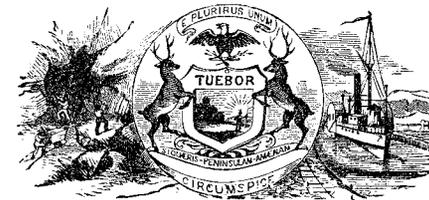


FIRST ANNUAL REPORT
OF THE
COMMISSIONER
OF
MINERAL STATISTICS

OF THE
STATE OF MICHIGAN,

FOR
1877-8 AND PREVIOUS YEARS.



CALIFORNIA STATE
MINING STATISTICS
S.F. FRANCISCO

BY AUTHORITY.

MARQUETTE:
MINING JOURNAL STEAM PRINTING HOUSE.
1879.

PREFACE.

OFFICE OF COMMISSIONER OF MINERAL STATISTICS,)
Marquette, Michigan, Jan'y 1, 1878.)
HON. CHARLES M. CROSWELL, Governor of Michigan :

Sir :—Herewith, in compliance with law, I have the honor to submit the first annual report of the commissioner of mineral statistics.

The report embraces the statistics for 1877-8, as required by the statute, and also, in order to completely exhibit the status of the mineral resources of the State, I have collated the statistics of previous years.

The arrangement of the topics, other than statistics, is as follows :

1. A popular geological sketch of the iron bearing series (Lower Huronian.)
2. Historical sketch of the iron district.
3. Description of the iron mines.
4. Historical and geological sketch of the copper district.
5. Lake Superior brownstones.
6. Slate.
7. Iron River silver district.
8. Ganister, or quartzite.
9. Marble.
10. Gypsum, or plaster.
11. Salt.

Prof. Charles D. Lawton prepared the historical sketch of the iron district, which I regard as the most reliable paper on the subject yet published. To him I am also indebted for the chapter on gypsum.

The chapter on copper is from the able pen of Hon. John H. Forster, whose thorough knowledge of the copper district and intimate connection, since its inception, with the practical development of that industry, together with that felicitous weaving of dry statistics into pleasing narrative, pre-eminently fitted him for the task. His paper is an invaluable contribution, which will be read and appreciated more and more as time passes.

I acknowledge my obligations to S. S. Garrigues, Ph. D., for his very interesting and replete account of the salt products of the State.

My thanks are due to the officers of the mining and furnace companies, as well as to the management of the Marquette,

PREFACE.

Houghton & Ontonagon Railroad and the Chicago & Northwestern Railway, for many courtesies.

To Mr. J. R. Grout, agent of the Detroit & Lake Superior Copper Smelting Works, and his assistants, Messrs. Z. W. Wright and E. Reeder, I am indebted for accurate statistics of the production of the copper mines; also to L. G. Emerson, M. E., for valuable information.

Valuable assistance was given me by Hon. E. G. D. Holden, Secretary of State; Hon. Ralph Ely, Auditor General; Hon. H. R. Pratt, Deputy Auditor General, and Mr. E. Row, in the office of the Secretary of State. Very many others have contributed to this report to whom I am under grateful obligations.

I have availed myself of information contained in the Geological Report of Michigan, 1873, and in the "Mineral Resources of Lake Superior," by Hon. A. P. Swineford.

It has not been possible to report on the coal mines or the blast furnaces; nor have I been able to complete a contemplated geological cross-section of the copper series. Considerable data relating to these subjects has been collected and reserved for a future report.

The compilation of statistics of previous years has consumed much more time than I anticipated would be required. No official compilation has before been attempted, and accordingly the data is necessarily scattered and in some respects unobtainable.

It is regrettable that some typographical errors in the text were not discovered and corrected, especially in a few analyses of iron ores, wherein the decimal point was inadvertently misplaced; reference is, however, here made to a table of errata at the end of the volume.

It has been my endeavor to make this report of practical value to the people of the State, and with that aim in view I have spared neither time nor necessary expense in the compilation. It is submitted in full confidence that the work will meet a want long felt—a compilation of statistics of the vast mineral resources of Michigan.

CHARLES E. WRIGHT, M. E.,
Commissioner of Mineral Statistics.

NOTE.—I understand that a bill will be introduced the coming session of the legislature to provide for a cabinet of minerals in the new capital building, representing the varied resources of the State. The cost of the collection would be small, while its value as a source of information could hardly be estimated.

GEOLOGY OF THE LAKE SUPERIOR IRON REGION.

It is desired within the limits of this report on the mineral statistics of the Upper Peninsula of Michigan, to present a brief but comprehensive view of the archean formation of this portion of the State. This season, however, will be considered, geologically, only the Laurentian and Lower Huronian* periods. So little is definitely known of the copper series, which overlie the Lower Huronian, that it is proposed next season to devote the greater part of this section of the report, to that district. I have collected considerable material relating to the copper region; but to publish it in its present crude state, would be doing neither this great interest nor myself justice.

To start with a clear record we will go back to the now generally accepted theory of the primitive condition of the earth; that is, when the surface of the molten mass of the globe had crusted over; that we may understand the source of the first sedimentary rocks, designated by most geologists, as the Laurentian. It is very questionable if any of the first rocks thus formed are extant; for, as the cooling of the globe progressed, the crust must have formed and reformed many times. This seems very natural, when we know that molten rock shrinks nearly 1-12 in cooling, which alone, would of necessity produce wide cracks here and there over the surface; and the contracting force would then cause the fiery liquid to shoot upwards and overflow the crust, which from the superimposed weight, would sink to be again lapped away

* This term "Lower Huronian" is used to distinguish it from the Copper series which by some is supposed to belong to the Huronian rocks, and it is not impossible that this latter series may eventually be designated as the "Upper Huronian."

by the seething bath beneath. This process, repeating itself over and over again, would, as we can readily imagine, afford us a very uneven surface. During this time we must suppose that the deposition of the sedimentary rocks, had in a measure begun; and it is highly probable, that even much of these early sediments were remelted: but this is a matter of speculation, and we will advance a step.

Our first rocks were mostly granitic; this is true, not only of the primitive, but also of the later Laurentian ones.—Among the latter, we frequently see coarsely crystalline massive granites, passing into gneissoid rocks; and these graduating into mica schists; and the latter even, as imperceptibly, into slate. So gradual is this change, that it is quite impossible to draw the line, separating each group by itself.

The cause of this great diversity of rocks, when derived from the same source, is to many, a matter of wonderment, though readily understood. Let us examine carefully, any exposed granite ledge. If it be of a feldspathic nature, the rate of decomposition will be proportionately rapid, and a slight blow, dealt on some of the disengaged blocks, will often break them into a thousand pieces, disproving the common phrase “as imperishable as granite.” In fact, some of the more basic granites may be classed, as among those, the least able to bear the wear of time.

Taking some of these broken fragments, the feldspar is readily made out. It may have a milky texture, and crumble in the fingers, still, the unmistakable cleavage is there.

In the fire clay beds near Grand Rapids, Wisconsin, which are nothing more than decomposed granite ledges, the original structure of the granite is plainly visible. The crystal form of the feldspar still remains, but its chemical composition is changed; for out of the feldspar has been dissolved the alkalies, leaving the white, greasy-feeling mineral, kaolinite, behind. The scales of mica are still perfect, but are more or less brittle; and the only unaltered mineral is the quartz, which may now be easily freed from the material that once held it so firmly.

Thus it is with the granite ledge before us. The moisture penetrates the rock, entering every seam and pore, the frost then opens the crevice still more, until the loosened rock is obliged to relax its hold, and “old gravity” hurls it down—not to its resting place, however; for the heat and cold, the wet and dry, co-workers of chemical action, all combine to lessen the size or break up the block, so that the mountain torrents are enabled to roll it along their rocky beds.

The boulder, in this rough-and-tumble journey, is either broken, or its corners become rounded. If it be a jointed block and easily fractured, the chances are that it will be reduced to pebbles, or ground into fine sand or silt. In any case above considered, the greater portion of our original block has disappeared, either as a sediment, or as we have already observed, in the feldspar, has been partially dissolved.

The disposition of the material in the former of these two conditions, is easily traced out. The coarser material is deposited first, which, too, is usually more of a silicious or quartz nature. The finer portion is borne still farther, until the point is reached, where the specific gravity of the particle, overcomes the velocity of the current and the buoyancy of the water. These deposits, however, are subject to frequent changes, since a heavy freshet will often transport them farther along, and, on the other hand, a drouth will locate them nearer their source. This sorting out and grading of the material is constantly in operation on every hill side; and we thus have depositions of variable degrees of fineness and of different chemical composition.

The material in solution is not so easily traced to the end. A large proportion of it is absorbed by the earth, where, meeting with other elements, it enters into new combinations. Another portion is taken up by vegetation; still another portion is conveyed in solution, to the sea or ocean, where, in case of the alkalies, it may combine with chlorine affording the chloride of sodium—domestic salt—and other less common salts.

There are other sources of rock building mat-

they are as easily understood, whether they be of a mechanical, chemical, or organic nature; and we have only to conceive of these agents constantly at work and we thus see how it is that such great thickness of beds is possible.

When the different layers had attained considerable depth, the lower ones were necessarily subjected to an immense pressure. This, combined with the heat, would very soon harden them. Crystallization was no doubt progressing at the same time. The resultant of these mechanical and chemical forces are our so-called metamorphic rocks.

The granite and gneisses have about the same composition, the only essential difference in most cases being that the gneiss has preserved its original bedding planes, while the granite is massive. The cause of this is supposed to be by some partially due to the variation of temperature and pressure during metamorphism.

The Laurentian rocks of our Lake Superior country, are chiefly granite and gneissoid rocks; but, unlike those of Canada, have not thus far proved to be of much economic value.

In Canada, the iron ore deposits occur largely in the Laurentian rocks, but in our region, when the experienced explorer "comes to granite," he turns away; for he knows only too well that the Laurentian fields have ever been to him as barren of iron ore as the Lower Huronian is of copper.

There are, however, narrow seams and fissures filled with galena, pyrites and quartz, which will often cheer up the heart of the novice, and cause him to believe that the galena is pure silver and the yellow pyrites, virgin gold; and that the only question is to devise some method by which they can be cheaply wrought. This may seem hardly credible; still I should not care to state how many times prospectors have brought to me small pieces of rock containing a few bright, yellow specks of copper pyrites, or silver gray ones of galena, or micaceous iron ore—the result, perhaps, of weeks, or even months, of hard, wearisome labor—only to find that they were worthless. If the explorer were honest in his convictions, his disappointment is correspondingly great; and as a rule he leaves behind him his former "bright prospects."

The fact that so little of value has been found within the Laurentian area, will account for our lack of knowledge of these rocks. It is possible that within the Laurentian fields are isolated knobs, or islands, of the primitive rocks; but as yet, I have never found or examined any granites from the Upper Peninsula, or from Wisconsin, that were other than metamorphic.

With the unaided eye, it is quite impossible to distinguish a metamorphic granite from an igneous one; but, since the lithologist has brought to his aid the microscope, it is a question that can in most cases be satisfactorily settled. We have seen that the materials of which the primitive granites are composed, was once in a fluid state, while that of the Laurentian rocks, is sedimentary. Each was then in an amorphous condition,—the one a fluid, the other, possibly, a fine mud, and in the granites, approximately of the same chemical composition.

During the process of crystallization it is very natural that the crystals of quartz and feldspar should have enclosed portions of the original material from which they were derived, also small crystals of the accessory minerals.

Taking a small chip of an igneous granite and making a thin, transparent section of it, and then, by placing it under a powerful microscope, we see in the quartz grains small cavities filled with glass or stone material. On the other hand, a thin section of the metamorphic granite will show in the quartz grains, cavities filled with liquid. The latter having been included at a higher temperature than what it is at present, has shrunk in volume, thereby producing a small vacuum bubble, which is constantly dashing around in its narrow confines. The liquid is sometimes water or a salt solution, or, as I have observed in rocks from other localities, it may be condensed carbonic acid. These cavities are usually very minute, averaging not more than 1-1,000 of an inch across. Though apparently very insignificant, their importance can hardly be appreciated.

So far as my own observation goes, we have, among our archaic rocks, two granites: one the Laurentian, and the oth-

er coming between the copper and iron series. They so nearly resemble each other in their lithological characteristics that it seemed for a long time quite impossible to distinguish them in hand specimens, or even in isolated outcrops with any degree of satisfaction. They are of the same mineralogical composition, and in other respects are much alike.

In a granite specimen from Wausau, Wisconsin, which Prof. R. D. Irving sent me two years ago for examination, I first discovered in granite the presence of liquid inclusions containing a small transparent cube of salt. Turning to my own cabinet of mounted sections, I soon found that these saline inclusions were confined entirely to the upper granite, overlying the iron bearing series. Here then, though trifling in itself, was an interesting discovery. Since then I have frequently applied this test and cannot assert positively that it has failed me in a single instance.

Our Laurentian rocks are often traversed by narrow dykes or fissures, filled with igneous rock material, such as basalt, or more frequently the filling is of a segregated or sedimentary character. It is more than probable however, that the majority of the apparent igneous veins, especially the dioritic ones—are the softened strata of the Huronian brought to a semi plastic condition by heat. To strengthen this view, one may often observe under the microscope, in thin sections of the diorite, a “fluidal” structure, showing crystals of hornblende, broken into pieces, and scattered along in one direction, still, not so greatly separated but what we can readily see where the various fragments could be reunited.

Dr. Rominger, our present state geologist, has devoted considerable time to investigating this vein phenomena, in the immediate vicinity of Marquette, which I trust, from a purely scientific stand point, will throw some light upon this long neglected branch, of the geological history of the Upper Peninsula.

After the Laurentian rocks were formed, and even during their deposition, the crust beneath was gradually cooling

Lower Huronian Series.

and shrinking, subjecting the partially crystallized sedimentary rocks to a strong lateral pressure: this of itself would tend to bring out their latent heat, which would expand them, increasing the pressure still more, thereby causing the strata to become more or less wavy, or folded.

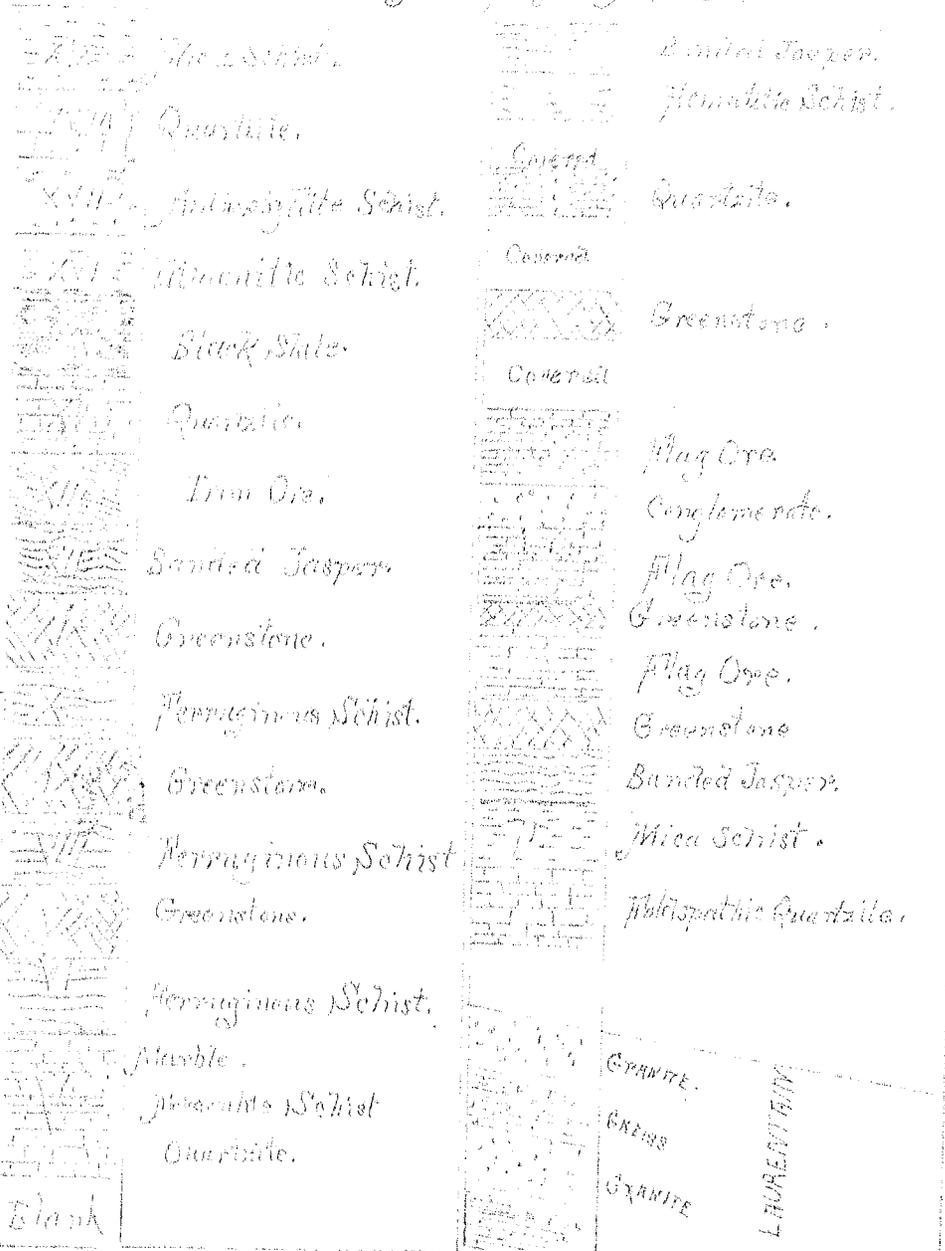
The surface of the earth at the close of the Laurentian, was, no doubt, very uneven: high mountain ranges existed where at present are only level plains, with nothing—save perchance, the dip of the strata—to denote their former presence.

The same destroying agencies that operated against the primitive rocks were even as active among the Laurentian, though probably the atmosphere was less acid, and the temperature much lower, in the latter than in the former: but there, no doubt, was more moisture, which would, in a measure, compensate for the partial loss of acidity.

Chiefly from the ruins of the Laurentian rocks have been formed the Lower Huronian strata, the home of the iron ore deposits of Michigan. This period was first divided by Major T. B. Brooks, in his geological report of Michigan, into nineteen different members, represented by Roman numerals. These have not all been classified, especially those at the base of the series. (See diagram of "Lower Huronian rocks.")

Some objections were made last summer, (1876), by Dr. Rominger, as to the non-conformability of our so called Laurentian and Huronian series, on the ground that he had observed in several instances "a perfect conformability of these supposed distinct series." It seems perfectly natural to me that this should often occur; and were I to find ninety-nine places where an apparent conformability existed, and only one of decided non-conformability, the latter would, in my estimation, outweigh all the former.

At Penoka Gap, where the Wisconsin Central Railroad crosses the Range, may be seen as complete a case of non-conformability of the Laurentian and Huronian as the most skeptical could wish. The strike of the gneissoid granite there is S. 75° E., and the dip is about 70° degrees to the



CALIFORNIA STATE
 GEOLOGICAL SURVEY
 SAN FRANCISCO.

south while the plainly bedded Huronian strata, in direct contact, have a strike of north 70° east, and a dip of 65° degrees to the north. The Huronian series of the Penoka Range correlate very well with the Michigan members of the same period.

The first member of our diagram of the Huronian series is a feldspathic quartzite, and the next above, a garnetiferous mica schist. The other strata, until we reach No. V. of the diagram, are the unclassified ones, and are taken from a geological section of the Cascade range, given by Major Brooks in his geological report.

In writing this, is suggested the possibility of these latter members of this locality belonging to those above V. In that case, we should have to consider the prevailing dip of the formation to the north; and, consequently, assume that some of the members were overturned. This folding and tilting over of the strata, is not an unfrequent phase of the Huronian beds.—(See cross-section of the McComber mine.) At some future day I hope to work out this interesting structural problem. We will therefore, leave, for the present, this comparatively unsettled field, describing only the ores and mines, which latter will be considered farther along in this report.

Formation No. V. is represented chiefly by quartzite, silicious marble and novaculite, or "whetstone rock." See specimens Nos. 2, 3 and 4, of State collection. The quartzite is usually of the lighter shades of grayish white, or sometimes white. It is usually vitreous, and has a coarsely granulated appearance. It is of sedimentary origin, as may be seen by the frequent occurrence of ripple marks. Some of the largest out-crops of this rock are just south of Marquette, which extend for several miles westward.

The quartzite is now used by the Bessemer steel makers, as a lining for their converters, and is technically known as "gannister." Several thousand tons have been quarried and shipped for this purpose, and it is considered fully equal to the English article. Eventually, no doubt, when the requirements of the consumer are fully understood,

this present infantile enterprise will become one of our important interests.

The marbles here are usually of a pinkish shade. They are silicious and often graduate into the quartzite. Formerly they were used quite extensively by the local blast furnaces, as flux; but at present, with the small margin of profit on pig iron, it does not pay to smelt limestone containing so much silica. A sample of the marble, from near the old Morgan furnace, gave me, on careful analysis, the following result:

Carb. of lime.....	49.10
Carb. of magnesia,.....	41.00
Oxide of iron,.....	.43
Silica.....	8.00
Undetermined.....	1.47
	100.00

Some portions of the marble are finely variegated with delicate shades of pink, yellow, drab, &c., and would make very beautiful mantles, table or stand tops. It is exceedingly fine grained and susceptible of a high polish.

Quite recently (Sept. 1878) has been found in the immediate vicinity of Ishpeming, some very superior varieties of marble and serpentine, which I shall describe farther along in another chapter.

The novaculite has furnished most excellent hones, equal in quality to the Turkish ones, and some of the large slabs, no doubt, would answer well for lithograph stone. The rock is more or less slaty in its structure and texture. It is usually of a pearly gray or grayish drab color. With the knife point it may be readily scratched; but is not easily abraded by mere friction.

It is to be regretted that this once remunerative industry—the manufacture of whetstones—has been allowed to remain idle so long. That there is money in it, is not denied; but it is a trade of which only a few know anything about, and therefore dislike to enter into it.

No. V. is sometimes represented by silicious slates, magnesian schists and argillites.

Turning to formation VI. we have chiefly siliceous slaty schists, usually jaspery or magnetic. At the Republic mine may be seen, better than any where I know of, the different members from VI. to XIV. inclusive of our diagram, and we will therefore describe those of that locality. No. VI., there is an actinolo-magnetic quartz schist. (See spec. 5). It is banded with purplish brown layers of variable thickness, from that of a sheet of paper to two inches. On the weathered out crop, north-east of the mine, it presents a very pretty and interesting sight. Glacial action has worn smooth and polished the upturned edges of the nearly vertical strata: showing in detail, to the best advantage, the banded structure. This is not only true of No. VI., but of the succeeding members to No. XIV. No. VI. is extremely fine grained, and is strongly magnetic. In the hand specimen, even with the aid of a good lens, but little of a definite character can be said of the rock. A thin transparent section of the rock, placed under the microscope, shows it to be composed of small grains of quartz, bushy fragments and blades of actinolite, (fibrous hornblende), and minute crystal particles of magnetite; also an occasional imperfect crystal of feldspar.

No. VII. This formation is commonly known in the Iron Region, as greenstone, diorite or trap. That at the Republic range is a hornblende rock. It is medium to coarse grained in texture, and has a dark green color, which weathers or fades to a grayish white. It is massive and strongly jointed, rarely ever showing any signs of bedding. Under the microscope, a thin section of the rock is seen to consist chiefly of hornblende and quartz, with plain and striated feldspar, brownish scales of mica (biotite), and grains of magnetite. This formation in other localities is not confined to one kind of rock; but is represented by slates and magnesian schists. On the Penoka Range, at the gap, the greenstones are replaced by the slates; but farther westward, a few miles, the greenstones again occupy their old position.

No. VIII. is a banded ferruginous quartz schist, differ-

ing mainly from No. VI. in containing less actinolite; while many of the layers, on their polished edges, present a graphic appearance, from small dendritic fragments of brownish jasper. In some localities the magnetite entirely disappears, or is replaced by the red oxide of iron, affording then a jasper.

No. IX. is a hornblende rock, to all appearance the same as No. VII., but it contains more quartz and less feldspar and mica.

No. X. is a banded ferruginous quartz schist. In the Ishpeming district, it is a jasper; but west of there, where the magnetic ores are found, it is usually a magnetic schist. In this formation are located the so called soft hematite mines. In these mines it appears that the finely divided silica has been more or less dissolved out by alkaline thermal water, leaving the iron oxide and other bases behind. In some of these hematite deposits, so complete has been this process that only a very small per centum of the silica remains. (See description of McComber mine.) One fact worthy of mention here is that these mines are generally located where has been the greatest amount of disturbance. This tilting and bending of the strata has broken up the formation somewhat, and afforded the dissolving agents a better chance for gaining access to the silicious layers. These mines offer excellent opportunities for studying the complex structure so common to the Huronian rocks.

No. XI. formation is a hornblende rock much like Nos. VII. and IX. and constitutes the last of the greenstone belts underlying the iron ore. It may be noted here that in these hornblende rocks, the quartz sometimes disappears, and the orthoclase is replaced by oligoclase, and there results a diorite. So far, however, as my own observations go, the hornblende rocks are much more abundant than the diorites; and it was for this reason that I chose the well-developed Republic range to illustrate in part the Huronian series.

No. XII. is a red banded jasper; and it generally forms the main foot-wall of our iron mines, though frequently a thin

layer of chloritic, or talcose schist comes between the jasper and the ore. When the jasper is of a blood-red color, as is often the case, and the narrow bands have a wavy structure, it is then one of the most beautiful rocks we have. With a little care in selecting, very good slabs could be obtained across the bedding planes, which, when dressed and polished, would surpass in beauty anything yet used for stand tops or other like ornamental purposes. A moment's examination of one of the diamond drill cores out of this formation will soon convince any one of the fact.

From No. XII. of our diagram we pass to XIII., the home of the hard ore deposits of Michigan. It must not be inferred, however, that this member always affords first-class ore; for often it is second-class, and more frequently worthless rock. In some localities No. XIII. is very prolific in good ore, while in others it is quite barren. The ore is usually found in lenticular shaped masses. At the different iron mines of the Marquette district, may be seen all the known varieties of the magnetic and red oxides. In the former, we have the coarse granular to the fine steely kind—the one quite friable and easily wrought; the latter exceedingly hard and not easy to mine. Among the red oxides there is even a greater variety. Some are coarse grained, while, on the other hand, we have those of an almost impalpable texture, with all the intermediate grades. Some are massive, others are micaceous or slaty in structure. Some of the micaceous specular slate ores are very friable, and easily frittered away between the fingers. Like the magnetic ore, there are found the hard, steely specular ores, even more difficult to drill and mine than the magnetic. The so-called soft ores are usually mixtures of the red and yellow oxides, (hydrates), and rarely ever can be divided into strictly soft hematites and limonites. As the ores will be fully described in the chapter on the iron mines, we will leave them for the present.

In the ore beds and on either side of them, are lenticular shaped masses of magnesian schists, which sometimes overlie, and again underlie, the ore; there appearing to be no rule—save locally—for their occurrence. Turning to the

true hanging wall of the ore, we have No. XIV., a quartzite or quartz conglomerate. The quartzite is usually of a grayish color, and is medium grained in texture. Sometimes it has a greenish tinge, owing to small leaves of chlorite scattered through it. This quartzite usually differs from the lower quartzite—already described in this chapter,—in being less vitreous, and is perhaps more arenaceous in texture though it requires considerable experience to distinguish them; and even then, it is often quite impossible to do so. The quartzites of the Michigamme, Republic, Humboldt and Champion ranges, and at some other mines, are almost identical in appearance. The hanging walls of the Cascade and the Ishpeming mines, are a jaspery quartz, conglomerate, or breccia. In some instances, as at the Lake Superior mine, the quartzite passes into a chlorite quartzite, and then even into a chlorite schist. Some very interesting facts are now being brought to light, from a diamond drill hole driven down at Ishpeming, on the division line between the Lake Superior and Cleveland Iron companies. It shows very nicely the alternation of the chloritic schist and gray quartzite, and the frequent imperceptible gradation of the one with the other. The hole is now down several hundred feet.

Next on our diagram, is No. XV., a slate. The color is generally black, which is due to finely disseminated carbon. The cleavage is quite perfect, though not always sufficiently so to render it suitable for roofing purposes. Scattered through the slate, and along the joints, are numerous grains and small crystals of iron pyrites. For a full description of these slates, see special chapter on the same in this report.

Overlying No. XV. is No. XVI., a yellow limonitic schist. It is possible that this is only a decomposition of the more pyritiferous lenses of No. XV. or is derived in a like manner from No. XVII. which is an anthophyllo-actinolite schist. This is a dark gray rock approaching a black, which is caused by a variable percentage of the oxide of manganese. It is highly probable that some portions of this bed

may locally prove sufficiently rich in manganese to render it valuable as a mixture in the manufacture of Bessemer steel iron. The rock, when examined under the microscope, presents a densely reticulated ground mass, made up of the fibrous actinolite and anthophyllite. So intimate is the mixture of these minerals that it is very difficult to distinguish one from another. In the thin section of the rock many of the crystal blades project from the edge, when it may be seen that in some of these the crystal axis and optical bisectrix, coincide (anthophyllite),* while in others it makes quite an angle (actinolite). There are some fine exposures of this rock in a railroad cut, on the north side of Michigamme Lake. It is easily recognized on close examination; for apparently spattered over the surface of a fresh fracture, are the small thistle-blow like spots of anthophyllite or actinolite from one to three-eighths of an inch across. The rock is quite tough and not easily fractured.

No. XVIII. Major Brooks has designated as quartzite, and overlying it is a mica schist. It may be that No. XVIII. is a less micaceous variety of No. XIX.

No. XIX. of our diagram—a mica schist—has usually a bronzy cast from the brownish mica (biotite). Scattered in it are frequently saw-buck shaped crystals of staurolite, and rounded dodecahedra of garnets. South of the Michigamme range, this formation is well developed; the same may be said of the Menominee range, near the mouths of the Michigamme and Paint rivers. Possibly at some future time we may extend the diagram of the Huronian series, so as to include a granite, which, in the Menominee district, overlies the mica schist; but for the present, we will consider No. XIX as the topmost member of the iron series or Lower Huronian.

Reviewing the ground just gone over, it must not be supposed that these members are always present in any one section, or that we can recognize in every instance an iso-

* It is possible that this may be an actinolite crystal, wherein the cutting plane of the section has passed at right angles to the clino-plane of the crystal, in which case, as will be readily understood by the mineralogist, the apparent optical bisectrix plane and the major axis of the crystal would become parallel.

lated member of the series. Still, I trust a careful study of the above diagram, will greatly aid the explorer in his search for iron ore deposits; and also assist the scientific student in his endeavors to solve the difficult problem, presented by the complicated geological structure of this region.

The question is often asked, "How do we account for our iron ore deposits?" Many theories have been advanced to answer this apparently simple question. Some believe in the replacement theory,—that is, that the iron ore beds were originally occupied by some other material, which has been dissolved out and replaced by iron oxide.

Others consider that the beds were primarily composed of jasper, or some other highly ferruginous rock, out of which has been dissolved the silica, leaving the iron oxide to be metamorphosed into the hard crystalline ore.

Others, again, hold that they are altered bog iron ore deposits, which latter—as is well known—are the result of the decomposing vegetation—usually the common bog of the swamps—being replaced by the hydrated per oxide of iron, a sort of a ferrifaction, so to speak.

Without adopting here, any one of the above theories, or advancing a new one in their stead, it may be well, before closing this chapter, to present a few of the facts, which I have observed during the past year or two, hoping they may throw a little light upon this interesting subject.

In the Michigamme mine was found, during the summer of 1877, a large piece of magnetic ore, weighing several hundred pounds, which had a concretionary structure exactly like that of brown iron ore. While at the mine last spring J. C. Fowle, the Superintendent, gave me an interesting specimen of specular ore, having on one side the cast of some mud cracks—very similar to the cut of one represented in Dana's work on Geology. In many of our iron mines are frequently seen octahedral crystals of specular ore (martite) after magnetite.

The McComber mine at Negaunee has furnished several minerals, among which are baryta or heavy spar, calcite,

rhodochrosite, (carbonate of manganese), pyrolusite, (binoxide of manganese), kaolinite and pseudomorphs of pentagonally striated crystal cubes of hard hematite ore after pyrite. These cubes, when unaltered, are very hard and dense, the sides have a bright bluish black shining luster, much like that of a tarnished cube of pyrite.* The most interesting specimen we have to offer is a very small bit of manganeseiferous hematitic shale, bearing the impression of some fossil. I sent this fossil to Prof. G. J. Brush, of New Haven, who, with Professors Verrill, Dana and Smith, pronounced it a fossil belonging to the lower fauna of life. Prof. Verrill, who is very familiar with these early fauna, said it reminded one of the foraminifera or bryozoa. I had hoped to obtain more material that this very interesting fact might be more definitely settled before the publication of this report, but for the present we must content ourselves with the above facts, trusting that the future will afford us something more tangible.

This article on the geology of our iron district would hardly be complete without noticing the Lower Silurian rocks,—represented in this region by the Potsdam and Calceiferous sandstones, and the magnesian limestones, and delineating briefly the outlines of the Laurentian, Huronian and Lower Silurian periods. Beginning with the Lower Silurian, we find in the southeastern portion of the city limits of Marquette, isolated patches and bays of brown sandstone, nearly horizontally bedded, and resting unconformably on and against the Huronian. The Lower Silurian member has an irregular shore line as we proceed southward from this locality. The first six miles its course is southwesterly, the sandstone resting on the Huronian. We continue south about fifteen miles, along a very crooked shore composed of granite; when following this dividing line we travel westward some twelve miles further; then in a gentle curve we return to our southward course, and in town 42, range 27 west, we cross a neck of Huron-

* For further information on the occurrence of these minerals, see description of the McComber mine in the chapter on the iron mines.

ian nearly six miles wide. Leaving this we skirt along the granite beach for fifteen miles more, when we meet again the Huronian, which forms the coast of the Potsdam for twenty miles or more, where it intersects the Menominee river and enters Wisconsin.

Returning again to Marquette, we find the Potsdam sandstone skirting the south shore of Lake Superior nearly all the way to Keweenaw Bay, and from thence southward, there appears to have been an extensive Lower Silurian bay, having for its northwest shore, the Copper Range, or Upper Huronian. The formation before us has furnished very excellent brown sandstone for building purposes, and many of the variegated varieties obtained from the Marquette quarries cannot be surpassed for beauty or durability. In the Huronian period it would be practically impossible to define the shore lines of the Huronian sea, owing, as we have seen, to the bending and upheaval of the strata, and the subsequent erosion.

Our purpose, then, is not to describe original boundaries, but rather to trace out the upturned edges of the strata. Glancing over this section of the country we find the Huronian fields limited by granite, or covered by the overlying silurian and drift. The general trend of the formation in the Marquette district is nearly east and west, and as we proceed westward from Marquette it gradually widens, until at Negaunee it appears to have attained its maximum width of about thirteen miles. The upper members of the Huronian are apparently wanting between Marquette and just east of Negaunee. The strata form a broad synclinal trough, resting on granite. The synclinal is corrugated in the direction of its axis with several minor folds. West and south of Negaunee and about Ishpeming, these minor corrugations are contorted and their upturned edges have a serpentine-like course. Nature here, apparently, in one of her uneasy moods, has, by disturbing the strata, brought to light her buried treasures, and rendered easy of development the several first-class specular iron ore mines about Negaunee and Ishpeming.

The Jackson mine at Negaunee is the oldest iron mine of the district and its products are largely sought for. At Ishpeming we have the Lake Superior, Barnum, Cleveland, New York, Lake Angelne and other mines. Their ores are of the best quality and average high in metallic iron.

North and south of Negaunee are located a number of soft hematite mines. These ores are in good demand by Bessemer pig iron makers, owing to their low percentage of phosphoric acid. Southward of Ishpeming are the Saginaw, Winthrop and other mines. The Saginaw ores are the first-class specular varieties.

As we continue westward from Ishpeming the formation again becomes more regular, though here, as east of Negaunee, may be observed the inferior folds. On the south rim of our broad synclinal are located the Washington, Edwards, Keystone and Champion mines. In the Washington and Edwards mines the ore—a fine quality of magnetic—occurs in pockets or irregular shaped lenses, while at the Keystone and Champion the ore belt is more uniform. At the Champion the vein or bed is nearly vertical, and on the lower level of the mine it is about one hundred feet wide. The ores, the magnetic and specular, are of a very superior quality, and in their present workings are very low in phosphorus and sulphur.

The Huronian, westward from Ishpeming, gradually narrows until it reaches Michigamme Lake, where it is only two miles wide. The northern edge of the trough maintains its course along the north shore of the lake, and includes within its iron belt the Michigamme and Spurr iron mines; also other undeveloped mines.

After we leave the Spurr mine the course of the formation appears to be west-northwest, and when we arrive at a point about eight miles south of L'Anse the formation takes a short turn to the northeast, but before reaching Lake Superior it dips under the Potsdam sandstone, and we return about five miles further to the northwest, in nearly a parallel direction on the northwest side of the Huron Mountains, along the Lower Silurian shore line to L'Anse. Coming

back to the east end of Michigamme Lake, and tracing the southern rim of the synclinal, we find it makes a gradual southwesterly turn and in an easy curve comes around to a southeasterly direction, conforming in a measure to the east side of Michigamme Lake and its outlet. We continue on our course, passing the Kloman mine, and finally reach the Republic mine. The ores of these mines are mostly specular. In the Republic has been found a deposit of very pure magnetic: the specular ores are very rich in iron oxide and are favorably known to our iron men.

The formation has here made a horse shoe-like bend, twisting and contorting the strata, and returned in a north-westerly direction along the southwest bank of the river. The strata are tilted at high angles, and in some instances are overturned. The dip, however, is usually away from the underlying granite, so that on each side of the river we find the strata inclining toward each other, thereby forming a narrow trough of less than one mile wide and six or seven miles long. On this range are located the Metropolis, Windsor, Canon, Erie and Magnetic mines. These mines are all on one of the lower iron belts. Immediately after we leave these mines the upturned edges of the Huronian begin to curve to the left, and in about one-half mile they have a direction of nearly due south, which continues for three or four miles, when it makes a little more easting, and finally we come to a point some eighteen miles south of the Republic mine; then we proceed southeasterly and easterly for about thirteen miles, when we meet the Potsdam formation mentioned above, in town 42, range 27 west. Following our previous trail southward for five or six miles, across this Huronian neck, we arrive on its southern edge. Proceeding now westward on the dividing line of the Huronian and Laurentian for thirteen or fourteen miles, we turn to the southwest, then to the east and northeast for a short distance, and ultimately in a more uniform course to the southeast. We are now in the Menominee region. The formations are more regular and have a trend of west by north. On the Menominee range are several new iron

mines which are doing well with fair prospects for the future. The ore, a soft specular averages well in metallic iron, is low in phosphorus and contains an appreciable amount of lime; qualities, which cannot fail to recommend the ore to furnace men, especially to those seeking to make Bessemer pig iron. Having in a superficial manner considered the region best known to us, and in which we are most interested, we will tarry a moment on the borders of the geologically unexplored Laurentian. In the Menominee region is a small Laurentian island, bounded on the north, west and south by the Huronian, and on the east by the Silurian. Immediately north of this and separated only by a narrow Huronian bay is a much larger granite island belonging to the same period, limited on the north by the Marquette iron district (Huronian) and on the west and south by Huronian, and to the east by Silurian. Still further north is another Laurentian island, even larger than the preceding. It is hemmed in on the north and east by Lake Superior and Potsdam Sandstone, to the west by the Huron Mountains, and on the south by the Marquette iron region. The first island has an area of about one hundred and fifty square miles; the second island of, say six hundred square miles, and the upper, or northern Laurentian island, probably numbers seven hundred square miles. With the Laurentian closes our chapter on the general outline of the geology of the Lake Superior iron region. A more detailed description will be found in the portions of this report relating to mines, sandstones, slates, etc.

GENERAL HISTORICAL SKETCH OF THE IRON REGION.

The knowledge of the existence of copper on the South shore of Lake Superior, was co-incident with the discovery of the country. The crude implements and uncouth images, composed of this metal, found among the natives by the white men who first visited the region early in the 17th century, afforded ample evidence of its presence, in considerable quantity and native purity, somewhere in the vicinity, to be found and developed in later years,—furnishing the basis for large accumulations of individual wealth; for the building up and sustaining of populous communities; and for contributing to the world, in large measure, one of its most necessary and useful articles.

But none of the early missionaries, *voyageurs* or explorers, became aware, that imbedded in the rocks of this perilous and forbidding coast, existed in vast quantity and of extraordinary richness, another mineral, which, though coarser in texture and more common in occurrence, is of far greater importance in the world's industries,—the most powerful of the mineral agents which mother earth affords, to develop the civilization and prosperity of her children.

The copper, the presence of which was noted and recorded by the early discoverers, and the iron, of which they knew nothing, both existed in unparalleled measure, and to them is due the development which the region has undergone; having produced in the iron district, as in the copper, important and thriving cities and villages, railroads, canals, lines of vessels and many other less costly though necessary improvements.

The discovery of the existence of the iron ore in the Up-

per Peninsula of Michigan, of which she has contributed so largely to supply the demands of the country, and which has been chiefly instrumental in developing the region where it exists, is primarily due to the U. S. surveyors, who first noted its existence in place, in Sept. 1844, while running the east line of T. 47 N. R. 27 W. They were led to the discovery by observing that the needle of the solar compass, the instrument used in making the surveys, deflected largely from the normal direction, and surmising the existence of some local attraction, they sought for the cause, and found outcrops of magnetic iron ore—specimens of which they secured and preserved in the collection of minerals, which was made in connection with the linear surveys.

Thus it was more than two hundred years, subsequent to the discovery of copper on Lake Superior, ere the knowledge of the no less valuable fact, of the existence here also of iron, became known to the world. And two decades of years were yet to elapse before that shipment of ore began, which ere a like period transpired, grew into a stream of upwards of one million tons annually.

In 1845, the year following the discovery of iron by the U. S. surveyors, a party of explorers under Indian guidance, found near the same locality, the remarkable outcrop, which they secured by a "permit," and which became known as the "Jackson location;" they proposing to commence operations under the title of the Jackson Mining Co. The party who secured the mine were members of an organization which had been formed at Jackson, Mich., but a short time previously, July 23, 1845.

This is the earliest and best known of the iron enterprises on Lake Superior and for many years became leader, also, in importance and value. The first ore was taken from the mine in 1846, the year following its discovery; and in the subsequent year the construction of a forge was begun on the Carp river, which was completed early in 1848, the first iron being made on February 10th, of that year. Thus the Jackson Co. became the pioneer iron maker of Lake Superior.

In 1850 a few tons of ore were taken to Newca and made into blooms; and two years thereafter a amount was carried to Sharon, Pa., and melted into iron. The first regular shipment to lower ports, comprising 5,000 tons, was made in 1856. During the four or five succeeding years the operations of the company were attended with frequent changes, constant disappointment and financial embarrassment; but upon the breaking out of the war, the great demand created for iron, put the fortunes of the Jackson, as well as the other iron companies of the district, upon the high road to success. It became, probably, the most prosperous iron mining company in the country, perhaps in the world. The Marquette Iron Co., becoming afterwards what is known as the Cleveland, and out of which grew also the Lake Superior Iron Co., began its operations soon after the Jackson Co. A forge, with ten fires, was built by the company at what is now Marquette, and the manufacture of blooms begun. But like all bloomeries started in Marquette county, it was a failure. The cost of production was ever in excess of the market value of the iron. Transportation, at that period, was irregular and expensive—there being no canal at the Sault; no roads in the country; no skilled labor; no supplies for men and teams; no materials for construction and repairs, except such as were obtained by the uncertain and unfrequent communication from below.

The consumption of ore, in the forges of the Jackson and Cleveland companies, amounted to about 25,000 tons and after 1856, the period when the shipments of ore began, the Jackson bloomery was finally abandoned; the other, having fortunately for the interest of those concerned, been burned two years previously.

The Pioneer furnace was the first built on Lake Superior: constructed near the Jackson mine, 13 miles from Marquette and completed, so as to make iron in July 1858. The Pioneer Iron Co., by whom the furnace was built, became subsequently merged into the Iron Cliffs Co.

The development of the Iron Region has been certainly

remarkable. The population of Marquette Co., which, until recently, embraced all the iron district, comprised in 1851, barely 150 souls.—A dense, unbroken wilderness, isolated hundreds of miles from the outermost confines of civilization, with no means of approach or of return, except by water in summer, and over the snow, through interminable forests in the long dreary winter—severe in climate, presenting in its impenetrable cedar swamps, sterile sands and denuded granite hills, a most uninviting aspect: and even where the indications were the most favorable for agricultural development, the inducement can hardly be said to have been such as to persuade the farmer to forsake the comforts of civilized life and emigrate to this far away and inaccessible region.

And yet, during the brief period of a quarter of a century, it has accomplished a development which may well excite our wonder and admiration. And when we consider the magnitude of the industry which has caused it, its apparently unlimited capacity for enlargement, and the proportionate effect which this increase must occasion in the growth and importance of the country, we may well view with complacency the past and be pardoned for entertaining, seemingly, extravagant hopes of the prosperity which the future has in store for it.

The towns, with few exceptions, owe their origin to the mines, and all of them are largely the outgrowth of mining work. The city of Negaunee began its existence with the discovery and development of the Jackson mine. South of the town, and also within its limits, are a number of hematite mines, comprising the McComber, Rolling Mill, Grand Central etc., some of which are now idle; and among the important industries which contribute largely to its business, are the Pioneer furnaces. The Chicago & Northwestern, and the Marquette, Houghton & Ontonagon Railroads, form a junction here, and have branches extending to the different mining locations.

A short distance west of Negaunee, and upon the lines of these two roads, is the city of Ishpeming, which has become

in number of population, the largest town on the Upper Peninsula. It is the business center for some of the most important mines, comprising the Cleveland, Lake Superior, Barnum, New York and Lake Angeline. The city contains a fine graded school building built of brick and roofed with the Huron Bay Slate, the best hotel in the region, some attractive dwellings, and other indications of intelligence and good taste; while its large blocks of stores, foundries, machine shops, &c., give evidence of business activity. Railroad tracks connecting with the main lines, extend to all the mines.

West from Ishpeming is a number of villages of greater or less importance, comprising Stoneville, Humboldt, Champion, Michigamme, and Iron City at the great Republic mine, the latter connecting with the M., H. & O. R. R., by a branch nine miles in length. The largest of these is Michigamme, which owes its existence to the development of the Michigamme mine. The Company began its operations by building a large saw mill, with machinery for making sash, doors, &c.: laid out the village and sold the lots, which were rapidly bought, and built upon, during the spring of 1872. In June of that year, a fire, that began in the woods, spread to the town and swept it from existence. It was speedily rebuilt, however, and within a few months thereafter, had several hundred houses, and a population of 1,300 persons. The village is on the line of the M., H. & O. R. R. and is well laid out, extending along the shore of Michigamme lake, a beautiful sheet of water several miles in extent, dotted with bold rocky islands conical in form and clothed with dark evergreen foliage.

L'Anse, where one of the earliest missions on Lake Superior was established, is also a village of considerable importance. It is at the head of Keweenaw Bay, 23 miles west of Michigamme, and is the present western terminus of the railroad. It is the shipping point for the ores of the Michigamme and Spurr Mt. mines, for the handling of which the railroad Co. has built an ore dock of sufficient capacity, and similar to those at Marquette and at Escanaba.

A few miles from L'Anse are some deposits of ore known as the Taylor mine, to which a branch railroad was built, but no mining has been done.

About four and one half miles from the shore of Huron Bay, a deep indentation of water which is separated from Keeweenaw Bay by a long narrow tongue of land, are extensive deposits of slate of an excellent quality; a full description of these slate deposits will be found further along in this volume.

The work at these quarries began in 1872, and during the following year a number of houses was built, and at the present location has since grown up quite a village. A tramroad was constructed, extending from the quarries to the bay, at which point a suitable dock was also built. The deposits being so far from settlements, making it difficult and expensive to get material and supplies to the locality, and the necessity of sending abroad for skilled workmen to prepare the slate, caused the outlay to be great and the progress slow. The company has passed through many vicissitudes; yet like all projects of this sort, based upon the actual existence of an abundance of raw material of a suitable quality, and which, when properly prepared has a good market demand, the obstacles, whatever they may be, are sure to be overcome, and success is certain in the end to crown the enterprise.

The early, and natural outlet for the products of all the mines which, until recently, were worked, was the harbour of Marquette; and from a few scattered houses which constituted the entire hamlet in 1853, has grown up, in a few brief years, upon the shores of this beautiful bay, the metropolis of the Upper Peninsula.

In its large and excellent harbour with its great curved sweep of shore line following the base of the low wooded mountains which form the back ground, in the magnificent prospect which the outlook over the great lake unceasingly affords, nature has given to it charms which art cannot rival. Marquette with a population of about 5,000 abounds in evidences of prosperity, intelligence and cultivated taste. Its large and elegant high school building constructed of the

handsome brownstone from the quarries in the city, roofed with the dark blue slate from Huron bay: its fine church edifices, hotels, business blocks and private dwellings, some of them also of brownstone with slated-roofs; its clean, well paved and shaded streets: the water works which furnish to its citizens, the pure water drawn from the cool depths of Lake Superior: the streets and dwellings lighted with gas: the ample facilities for transportation and communication, afforded by railway, lines of steamboats, vessels, and telegraph, place it among the most favored cities of a state everywhere noted as abounding in charming villages and thriving cities.

Marquette has become somewhat of a watering place; and in common with many other Lake Superior towns, possesses attractions and advantages, as a summer resort, that are being appreciated and enjoyed, in an increased degree from year to year. Health seekers, pleasure seekers, artists and tourists, come to Lake Superior in considerable numbers. The excellent hotels afford ample accommodation for travelers and sojourners. The cool salubrious air brings health and vigor to the enervated frame. The speckled denizens of the mountain brooks tempt to piscatorial wanderings and gratify the epicurean appetite; while everywhere about the unbroken forest, the rugged hills, the rocky gorges, the impenetrable glens, the picturesque lakes and beautiful water falls, to delight the artist and, in the fullest measure, afford to the lover of nature, in her wildest aspects, the enjoyment which he seeks.

The chief manufacturing industries at Marquette, are the Grace furnace, Rolling Mill furnace, Carp River furnace, Iron Bay Foundry, Railroad Shops, &c., and its extensive and valuable sandstone and quartz quarries, &c. The harbor, which is perhaps the best on the lake, is provided with two large ore docks belonging respectively to the M., H. & O. R. R. Co., and Cleveland Iron Co., and also with ample merchandise, docking and store house facilities.

At Escanaba, a town of considerable importance, which is situated near the mouth of the Escanaba river, on Little Bay

de Noquet which is formed at the head of Green Bay, are also two extensive ore docks belonging to the Northwestern R. R. Co. The most costly charcoal blast furnace on Lake Superior is found at Escanaba. It was built by the Cascade Iron Co., but has never been successfully operated. Connection with the Lower Peninsula is made at this point by steamer making regular trips to and from Traverse Bay.

At Fayette, in the same county, on Big Bay deNoquet, the Jackson Iron Co. has a furnace with two stacks, which has made an excellent record. In the vicinity of this place considerable farming has already begun, and the results have been such as to give favorable indication of the adaptability of the land to this purpose. The soil is of a limestone formation, and fine crops of wheat and other grains are raised. Delta county claims to be the banner county for farming; an agricultural fair was held at Escanaba this season for the exhibition of the products of its pioneer farms.

Menominee, near the mouth of the Menominee river which, in part, forms the dividing line between Michigan and Wisconsin, has large lumber interests. It is also favorably situated for the manufacture of charcoal pig iron, and has a blast furnace with two stacks, which when the market demand is sufficient to consume the product, ought to be operated with remunerative results.

The extensive ore deposits that exist in Menominee are now being partially developed, and the entire range bids fair to become, in a few years, the scene of active mining operations. A large population of consumers will thus be provided, which with the unusual excellence of the lands embraced in this county, furnishes strong inducements to farmers for settlement.

Much of the land in Menominee county is no wise inferior in agricultural value to that in many of the most favored portions of the Lower Peninsula. This may seem a strong statement; but to one who has seen its fine sections covered with excellent hard wood, and noted the evident fertility of the soil, it will not appear an exaggeration. There are also

large bodies of pine and much other sawing timber; and along the railroad may now be noticed quantities of cedar posts ready for shipment, giving indication that the product of the extensive areas of this valuable timber, found in Menominee and elsewhere on the Upper Peninsula, will be in demand as rapidly as transportation is afforded. Settlement would be much more rapid if the lands in the vicinity of the range could be purchased; it is mainly in the hands of speculators and of corporations who are averse to selling. The Commonwealth Iron Co. have arranged for the immigration of several hundred Swedish families, to whom they propose to sell lands as soon as the railroad shall be extended to the property. Eastern parties have also stated an intention of utilizing the excellent water power at Twin Falls, by erecting machinery for making paper, etc. of the poplar wood which is also available at this point in sufficient quantity. The mines on the range will ship during the present season upwards of 70,000 tons of ore, which goes by the way of Escanaba.

The want of railway connection with the Lower Peninsula, such as would be effected through the construction of the projected line to Mackinac from Marquette, is grievously felt on Lake Superior, and the completion of this road would result in scarcely less value to the interests of Lower Michigan, since, while it would afford a much needed outlet to the people of this region, it would also open their markets to the farming and manufacturing interests of the Lower Peninsula. For it must be borne in mind, that the large amount of products necessarily consumed in the mining regions, is almost wholly imported, and that as communication now is, very little can find its way here from the lower part of this state. The only railroad reaching here from "below" starts from Chicago and passes through the state of Wisconsin, and constitutes the main artery which supplies the wants of the Lake Superior towns. If the Marquette & Mackinac railroad were constructed, connection would be furnished with Lansing, Detroit, and all parts of the state without passing beyond its borders; and such speedy com-

munication between the two peninsulas would strongly tend to the formation of greater harmony of interests.

It is also a fact that the 150 miles of absolute wilderness through which the line extends, possesses great natural wealth, which can only be developed through the construction of a railroad. The immense quantities of valuable timber cannot otherwise be utilized, nor the excellent farming lands brought under cultivation. For here, as was said of the Menominee region, the surface, timber and soil of much of the land, strongly favor the assumption that it is adapted, in an admirable degree, to successful agriculture. Wheat, oats, barley, buckwheat and the earlier varieties of corn, can be profitably grown; while for the production of peas, potatoes, turnips, cabbage &c., the country cannot be excelled; the quality of the vegetables raised in this country is always superior and the yield generally satisfactory. There are also many indications favorable to the production of butter and cheese—the soil when cleared of timber is speedily clothed with an ever-green and springing turf of rich nutritious grass.

In the Lower Peninsula the pastures and meadows usually become dry and parched early in autumn, affording but little sustenance at that season for cattle; and the ground being bare much of the winter and during the spring months, undergoes a process of frequent freezing and thawing, which prevents the grass from attaining a sufficient growth to support cattle until late in the spring; thus generally rendering it necessary to fodder during seven months of the year. On the Upper Peninsula the grass remains green until covered with snow in the fall, which happens before the ground becomes severely frozen, and it remains covered during the winter.

Of course the ground by reason of this heavy covering does not freeze; and as soon as this mantle of snow is removed, through the genial warmth of returning spring, the dormant vegetation, which has so long lain warm and protected beneath it, springs rapidly into renewed life and activity; speedily affording sufficient nourishment for grazing animals. So that, in reality, the period during which foddering is

necessary on Lake Superior, is not greatly in excess of that, which is required in Lower Michigan.

True, not all of the land in the Upper Peninsula is favorable to cultivation; much of it is sand, swamp, or rock; too poor, too difficult, or impossible to cultivate. And as country of this character frequently prevails in the vicinity of the mines and towns and adjacent to the lines of railroads, persons coming here temporarily, and judging from what is apparent in the neighborhood where improvements already exist, and exaggerating the severity of the winters, are apt to condemn the country as practically worthless for farming.

But fortunately the arable lands are greatly in excess; and whatever may be the drawbacks, and as yet they are manifold and great, the Lake Superior farmer will always possess an active home market, eager to absorb all his surplus production, at prices largely in advance of those realized elsewhere. Hay, of which necessarily large quantities are consumed in the mines, brings \$15. and upwards per ton; and now butter sells at .25 per pound; eggs at .25 per dozen; potatoes at .75 per bushel; milk at .10 per quart. And at this season of the year, it is frequently assumed, by those unacquainted with the country, that Lake Superior is already a region of snow and frost; but in contrast to this mistaken opinion, I am to-day, Oct. 7th, sitting by an open window, and observe, in an adjacent garden, a person gathering tomatoes; and notice that the beets and cabbages are yet fresh and growing; and that the squashes and pumpkins, to be seen, are, apparently, uninjured; and I am informed, that from a strawberry plat, which seems scarcely larger than the top of a dining room table, were picked the past season 113 quarts of berries, which attained an enormous size and were of excellent quality. Flowers are still blooming in many of the yards; and shade trees and shrubbery have not yet lost their foliage and greenness. The cows one sees about the streets and in the pastures, cropping the grass, which is fresh and ample for their wants, have the fatness and sleekness peculiar to animals where the herbage, upon which they feed, is rich and nutritious. The robins have not yet disappeared;

for but a few moments ago, one came and perched himself upon the fence within a few feet of me and some of his companions together with other smaller birds are visible at no great distance—the bright sunshine and pleasant air, of to-day, do not indicate a very near approach of winter.

The other important towns, situated in the eastern part of the Upper Peninsula, or connected with the iron industry, of which mention has not yet been made, are the villages of Mackinac and Sault Ste. Marie. The former charmingly situated upon the shore of the beautiful island which bears its name, and protected from imaginary foes by the frowning canon which overlook it from the walls of the ancient fort upon the high bluff beneath which it nestles, is too well and favorably known to render extended description necessary.

Mackinac island, situated in the straits which separates the two Peninsulas, is certainly a delightful spot; abounding in natural objects of great beauty and interest, and affording ample opportunity for scientific examination and for recreation. To those seeking rest and quiet, cool bracing air, pure water, and interesting natural scenery, combined with unlimited opportunity for such amusement and exercise as are afforded by fishing, boating, and forest excursions, no better place can be found. Situated in the pathway of vessels passing through the straits, it is easily accessible in summer, but in winter it is still greatly isolated; although the extension northward of railways in the Lower Peninsula, and the advancement of settlement in that direction, is rapidly tending to make it easily accessible at all seasons of the year. And when the railroad from there to Marquette shall be built, connecting it with the iron and copper region, as well, it will be on the great inland thoroughfare between the two Peninsulas, and in proximity to the point where the transfer of the freight and passengers will be made, which with the development of the adjacent country, thereby occasioned, must greatly increase its importance. Both Mackinac and Sault Ste. Marie are among the oldest villages upon the lakes. A mission was established

at the latter as early as in 1668, by the Jesuit fathers Marquette and Dablon. The river, to which the early missionaries gave the name of Ste. Marie, is the channel through which the waters of Lake Superior flow into Lake Huron. In this river occur the Sault, or rapids, which long before the advent of the early missionaries had been a favorite fishing ground for the Indians; here they resorted in large numbers at such seasons of the year as they were enabled to secure a plentiful supply of one of their most indispensable articles of food. It was hence an excellent point for a mission, the advantage of which the Jesuits were not slow to see, and which they did not fail to improve. Missionaries enjoyed here favorable opportunities for preaching to the Indians, and for endeavoring to convert them to christianity.

The Jesuits sought only the conversion of the savages, and were followed by traders who bought furs of them in exchange for such trinkets and articles as pleased the savage fancy or met his wants; so that for two hundred years, it remained little else than a missionary station or trading post for intercourse and traffic with the Indians. In subsequent years, when expeditions for scientific and practical exploration, speculation, and for permanent development began, the Sault became the *point d'appui*, from which these expeditions set out for the unknown regions bordering the great lakes. Communication was early kept up with Detroit by small schooners and other light sailing craft; and from thence above the Sault, the journey had to be made in canoes or *batteaux* with Indians or French *voyageurs* for guides. All persons or freight, passing between the lakes, went through this point; and all outfit and material had to be carried over this portage. Much delay and annoyance was necessarily occasioned, and thus, in the early developments of the Lake Superior region, the Sault was an important place. The rapids, at Ste. Marie, are about one mile in length, and have a total fall of about seventeen feet, making a barrier in the river or strait which connects the lakes to communication between them.

In the early travel and traffic between the lakes, articles

of use or commerce were borne around this barrier on the backs of men; later, mules and teams were employed, and previous to the building of the canal a tramway was used, and all materials of the rapidly increasing commerce had to be transferred and reshipped in both directions. The necessity of a ship canal, to overcome this difficulty, was early foreseen by those best acquainted with the interests of Lake Superior, and its construction became finally imperative. The matter had been brought before congress as early as 1840, a bill having been introduced that year, asking for an appropriation of 100,000 acres of government lands for this purpose. But it was not until 1852 that definite action was taken. Congress, that year, granted 750,000 acres of land, to be devoted to the construction of a ship canal around the falls of Ste. Marie. The legislature of the state of Michigan having formally accepted the grant, work was begun, under contract with the State, by the Sault Ste. Marie Ship Canal Co.—an organization chartered under the laws of the State of New York for this purpose—in the following year, 1853.

Owing to causes necessarily incident to the construction of a work of such magnitude, under circumstances so unfavorable for procuring the large force of workmen required, and for furnishing them with supplies, and for procuring the necessary tools, machinery, and other materials—the completion of the canal was not effected until 1855. The total cost of the work, inclusive of the expense of locating the lands which were granted in compensation therefor, was \$1,000,000.

The building of this much needed channel of navigation gave an impetus to the commerce of Lake Superior that was speedily felt in the greatly increased prosperity of all industries in the region bordering upon it. From this period dates the first shipments of ore; and probably to no one thing is the iron region more indebted for its development and subsequent prosperity, than to this great public work. Prior to the building of the Peninsula railroad to Green Bay on Lake Michigan, ten years later, all the ore

passed in this direction; without it, these enormous mineral deposits, rich and abundant as they are, could scarcely have been given to the markets of the world.

The General Government, by making a water-way through the St. Clair flats sufficient for the passage of the largest vessels, has succeeded in undoing the work of Nature—constructing a water course where, for centuries, Nature has evidently been endeavoring to create dry land. The effect of the widening and deepening of this channel has been that vessels of far greater tonnage than has originally been anticipated, can be employed; and in order that such vessels may pass into Lake Superior, and for other important reasons, it soon became necessary that the canal also should be enlarged; the work of improvement was undertaken by the General Government, eight years ago, and Congressional appropriations to the amount of \$800,000 were made for it. The Government is now engaged in the construction of a substantially new canal, which is designed, when completed, to be adequate to the wants of Commerce for all times to come. The capacity of the new lock will be 80 feet wide, 500 feet long, and with a lift of 18 feet, providing 16 feet of water on the mitre sill, at low water. The result of the enlargement will necessitate further improvements in the channel through Mud lake and the St. Clair flats.

Aside from the shipping interests with which it is associated, Sault Ste. Marie possesses little of present importance; it is in the east end of Chippewa county, and has just completed a court house to meet the requirements of its legal profession. There are some large mills for the manufacture of lumber, etc., and considerable farming is carried on in the vicinity, which latter consists mainly in raising potatoes; large quantities of which, for many years have annually been produced. The crop, as elsewhere, in the Upper Peninsula, frequently remains in the ground until spring, when it is dug and marketed. The yield is almost certain to be abundant, and the business is a profitable one.

About 130 miles west of the Sault, and 40 miles east of Marquette, is the settlement of Munising, situated on the

main land opposite Grand Island. A branch railroad, connecting with the projected line from Marquette to Mackinac, was surveyed to this point; and there are two blast furnaces,—the Munising and the Bay Furnaces,—in the vicinity. The latter, however, at Onota, is six miles distant, and was recently, while working partly destroyed by fire, and has not been rebuilt. Some farming has been undertaken at Munising, and the adaptability of the soil to this purpose is indicated by the fact that last season one person raised there four hundred bushels of wheat.

The construction of the Sault Canal was not the only important improvement in transportation facilities that became necessary to meet the growing interests of the mines, for the ore had to be carried, somehow, to the lake for shipment, thirteen miles and upwards, of distance. At first this was accomplished over a rough wagon road, which became, at times, as may readily be inferred, almost impassible. Subsequently this gave way to a plank road, constructed by the Jackson and Cleveland Iron Companies. Upon this road longitudinal sleepers were ultimately placed and laid with strap rail, and it was operated with horse cars.

But all of these methods of transportation were only expedients; the necessity of a railroad from the mines to the lake was early realized, and with an increase of business the construction of one became imperative. The project was finally undertaken as an individual enterprise; but little progress being made, however, until the enactment of a general railroad law, in 1855, when an organization was effected, with the corporate title of the Iron Mountain R. R. The work was then pushed forward with vigor, resulting in the completion of the road in 1857.

About this time the project of connecting the mines, by rail, with lake Michigan became agitated, and in 1856 a large grant of land was secured for this, and other associated railroad enterprises. Numerous changes and transfers occurred, but the lands were finally conferred on the Peninsula Railroad Company, by which the road, from Negaunee to Escanaba, was begun in 1863, and completed in the follow-

ing year; a consolidation with the Chicago & Northwestern having been effected, the road became known as the Peninsula Division of that line. Up to 1870 the Chicago & Northwestern extended only to Ft. Howard, a distance of 242 miles from Chicago; in that year, however, the work of further extension was begun and completed to Escanaba in 1872, thus giving complete railroad communication from the lower region to Chicago, and under the efficient management of this great corporation.

Thus, to the enterprise and sagacity of the Chicago & Northwestern Company is due the fact that the people of Lake Superior enjoy the advantages and conveniences which accrue to them through this railway connection with the outside world; and in meeting the responsibility thus assumed of providing for the passenger travel and business traffic, the care and liberality shown by this company have been such as to meet the general commendation. The length of the Peninsula Division from Negaunee to Escanaba is 62½ miles, and the aggregate length of its branches amounts to 66 miles; making 138½ miles of track. The Company's ore docks at Escanaba have 352 pockets, having a total capacity of 24,000 tons; the docks are built in 14 to 20 feet of water; vessels carrying 1,600 tons, and drawing 18 feet of water, have loaded. The rolling stock of this Division, comprises 30 locomotives and 1,957 ore cars, and the amount of ore shipped over the line amounts to upwards of 400,000 tons annually, about 60,000 tons of which are from the Menominee Range.

The Marquette, Houghton & Ontonagon Railroad is the outgrowth of many railroad enterprises which have been formed during the period that has transpired since 1856, to meet the growing wants of the country, and to earn the grant of lands, which as before mentioned, was donated by Congress for this purpose. The present Company was incorporated in 1870, and the State having conferred upon it the unearned lands, work was begun in the Spring of 1871, and before the close of the following year, thirty additional miles of road were constructed, extending from its previous

terminus, at Champion, to L'Anse, at the head of Keweenaw Bay, a total distance from Marquette of 66 miles. The further extension of the road, provided for in the charter and in the grant of lands, to Houghton and to Ontonagon, it is unnecessary to add, is anxiously hoped for.

The road is well managed and provided with an equipment adequate to the wants of its business, and has an estate of upwards of 400,000 acres of land, which, extending for a distance of 50 miles along the great Iron Range, must doubtless embrace many valuable deposits of ore, some of which are already known. The total number of miles of road, including the branches extending to the mines, is $88\frac{1}{2}$ miles; and the number of stations is 16, and of employes 400. Its equipment comprises 30 locomotives, 1,613 ore cars, 5 passenger and 4 express cars, freight box cars 28, platform cars 72, and of gravel and of other cars not mentioned, 78. The amount of iron ore transported over the road was in 1877, 600,000 tons, being 93 per cent. of the tonnage of its freight business, the total number of tons freight carried, being 951,687. At each of the termini, the company has an ore dock; the one at Marquette has a total length of $1,222\frac{1}{2}$ feet, and the one at L'Anse of 546 feet. The docks are provided with "pockets" which hold from 55 to 100 tons each; these pockets are made somewhat in the form of a chute, to discharge their contents directly into the hold of vessels, and are filled from the ore cars, which are run over them. The company's dock at Marquette is 53 feet in width on top, and has four railroad tracks, and rises 38 feet above the water. There are 136 pockets on both sides of the dock, and from them eight vessels may be loading at the same time. 6,000 tons have been loaded in a single day. Vessels may be loaded in from one hour and fifteen minutes to one hour and thirty minutes, varying with the capacity of the vessel; the average time of loading a vessel is about three hours. About one-third of the ore is taken in steam vessels, the remaining two-thirds in sailing vessels. This dock has a capacity of upwards of half a million of tons of ore for the entire season. The company have also substantial shops for construction and repairs.

When this road shall have completed its extensions, and the Mineral Range R. R. shall have reached the extremity of the Keweenaw peninsula; when the Menominee branch shall have penetrated through the wilderness of that valuable region; and the much desired road to the straits of Mackinac shall be built and extended thence to the Sault, then will the railway requirements of the Upper Peninsula be measurably met. Its important Sections will then be brought into communication with each other, and with the rest of the state. The development of its vast mineral resources will be more rapidly advanced; its great bodies of valuable timber be rendered available; its excellent farming lands will become accessible, and a more rapid settlement, increased activity and general prosperity must gradually result. The business of quarrying sandstone and preparing it for building, is slowly developing into an important one. Inexhaustible deposits of this rock, suitable for building, are found at various points, but the quarries at Marquette are the most advantageously situated for working at present. Buildings constructed of these beautifully colored stones, brown or richly variegated, and possessing great durability, have an outward elegance and a substantial character that no other material can give. Several public and private buildings in Marquette, with walls of this stone, are the admiration of all visitors.

None of the deposits of marble, many of which are known to exist, have yet been worked; but it is altogether probable that, with the future development of the country, some will be found of sufficient value to be in active demand.

Many years ago a whetstone quarry, near Marquette, was worked for a short time, but soon abandoned, not from lack of excellence in the quality of the material, but that the business did not then seem sufficiently profitable; doubtless it will sometime be again resumed, with better success.

Some of the deposits of plumbago or graphite, which are known, are believed to be sufficiently pure to answer for many of the purposes for which that substance is employed; but no special examination of any with view to its economic

use has been made, and none of apparently good enough quality for the finer uses, has yet been discovered.

A valuable deposit of quartz, known as "gannister," has recently been opened in the vicinity of Marquette, and some demand for it already established. No doubt the interest will grow in importance as the quality becomes known and the necessity for this material increases.

Some promising deposits of serpentine rock are known, and one recently discovered near Ishpeming may possibly prove of much value.

The great business depression, which is so seriously felt throughout the entire country, affecting all branches of industry and all kinds of trade, has borne with particular severity upon the iron interests everywhere, closing blast furnaces and crippling the mines. And hence the check given to the activity of Lake Superior has been correspondingly great. During the years immediately preceding the panic of 1873, the development had been unprecedentedly rapid. The mines were worked to the utmost of their capacity, to meet the demand for their products. Heavy expenditures were made, to develop new mines. New furnaces were built, at ruinous cost, and all were run to their maximum limit. The mill men and dealers were strenuously seeking to supply the markets with lumber. Sailing vessels, steam barges, and propellers, tarried briefly in port, quickly discharging and receiving their freight, and, impatient of storm signals, spread every sail, or plied all steam, in the laudable endeavor to convey away the products of this country and to bring to it its supplies. Night and day, scarcely without pause, the great ore docks resounded with the sound of discharging ore. Explorers were everywhere traversing the woods, looking eagerly for sections of pine, or with dip compass and pick in hand, anxiously seeking for magnetic attractions, and carefully examining boulders, outcrops, and ledges, in search of evidence of iron, or other valuable minerals. The U. S. Land Office was besieged with applications for maps, information, and for entries. Persons having "Notes" of pine lands to sell found ready customers. The

mysterious accounts of extraordinary "finds" were poured into credulous ears, and favorable specimens were eagerly examined. The air was filled with rumors of wonderful discoveries, of gold, silver, copper, iron, and other valuable minerals. Wary capitalists were flocking here, ready to invest in shares, mining stocks, and lands, frequently where, except in imagination, the "show" promised but faintly a hope of realizing any return, save disappointment.

But with the advent of hard times, all this excitement passed away, and the ephemeral projects which owed their existence to, and drew their support from such an unhealthy condition of affairs, speedily collapsed. The staunch and legitimate industries, however, having a solid foundation, have continued active, and in a measure prosperous. Many new mines, though not altogether valueless: yet from want of capital, or from bad management, or that the quality of the ore which they afford was below the standard necessary to fulfill the requirements of the markets, have either maintained a precarious foothold, or have been obliged to suspend operations altogether—some never to be revived, and others, possibly, to renew work when more favorable times shall occur.

But the old mines, those of strength and of established reputation, have suffered very little diminution in their product. The shrinkage has been in the price received for it; but as there has been a corresponding falling off in the cost of labor, and of transportation, and in all other values, the cost of mining is much less than heretofore; so that, while the market price of ore has been greatly reduced, the greater economy in its production doubtless enables the companies to realize a fair degree of profit; and while the total product, as will be seen from the tabular statements, elsewhere contained, is slightly less than was attained in 1873, it still reaches the enormous yearly aggregate of 1,000,000 tons, possessing a present market value of about \$5,000,000. A single mine, which only began work in 1872, has already attained to an annual shipment of 175,000 tons of ore, worth this season nearly \$1,000,000. Certainly,

these figures hardly justify the assumption that the region, presenting the activity which they necessarily imply, can be dormant. Nevertheless, one cannot but anxiously hope for such a revival of business activity as shall rekindle the fires in the many now idle furnaces scattered over the peninsula; as shall utilize the immense forests of hard wood, so contiguous to the ore beds, and suitable for charcoal, as shall require in a greatly increased degree, the valuable sandstones and slates, so beautiful, so abundant, and durable for building; and as shall develop the many other incipient industries, the basis of which exists in inexhaustible quantity, in the mineral deposits of this region. Experience teaches that prices will rise as well as fall, that a period of depression is followed by one of activity and relief. The present is not the first time, since furnaces have been built on Lake Superior, that the cost of the production of pig iron has approached so near the price it would bring in market, or be even in excess of it, that the manufacture of it was practically inhibited. In the financial depression of 1857 the Pioneer Iron Company were obliged to sell their iron for \$22 per ton, while it cost \$24 to produce it. And in 1860 the property was leased for four years, the lessee agreeing to manufacture pig iron during the period of his lease, himself paying all expense therefor, including the delivery of it on board of vessels in Marquette, for \$17.50 per ton. Certainly the price of iron has not yet fallen to that point, while the prospects of the region since that day have vastly improved.

All great reversals have their compensations, and no doubt the greatly increased care and economy, necessitated by the circumstances of the present time, will really result in more substantial benefit to this section, in the long run, than if the wild speculative period preceding the panic had continued. The work is now rapidly becoming more systematic, and partakes less of the hap hazard quality, which in a measure, characterized the earlier mining operations. The nature and the manner of the deposits, are being carefully studied and understood; scientific knowledge and practical experience go hand in hand, in the prosecution of the work, in the great mines.

Hereafter the skill of the analyst, the engineer, the experienced miner, and of the thoroughly qualified iron maker, will be required, to a greater degree than has heretofore prevailed, to meet the exigences of the more elaborate and expensive methods of mining that will be practiced in the future, and to fulfill the increasing requirements of the iron trade.

Explorations and investments still continue to be made; but recently to a greater extent in Menominee County than elsewhere. The developments in that region are of so promising a character as to stimulate those already owning lands there to examine them, and those who desire to purchase, to search for deposits, hoping doubtless to discover something that shall rival in value anything that has yet been found. Certainly there is enough to encourage them; for the mines now opened along the Menominee Range indicate a degree of value that ought to be satisfactory to any class of owners. The ore in the best mines is extraordinarily rich in iron, and there is unquestionably a vast amount of it. Probably no better opportunities for investments, on Lake Superior, have ever occurred than the present time affords. But, unfortunately for their interests, people seek investment mainly during periods of speculative excitement, when prices rule high. After the excitement dies out, and prices subside to their normal rate, few want to buy; then, only the wise ones seem to realize that this is the best time to invest. In a time of depression and financial embarrassment one ought to be able, if ever, to secure desirable property at a price at least not in excess of its real value. For this reason, and from the fact that the value of mineral deposits here can be better determined, than heretofore, since much more is known about them, and a sufficiently safe estimate of the amount of ore in most of the mines may be made, and the quality, the market demand, and price, and cost of transportation, etc., are known—thus eliminating, in a measure, the element of uncertainty—it is as before stated, a most favorable time to invest in this region.

The country is, in reality, a comparative wilderness; the greater part is yet to be examined, and offers an excellent field for exploration; desirable portions of it can be easily secured of the Government, if the land has not yet been entered, or, if already taken, can generally be purchased of the party owning it. The large amount of lands held by the R.R. Co.s, and the Portage Lake Canal Co., are offered for sale. The latter Co., and the M. H. & O. R. R. have each an office in Marquette for the sale of their lands; and the C. & N. W. Co., also have one at Escanaba. Through each of these offices purchases may be made, or any desired information obtained. The U. S. land office, for the Upper Peninsula, is at Marquette.

In tracing the development of the Upper Peninsula great credit must be given to the U. S. survey. The wisdom of the plan upon which the survey of this region was made, and the careful manner in which the work was executed, has ever since been apparent. Upon the maps of these surveys are recorded the topographical features of the land; the character of the timber and soil; the streams, water powers, lakes, etc., and also, what is more important to the explorer for minerals, are noted the magnetic variations, the outcrops, and ledges, the kinds of rock which compose them, and other observed geological facts. These data, given upon the plats, have been found to be accurate and reliable, and have led to the discovery of the greater portion of the valuable mineral deposits which have been found. Especially is this true of iron ore, much of which, being magnetic, the deposits are indicated by the influence which they exert upon the compass needle. In originally running the township and section lines of this peninsula, the surveyors were required to note down the magnetic bearing at each compass station, and these bearings are given on the recorded plats, along the surveyed lines, at the points at which they were taken; and a careful examination of localities, where unusual variations are found indicative upon the corresponding map, has led to the discovery of many important mines. A valuable chapter on exploration, giving

full details, will be found in Maj. Brooks' report, 1873. The idea of combining geological examination of the country with the linear surveys, and of recording the results upon the same maps, is due to Dr. Douglass Houghton, the earliest state geologist; and the faithful execution of the work in a great measure, is to be credited to Wm. A. Burt, the inventor of the Solar Compass. Dr. Houghton's plans embraced a geological survey of the country as well as a linear one, but owing to his untimely death this result was only partially carried out. Enough, however, was done to entitle those who performed it to grateful recollection, and to sadly awaken a deep regret that the waves of the great lake had not spared the fitful spirit they so ruthlessly engulfed, to the full accomplishment of the noble work he so admirably devised. An important adjunct to all other industries, is the press, and in this particular the Upper Peninsula is fortunately represented. The MINING JOURNAL, published at Marquette, is the largest of the papers issued, and is a truthful exponent of the interests of the iron region. The Houghton Mining Gazette, is an old, and long established paper, highly esteemed, both on Lake Superior, and throughout the country, for the reliable character of its information, relating to the copper and other interests; the Ontonagon Miner, the Northwestern Mining Journal, the Iron Home, the Negaunee Iron Herald, the Menominee Herald, the Escanaba Tribune, published respectively at Ontonagon, Hancock, Ishpeming, Negaunee, Menominee, and Escanaba, are all enterprising chroniclers of local and general intelligence. All the towns on Lake Superior have good schools, and some of the school edifices are very commodious and elegant, and good order and intelligence everywhere prevail. In a volume, entitled the Mineral Resources of Lake Superior, published by Hon. A. P. Swineford, of the Mining Journal, will be found much interesting matter relating to the Upper Peninsula; also in Maj. T. B. Brook's report, the preliminary chapter of which is devoted to the early history, etc., of the iron region, 1873.