake to Toledo, Ohio, by the Lake Erie Asphalt Block Company, which mixes the sand with asphalt in the manufacture of paving blocks. The industry seems to be a growing one, and the blocks made by this concern, have given great satisfaction wherever used.

### GYPSUM.

The gypsum trade is an important one, Michigan furnishing more than one-third of the entire production of the United States. The principal seat of the industry is at Grand Rapids, which is underlaid by several strata of hydrous sulphate of calcium, which is the raw gypsum. The beautiful mineral alabaster is merely a massive gypsum, cemented under great natural pressure, and is the purest white found in nature in mineral form. The gypsum trade of 1898 was very active, the Michigan production amounting to 94,874 tons, having a value of $193,576, while the entire United States output was 288,982 tons, valued at $7.55,864. For 1899 the high water mark of the preceding year was left far behind, the Michigan production amounting to the remarkable total of 144,776 tons, worth $283.537, while the output of the entire country was 428,661 tons, valued at $1,036,860. Of the 1899 production of Michigan quarries, 39,266 tons were sold crude, for $47,178; a quantity of 17,195 tons was ground into land plaster and sold for $27,030, and 88,315 tons of crude gypsum were calcined into stucco, making 71,543 tons of the finished plaster of paris, valued at $209,329. The finished product is used for stucco work, mainly for interior finish, and a large portion is put through further processes, in which various retarding elements are added, and sold as patent plasters. The varieties of wall finish for which Grand Rapids is famous all over the world have plaster of paris as a base, with sundry mineral colors added for tints, and are prepared under secret formulæ, by which suitable ingredients are added to secure greater adhesiveness, to retard setting and to prevent flaking. This product is growing in popularity and is rapidly displacing other forms of wall finish.

### MARL.

Marl is a mechanical mixture of carbonate of calcium (limestone), mainly in the form of infusoriæ, with clay and sand, and is found at a number of points in Michigan, notably in the vicinity of Coldwater, though of frequent occurrence at a number of other points in the lower peninsula. Further, investigation will doubtless reveal additional deposits. The workable beds of marl are usually found underlying inland lakes, and the beds are frequently of considerable thickness. These beds vary greatly in grade, as limestone, sand or clay predominate in their composition, and are accordingly of different degrees of value. The commercial uses of marl are for fertilizers and the making of cement, and for this latter purpose some of the Michigan beds are excellently adapted, while nearly all are of more or less value for cement manufacture, though not all of the deposits will give the higher grade products.

In 1893 the United States made only 25 per cent of the Portland cement used in the country. There was a general distrust of the domestic article, which was perhaps warranted by the inferior cements so commonly manufactured in the United States. In the past seven years there has been a remarkable advance in this industry, and the good brands of domestic cement are rapidly finding their way into popular favor, and are more extensively used every year by critical builders, who would have laughed at the idea of employing anything but an imported cement for the better grades of cement and concrete work, ten years ago. In 1898 the United States made 70 per cent of the Portland cement used in the country, and in 1899 the figures of 1893 were reversed, three-quarters of the Portland cement used being made at home and only one-quarter imported. Five or ten years more will see practically the end of importations of cement into the United States.

In 1898 there were 18 factories in the United States making Portland cement with quarried limestone as a base, the sand and clay being added in the factories, while 11 factories were making cement directly from beds of marl. In no other state is the industry of cement manufacture growing so rapidly as in Michigan, and I look to see this state take the commanding position in marl that it has long enjoyed among the sisterhood of American commonwealths as a producer of iron ore, copper, gypsum and salt.

Recent explorations by the Michigan Geological Survey—which is doing a practical work of great value to the entire state—have shown the existence of promising beds of marl in the upper peninsula, these being to the east and south of the iron and copper districts. There seems no good reason why cement manufactories

started with adequate capital and properly managed could not do well in the upper peninsula, especially as the marl beds are well located with a view to shipping facilities, and would be able to get the benefit of cheap rates by water transportation.

Marl is frequently used as a fertilizer, but is of very unequal value for this purpose. Some lands are improved by it, and others are not, while not all varieties of marl are good manures, those deficient in phosphoric acid and phosphates not being of much benefit. The probable value of marl as a fertilizer is a matter that ought to be left to the chemist, and assays both of the soil and of the marl will soon determine whether the proposed dressing will or. will not be beneficial, and if the former, to about what probable extent.

## ASBESTOS.

Asbestos is used extensively for fireproofing, fireproof paints, steam packing and covering for steam pipes and boilers, to all of which uses it is well suited, being absolutely incombustible, and an excellent non-conductor of heat. This mineral was found some seven years ago in the serpentine group north of Ishpeming, the fibres being rather short, running about an inch in length. Asbestos has also been found near Republic. The demand for a good quality of the mineral is strong and constant. In 1898 the United States imported asbestos, mainly from Canada, to the value of $300,533, and produced only 605 tons, worth $10,300, the domestic production being made by the states of California and Georgia.

## CLAY.

This mineral is as common as mud, and twice as sticky, in Michigan. Few counties are without considerable quantities, though it is rather scarce in some of the mining counties of the upper peninsula, where there are insufficient deposits for brick making. There are extensive manufactories of brick, tile and sewer pipe at a number of points in the lower peninsula. In 1898 the production and value of the brick made in Michigan were as follows:

| Kind. | Number. | Value. |
|---|---|---|
| Common | 120,626,000 | $467,118 |
| Pressed | 15,726,000 | 82,533 |
| Paving | 34,000 | 510 |
| Total | 136,386,000 | $550,161 |

Clay is extensively used in Detroit for the manufacture of pottery, though the article is not the true China clay, and does not give the better grades of porcelain.

## SHALE.

Shale is of frequent occurrence in the upper part of. the lower peninsula, and will probably be found also in the adjoining portions of the upper peninsula. This is valuable for the manufacture of superior grade brick, and will doubtless be utilized for that purpose within a short time. The ordinary shale brick is as cheaply made as the brick of common clay, and while fully as durable is a much handsomer article.

## KAOLIN.

Kaolinite. commonly known as kaolin, is the true china clay, and adapted for the making of the finest porcelains and pottery. It is a hydrous silicate of alumina, averaging about 40 per cent oxide of alumina, 45 per cent of silica, and 15 per cent of water. It is rarely found free from some one or more of along list of impurities, usually of a mechanical rather than a chemical nature, this formidable list of undesirable elements including iron in various forms, magnesia, titanic acid, mica, quartz, feldspar and sundry alkalies. Kaolin is extensively used in making high-grade pottery and encaustic tiling and to some considerable extent in paper making, where it is used to "load" the weight, while also imparting a smooth surface to the cheaper grades. Very few of the cheap "S. & S. C." book papers ever see the white of an egg or any other expensive sizing material, kaolin doing the work. The refined kaolin is worth $7 to $12 per ton at the potteries of New Jersey and Ohio, the price depending on the amount of impurities left after the rough cleansing process has been completed at the quarries.

There is a deposit of kaolinite, apparently of considerable extent, outcropping on a bluff on the east bank of the Ontonagon River, near the old Minnesota Landing. This was worked in the seventies, in a primitive manner, one small cargo having been shipped annually for a number of years. A company was organized in Marquette in 1875 to develop and operate this bed, but the property was sold in the following year to W. Robinson & Co., of Akron, Ohio, who still owned it, at last accounts. Other beds of kaolin have been reported in the upper peninsula, in Baraga, Marquette and Ontonagon counties, but have never been worked.

## FELDSPAR.

Feldspar, frequently known to the trade as "spar" only, is a silicate of alumina, carrying silicates of potassium, sodium and calcium in varying quantities, and occasionally barytes also. The varying proportions of these constituent elements affect the value and color of the spar, which ranges in shade from white, lemon, and light green, to pink. Frequent impurities, which detract greatly from the value of the product, are oxide of iron, mica and crystals of quartz. The basic, or plagioclase spars are usually quite impure, augite being the most common element of detraction. The orthoclase, or potash-base feldspar is more commonly used, because of its greater freedom from impurities. Kaolin is merely a decomposed feldspar, and the spar itself is used for practically the same purposes as kaolinite, but being a true rock form rather than a clay, must be pulverized by grinding before becoming available for the various commercial uses to which it is put. Spar is used as a flux for pottery mixtures, and also as a glaze for white porcelain. It furnishes the beautiful gloss seen on

encaustic tiling, and is used to considerable extent as a soft abrasive for polishing silver and other metals. Another important use is in the making of soap, where only the orthoclase or alkaline variety is valuable. The carefully prepared ground spars are replacing tripoli for polishing purposes, to a large extent, arid the market for feldspar is a steadily growing one. The American production of commercial spar in 1898 amounted to 21,350 tons, valued at $107,147, and the figures for 1899 and 1900 will be found to show a considerable increase in production.

The home of feldspar is in the granite and serpentine rocks, which are so freely found in the iron ranges of Michigan. A lease of the southeast quarter of Section 22, Town 47 North, Range 29 West, was taken by Edward Gannon, in the spring of 1900, for a thirty-year term, for the mining of feldspar, at a royalty of 30 cents per ton on the production secured. The average price of good spar is $5 to $6 per ton, and even more for the best grades, delivered at the potteries. Spar has been found at several other points in this state, but as a rule the Michigan product is quite impure, and hardly suited to the finer requirements of the pottery trade. With such a vast range of minerals as is found in the upper peninsula—almost a mineralogical cosmos—it is probable that the best grades of feldspar exist in large quantities, and can be found by careful search.

### TALC.

This is one of the most common minerals of the iron districts of Michigan, the soapstone walls so frequently found in the iron mines being of talc. This grade is of no value, however, the commercial product being the fibrous talc, which at present is mined in the United States only in St. Lawrence County, New York. It is said in the report of the United States Geological Survey for 1898 that the St. Lawrence County beds are the only deposits known in this country, but the statement is erroneous. On the lands of the Deer Lake Company, in the serpentines north of Ishpeming, that mineral treasure-house so frequently referred to in this chapter on the minor minerals of Michigan, there exists a considerable deposit of talc of fine, fibrous nature, apparently of as good quality as the product taken from the New York mines. The American production of fibrous talc in 1898 was 54,356 tons, valued at $411,430, all from St. Lawrence County, Michigan capital being quite extensively interested in the operation of the New York talc mines. Michigan should be, and doubtless will become, a producer of this mineral.

### MICA.

Muscovite, or potash mica, commonly called isinglass, is a somewhat complex silicate of potassium, aluminum and sodium, frequently containing small amounts of iron and manganese. It is held by mineralogists to be of both igneous and secondary origin, and is found with the granitic and schistose rocks, occurring usually in pegamite dykes in granite. It is mined in this country principally in New Hampshire and South Carolina, though produced to a limited extent in the Black Hills of South Dakota, and occurs in many of the western states. The American production is not equal to the demand, and large quantities are imported annually. Its principal uses are for furnishing transparent doors for stoves, where glass would crack or melt from heat, and in the electrical industries, where it is very extensively employed for insulating purposes. It is also used to a limited extent as the base of lubricants for heavy bearings, and in a small way for other purposes.

Muscovite is usually found in a matrice of feldspar, and occurs in masses ranging from a fraction of an inch in cubical size to pieces running as large as a foot or two in width by two and even three feet in length, the larger pieces being of comparatively rare occurrence. The average of the best deposits worked in this country give "books" 3 to 12 inches square by one to six inches thick. These "books" have been found running up to several hundred pounds in weight. The larger the superficial area of each "book," the greater its value, as high as $8 per pound having been paid for the very choicest and largest sheets of mica. The average price of commercial mica is 25 cents to $2 per pound, according to grade and size. There is much waste, running from 25 to 90 per cent, in preparing the sheets for market from the crude "books" mined, the waste being ground up and sold for making lubricants. Mica ranges from a beautiful transparent sheet, almost devoid of color, through yellow and pink shades to the grade known as "smoky", which in its natural state has about the same color as a sheet of mica in a parlor stove after it has been smoked by a winter's use with hard coal. Specks are also common, and greatly injure the product in price, as they detract from the appearance of the sheet as a transparency; and ruin it as an insulating material, because the specks usually have an iron base, and short-circuit the electrical currents.

The existence of mica in the vicinity of Republic has been known for many years, and a little work of an exploratory nature has been done at several points, but at no place has any very decided effort been made to do more than secure a few good specimens of block mica. Not enough has been done in this line to assure the existence of high-grade deposits of muscovite in the district, many of the specimens secured being smoky, but there is a fair prospect that workable deposits of considerable value might be developed if the development were gone about systematically, and with sufficient capital to assure a fair test. Perhaps the most promising deposit of mica found in the state was discovered near Bessemer, in 1897. Some "books" cleaving into sheets 3x4 inches were secured near surface, and the mica was exceptionally clear, both as to color and freedom from specks. No serious attempt has ever been made to develop the deposit near Bessemer.

## GRAPHITE.

This mineral is an allotropic farm of carbon, which is found in nature in hexagonal crystals and in foliated form. The production of the United States for 1898 amounted to 890 tons of amorphous graphite and 1,180 tons of crystalline graphite, taken from the mines of Alabama, New York, Pennsylvania. Rhode Island and Michigan. The principal sources of supply for many years were in the neighborhood of Brandon, Vt., and Fort Ticonderoga, New York. The aggregate value of the American production, of a trifle more than 2,000 tons, was $75,000, and in the same year 13,482 tons, valued at $743,820, were imported, showing that the United States produces only 10 per cent in value of its annual consumption of this indispensable mineral. The chief uses of graphite are for making lead pencils, stove polish, lubricants, paints, and crucibles, though it is used to some extent in other industries. Amorphous graphite is manufactured as a by-product in the making of carbide of calcium, at the electrical furnaces at Niagara Falls, resulting from the excess carbon placed in the retorts in the form of coal braze.

Graphite is found throughout the iron formations of Michigan, usually in thin seams of impure mineral along the walls, occurring most frequently on the footwall. It is also found in the granite north of the iron measures. A graphite mine was opened in Section.16, Town 49 North, Range 33 West, Baraga County, in the early eighties, but was never worked extensively, and was closed down nearly ten years ago. This mine was the property of the Detroit Graphite Manufacturing Company. The Hathaway Graphite Manufacturing Company, of L'Anse, Mien., was organized in July, 1900, the incorporates being all residents of Detroit, with Rollin Hathaway as president and general manager. The old company used the product of the mine mainly in the manufacture of mineral paint, which is very durable, and especially well suited to covering and preserving metallic surfaces. The mine is located about ten miles east of L'Anse and is developed as an open pit. The Hathaway company has prepared quite elaborate plans for the operation of the mine and manufacture of the product, it being intended to utilize the energy now running to waste in Fall River, at L'Anse, where a 150-horse-power turbine wheel may be installed, to furnish power for grinding and manufacturing the graphite. Electric light carbons will be made and a portion of the raw graphite shipped for manufacture into paint, stove polish and possibly leads for pencils. The latter use demands the very finest grade of plumbago, but the owners of the Baraga County mine feel confident that they can supply an article fully equal to the best imported product, and if this proves the case, a large market can be found readily for the output of the mine. The bed of mineral has a dip of about 45 degrees, and is apparently of unusual width and extent. The overburden is removed by stripping, and the mine will be operated as an open pit during the spring, summer and fall months, closing down each winter.

Graphite is found at a number of points in Dickinson County, but no wide seams have yet been opened in that district. A considerable body of the mineral was found near Humboldt, in 1884, and a little work was done on it by Zinner Brothers, of Milwaukee. Graphite is of quite common occurrence at the iron mines of the Marquette and Menominee ranges, but when associated with iron ore is nearly always found in seams too thin to work profitably.

## GRIT.

This is a sharp-grained, silicious sandstone, used for making grindstones and whetstones. The American production is practically all from different varieties of Lake Erie sandstones. The Berea stone, so widely used for flagging, is the best known sort, and is very extensively quarried for building purposes and for sidewalks and stone steps, but the variety best adapted to grinding uses is found near the end of the "thumb" of the lower peninsula of Michigan, in Huron County, in the vicinity of Grindstone City and Port Austin. In this district the grit strata lie in a nearly horizontal position, with a very light drift overburden, and frequent outcrops to surface. The strata giving the finest stone vary from 3 inches to 3 feet in thickness, the series of strata being 15 to 20 feet in average thickness. The stone is soft and easily quarried, but soon hardens on exposure to air. The first quarry in Huron county was opened in 1838, and the industry has been a small but steady one for the past forty years. Grindstone City is what its name implies—a town devoted to the making of grindstones. The product of its quarries and stone-shops is favorably known throughout the United States, and in many foreign countries. The value of the Huron county output of grindstones and allied products averages above $100,000 annually.

## BUHRSTONE.

A quartz conglomerate, excellently suited to the making of buhr-stones for flouring mills, is found at several points in the upper peninsula, though it has never been quarried for this purpose. Owing to the very general adoption of the so-called "patent" process of milling, in which steel rollers with corrugated surfaces do the grinding, the demand for buhrstone is decreasing throughout the world.

## NOVACULITE.

This mineral, known also as Turkey Stone, is a silicious slate of exceeding density, with a close, sharp grain, and is the sole material used in the making of fine razor hones, other than the composition hones, which are inferior to those made of novaculite. The mineral is found in the granite, near Marquette.

## ABRASIVES.

Altered garnets are of very frequent occurrence in certain of the Michigan iron mines, notably at the

Michigamme. These are excellent abrasives, being similar in composition to the garnets mined in Connecticut, New York and Delaware for that use, but it is not certain that they could be found in sufficient quantity to render their production profitable in this state. The American production of abrasive garnets in 1898 was 2,967 tons, valued at $86,850.

There is a possibility that the electrical furnace at Sault Ste. Marie may manufacture carbide of silica (carborundum) a sa by-product in the making of carbide calcium, which is the base of acetylene gas. The chemist has long imitated nature in the manufacture of certain minerals, but since the discovery and practical use of the electric furnace, with its titanic power, the chemist is enabled to copy and even surpass nature in certain fields, as in the manufacture of carbide of calcium—which is not a natural mineral—and in making carbide of silica—which, under the name of carborundum, has almost entirely displaced corundum—a product of nature—in uses where a high grade abrasive substance is required. There is a probability that the chemist, fortified by the electric furnace, will become an even sharper competitor of the miner, in future years, in the production of certain rare and expensive minerals which would come into quite general commercial use, were they furnished at materially lower prices.

## GANNISTER.

This is a quartzite, carrying finely comminuted silicious particles in a matrix of fire-clay. Its principal use is found in lining converters used in the manufacture of bessemer steel. It was formerly quarried at Deer Lake, just north of Ishpeming, but has not been marketed for several years past.

## PRECIOUS STONES.

The United States, despite its vast area and unparalleled wealth in minerals, is not a gem-producing country to any important extent. The total value of the precious stones found in the United States during 1898 was less than $200,000.

Several diamonds have been found in Michigan since 1890. The largest gem weighed nearly two karats, and was discovered near Dowagiac. These gems were found in the terminal moraine marking the southern limits of the northern ice-cap which in glacial times covered nearly the entire state of Michigan, and were presumably torn from their original matrix many hundreds of miles to the northward. The possibility of locating a dimantiferous district in the Labrador or Hudson Bay districts of Canada has long interested mineralogists and geologists, but has so far been discussed in merely an academic spirit.

Chlorastrolite is essentially a Michigan gem, as it is found in the shingle along certain beaches of Isle Royale, and nowhere else in the world. Chemically it is a hydrated silicate of aluminum, magnesium, calcium and sodium, containing a minute proportion of oxide of iron. Some twenty years ago it was common, and a small vial filled with the gems could "be bought of the curio dealers for $5, but of latter years the beauty of the stone has led to a considerable demand, and the beaches are not as productive as formerly, so that several times the price once asked for a bottle filled with the gems is now demanded for a single small stone. Chlorastrolite is a beautiful milky-green gem, having numerous globules with green star centers, shading to almost milky whiteness at the perimeters. It takes a fine polish, and unless considerable accessions to the present limited supply are found in the future, will continue to advance in price.

Thomsonite is another Lake Superior gem, also found on the shingle at Isle Royale, and is somewhat related in chemical composition to chlorastrolite, being a hydrated silicate of alumina, calcium and sodium, and having a radiated structure. It is sometimes known as Comptonite.

Lake Superior amethysts are found in considerable masses, the crystals standing in a quartzite matrix. These are inferior in purity and value to the amethysts of the dealer in gems, but afford most beautiful cabinet specimens, the crystals being frequently of very large size, and of a fine pink color.

Agate, in handsome markings, is of fairly common occurrence, both on Isle Royale and portions of the mainland of Keweenaw Point.

## PETROLEUM.

There are numerous indications favoring the existence of petroleum and natural gas in Michigan. Opposite Port Huron the Canadian oil fields of Petrolia are of considerable importance. The anticlinal underneath the Saginaw Valley serves as a blanket to hold down the brine which has rendered that district famous as a producer of salt, and the general geological conditions are favorable for the existence of both petroleum and natural gas at points in this inverted basin. The State Geological Survey has found indications strongly pointing to the presence of petroleum and gas in the vicinity of Alpena, and also in the neighborhood of Port Huron. In the upper peninsula small quantities of petroleum have flowed from wells driven on the property of the Cleveland-Cliffs Company, north of the charcoal iron furnace at Gladstone, and on lands owned by William Black in Masonville township, in the same district. As these wells were driven for water, and were not put down to sufficient depths to reach oil-bearing sands of permanent value, if such underlie the district, the possibilities of striking paying oil wells at greater depth are at least worthy of careful consideration, and might justify the expense of driving test wells to to the considerable depths that would be required to thoroughly prove the underlying strata.

## MINERAL WATERS.

In 1898 there were 17 reporting springs in Michigan, which marketed 858,000 gallons of mineral waters, valued at $131,690. In addition to the water sold in wood and glass, the springs at various points, notably at Mt. Clemens, afford employment to many people, owing to the number of invalids flocking there for baths, and to drink the waters. The springs at Mt. Clemens have a national reputation, being of marked efficacy in the treatment of rheumatic and sundry other diseases. The reporting springs of the state are located at Mt. Clemens, Ypsilanti, Lansing, Big Rapids, Spring Lake, Midland, Reed City, Plymouth, St. Clair and Hudson, in the lower peninsula, and at Crystal Falls, in the upper peninsula.

## PEAT.

There are immense deposits of peat at a number of points in the-upper peninsula, only one of which has ever been worked. The present Excelsior furnace, at Ishpeming, was originally known as the peat furnace, from using that material for fuel. The peat was cut from the vicinity of the present Section Sixteen mine of the Lake Superior Iron Company, andiron was made several seasons with turf for fuel, but the experiment was apparently not a profitable one, and the furnace was blown out. Whether the failure to realize the anticipated profits was due to the nature of the fuel, or to other causes, cannot be said. It is probable that science will eventually find some method of utilizing peat on an economical basis, there having been considerable experimental work done in Europe recently, in the way of making fuel briquettes, through drying and compressing peat. Owing to the great demand for fuel, and the lack of coal measures in the northern peninsula, a successful process for compressing peat briquettes would probably be adopted in the district, if found.