LAKE SUPERIOR BROWNSTONES.

Skirting the south shores of Lake Superior, at intervals, may be seen beds of sandstone resting nonconformably against the archæn rocks. At some points, as at Grand island—where the "capping strata" are more highly indurated—the sandstone forms high bold cliffs, as those of Pictured rocks at Grand island, discolored from the decomposition of thin seams of pyrites.

These sandstones are supposed to belong to the Potsdam period, and therefore form the base of the lower Silurian. The sandstone is usually of a brownish color, and many of the shades are very rich and warm. At Marquette and L'Anse have been opened brownstone quarries which are now furnishing a very excellent building material that is rapidly gaining favor among architects.

The quantity of stone at these quarries, so far as developed, is apparentely inexhaustible, and the quality fully equal to the best eastern grades. This interest, however, is only in its infancy; and there can be no question but that it will grow and eventually become one of the prominent industries of our state.

The Marquette Brownstone company was organized in Sept., 1872, with S. P. Ely, president; Peter White, secretary and treasurer; Sidney Adams, general agent, and J. H. Jacobs, superintendent. This property was previously known as the Wolf quarry. It is located in the southern portion of the city of Marquette, and is only a short distance from the lake shore.

The first shipment of brownstone was made by Wolf & Co., in 1869. The present (1877) officers of the company are F. P. Wetmore, president; S. Brownell, secretary, treasurer and general manager, and J. H. Jacobs superintendent.

The brownstone is one of the layers of the Potsdam sandstone which at one time covered the greater portion of the lower horizons of the Lake Superior country, but now only limited fields or small patches remain. About Marquette are narrow ridges of greenstone and quartzite of the Huronian period, having nearly an east and west trend, and which rapidly terminate as we approach the lake. In these sheltered bays bounded by the termini or spurs of the ridges, are often small fields of sandstone. The above quarry is one of these isolated patches, protected as it is on its north side by a high greenstone ridge.

In the quarry there is now (March, 1878,) a working face at the west side 250 feet long, having a thickness of four feet on the south end and varrying from six to nine feet on the north end. The stone has a rich, warm, brown color, and is of a medium grained, very uniform texture. Some portions of the bed are variegated, and when first quarried works "very free" under the hammer or chisel, and from it have been sculptured some very fine and elaborate pieces of art. This latter fact is given to show its homogeneity and freeness from treacherous seams which are often so discouraging to the stone cutter. It weathers well, and when seasoned, becomes hard and is not then affected by the frost.

Wishing to present the opinion of those who have made building material a special study, I addressed the leading architects of Detroit, Chicago and Cleveland, with the following pleasing results:

DETROIT MICH., Nov. 28, 1877.

CHAS. E WRIGHT, M. E., Commissioner Mineral Statistics, Marquette, Mich.—*Dear Sir:* In reply to your favor of the 22inst., we have used the Marquette Brownstone, and consider it to be of the very best quality for building purposes, fine grained, easily cut, and keeping color, while the stone hardens with age and exposure to the atmosphere. We consider it fully equal in quality to the Portland Brownstone. Respectfully yours,

WILLIAM SCOTT & Co.,
Architects & Civil Engineers.

CHICAGO, ILL., Dec. 17th 1877.

CHAS. E. Wright, M. E., Commissioner, &c., Marquette, Mich.—*Dear Sir:* In reply to yours asking for information regarding the Marquette Brownstone, we would state that having used it to a considerable extent, we consider it an excellent building stone, especially adapted to elegant residences and structures, where its beautiful color appears to an advantage. This latter feature must ever secure it favor with the true artist, being rich and warm, and suggestive of vitality. As a working material, it is all that the artist can desire, being very soft and tenacious, thus enabling the stone cutter to cut and carve the most elaborate and intricate designs of the architect. Durability being one of the essential qualities, we would add that having carefully observed buildings constructed from this stone which have stood for a number of years, that in our opinion it possesses this property in a high degree. During a short visit to the quarry last summer, we were highly pleased with what we saw, and the inexhaustible quantity of brownstone. Yours, &c.,

CUDELL & BLUMENTHAL, Architects.

CLEVELAND, OHIO, Dec. 14, 1877.

CHAS. E. WRIGHT, Marquette, Mich.—*Dear Sir*: In reply to yours of the 22nd Nov., would say, I have used but little of the Marquette Brownstone; but so far as I can judge from my limited knowledge of it, I regard it as being a very superior material as to color, soundness, and working qualities. In this vicinity its use will doubtless be limited to surface decoration upon white sandstone buildings, and for this purpose it is far preferable to the Connecticut stone, particularly as to its durability; nor would I hesitate to recommend it for entire facing of walls, should any of my clients approve of a "brownstone front," and not object to the cost of it.

Yours truly,

JOSEPH IRELAND, Architect.

The above are but a few of the letters from equally reputable parties which I have received in answer to my inquiries, and coming from such unbiased sources, and from those, too, whose opinions must be authority in matters of this sort, they seem to settle the question as to the value of our Lake Superior brownstone.

The quarry has good drainage, and possesses many other natural advantages, one of which is a large living spring of water running close by the openings. The water has been utilized by constructing a dam some distance above the workings, and conducting it through a 26-inch pipe to the stone saw mill of the company. This affords a sixty-foot head of water, quite sufficient to drive the two gangs of saws.

Explorations made 800 feet to the west have discovered a layer of brownstone similar in quality to that in the quarry, and it is highly probable that it is of the same bed. It is the intention of the company to thoroughly explore, with the diamond drill, their lands in the immediate vicinity of the quarry.

The product of the quarry since its opening has been as follows:

YEAR.	CUBIC FEET.
1869	26,300
1870	37,640
1871	56,000
1872	53,000
1873	53,000
1874	48,000
1875	37,300
1876	55,000
1877	59,000
1878	34,290
Total	459,530

Adjoining the Marquette Brownstone quarry is the Burt Freestone quarry, from which has been produced about 6,500 cubic feet of commercial brownstone; but the quarry is now idle.

THE L'ANSE BROWNSTONE QUARRY.

This quarry is situated about one and three fourths miles northeasterly from L'Anse, on the east shore of L'Anse bay and possesses many natural advantages that could hardly be more desirable. The first work was done on this location in September, 1875, by T. T Hurley, Esq., of Marquette, and a little later in the season the above company was organized, with T. T. Hurley, president and general manager, John J. Graham, secretary, and Hon. Ed. Breitung, treasurer. Mr. Hurley continued the development of the property, and in the spring of 1876 constructed substantial crib docks, ballasted with rubble or waste rock. The docks are conveniently located abreast of the quarry, a tram road is laid along them, and everything is so arranged that by means of derricks the large blocks of sandstone are

swung directly from their beds and loaded on the tram cars, or, when desired, are stored away to one side ready for future shipment. At the end of the dock other derricks are erected to transfer the stone from the cars to the vessels.

The first shipment of stone, consisting of ten tons, was made to Chicago by rail in march of 1876, while the entire product of the quarry for that year amounted to 8,500 cubic feet; in 1877 the product was 10,000 cubic feet. The present (May, 1878.) working face of the quarry is about one hundred feet from the water's edge. The thickness of the bed varies from four to fourteen feet, and is seven hundred feet in length. The stone has a rich brown color, and is very even in texture. The upper portion of the bed is, frequently, slightly banded with light grayish layers, alternated with brownish ones. Some portions of the bed are somewhat mottled with pale greenish-gray spots of from one-eighth to three-fourths of an inch across; no difference, however, can be detected in the hardness of these spots and the material which encloses them.

It appears that the only difference consists in the color, which, in all probability, is due to the unequal oxidation of the protoxide of iron; that is, it is possible that the entire bed was at one period of a much lighter shade than it is now. I am inclined to believe that the contrast in color between the spots and the ground mass will gradually lessen on exposure.

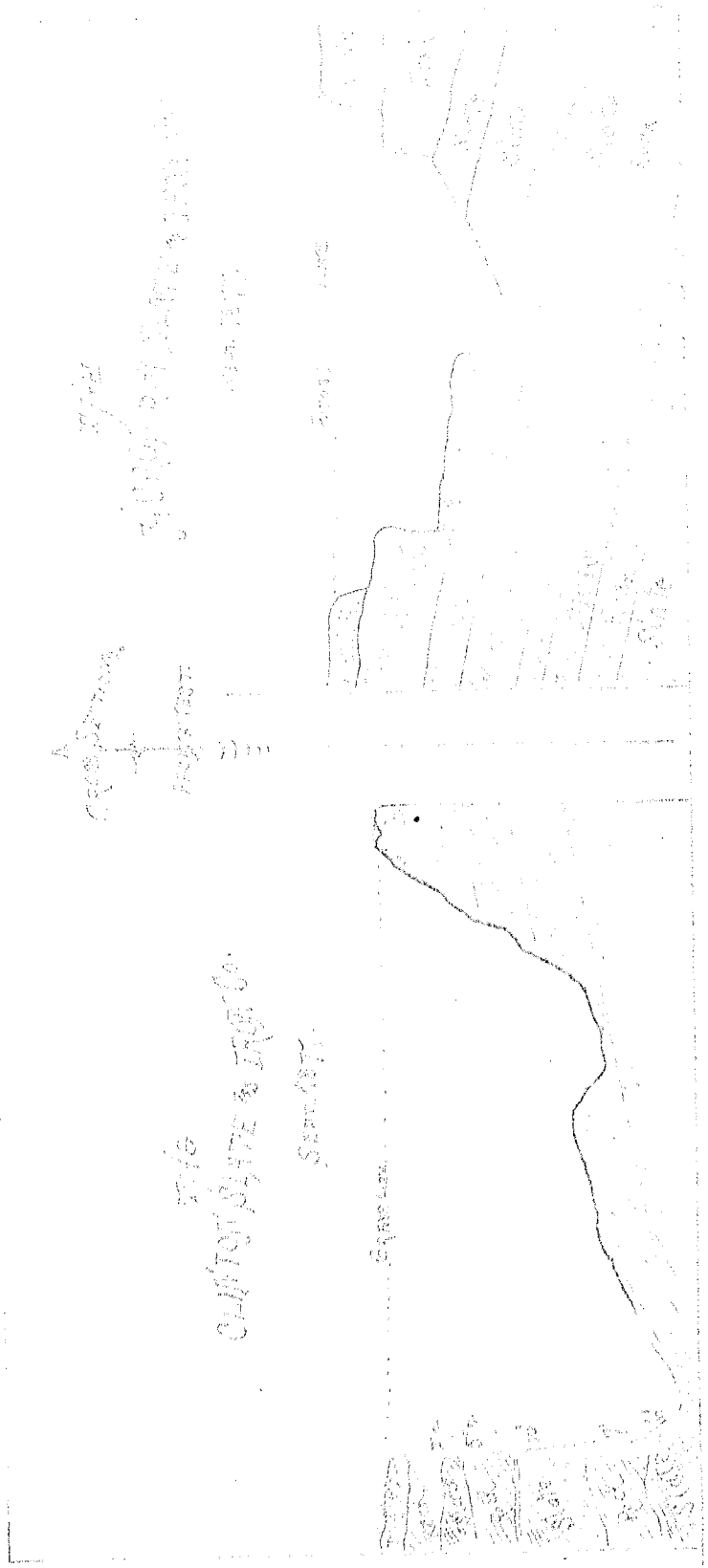
The formation in which this brownstone occurs belongs, as before stated, to the Potsdam period, and the stone being horizontally bedded enables nearly perfect blocks of almost any desired size to be obtained; as for instance, a block was taken from the main bed and practically perfect in every respect, of which the dimensions were 34 feet in length 12 feet in width and 10 feet in thickness.

It is the intention of this company to increase their facilities and endeavor to do a much larger business in the future than they have heretofore done. The shipments are;

YEAR.	CUBIC FEET.
1876	8,500

1877	10,000
1878	10,300
Total	28,800

As the matter of building materials is one of large public interest, it is a subject of much congratulation that we have within the borders of our own state an article of such surpassing beauty and excellence as our brownstone is shown to possess. It has been spoken of everywhere, by those competent to judge and whose business it is to know the quality of building material, in terms of the highest commendation, and in no particular has it met with adverse criticism. Mr. Hurley, of the L'Anse quarry, has in his hands a large number of letters from leading architects and builders in Chicago, Detroit, and elsewhere—all of whom, unqualifiedly, pronounce it to be one of the best brownstones in the market, as being nearly if not wholly exempt from defects—as having a uniform color, a close fine grained texture—easily cut, carved or sawn,—and as capable of being procured in as large size and as perfect form as any which the country affords.



SLATE.

In the general sense of the word, slate occurs in several horizons of the Huronian series, as has been already noted in the chapter on the geology of the iron bearing rocks. In the Marquette district it is chiefly confined to formations V. and IV. and constitutes formation XV. The latter approches nearest in quality to a roofing slate, but as far as my own observation goes, within this district, it contains too much of iron pyrites, even if the cleavage were perfect, to fulfill the requirements of merchantable slate. In the Huron Bay district, however, slate fully equal, if not superior to, the best eastern slate, has been found, and is now produced at two quarries which are described in detail further on. The slate formation in these quarries forms a wide belt, and extends over a portion of the Huron Mountains. It consists of several strata, or narrow beds, of good slate and slate rock. The cleavage, or splitting planes of the slate, dips very uniformly to the south; but the natural bedding is in broad anticlinal and synclinal waves, which have a trend of nearly east and west, and a consequent dip to the south or north as the case may be. The building planes are very *plain*, still, an *expensive error* was made, at one of the quarries at their opening, in mistaking the cleavage for the bedding. Our present state geologist, Dr. C. Rominger, who made in his official capacity a personal examination of this mine, also failed to distinguish between the bedding and cleavage planes, as appears in his state report for 1876, page 163. This structure may be readily understood by reference to the diagram on the opposite page, and its importance from a scientific as well as an economic stand point can be easily appreciated. It will be noticed that the formation in the Huron Bay quarry dips

about 15 degrees to the north, while the cleavage pitches about 30 degrees to the south. In the Clinton quarry the cleavage is the same, but the bedding is about 12 degrees to the south, or very nearly conforms to the cleavage. If the strike of the Huron Bay were extended westward it would pass about 450 feet north of the Clinton quarry. This gives us an anticlinal wave between these quarries. It is hardly possible, however, with our present data, to correlate the beds of the two quarries. The above named companies are the only ones which have thus far shipped any slate, though several others have been formed and considerable exploring has been done.

THE HURON BAY SLATE AND IRON COMPANY.

This property is located in T. 51, R. 31, and embraces altogether some 1,100 acres of land which includes that of the quarry now worked. It is situated on the S. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Sec. 28.

The company was organized Nov. 2nd, 1872, with W. L. Wetmore, president; M. H. Maynard, secretary and treasurer; John J. Williams, agent, and John Thomas, sup't. During the fall of 1872 preparatory work was begun, and in the following spring actual mining commenced. A three foot tram road of four and one-half miles was constructed down to Huron bay, and a dock was built at this point extending 600 feet into the bay. Along the outer end of the dock is some 14 feet of water, sufficient to enable the lake steamers to load directly from the dock. At the quarry location (July, 1877,) are several substantial buildings, and everything is in very fair "shape" to do a large and profitable business; what appears lacking is want of sufficient ready capital to make this one of the leading interests of the state.

The slate formation, as developed here, as before stated, (see diagram) dips 15 degrees to the north, and the strike is N. 85 ° W.; but on the other hand the cleavage planes of the slate dip 25 degrees to the south. The upper slate bed is about 13 feet thick; then comes a layer of poor slate 4

feet thick, and under this is another bed of slate 7 feet thick, then a poor bed of three feet, and underlying this again is still another bed of slate 4½ feet thick; this is as far down as they have explored the quarry.

The quality of the slate, as has been already remarked, is of the very best; it comes out in large jointed blocks, and is easily cloven into as thin slates as are required. One slab 36 by 18 inches and 4 inches thick split into 29 perfect slates, which presented a very even face, free from any corrugations or scales. At the company's office in L'Anse they have on exhibition a much larger slab than this one, split into equally as thin and perfect slates. They have also some very handsome tiles which have been planed down to show the adaptibility of the slate to mantles, table tops, &c. The color of the slate is a rich unfading bluish black. It is very tough and gives forth a metallic ring when struck.

The company shipped previous to 1878, 5,100 squares and during 1878, 1,535 squares.

CLINTON SLATE AND IRON CO.

This quarry is situated 1,600 feet west and 300 feet south of the Huron bay quarry, and is on the N. W. $\frac{1}{4}$ of sec. 33, close to the section line.

The officers of this company are Dewitt C. Wheeler, president; Jas. H. Seager, secretary and treasurer, and R. R. Williams, superintendent. The first work was done at this location in August, 1874, but no shipments were made that year. The slate is very similar to that in the Huron bay quarry. The formation, as already noted, dips about 12 degrees to the south, and the cleavage a few degrees more in the same direction; (see diagram). The manufacture of slates is a very interesting operation, and the various manipulations though apparently simple, require considerable skill and good judgment to reduce the waste to a minimum. The quality of this slate is essentially the same as that of the Huron bay quarry.

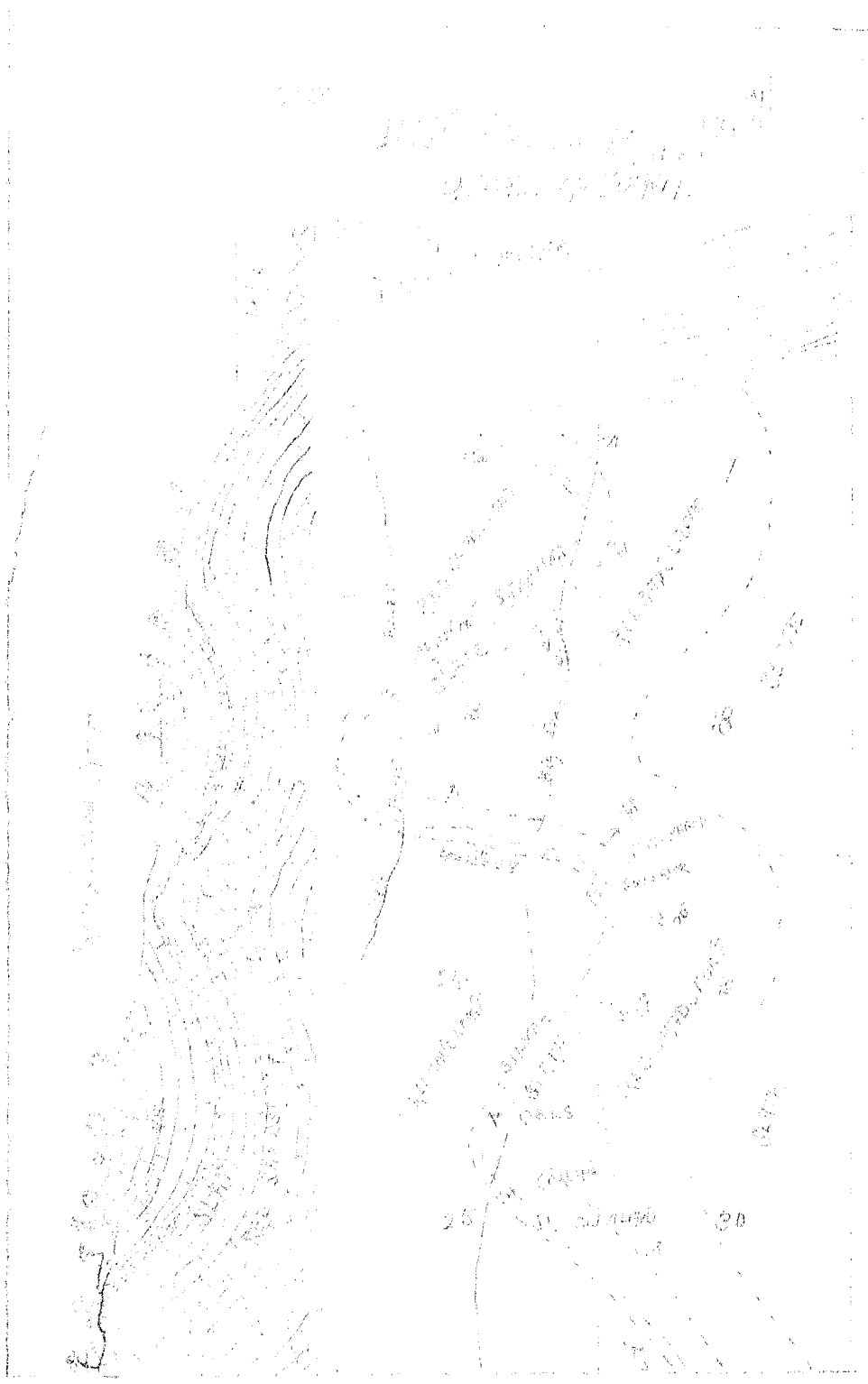
The shipments from the quarry have been as follows:

YEAR.	SQUARES.
1875	405
1876	1,045
1877	1,034
1878	600
Total	3,084

THE IRON RIVER SILVER DISTRICT.

Is situated on the south shore of Lake Superior, about ten miles west of Ontonagon. The rocks, as exposed along the Little and Big Iron rivers, are sedimentary, and consist chiefly of alternate beds of brown sandstone, argillaceous and arenaceous slates. The structure is very simple and easily made out. It appears that these once horizontal strata have been buckled up or rendered wavy by lateral pressure along a north and south line, and that the subsequent uplift of the Porcupine mountains has tilted them, thereby giving the formation in addition to its northerly or southerly dip as the case may be, a general pitch to the east, while later erosion from glacial action and other abrading forces have worn away the upturned edges of the strata, affording, as we can readily imagine, the serpentine like course of the various beds as they appear upon a sketch of this district on the opposite page.

The stratum of rock which carries the silver is a gray quartzite, or highly indurated sandstone. Overlying this member is a dark colored argillo-arenaceous slate, and underlying it is a heavy bed of brown sandstone. The silver occurs in the native form; sometimes it is deposited in thin seams or joints filled with a chloro-plumbaginous substance, or it is disseminated in the ground mass of the quartzite, and again it is seen in the overlying slate. During the season of 1874, great activity prevailed in this section; all the vacant government lands near this locality, where there was a possibility of finding silver, were soon entered. Large numbers of assays were made; many with poor results, while others gave rich returns in silver. Several companies were organized, and the stock of some of them, for undeveloped properties, sold at a high figure.



A small stamp mill was erected at the mines, and three or four mill tests were made with, apparently, good results. At the mouth of Big Iron river a town site was laid out and the lots were held at fancy prices. Some harbor improvements were begun, and everything for a time promised well. Silvery visions seemed to cloud the intellect of some of the more sanguine, thereby seriously affecting their better judgment. Stress of hard times, however, soon brought them face to face with stern reality; then came the reaction which is always sure to follow a period of great excitement. To day, the timid deer browses undisturbed among the small clearings made by the different companies.

GANISTER OR QUARTZITE.

This material is used for the lining of Bessemer steel converters, and similar purposes. Formerly it was imported from England, but now our Lake Superior quartzite* has been found fully equal to the best English article.

During the past two years several thousand tons have been quarried. Eventually, however, when the requirements of the consumer are fully understood, there can be no question but what we shall see established in this new industry a large and profitable business.

The shipment of quartz in gross tons, by different parties, are respectively as follows:

Years.	Lake Fairbank Co.	Carp River Iron Co.	R. P. Traverse.	Totals.
1873	718	.....	.....	718
1874	954	.....	.....	954
1875	2,390	.....	.....	2,390
1876	1,048	664	.....	1,712
1877	379	1,051	1,281	2,711
1878	2,443	3,101	.....	5,544
Totals	7,932	4,816	1,281	14,029

*See page 12.

MARBLE.

Northeast of Ishpeming, about three and one-half miles, is a series of sharp ridges composed of serpentine, marble, magnesian schists, greenstones and quartzite, which have nearly an east and west trend. The ridges of serpentine and marble have been traced for three or four miles, and the former is, no doubt, the equivalent of that at Presque Isle, some fifteen miles to the easterly. The idea of applying these marbles and serpentines to economic purposes is largely due to J. Ropes, Esq., who, with his characteristic energy, has collected and polished several specimens of these rocks to illustrate their many excellent qualities.

This fall (Nov., 1878,) in company with Mr. Ropes, I made a hasty examination of the locality. The points we visited were within the south half of the northwest quarter of section 29, T. 48, R. 27. Proceeding at once to the west side of the section we found there a sharp ridge, presenting on its north side an abrupt face forty feet or more in height, of massive serpentine. The ledge is strongly jointed and apparently free from minor checks or sub-joints, and I should judge that perfect blocks of any desired size could be obtained. On close examination the veining on the smooth, weathered face of the bluff is plainly visible; but to "bring it out" fully the surface requires to be polished. It presents then all the imaginary shades of green, varying from a deep greenish black to a pale pea green or greenish white. The darker green, often semi-translucent, forms the rich back ground of the polished surface, which is beautifully mottled and enriched by delicate moss-like tracery of the lighter shades, and the entire surface is then rendered mosaic by irregular veins of greenish white marble traversing the rock in every direction, and even then, as if nature

were not satisfied, to enhance the pleasing effect still more, are minute veinlets "shooting out" from the larger ones, hich, in their branchings, finally disappear, blending imperceptibly with the dark back ground.

Farther to the east the ridge becomes broader, and there rises up on its north side a ledge of very handsome variegated marble breccia. The outcrop is a large one and promises well. The colors of the breccia appearing on the polished surface are white, yellow, brown, purple, drab and blue, with numerous shades of these producing indescribable combinations. The polished specimen in hand is traversed by a large vein of coarsely crystallized marble, and in the vein are strewn angular fragments of the colored base of the rock. The rock resembles in many respects the famous *Breche Herculaneum* from Belgium. A little farther east is another large outcrop of serpentine marble, which is very similar to the celebrated *Vert Maurin* from Grenoble, France. It is slightly mottled, and is thickly veined with white and pale green marble. There is a certain parallelism to the veins which is very apparent when viewed at a distance.

Continuing east we pass another ledge producing a variety of marbles. One, particularly noticeable, has a sort of a wavy appearance from fringy-like colored rows of shades of green and yellow. It is an odd looking specimen. The most easterly ledge we examined was a large outcrop of dolomitic marble. It is massive and apparently very free from seams. The polished specimen is beautifully clouded and mottled with the various shades of grayish white and light drab; it is also traversed by white veins of coarsely crystallized marble, which often contain small concretions resembling fossil remains.

Another specimen, taken from a low ledge just east of here, is very attractive. It has a very rich dark green color, sprinkled with fleecy clouds of a little lighter shade; it is also veined with branching veins of pale green, and others of bright glistening seams of copper colored penninite, which latter sometimes has a soft silken lustre. The speci-

men take's a high polish. These are only a few of a very large number of different specimens which Mr. Ropes has collected and polished from this locality, and it would seem that his cabinet represents nearly all the possible varieties of serpentine marble, and the quantity appears to me to be "practically" inexhaustible. It is one of our infantile industries, and like our slate, sandstone and other partially developed interests, will sooner or later win its way into public favor

Since writing the above, I learn that Mr. Robert Nelson, of Ishpeming, so well known as the pioneer of many successful enterprises, has taken an interest in this marble, and no doubt in our next annual report we shall have something more definite to chronicle.

GYPSUM.

The determination of the origin, qualities and extent of the plaster deposits of Michigan is a scientific problem which possesses much geological interest and great economic value. The utility of ground plaster in promoting the growth of important agricultural products has become so well understood and accepted by American farmers, that it is no longer a subject for argument. It is consistently believed that by its free and general use the original fertility of our soils may be maintained and even increased and rendered, constantly, more and more productive, a result which within our present experience would not be possible, without it. Agriculture, the chief industry of our state and, hence the prosperity of the entire commonwealth, is so greatly promoted by the application of this fertilizer, that it becomes a matter of general importance that its value be everywhere understood, and its ready distribution be provided for; and well may we congratulate ourselves that we have within our own state inexhaustible deposits of this important material, accessibly located, and possessing, as experience has proven, the requisite fertilizing qualities, and also the properties which have brougth it very largely into use for the purposes which the finer grades of gypum are used, especially as stucco. At Grand Rapids, the gypsum occurs in horizontal deposits from forty to seventy

feet below the surface, and extends, in the vicinity of Grand river, over an area of ten or twelve square miles.

No person visiting Grand Rapids can fail of being pleased with the substantial character of the improvements found at the plaster quarries of the older and larger companies; the convenience of the arrangements for carrying on the work with facility and economy, and the general care and system which evidently prevails in the conduct of the business.

The two oldest of the present companies are the Grand Rapids Plaster Co., and the firm of Godfrey & Bro. At the works of the former the quarry is all underground, and is entered through a gently inclining shaft, up through which the product is drawn in cars into the building where it is crushed and ground, and thence carried in conductors to the department for calcining or into the room for storing land plaster. On being brought into the building and before going into the crusher, the material is carefully assorted and all flinty or otherwise impure product is rejected; the grayish colored rock is selected for calcining, and the lighter colored for grinding into land plaster.

There is no practical difference in the fertilizing value of these different kinds of plaster; the choice being determined by the hardness and grit, properties essential to suitable stucco plaster. There would seem to be very little necessity or inducement for using worthless material in the manufacture of either land plaster or of calcined plaster; for the product, as it comes from the quarry, is remarkably free from extraneous rock, and the deposits are of such unlimited extent, and so easily mined, that there could be but little gain in using the impure rock; besides the difficulty of grinding the flinty or slaty material as compared to the soft gypsum, would occasion a degree of injury or increased wear of the mill stones, that it alone necessitates care in assorting.

The quarry of the Grand Rapids Co. is quite dry; the only water in the underground workings that finds entrance is down the incline shaft at times of rain, or from the melting of snow; but this is drawn off into a sump, and thence

is pumped out of the mine as occasion demands. The roof is supported by pillars of gypsum, which are left at about seventy feet apart, and intermediate timber supports are put in so as to realize perfect safety.

Tram-way tracks extend in all directions as required, and the cars which run over them to convey the material to the surface, are drawn by mules; light is furnished by gas, which is manufactured in the quarry from gasoline and conveyed to points required in rubber tubing. About eighteen barrels per year of gasoline are used in this quarry for the purpose of lighting and they are kept, for safety, in tanks filled with water. The depth of the workings is ten or twelve feet, the whole thickness of the deposit not being worked out, leaving the roof and floor of the same material.

In other quarries in this vicinity the deposit is stripped, the large amount of superincumbent drift being first removed, and the gypsum openly quarried.

The quarries are provided with railway side tracks and docks for conveying away the products by cars or boats.

At Alabaster, in Iosco county, on the east side of the state, the gypsum deposit is exposed in a bluff contiguous to the waters of Lake Huron, and the plaster rock is readily transferred into vessels for transportation to distant points to be ground and prepared for use.

That these deposits are extensive is well known, and their economic value can scarcely be overestimated; but their origin is a matter which has not yet been determined; as they are associated with the salt, it is generally supposed, as is the case with the gypsum deposits in England and elsewhere, that they were originally great salt basins, subsequently changed into their present character; but they are facts which lead one to conjecture that they may have been deposits of carbonate of lime, that have been altered, through chemical action, into sulphate of lime. Possibly a thorough geological examination of the localities, with the aid of borings carried down to a sufficient depth at suitable points, would lead to a satisfactory determination of this interesting subject; as elsewhere stated, it is hoped that proper attention may be given to it at some future period.

It is difficult to ascertain, with absolute certainty, the annual product of the quarries for past years, as some who have been engaged in the work have kept but meagre record of the results of their operations. Considerable pains have been taken to render these statistics as accurate as possible, and they are doubtless as reliable as can be obtained under the circumstances. The business of calcining plaster was of small importance prior to 1870; but, a few years subsequent to the Chicago fire, it assumed large dimensions, ending in 1873-74, 100,000 barrels for each year; the Grand Rapids Co., and Godfrey & Bro., each making nearly 40,000 barrels —since then, however, the business has fallen off, so that these parties now make but about 10,000 barrels each.

The total number of tons of land plaster for the State, since 1860, a period of eighteen year, is probably 500,000. Of calcined plaster, 700,000 barrels of 300 pounds each.

These estimates are based upon the actual production of a few of the oldest companies, taken from their books particularly those of Messrs. Godfrey & Bro. and Wm. Horey, agent of the Grand Rapids Co., the two oldest of the companies, the latter having been organized in 1860—previous to this time the annual out-put was very light. The total product of the Grand Rapids Plaster Co. since 1860 has been 200,140, tons of which 132,900 tons were land plaster, and the remainder calcined plaster. The firm of Godfrey & Bro., organized in 1863, has done the next largest business, amounting to nearly the same as the Atlas Company. The present plaster companies in the state are as follows:

Grand Rapids Plaster Co., Wm. Harvey, Agent, Grand Rapids, Kent County, Mich. Godfrey & Bro., Grand Rapids, Kent County, Mich. Geo. H. White & Co., Grand Rapids, Kent County, Mich. Taylor & McRengolds, Grand Rapids, Mich. Day & Taylor, Grandville, Kent County Mich. Union Plaster Mills, Grandville, Mich. Smith, Bullard & Co., Alabaster, Iosco County, Mich.

The total product for the past two years are as follows: 1877, land plaster 40,000 tons, calcined plaster 50,000 barrels. 1878, land plaster 75,000 tons, calcined plaster 50,000 barrels.

MICHIGAN SALT.

S. S. GARRIGUES, Ph. D., STATE SALT INSPECTOR.

HISTORICAL.

It is not proposed to enter upon an exhaustive history of this, one of the great Michigan staples, but as salt forms one of the leading factors in our commercial relations and interests as a state, a brief historical compendium will be in keeping with our subject. The first discovery of the great salt deposit of Michigan is hidden in obscurity, but it is a well established fact that its presence was well known to the Aborigines of the country long prior to the earliest settlement by the whites. Salt springs abounded upon the Lower Peninsula from which the Indians obtained their supplies of salt, which fully established the existence of a great, natural salt deposit, principally located in what was known as the Saginaw Valley, but whether in the form of rock salt or reservoirs of brine, was a mooted question with those whose attention had been early turned to the subject. Still, in view of the presumed value of the undeveloped salt springs, the general government made numerous reservations of lands, embracing within their area the supposed salt deposits, which even at that early day had created such interest in their development that it is a matter of record that successful attempts to manufacture salt in Michigan had been made many years before Michigan had been organized into a state government. This wise action on the part of the government was perpetuated by the provision in the act of admission of Michigan into the Union in 1837, by which the state authorities were permitted to select from the various salt reservations seven-

ty-two sections of lands which embraced within them the best portions of the then known saline springs in the then territory.

The wisdom of this action was more fully understood and appreciated when the late, lamented state geologist, Dr. Douglass Houghton, was appointed by the first Michigan legislature in 1838, and who in his report at a subsequent session of the legislature recommended strenuously the immediate selection of the spring lands by the state, and following his instructions he at once proceeded to thoroughly survey the salt indications as observed on the Grand and Tittibawassee Rivers, in Kent and Saginaw counties, and also continued his researches and surveys in the counties of St. Clair, Macomb, Wayne and Jackson. In this Dr. Houghton met with a measure of gratifying success.

Still, though public attention had thus been called to the mine of saline wealth possessed, and while practical experiment and investigation looking to the rapid development of this important commercial interest had received a forward impetus from the report of Dr. Houghton, these experiments failed of perfect success in the subsequent death of the learned geologist who had given so much of his time and scientific attention to the salt interests of Michigan, thus depriving the state of one in whom implicit reliance had been placed to give intelligent direction to these experiments and enterprises—a loss which for a time discouraged further action in their development.

But where Dr. Houghton laid down his burden of investigation and research in this particular, other investigators took it up and became so fully satisfied of the existence of abundant reservoirs of saline waters in our state that they at once determined to extend their experimental researches still further, resulting in fully demonstrating in the most satisfactory manner the entire truth of the theories advanced by Dr. Houghton and others.

Especially was this the case in the Saginaw Valley, then becoming prominent as a good objective point for the capitalist and laborer. Encouraged by the favorable report of the state geologist, borings for brine were begun in vari-

ous localities, and the most gratifying results obtained in the superior strength and purity of the brine produced; the borings have been continued, or rather extended in the later wells, to the geological formation embracing other groups of rocks much older and lower than any previously reached, viz: The "Onondago salt group," or rather the group in this state, so represented in the state of New York, and while, up to this writing, the results obtained may not have sufficiently established its productiveness, still sufficient encouragement has been had to fully establish the fact that this "group" may yet yield such an inexhaustible supply of salt as to render them a source of profit to the enterprising operators, and an augmented addition to the wealth of the state.

The field of abstruse speculation might tempt the curious in striving to elucidate the problem of the actual configuration of the salt reservoirs underlying the Lower Peninsula of Michigan. Whether these vast subterranean saline lakes are intimately connected with each other by arteries and veins, causing depression or increase in the located bulk of each, or whether the salt rock is the source of supply moistened in the secret laboratory of nature by the percolation of surface drainage, or otherwise, are points which must remain, for the present, sealed from the gaze of the interested scientist. We but know that the great depositories for brine thus far discovered in Michigan are located in the Michigan salt group, with the associated sandstones, particularly in what is known as the "Waverly Group." Also, is it undetermined to what extent these depositories extend in which brine may be found in quantity and quality sufficient to repay the cost of manufacture. With this fact in view, it is to be sincerely regretted that the wise provisions made by the state legislature some years ago to fully ascertain this much desired point, has not been made available in the collecting of the records of the various borings throughout the salt bearing portions of the state. It is to be sincerely hoped that this grave omission may yet be rectified, so all the *data* possible may be preserved for uture calculation and reference.

In regard to the full extent of the salt territory of Michigan, speculation need not greatly err. Arguing from simple analogy, we are led to the conclusion that those portions of the group of rocks showing the greatest depression below the level of the lakes are found to possess the superlative in the character of the brine produced. Actual experiment has proven this to be the case, and the regions over which the Saginaw valley extends are found to be the territory where the greatest depression is had. In the work of boring, a depth of over 1,000 feet below the level of the lakes has been attained before reaching or passing through what is known as the Michigan salt group from which our brines are obtained. In accordance with this theory we find that the salt wells of the Saginaw valley are found to produce a brine of greater specific gravity than any other portion of the state.

When we state that the supply of brine thus produced is illimitable, where these depressions are found, we speak from actual knowledge. With each new well is found a full supply, and while some slight fluctuation in quantity and strength is discoverable, still this is but temporary in character. The same rule will apply not only to quantity but to quality, and no better illustration of the fact can be had than in the report of the committee of the New York legislature, which, as a commission to investigate the salt interests of Michigan, visited the Saginaw valley in 1868. The commission, on pages 21 and 22 of their report, truthfully says, "it is only by chemical analysis that the "value of brine can be determined. All the brines used in "the manufacture of salt this side of the Mississippi river, "with one exception, are more or less loaded with impuri-"ties which must be removed or the salt is valueless."

Further reference will be found in this report, to the higher value of Saginaw brine; and experience has taught that the best quality of salt can be made from Michigan brines; and, further, that a large proportion of Saginaw salt sold in the market, is as pure, as efficient, and as antiseptic

as any mined or manufactured, either in our own, or in foreign countries.

This leads us to note more at length the process of

SALT MANUFACTURE.

There are two modes of salt making: one is the evaporation of the brine by artificial heat, the other by solar evaporation.

SOLAR SALT.

Solar salt at Saginaw, as at Syracuse, is made by evaporating the brine in shallow wooden vats, which affords a salt much purer and cleaner than that made in vats dug in the ground. A salt cover is 18 feet square and 6 to 8 inches deep, and gives an annual product of fifty bushels. The solar process is a very simple one. Late in the month of March the brine, which has remained in the vats during the winter, is withdrawn and everything cleaned and put in order. The vats are kept partly full of brine during the winter to preserve them from the action of the frost, while the drippings prevent the ground from freezing so hard as to force the supporting posts out of position. As soon as the sun begins to have sufficient power, the brine is run into the innumerable wooden vats from the reservoirs. Each vat is provided with a roof, which may be moved backward or forward on a moveable stage, so as to protect or expose the water as the weather may render desirable.

The brine is required to remain in the vats from six weeks to two months to evaporate according to the number of sunny days. The salt covers produce three crops of solar salt during the year, the middle crop being the largest and most valuable. The first crop is gathered about the middle of July, the second in September, and the third, the last of October. Solar salt is of exceeding coarseness in its granulation and this coarseness gives it increased value. The pork and beef packers prize solar salt highly, as, in consequence of its coarseness, it prevents the meat from packing too closely and permits a free circulation of the pickle.

For manufacturing salt by artificial heat, three processes are used, known as the kettle, pan and steam process.

KETTLE SALT.

A kettle salt block, properly speaking, consists of fifty or sixty kettles, and the stone or brick work in which they are set. The kettles are set in two rows, over two arches, reaching from the mouth of the furnace to the chimney. These arches are close together, merely a dividing-wall separating them, and the kettles are set close together in each row. Each block is housed under a building from 75 to 100 feet long, and about twenty feet high in the center, with sheds on each side containing bins for depositing the salt as made. The salt after remaining in these bins fourteen days, for complete drainage, is packed in barrels for market. When the works are in operation, an engine is kept running for the purpose of pumping and forcing it in pump logs to the cistern near by. From these vats another set of pump logs carries the purified brine into the block house and along the top of the brick work between the two rows of kettles, and from which a spout extends over each kettle. After a kettle of brine is boiled a short time, the crystals of salt commence forming on the surface and fall to the bottom. When the quantity of brine is boiled down to about one-third, the salt is dipped out with a long handled shovel and thrown into a basket which is placed over one side of the kettle where it remains for drainage. The bitter water is thus drained off, carrying with it all other impurities. A thorough drainage is considered one of the most important points in this mode of the manufacture of salt.

STEAM SALT.

In the steam process, the brine is pumped into the outside cisterns where it is settled as in the kettle process. From here it is drawn into the inside settlers, which are wooden cisterns from 100 to 120 feet long by 8 feet wide and 6 feet deep and strongly keyed together.

The brine in the settlers is heated by three or four steam pipes, and, after being brought to saturation, it is allowed to

rest for a few hours so as to insure a perfect settlement of the impurities. At the proper time this purified brine is drawn into the grainers, they being filled to about two-thirds their capacity. The length of these grainers is from 100 to 120 feet, ten to twelve feet wide, and twelve or fifteen inches deep. These are heated in the same way as the settlers, the steam being carried through by galvanized iron pipes, all being controlled by steam gates. As the purified brine comes into these grainers quite warm and fully saturated, it soon commences to make salt, which forms on the surface and falls to the bottom, when a new lot of crystals are formed to fall in the same way. Thus the evaporation continues until enough of the brine is evaporated. During this time the brine is occasionally stirred so as to make the crystals fine. As soon as the brine is sufficiently evaporated, the bailers commence the lifting of salt. This is done by first washing the salt thoroughly in the brine that is left in the grainers, and taking it out with shovels and throwing it upon the draining boards, where it remains for a number of hours for drainage, a large drain completely filling the boards. From the drain boards it is taken to the bins in the packing house where it remains for fourteen days for complete drainage. It is then packed in barrels, weighed and branded if of prime quality, and by the inspectors branded as "fine salt."

PAN SALT.

A pan block is a building of a size to properly cover the settler, pan and packing rooms. The brine is either settled cold or hot, it being a great advantage to have the brine in a saturated condition before it is drawn into the pans. These pans are either set in double flues, running to smoke stack, or are made wider when the flues are built to return—the heat in this way being greatly economized. The fire being applied directly to the bottom of the pan, the evaporation of the brine is very rapid, and the salt makes continually and requires to be drawn out upon the draining boards constantly. This process has great economy and, where there is no exhaust steam from a mill, is the most

practical process. The grain of salt made by this method is very fine.

Since the discovery of salt in the Saginaw valley, and the organization of the first company in 1859, wonderful changes have taken place, not only in the mode of manufacture, but in the general conduct of the business. The discovery of salt gave an impetus to trade; and the growth of the valley cities, during the few years following, was more rapid than during any previous or subsequent years. Immense capital was invested in salt manufacturing operations, and the business of the first few years was more of a speculative character than of a substantial nature. The more systematic methods of manufacture in vogue at Syracuse and other salt manufacturing points, the lack of uniformity of the grades of Saginaw salt, and other causes began to tell against us. Even at the price of salt ruling previous to 1870, many found the business unprofitable and block after block was abandoned.

Our manufacturers, however, profited well by the experience of the first ten years and turned it to a good account in several ways. The process of manufacture was materially cheapened by dispensing with the item of fuel and utilizing the exhaust or surplus steam from the saw mills. Kettle blocks have fallen into disuse, and steam and pan blocks have taken their place. The law for the uniform inspection of salt went into effect in 1869, and has been rigidly enforced. From $1.50, which was originally estimated as the cost of making a barrel of salt on the Saginaw river, the cost has been reduced to 50 or 60 cents—some manufacturers asserting that they can place their salt on the dock for shipment at 40 cents. This, however, will not include the cost of repairs, insurance or interest on the investment.

MODE OF MANUFACTURE.

The following table shows the method of manufacture and the amount manufactured during the past nine years, by each method. It will be observed that there is a large decrease in the amount manufactured by the kettle or

boiling process, and a large increase in steam. Solar evaporation about holds its own, the quantity, in a measure, being regulated by the favorableness of the season.

	Kettle.	Pan.	Steam.	Solar.
1869	335,663	42,000	176,761	15,264
1870	301,901	56,430	255,142	15,507
1871	290,550	68,080	336,162	37,645
1872	202,800	65,800	435,920	20,461
1873	192,250	127,700	471,128	32,267
1874	181,200	130,500	685,888	29,391
1875	117,000	199,100	741,429	24,336
1876	177,469	341,660	919,182	24,418
1877	182,560	371,642	1,083,646	22,946

STATISTICS.

Salt operations in the Saginaw valley were first commenced in the year 1859. Through the influence of Geo. A. Lathrop, M. D., the East Saginaw Salt manufacturing company was organized in April of that year, and commenced operations in May following; first well, completed in March, 1860. First salt made in July, 1860. The following table shows the strength of brine obtained from this well at various depths:

At 90 feet	1 degree.
At 102 feet	2 degrees.
At 211 feet	10 degrees.
At 212 feet	14 degrees.
At 487 feet	26 degrees.
At 516 feet	40 degrees.
At 531 feet	44 degrees.
At 559 feet	60 degrees.
At 569 feet	64 degrees.
At 606 feet	86 degrees.
At 636 feet	90 degrees.

The following tables show the amount of salt made in Michigan for 1877, and preceding years:

	BARRELS.
1860	4,000
1861	125,000
1862	243,000
1863	466,356
1864	529,073
1865	477,200

1867	407,077
1868	474,721

Amount and quality of salt made in the state since 1869, when the inspection law went into effect:

	Fine.	Packers'.	Solar.	2nd Quality.	Total.
1869	513,989	12,919	15,246	19,117	561,988
1870	568,326	17,869	15,507	19,659	621,361
1871	655,925	14,677	37,645	19,930	728,175
1872	672,034	11,110	21,461	19,876	724,481
1873	746,702	23,671	32,267	20,706	823,346
1874	960,757	20,090	29,391	16,742	1,026,979
1875	1,027,886	10,233	24,336	19,410	1,081,865
1876	1,402,410	14,233	24,418	21,668	1,462,729
1877	1,590,841	20,858	22,949	26,249	1,660,897
Total for nine years					8,691,821
Previously manufactured					3,278,117
Aggregate to Dec. 1, 1877					11,969,938

The State inspector's report for 1877, also shows the following statistics in reference to the salt manufacturing business of the State:

	No. Companies.	No. Kettle Blocks.	Steam Blocks.	Pan Blocks.	Salt Covers.	Capacity.	Manufactured.
District No. 1	14	9	10	2	500	250,000	183,467
District No. 2	10	2	8	2	.....	250,000	138,553
District No. 3	9	3	8	2	.....	250,000	238,400
District No. 4	6	1	4	4	2,800	250,000	114,524
District No. 5	10	..	13	2	.....	300,000	247,954
District No. 6	10	3	8	1	500	250,000	328,300
District No. 7	9	2	8	2	.....	200,000	130,144
District No. 8	5	..	10	4	.....	150,000	145,895
District No. 9	2	..	..	2	.....	100,000	88,864
District No. 10	4	..	4	1	.....	100,000	44,796
	79	20	71	22	3,800	2,100,000	1,660,897

The districts are divided as follows: No. 1, East Saginaw, George W. Hill, inspector; No. 2, Saginaw City, V. W Paine, inspector; No. 3, Carrollton, James Hill, inspector; No. 4, Zilwaukie, John Haight, inspector; No. 5, Portsmouth and part of Bay City, W. R. McCormick, inspector; No. 6, part of Bay City and Essexville, Castle Baker, in-

spector; No. 7, Salzburg, Wenona and Banks, W. R. Wands, inspector; No. 8, Caseville, Port Austin, New River and Port Hope, Huron County, J. Dwight Hill, inspector; No. 9, Sand Beach, White Rock, and balance of Huron County, J. M. Muldrock, inspector; No. 10, Iosco County, C. W. Gabrielle, inspector.

GRADES OF SALT.

The grades of salt established by the state inspector are as follows:

NO. 1 SALT.

Fine—In bbls. of 280 lbs. for general use and for all family purposes.

Packers'—In bbls. of 280 lbs. suitable for packing and bulking meat and fish, one of the finest and best brands of salt for such purposes in the market.

Solar—In bbls. of 280 lbs. when screened, branded C solar—C for coarse, and F solar—F for fine grades. The solar salt is equal in all respects to New York solar salt.

NO. 2 SALT.

Second Quality—All salt intended for No. 1 of any of the above grades, when condemned for any cause by the inspector, is branded second quality, and sold as such. This salt is good for salting stock, hay, hides, etc.

WHO MAKE THE SALT.

Below is a full list of manufacturers, together with a statement of the amount of salt made by each during the years named. From this list it appears that a large proportion of the number are also engaged in the manufacture of lumber:

THE SHORE.

	1877.	1876.
Ayers & Co., Port Austin	37,419	35,427
Frank Crawford, Caseville	45,479	41,575
New River Salt Co., New River	19,976	14,279
Port Hope Salt Co., Port Hope	40,720	34,123
Jenks & Co., Sand Beach	47,083	7,067
Thompson Bro's, White Rock	41,276	40,465
J. L. Wicks Bro's, East Tawas	22,024	24,136
Oscoda Lumber & Salt Co., Oscoda	14,483	5,456
Emery Bro's, East Tawas	7,260	.....
Pigeon River Salt Co., Pigeon River	.....	11,948
Smith, Gratwick & Co., Oscoda	3,835	.....
Total	279,555	214,476

BAY COUNTY.

Ayrault, Smith & Co.,	12,837	6,095
N. B Bradley & Co.,	37,047	31,329
Eddy, Avery & Co.,	53,574	49,103
H. M. Bradley & Co.,	18,885	18,415
Pitts & Crannage	23,376	31,746
Folsom & Arnold	22,918	19,358
Chapin & Barber	45,881	38,380
Dolson, Chapin Bro's	39,688	45,624
John McEwen	17,508	13,927
J. R. Hall	36,422	17,254
Carrier & Co.,	5,388	14,447
Atlantic Salt Co.,	3,536	3,234
Laderick Bro's	13,243	10,157
H. W. Sage & Co	65,609	65,480
W. H. Malone	22,522	16,702
Moulthrop & Lewis	12,491	18,396
Moore, Smith & Co.,	7,543	5,086
L. L. Hotchkiss & Co.,	34,278	24,832
Key Stone Lumber and Salt Co.,	11,047	6,719
Jno. McGraw & Co.,	51,133	45,217
Bousfield & Co.,	2,698	.....
A. Miller	35,536	65,967
S. McLean & Son	39,189	33,199
B. H. Webster	26,290	23,532
A. Rust & Co.,	29,008	30,681
Hay, Putman & Co.,	19,121	4,576
Wm. Peter	18,933	15,786
North Western, G. & W. P. Co.,	.....	1,899
Long & Bradfield	.....	107
Total, Bay County	706,701	657,288

SAGINAW COUNTY.

W. R. Burt & Co.,	64,412	77,945
Jno. F. Driggs	17,648	15,140
E. F. Gould	21,449	19,042
Sanborn & Bliss	11,448	.....
H. B. Allen	10,493	7,898
Shaw & Williams	23,576	16,620
A. T. Bliss & Bro	57,467	55,175
H. P. Lyon & Co.,	17,542	7,647
T. Jerome & Co.,	18,780	20,848
William B. Mershon	3,722	911
Rust, Eaton & Co.,	25,639	22,272
Wylie Bro's	11,924	.....
Booth & Hickey	7,054	18,488
Sturtevant & Green	33,114	30,433
Conrad Kull	14,595	14,932

Barnard & Binder	21,958	17,479
George F. Williams Bro's	27,004	28,033
D. Hardin & Co., (new)	691	.....
Pearson & Son	8,951	.....
Swift & Lockwood	28,310	24,990
C. T. Brenner	3,088	3,813
Pearson, Wright & Co.,	34,338	25,570
Shimons Bro's	2,962	.....
Stephens Bro's	11,087	.....
Cook & Davis	3,263	1,311
George Rust & Co.,	20,157	26,220
C. & E. Ten Eyck	17,212	16,547
Remington & Co.	14,787	.....
Burnham & Still	6,150	5,613
Eaton & Potter	5,754	7,483
Thompson & Camp	9,698	15,912
Warner & Eastman	20,056	11,164
Sears & Holland	27,169	31,060
A. P. Brewer	18,203	17,901
East Saginaw Salt Manufacturing Co.	39.318	27,727
H. Bischkie	3,381	2,585
Bundy & Yousman	4,994	14,721
Titterington & Co.,	5,187	6,254
Robert Conner	5,060	4,043
Champion Brown	.....	1,045
Oneida Salt & Lumber Co.,	.....	538
Rochester Salt & Lumber Co, (burned)	.....	586
Total for Saginaw county	674,641	590,976
Total for the State, barrels	1,660,897	1,462,729

BRINE ANALYSES.

Analysis of brines taken from salt wells on the Saginaw river and analyzed by C. A. Goesmann, Ph. D., the investigation being directed to ascertain their commercial value.

Gilimore well, Bay City. Depth of well 505 feet, brine 65 ° by salinometer.

Sulphate of Lime (Gypsum)	0.3961
Chloride of Calcium	0.5302
Chloride of Magnesium	0.4115
Chloride of Sodium (Salt)	15.2674
Water	83.3948
	100.0000

The above brine comes from the upper salt bearing sand rock.

Swift & Lockwood well, Saginaw City. Depth of well 860 feet, brine 86 ° salinometer.

Sulphate of Lime	0.0983
Chloride of Calcium	2.6430
Chloride of Magnesium	1.0685
Chloride of Sodium (Salt)	17.5102
Water	78.6799
	100.0000

Long & Bradfield's well, Banks Bay. Depth of well 774 feet, brine 95 ° salinometer.

Sulphate of Lime	0.0722
Chloride of Calcium	2.9611
Chloride of Magnesium	1.2612
Chloride of Sodium (Salt)	19.8595
Water	75.8460
	100.0000

These two brines, as the depth of the wells indicate, are from the lower salt bearing sand rock and are supposed to belong to the Waverly group. They are the representative brines of the Saginaw valley and are those that are most worked.

Analysis of brines taken from wells outside of the Saginaw valley. Ayres & Co.'s salt well, Port Austin, Huron county, Mich. Depth of well 1198 feet, brine 88 ° salinometer.

Sulphate of Lime	0.0109
Chloride of Calcium	3.1274
Chloride of Magnesium	1.5675
Chloride of Sodium (Salt)	17.6161
Water	77.6761
	100.0000

This well, with those at Caseville, Oscoda and East Tawas, shows a marked increase in the earthy chlorides and come from the lowest portions of the Waverly group.

Analysis of brine taken from the Thomson & Bro. salt well, at White Rock, Huron county, comes from another saliferous horizon. Depth of well 556 feet, brine 98.5 ° salinometer.

Sulphate of Lime	0.2622
Chloride of Calcium	0.5373
Chloride of Magnesium	0.4106

Chloride of Sodium (Salt)	18.9134
Water	79.8764
	100.0000

ANALYSES OF SALT.

Kettle salt made by the East Saginaw Salt Co. Analyzed by Dr. C. A. Goesmann.

Sulphate of Lime	0.3165
Chloride of Calcium	0.3564
Chloride of Magnesium	0.1408
Moisture	3.3441
Chloride of Sodium (Salt)	95.8422
	100.0000

Pan salt made by the Bay City Salt Co., Bay City. Analyzed by S. S. Garrigues, Ph. D.

Sulphate of Lime	0.697
Chloride of Calcium	0.329
Chloride of Magnesium	0.340
Moisture	1.346
Chloride of Sodium (Salt)	97.288
	100.000

Steam salt made by the New York and Michigan Salt Co., at Zilwaukie. Analyzed by Dr. H. C. Hahn.

Sulphate of Lime	0.363
Chloride of Calcium	0.699
Chloride of Magnesium	0.313
Moisture	3.303
Chloride of Sodium (Salt)	95.327
	100.000

Solar salt made by New York and Michigan Co., Zilwaukie. Analyzed by Dr. H. C. Hahn.

Sulphate of Lime	0.173
Chloride of Calcium	0.743
Chloride of Magnesium	0.417
Moisture	2.19.
Chloride of Sodium (Salt)	96.470
	100.000

DAIRY SALT.

There has been a great want of a good quality of this kind of salt, so as to complete the list of Michigan salts

now in the market. Several attempts have been made to start its manufacture, but none has been successful, owing in a great part to the want of care in making an article of sufficient purity.

I have now the pleasure of stating that during the past summer the Michigan Dairy Salt company, located at East Saginaw, was organized for washing, purifying and grinding the salt, with a capacity of two hundred barrels, daily, and is now in successful operation, turning out a superior quality of dairy salt, as the following analysis will show. We can hardly realize the importance of the manufacture of this grade of salt, putting, as it does, the farmer in possession, at a cheap rate, of a quality of salt for dairy purposes that cannot be excelled.

Sulphate of Lime	0.57
Chloride of Calcium	0.08
Chloride of Magnesium	0.09
Chloride of Sodium	99.03
Moisture	.23

ERRATA.

Page 10, 10th line from bottom, for seperated read separated.
Page 11. 14th line from bottom, for 1876 read 1877.
Page 14, 1st line from top, for silicous read silicious.
Page 39. 21st line from top. for 500 feet read 515 feet.
Page 41, 9th line from top, for lower read iron.
Page 42. 2nd line from top, for 66 miles read 63 miles.
Page 45, 17th line from top, for afford read afforded.
Page 48, 3rd line from bottom, for indicate read indicated.
Page 49, 13th line from top. for fitful read gifted.
Page 59. 15th line from top, for 1873 read 1853.
Page 76. 16th line from top, for 38,332 read 37,332.
Page 82, 7th line from bottom, for 25 read 225.
Page 107, 3rd line from bottom, for 1877 read 1878.
Page 112, in table of analyses, for 0.47 phosphorus read .047.
Page 114, in table of analyses, for 0.44 phosphorus read .044.
Page 118, in table of analyses, for 0.27 phosphorus read .027.
Page 118, in table of analyses, for 0.22 phosphorus read .022.
Page 115, 26th line from top. for undelying read underlying.
Page 116, 27th line from top, for lead read led.
Page 125, 17th line from top, expunge the word most.
Page 129, 4th line from top, for Huron read Hudson.
Page 132, 12th line from bottom, for 47° W. read 47 N.
Page 134, 14th line from top, for noticable read noticeable.
Page 137, 5th line from bottom, for and read an.
Page 139, 1st line from top, for mor- read more.
Page 193, 16th line from bottom, for apparentely read apparently.
Page 194, 14th line from top, for varrying read varying.
Page 199, 5th line from top, for approches read approaches.
Page 199, 21st line from top, for building read bedding.
Page 208, 8th line from bottom, for they read there.
Page 209, 9th line from top, for ending read amounting.
Page 209, 2nd line from bottom, for 75,000 read 45,000.

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