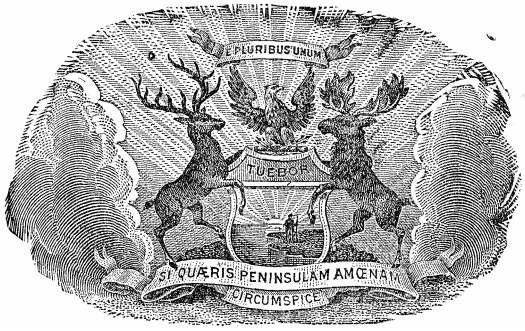
STATE OF MICHIGAN,

MINES AND MINERAL STATISTICS

BY

CHAS. D. LAWTON, A. M. C. E.,

COMMISSIONER OF MINERAL STATISTICS.



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STATE OF MICHIGAN,
OFFICE OF THE COMMISSIONER OF MINERAL STATISTICS,
Lawton, Michigan, June, 1888.

HON. CYRUS G. LUCE,
Governor of the State of Michigan:

SIR,—In fulfillment of the duties of my office, I have the honor to submit herewith the following report upon the mines and mineral interests of the State.

Respectfully your obedient servant,

CHARLES D. LAWTON,
Commissioner of Mineral Statistics.

INTRODUCTORY NOTE.

As in former Reports this volume is largely devoted to descriptions of mines, the aim being, chiefly, to bring the record down to the present time.

I am encouraged to adhere to this practice, which has continued since the office was created, ten years ago, as there are many people in this country and abroad who are eager to obtain information about the mines of this State and who have come to regard these Reports as convenient and reliable sources to consult.

I am assured from the information that comes to me in many ways that these Reports have been of much benefit to the mineral interest of the State, and I have made every effort that the present volume shall be in keeping with those that have preceded it. It is somewhat briefer than the more recent ones, but it will not, I think, be found that on that account anything material has been omitted. While the volume is designated as the Report for the year 1887, it is strictly such only in matter of products; since although the book was mainly written in the winter of 1887-8, I have been enabled, through delay in publication, to visit the mines during the spring and summer of the present year, and thus to revise my manuscript and bring the information down to date. The maps of the leading copper mines are from new plates and show the workings up to the close of the year 1887. I have also added a map of the Chapin mine showing elevation, cross sections and ground plan. I would like to give similar maps of other leading iron mines, but I found that the cost of engraving was greater than I could afford.

There are some very interesting, and practically important, mining and geological facts that appear in the mines, particularly at Ishpeming, in Menominee county, and still more especially in the Gogebic range, that I have alluded to and endeavored to explain, but which can be much better understood with the aid of maps.

I must continue to acknowledge my obligations to mining officers and others for uniform kindness and assistance. My long connection with the Lake Superior country has enabled me to establish frank and confidential relations with almost every one connected with the mining industry in this State that are at once pleasant to me personally and of advantage in obtaining the necessary information for my Reports.

COMMISSIONER.

THE MINING INDUSTRY.

The year 1887 closed with a somewhat dull outlook for the iron mining Industry but a hopeful one for the copper. It seems doubtful if the advance in the prices of ore which was made at the opening of the year and which has held throughout the season will still be maintained. There is every prospect of a retrograde in prices.

At this writing no sales of ore for next season's shipment are reported. The mine owners are asking last year's prices for their ore, but expect to be compelled to accept less. It is reported that as much ore will be wanted, but there will be a greater production. If there is a market for it more ore will be mined. Many of the mines are in condition to produce more ore than they ever have before. It is only a question of demand.

Notwithstanding that ores sold at an advance, generally about a dollar a ton above the previous year's prices, it is probable that few companies realize thereby any great increase of profit. An advance in ore means also an increase in the price of labor. Miners' wages invariably advance with the demand for ore. In other ways there is also an increase of cost added. But the greatest drawback in the iron ore mining business in the Lake Superior region the past year has been the matter of transportation, especially of lake transportation. The difficulty in securing vessels and the excessive charges

for carrying by water to the ports to which the ore is uniformly consigned became so great as to amount to a virtual embargo on the mining business. Those mining companies which had secured contracts with the vessel men for the season were indeed fortunate. At the beginning of the year the charge of $1.40 per ton for the season's carrying of the ore from the port of Escanaba to Cleveland seemed exorbitant, and generally the mining companies hesitated to close their contracts at those figures; it was expected that lower rates would soon prevail, so that in most cases only limited contracts were entered into, that is contracts that covered only a portion of the season's product. But instead of lessening, the vessel rates rapidly appreciated, until before the close of the season the advance was, in instances, seventy cents on a ton, becoming $2.00 to $2.10 per ton for carrying the ore from Escanaba to Cleveland. The same, of course, was true of Marquette and other shipping points, and if we add to this the railroad charges of eighty cents per ton and thirty to fifty cents per ton for royalty we readily see that the circumstances for mining must be extraordinarily favorable in order that any profit should accrue on ores that must sell at $4.00 per ton. In point of fact where such conditions prevailed there could be no profit at all. Mines in low priced ores that were at the mercy of the vessel men were forced to shut down or discontinue shipping; if they had contracts to fill and thus continued to ship they did it at a loss, or at least with little or no profit. Other companies having high priced, rich Bessemer ores, and who had made contracts early in the season and were able to secure their execution, have naturally a better showing of the year's business.

The scarcity of vessels, the irregularity of their trips, the uncertainty in the time of their appearance in port, gave much embarrassment to the mining companies, delaying the work and added to the cost of the ore aside from the increase in the rates of transportation.

There was no end of trouble throughout the season from want of cars. The mines were hampered beyond measure throughout the season by this restriction.

It generally facilitates the mining and lessens its cost if they are able to discharge the ore, as it comes up out of the mines, directly into the cars all the expense of subsequent handling is thus avoided. If not dumped into the cars or into the pockets ready to shute into cars, it must be run out onto an ore dock and thence subsequently transferred into cars, generally by the ordinary process, with wheelbarrows and shovels.

When vessels are sufficient and regular, the ore docks at Escanaba, Marquette and elsewhere have room for the constant reception of ore, and the flow of ore in and out is unceasing. But if vessel transportation is inadequate then speedily there is a glut; the pockets in the ore docks become filled; the cars of the railroad companies are full and left standing on the tracks, and sometimes even the docks and pockets at the mine are loaded to their entire capacity, in which latter case such a mine is nearly at a stand! still. There is little for the miners to do maybe; they must work at a disadvantage to the company. Perhaps the company may be prepared for pushing its shipping, may have a force of men to load the accumulated ore into the cars; if there are no cars the men are idle. The company may be forced to keep them, not knowing how soon their services will be required, and realizing that in an emergency it could not, probably, secure them speedily again. When a vessel arrives it expects to load on the shortest possible notice and to quickly be on the return journey; no delays or excuses for delay are admissible; if delay arises in ever so small a degree, some party must pay the cost, and generally the mining company, in addition to its other burdens, is also saddled with this, though in truth it may not be at fault.

When vessels come for the ore that happens to be in the docks in the harbor there is no trouble, but when the demand is for ore that is still at the mine far away then indeed there is sometimes commotion and hurry; if sufficient cars can be had quickly, the emergency is generally met. All the available force at the mine is put to loading cars, and a train is soon in readiness to dispatch. But sometimes the railroad companies cannot furnish enough cars, and this happens more often than otherwise; then the vessel is perhaps delayed and there becomes a matter of damages, which is to be adjusted between the railroad company and the mine owners.

Facilities for railroad transportation have much more nearly kept pace with the growth of the mining industry than have those by water. There has been great advance within the thirty odd years that have transpired since the primitive tram road from Ishpeming to Marquette gave place to one with iron rails and the mule team to the locomotive engine. For ten years this sufficed, and when in 1865 the Peninsula road was opened between the mines and Escanaba, and a fine ore dock was built at the latter place, it seemed that the acme of progress was attained. Eight years thereafter the connection was made by rail to Chicago, and the original line, which had been from time to time added to and pushed westward, was further elongated to the head of Keweenaw Bay, where an ore dock for vessels to load was built, as in the meantime additional ones had been constructed at Marquette and at Escanaba.

A few years thereafter and the discoveries of ore in the Menominee district led to the building of the Menominee River Branch of the Chicago & Northwestern, and of its later extensions northerly and westerly to the Paint and to the Iron river, and soon after further developments occasioned the opening of the branch to the Felch Mt. range. More recently still the line to the Straits of Mackinaw was constructed and thus connection made with lines reaching east and south. But it is within the past two years that seemingly the greatest changes in this matter have occurred. The Milwaukee & Northern has opened its line from Champion to Chicago, passing through Republic, Iron Mountain and Menominee in Michigan, and is preparing to build branches to the various mines, and to compete for the carrying of the ore. The portion from Iron Mountain to Champion has been constructed in the past year, and within the same

time has been built a western prolongation of the Menominee River Branch of the Peninsula Division of the Chicago & Northwestern R. R., from its western terminus at Iron River, 35 miles to Watersmeet, to connect with the Milwaukee, Lake Shore & Western R. R., which latter reaches from Milwaukee to Ashland, passing along through the mines of the Gogebic Range.

In the business of handling these ores this railroad is now met with the competition of the line that has thus pushed westward, and which has already engaged in carrying the Gogebic ores over its line to Escanaba. And it i further crowded by the Wisconsin Central, which latter company has constructed a branch from Ashland east to the Gogebic mines and built an ore dock at the above named port.

And this is not all. In the past year the Marquette, Houghton & Ontonagon company, which had a year or two previously extended its road to Houghton, passed with the Detroit, Mackinac & Marquette line to the ownership of a new company, the Duluth, South Shore & Atlantic, which organization is already vigorously at work building its road through the western part of the peninsula, and will, when completed, give a through line from Duluth to Marquette, Houghton, Sault de Ste Marie, Straits of Mackinac, and in fact with all points east, west and south. A branch will also be built to the harbor of Ontonagon, and thus all important points in the Upper Peninsula will be connected by rail.

Already the northwest has direct connection with the extreme east through the eastern portion of the peninsula by a rapidly constructed line that is but just ready to be opened for traffic, the Minneapolis, St. Paul & Sault de Ste. Marie R. R. It crosses into Canada over a magnificent bridge that has been made to span the St. Mary's River.

The copper district has been made accessible by the building of the road from L'Anse to Houghton, thus giving daily trains between the latter place and Marquette, in fact with Detroit and Chicago, etc. And the spanning of the lake between Houghton and Hancock with a bridge on which trains may cross permits of direct connection between Houghton, Calumet and Lake Linden, etc.

The C. & N. W. Co. has added to its equipment in the past year 500 ore cars that hold 20 tons each and upwards; 26 tons of ore maybe loaded into them. The Mil, & Northern and Mil., L. S. & W.Cos. had previously introduced these large ore cars; but the C. &. N. W. Co. has found it expedient to modify the form of the body of the car somewhat in order to make the car conform in heighth to the ore docks, ore shutes, etc, at the mines; in fact they are made the same heighth as the small cars so long in use, and in conformity with the heighth of which all the arrangements at the old mines have been made.

The C. & N. W. Co. is also building an ore dock at Escanaba, where it already has three. The fourth, when completed, will make the aggregate capacity 90,000 tons. There are three ore docks at Marquette, but they are greatly inadequate to what is required. The R. R. Co. is not waking steps to increase the capacity for the temporary storage of ore. In addition to these the same company (D., S. S. & A.) has two other ore docks, one at St. Ignace and one at L'Anse. The M., L. S. & W. has two at Ashland, and the Wisconsin Central one, and it is said that the M. & N. Co. contemplates building similar ones at some point at the head of Lake Michigan.

As it is there are 12 ore docks for loading vessels with the ore sent from the Michigan mines.

The rapidity with which this work of loading can be accomplished is illustrated in the fact that in August last, in a period of less than three days, 60,000 tons of ore were transferred from the docks into vessels at Escanaba. It simply so happened that there were vessels enough in continuous attendance for ore to keep matters moving.

But as before stated, while there has been much progress in the matter of railroad construction with the view to meet the needs of the mines, the same can scarcely be said of the increase of facilities for water transportation. Throughout the season for shipping there is a constant complaint of the want of vessels. All through the spring, after the opening of navigation, and early summer, when the winter's accumulation of ore should have been moving rapidly forward, there were few vessels; they were mainly engaged in moving grain, and as a consequence the mines were much hampered; their docks were already full and they could not obtain enough cars in which to dump the ore that came out of the mines. The vessel owners had matters all their own way the past year.

They were driven with business and charged exorbitant rates. The parties who made the most money out of the ore business the past season were probably the vessel owners.

It is an undoubted fact that the growth of the north and northwest, of the country whose business thoroughfare lies through the waters of Superior and the lower lakes, has outgrown the facilities provided in these channels for transporting its products. The iron ores of Michigan and Minnesota, much of the pine, the copper, slate, sandstone, and other minerals, the flour and grain from Minnesota, and the great grain fields of Dakota and the Red River of the North, find their natural outlet through the channel of Lake Superior. This vast area, rich in an untold degree, is yet in its veriest infancy, and its carrying trade is but a tithe of what it may be expected to become in the future, and yet the means adopted for overcoming the natural obstructions to the commerce of the great lakes are nearly taxed to their utmost capacity. The ship canal at the Sault has little capacity in excess of what is already required. It must inevitably soon become inadequate, and then the ship canal that connects the waters of Portage Lake with Superior is scarcely an apology for what is required, if the wants of the commerce of Lake Superior are fully met. Certainly this canal should be deepened, as should also the channel at the eastern entry, and both rendered free as

the air, so that vessels of the largest build could freely pass without danger or hindrance, either natural or legal.

It is somewhat of an anomaly that a government which is burdened with a plethora of wealth, that complains of the distended condition of its treasury, and affects to be greatly alarmed at the influx of treasure into its vaults, should object to dispensing a moiety of this burdensome treasure, in freeing these waterways of the restrictions which hamper the traffic through them, and out of the nation's great abundance of treasure to pay for such enlargements and improvements as shall enable any vessel that floats upon the waters of Lake Huron to be as readily passed to the surface of Superior as to that of Lake Michigan. It cannot be otherwise than a mistaken policy which neglects any measure of improvement in these great waterways of the nation.

Certainly a surplus burdened nation has no occasion to scruple in the matter of expense.

No better disposition can be made of millions of the surplus, as much as is necessary, than to expend it in improving the Sault Ste. Marie's, the Portage Lake canals, in deepening the channel through Lake St. Clair, and elsewhere along the watery route; in improving the harbors, making them safe, commodious and accessible; and in every needful way rendering this great thoroughfare adequate to the wants of the rapidly increasing commerce of the growing northwest.

Every year makes noticeable changes in our mines; new ones are added, old ones become deeper and larger; there is something new to be noticed at nearly every mine in the way of machinery, methods of working, in the deposit of mineral, and in many things that give interest and variety to the industry.

As usual there has been much exploring done, and out of it all some valuable results have been obtained; noticeably among these are the finds of ore recently made in the vicinity of Crystal Falls, in township 43, R. 32, to be hereafter described; and also west of Lake Michigamme, in T. 48, R. 31, in T. 47, R. 30, and near the city of Negaunee. Also at Norway additional ore has been discovered to an extent to render it probable that a large mine of Bessemer ore will be soon opened.

Discoveries have been made on some abandoned properties that make them again of considerable value, as the Curry, the Manhattan, the Argyle, etc. In very many places discoveries of ore have been made, most of which I have personally examined, and some have ore of good quality and afford indications of there being an abundance of it.

The practice of filling the mines, that is, filling up the spaces made by removing the ore, with rock and sand, etc., I am pleased to observe is taking a permanent foothold, and coming to be practiced as one of the established methods of mining in Lake Superior.

I regard this as a noticeable advance; it is safer and cannot but be more economical in the long run than either of the methods of sustaining the walls by having ore pillars or by elaborate and costly timbering. The system of filling in the Chapin is now working excellently well, and they are putting it into full practice at the Norway and Vulcan mines, and elsewhere it is fully or partially resorted to. At nearly all the old mines the plan to be adopted to mine out the pillars that have been left and which in some instances amount to 50 per cent of the ore which the mine contained, must arise and must be decided in one of two ways, either by filling the mine first and then removing the pillars and ore, or by first wrecking it and reaching the pillars through the crush. Probably where the ore in the pillars is all that is to be obtained, a combination of the two methods will be practiced.

The speculative excitement in mining stocks, options and property which prevailed in the Gogebic district at the opening of the year has had its natural outcome: a reaction has taken place, and a great shrinkage or utter collapse in the fictitious values which had obtained. The result is much disappointment, pecuniary loss, financial ruin and depression.

The good mines are now estimated at more nearly their true value, and will assume a more natural, healthy life in future. Probably the condition of things will by and by become as they are in the older iron sections of the peninsula, the crude and exaggerated notions, which have in a measure prevailed will be replaced by sober sense, by ideas based upon well comprehended facts. Ore deposits will have to be estimated according to their proved value, instead of being rated from a basis that is largely or wholly imaginary or assumed, as has been the case with many of the so-called mines in the Gogebic range.

There are fine deposits of ore in this district and they afford all reasonable conditions for systematic and profitable working; probably there is a prosperous future in store for the companies holding such mines. Some of them are certainly remarkably fortunate. They possess deposits not only of great magnitude, but the ore is of such purity and excellence as will insure its demand whatever may be the conditions of the market. It is this fact, the fact that the ore, wherever found, is so generally Bessemer, that has enabled interested persons to stimulate the speculative craze that prevailed. Of course they have had the Colby and other large mines as existing facts and persuasion, imagination, and, not unfrequently, misrepresentation has done the rest. But it has all come to an end. There has been an utter collapse in these distorted assumptions, and numberless men have proved to themselves how ephemeral indeed are riches. The coveted wealth that they may have thought to possess in these inflated mining shares, has suddenly vanished "into air, into thin air," and the magic gold has turned to ashes upon their lips. These unfortunate experiences of so many will result in greater conservatism for a time at least. But another generation, with more imaginary wisdom, will be just as ready to grasp at some similar bubble and will in the end find itself in like predicament.

Aside from the collapse of the speculative boom along the Gogebic range, the valuable working mines have not found the year one of great profit, generally. This has been due to the excessive cost of transportation and to the low price of ore. The larger mines have made money, but not as much as was anticipated.

But the greatest change for the better has taken place in the copper region; the sudden rise in the price of copper that has occurred at the close of the year 1887, has put an entirely different aspect to the business of copper mining. At the opening of the year 1887, the price of copper ruled at about 10 cents per pound, but at the close of the year it is 17 to 19 cents. The advance has been made in a few days, and while it is no doubt in a measure speculative it is at the same time based upon causes that must insure the price of copper remaining at a considerably higher figure than has heretofore prevailed for the past two years, and while it is not necessary to enter into a discussion of these causes, I deem it reasonably certain that the price of copper will be from 13 to 15 cents the ensuing year. Of course this means prosperity to the Lake Superior copper mines. If they can live on copper at 10 cents, they can make a great deal of money when copper is 15 cents.

If the price of copper was to remain permanently at 10 cents per pound, the most of the mines in the Lake Superior country could have little value. The Calumet & Hecla, Tamarack and the Quincy could still make money for the stockholders; but the others, in varying degree, could simply live and keep up their equipment and a good surplus. To be sure the Osceola, Atlantic, Central and Franklin Co.'s pay small dividends to their shareholders but it is doubtful if it is wisdom to do it, that if the money will not be required by and by in renewing or increasing their equipment.

The Calumet & Hecla Co. has had a serious experience, and now at the close of the year there is not much of a silver lining in the clouds which overcast its prosperity. The fire which broke out in this mine in August last and which caused the closing up of all the shafts until it could be extinguished with carbonic acid gas, again broke out on Nov. 20th, and the shafts are now closed at the top and the work of endeavoring to extinguish the flames by the application of carbonic acid gas is vigorously pursued. If this fire were to spread and involve the whole mine in its ravages the effect would be serious indeed. At the present time it is thought at the mine that the origin of the fire is the work of incendiarism.

With this unfortunate exception the year of 1887 closes auspiciously for all our mines, both of iron and copper. There is every reason to think that 1888 will prove as prosperous as has 1887. Ores will probably be a little lower in price, but there will be, undoubtedly, a saving in freights that will compensate the companies.

In southern Michigan there has been a great deal of interest shown in the matter of gas exploration, that is, in boring in the earth for the purpose of obtaining a flow of natural gas that should be sufficient in quantity for lighting and manufacturing purposes. Very many wells have been projected and borings have progressed in various parts of the State to a depth of from a few hundred to 3,000 feet. But only at Port Huron has gas been obtained in quantity sufficient to be of any practical value.

It is not expected to find gas beneath the surface of our State in quantity to be of value until the Trenton limestone is reached, if at all, and as this lies at a great depth it follows that the investigators must be provided with a good deal of patience and not a little length of purse. If both these hold out they may reach the Trenton limestone within the depth of 4,000 feet and possibly find gas. In this boring at different points many thousands of dollars have been expended in the past year and in some places the work is not yet abandoned, merely suspended during the prevalence of cold weather.

One good result will arise from this work: we shall know more about the crust of lower Michigan than we did before. So many borings in so many different localities and to so great depth become very valuable if we know all the data. Fortunately Mr. C. E. Wright, the State geologist, has the matter in hand. At his request many of the parties making these borings are preserving specimens of the rock passed through with the drill at each five feet in depth. Mr. Wright furnishes small labeled bottles for this purpose, in which to put the specimens and the record on the label.

From these specimens a geological section of each boring can be accurately constructed and thus gives a pretty definite knowledge of what the crust is composed down as far as the drill penetrates. These explorations are so numerous, are at places along Lakes Michigan, Huron and St. Clair, the southern border and in the interior of the State, that the results in the hands of so competent a geologist as Mr. Wright are invaluable. They are the data for geological sections of the lower peninsula such as were never before afforded.

THE JACKSON IRON COMPANY.

The Jackson mine, after being for 30 years under one management, passed into other hands, and thus for the first time for so long a period, other parties are directing the work. Capt. Henry Merry and Mr. Edward Blake, who had come to be regarded as life long fixtures at the Jackson location, are no longer responsible for its fortunes. The new agent is an old resident of Negaunee. He has known the Jackson mine almost from his boyhood; he is an experienced miner and mine agent, and has made a fortune through his success in this business. He is also one of the chief owners of the Jackson, so his pecuniary fortunes are identified with its success.

It has long been thought by some people, that the old management at the Jackson was a little slow; that a little more enterprise and go-aheaditive-ness were in order. If such were the case, then the change will be for the better, for Capt. Mitchell has the reputation of being an energetic man. In visiting the mine recently, I find that

there is need for the exercise of all the skill that he may possess in his endeavors to discover ore.

The fact is, when he took possession of the mine there was not much ore in sight, and it was by no means certain where ore in quantity would be found. Capt. Mitchell has kept up a pretty diligent search for it the past season, while at the same time managing to obtain a larger product than it has been customary for the Jackson mine to furnish for the past few years.

The chief piece of new work which has been in progress the past season is the sinking of a new shaft west of the Merry pit, and north of the railroad track, to reach a body of ore that was found years ago with the diamond drill. I have previously given, in a former report, a record of this find. The new shaft is inclined down to the northwest at an angle of 45° and has been all the time in sand, etc., 95 ft. of it. They have been since last March till December, getting through this sand. The shaft had just reached the quartzite ledge.

Northeast from this point they were boring with the diamond drill, had bored one hole which penetrated 13 feet of ore, and had started the drill at a different angle for a second hole. There is quite a body of ground in the northwest corner of the property that has never been explored to any great extent. It is favorable for the occurence of ore, and Capt. Mitchell proposes to give it his attention. On the west line, under the bluff adjacent to the old No. 10 of the Cleveland company, they are mining a small amount of ore. It lies pretty flat and they are down 60 feet. It don't promise to be very large. In the east end of No. 5 pit is a stope 6 to 8 feet wide, and No. 7 is looking as well as ever. It is the main dependence of the old mine.

Some development work is in progress at the South Jackson; three shafts are sinking, and the ground will be tested to greater depth than has been done heretofore.

The mine will furnish as much, probably more, ore the coming season than it has done in any former year.

I forbear to enter into any detailed description of this mine, I have done so in former reports and I do not deem it necessary now.

MAJOR FAYETTE BROWN,
Gen'l Agt. Jackson Iron Co., Cleveland, Ohio.

CAPT. SAM. MITCHELL,
Prest. and Gen'l Manager.

Annual products of the Jackson mine are given in the following table:

Year.	Tons.	Year.	Tons.
Previous to 1856 (estimate)	25,000	1872	114,910
1856	417	1873	130,131
1857	12,442	1874	94,708
1858	10,309	1875	87,283
1859	28,377	1876	98,480
1860	41,295	1877	80,340
1861	12,919	1878	83,120
1862	46,046	1879	112,921
1863	77,237	1880	120,622
1864	83,905	1881	118,969
1865	65,505	1882	93,670
1866	92,287	1883	71,278
1867	127,491	1884	76,626
1868	130,524	1885	67,657
1869	125,908	1886	89,525
1870	127,642	1887	109,947
1871	132,297		
Total			2,694,839

THE EAST JACKSON,

formerly the Pendill mine, joins the Jackson mine on the east. The old mine shaft is but a few feet south of the railroad track at the union depot in Negaunee. The property is the west part of the S. W. ¼ S. W. ¼ Sec. 7-47-26, and is now held on a lease from the Pendill estate, by Hon. J. Q. Adams, Capt. J. F. Foley and others of Negaunee. Some explorations have been made with a diamond drill and good results obtained. A boring 200 feet in length at an angle of 45° with the horizon, so taken to be at right angles to the formation, cut, I am assured, 38 feet of ore.

Also at a distance of 14 feet from this boring, a width of 17½ feet of hard ore was obtained, which if it all is like the specimens shown to me this ore is of fine quality.

The Pendill mine produced in the aggregate, from 1878 to 1883, 27,000 tons of ore.

THE LUCY MINE,

formerly the McComber mine, is next north of the Pendill and east of the Jackson. It was idle, since 1883, until the beginning of 1887 when it was re-opened and is now operated by the Lucy Mining Co. No important changes have been made; the machinery was all intact; it was only necessary to put it in order and pump out the water. The mine is an old one and the location presents a number of large open pits that have been formerly worked. The mine is now all underground and is reached by two main shafts through one of which most of the ore obtained the past year has been hoisted.

This is designated as No. 3 and is situated a short distance southwest of the engine house; it is 230 feet deep and they are about to sink to another level, 50 feet. In the bottom are three drifts, one to the southeast in the direction of the new shaft 170 feet long. In this drift is a body of ore which is shown to be 30 feet wide and 150 feet long; it will also be reached from the new shaft in a drift coming north. To the southwest from No. 3 shaft is

a drift 110 feet, and another to the northwest to cut along near the east side of a large open pit where ore is expected to be found. The new shaft, No. 5, is sunk in the foot wall side at a distance of about 300 feet from No. 3, in the southwest direction. It is 178 feet deep and is 12'x14' inside the timbers down to a depth of 170 feet. In the additional depth to which it will be sunk it will be made smaller, 8'x12', large enough for double cage and ladder road. At about 150 feet east of the new shaft they are sinking in the bottom of an old pit and hoisting with derrick and bucket. In the bottom of No. 5, the new shaft, they have cut a drift east 100 feet and then south 100 feet through a body of ore 20 feet wide. Capt. James Rowe, the superintendent, estimates that he will raise at least 30,000 tons of ore the coming season of 1888. The product in 1887 was 11,584 tons, and the annual products in previous years are as follows:

Year.	Tons.	Year.	Tons.
1870	4,856	1879	28,962
1871	15,442	1880	31,028
1872	25,030	1881	28,230
1873	38,332	1882	40,390
1874	2,642	1883	14,676
1875	10,357	1684	
1876	17,282	1885	
1877	19,691	1886	
1878	30,180	1887	11,584
Total			319,192

The mine is in the N. W. cor. of Sec. 6, T. 47, R. 26, in the city of Negaunee. It is situated in the side hill that slopes somewhat steeply down to the north for a distance of upwards of a quarter of a mile.

The officers are: Wm. H. Barnum, Pres., Lime Rock, Conn.; A. Maitland, Gen. Manager, Negaunee, Mich.; James Rowe, Mining Capt.

THE MILWAUKEE MINE

still holds the prominent place which it first assumed among the Negaunee hematites, having shipped 51,000 tons the past season. The mine is still operated by the Carmichael Bros., for the company on contract, and I find on examination that they are reasonably sure of the usual product the ensuing year. Still all the pits to the east have been gradually exhausted, until now the stoping is confined to No. 8 and to No. 9 pits, the latter holding still, as it did a year ago, the chief ore deposit of the company. It has a length east and west of about 175 feet and a width of 40 to 50 feet. All the ore lenses on this property have been found to lengthen to the west and shorten to the east, that is the lenses "pitch to the west," as it is termed. Each succeeding level extends further to the west than did the one above it. The misfortune with the Milwaukee is that the No. 9 pit has reached the west line of the property and the ore passes to the Grand Rapids people. Luckily the ore body in No. 9 has not, in the last few levels, shortened on the east, so that they still have the ore, within their line, of the same length. In my last report I mentioned the fact that they were sinking a downright shaft to mine the ore in No. 9; but this work has been abandoned. The shaft penetrated the body of ore, and so would require that pillars of ore should be left to insure stability; it was deemed inadvisable to do this. Some exploring is doing elsewhere on the property, but no striking results have been obtained as yet.

The ore is somewhat variable in quality, but it averages above 60% in metallic iron, and but little above the Bessemer limit in phosphorus; in fact the ore used to be sold for Bessemer.

Mr. A. Kidder, Agent, Marquette, Mich. Carmichael Bros., Mining Contractors, Negaunee, Mich.

The Milwaukee has produced annually as follows:

Year.	Tons	Year.	Tons
1879	941	1884	25,000
1880	13,141	1885	38,466
1881	31,254	1886	46,693
1882	41,200	1887	50,471
1883	805		
Total			247,972

THE GRAND RAPIDS IRON CO.

is an organization formed during the close of the present year, 1887, for the purpose of operating the property which joins the Milwaukee on the west and heretofore known as the Wheeling mine. The officers are L. H. Withey, Pres.; H. R. Durkee, V. P.; J. C. Holt, Sec. and Treas., all of Grand Rapids, Mich. The property was held by Messrs. J. Q. Adams, Jas. F. Foley and Ed. Anthony, of Negaunee, who sold it for the sum of $30,000; though as the transaction was made through the medium of a Chicago mining agency it cost the present owners $60,000, one-half of this sum cash and one one-half stock of the Co.

However, it is not a bad bargain for the new company, since for the small amount of work that has been done the mine is looking finely. The old shaft was 180 feet deep. The new company has sunk it to 220'-40' deeper and has drifted south 120 feet and west 50 feet, and has cut through three different deposits of ore, which have respectively widths of 30 feet, 25 feet and 28 feet. In the new level, 220 feet down, they have drifted west 190 feet from the shaft and east to the Milwaukee line 80 feet. Of this distance 180 feet is through ore. The ore dips south but inclines also to the west. The quality is the same as that of the ore from the Milwaukee mine, well up in iron and nearly low enough in phosphorus to be Bessemer. They have also begun to sink a new shaft, located 210 feet west of the old one. The necessity for doing this arises from the fact that the old shaft is deemed insecure and is likely to give way. This new shaft is made to dip S. 55 with the horizon and will be sunk 285 feet, and it is expected that this depth will be reached by July next. They will rise up in it from below. They have a hoisting plant with two Rochester drums 4½ feet diameter. The company mined 1,100 tons, taken from the drifts, and expects to secure a good product in 1888.

The work is in charge of Mr. Henry Warner, of Marquette, a gentleman of recognized business and mining ability.

THE ROLLING MILL MINE

is east of the Milwaukee and is owned wholly or mainly by Mr. Luther Beecher, of Detroit. His son, George L. Beecher, resides at the mine; 1,058 tons of ore were shipped in 1887, and in the aggregate the mine has produced 228,461 tons; all since 1871.

The others of the south side hematite at Negaunee have all been idle during the past year; but going east of the city we have a new series of mines of which the first mention was made in my last report.

The most prominent of these is the

BUFFALO MINE

in the N. W. ¼, S. E. ¼ sec. 5, T. 47, R. 26, which has been held and operated the present company just one year. The mine is now all underground and reached by two shafts which are in separate deposits of ore, which latter I have examined and find to be of good dimensions. No. 1 shaft is the easterly one, it is 135 feet deep and sunk in the foot wall. The ore is reached through a cross-cut from the shaft and is opened east 92 feet into the open pit. The width of the ore is about 40 feet, and it is a clean body of ore; west of the cross-cut the opening extends 45 feet, and the ore maintains its full width. In fact the breast of the drift towards No. 2 shaft is ore. I discovered no indications of the ore narrowing.

No. 2 shaft is about 325 feet west of the former; it is also in the foot wall through which this cross-cut to the ore that west of the shaft is 45 feet wide and is opened a length of 120 feet, the breast of the drift west being still in ore. East of the cross-cut the ore is at first narrow, but widens out so that at the east end it is 60 feet wide.

The shafts require skips and also that the surface apertures be covered with comfortable framed structures. At the time I was last at the mine, Dec. 20, 1887, there were 37 men employed and the work for the coming year had not been decided upon. Capt. McGregor was expecting orders to sink the shafts and to open up for the seasons stoping. At least double the last year's product can be obtained the coming year. There are two 4' drums and a 60 horse power engine. The mine has yielded as follows:

1886	10,860 tons.
1887	24,686 tons.

The officers are John Paulson, President, Minn.; C. A. Avery, Sec., Milwaukee, Wis.; Chas. McGregor, Supt., Negaunee, Mich.

THE SOUTH BUFFALO MINING COMPANY

holds the 40 next south of the preceding, that is, its estate is the S. W. ¼ of S. E. ¼, Sec. 5, 47, 26. The land belongs to the Pioneer and the Arctic Iron Co.'s and is held on a lease by the South Buffalo Co., in consideration that it pays a royalty on the ore mined of 25 cents for all sales, at a price of not above $3.00 per ton, and for all sold in excess of that price the royalty to be 30 cents per ton. The number of shares is fixed at 40,000, par value $25. The company began in April last to sink a shaft, which is now 125 feet in depth. Its location is 300' from the east line, and midway between this shaft and the line they have begun to sink No. 2 shaft; it is east 150 feet and north 60 feet from No. 1 to get into foot wall. The mine is in the N. W. corner of the 40. The first level is at 90 feet, and it is opened a length of 250 feet south and west, and they are still in ore going east; but west it is mixed. The ore attains a width of 90 feet at the cross-cut. The shaft is in the hanging wall, but a seam of ore 4 feet wide was cut in sinking it, at half way down. The ore is banded, hematite and soft ore, with a belt of hard jasper, about 5 feet wide running through it.

An output of 30,000 tons can be made next season if they desire to do so. New machinery will be required, and also suitable buildings. They mined and shipped the past season 4,914 tons of ore. The officers are Wm. F. Anderson, President; Chas. Sudbury, Secretary and Treasurer.

Joining the South Buffalo on the west is

THE SWAN EXPLORATION,

where they are sinking a shaft which December 20, was 125 feet deep in ore and rock. They have engine, boiler, hoisting drum and pump, are working ten men.

The work is undertaken by Mr. E. J. Swan, of Minneapolis, Minn. Andrew Gullgren has charge of the work. It is the S. E. ¼ of S. W. ¼, Sec. 5, 47, 26.

Joining the Swan on the west is

THE KAUFMANN

option, where they are operating a diamond drill. It is the S. W. ¼ of S. W. ¼, Sec. 5, 47, 26, and is called the Blue mine.

North of the Swan and west of the Buffalo, in the E. ¾ of the N. E. ¼, S. W. ¼ of Sec. 5, is

THE GEORGE MITCHELL

Exploration. Mr. Mitchell has a plant of machinery and has sunk 75 feet and is drifting to discover ore.

Still west, adjoining the Mitchell, is

THE LUCKY STAR,

though on what ground it is deserving of an appellation that is evidently intended to suggest the possession of unlimited quantities of ore, I am not informed.

Going east from the Buffalo we arrive at

THE DELAWARE AND LACKAWANNA MINE,

formerly the Sam. Mitchell, Section 5. It was sold last spring to the D. & L. Coal & Iron Co., which corporation worked the mine the past season.

It is reported that the ore is all worked out and that the company will abandon the property. In Dec. last when I was at the mine it was full of water and all work had been suspended. I judge that the company has made no effort to find more ore; it simply worked out what was already in sight and at the close of the shipping season suspended work. During the two seasons since the mine was discovered, it has yielded as follows:

1886	8,823	tons
1887	8,411	"
	17,234	"

THE PIONEER,

which it will be remembered is contiguous with the foregoing, is also worked out and shut down.

It afforded in 1886, 5,140 tons, and in 1887, 1,203 tons.

It is one of the Iron Cliff Co.'s mines.

In the same section in which are found all the foregoing mines is also

THE NEGAUNEE

in the center of the N. W. ¼ of Sec. 5, 47, 26. It is the only one of the mines in Section 5 that has Bessemer ore; the ore in all the others is non-Bessemer.

But then it ought to be good ore, for certainly there has been a world of trouble and expense in getting to it.

No hematite mine in the country has involved so great an expense to open as this one.

The ore is identical with the Cambria and probably in a continuation of the Teal Lake range, while the Buffalo, etc., half a mile to the south, are probably in the range with the South Jackson and its associated hematite mines.

The work of sinking a shaft on this property was begun two years ago the 7th of last July, so that two and a half years have been consumed in accomplishing this difficult enterprise. Two shafts were started, but only one has been completed. It is 432½ feet from the surface to bottom, vertically down. It was begun 12'x12' in size, but was reduced to 10'x10' inside the timbers; the hoist is a single cage. The difficulty in sinking this shaft arose from the fact that the situation is in a swampy ravine and that they had to penetrate, before reaching the ledge, 105 feet of drift deposit, quicksand, etc., thus making it one of the most difficult undertakings of the kind that has ever been accomplished in the iron region.

Capt. Newcome states that they are raising 850,000 gallons of water each 24 hours.

No. 2 shaft is 500 feet distant in a northwesterly direction from the former and is 200 feet deep.

No. 1 shaft is north of the ore, and the cross-cut at the bottom to reach it is 30 feet. This drift is continued south horizontally 90 feet, where it strikes the foot wall.

The drift rises southeasterly in the ore about 100 feet, and is still in it; in fact, no doubt the ore continues to rise to the sand. East and west they have drifted 300 feet, 150 feet each way, and have some rock at both extremes.

The rise of the foot wall is at an angle of 24°, and it is the intention to locate a test pit on the surface at a point in the line where the ore may be expected to reach the sand.

In the mine eight rooms have been started, to run north and south, to be 20 feet across, leaving 20 feet of ore between for pillars. It is thought that the rooms will not have to be timbered, that the ore has sufficient stability to stand without such aid. They will continue to rise up from the shaft along; the foot wall, which is apparently smooth and regular—hard, compact jasper. Measured at right angles with the foot wall the ore body is about 30 feet or 35 feet wide.

So far there has not been a man seriously injured since work began at the mine. About 100 men are at present employed—Dec. 20.

The ore is of the best hematite, about 65% and upwards in metallic iron .037% in phoephorus. They are now hoisting 102 cars per day.

Capt. Albert Newcome, the chief local officer, has been in this employ since the first blow was struck.

They have made a new brick boiler house; 5,359 tons of ore were shipped in 1887.

Capt. Sam. Mitchell, General Agent, Negaunee, Mich.

West from Negaunee is the Teal Lake range. We first arrive at

THE HARTFORD,

which is the name assumed by the parties who purchased the property known as the Ben Neely exploration, comprising workings in the E. ½ of lot 5 and lots 6 and 7 in section 35, T. 47, R. 27, being on the east end of Teal Lake, on the south margin. It lies next east of the Cambria mine; in fact a pit from which Mr. Neely had mined several hundred tons of fine ore, was found to belong to the Cambria when the lines came to be

properly adjusted. There has been considerable exploring done on the property and good ore found at several points, and where they are now working, about 850 feet from the west line and 450 feet from the south line, they have good ore in sufficient quantity to insure a mine.

Two thousand tons were taken from the deposit found by Mr. Neely on the west line; this was secured, however, by the Cambria Co. So far as they have explored at this west end they did not find any continuation of this body of ore on the Hartford property. They sunk to the depth of 90 feet, and drifted some — were in rich ground— jasper, but no clean ore.

The main working shaft is about 60 feet deep, and the ground has been proved to the west and north of it sufficiently to enable them to know that they have a good body of ore. It seems to me that they are not deep enough down to determine much yet. There are a good many shallow test pits; some deeper sinking would be in order.

A fine plant of machinery has been procured in the past summer, consisting of new steel boiler, two Merritt drams, each 5 feet diameter; all working in a new engine house.

I went over this property carefully some months ago and examined all the pits, and again visited it in December. I found many favorable indications for ore, and also concluded that the mine will have a place in the shipping list next year.

Some of the officers are, S. R. Bell, Sec., Milwaukee; A. V. H. Carpenter, Treas. and Vice President, Milwaukee; Ben. Neely, General Manager, Negaunee, Mich.

THE CAMBRIA MINE

still holds its own and promises as well as ever it did, though the mine is in a different place from what it formerly was. They are now working over to the north, and the long axis of the main ore body seems to lie north and south; formerly it was east and west. The old ore pockets lay in regular succession in that direction.

No. 1 shaft which was sunk three years ago north of the then workings, is now 360 feet deep; 100 feet of which distance having been added in the last year. From the bottom they have drifted south 200 feet, cutting through lean ore; expect to reach in this drift some ore that was cut with the drill from old No. 1 pit. At 400 feet northwest from No. 1 they have sunk a new shaft, which is at this date, Dec. 23, 250 feet deep. The two are connected in the 2d, 3d, 4th levels, and nearly so in the 5th also. That is the drift from No. 1 in the 5th level is under No. 2 shaft and they have started to rise and connect. These drifts between the shafts are all in ore, which is mined and hoisted in both shafts. In addition they have drifted from No. 2 shaft north 120 feet, in the third level, all in ore. This ore runs directly north; it is in places 45 feet wide; they have roomed out in it preparatory to stoping. It is found to contain from 61% to 64% metallic iron and to be within the Bessemer limit in phosphorus. It is also pretty hard for Cambria ore; more like the ore found in the Negaunee mine, three miles to the east of this.

The mine is in far better shape than it was a year ago. Now they can tell where the ore is to come from and how to get it; a year ago the mine at No. 1 had crushed in and the ore itself became somewhat a matter of conjecture. They are just now engaged in opening work and are employing 75 men.

There are in stock at the mine 15,000 tons of ore. In the north shaft they followed a stringer of ore west 130 feet, and it has opened into a breast of ore 18 feet wide. The shaft was begun the 5th of last March and it has yielded 20,000 tons of ore; it is 5½'x9½' lateral dimensions, inside the timbers and will soon be to the 5th level. The dip of the ore is west, so that the bottom of the shaft is in the foot wall—shaft being vertical. The mine will easily afford its usual product.

Mr. A. Maitland, Negaunee, General Manager; J. B. Jeffrey, Supt.

The Cambria has produced as follows:

Year.	Tons.	Year.	Tons.
1876	6,324	1882	47,545
1877	10,082	1883	47,508
1878	3,754	1884	59,740
1879	6,860	1885	50,796
1880	7,232	1886	59,406
1881	18,837	1887	41,138
Total			359,286

THE LILLIE MINE

is under the same management as the Cambria, and is but a short distance west of it. The Lillie has turned out to be a good mine, a good investment no doubt for Mr. Barnum and the others who purchased it three years ago. The ore body, which has proved to be so favorable, lies south of the workings of the former company, and the new shaft was sunk to reach it. This shaft is 294 feet to the bottom level. The run of ore is 175 feet long, east and west, and has a maximum width of 75 feet. There are 10,000 tons of ore in stock now, December 23, and 23,031 tons were shipped the past season. Probably 30,000 tons can be readily produced the coming year if required.

There is a long stretch of ground held by this company lying north, between the mine and Teal lake, that has not been much explored. Just now they are doing some exploring in that direction. The estate consists of 70 acres in the N. E. ¼ Sec. 35, T. 47, R. 27, and is owned, as is the Cambria, by the Teal Lake Iron Co., from whom the Tillie M'g. Co. holds on a lease. Statement of annual products:

Years.	Tons.	Years.	Tons.
1875	144	1882	28,221
1876	6,801	1883	2,172
1877	10,127	1884	2,683
1878	8,506	1885	708
1879	21,681	1886	3,957
1880	18,347	1887	23,041
1881	16,718		
Total			145,548

Wm. H. Barnum, Pres.; A. Maitland, Gen'l Ag't; Charles Koch, Supt.

Continuing west and passing the Cleveland Hematite, which will be described elsewhere, we reach next

THE DETROIT MINE,

which had a very doleful experience last spring, but which is in most excellent shape at present. It will be remembered that the shaft is near the east line of the property and that it descends vertically 245', thence inclines to the south at an angle of 45° until it attains a depth of 350 feet. The old mine extended to the west line, 80 rods, and the ore is non-Bessemer. A boring was made to the south which discovered a body of Bessemer and a drift from the shaft made to reach it.

When this drift intersected the ore there was such a sudden influx of water that the mine became completely filled, and its removal was the occasion of considerable delay and of difficulty.

The drift is 500 feet long from the vertical line of the shaft and rises about 1" to a foot to the south. The depth below datum where the ore is struck is 342 feet.

At the depth of 221 feet another cross-cut to this ore has been started from the shaft.

The ore body inclines down to the west. The extreme limit of the working is south from the shaft 630 feet, but the ore is crossed by several drifts and shows a width of 90 to 100 feet. It is not probably so wide as this, estimating clean ore; but apparently there is a pretty good width. The length east and west seems to be about 300 feet. It is difficult at this writing, Dec. 23, to state only approximately the dimensions of the ore, even so far as it is opened. They have worked east by a series of rises until in this way they have come out to the surface, rising up in the ore and following up on the rock. The slope of this inclined foot wall down to the west is about 45°. They are preparing to make this rise into a skip road.

The ore is light and dry. The following are several analyses of this ore:

No. 1, by Joliet Steel Co.—

Metallic iron	61.40%
Phos	.049%
Silica	5.58%
Manganese	0.55%
Sulphur	0.09%

No. 2, by Battle, Nye & Co.—-

Iron	61.10%
Silica	7.41%
Phos	.045%
Manganese	.371%
Alumina	1.71%

No. 3, by same—

Iron	62.55%
Silica	5.71%
Phos	.067%
Manganese	.411%
Alumina	1.44%

The following is the annual product of the Detroit mine:

Year.	Tons.	Year.	Tons.
1882	5,402	1885	19,755
1883	12,314	1886	36,066
1884	3,098	1887	22,656
Total			102,291

Lee Burt, Gen'l Manager and Sales Agent, Detroit, Mich.; W. J. Officer, Supt., Ishpeming.

A shaft was begun south of the new find, but has lately been abandoned.

THE CLEVELAND MINING COMPANY

has something new in the way of improvement every year. The most conspicuous additions to arrest the attention that have been recently made, are the new shaft house at No. 2, and the new pumping engine house at the same shaft. The building is 100"x30', brick walls inside, and the outward walls and roof covered with corrugated iron. The pumping machinery is placed upon the most substantial foundation, pump 14"x9', engine, Corliss 18"x60", iron bobs, will raise the water from the bottom 560 feet by three lifts. This will make three separate pumping plants on this location, and the three tall brick chimneys are conspicuous objects. The Cleveland Co. makes everything with a view to its efficiency and permanency. The new pumping plant has cost $40,000.

The several pits look certainly as well as they did a year ago. The Moro and Hematite even better.

Starting with the Incline pit, formerly one of the largest mines in the state, it has gradually become of greatly diminished value. This mine is 1,310 feet in length east and west, and an extreme depth below datum of 300 feet; its general depth in the west part is about 240 feet. At the west end is an underground skip road of 450' long, then a tram of 420 feet, thence a skip-way up to 4 the surface of 490'. The ore now obtained in this mine conies from between the old levels and along the south side.

No. 2 pit, which lies parallel with the former and north of it, is also opened at the east end and is longer and

deeper, having a maximum depth of 540 feet. The bottom is poor, mixed ore and jasper, but in the 390 feet level a turn to the north recently has given a large stope of ore. They designate it as the magnetic stope. It carries considerable carbonate of lime and some magnetite, and is sold as Scotch ore.

They are also stoping in this pit all along the south line between the levels. The two mines are about 70 feet to 100 feet apart; at one point, however, the No. 2 has come under the Incline, but is 300 feet below it. The vertical shaft is 180 feet to the knuckle where is the old skip road. In passing through the old openings they have built a pillar of masonry on the east side of the shaft 25 feet wide, with an arch over the old skip road. On the north of the old skip road they will rob the ore pillars—between the skip road and the north line. Connection will be made between the two pits sometime, for safety and to take the ore from the Incline to the new downright shaft, thus saving the long haul now made to take the product from the Incline pit to the surface.

No. 2 mine has an abundance of ore, but it is not generally first-class,

The Moro is in several lenses, but they seem to be working together. They show as a whole in the ground plan a circular form.

Last year the working was all at the north of the shaft to the west end of the mine, and it was looking finely when I was last under ground. Now the work is all south and east. Of the two long cross-cuts to the south ore they are working in the upper one around to the east and north, and will soon be at the shaft, with the east stope circling around east and north from the south lense.

The first cross-cut south at 296 feet depth, 280 feet long; second cross-cut, depth 248 feet, length 240 feet; third at 247 below datum, 80 feet long; fourth cross-cut, 70 feet long. The first and second cross-cuts reach the same ore, but the latter also cuts an intermediate lense in which they are now also working, driving east and slightly north, and will come into the ore that is mining in the level of No. 1 drift. A drill hole shows this body of ore to go down below the level of No. 2 drift. Nos. 3 and 4 drifts are in Nos. 6 and 7 levels respectively, and in the same body of ore. In the 6th level they have opened a length of 300 feet, with a width of 20 feet and upwards. In one place it is 40 feet wide. In addition to this they have in the 6th level a circular deposit 150 feet long, 10' to 18' wide, lying south of the main deposit behind a body of soap rock.

They are still working west in ore, going towards a drill hole, which at 389 feet from surface came to ore and continued in No. 1 ore for 24 feet.

The drift in direction of this ore is 370 feet down. On the whole the mine is showing first-rate, good for 50,000 tons of ore the coming year.

They are engaged in no dead work now, but have many stopes to work. The greatest depth is 570 feet. Shaft, downright, 305 feet, then to west down at angle of 45°.

Considerable interest attaches to the new work begun at Lake Angeline.

The Cleveland Co. owns the land bordering the east part of the lake, and last winter advantage was taken of the season by placing a machine on the ice and exploring with the drill the rock underlying the lake.

Five holes were bored, so distributed as to cover considerable surface area.

The record of these holes is as follows:

L—32 feet water, 20 feet soil, 83 feet ore, which analyzed 45%, 39%, 57. 85%; and in phosphorus, .0263%, .027%; silica, 3.39 to 8.55%; Manganese 1.31 to 8.18%. The total depth of hole 116 feet; ore, red hematite.

M—37 feet water, 44½ feet soil; 115.7 feet paint rock, 48.2 feet hematite ore.

Analyses of which gave 35.55%, 64.38%, and phosphorus .067%, .080%,

N—Water 37 feet, soil 38 feet, jasper 56 feet, paint and soap rock 110.3 feet.

O—Water 33 feet, soil 47.6 feet, ore 20.3 feet. Analyzed 59.57%, phosphorus, 0.70%, paint rock 10 feet, ore 19.6 feet. Analyzed 60.32%, phosphorus, .184%, soap rock 63 feet, diorite 47.2 feet.

P—Water 37 feet, soil 42 feet, jasper 16 feet, lean ore 100 feet, paint rock 15.7 feet, ore 31.2 feet. Analyzed 57.6%, iron, phosphorus .051%, 54.16% and 59.31, iron, phosphorus, .062%. Then paint rock 3 feet, ore 48 feet; still in ore when drill was taken out.

To reach this body of ore a shaft is sinking from the north side of the lake, inclining downward to the south at an angle of 50°. It is, of course, well made, 5'x18' inside the timbers, and at this date, Dec. 10, is 180 feet long; it will be continued to 200 feet, when they will cross-cut south to the ore.

N—Hole is not far from the 16th corner, and P. is south of it. N. M. P. I. form the corners of a rectangle, of which the two first connect the north side. O. is to the east. The line of the shaft is about midway between M. and N.

East from the shaft to where the east line crosses the lake is 1,500 feet. The ore is identical with that of the Lake Superior mine hematite, of which it seems to be the continuation. In sinking the shaft power drills are used, the air being brought over the hill in pipe from the mine.

The small hard ore pit that was opened east of the mine, close to what is now called the East New York, is still worked and affords a small amount of ore. I cannot see that it is likely to be of much importance.

Mr. F, P. Mills, the new superintendent, succeeded Capt. Bacon in July last, the latter gentleman having been placed in charge of the celebrated Minnesota mine. Mr. Mills, though young, has had a large experience and a thorough theoretical education. He was formerly the mining engineer at the Cleveland, and assistant to Capt.

Bacon; and subsequently General Manager for the Briar Hill Coal & Iron Co. of their mining interests in Michigan, comprising the Iron River and Youngstown mines, etc.

For the past two years he has been in Chicago, Assistant Manager in the Union Steel Co., so that his experience has been important and varied, and in all his several vocations he has shown great energy and skill; thus he comes back to the Cleveland to occupy the chief position, a place he is well qualified to fill.

THE CLEVELAND HEMATITE

mine is in the Teal Lake iron range, a mile north of the Incline, etc., pits. The mine has greatly improved lately, that is the deposit of ore has been found to be larger than it appeared to be a year ago.

During the summer it was thought that the mine was rapidly approaching exhaustion; that the pumps would be soon pulled out and the mine abandoned. The deposit had diminished to lateral dimensions of 25 feet; but on sinking a winze 100 feet in the ore and drifting from the bottom of it, it was found that the ore body expanded in size and was at this greater depth 100x 112 feet, with still appearances of greater length. The misfortune is that the ore is so far away from the shaft. The latter is vertical and is 440 feet north of the ore at the 500 feet level, increasing in distance away with the increase in depth, so that at 600 feet down the cross-cut will be about 550 feet long. It is very hard rock, costs $15 to $18 per foot to drive in.

They have delayed the matter of sinking the shaft further and driving the long cross-cut, first to explore the ore deposit to find if it would pay, under the circumstances, to attempt to mine it further, and then also it was a matter of uncertainty as to the expediency of continuing the present shaft or of sinking a new one. It was concluded to lower the old shaft another lift and the work of doing this and of driving the cross-cut has just been commenced.

The mine is fully equipped with mining plant, new duplex Knowls pump, compressor, &c.

The Cleveland Hematite has been given a prominence through the method of mining early adopted to obtain the ore. This plan has been fully described in my Report for 1885, with some modifications given in the last report.

Capt. Geo. Williams who had been long in charge of the work at the Hematite, accompanied Supt, Bacon, as did also Capt. James Williams of the hard ore mines, to Minnesota. Capt. John Eddy is now in charge and has about 80 men at work; he is familiar with the mine and with the method of mining followed.

At the hard ore mine the mining captain is Harry Mills; both of these new officers are locally well and favorably known.

I noticed at the mines several things that seemed to be excellent plans to adopt: one is a new way for sending coal down into the Incline pit for the use of the forge that is maintained there, in a box shute from the surface. It is much easier and more expeditious than sending it down in the skip. Another simple scheme is, running the oil down in all the pits directly from the surface through iron pipes; the oil runs directly from the barrels down into the tanks in the mines. Formerly the barrel of oil was loaded into the skip and run down and when empty returned to the surface, but frequently the barrels were destroyed; now of course they are all saved and sold for $1.00 each.

Another simple thing I noticed that is a matter of economy and is effectual; formerly it was necessary to keep a fire down in the Moro pit to warm the sticks of giant powder and for the men to warm their coffee at dinner. Mr. Mills tried turning the exhaust pipe from the pumping engine, at the Moro, down the shaft to the bottom, and is found to afford all the heat that is desired, and saves coal, etc.

The officers of the Cleveland Co. are: S. L. Mather, president, Cleveland, Ohio; Fred A. Morse, secretary; F. P. Mills, superintendent, Ishpeming, Mich.

The Cleveland Co. has shipped annually as follows:

Year.	Tons.	Year.	Tons.
1854	3,000	1871	142,658
1855	1,444	1872	151,724
1856	6,343	1873	133,265
1857	13,201	1874	105,855
1858	7,909	1875	129,881
1859	15,787	1876	145,661
1860	40,041	1877	151,554
1861	11,794	1878	143,320
1862	40,364	1879	113,108
1863	46,842	1880	187,234
1864	49,954	1881	197,843
1865	33,355	1882	204,341
1866	42,680	1883	218,219
1867	75,864	1884	224,479
1868	102,112	1885	218,632
1869	106,133	1886	203,386
1870	133,884	1887	204,828
Total			3,699,856

THE LAKE SUPERIOR IRON CO.

has no striking developments, made lately. It has simply sent out a larger product the past year than ever before and the mines are in condition to duplicate the output the coming season.

The new find west of the Lake Angeline mine produced 900 tons of ore and they are developing it with the view to a much larger yield. There is no doubt of their finding ore, ultimately, in quantity at this point.

At a depth of 275 feet they drifted south 22 feet, 18 feet of which was ore; in this body they drifted east 45 feet, and the breast is still ore. It was here that the 900 tons product was obtained. The shaft has been sunk to 305 feet, at which depth a drift south found ore at 8 feet which, however, cut out in a few feet. At this date, December 15, the drift is in rock but it is thought it is but a "horse," since the diamond drill, further south, passed through ore. At a point 129 feet down in this shaft 7

holes were bored to test the ground. The shaft is in the dolerite dike described in a previous report. The company has erected a stone engine house at this shaft. The ore is the best hard specular Bessemer.

The Hematite mine is one of the best in the State. One of the largest and cleanest deposits of hematite ore.

The bottom is the 444 feet level, that is its depth below the datum of the main engine house floor.

It has been extended east to within 250 feet of the margin of Lake Angeline and the drift is still ore.

There are two deposits in this direction, the north one 15 feet wide and the south one 30 feet, the latter 210 feet from the water. A drill hole 40 feet above this level was made through the intervening ground to under the lake, but no ore was cut. The length of the mine in the 340 feet level is 1,400 feet, and the bearing of the axis is S. 60° E. and for a hematite mine it shows considerable regularity; the drifts are generally parallel and so are the headings. The ore lies in a syndinal which now at the bottom gives a width of ore in the widest part of 350 feet, foot wall to foot wall.

The headings or rooms are filled with rock and sand as fast as the ore is removed. Their method of mining differs from that of a similar kind practiced elsewhere, but it is found to work admirably.

As I have fully described it in my last report I will not repeat the details. Two pillars were mined out in the west end of this mine and no difficulty whatever was experienced.

The mine extends now east of the new shaft 375 feet, but the great body of the ore is between the two shafts, No. 1 and the new cage shaft, which are distant about 600 feet. It will be seen that the mine has not increased any in depth, it was the same depth last year as now; in fact they went to the bottom and then began to work up. So that ultimately the ore will all be taken out and the mine filled up with rock.

The ore is continuous through the mine, but at the cage shaft there is an up-lift in the rock beneath the ore, the ore going on over it, but the drifts go through it. To insure entire safety the company, in the past year, has reported to the plan of cutting drifts in the foot wall, in the south side, 40 feet in from the ore. These have been made in the 340 and in the 400 foot levels east from No. 1 shaft. There is a shaft for rock and timber on the north side between the other two.

The rock for filling is taken from the old open pit situated south of No. 1. It is drawn down through winzes into the shutes in the different levels as required. Thence by tram cars it goes to its final destination. There is plenty of loose rock in the open pit that has been hoisted from the hard ore mine, but just now enough rock is taken from the rock drifts. The rock and timber shaft is at the 340 foot level and will soon be at 400 foot, and they are driving in the 444 foot level to come under it and then rise up, and thus carry the shaft to the bottom of the mine.

No. 2 mine, as intimated in my last report, has not been sunk any during the year. It was then as now, at the 720 foot level, and presents no new features. They have explored with diamond drill in all directions and find nothing to warrant the continuance of the shaft. It is not expected that it-will ever he sunk any deeper. In the stopes in all the levels a good deal of jasper is met with. They appear about as they have for a few years past, nothing new or encouraging. The work in all is in the west end, except in the 680, which has stopes at both ends. They are taking out ore in all the nine levels from the 400 down, and still have good stopes in some, even if they are smaller and less clean than they used to be. For instance in the 500 foot level the stope in west one is 30 feet wide; and in the 680 it is 18 feet wide.

In the bottom a horizontal drill hole running with the formation N. 70°, W. 710 feet long cut in the aggregate 198 feet of fine slate ore. The average of the analyses gives 65.60% metallic iron, and .060% phos. The last 41 feet gave 65.4% iron, .049% phos.

They have decided to drive to this ore, following the drill hole. After passing through 275 feet of rock they will reach ore. A second hole from some point also to the west, but angling a little more to the north than the former, also intersected considerable ore, some of the bodies corresponding with those in the first. The ore in No. 2 is first-class, hard, specular slate ore; it averages about 66% in iron, and .100% in phos.

No. 3 shaft has been sunk an additional level; it is now at the 520, but it has not been much opened. A drift 100 feet west, cut a deposit of ore, which corresponds with one worked in the level above. The bottom and two other levels are all that are worked in this mine and those in the west ends; they are the 417 and 480 foot levels, both in the old No. 3 Barnum mine vein. The former is very near the north line. The ore is about the same in quality as the No. 2 mine ore; averages 66.2% iron, .120% phos. It is a little higher in phosphorus than that from No. 2.

The company is now exploring with the drill to determine if it will be policy to sink the shaft any deeper, a matter that seems likely to be decided in the negative. In mining they break about 10% of rock, and the product is one-fifth to one-third second class.

No. 7 is so nearly exhausted that it does not pay for working. The bottom is to the 520 foot level, one level having been added in the past year. The ore body in the bottom is about 100 feet long and 6’ to 8' wide, having narrowed from a width of 20 feet, which it held in the 480 foot level. If sunk 200 feet deeper the shaft would be in the level of the ore found with the drill west from the bottom of No. 2. It is thought that they may decide to sink to the 720 level and drive east to this ore. At 200 feet is a body of it 42' one dimension. Nos. 2 and 7 would thus be connected, and if the ore between proves to be of magnitude a good mine will result, and will be drained from one shaft.

A-shaft is barren at present, no ore is coming out, and it is not known to a certainty if there be any more to come. The shaft is to the 3d level; the 1st and 2d are exhausted. The ore was 10 to 15 feet wide, and 215 feet long—the north lense.

It is uncertain how it will prove in the 3d level; the ground is much broken and irregular. First level is 287 feet below datum, 2d, 327 do.: 3d, 467 feet do.

There is ore still in the open pit, and a good deal of A-shaft ore has come from the open pit; but now the west wall of the pit, which holds the ore is close to the margin of the street, and if the ore is taken some plan must be resorted to besides open cut work.

For a description of the situation of this and the other shafts, I must refer to previous reports.

In Sec. 21, T. 47, R 27, at 850 feet east of the Lowthian mine shaft, an old exploring pit was cleared out and at a depth of 35 feet a ledge of clean, soft ore was reached into which the shaft was sunk 24 feet. At the bottom a drift north 20 feet was mainly in ore which averaged on analysis 63.3% metallic iron and .039 % phosphorus.

A drift east 30 feet at the bottom of the shaft, is all the way in clean ore and the end also ore.

The shaft sunk on Sec. 3 just west of the Detroit mine did not pan out well. Its depth is 96 feet, and some drifting done from the bottom, but nothing of value obtained. The work was abandoned in September last.

A new set of compressors has been added during the past year.

The company's officers remain as heretofore.

JOS. S. FAY, JR., Treas., Boston, Mass.
H. C. HALL, Agt., Ishpeming, Mich.
W. H. JOHNSON, Supt., Ishpeming, Mich.
H. B. STURTEVANT, Mining Engineer.
JOHN MC EHTEE, Capt. Hard Ore Mine.
JAMES TREBELCOCK, Capt. Hematite Mine.

Lake Superior mine yearly products:

Year.	Tons.	Year.	Tons.
1858	4,658	1873	158,428
1859	24,668	1874	104,311
1860	33,015	1875	119,365
1861	25,145	1876	110,570
1862	37,704	1877	127,349
1863	78,976	1878	104,674
1864	86,773	1879	174,747
1865	50,201	1880	204,094
1866	68,002	1881	252,235
1867	114,935	1882	296,504
1868	105,745	1883	200,799
1869	125,560	1884	204,796
1870	166,582	1885	226,040
1871	158,074	1886	268,035
1872	145,070	1887	302,909
Total			4,139,997

The product of 1887 is made up as follows:

Hard ore, tons, No. 1	115,931
" " " " 1, A shaft ore	21,308
" " " " Section 16	840
Summit ore, No. 1, No. 7 shaft	16,047
Essex ore	30,766
No. tons hard ore	184,892
Hematite	118,017
Total	302,909

THE BARNUM

presents no new features; they are working west along the Lake Superior Co.'s line and get annually about the same amount of ore; in 1887 it was 18,123 tons. It is good ore, No. 1, first-class specular non-Bessemer.

THE CLIFF SHAFT,

to the north, under the same management and belonging to the same company, is a far greater mine. It is a well equipped, first-class, hard ore mine in every particular except in the ore, which does not average first-class.

The shafts are near the ridge of the hill, which slopes to the south to the valley and are designated as A and B, the latter being the westerly one and being 420 feet deep. A, the east shaft, is 472 feet deep and is the main one. Both are vertical, are two cage shafts and are 835 feet apart. They are connected by a main draft from the bottom of A shaft.

The mine is in a synclinal fold of the formation, so that in places they are working against two foot walls.

The shafts are north of the bottom of the fold. The upturn in the fold of the rock is run both in the roof and in the floor of ore.

87,346 tons of ore were raised in 1887, mostly from A shaft; it is expected to mine 100,000 in 1888. The stopes are all what are termed breast stopes, no underhand nor back stoping in the mine. B shaft was got in readiness for hoisting ore in March last and now furnishes about 25% of the ore of the mine. The workings have not been extended east beyond where they were a year ago; they are already nearly as far east as the Nelson house, having a length from B shaft east of 1,400 feet.

The mine has a fine pumping plant—two 14" plungers in A and two 20" and 14" plungers in B shaft. The former raise 240 gallons per minute and the latter 600. One man has charge of the pumps, it is his business to attend to them night and day, as required.

A new boiler house has been built, stone walls and iron roof. Its dimensions are 112 feet by 66 feet, and is to contain all the boilers. There will be 10 boilers, five in each set; one set will be as a reserve. The five new ones will be 5' x 16'; the old ones are 5' x 14'.

It is also the intention to have a new hoisting plant, two 10 feet Merritt drums. The old ones limit the hoisting, they are inadequate.

The Barnum and Cliff are among the mines of the Iron Cliff Co.

The Cliff and Barnum have produced each year as follows:

Year.	Tons.	Year.	Tons.
1868	14,386	1878	26,680
1869	37,503	1879	24,911
1870	44,793	1880	24,921
1871	45,939	1881	27,381
1872	38,381	1882	41,424
1873	44,368	1883	62,752
1874	40,255	1884	67,782
1875	40,914	1885	47,458
1876	37,750	1886	82,686
1877	38,314	1887	95,586
Total			884,329

Wm. Sedgwick, Superintendent, Ishpeming, Mich.; Tom. Barge, Clerk, Ishpeming, Mich.; Alex. Maitland, General Manager, Negaunee, Mich.

THE YORK MINING CO.

is the name of the corporation organized a few years ago to operate the New York mine. The mine has been idle several years. I have heretofore described it with sufficient fullness. There was shipped from the mine the past year 5,556 tons of ore. This ore was mined several years ago and there still remains a considerable quantity on hand.

August Beerling, Superintendent, Ishpeming, Mich.; J. McCloskey, Agent.

THE EAST NEW YORK MINE

is a new enterprise in the city of Ishpeming. The parties who are conducting this undertaking found workable ore in the bluff adjoining the old New York and Cleveland mines. The outlook for a mine is thought to be promising. When I saw the location last they were sinking a shaft north from the ore preparatory to drive south and cut it at some depth below the distance they had worked in it. They were erecting an engine house and had secured a new plant of machinery for hoisting, pumping, etc.

Capt. W. H. Johnson of the L. S. Co., superintends the work; C. R. Ely, Secretary.

There is nothing especially new at the

PITTSBURGH AND LAKE ANGELINE MINE.

I went through it about the 8th of December, and found an abundance of ore of the best quality and excellent provision made for taking it out.

It so happened that they were not hoisting; the delay being occasioned by reason of the hoisting machinery being out of line and they were engaged in putting it right. The mine has a fine stone engine house, built but a few years ago, and an excellent, new plant of hoisting machinery.

At the time the building was placed it was thought that the foundations were laid in secure ground.

But in hematite ore deposits it is impossible to tell what direction the ore may take, and while they have not allowed the engine house to be undermined they have caved a portion of the mine southwest of the engine house, and as the northeast side of this cavity is pretty straight up and down, it has caused the ground to settle, "to draw," as it is said. Possibly in time it may necessitate the moving of the building.

The mine has 3 shafts A, B, C. B is in the foot wall side, inclining down north. A is somewhat centrally located, on the north side of the ore body. The 1st level extends about 1000 feet east of A shaft to within 854 feet of the east line. The 6th level extends to within 1,164 feet of the line and the 7th is 1,335 feet away.

The sixth level has a length of 1,125 feet, while the 7th is only opened east. The second level is west of A shaft 520 feet. Across section of the mine would show a curved bottom. The several lenses which compose the mine incline down to the west, lapping the one over the other, but separated by bars of rock. I have described these so fully in my last Report that I shall not do so now.

The method of mining has not varied, but they are getting the ore from the upper levels, taking out the pillars and letting in the ground. It is this around that caused the disturbance of the engine house. In the fifth, sixth and seventh levels not much has been done except to run the opening drifts.

The last year's product has been largely obtained from the first, second third and fourth levels, taking some of the pillars. The bottom levels hold large resources of ore. The hard ore in the west part has not yet been much disturbed; they are getting into it, and all developments tend to show that there is a great store of wealth in this hard ore deposit.

A shaft is 464 feet deep. C shaft is 300 feet down. All double skip-shafts.

The ore continues to be of the same high grade. First-class averages 68% in iron and .025% in phosphorus; second-class, 60% in iron, phosphorus same as the first-class. They draw the line at .060%, all above that is classed as non-Bessemer.

The officers are, Alfred Kidder, General Agent; Thomas Walters, Superintendent; E. Z. Burns, Mining Engineer.

The yearly product of the mill has been as follows:

Years.	Tons.	Years.	Tons.
1864	19,500	1876	22,539
1865	20,151	1877	19,113
1866	24,073	1878	28,161
1867	46,607	1879	25,420
1868	26,651	1880	14,794
1869	39,644	1881	18,000
1870	53,467	1882	14,518
1871	33,645	1883	27,259
1872	35,221	1884	87,018
1873	43,933	1885	111,051
1874	30,499	1886	131,384
1875	30,281	1887	191,121
Total			1,094,161

THE SALISBURY

is one of the Iron Cliff Co's. mines located adjacent to the Lake Angeline, being in the S. ½, S. W. ¼, of Sec. 15, T 47, R. 27. There is very little change in or about this mine, since I last saw it a year ago. The Salisbury is a good soft hematite mine and must be profitable to the company. Years ago the mining was all in the great open pit against the north line; now it is nearly all underground south of the former and reached by a single shaft, which descends from near the east end of the open pit.

I have heretofore described this shaft, which is peculiar, and also the deposit. The shaft is 420 feet long, reaching a vertical depth of 370 feet. The ore body is about 300 feet in length east and west and about 70 feet wide from foot wall to the jasper hanging; but it is not all clean ore; there are horses of rock in it which they generally manage to leave. At a depth of 270 feet below surface, is a drift in south 670 feet, which will be continued 200 feet more to the diorite. The purpose of the drift is to explore the ground; about 200 feet in width of lean ore were cut in the drift and some good ore; one deposit was 12 feet wide. A drift in this, however, 15 feet long came to the end of the ore.

The open pit and the underground workings are connected and some ore is brought up on the skip road that rests on the south wall of the open pit. There is also a drift east, 200 feet long to explore the ground. The ore body lengthens east and shortens west so that it just about holds its usual dimensions. The ore is all in one body now.

The officers remain as heretofore.

Alexander Maitland, General Manager; Thomas Buzzo, Mining Captain.

The ore averages at about 60% metallic iron and is close to the Bessemer limit.

The following table shows the yearly product:

Year.	Tons.	Year.	Tons.
1872	545	1880	22,387
1873	11,023	1881	41,888
1874	6,730	1882	42,019
1875	4,571	1883	17,028
1876	20,510	1884	23,171
1877	37,868	1885	29,503
1878	52,155	1886	51,231
1879	39,770	1887	49,229
Total			452,963

At about a mile and a half south and east of the Salisbury are

THE WINTHROP AND MITCHELL MINES,

now and for a few years past operated by the Winthrop Hematite Company as lessees of the Winthrop Iron Company, and of the Mitchell Mining Company, of these two contiguous mines.

These are working in the same deposit of ore. The line between the properties crosses through the main ore bodies and through the engine house of the Winthrop mine. The Mitchell lies east of the former, and its workings are nearly wholly underground.

There are three working shafts, the west one of which is designated as A shaft. It is the main shaft of the mine, the one that affords the most ore: is 350 feet in depth, inclining to the north. The Mitchell, being the deepest mine, takes the water of both of them, and there is a good deal of it. The pumping plant is placed west of the Winthrop, so that there is a line of 1,800 feet of rope to work the plungers.

The mines are not much deeper than they were a year ago, though 98,078 tons of ore have been removed in the meantime. There are 10,000 tons in stock now, December 16.

In looking over the formation at these two mines it would not seem that the possibilities for finding other equally good deposits of ore on the properties had been exhausted.

The St. Clair Bros., who control the mines, have recommenced to sink the downright shaft in the foot wall at west end of the Winthrop. This shaft was made to a depth of 200 feet several years ago, and then discontinued; it will require to be sunk to a depth of 400 feet. When completed it will take the ore and they will be in a much more independent position as regards the matter of obtaining the ore. The Winthrop has been a fine deposit of ore from the first. It is always salable at a good relative price, and should have been a profitable mine; perhaps it has been, but a different system of mining would have made it more so. The trouble has been, it has been continued as an open pit to a great depth, and several serious "caves" have occurred when the ore was buried beneath a vast quantity of sand and rock that has taken much time to remove.

These "falls of ground" have occurred in the spring just when the company was in readiness to break the ore for the season's product. There is now a pile of this debris, 100,000 tons of ore mixed with dirt, which has been bought by Messrs. John Jones and others, who are shipping it to furnaces. There is market for it at low price, so that if freights are sufficiently moderate it can be handled at a profit. It is plain to see that when a mine is opened ready to stope the ore, to have it collapse is a serious matter in several ways, and to this disaster the owners of the Winthrop have been subjected more than once.

Both mines seem to be in unusually good shape now, and have a favorable outlook for the future. The local officers in charge are Geo. A. St. Clair, Superintendent Winthrop Hematite Co., Ishpeming, Mich.; Samuel Roberts, Capt. Winthrop Mine; Norick Anderson, Capt. Mitchell Mine.

The Mitchell mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1872	197	1880	12,750
1873	8,552	1881	20,964
1874	7,699	1882	33,394
1875		1883	
1876	5,506	1884	29,883
1877	3,897	1885	7,415
1878	4,259	1886	42,044
1879	11,450	1887	53,592
Total			241,698

The ore is non-Bessemer, but close to the limit.

The annual product of the Winthrop has been as follows:

Year.	Tons.	Year.	Tons.
1870	2,469	1879	27,050
1871	7,314	1880	45,247
1872	14,239	1881	43,900
1873	31,150	1882	23,259
1874	8,248	1883	50,143
1875	8,642	1884	53,077
1876	27,236	1885	63,915
1877	12,549	1886	44,274
1878	23,740	1887	44,486
Total			531,823

I visited

THE FOSTER,

which is one of the oldest of the hematite mines, and which is in a pleasant, romantic locality. It is in Section 22, T. 47, R. 27, east of the Winthrop, in the estate of the Iron Cliff Co., by which corporation it has always been operated. The mine having been worked many years one would expect to find, what really does exist in fact, a large number of irregular open pits, which have been successively worked and abandoned. The mine is in high ground, in a wide hematite formation that is made up of lean ore, of jasper and ore with the occurrence of occasional pockets of ore that are sufficiently clean to pay to mine. It has never been high grade ore; it probably would not pay to mine and ship but it makes good foundry iron and is used constantly in the Pioneer furnaces at Negaunee.

The mining here for a year or two past has all been in a single pit, which is open to a depth of about 100 feet, when the skip road descends through the bottom to the north at an angle of 45°. The total length of this skip track from the surface to the bottom is 500 feet.

The bottom is ore; it is hard and firm, no timbers are necessary to hold up the ground. The pillars of ore amply suffice. The quality of the ore seems to improve in the bottom. It is richer in iron and holds less silica. It is said to average above 60% in iron now. An exploring shaft has been started in the low ground N. E. of the mine, and is 40 feet in depth, in lean ore. The product for 1887 was 7,876 tons, and the aggregate to the close of that year is 162,212 tons. Alexander Maitland, General Manager, Negaunee, Mich.

THE NONPAREIL,

formerly the St. Lawrence, was worked the past season for the first time in several years. All work was suspended some time ago, and I conclude, from conversation with Mr. John R. Wood, the General Manager of the mine, that it is a matter of uncertainty if it will be again resumed. The product is rather a lean, low grade ore. It was hoped, by those who took hold of the matter, that something better would be found. The mine is in the N. W. ¼, Sec. 5, T. 47, R. 27, and is reached by a branch of the C. & N. W. R. R. The product for 1887 was 1,578 tons, thus making an aggregate production of 23,171 tons. The officers are: Sheppard Homens, President, New York; John R. Wood, Appleton, Wis., General Manager, etc.

THE DEXTER CONSOLIDATED MINING CO.

is a new organization effected to combine and operate the Dexter and Dey, two contiguous mines, the former being the E. ½, N. E. ¼, and the latter the W. ½, N. W. ¼ of sec. 3, T. 47, R. 28.

Sigmund Rothchilds, President, Detroit; F. O. Clark, Managing Director, Marquette, Mich.

There are two shafts, one in each mine, 200 feet apart, which descend to the north at an angle of 75°. The Dexter shaft—the west one—is about 300 feet long, 100 feet of which distance has been sunk in the past year by the new company. The Dey shaft is 150 feet deep on the incline. The shafts are in the quartzite foot wall.

The work formerly done was all between the two shafts, but the new company is working west of the Dexter shaft. I went through the mine Dec. 31 and examined the drifts carefully and found that they had cut some fine ore, both hematite and hard specular slate. Of the former there were two limited stopes, and of the latter, I found no stopes, but small bunches of excellent hard ore in the jasper. The hematite is far better than that formerly mined between the shafts, but there is not enough of it as yet.

A few hundred tons have been taken from the drifts. I find that this stock pile holds some rock mixed with the ore. It will require sorting when it is shipped. The company was working 30 men; it is hard, difficult ground to penetrate and with hand drills they cannot advance rapidly. It would seem to me to be better policy to discharge the men and explore with a diamond drill.

I was told that there is a deposit, 23 feet wide, of medium ore, east of the shaft, but as the stope was under water I did not see it.

The property is in a fine ore formation and further work may afford good results.

The two mines have yielded in all 24,539 tons. A new engine house was built last summer with two 4½ feet Merritt drums in it.

West from the Dexter a few miles is

THE BOSTON MINE,

80 acres, the S. E. ¼, S. W. ¼, and S. W. ¼, S. E. ¼, sec. 32, T. 48, R. 28, which the company owns in fee simple.

The Boston is a well equipped mine, having a first-class plant of mining machinery, including new Norwalk compressor. There are also about a dozen good dwelling houses on the property belonging to the company. The mine has been very fully described in previous reports, and, as there has no work been done in several years, there is nothing to add.

There is no better ore in the State than that in the Boston mine, high grade, Bessemer, slate ore. The mine is against the west line, where it has been worked for a length of 400 feet to a depth of about 200 feet. The ore deposit is very regular and has a width of 10 feet. The mine has produced a total of 61,715 tons.

THE AMERICAN MINE,

formerly at Sterling, adjoins the Boston on the west. It has also been idle until last summer when a new organization was made, an engine house built, a new plant of machinery procured, the mine pumped out and the work of sinking, drifting and stoping duly entered upon. The ore deposit is as yet not very wide—5 to 6 feet—but the ore is of the best, identical with that of the Boston. They are in the same deposit and the ore does not vary.

The shaft is 250 feet deep, it is supplied with skip, and still sinking.

The new machinery is Camp, Webster & Lane; two drums 4' diameter, and two steel boilers.

W. C. Reed, Superintendent; C. R. Ely, Secretary and Treasurer; W. H. Johnson, President, Ishpeming, Mich.

There were mined and shipped in 1887, 370 tons; making total output to date of 16,012 tons.

The company contemplates adding a compressor and power drills. There are 3,000 tons of ore in stock, which averages 66% in iron and .045% in phosphorus.

They are drifting west to reach the point, 490 feet distant, where the ore was found to be 19 feet wide.

Of the range of mines north of Champion and west of Lake Michigamme there is not much to be said. They have been described so many times in previous reports and there has been so little work done since the first year in which they were opened, that they present no new features.

There are, however, a few new ones that it will be of interest to describe. The first of these is

THE NORTH CHAMPION IRON CO.,

organized Sept. 23, 1887, with a capital stock of $1,000,000, having leased the E. ½, N. E. ¼, Sec. 29, T. 48 N., R. 29 W., being a mile north of Champion station.

They have a vein of 40 feet wide, all merchantable ore, so far as opened. A shaft 7 feet x 7 feet has been sunk 83 feet in about the center of the south 40 and the ore tested to the west line of the property, showing it to be continuous. It has also been explored to the east. An engine house has been located south of the shaft on the hanging wall side, though there is a slight inclination from the vertical noticeable. The machinery consists of a boiler, hoisting engine, and a No. 7 Knowles pump.

An average of a stock pile of 1,500 tons sampled and analyzed by Mr. C. E. Wright gave metallic iron 57.96%, phosphorus .156%, silica 4.65%. Other analyses of this ore of some forty samples from different pits, etc., are as follows:

Metallic iron	59.01 %	Phos.	.215	Silica	3.65
" "	55.79 "	" "	.181	"	5.45
" "	56.92 "	" "	.178	"	6.65

Also the following analysis of a cargo sent to the Cleveland Rolling Mill Co., by Rattle & Nye:

Metallic iron	59.15
Phos.	.19
Silica	4.96
Sulphur	.081
Lime	.82
Manganese	.181
Magnesia	.57
Alumina	2.10
Water and organic matter	7.07

They expect to mine all that can be sold in 1888. Product 1887, 883 tons; royalty, 25c per ton.

Officers—Henry C. Hart, President; Seymour Brownell, Secretary and General Manager.

In the same section is the

GIBSON MINE,

being the N. ½, S. E. ¼, Sec. 29, 48, 29. It is worked in an open pit, and 2,700 tons were shipped in 1887, making an aggregate of 16,357 tons to date.

Mat. Gibson, Superintendent, etc.

THE PHŒNIX IRON MINING CO.

now owns the Daliba, which is also in sec. 29, S. ½, N. W. ¼, and N. ½, S. W. ¼. Work was resumed in this mine in April last under the direction of Mr. Peter White, of Marquette, who holds the property.

The mine was freed of water and a small product of ore shipped—1,605 tons.

The total production of the mine to date is 54,114 tons.

Full descriptions of this mine will be found in previous reports.

THE PASCO IRON CO.,

holding S. ½, N. E. ¼, sec. 29, 48, 29, has not produced any ore the past year. The ore is of poorer quality than that found in some of the other mines of this range, as the North Champion, Wetmore, etc. It ranges at about 55% in iron and as high in phosphorus as any of them. Possibly a more extended development of the mine would result in obtaining better ore.

The mine has produced 58,667 tons.

D. H. Merritt, President.

THE WETMORE MINE,

west of Michigamme, is the same class of ore as those just described, but the ore deposit is free of rock; it is clean ore, and there is plenty of it. The following analysis, made by Mr. C. E. Wright, shows the quality of the ore. Iron 59.49%, phosphorus .139%, silica 5.52. Certainly if this is an average it is good ore, and as it can be mined cheaply there should be a profit in producing it. But money can only be made in mining such cheap ore by disposing of a large quantity of it. The product in 1887 was 3,335 tons.

In my last report will be found an extended description of this property, and, as the work subsequently has been mainly in the way of stripping, I find nothing more of interest to add. Total production to date 29,106 tons.

Ed. Wetmore, General Manager, etc.; Wm. D. Davis, Superintendent.

Joining the Wetmore on the west is

THE WEBSTER MINE,

from which, at the time of my visit at the mine last year, I was told, a large product would be mined. This expectation has not been fulfilled, however, as the only work done was to send away a portion—2,054 tons—of the ore already in stock. Perhaps the misfortune may have been that enough pains had not been taken in mining the ore to keep it clean—free of rock. The ore was mined on contract at 80 cents per ton, and I judged when I examined the pile, that it would require further sorting to make it merchantable.

The mine has a plant of machinery adequate for all mining work and there are a number of dwellings and other buildings on the property.

The total shipments to date amount to 14,668 tons.

Messrs. Watson and Palmer, of Marquette, control the mine.

West of the Webster, between it and the Beaufort, are three mining properties, which have been developed during the past year to a degree that they promise to become largely productive mines. The first is

FOWLE'S OPTION,

the S. ½, S. W. ¼, Sec. 23, T. 48, R. 31, owned by the Michigan Iron and Land Co., and held on a lease by Mr. J. C. Fowle, of Michigamme, at a royalty of 30c on the ore.

Mr. Fowle has explored the land recently very systematically, by sinking two rows of test pits about 65 feet apart and parallel—the north row thought to be near the foot wall and the south one near the hanging. There are 7 pits in each row, which are at an average distance apart of about 80 feet, east and west. All these pits are in ore, clean ore, there is no rock intervening between the surface soil and the ore, and they have all been blasted in. Thus the explorations develop 600 feet in length and 60 feet in width of ore.

I went to all the pits and found no rock in the ore in any of them. Several analyses of samples made up of 80 to 100 separate pieces of ore gave:

Iron	56.82	Phos.	.148
Iron	57.40	Phos.	.26
Iron	60 %	Phos.	.19

A branch railroad is graded to the property and it would be a simple matter to soon be in readiness to mine and ship ore.

Adjoining this on the west is

THE OHIO,

being the S. ½, S. E. ¼, Sec. 22, 48, 31, which also has been as thoroughly explored as is necessary before beginning systematic mining work.

The ground has been tested for a length of 400 feet west from the east line, showing a width of ore of 50 to 80 feet. Two shafts have been started, 300 feet apart, east and west of each other, on the foot wall side of the ore. The west one is 18f in the ledge, all ore. There is a dwelling house, shop, etc., on the land, and the railroad track is ready for the iron.

The ore analyzes at 55 to 60% iron, .14 to .27 phos.

The exploring work has been done under the direction of J. C. Fowle, who acts as the company's agent.

The next property west is

THE NORWOOD,

which is in a more advanced state of development than the two preceding. The Norwood is the S. ½, S. W. ¼, Sec. 22, 48, 31, and has reached the dignity of a productive mine. Late in the season the railroad track was completed to the mine, and a cargo of ore was shipped. The development work has shown up a length of 600 feet of ore, and a width of perhaps 200 feet, at any rate there is a row of test pits, all in ore, across the formation, at one point between shafts. Two shafts have been sunk, the west one about on the line between the two forties. It is 50 feet vertical to the ore, then inclines south, but the ore is both north and south of the shaft. They have gone east and west far enough to open two rooms each way from the shaft. This shaft was idle the last time I saw the mine—Dec. 20—and they were working in the east shaft, which also was 50 feet deep.

These three properties could be made to produce a good deal of ore. If properly managed the ore can be mined cheaply, and if largely worked, that is, if a large product is mined and sold, at even a low price, there can be money made.

But to mine a small product would be a losing business. The margin is too small and the preliminary outlay would be too great.

Mr. J. C. Foule, Michigamme, is the Agent.

Product, 1887, 2,200 tons.

The ore in these three properties is of the same quality.

West from the Norwood is

THE BEAUFORT MINE.

in the W ½, N. W. ¼, sec 22, T 48, R. 31, which I found to be at the time of my last visit—Dec. 20—wholly idle; the mine full of water; no one working.

The families of most of the men still occupy the dwellings, but the men are at work elsewhere, mostly at the Ropes Gold mine, where the superintendent, — Williams, has also gone.

It is expected that the work will be resumed at this mine in the spring. I have described the mine pretty fully in my last report; it is wholly underground, the formation lying pretty flat to the south, having a width of opening of 600 feet and a depth on the lay of about 200 feet. The width of the ore at right angles to the walls is about 20 feet. The ore needs to be watched so as to keep it free of rock. It is good ore when clean, but a lack of care in this respect results unfortunately.

It is not likely that this company has made much money; it has mined too little ore. The ore can be produced cheaply enough, but it sells at a low price, and the margin is small when all expenses are covered. The last season has been a particularly discouraging one by reason of the high lake freights that prevailed. It was expected to send out a greater amount of ore than usual; on the contrary a less product was secured. There was no market at a profit. Hon S. S. Curry has relinquished the management of the mine, and Mr. M. Jenks, of Ishpeming, is acting as Agent.

What I have said of the Beaufort is equally applicable to

THE TITAN MINE,

which adjoins it on the west, and is under the same management. This mine is also idle and full of water. The two mines are nearly identical, quite so as to the ore and the manner of its occurrence. The ore in both mines is firm and hard. They are able to mine it out in large rooms and the pillars and roof stand well.

The Beaufort sent out in 1887, 12,829 tons, and the total to date is 89,566 tons.

The product of the Titan in 1887 was 16,003, and the total to date is 86,668 tons.

M. Jenks, Agent, Ishpeming, Mich.

THE SPURR MINE

continues idle. There is probably enough income derived from rent of houses to pay taxes, etc. The total production has been 164,941 tons. But west from the mine, in the same ore formation, on

SECTION 23,

T. 48, R. 31, the old Stewart mine, Mr. J. C. Fowle has discovered a fine vein of ore,—hard, blue granular ore, three samples of which taken at different times analyzed as follows:

No. 1—Iron	66.30	Phos.	.290
No. 2—Iron	62.73	Made Dec. 3, 1887.	
No. 3—Iron	66.30	Phos.	.269

No. 1 specimen was taken from the deposit as uncovered in the foot wall of the old mine pit.

No. 2 at 75 feet west of old mine, where the vein in the test pit shows 8 feet wide, with 8 feet of earth over the ore and where they have sunk 8 feet into the ore.

No. 3 is from a test pit 50 feet west of No. 2.

Still exploring Dec. 20, 1887.

THE MICHIGAMME MINE

shows no new features; it has produced pretty well the past year—51,975 tons of ore were shipped and the Superintendent estimates the amount in stock at 33,000 tons more. The mine is no deeper than it was a year ago and looks about as well.

The mine now is producing very little ore as good as that which used to be afforded in old No. 4 shaft. It is believed that No. 4 still has ore in the foot or hanging wall of the old deposit, since a diamond drill boring down from the bottom of the mine has shown this.

The mine is operated very economically, the ore having been produced at a total cost of $2.26 per ton for the year. Mr. Fowle, the Superintendent, is a careful manager; he has held this position here for 12 years or upwards and the effects of his care are always apparent. It has always seemed, however, that back of him was a power that needed a little more enterprise. The push, which is not wanting in the local management, should be accorded to the ultimate directing powers of the company. The Michigamme Company is esteemed somewhat slow. The mine is in a formation rich in possibilities but there has not been very much expended to explore it.

When No. 4 pit was approaching exhaustion it would seem as if considerable effort were in order to discover an equally good lense to take its place. Some borings with the diamond drill were formerly made, which led to discoveries of ore that promise well but which no effort has been made to reach further.

The company has preferred to devote its surplus to dividends to opening op the mine.

The work now is mainly in the west end of the mine. The mine has been working west for several years in the direction of the old shafts, Nos. 5 and 6, which were for a long time abandoned but which now are worked again, not from the surface but by drifts extending west from the bottom of No. 4.

This underground work is west beyond No. 6 and far below old No. 6 shaft. It is thought to rise up and connect this shaft with the workings below and thus make use of No. 6 to hoist in again.

Of course this formation is a *very* hard one. It is expensive rock to sink and to drift in, thus making exploring costly work.

While the main stopes are in No. 5, still ore is obtained from all over the mine, between No. 3 and No. 6 shafts.

No. 4, the deepest shaft, has a length of 600 feet, and No. 5 is 450 feet deep, but the description I wrote of the mine one year ago is nearly as applicable now, and as I took a good deal of pains in examining the mine and in describing it at that time, I shall not dwell upon it now further than to say that I did not find anything new to note upon my recent visit. The mine looks neither better nor worse than it did last year.

Hon. Wm. H. Barnum, President; J. C. Fowle, Superintendent, Geo. Orr, M'g Capt.

The annual products have been as follows:

Year.	Tons.	Year.	Tons.
1872	141	1880	52,944
1873	28,966	1881	57,118
1874	45,218	1882	43,712
1875	44,756	1883	42,538
1876	20,074	1884	28,787
1877	28,238	1885	12,372
1878	58,622	1886	48,806
1879	56,935	1887	51,975
Total			567,803

The estate covers 1,400 acres of land.

THE CHAMPION

impresses one as a pretty big mine. I went through it recently—Dec. 16—and I found it to be quite a task, although I confined my observations to only parts of the mine. The openings are a good deal bigger than they used to be, but the stopes are not. A few years ago it was not much trouble to handle the Champion mine; it has always been rich ore; it has brought the highest market price, and there was an abundance of it always in sight. Great stopes of ore, 30, 40, 50, and 60 feet wide, clean, first-class, high grade ore. But the days of its glory have passed. They are contented with much smaller things now, and places in the mine that were neglected before are now looked to for ore and enables the mine to respond to the demands that are made upon it. In fact the min produced the most ore last month—November—that it ever has in any month before, 17,477 tons.

I first descended No. 6 shaft, which is 225 feet to the bottom. There are two skip roads to the third level; east of the shaft in third level they have worked 125 feet. Apparently some more opening work must be done in this shaft. A pocket of ore in the bottom, which was 18 feet wide, seems to be worked out. There is not much ore in sight in the shaft. Ascending to the surface and going down No. 5, we find before leaving this pit that it contains a great deal of ore. As Capt. Cundy says, "No. 5 is a daisy." Stopping at the 8th level, 480 feet below the surface we make a hasty inspection.

They are driving west from the west end of the opening to find the ore which is worked in below, and which there, is 18 feet wide, and which it is believed extends upward to this level. East they have a stope of ore 15 feet wide.

In the 9th level the ore that was 12 feet wide is narrowing to about 9 feet, black and slate ore.

In 10th level, 600 feet down, dip 85°, 315 feet west of shaft, are boring with diamond drill to the south and west to explore the ground under No. 6.

East of shaft the ground is worked out.

In the 11th level the breast of ore is 218 feet west of shaft and is 12 feet wide; it will hold for 100 feet further still, perhaps get smaller. There is a length of ore of 180 feet long and 16 feet wide in this level. They are sinking

a winze for another stope to work west. East is a drift into No. 4, but no ore.

The 12th level is the bottom of the skip road; have on the east side only a sump, but west they are drifting in rock to get to the ore; are in 30 feet and will reach the ore at about 50 feet more. The shaft is sunk to the 13th level but they have not opened out yet. No. 4 shaft is sunk to 20 feet below the 14th level. The shaft is 20 feet below the 15th—960 feet deep. They are opening out in the 15th and have ore near the shaft but not west of it in the south deposit. But in the north deposit, the hanging wall ore, they have a fine stope going west.

Are making a rock drift in the south lense to catch the ore.

In the 18th level in No. 3, they have worked out 260 feet west of shaft. The ore was 30 feet wide and is still so in the bottom of the level, which will be reached by rising stopes in the level below.

To the east in No. 4, 11th level, they have a new run of ore, which was found by extending the drift through rock 50 feet. The ore is 8 or 10 feet wide, and goes east under No. 2 shaft.

In No. 3, 14th level, the foot wall lense of ore is 20 feet wide, both stopes east and west. The north lense is 18 feet wide. The shaft is 20 feet below the 14th level.

In No. 3, 12th level, the ore is 18 to 20 feet wide, both east and west.

But it is useless to describe all the stopes in the mine. There are enough to assure a product the coming year of 125,000 to 150,000 tons of ore.

The mine is getting to be pretty deep, nearly 1,000 feet. The skip roads rest on the foot wall of the south lense and incline downward at an angle of 80° with the horizon. North of the shafts in the hanging wall is another lense of ore that is reached by cross-cuts from the shafts through the rock that separates the two deposits of ore. These deposits, which were formerly in the upper levels, wide and long, are now becoming much restricted in their dimensions, being narrower and shorter than heretofore.

They hoist ore from Nos. 3, 4, 5, 6 and 7 shafts. The three first named are in the main mine and are connected together underground; but 6 and 7 are separated from the rest and from each other.

The mine is so deep and the shafts so straight that it is a difficult task to ascend from the bottom.

To climb 900 feet of nearly vertical ladders is hard work for the men; to escape it they ride in the skips. But experience has shown this to be a dangerous proceeding; for instance, a few days after I was at the mine five men were ascending in a skip, when the skip got off the track and dumped; three of the men were in the skip and others were standing on the bail. The former were destroyed, the two latter succeeding in escaping with their lives. One jumped at a level and the other clung to rope and went up to the surface.

In the same manner three men were killed at the Cleveland mine a few months ago riding up in a skip that got off the track and dumped them down the shaft.

It so happened that I was once descending the ladders in a shaft when a skip passed me going up with a man riding in it. A moment later the man passed again, falling down the shaft. He had attempted to get out at the surface and had missed his footing, and so lost his life.

The Champion Co. has given so much evidence of interest in and care for its employees that I look to see it adopt some plan for sending the men down into the mine and bringing them out again that shall secure both their comfort and safety.

Heretofore in sinking winzes the company has used small hoisting machinery underground. These are to be done away with, an engine house has been made with a plant of machinery in it consisting of eight small drums for underground sinking, etc.

Everything on the surface is in admirable order, denoting the best of management.

The pit east of the East Champion that looked promising a year ago soon worked out; it proved to be shallow.

Products of Champion mine in previous years:

Year.	Tons.	Year.	Tons.
1868	6,225	1878	73,764
1869	21,535	1879	93,203
1870	73,161	1880	112,410
1871	67,588	1881	144,025
1872	68,402	1882	157,516
1873	72,782	1883	104,960
1874	47,097	1884	208,156
1875	56,877	1885	173,914
1876	66,002	1886	137,593
1877	70,883	1887	146,330
Total			1,902,215

The officers are W. E. Stone, Treasurer, Boston, Mass.; A. Kidder, Agent, Marquette, Mich.; W. Fitch, Superintendent, Champion, Mich.; James Cundy, Mining Captain; Wm. Williams, Master Mechanic.

The Champion mine ore is all Bessemer but it is sorted, Mr. Kidder tells me, so that four grades are made of it; the first is about 68% iron, the second 64%, the third 61%, fourth 58%.

THE HUMBOLDT MINE

has developed nothing new that is of value. They are working only one shaft, No. 2, which is down 450 feet.

They have a single stope of ore south of the shaft, which is about 15 feet wide. Slate ore and very good clean ore, mainly first-class. The shaft is in ore now but has been for the last two lifts in rock.

The ore is working north again.

Off to the south, close to the highway and the Republic Branch Railroad, the company is boring with a diamond

drill. They first encountered 70 feet of drift; are now—Dec. 16—in the ledge.

Considerable diamond drill work has been done on this property without much avail. I judge the present location of the drill to be a good one.

Not far away to the southwest, just over the line, the Excelsior Mining Co. is also boring with the drill; is now 40 feet down.

There is now, at the close of the year, but little ore in stock.

The formation presents many features of an encouraging character. The ore is hard specular, of good quality, but non-Bessemer.

J. B. Maas, Agent; Ed. Maas, Superintendent, Humboldt, Mich.; G. A. Garretson, Sec. and Treas., Cleveland, Ohio.

The Humboldt mine, including its predecessor, the old Washington, has produced annually as follows:

Year.	Tons.	Year.	Tons.
1865	4,782	1877	16,546
1866	15,150	1878	23,921
1867	25,440	1879	18,204
1868	37,757	1880	14,727
1869	58,462	1881	26,302
1870	79,712	1882	43,436
1871	48,725	1883	31,866
1872	38,841	1884	23,763
1873	38,014	1885	11,776
1874	27,890	1886	20,207
1875	9,642	1887	17,874
1876	3,333		
Total			644,419

THE ARGYLE MINE

joins the Humboldt; it is an old mine, yielding specular slate and magnetic ore, but has never been a large one. The mine is near the Humboldt railroad station in the northerly hillside, which extends to the west. A pleasant location with many favorable indications for ore. It is adjacent to the old Washington mine, the Excelsior mine, etc., and thus is in a formation that was early explored in and mined in. But none of them were ever profitable; it-is a very hard jasper formation, making it expensive to sink and drift in; and the lenses of ore that have been found and mined have proved to be small; the ore has cost too much. The formation in this hillside is full of ore pockets—small ones—so that when a deposit of ore is found, no matter how favorable it may appear, it must be regarded with suspicion until thorough development has demonstrated its value. The mine as formerly worked, is a succession of small lenses or pockets of ore lapping each other and separated by rock that also has to be cut away, thus making a good deal of dead work.

It is a good property to explore with a diamond drill, but such work should be done thoroughly. There are two shafts, one of which, No. 2, is 500 feet in length, and No. 3, about 600 feet.

The mine has not been worked since 1883. One of the final pieces of work done was to sink a shaft near the ⅛ post, midway in the south line. This shaft is but a few feet north from the one on the old Washington side of the line that was sunk years ago, and in which, it was claimed, was found a vein of slate ore that passed to the Argyle land. Capt. Cundy, who did this work, tells me that he sunk 50 feet and found the ore, and that there is a stope now west of the shaft 10 feet wide.

Much of the old mine has caved in, going down from the surface, and has thus exposed the foot wall in which at one point, has been found some slate ore, that has been exposed by cutting a trench south 75 feet long. This trench is on the ledge and shows most of the way fine slate ore, which has led to the claim of finding a body of ore 75 feet wide. At one other point, to the east, this same ore, or ore that is identical with it, has been tuched in the foot wall, by which also it is claimed that there is length as well as width in this alleged newly found ore body.

Close to the west shaft on the west side of it is a pit designated as the Bray pit, from which 700 tons of ore were mined two years ago, and still remains in a pile on the surface. The bottom of this pit still exposes the same deposit of ore. Also at a little distance west they have sunk a small pit in the foot wall, and the same kind of ore is found as in the Bray pit, and the conclusion is drawn that the ore extends all the way; in fact, that here also is a large body of ore. I should have stated that these "finds" have been recently made by Mr. D. M. Wadsworth and two other Ishpeming gentlemen, who have the property on an option, and who, it is reported, have just sold the mine for $250,000, by which transaction they realize $10,000 apiece. Certainly if the mine proves to be as good as it is claimed to be by a correspondent of the New York *Engineering and Mining Journal*, who places it ahead of any mine in the country, "excepting, perhaps, only the Republic," it is cheap enough at that price.

The owners are Detroit men. Hon. Don M. Dickinson, President; Sigmund Rothchild, Vice President. Since 1866 the mine has produced 256,744 tons of ore.

THE REPUBLIC IRON CO.

has met with misfortune in the past year through the death of its able president and general manager, Mr. David Morgan. A year ago I accompanied him through the mine, the first time he had been underground for several years, and it proved to be his last before going to his final resting place.

I find nothing new to record in the Republic mine, but will briefly refer to the several pits in succession, commencing at the west end.

The Morgan pit has not been sunk any in the last year. The shaft had been lowered 120 feet, and two levels have been opened out. It is looking as well as it did a year ago at least.

In the two levels immediately above the bottom, there is in each, in the hanging wall, a fine stope of ore 15 feet wide, 30 feet long, slate ore.

The Pascoe pit looked poor when I went through it a year ago, but now the reverse is the case. It will afford 25% more ore than it did last year.

There is one new stope, 18 feet wide, going off into the hanging wall, and there is also a 5 feet stope of black ore in the bottom.

The Morgan is the pump shaft—takes the water from the Ely and Pascoe pits.

Another lift has been added, 12" plunger 5' stroke.

The Ely has been sunk 60 feet, in jasper, but in the hanging wall is a fine vein of ore; altogether the pit about holds its own.

Gibson is no longer worked, but they are boring in the bottom to explore the ground between it and No. 1.

The latter shaft is about 1,060 feet down on the inclination of 50½° with the horizon. The lowest level worked in it is the 1,000, the shaft is down 60 feet more. The main run of ore is 175 feet long, 7 or 8 feet wide; besides this is a loop of ore 15 feet wide that gives considerable addition to the product.

The encasing rock is soapstone, which underlies the quartzite and overlies the jasper.

No. 1 runs into No. 5, where they are mining out the ore pillars and filling in with rock; are now at this work in the 8th level; were working higher up last year.

No. 6 shaft comes down in rock and required besides a long horizontal drift to the ore, to avoid which they have sunk a shenel shaft; that is they make a horizontal run from the foot of the main shaft to the ore and them put down a skip road inclining 60°, following the pitch of the ore. The slate ore keeps along with the black and both pitch off to the northwest. They are separated by about 20 feet of soap rock.

The slate ore is 25 feet wide, with a working length of 100 feet. No. 6 will afford as much slate ore as last year but the black ore will be mainly in No. 7.

Both have been lowered another level and are now at about the same depth as No. 1. Capt. Pascoe has a finished chamber in No. 6. The roof is admirably arched; it distributes the pressure finely.

In No. 7 also is a shenel shaft, or there soon will be one. The shaft is too far from, the ore and the introduction of an underground skip road has been decided upon. The same will be done in No. 8 also. Otherwise they must continue sinking in rock and drive 200 feet to the ore. In No. 6 it is run up on the skip track, trammed to the shaft and sent to the surface.

The product from No. 7 is largely black ore. The main lense is 300 feet and forty feet wide; but it holds some rock, that is there are bunches of jasper, horses of it, the ore itself is free of it.

No. 8 is a lense of slate ore by itself, 200 feet long and 8 to 9 feet wide. The ore is 225 feet northwest of the shaft, necessitating that length of drift. They will not sink the shaft further but resort to the underground skip road.

No. 9 will be taken by No. 8 soon.

Product of the several pits for the year 1887:

Morgan	32,197
Pascoe	11,686
Ely	16,248
Gibson	268
Nos. 1, 5, 6	99,255
No. 7	50,513
No. 8	18,950
No. 9	4,105
West Republic Scram	153
Total	233,375

Chas. Hickox, President, Cleveland, Ohio; W. D. Rees, Secretary and Treasurer, Cleveland, Ohio; Geo. Wilson, Agent, Republic, Mich.; Peter Pascoe, Superintendent, Republic, Mich.

The product for each year has been as follows:

Year.	Tons.	Year.	Tons.
1872	11,625	1880	235,385
1873	105,435	1881	233,651
1874	122,639	1882	235,108
1875	114,726	1883	152,565
1876	120,045	1884	277,739
1877	165,836	1885	249,070
1878	176,221	1886	241,161
1879	135,131	1887	233,375
Total			2,784,202

Since the above was written the company has ordered of the Hand Drill Co. of New York, an air compressor 20"x48", also two Haxton steam boilers, 6'x18'.

THE REPUBLIC REDUCTION CO.

is still experimenting; that is, it has not begun the work of separating the ore from the rock on a commercial scale yet. The work so far is esteemed favorable.

Peter Gottstein, General Agent, etc.

THE WEST REPUBLIC MINING CO.

has closed down the mine. The only work in progress when I was there—Dec. 5—was boring in the bottom of the mine. I was told that the stopes were all exhausted. This I can well believe, since it was plain to see that unless something new was found the end must soon come. In previous reports I have described the mine, and also such other facts, relating to explorations, etc., as are of any value. I need not repeat here.

The West Republic was opened in 1881, and since then has produced in all 122,125 tons. The product of 1887 was 12,777 tons.

A. C. Saunders, Sec., Cleveland, Ohio; J. O. St. Clair, Supt.

NEW EXPLORATIONS,

west of Republic and south of there, I have noted as follows: The St. Clair Bros, have a recent find of fine slate ore in the N. W. ¼, sec. 35, 47, 30, three miles from Republic, opposite the Standard mine. Enough has not been done—Dec. 10—to make much estimate of its value. They have sunk 25 feet and are 5 feet in ore.

In section 28, E. ½, S. E. ¼, T. 46, R. 33, Mr. J. C. Fowle and others have a find of hard hematite of which several analyses have been made which give an average of 60.41% in iron, .080% phosphorus. Royalty 40 cents per ton.

Michael Gleason and others at Republic have explored in the N. ½, S. E. ¼, sec. 19, 47, 30. Have two shafts, 146 feet deep. 50 feet of soil. In this they have a width of ore of 11 feet.

Three hundred feet from this is another shaft 125 feet deep, in which they have 8 feet of magnetic ore. Analysis gave iron 65.16%, phosphorus .035%. Royalty 30 to 50 cents. I have seen six analyses of this ore which gave in iron from 66 to 68%, and in phosphorus .024 to .069%.

One by Mr. C. E, Wright, gave iron 67.72, phosphorus .057.

Also in section 4, T. 44, R. 33, Capt Peter Pascoe is conducting an exploration which results favorably. Have ore 30 feet wide, 180 feet long, hard hematite. Analyzes above 60% in iron, but non-Bessemer. They are preparing to sink it.

THE PITTSBURGH AND LAKE SUPERIOR IRON CO.,

has succeeded excellently well in the new mining work which it has had in progress for the past three years, and which I have described in the Commissioner's Reports for 1885 and 1886 with sufficient fullness. The vertical shaft, which was sinking a year ago is now in full working order and obviates the long underground tramming that was previously necessary.

I drove out to the mine a few days ago but unfortunately found it shut down for repairs to the compressor, and also the superintendent was away east, so I did not go through the mine, as has been my annual custom heretofore.

I found the company exploring near the highway east from the location. A shaft was sunk 60 feet, and they were drifting north, had hematite ore.

Jos. Kirkpatrick, Agent, Palmer, Mich.

Year.	Tons.	Year.	Tons.
1871	4,171	1880	38,595
1872	34,495	1881	34,273
1873	41,204	1882	40,590
1874	16,106	1883	19,414
1875	4,070	1884	11,747
1876	15,324	1885	5,679
1877	20,211	1886	24,034
1878	4,704	1887	47,454
1879	24,141		
Total			396,215

THE WHEAT MINE

is looking well. The company's new "find" just north of the railroad, north of the deep open cut hematite pit, has turned out well. It proves to be a clean deposit of excellent ore.

There are two shafts about 60 feet apart, 70 feet deep. They are 40 feet in ore, which has a width of 25 feet and so far seems 100 feet long.

The dip is to the north 50° and also has a seeming pitch east of 35°. The ore analyzes 63% .040% Phos.

The officers are Daniel McGarry, President; Thomas Prout, Superintendent, Palmer, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1879	850	1884	6,824
1880	3,324	1885	9,200
1881	9,040	1886	15,851
1882	9,554	1887	17,537
1883	6,625		
Total			82,026

THE SWANZY MINE

was operated for a time the past season; 2,842 tons of ore were shipped, making an aggregate production to date, which includes also the Cheshire, of 154,942 tons.

The Swanzy is in the S. W. ¼, N. E. ¼, Sec. 18, T. 45, R. 25. J. J. Pierce, Sharpesville, Pa., President; J. E. Wood, Superintendent, etc., Appleton, Wis. J

THE HOME MINE

is an old property in Sec. 28, 47, 26, adjoining the Wheat mine. A small amount of exploring was done in 1886 resulting in a "find" of ore that enabled the parties who held the option and did the work to sell out. Nothing has since been done.

Adjoining it on the east is

THE ROYAL MINING CO.,

formerly the Gribben, being the S. ½, S. E. ¼, Sec. 28, 47, 26. G. E. Tarbell, President, Milwaukee; D. H. Merritt, Secretary and Treasurer, Marquette; J. F. Foley, Superintendent, etc.

The company has a shaft sunk to a depth of 60 feet, at the east end of an old open pit from which ore was mined years ago. They were driving a crosscut to cut some ore that was found by the diamond drill boring made last spring; at the time of my visit to the mine the drift was in lean ore.

Adjoining this on the east is

THE RICHARDS LAND AND IRON CO.

Hugh Richards, Pres't, Milwaukee, Wis. The property is the N. W. ¼, N. E. ¼, Sec. 33, 47, 26.

The company has built an engine house, and put into it a fine duplex compressor, which has not yet been put to any trial.

There is a large open pit, which contains banded, flag ore; that is, the formation is made up of alternating bands of ore and jasper. The ore is good, and if care is taken to leave out the rock a merchantable product may be had, even if there is no profit in obtaining it.

Capt. Foley says he mined and shipped 400 tons from the Richards that was good ore. Subsequently a contract was let to mine by the ton, and the contractors sent nearly as much rock as ore. Naturally it failed to give satisfaction. The amount shipped in 1887 was 1,374 tons.

THE JOYCE EXPLORATION,

so called, lies north of the Royal, in the valley. Both the Richards and Royal are in the steep jasper bluff, which extends east and west and forms the most notable feature in the Cascade range.

THE MENOMINEE RANGE MINES.

Commencing at the east end of the range with the mines of the Penn Iron Co., I will describe them in succession to the west.

The mines of the Penn Co. are among the best in all respects. They yield a large product of ore of a quality that is in universal demand. They are excellently well equipped and well managed. It is plain to see that the affairs of the Penn Co. are at all points in proper hands.

THE EAST VULCAN

has been an expensive mine ever since it come into the possession of its present owners. Had it not yielded the best of ore, or had it been under poor management, it might have been permanently closed long ago; fortunately it is in good hands, and skill and care have compensated somewhat for the excessive requirements of the mine.

The company has just now undertaken a course of expenditure that requires a long purse and good courage to carry through.

It will be remembered, perhaps, by those who are acquainted with the mine, or have read the descriptions given of it in previous reports, that No. 1, the chief producer of the mine, is a long chimney of ore that descended nearly vertically for 200 feet, when it declined to the west, so that at a vertical depth of 500 feet, the present length of the shaft, the ore is 425 feet away. At this point the floor of ore is in dimensions 110 feet by 90', and a diamond drill has been bored down into it depth of 114 feet. As this ore body is dropping away to the west at an angle of 27° with the horizon, it will thus be at the 700 foot level up wards of 800 feet away from the shaft, making it necessary to drift through the rock all that distance to reach the ore after the shaft was sunk.

This matter has been held under consideration during the past year, while no work has been done in the bottom of the mine. It was finally decided to sink a new shaft, which is already under way, 63 feet down from the surface—Jan. 18. The location of it is midway between the present No. 1 and No. 3 shafts, 800 feet from each. The shaft has three compartments, is 16' 1"x6" inside, 20'x9' outside measurement. The two end compartments are for the cages, the middle one, 6'x6', for pump, etc.

At the present depth of the shaft it will be intersected by a tunnel driven! in from the south. The adit will be 261 feet long, and from the mouth a trestle has been built 489 feet long that is 40 feet above the railroad. The ore will all come out through the adit. Capt. Curnow has known skill in the work of sinking; his method is excellent, and his form of shaft, the arrangement of the timbers, etc., leave little, if anything, to be desired. It is sure to be an expensive operation, but the company, that must pay the bills, is fortunate in having Capt. Curnow to superintend the work.

They are driving from the mine to the shafts at the 227 feet, and the 500 feet levels. The first is within 125, and the latter to within 75 feet of the shaft. The two drifts, each 800 feet long, make 1,600 feet of length. These drifts are partly to explore the ground; they are not in the same vertical plane, the upper one being 126 feet south of the lower one, each in separate ore formations, with intervening soap rock.

Assuming the ore to continue in the same westerly pitch, the new shaft will intersect it at a depth of 775 feet; but they will drift east to it at 725 feet, at which depth there will be a back of ore of about 300 feet.

They are sinking with a simple Rochester hoist, but when completed the shaft will require a new plant of machinery. Capt. Curnow thinks he will have the shaft down in a year; if he does it will be extraordinary good work. I do not doubt but he will make every effort to accomplish it. It will be readily seen that this shaft, the long drifts and the necessary machinery, etc., will cost at least $75,000 in cash, and more than a year's work,—all preliminary to reach a body of ore that by a freak of nature has dipped away from the shaft they already have.

While No. 1 was not sunk any deeper last year, it afforded a good deal of ore from the flat deposit that was found under the sandstone west of the shaft and which continued down to the bottom overlying the main deposit. The mine, however, above the present bottom, has been pretty well exhausted, and not much more can be expected of it until the new shaft is completed.

No. 3 mine, however, away up on the hill 800 feet to the west, is doing finely. It is just a year since I visited the East Vulcan; they were then about in readiness to begin pumping out the water from No. 3. The mine had been idle since 1884, but it was known to have a floor of ore west of the shaft. And it was to mine this that the work was undertaken. The shaft was lowered 116 feet to the 300 foot level, and a drift made west, also a rise and a return drift to the shaft, but no ore was found. Fortunately, however, Capt. Curnow had drifted east (he has a habit of poking about with his drifts) 41 feet, and came into ore, which proved to be a body 90'x95', in lateral dimensions, clean ore; not a bit of rock in it. They stoped up in this ore 80 feet, when it lengthened northwest, as shown by a drift, to 125'.

The ore body diminished in size after the first few sets up; but the bottom is all ore and the indications are that it may continue to increase in size, downward. It is very fine blue ore, rich in iron but non-Bessemer. The shaft has been sunk 80 feet, or to the 400 feet level.

As in the new shaft at No. 1, they are driving an adit from the south at No. 3, which will intersect the shaft at 117' from the surface, and will be 425' long. The product will go out of this tunnel on to the trestle already built, 350 feet long and 45' above the railroad track. It is estimated that this arrangement will result in a saving of 14 cents per ton, which is the cost of running the ore down the incline 2,400 feet to the point where it is now discharged. The estimated product of No. 3 for 1888 is 33,000 tons.

No. 2, which is east from No. 1, has been sunk 100 feet, to the 351 feet level. The cage goes down as fast as the shaft is sunk. The buckets used in sinking are raised and lowered by being attached to the bottom of the cage. The cage goes up above the landing, carrying up the attached bucket filled with rock; a car is run in under, over the mouth of the shaft; the bucket is detached from the cage and rests on the car, whence it is trammed out to the dump and is so placed as to discharge its contents automatically.

There is nothing very promising about No. 2 mine. The known ore body is of contracted dimensions, but they will have now 100 feet of depth of it.

The produce of East Vulcan in 1887 was 50,954 tons.

Capt. John Curnow, Superintendent; J. E. Hagey, General Manager P. I. Co.

THE CENTRAL VULCAN

is a new mine, which has been opened and worked the past year, producing 12,772 tons of 62 per cent Bessemer ore. It is in the side hill, east from the West Vulcan, at the site of the Co's. old saw mill, the old mill house being used for the machinery. The shaft—-vertical cage—is 160 feet deep. There are two levels: 1st one 87 feet from surface and the ore was 20 feet wide and 120 feet long; but in the 2d its width has diminished one-half. So that it is estimated that from present appearances there may not be above 14,000 tons of ore in sight.

They are filling up all the rooms from which the ore has been taken by running down sand, etc., from the surface over the ore. All the openings will be filled and all the ore mined out.

Exploring drifts in the mine may lead to finding other pockets of ore. In fact a long drift in the bottom going east gives evidence that such a result may be looked for.

The work is directed by Capt. Roberts of the West Vulcan.

There is a long stretch of ground from the Central to the East Vulcan that seems favorable for the occurrence of ore; but as it is deeply covered with soil, exploration is slow and expensive.

THE WEST VULCAN MINE

holds its own admirably. It is 100 feet deeper than it was a year ago, and the magnitude and quality of the ore remain undiminished in value.

It is also one of the best equipped mines, in the matter of machinery, in the state. A new engine house has just been built on the level ground west of the new shaft, and in it is placed two sets of hoisting machinery, each consisting of two drums 12 feet in diameter. One set made by Webster, Camp & Lane, Akron, Ohio, the other by M. C. Bullock & Co., Chicago. The former, one engine 28"x48", and the latter, two engines, each 28"x60". Nothing can be finer, of the kind, than the foundations; 250 cords of sandstone masonry on which these ponderous drums and engines rest, besides 50 cords of the same are laid in the walls surrounding the foundations. With this new hoisting plant are two of Dean's steam condensing pumps. The latter are said to cause a saving of 25% in heat by reason of sending the steam into the cylinders in a condensed form.

The new machinery is all in place but is not yet connected to work.

Among other important improvements are eight new dwelling houses each 30x38, 2 stories; each house is designed for two families. They are well built, with cellar under all.

The West Vulcan has been gradually approaching the point when there would be a radical change in the method of mining, that is, hereafter the plan of filling the mine with rock as fast as the ore is removed will be alone followed.

It is already filled from the bottom level up, practically; there are a few pillars left, and when these are mined out the whole mine will be filled, and hereafter the system of

expensive timbering and ore pillars will be a thing of the past.

The downright shaft is in the hanging wall at the west end of the mine and is sunk to the 9th level, 670 feet down from the surface. No. 2 shaft is on the foot wall near the east end of the mine. The 8th level is fully opened but the 9th is only partially so; the cross-cut has been made to the ore from the downright and continued into the foot wall, where a drift has been cut east to No. 2 and on both ends of the ore. At each 100 feet of distance along this foot wall rock drift, cross-cuts have been made to the ore and "rises" made through the ore to the level above. These "rises"—winzes—are for running rock through for filling.

They will work each way in the ore from these cross drifts, taking it all out in a succession of horizontal sections, 7 feet high, and filling the space with rock as fast as the ore is removed. Capt. Roberts' plan is to work from the drift along the foot wall, taking about half the width of the ore, then in returning, stope the remainder and fill the whole space as fast as advance is made. When this section is exhausted they will rise up on top of the filling and mine out another section in the same manner and fill as before; thus in succession continuing to rise until the level is reached. As they rise they will "carry up" the necessary winzes through which to run down the ore into the shutes in the main drift. Very little timber will be used. Mr. Hagey tells me that upwards of 2,000,000 feet of pine were used in the mine last year, besides 60,000 pieces of lagging, in all representing an expense of 37 cents per ton of ore mined.

The ore in the 8th level is 600 feet long and has an average width of 25 feet. In the 9th it seems likely to be larger, since at the east end it proves to be 35 feet wide, a considerable increase.

The downright shaft is giving some trouble; it is 10' x 16' inside and divided into 4 compartments. On the whole this plan of section proves to be a weak one, the pressure of the ground on the north side displaces the timbers and it is thought that if the other means fail to arrest the effects of this pressure they will make a "false rise," 15 feet north of the shaft, through the ground where the pressure is greatest.

The new machinery will operate the two cages and the timber way in this shaft and the skip in No. 2 shaft. The latter shaft has been heretofore in the foot wall and required a cross-cut to the ore; but the greater inclination of the shaft brings it constantly nearer the ore and now, in the 9th, it is just to the limit. I should have mentioned with the machinery a new duplex compressor—capacity 23 drills. These become necessary by reason of the long drifts in the foot wall now and to be hereafter made in each level.

The product of the West Vulcan, 1887, was 141,400 tons, an increase of 35,211 tons over the previous year. The ore is first class, Bessemer.

The Penn Co. made a fortunate investment recently in the purchase of the lease of the Curry mine, which joins the West Vulcan on the west. The former company had, previously to relinquishing the property, sunk a shaft 47 feet deep at the foot of the hill below the old mine, and had drifted south 30 feet. The Penn Co. pumped out this shaft and continued the drift 8 feet further and found a body of ore 14 feet wide; this they have proved extends east 125 feet, possibly much further.

At any rate at this distance away they are now sinking a shaft 5½'x5½' inside. The shaft has reached a depth of 60 feet, and is in ore on the hanging wall side. The purpose is to sink 100 feet and then mine out the ore and fill up with rock. This ore is the same as the West Vulcan south vein, and is in line with it. The old Curry is on the West Vulcan north vein.

The work is in charge of Capt. E. S. Roberts, Superintendent of the West Vulcan mine.

There are employed at West Vulcan 400 men.

The Vulcan mines were opened in 1877, and have yielded as follows:

Year.	Tons.	Year.	Tons.
1877	4,543	1883	79,874
1878	31,239	1884	101,722
1879	57,350	1885	124,130
1880	72,405	1886	143,930
1881	85,671	1887	205,127
1882	94,042		
Total			909,993

J. E. Hagey, General Manager, Penn Iron Mining Co.

Since writing the above I learn that Supt. Roberts has resigned, and the duties which he has so long and ably performed will hereafter devolve upon Capt. Wm. Bond, formerly of the Nanaimo, and Capt. John Oliver, of the Norway. The latter will have the general oversight of the work.

THE NORWAY MINE,

also, is undergoing a noticeable change especially in the east end, which is a broad underground mine, and is filling from the bottom up with sand and rock. From No. 5 east at the Perkins line, a distance of 700 feet and a width of 30 feet, the mine is all underground, 400 feet down to the 5th level, and will be all filled. They are filling it now with all due rapidity. There are immense rooms in the mine; few formations admit of such large openings being made as exist in the Norway mine, and there are, of course, many pillars of ore, which can be attacked as soon as the rooms are filled. Through the filling have been left secure drifts leading to the pillars and stopes of ore.

This part of the mine is reached by two shafts, mainly, the downright or new shaft, sunk in the hanging, south of the mine, is 480 feet deep—100 feet below the 5th level. They are making a drift in the foot wall to extend east 500 feet from the shaft to the east line. All parts of the

mine, at this end, can be reached from this drift. The mine is irregular by reason of the underlying limestone, which rolls and is a good deal contorted. The cross-cut from the downright, north cuts through a point of limestone at 45 feet from the shaft, while the main foot wall, limestone, is reached at 205 feet north.

From No. 5 west to No. 9 750 feet, the mine is a deep, wide open chasm that in the west end has yet a fine stope of ore, 45 feet high, 27 feet wide, and in No. 9 are the great exposed ore pillars, which sustain the overlying sandstone. West from this point the mine is again underground, and is worked for 500 feet to No. 10, and shows a good deal of ore.

They estimate the product for No. 8 and No. 9 at 30,000 tons for 1888. It will easily reach that amount. The mine has continuous workings for a length, east and west, of 2,200 feet. It is a very peculiar mine, but I have described the formation, etc., in previous reports, and I do not think it necessary to enter into the matter now. It is one of the pleasantest mines to work in, in the whole country, easy of access, dry, airy and safe. The Norway is a favorite with all miners who have been employed in it. J. E. Hagey, General Manager, Penn Iron Co.; John Oliver, Superintendent; James Haskins, Assistant Superintendent.

The product of the Norway for each year is as follows:

Year.	Tons.	Year.	Tons.
1878	7,533	1883	114,836
1879	73,540	1884	71,515
1880	198,765	1885	57,741
1881	137,558	1886	93,878
1882	165,084	1887	95,558
Total			1,015,178

THE CYCLOPS MINE,

joining the Norway on the west, shows no new features. It produced more ore last year than was estimated, and perhaps the output in 1888 will equal that of 1887. There are a number of places from which ore is obtained and they are safe for a product of 10,000 tons and upwards. It is also one of the Penn Iron Co.'s mines and is superintended by Capt. Oliver.

J. E. Hagey, General Manager, Penn Iron Co.

The output in 1887 was 14,308 tons, and the aggregate to date, 1878-1887, is 245,784 tons.

THE QUINNESEC MINE

has been abandoned by the Penn Co. It obtained from the mine in 1887, 6,580 tons of ore, which makes all that they find to be profitable to take out.

Mr. Ed. Wetmore, who is one of the fee owners, is just now looking after the property, thinks there is still a good field for exploring in the Quinnesec mine

The mine was opened in 1878 and has produced all told 281,299 tons.

The Penn Iron M'g Co. produced in 1887, from all its mines, 321,574¼ tons.

On Section 25, N. E. ¼, S. E. ¼, T. 45, R. 34, the company is still working but with no very encouraging prospects. All the work since that described in my last report has been with diamond drill.

THE PERKINS,

for an abandoned mine, produces a good deal of ore—16,834 tons in 1887.

The mine is close to the Norway and was opened and worked from 1874 down to 1885, by the Saginaw M'g Co., when, having caved in badly, the mine was abandoned by the company, and was then taken hold of by Capt. John Perkins, the Superintendent, as a personal venture, with the result that he has since mined and sold 29,690 tons of ore.

This ore is derived mainly from the pillars that were left, that Capt. Perkins was enabled to reach by reason of the fact that the mine had all caved in and it was thus safe to mine the ore pillars. The ore has not been very expensive; there is no pumping to be done. The Norway, which is deeper, drains it.

But I described it all in my last report and I find nothing to add. There have been no new discoveries. Altogether the mine has yielded 359,620 tons of ore.

THE STEPHENSON MINE,

which I examined and described a year ago, has not been very actively pushed since.

The mine is in the foot wall of the Perkins and no ore body of much magnitude has ever been developed. At my recent visit to the locality I found the mine idle; during the year, however, the company sent out 3,589 tons of ore, making a total that the mine has produced of 39,602 tons.

The estate is N. W. ¼, S. W. ¼, Sec. 4, T. 39, R. 29.

H. G. Fisk, General Manager, Iron Mountain, Mich.

THE SMITH-BUTLER EXPLORATION,

so called, is one of the most promising of the new undertakings in the Menominee range.

A syndicate, comprising J. D. Butler, Angus Smith, J. N. Porter, Wm. H. Osborn, O. C. Davidson, H. J. Colwell, Byron White, secured the lease of Sec. 8, except N. ½, N. W. ¼, and of the N. W. ¼, Sec. 9, in all 720 acres. This land embraces the Norway town site and the Briar Hill mine, etc. It is south of the Norway and Perkins mines, and in line with the South Vulcan, Central Vulcan, and the Curry new "fine"–a mile east and west.

The syndicate began exploring with diamond drill several months ago, and met with excellent results. The first boring was made at 50 feet west from the line between Sections 8 and 9, in the N. E. ¼, N. E. ¼ of 8, and at

midway of the 40, north and south. Ore was found at the depth of 271 feet. The drill continued in ore 24 feet, when it broke. A second boring was made 30 feet north, and 30 feet east of former, in which ore was found at the depth of 209 feet, and continued in it for 146 feet.

Analysis of ore at 249 feet, gave iron 59.10, phos. .019%.

At 270 feet depth, iron	68.85%	phos	.012
" 315 " " "	66.97	"	.027
" 345 " " 142' in ore, iron	65.52	"	.033

They are sinking a shaft in the N. E. ¼, N. E. ¼, of Sec. 8, close to the west line on the foot wall side of the ore. The depth to the ledge is but 50 feet, but it is in wet ground, and thus, seemingly, endless difficulty is experienced in getting through this quicksand, etc. The shaft is, at this date, January 10, within a few feet of the ledge, but it has been at this point for some time.

Going west from Norway, there is nothing of importance in the way of mining, or of ore discovery until Iron Mountain is reached, where are found several mines, including the great bonanza,

THE CHAPIN MINE,

which is perhaps the best iron mien in the State; at any rate, it led all others in production last year, and it is pretty safe to conclude that it will do the same in the coming year. The Chapin mine has been, for a few years past, in a state of transition. That is, making a radical change of its entire system of mining. This work involved the sinking of new shafts, all in rock, that should be of adequate capacity for the entire operating of the mine; new plants of hoisting machinery, new ore pockets, new ore docks; the moving or destruction of all the buildings that were located over the mine; the grading of new side tracks, and the filling of the mine. At the same time, while this work was in progress, the product must be kept up.

Naturally, considerable trouble has been experienced to bring matters to the present systematic working.

The problem was an important one and one not easy to solve; it involved the expenditure of a vast deal of money and the exercise of great mining skill. However the end has been accomplished, the mine is harmoniously working in all its parts, on the new system. It is all simple enough too, now that it is in operation. The mine is in excellent shape. I have never been so well pleased with the Chapin as now. I have always detested that old system of timbered rooms and ore pillars, especially as applied in this mine. But that is done away with. The mine is filled now from bottom to top, with the exception of the necessary drifts, with sand and rock, and in the work of stoping, as fast as the ore is removed, rock is made to take its place.

There is no longer any danger of the stupendous "caves," the occurrence of which rendered necessary the filling of the mine and the abandonment of the old system. It is safe and economical.

A great part of the product, the past year, has been taken from the pillars, and the output for several years to come will be derived, in great measure, from the same source. Two years ago, when they began at these pillars, it was somewhat discouraging work and it seemed then that a good deal of the ore contained in them would be lost, but a modification of the method then pursued has secured better results. There is no ore lost now. They are sure of saving all the ore in the pillars except, possibly, where they were crushed and the ore mingled with surface dirt in the portions where the mine caved in. The removal of the pillars of ore was the most puzzling part of the problem. It is accomplished in this way: Where the shafts are in the hanging wall side of the ore, cross-cuts are made north to the opposite wall from the shafts and then main drifts cut along the foot wall parallel to the ore; from this foot wall drift cross-cuts are made through the pillar south to the hanging wall. A track is laid in this cross drift and a rise made through the ore to the level above.

Stoping is begun at the south end of the pillar, the whole width, 18 or 20 feet wide, is cut out to a height of 7 or 8 feet, and as rapidly as advance is made the space behind is filled with rock. The ore is run out in a tram car to the main drift and thence to the shaft. As one horizontal section is cut out another drift is made through the ore, on top of the filling, to the hanging wall and a second section of ore taken out and the space filled with rock. And so on in succession the pillar is mined away by cutting out one horizontal section after another from the south to the north. As they rise up a "mill" is brought up through the filling that discharges the ore into cars in the main drift. The lower end of the mill is, of course, cut through the rock that separates the ore from the drift. The "mills" in this mine are circular in form of horizontal section, 2½' diameter, and are made of blocks sawed to a pattern at the Co's. mill, so all difficulty in their construction is obviated. The rock for filling comes down through the winze in the ore and is drawn out by means of a shute into a car, as fast as it is required.

For greater convenience in reaching the pillars at the east end of the mine a temporary shaft has been, made on the foot wall side. It will be seen that, now, as all the rooms are filled, and, as there are 600,000 to 800,000 tons of ore in the pillars, which are thus, virtually, in solid ground, there is-scarcely no limit to the stoping that may be done. The mine is a large one, and the pillars may be attacked in all the levels.

The two vertical shafts, B and C, have been sunk 100 feet to the 7th level in the past year; but no stoping has been done below the 6th, which was well opened a year ago and still contains a good deal of ore.

The shafts are still in the limestone; B at the edge of it, while C is 40 feet south of the under edge of the limestone. This is due to the fact that the ore at B dips at an angle of 65', while at C the dip is 80°.

It has long been a question as to the proper position of this limestone belt with reference to the ore. Here it overlies the ore with great seeming regularity, while in

the mines to the east, Quinnesec, Norway, etc., it is the foot wall rock. Is it thus the underlying or the overlying rock? In the Chapin mine is seen in the cross-cut from the shaft, north from B shaft, in the 3d level, a conglomerate underlying the limestone; the rock of which the conglomerate bed is made up is slate and limestone. The limestone boulders are the same rock that composes the overlying belt, thus indicating that the latter is the older formation, and properly belongs as a foot wall rock. But I will not attempt to discuss this geological problem at this time. Its conclusive settlement will be a matter of practical value. For instance, the Emmett Mining Co., in sinking its shaft at the corner of the Chapin, expecting to intercept the Chapin deposit of ore in its underlay to the north, has gone on the supposition that the limestone here occupies its true position with reference to the ore; certainly if it is to turn and become the foot wall rock, the Emmett Co. has made a great mistake.

All the mine above the 5th level was opened on the old system, but in the 6th the plan of filling has been proceeded with from the first. In the west part of the mine, in the wider portion of the deposit, the method of proceeding is essentially the same as that pursued in mining the pillars. They cross the ore to the south with a broad drift—double track—and cut a tunnel in this foot wall rock parallel to the ore; at each 50 feet an ore-shute is made which ultimately receives the ore through the winze that is carried up as the stoping proceeds upward. The ground is thus marked off into blocks 50 feet wide.

A drift is made through each of these blocks of ore to the hanging wall and a rise is made through the ore to the level above. The rise is for the rock filling, dumped in from above. The stoping is begun at the farther side against the hanging wall, the full width of a block—50 feet—and carried south to the main tunnel. The ore is trammed to the cross-cuts where, being attached to a cable, they are drawn to the shaft. As fast as the ore is broken the space is filled up with rock, up to the back of ore. Just space enough is kept open between the wall of rock in the rear and the ore in front to suffice for the workmen. Slight modifications are seen in the different stopes due to change in the hanging wall or in the stability of the ore.

I was informed that the total mining cost by this method, which includes the cost of filling, supplies, etc., was 60 cents per ton of ore. The filling costs 15 cents per ton of ore. On the average they obtain five tons of ore to the man. It is proposed to cheapen the cost somewhat. They will do the filling by separate contracts, by other parties than do the stoping.

Sufficient filling material comes from the rock cuts in the mine, shaft sinking, winzes, and the long drifts in the foot wall. By weight one ton of the ore equals two and one-half tons of the rock. The ore shutes for milling down the ore are carried up as the successive horizontal sections are cut off. They connect with the main drift, as previously mentioned, and are so constructed as to hold a supply of ore that is drawn out into the tram cars. It also is made to contain a ladder way by which to reach the stope above.

In the east end of the mine there are portions of the ore lenses that are sufficiently narrow to admit of the stoping being done longitudinally with the ore body instead of transverse, as just described. The method is essentially the same, however. They simply carry the stopes east and west with the ore, and fill up behind them with rock. There are some modifications according to circumstances; as a stope, corresponding to a drift, may be cut through transversely from the main foot wall drift, and then filled with rock and another one cut out, and so on. These drift stopes are 8'x9' in section, and any number of them may be proceeding at the same time. To facilitate the work in this longitudinal stoping a drift is made in the ore along the foot wall in each successive rise. The mills for sinking down the ore and for receiving the rock are kept in this ore drift.

When in full working it is expected that the tramming will be expeditious and systematic. The cars will be of capacity of two tons each and will go to and from the shafts by being attached to endless rope, one running in the 5th and one in the 6th level. The power is furnished by two horizontal compressed air Corliss engines, 12"x36", placed at C shaft in the 6th level. The empty cars go out on one track and the filled ones go in on another.

The particulars regarding the shafts and the machinery I have given in previous reports.

The sinking of the 3d shaft, D, has not proceeded further than to commence to sink the stand pipes for the freezing process that has been determined on. The location is in low, wet ground, where it is 98 feet to the ledge on the foot wall side, and 1,100 feet west of C, and 600 feet east of the west line.

They have at this date, February 1, 13 pipes down to the ledge. The pipes are 10" diameter and there will be 26 in all. The estimated time to complete this is till April 1. At present four shafts are used in hoisting, the one in addition to the three already mentioned being A, the pump shaft, which is 750 feet east of B. In addition is a timber shaft between B and C, vertical from surface to 6th level, in foot wall.

The officers of the Chapin M'g Co. are John H. Van Dyke, Vice Pres., office Milwaukee, Wis.; C. H. Cady, Supt., Iron Mountain, Mich.; Wm. Oliver, Mining Capt.; Per Larsson, Mining Eng., etc.

The annual product of the Chapin has been as follows:

Year.	Tons.	Year.	Tons.
1880	34,556	1884	290,865
1881	134,717	1885	177,978
1882	247,505	1886	198,871
1883	265,830	1887	334,026
Total			1,684,348

Among the late improvements are a new machine shop 60'x100', forge shop 60'x80' and carpenter shop

40'x100', all in one structure 280' long; also a new laboratory.

So far as the 7th level has been explored the indications point to an increased size of the deposit. At B shaft the ore is 70 feet wide in 7th level, and also from the 5th to the 7th the levels have not shortened materially at east end, while they steadily lengthen at the west end.

The company is also building a new office 50'x40', nearly done.

THE MILLIE MINING CO.

is a new organization but an old mine, i. e., it is a new company that has taken hold of the Hewitt, which mine had been abandoned by its former proprietors.

So far the new company has been fortunate; it began work in June last, and sunk a pit 200 feet west of the old workings and immediately found a lense of fine ore. The shaft is 70 feet deep, and the ore body is 130 feet long with a maximum width of 16 feet. The royalty is 50 cents per ton and includes use of old machinery, etc. They claim that the ore is costing $1.50 and is worth at the mine $4.25. It is beautiful fix ore 67% iron, phos. .030%. Have 3,000 tons in stock, and Mr. Jones estimates product at 10,000 tons for 1888.

The officers are D. G. Dessau, President, N. Y.; Vice President, C. W. Kennedy; Secretary and Treasurer, F. Dessau, W. Y.; Superintendent, J. T. Jones, Iron Mountain.

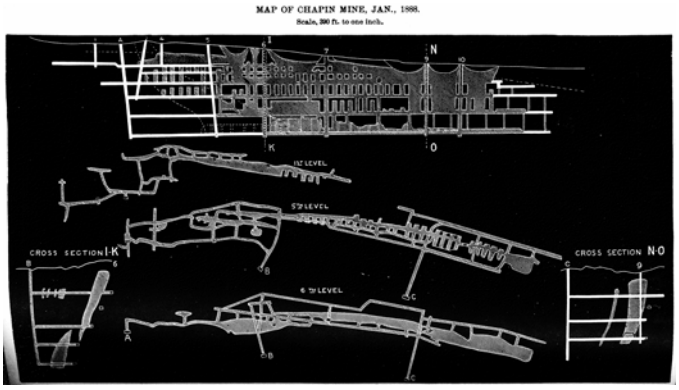
The location of the mine is south of the Chapin, in the Chapin mine foot wall. There were shipped in 1887, 1,163 tons, making a total of 40,769 tons.

THE WALPOLE MINE

also joins the Chapin, being immediately east of it. A shaft has been sunk 270 feet deep, and 1,740 tons of ore got out. The property was formerly explored by the Menominee Mining Co.

The present company is working thirty-five men, Dec. 3, under the direction of Capt. John Barker, I did not learn as they deemed the prospect of the mine very bright. The ore, so far as found, has proved narrow and irregular, about 6 feet wide in a winze in the bottom. It is good ore, but they do not find enough of it. The description of the property is E. ½, N. E. ¼, Sec. 31, and the S. E. ¼, S. E. ¼ of Sec. 30, and the S. W. ¼, S. W. ¼ Sec. 29, all in T. 40, N. R. 30 W.

The lands are held by Pickands, Mather & Co., Cleveland, O.; C. H. Cady, Agent, Iron Mountain, Mich.



THE PEWABIC MINING CO.,

is at work near the Chapin. The work so far is embraced in sinking a shaft which is at a depth of 350 feet, with some drifting. At the present time, May, they are cross-cutting at the bottom in a northeasterly direction and are in 100 feet, in mixed ore. The ore is similar to the Chapin ore. Also a cross-cut southwest 75 feet, is in red slate. The company's estate consists of N. ½, S. 32, 40, 30, and joins the Walpole on the east. Some diamond drill boring was done on the property 6 years ago by the Menominee M'g. Co. The present work has been pursued during the past year. The Co. comprise the same gentlemen who control the Chapin. N. P. Hulst, Manager.

THE LUDINGTON MINE,

which is a continuation of the Chapin, west, though it does not seem to be a very large mine after going through the Chapin, still furnishes a good deal of ore.

The Ludington is much better opened than it was a year ago, and if it were not for the limestone and silica appearing in the ore at the east end, I should say that the outlook for the coming year is exceeding good.

There are 3 shafts, No. 1, nearest the Chapin line, goes down through the part of the mine that has caved in. A shaft is in the hanging wall and is a vertical, double cage shaft. No. 5 is at the west end, and is sunk to the 8th level. An addition is the old mine 1,000 feet, west of the west end of No. 5. The mine in the bottom, in the 7th level, at the east end where the ore is the widest, presents one unfavorable feature in the fact of the occurrence of silicious limestone in the ore. The bottom is 5 to 7 sets wide for a length of 200 feet; but on rising up 2 sets high they encounter in the back of ore, in the 3d rise up, this mixture of the rock with the ore.

They have nearly all the back from the 7th up to the 6th level standing and fully opened for stoping. In addition, A shaft is sunk 60 feet below the 8th level—810 feet deep. The cross-cut in the 8th level has been driven 118 feet to the ore.

The west end of the mine does not show any improvement, it is broken up badly and presents considerable irregularity in the 7th level.

They do a good deal of dead work in the Ludington mine. Besides the cross-cut to the ore at A shaft is a rock drift west towards No. 5, 280 feet long, but in the 7th level this rock drift is much less—ore has taken its place.

They are driving in the 6th level west to the old mine, all the way in rock 1,000 feet. The drift is now 300 feet in. As this work costs $10 per foot, the whole represents considerable money. They proceed quite rapidly, 55 feet in December.

In the 7th level is another long rock drift going from No. 1 S. E. in direction of ore found with a drill by the Chapin Co. This drift is now 216 feet long. It is easier ground to drive in and costs but $5.00 per foot.

If I were further to describe the the mine I should repeat figures and statements which I have already made in my last report.

The old mine produced about 8,000 tons all Bessemer ore; the main shaft in the old mine is 200 feet deep. Two grades are made of the ore, Bessemer and non-Bessemer. The former is designated as Ludington and all comes from the old mine and No. 5 shaft; it amounted to 40,068 tons and 1,185 lbs. in 1887. The Star ore, non-Bessemer, was 61,584 tons, 40 lbs. Lean ore 2,636 tons, 1,700 lbs.; total product 104,289 tons, 655 lbs.

The Ludington ore goes 67.7% iron, .021% phos.

The Star ore goes 64 to 65% iron, .095% phos.

The company sold to the Union Steel Co., Chicago, guaranteeing the ore at the above figures, and came out all right.

The Ludington mine has annually produced as follows:

Year.	Tons.	Year.	Tons.
1880	8,576	1884	101,165
1881	3,365	1885	124,194
1882	52,519	1886	76,983
1883	102,632	1887	104,289
Total			574,023

The mine is in the northeast corner of the S. ½, S. E. ¼, S. 25, T. 40, R. 31.

A. D. Moore, General Manager, Iron Mountain, Mich.

THE CORNELL MINE

is now idle. The company is only exploring, driving a cross-cut and boring with a diamond drill. There is not much to say about the mine beyond what has been stated in previous reports. The product for 1887 was 2,068 tons, making the mine's entire production 49,306 tons.

Joseph Fleisham, President, Menominee, Mich.; Capt. Carbis, Superintendent, Iron Mountain, Mich.

THE CANADIAN MINING CO.,

holding a lease of the N. E. ¼, N. E. ¼ and W. ½, N. E. ¼, Sec. 26, T. 40, R. 31, near Iron Mountain, has been exploring during the summer. A reorganization of the company has just been made, January 15, whereby P. J. LaChapelle is made President, D. F. Wadsworth, Secretary, W. J. Officer, Superintendent, all of Ishpeming, Mich.

THE HAMILTON ORE CO.

is still sinking its deep shaft in the corner of its property close to the Chapin and Ludington lines.

I descended to the bottom a few days ago, 920 feet down. A chamber has been made for a pump room on the east side of the shaft; it is 15'x46' in size of floor. The ore extended about 25 feet on the north side and 40 feet on the south side of the room, the east end being in rock in which the men were then working. They mined out of this place 2,000 tons of ore and expected it would prove to be all ore. Originally the shaft was laid out to be parallel and at right angles to the strike of the ore, but it proved to be "angling." They seem to have cut the hanging wall rock going east. The pump will soon be lowered into the place here made ready for it; it is a double acting Worthington, warranted to raise 1,000,000 gallons per 24 hours, 1,000 feet. The shaft will be sunk another level—100 feet—as soon as the pump is in. The dip of the ore is about 80°, and as the shaft is close to the boundary lines and the ore also only appears in this corner, it is plain that the body of it cannot increase in dimensions very rapidly. Further than this there is an apprehension that the formation may turn and dip to the south ere long. When the shaft was begun Mr. Jones expected that the formation would flatten out to the north and that at a much less depth than the shaft has already reached they would be in a large body of ore; naturally there is disappointment.

The company shipped 583 tons of ore the past season.

President, Norman Hall; T. L. Kimberly, Vice President; Secretary and Treasurer, R. Williamson, Sharon, Pa.; John T. Jones, General Manager.

Going west from Iron Mountain on the C. & N. W. railroad, we reach the Commonwealth and the Florence mines, which though not in the State of Michigan, it has been my custom to annually visit and to describe.

THE COMMONWEALTH MINING CO.

has put in a new plant of hoisting machinery, consisting of three drums, ten feet diameter, made at the Marinette Iron Works, with engine 24"x30", and three new Armstrong steel boilers, 62"x16". There is nothing especial to note, that is new, about the mine. They expect with the aid of the new machinery to considerably increase the product in future. The mine is exceedingly irregular. The ore is now making north. Last year the extension was wholly to the south; the increase in the length of the ore north is 50 feet at the 4th level—that

much further north than it was in the 3d. South of the pit there are ore bodies which have been found with the diamond drill, one 75 feet south has a lateral dimension of 191 feet.

The three shafts, B, C and D, are sunk to the depth of 326 feet, 4th level. The west shaft is C, through which a good portion of the product is hoisted. they are opening in the southwest and the west part of the mine. The dimensions of the mine are north and south 250 feet, with an irregular width of working of 200 feet. B is the east shaft, C the west one, and D the north, all to the 4th level and B and D on their way to the 5th.

The mine produced 57,000 tons of ore last year. It averages 60% in iron and is non-Bessemer; the quality of the ore is said to be improving slightly.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1881	97,410	1885	42,947
1882	115,865	1886	51,189
1883	21,943	1887	57,000
1884	34,622		
Total			420,976

W. E. Dickinson, Superintendent, Commonwealth, Wisconsin.

THE FLORENCE MINE

only needs that its ore should be Bessemer to make it one of the most valuable mines in the Upper Peninsula.

I went through the mine a few days ago and I have seldom seen larger stopes of clear hematite ore. The mine is like the Norway in respect to the stability of the ore and of the rock formation with which it is associated.

In the old mine are some very large chambers that have shown no change since they were formed, and there are some large spaces opened in No. 4. The company unwatered the old mine the past year and mined some ore in it, but it proves to be of inferior grade. There is not market for it.

No. 4, the new mine, 1,200 feet west, is clean ore, and there is a good deal of it; 6% ore, average.

It is 110 feet to 1st level, 160 feet to 2d, and they are sinking to 3d, down 80 feet. It is vertical, double cage shaft.

In the past 3 ear No. 5 shaft has been sunk. It is west and north of No. 4, and the ground between and beyond them is all opened in ore, 450 feet in length, but the limit is not reached; it is still ore beyond. In the 2d level the ore, where it is crossed, is 120 feet wide. They are carrying stopes 42 feet wide and 50 feet high.

The stopes are so large and the roof stands so well that the ore can be broken and put into the cars very cheaply. The Co. employs now, January 15, 100 men, and is mining about 250 tons per day. They have mined and hoisted 510 tons in 10 hours. The mine has four 6½ feet drums, and new Norwalk compressor.

The mine is favorably located, being in the city of Florence, a pleasant, prosperous town.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1880	14,143	1886	840
1881	100,501	1887	79,399
1883	160,155		
Total			395,270

Henry Tod, President, Youngstown, O.

J. N. Porter, General Manager, Stambaugh, Mich.

O. C. Davidson, Superintendent, Florence, Wis.

Edward Ball, Mining Captain.

THE IRON RIVER CO.

has a fine new plant of machinery at the Isabella mine; it consists of three 5 feet Lane drums, engine, Rand compressor, eight power drills, two steel boilers, 5 feet x 16 feet, all in a good, commodious building. The Isabella has turned out remarkably well, having produced 39,493 tons the past year, and is opened to give still more the coming season. It is an open pit 150 feet deep, 77'x65' on the bottom, all ore, besides a drift in south 15 feet is ore. At the north side is a stope of ore 26 feet high, 18 feet long, where a second stope is reached that is 38 feet wide, and extends north 85 feet, coming then to a third one that is 21 feet x 18' and goes north 62 feet. The ore is clean, goes 60% without any sorting. It requires no watching for rock. With the new hoisting machinery the mine is in good shape.

The north mine is also looking excellently well. There has been so little change in the past year that it is scarcely worth mentioning. If the Iron River mine were pushed it could produce a great deal of ore—200,000 tons; but the company seems to produce all it can sell by working the mine only part of the year. No. 1, the main shaft, is down to the 300 feet level, where the cross-cut to the ore, 80 feet, has been made. In the 200 feet level, south of shaft, have back stoped and filled a length of 150 feet, 50' high and 60 feet wide. There is yet 130 feet in height of ore to the surface sand in this direction. In No. 3 there is a length of stoping ground of 500 feet, with an apparent width of 30' to 40 feet.

There are some new features in No. 2, southeast, the ore has gone 300 feet from the shaft in the 200 feet level. In point of fact the run of ore is all the way from the engine house to the north line, a distance of 1,600 feet. The ore varies in quality, however. In No. 3, north, the ore is lower in iron and higher in phosphorus.

The company has a laboratory and employs a chemist at the mine and the ore is constantly sampled and analyzed.

The annual product of the Iron River mine has been as follows:

Year.	Tons.	Year.	Tons.
1882	29,115	1885	55,693
1883	100,369	1886	78,591
1884	52,584	1887	82,464
Total			398,816

Robt. McCurdy, Treasurer, Youngstown, Ohio.

James N. Porter, Superintendent, Stambaugh, Mich.

THE SELDEN MINE

produced 1,302 tons of ore last year, making a total in the two seasons of 092 tons. The pit from which it was obtained is close to the railroad track on the south bank of the river, about a quarter of a mile north of the Isabella pit of the Iron River Co. The company having failed to pay its royalty, its franchises have been cancelled and property is again in the hands of Mr. Selden. As the company had also failed to pay its laborers, the men had seized what little machinery there was by attachment.

THE NANAIMO MINING CO.

I found to be operating its mine, in the N. W. ¼, S. W. ¼, Sec. 25, 43, 35. There are two pits, situated north and south of each other. The one that has been recently worked is the north one near the river, from the bottom of which they are cutting a drift south to the one on the hill. As the south pit is in much higher ground, the drift will come quite a depth under it. The mine has not been deepened any in the past year. The ore has all been obtained above the old bottom in the north pit, and the shaft is 180 feet deep on an angle of 63°. The south drift will be 720 feet; it is now 440 feet long. The ore was mainly in three irregular pockets respectively, in size, 25' x 40', 15' x 40', and 12' x 40'. They have filled the rooms and mined out the pillars and also filled up the spaces thus made.

They are going to sink 150 feet and rise up and fill, but have first to prepare for taking care of the excess of water. They get 600 or 700 gallons per minute more than their pumps, three No. 9 and one No. 7 Knowles, can well take care of; will add a No. 11 Cameron.

In sinking 150 feet they will make two levels, each 75 feet; work 50 men. I do not regard the present outlook of the mine as very favorable. There is not much ore in sight and they are having a good deal of water, more than the machinery can care for. There is a good deal to be done to get the mine to producing ore—first they must find the ore and open it up.

The officers are: J. C. Wedge, President; John Spence, Secretary and Treasurer, Pond du Lac, Wis.; Wm. Bond, Mining Captain, Iron River, Mich.

The product of the mine for each year has been as follows:

Year.	Tons.	Year.	Tons.
1882	2,250	1886	5,400
1883	29,221	1887	30,450
1884	38,766		
Total			105,171

Analysis of the ore in the bottom level gave iron 61.22, silica 3.72, phos. .363, sulphur .004.

THE BETA MINE

is a small pit east of the Nanaimo, being N. E. ¼, S. W. ¼, S. 26, T. 43, R. 25. The ore was mined by John McDonald, Iron River. D. C. McKinnon, Secretary and Treasurer, Iron River, Mich.

Product 1886, 1,585; 1887, 1,226; total, 2,811 tons.

THE SHERIDAN EXPLORATION,

adjoining the Beta, is progressing. Mr. Sheridan has a few men at work and has some ore exposed, not enough as yet for a mine of much value.

THE YOUNGSTOWN MINE

has been worked the past year, though it is idle now and the mine full of water.

The work is all at the east end, at the Nelson shaft, where is an abundance of ore. It is too low percentage in iron and too high percentage in Phos. to be very salable. About 55% to 57% in iron and as many hundredths in Phos.

The company shipped 34,041 tons of ore and has 10,000 tons in stock at the mine now.

The shaft, No. 4, is 160 feet deep; it is protected by large ore pillars 40 feet square. The width of the ore is upwards of 200 feet and to what length it may extend is not known, as but little opening has been done. Ventilation is secured by having the opening connect with a small shaft, No. 5, further west.

A new plant of hoisting machinery has been procured, comprising two 5 feet drums; also compressor and power drills. The mine is in shape to produce ore, there is every necessary appliance of the most approved kind.

The owners are the Briar Hill Coal and Iron Co., Youngstown, Ohio.

The officers are: J. N. Porter, General Manager, Stambaugh, Mich.; E. J. Gilbert, Superintendent, Crystal Falls, Mich.; Thomas Ball, Mining Captain, Crystal Falls, Mich.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1882	6,198	1886	25,638
1883	15,292	1887	34,418
1884	8,343		
Total			89,887

THE PAINT RIVER MINE

is not being very strongly worked. It lies east of the Youngstown, and just over the river north of the village of Crystal Falls. The mine holds considerable ore, but like that in the Youngstown it is very high in phosphorus. All the mining work for the past two years has been near the west line of the property, where they have penetrated to a depth of 160 feet. Captain Roberts, who is working the mine by contract, met with the misfortune last summer of having a main shaft, A, cave in. It was sunk through the open pit to a depth of 90 feet. B. shaft is close to the west line. The ore is 70 feet wide, goes 55 to 58% in iron and .50 and .60 in phosphorus. The stoping is mainly in the 90 feet level, going east from B 250 feet. The plan is to let the ground cave in by removing the ore. The shaft is down to 160 feet, but not much done below 90. They aim to mine 25,000 tons of ore in 1888.

Officers are Madison La Monte, President, Chicago; Wm. Eisenbath, Secretary and Treasurer, Chicago; M. R. Hunt, General Manager, De Pere, Wis.; C. T. Roberts, Superintendent.

The annual production has been as follows:

Year.	Tons.	Year.	Tons.
1882	4,615	1885	2,374
1883	5,971	1886	13,933
1884	11,546	1887	10,240
Total			58,679

THE MONITOR IRON M'G CO.

holds lot 6 in S. E. ¼, Sec. 20, W. ½, T. 43, R. 32.

The company has a body of ore in which a shaft has been sunk 70 feet deep at 25 feet west of the boundary line, 400 tons were mined last summer that are still at the mine. The shaft is 25 feet in ore, having passed through 40 feet sand and rock, and they have a drift south 50 feet, all in ore, and one west 25 feet. It is also all ore through east to Paint River deposit.

It is apparent that quite a large output could be made if the ore can be sold. It is the continuation of the Paint River deposit.

Officers are W. S. Coffman, President and Treasurer; F. H. Rood, Secretary, Home Insurance Buildings, Chicago, Ill.; C. T. Roberts, Superintendent.

THE FAIRBANKS MINE

was taken on an option the past summer, by Mr. Carl Sheldon and several Milwaukee men, who were to pay $24,000 for the lease of the mine. They attempted to pump out the shaft adjacent to the Great Western, with the view of sinking it deeper. They did very little, however, and threw up the option.

THE GREAT WESTERN MINE,

The property of the Iron Star Co., I find to be looking about as usual. The mine is systematically worked and yields good ore; but it is not a mine that can be worked economically. There is too much rock drifting for the amount or ore obtained. The mine is in seven separate pockets or lenses of ore, lying east and west of one another, and they have to be connected by drifts through the intervening rock.

The three shafts are sunk to the 4th level, and on their way down to the 5th. Thy are also sinking a fourth shaft at 370 east of No. 3. This shaft is down 34', and as it is still 16 feet further to the ledge through quicksand, they are having some trouble to get to the rock. It is 50 feet northeast of the engine house.

The length of the mine—the aggregate of the pockets and their connecting drifts east and west—is 720 feet. No. 1 is 134 feet from the west end of the mine, 221 feet to the 4th level, 271 feet to the 5th. No. 2 is 112 feet east of No. 1. Some of the pockets have fine ore bottoms, but not all; in some the ore has cut out. No. 7, the east pocket, is under the engine house; it is a large, flat deposit. At 210 feet east of No. 3, and 100 feet northwest of the engine house, a vertical hole was bored 328 feet deep, in which ore was found at a depth of 237 feet, and the drill continued the rest of the way in ore. They are opening a drift to it in the 4th level, and a branch drift will also be made to the No. 7 room; I went through the mine; Capt. Hooper keeps it in good shape. He is evidently a thorough minder, but there are some serious things to contend with. One is that the mine is so wet. I spoke of this a year ago, and I find it just as bad now. I found some men trying to "make a rise," where a lamp could not be made to burn. They might as well be out in a heavy rain. There are some good stopes, one in the west end that is 70 feet x 12'; also, between No. 1 and No. 2 shafts in the 4th level there is considerable ore, 80' long and of equal width, a fine body of it; another run of ore 115 feet long, and 10 or 15 feet wide. Altogether, I should say, the mine looks neither better nor worse than it did a year ago. I doubt if any profit accrues to the company in working it, and shall not be surprise if the mine is soon closed down.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882	587	1884	20,7[illegible]
1883	22,825	1886	25,7[illegible]
		1887	23,3[illegible]
Total			93,0[illegible]

The location is about a mile in direct line from the village of Crystal in section 21, T. 43, R. 32.

V. K. Moore, Sec., Detroit, Mich.; Wm. Hopper, Supt., Crystal Falls, Mich.

THE JUNIATA

is a name recently given to the Kimball mine, which is situated in the outskirts of the village of Crystal Falls.

They mine is in the S. E. ¼, S. E. ¼, Sec. 28, 43, 32, and near the south line. The work underground may be described in brief: No. 1 shaft 110 feet deep, No 2, 86 feet; the former the east shaft. They are 245 feet apart and are connected by a drift at the 86 feet level. At No. 1 is a cross-cut north 40 feet, and between the shafts is another cross-cut 84 feet. There are a few other short cross-cuts to explore ground. All the openings are in a good ore formation. Ore—lean ore and mixed ore. There is considerable good ore but it is not yet found of sufficient width. The outlook is favorable for further exploratory work.

The best ore analyzes at 60% in iron, .070% phos.

A few men are working—sinking No. 1 shaft—under James Record. The lease is owned by Dr. H. C. Kimball, who, unable to provide the necessary capital, is anxious to sell the mine or to associate others with himself in working it.

THE SHELDON AND SHAFER MINE,

the N. W. ¼, S. 3, and S. W. ¼, S. 30, T. 43, R. 32, is at present idle. There has been very little done in the past year, the efforts of the owners having been to sell or lease the property.

R. Sheldon and J. F. Shafer, proprietors.

The product of 1887 was 2,377 tons of ore, making a total to date of 43,714 tons.

Still further south in Section 1, T. 43, R. 33, is the Dunn mine, now the property of

THE YORK IRON CO.,

which has been opened in the past year and has developed in a manner to verify the most favorable expectations of its owners.

The deposit extends north and south and is worked in open cut. The ore lies in two lenses, overlapping to the north and separated by rock; the south lense gives a horizontal length of 120 feet, and the north one double that distance. The walls on the east and west go down vertically. The bottom of the mine is clean ore and at one place it has a width of 110 feet. The showing is remarkably good. The "stripping" is pretty heavy; they estimate the amount removed at 14,000 yards. The company shipped in 1887 25,470 tons, and estimate a product of 75,000 tons for 1888.

It is good hematite ore, averages 60% or upwards in iron, and about 25% in Phos. The C. & N. W. Co. has built a branch to the mine and the Co. has conveniences, suitable for the present, to handle the ore. Machinery comprises two 5 feet drums.

F. Schlefinger, President and Treasurer, Milwaukee; H. Schlefinger, Secretary, Crystal Falls; E. Florada, Superintendent; F. C. Bennett, Mining Captain.

THE MASTODON MINE

has a good deal of ore in sight, and Capt. Roberts has things in better shape to get the ore out than he had a year ago. The new shaft north of the open pit is down 200 feet and connected with the open pit mine. So that there will soon be more than one avenue through which to send out ore. Last summer a large ore pillar in the south side of the open pit gave way, precipitating the sand, of which there was a great quantity lying above it, into the bottom of the pit, thus burying the ore beneath a debris that took some time and expense to remove, and delayed the hoisting of ore, as there was but one skip road and that one where the ruin occurred. The pit is about 150 feet deep and at No. 1 skip road the ore is upwards of 200 feet wide. It has been opened a length of 300 feet. It is a lense of ore pitching north 45°.

A boring was made at the downright shaft 300 feet in ore; it makes it pretty certain that the large body of ore, apparent to the eye, will continue in depth. The ore is very hard and firm and stands well in the mine, as is indicated, by the immense arch which roofs a portion of the open pit.

The new shaft is 220 feet north of No. 1 skip road, it is 8'x12' in the clear, and worked with a cage.

A new engine house has been built and a new plant of machinery procured, made at the Marinette Iron works. There are two 5 feet drums. The company has also built several new dwelling, which includes a commodious one for the Superintendent, C. T. Roberts. Capt. Roberts works the mine on contract; that is, he mines the ore for 90 cents per ton. The ore averages above 60% in iron and sells well. No fatal accidents occurred the past year; but a look upward at the great roof which spans the pit in the west side of No. 1 must beget with the workmen somewhat of the feeling of uneasiness which is said to prevail among the Assemblymen in the New York Legislature just now regarding the security of the stone ceiling of their chamber. However it is safe enough—the mine is, not the Assembly chamber—until the breakup in the spring, then they “better look a leedle oud.”

Joseph Austrian, Secretary and Treasurer, Chicago.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882	3,477	1885	11,773
1883	18,577	1886	41,640
1884	18,020	1887	49,115
Total			142,566

The estate is the S. ½, N. E. ¼, S. 13, T. 42, R. 33 W.

THE MANHATTEN MINE

is close to the Mastodon. It was simply a shaft sunk several years ago to the depth of 90 feet, from the bottom of which a small amount of drifting was done, but no ore was found and the attempt was given up. A short time ago Mr. Ed. Blake, having associated with him a few other men at Negaunee, undertook to explore the property. Mr. Blake pumped out the water and sunk the shaft three or four feet deeper, when the workmen found a great cavity, vug, in ore. They have gone down 30 feet now, January 10, and are all the way in clean ore, ore crystallized into form of kidney and grape ore, etc. In quality it corresponds with the Mastadon and is, probably, another lense underlying to the north. At the time I saw it they were only sinking. The description is the N. E. ¼, S. W. ¼, Sec. 24, T. 42 N., R. 33 W.

THE DELPHIC MINE

is in the N. E. ¼, S. W. ¼, Sec. 24, 42, 33. It has been held under a lease from the Delphic Iron Co. by the Messrs. Whittlesey, of Florence Wis., but I understand that they have relinquished the lease or that it has expired. At any rate there is nothing doing at the mine. It has been idle for more than a year. The ore shipped was from stock pile on hand, 1,801 tons, making a total to date of 33,246 tons.

THE CALADONIA,

which gave some promise of becoming a mine, has developed nothing of value. The location is in Sections 17 and 20, T. 43, R. 31. Some exploring work was done during the past year under Capt. C. T. Roberts, by Moor, Benjamin & Co.

THE CRYSTAL FALLS EAST RANGE EXPLORATIONS

are very promising. Recent developments have given a good deal of interest to the work in this quarter, especially in township 43, 32. It is in a locality of fine hard wood timber and level land where are few, if any, outcrops, so that there is not much to guide one in exploring.

Last year I described the Blaney, which is now called

THE WAUNETA,

in the N. ½, S. E. ¼, Sec. 27, 43, 32. Some additional work has been done, and about 1,500 tons of ore taken out. Those interested call it a fair property.

There is one shaft 110 feet deep, with a cross-cut 18' in ore, and a drift with the formation 90 feet long that is in ore.

Mr. H. B. Swain, a reliable explorer and mining man, has charge of the work. He also superintends the work at

THE LEE PECK MINE,

which is in the S. W. ¼, N. E. ¼ of Sec. 26, 43, 32. The mine is in the center of the 40, about 80 rods west of a belt of diorite, that runs north and south, and marks the line of the ore belt through this range. Mr. Swain commenced at the diorite, and made a line of test pits west until he came to the ore.

At the time I went down in the shaft, January 15, it was 78 feet deep. At 56 feet down a drift east, cut 13 feet of ore; one west also found 20 feet of it; but the ore gives way to lean ore again. The formation is mixed ore and rock, and it does not seem that they have yet cut a large body of merchantable ore. What gives interest to the mines in this range is the quality of the ore, which is very nearly Bessemer. None of it is better than is found at the Lee Peck. There is no machinery on the location. Other work has been done, but the above has the main showing of ore.

Mr. S. D. Hollister, of Crystal Falls, has secured options of the W. ½ and the S. E. ¼, S. W. ¼, Sec. 13, S. E. ¼, N. E. ¼ and S. ½, S. E. ¼, Sec. 14, 43, 32. He has explored for a distance north and south of 2,400 feet along the center of the W. ½ of the W. ½, Sec. 13. This line is about 170 paces east of the west line of the section and extends 200 feet north of the east and west ¼ line. In the north pit is hard ore, which analyzes 65% in iron, .013% in phos. South of the ¼ line 70 paces is a pit 40 feet deep which is 12 feet in depth in ore; another pit southeast of this is 28 feet in ore, and 50 feet in depth; 100 paces south of ¼ line are three pits, all in ore, and in the south pit of all, 80 rods from the ¼ line, I found them raising ore.

Among the analyses of the ore from these pits are the following:

1. Iron, 64.10%; phos., .033; silica, 3.58; man., 2.18; sul., .055.

2. Iron, 63.65; phos., .039.

3. Iron, 59.45; phos., .658; sil., 1.10.

By C. E. Wright, January, 1888.

THE ANGUS SMITH MINE

is as yet the largest find of ore that has been shown up in this east range. It is in the E. ½, S. E. ¼, Sec. 23, 43, 32, where they have the advantage of being obliged to

penetrate but little surface sand—8' or 10 feet only to the ledge. A shaft 60 feet deep is all the way in ore from the sand down, and a cross-cut east and west, 80 feet, is all ore; also a test pit, sunk from the surface 24 feet beyond the end of the cross-cut, came into ore, thus proving a width of ore of 104 feet. It is a very nice, clean brown ore. I have seen several analyses of it that gave above 60% iron and within the Bessemer limit in phosphorus.

The company has no machinery, and at the time I was at the location a pit had been commenced in low ground to the south. The pit was down 16 feet, still in soil.

There are other explorations in progress in this locality, among them on the S. E. ¼, N. E. ¼, Sec. 23, Thomas Mc Cusker has just begun, but his pit showed some ore.

Also in the N. W. ¼, S. E. ¼, Sec. 23, 43, 32, Paul Du Charme has sunk 42 feet, and was in mixed ore and rock. The exploration is undertaken by Tobin, Parks and Gonyou.

THE JAMES AND RAHRER EXPLORATION

is about ½ a mile east of the Kimball, on the west side of the Paint River, in Lot 6, S. E. ¼, S. W. ¼, Sec. 28, 43, 32.

They have developed a body of mixed ore 50 feet wide and 100 feet long.

THE METROPOLITAN

is the only mine in the Felch Mountain district from which any ore was shipped in 1887. The product was 9,069 tons. It is the property of the Metropolitan Iron and Land Co. Office 151 New Insurance Building, Milwaukee, Wis. H. S. Haselton, Secretary.

I have heretofore described this and the other mines in the vicinity and the descriptions are published in former reports, particularly in that for the year 1882. There has been little change since the season of 1883.

THE GROVELAND IRON MINING CO.

is a new organization formed to operate a mine in the S. ½, S. W. ¼, Sec. 32, and the N. E. ¼ and S. E. ¼, N. W. ¼ and N. E. ¼, S. W. ¼, Sec. 31, T. 42, R. 29. The lands belong to the Lake Superior Ship Canal and Iron Co., and are held under a lease by the mining corporation. They are described by the company as the East Groveland, Groveland and West Groveland mines.

I have not visited the mine as there is no railroad, as yet, within several miles of it, but I am assured by disinterested men, competent to judge, that it promises to be a good mine. Some of the ore is the fine blue ore, which gave to the Felch Mountain district its early prominence, and which analyzes above 60% in iron and within the Bessemer limits in Phos.

Considerable work has been done; several shafts sunk, one to a length of 75 feet, at which depth it is stated the ore has a proved width of 60 feet. The company has mined 3,000 tons of ore, and altogether the outlook for the mine is a favorable one.

The Superintendent is Capt. Rich'd Lowry.

THE GOGEBIC IRON RANGE.

The great excitement which has prevailed in the Gogebic district since it was opened and became accessible, has utterly died away; the wonderful boom has collapsed, and the succeeding quietness is in remarkable contrast to the activity which till but recently existed.

As a result of this extraordinary boom, while a few men have made money, a far greater number has suffered disappointment and loss, and the final collapse has brought financial ruin to thousands of people. The anticipated fortunes which so many investors eagerly expected to realize, eluded their grasp, and, like the baseless fabric of a vision, vanished into air.

The Gogebic mining craze has had no parallel in the previous history of the Lake Superior region. Something like it may have occurred in an early day, on the opening of mining operations on Keweenaw Point, and in the Ontonagon range; but there were many concomitants in the recent excitement that were wanting in the former period. The Gogebic boom was after the manner of the modern western mining methods, and was accompanies with all the accessories that pertain to the camps, in their earlier stages, in that region.

Gogebic has passed through the experience of a veritable western mining district, slightly modified by, possibly, less lawlessness, and a better observance of the demands of civilization and decency.

But with all that was baseless and ephemeral, there has been much substantial progress. Nowhere else, in any mining district on Lake Superior, has the development been so rapid as in the Gogebic Range. In the brief space of the three years, it is really wonderful how much has been done; in the production of iron ore, in exploratory work, in railroad construction, and in the rapid and substantial growth of the towns. The villages of Bessemer, Ironwood and Hurley are as large and as well provided with the conveniences essential for business and personal comfort as are usually found in towns of equal population only after many more years of existence; fine school buildings, graded streets, plank walks, efficient fire department, water-works, electric lights, elegant private residences, etc., all give evidence that there has been a practical character in the enthusiasm which prevailed. It is marvelous to note with what speed the wilderness has been transformed; but as sometimes happens, the building has been in excess of the demand.

Residences and business blocks have been constructed in advance of the mineral development. The surpassing mineral wealth of the country was taken for granted; the exorbitant claims of reckless men, who were making every effort to boom the region, regardless of facts, too greatly formed the basis of all the estimates of its

mineral wealth. The mistake was made of assuming that the conditions here were wholly different from those which hold elsewhere—that there were two continuous veins of ore extending through the whole length of the range, and thus on each succeeding quarter section of land a valuable mine would occur—and so it transpired that innumerable companies were formed, a company to every quarter or half quarter section for many miles along the range. In all instances, to a greater or less extent, purchasers were found for these stocks, although so far, but a small percentage of these so-called mines has proved to be of any value. Purchasers of stocks or options were disappointed, disgusted, and there is as a result, stagnation, distrust, recriminations, and legal strife, charges of deception, misrepresentation and fraud.

Exploring work is utterly prostrate at this time, June, 1888. Only the mines that have ore, that is ore in quantity sufficient to make it profitable to work, are now active, and these, lying east of the Montreal river, are as follows: The Ashland, Norrie, Aurora, Pabst, Iron King, Colby, Palms, Anvil, Brotherton and Sunday Lake. These are all producing ore, and besides them there are a few others that are worked to a small extent the present summer, as the Puritan, Ironton, Tontine and several explorations where the search for ore has as yet not been given up.

Aside from the vast amount of disappointment which was felt by the many unsuccessful searchers for ore, the year 1887 proved a discouraging one even for those who were able to produce ore in abundance. The cost of transportation from the mines to Cleveland averaged for the season about $3 per ton, adding 50 cents per ton for royalty—the price that these mines have to pay—and a mining cost of $2 per ton, and it follows that there was not a very great profit on ore that sold at $5.50 to $6 per ton.

For the season of 1888 the prices for ore transportation from this range are fixed at $1.95 per ton: 70 cents rail freight to Ashland, and thence vessel freight $1.25 per ton. Even this is excessive. The ore cars now used hold 20 tons. The mining companies load them, and, being built hopper form, they are made to discharge in a moment, so that for the simple matter of hauling a car of ore over its track from one of the mines to Ashland, a distance of about 40 miles, the railroad companies charge $14.00. The Ashland mining company paid last year, I was told by the officers of the company at the office, upwards of half a million of dollars for freight. The ore from the mines of this range will probably sell the present season at from $4.50 to $5.00 per ton; transportation and royalty will be about $2.50 per ton, mining cost, inclusive of necessary purchases, machinery, construction, interest on capital invested, will run up to from $1.50 to $2.00 per ton, so that the season is not likely to be one excessively remunerative to the mining companies. If ore is to remain at its present low price some part of the cost must be cheapened, and in no part can this necessary reduction be made with so much justice as in the transportation. Miners' wages are low enough, $1.50 per day for company account men—which is now the ruling rate at the Gogebic mines—is as low as they can be and allow the men to live decently.

The important fact regarding the ore of the Gogebic range is that it is practically all Bessemer, ranging from 48% to 65% in iron, and .030% to .050% in phosphorus. Nearly all of the ore which is shipped averages above 60% in iron, and most of it below .042% in phos. So that it is good ore.

Since Bessemer pig metal enters more and more into construction of all iron materials it follows that the demand is for little other than for Bessemer ores, and, so long as these ores can be obtained in sufficient quantity and at a moderate price, there is no other process of steel making likely to supersede the Bessemer.

An important feature of the Gogebic iron range, affecting adversely the continuity of ore deposits, is the occurrence of dykes of eruptive rock that are found in most of the mines and show a tendency to cut out the ore. The miners designate them as soap rock. The material is generally soft and friable, but is sometimes hard, approaching diorite, which it originally, probably, was.

They cut through the formation, dipping southeast, making an acute angle with the horizon, usually about 30°. I have observed but one instance where the dip was, apparently, to the southwest. Where one of these dykes is found under the ore, if it is of much thickness, it cuts out the ore completely. It seems to constitute a boundary of the particular lense of ore with which it is found to be in contact.

The Gogebic range is too new for me to say too much regarding the continuance of the ore. The surface has been a good deal explored by test pits and these show everywhere along the range very similar results, a ferruginous schist, jaspery schist, ore mixed with rock. Sometimes small seams and pockets of clean ore, which lead to the hope that deposits of greater magnitude will soon be found, and so the work is continued, but, probably, no better result is obtained.

A little ore may be found but not in quantity great enough to be of any practical value.

Perhaps it is necessary to sink to a greater depth; there are properties on which much exploring work has been done and where I should certainly recommend that they penetrate deeper.

I have recently spent a few weeks on the Gogebic range, going through the mines, and will extract from my notes briefly such statements regarding them as it seems to me it may be desirable to mention.

In doing this I shall, as heretofore, commence with

THE ASHLAND,

which is the most westerly of the Gogebic range mines in this state, being just east of the Montreal river, the

boundary, at this point between Michigan and Wisconsin.

A year ago the Ashland was regarded as perhaps the first mine on the range in point of value. It had just been purchased by gentlemen connected with the Wisconsin Central R. R. at, as reported, $40 per share, $1,600,000. In examining the mine I saw but one thing that could awaken apprehension regarding the continuance of the ore, and that was the "soap rock," the eruptive rock cutting the formation. The subsequent development has disclosed this rock in all the shafts in the mine, probably occurring in a succession of dykes. The company holds a quarter section of land and thus has a half mile in length of the ore formation. The shafts are located on or near the quartzite foot wall, so frequently referred to, and commencing at the west, No. 1 shaft, the distance thence to No. 2 is 290 feet; thence to No 3, 220 feet; thence to No 4, 250 feet; No. 4 to No. 5, 350 feet; No. 5 to No. 6, 420 feet; No. 6 to No. 7, 300 feet; thence to No. 8, 380 feet, and from No. 8 to east line 60 feet.

The shafts are in depth respectively as follows: No. 1, 80 feet; No. 2, 100 feet; No. 3, 340 feet; No. 4, 340 feet; No. 5, 100 feet; No. 6, 200 feet; No. 7, 145 feet; No. 8, 175 feet.

In No. 1 are two levels. The ore in the 1st, extends west of the shaft 180 feet, and to the east 100 feet.

In the 2d level the ore extends 40 feet west and 100 feet east; below the 2d level is a triangular prism of ore between the "soap rock" and the foot wall.

Just at present all the ore taken from the mine comes from Nos. 3 and 4 shafts, with a little from No. 8. In the former pit the ore is pretty well exhausted above the 3d level, but between the 3d and 4th levels, a depth of 80 feet, it is nearly all standing opened ready for stoping. Below the 4th level the ore will be east of No. 4 shaft, reaching a length of 280 feet; assuming that the underlying rock and the rock capping continue at their present angles. Both shafts are sunk to the "soap rock" and through it No. 3 goes down vertically 150 feet, when it intersects the foot wall, which it is then made to follow, occasioning two angles in the line of the shaft. No. 4 shaft cuts the dyke at 300 feet from the surface, and is sunk 45 feet further; below the 4th level at No. 4 there is 25 feet of ore to the rock; the dyke has a thickness of 30 feet, and below it is the same rock that is found above the ore "capping." At No. 3 shaft the dyke seems to split, the main body continuing at the same angle, while a portion goes off much flatter to the east. Under this latter, between it and the main body of "soap rock," ore is found, but of a harder texture and higher in phosphorus. The ore body in the 3d level at No. 4 shaft has an average width of 100 feet and a length of 540 feet. At the 4th level the average width is 60 feet and the length 440 feet. No. 4, which is vertical, intersects the foot wall at a depth of 310 feet. The ore is reached from the shaft by cross-cuts to the north through mixed ore and rock. In the 3d level the cross-cut is 75 feet, and in the 4th it is 25 feet.

The hope is entertained that the ore in No. 4 in its pitch to east will make under the dyke at 6 and 7 shafts. It is certainly a lense of ore underlying the ore at the east end, and also is north of it, and may be found, at greater depth, below No. 6 and 7 shafts, or rather be found north of and under the dyke that cuts out the ore at these shafts.

Nos. 6 and 7 shafts have both been sunk below the dyke but no ore was found.

I shown two analyses of ore, recently made which gave

Iron	67	Silica	1.87%	Phos.	.050%
Iron	65	Silica	3.00%	Phos.	.042%

The following table is of interest. Analyses made by Mr. Olcott, the company's chemist and engineer.

Comparative Statement of Ashland Mine Ore for the season 1887.

Month.	No. 1 Shaft.		No. 3 Shaft.		No. 4 Shaft.		Nos. 6 and 7 Shafts.		Monthly Averages.		Cargoes.	
	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.	Iron.	Phos.
June	62.41	.061	60.22	.052	60.36	.043	62.75	.036	61.45	.048	62.66	.053
July	62.71	.064	58.19	.054	58.86	.042	62.66	.039	60.60	.050	61.97	.048
August	62.56	.061	61 81	.053	58.11	.044	62.58	.036	61.26	.0485	61.75	.047
September	62 69	.059	64.51	.058	61.78	.043	63.08	.038	63.01	.0495	62.90	.048
October	63.70	.074	65.07	.052	.....	.....	62.82	.050	63.94	.0586	62.29	.053
Av. for season	62.82	.064	61.96	.054	59.78	.043	62.82	.040	61.88	.050	62.29	.050

Up to June 1 the following table shows quality of the ore shipped:

Average of Analysis of Ore shipped in 1888.

Number of Shaft.	No. tons of ore shipped.	Percentage of Iron.	Percentage of Phos.
Three	20,073	65.77	.046
Four	11,677	65.02	.045
Six	948	64.91	.029
Seven	19,464	62.54	.057
Season	52,162	64.38	.0498

The timbering in the mine costs 28⅓ cents per ton of ore. At the present time the force employed is 350 men.

The officers are Chas. C. Colby, President, and W. H. Abbott, Secretary, both of Milwaukee; E. A. Hayes, General Manager, Ironwood, Mich.; John A. Taylor, Superintendent; W. J. Olcott, Mining Engineer and Chemist. The mine is at Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885	6,471	1887	175,500
1886	74,015		
Total			256,047

THE NORRIE MINE,

which joins the Ashland on the east, is now, apparently, the best mine in the Gogebic Range. It is producing the most ore, and seems to have the most of it. Certainly there is more ore in sight available for mining than is found in any other mine in this range. The Norrie has

improved since one year ago. Formerly, the length of the mine underground was 850 feet; it is now 1,600 feet, with no diminution in width.

One can enter the mine at the west line, where it is opened through into the Ashland No. 8 shaft, and traverse in the third level through a continuous run of ore to No. 6 shaft, 1,600 feet distant. The ore is, of course, varying width, attaining a maximum of 270 feet. The 4th level, to which the shafts are sunk, is not much opened yet, the ore being derived from above the bottom of the 3d.

Already there has been shipped in 1888, 100,000 tons of ore, and the output will reach before the end of the season, 250,000 tons; perhaps 300,000. There is so me non-Bessemer ore obtained at No. 6 shaft, otherwise the product is all of the best quality of Gogebic Range Bessemer ore, about 63% iron average. Fortunately, there is, as yet, no occurrence of soap rock dykes in the mine, but there is a peculiarity of the foot wall which is not found elsewhere, at least to so exaggerated an extent, though this does not in the least affect, adversely, the quantity of ore. The foot wall flattens out and extends a great distance north, carrying the ore body with it, thus necessitating long cross-cuts from the shafts to the ore, the shafts being started on the foot and continued down at the same angle. Nos. 3, 4, 5 and 6 shafts are to the 4th level, 330 feet deep. No. 1 is in the low ground near the Ashland line, and opens a fine body of excellent ore. The method of mining, which I have heretofore described, consists of the now common plan, of cutting out the ore in sections across the formation, making what are termed rooms, which are separated by pillars of ore. The open spaces are timbered after the Nevada system. A period has been reached when a change must be made; “caves” are liable to occur, and must occur before long. The rooms must be filled either by letting in the surface, or with material derived elsewhere; no doubt the plan adopted will be to let down the overlying dirt and rock, and then mine out the pillars and fill the spaces thus made also. The timbers used at the Norrie and at other mines in the vicinity, are all framed by machinery to an exact pattern. The tenons on the posts are round, and the caps, when set on the posts, make a perfect fit, and secure the greatest strength and stability. But no timbering, however well done, will, in the long run, hold up a mine so extensive as the Norrie.

The officers remain as heretofore: S. S. Currie, Pres’t Metropolitan Iron and Land Co.; H. S. Haselton, Sec.; R. H. Hanna, Treas., Milwaukee; Jeff. D. Day, Sup’t; Wm. Treblecock, Mining Capt., Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885	15,420	1887	217,384
1886	124,835		
Total			357,639

In the above is included the product of the East Norrie, which produced in 1887, 15,896 tons.

THE EAST NORRIE

joins its namesake on the east and is greatly improved of late. No. 1 shaft near the Norrie line has opened into a fine body of ore, 200 feet long and 80 feet wide, though as to the full width, that is not determined yet, as the hanging wall had not been reached at the time I last saw the mine, June, 1888. The shaft is 170 feet deep on the foot wall, and there are two levels; the 2d level is proving far better than the 1st did. The ore body is wider.

The mine is under the same management as the Norrie.

THE AURORA MINE

is also looking well, though the west part of the mine, the Aurora mine proper, is exhausted. The ore is about all worked out, and the mine is now mainly in what was a year or two ago new ground, all to the east, in what is known as the Vaughn property.

The mine has continuous opening for a length of 2,000 feet. The most westerly shaft is 90 feet deep, and thence to "old No. 1," it is 360 feet. No. 1 is 140 feet deep, is in the open pit, and thence to No. 2, it is 172 feet to where the underground mine begins. No. 2 is to the 3d level; from this to an air shaft 60 feet deep, is 155 feet; and thence to No. 3 shaft is 343 feet; the latter to the 4th level, 235 feet deep. From No. 3 to No. 4 shaft is 286 feet: the latter is 300 feet deep, sunk to the 5th level, and is used for pump and timber shaft. They sink No. 4 and drift each way to the others, and rise up for connection with the levels. To No. 5 is 146 feet east from No. 4, and the shaft is 229 feet deep, to the 4th level. Thence to an air shaft, which is 52 feet deep, the distance is 177 feet; and from this to No. 6 it is 266 feet.

Descending No. 6 shaft to the 4th level, we begin at the east end of the mine and may walk westerly, through a continuous opening in ore 20 feet to 100 feet wide, for length of 1,200 feet. From No. 6 west for 800 feet, the ore is from 3 to 5 “sets wide;” that is, fro m21 feet to 35 feet, averaging about 30 feet. At No. 6, the width of the ore is not determined; the ground is new; they have cross-cutted north from the wall 35 feet, and are still in ore; it may attain a great width here as at No. 3, where, for a length of 300 feet, the ore is 12 to 13 “sets” wide; in fact, they were putting in the 13th “set” and were not to the hanging wall; each “set” is 7 feet square. In this part of the mine pillars of ore are left to aid the timbering in supporting of the mine; but elsewhere the ore is all taken out, and the timbers alone suffice. The timber work is

well done, and there is no evidence, anywhere, of an undue pressure. The ore is very firm and dry, and stands well in the "back." The miners can advance a whole "set," or even the space of 2 or 3 "sets" before putting in the timbers, without danger. All the water in the mine is pumped up through No. 4 shaft by one Knowles pump.

The foot wall is generally very regular. The mine can not extend much further west since it will reach the Pabst line. The "soap rock" which cut out the ore west is found at the bottom of No. 2 shaft. It held a regular dip and pitch to the southeast in the great open pit where it formed the bottom of the ore and will, probably, be ultimately found in the same manner under the ore going east.

The mine is not open below the 4th level, and above this bottom they have raised "4 sets" 28 feet, leaving about 6 sets to be mined before reaching the bottom of the 3d level. It is expected to mine 150,000 tons in the season of 1888. If the 5th level were opened, and the work were pushed vigorously, a much greater product could have been secured. The Aurora, properly, is the E. ½, S. W. ¼, and the Vaughan consists of the N. ½, S. E. ¼, Sec. 23, 47, 47, making ¾ of a mile of length of the iron range held by the company.

The title of the corporation is the Aurora Iron Mining Co.

The officers are Stevenson Burke, President; Andrew S. Upson, Vice President; Franklin T. Ives, Treasurer; Charles F. Rand, Secretary. Office, 101 St. Clair street, Cleveland, O. Nat'l Hibbert, Superintendent, Ironwood, Mich.

The following summary of analyses will convey a clear idea of the quality of the ore:

Eleven analyses of average samples from No. 2 shaft give an average, iron, 62.30%; silica, 6.50%; phos., .033%.

Same number from No. 3 give, iron, 62.60%; silica, 4.22%; phos., .032%.

Twelve samples from No. 5 shaft give, iron, 62.75%; silica, 3.88%; phos., .0327%.

It will thus be seen that the ore is of extra quality. Some analyses go below 60% in iron and a few above .040 in Phos., but the ore seems to be all clearly Bessemer.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1886	101,037	1887	154,095
Total			255,132

THE PABST MINE,

joining the Aurora on the east and north, is looking much better than it did when I previously saw it. The company has sunk a shaft 360 feet north of the quartzite foot wall, 200 feet deep, and has opened a large body of ore. It is the best showing, by all odds, that the Pabst Co. has found on the property. This shaft is a good piece of work, mechanically, and was rapidly done. It is 6' x 14' inside the timbers, inclines to the north at an angle of 66°, is in the rock 40 feet south of the ore and is provided with two skips. The bottom level is much the best. The body of ore is larger and the ore is cleaner. They are working 180 feet east and 150 feet west of the shaft, ore continuing in both ends; east of the cross-cut from the shaft they are rooming out and were putting in the 9th "set," will probably be about 12 "sets" wide—84 feet. West of the cross-cut are five "sets" wide, so that it shows from 30 to 80 feet wide for a length of 340 feet, with probably an increase of these dimensions. Now this would be very nice for the Pabst folks if the ore were clean; unfortunately it is not, it contains too much sand, disseminated in spots and seams, etc., throughout the ore body. Of course it is worse in some portions than in others, but it is difficult to separate anywhere from the ore and reduces the iron percentage to about 58% to 60%, Phos., .035 to .042%.

Capt. Stevens has an ingenious and effect contrivance for stopping the skips in this shaft which I have never seen elsewhere. This ore was found by sinking an exploring shaft 170 feet deep, now used as an air shaft for ventilation. This new pit is called the Baetz shaft.

The positions of the shafts are described in my last report. No. 1 is the east shaft, 45 feet west and 360 feet north from the corner of the property. The plan is to work this and Nos. 2 and 4 shafts, the latter being the west shaft and No. 2 being about midway between them. No. 4 shows well, the shaft is 200 feet vertically down, where it intersects the foot wall, thence 45 feet following this foot. Drifting west from the shaft only rock is found so far as gone, but east there is ore all the way to No. 2, 450 feet. At 175 feet west of No. 2 the ore widens out to 35 feet. They are opening towards No. 4 and have the ore this width for 50 feet. It will continue 30' to 35 feet wide for, perhaps, a length of 100 feet. There is a drift all the way, along the foot wall, in ore from one shaft to the other, and altogether this bottom level shows much more ore, and cleaner ore, than was found in the level above.

No. 2 has been sunk to this bottom level, 245 feet. The ore went south into the foot wall so that the shaft, which starts at the surface of the foot with an angle of descent of 60° is now 80°, and still there are several feet of ore behind it, between it and the wall.

Altogether the Pabst has improved in the past year considerably.

The officers remain as heretofore, Fred Pabst, President; Chas. Best, Jr., Vice President and Treasurer; Henry Baetz, Secretary and General Agent; W. W. Stephens, Superintendent,

Offices, 917 Chestnut St., Milwaukee, Wis.

Mine office, Ironwood, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1885	1,153	1887	19,908
1886	17,925		
Total			38,984