GOLD.

MICHIGAN GOLD MINES.

An unusual degree of attention has been given of late to the gold prospects in the vicinity of Ishpeming. A greater amount of exploration is in progress at the present time than ever before, and the success which is met with, at least in some instances, is sufficient to stimulate activity in this direction, and to sustain and even to increase local and general public interest in this work.

The winter has been favorable for exploration, being comparatively mild and open, and some very rich pockets have been discovered in the quartz veins that have been uncovered and worked in.

One can see small bottles full of bits of native gold that have been picked up recently after blasts were fired, and procured by crushing and washing fragments of quartz. Also pieces of the rock that are as well charged with gold as the Calumet and Hecla conglomerate is with copper; pieces of rock as large as one's fist that contain $20 in value of pure gold. These rich pockets are not large, but a number of them have been found at different places, and one quite recently that was the equal in richness of any heretofore discovered. Almost daily some explorer exhibits specimens of quartz showing native gold that he has found in his searching for the precious metal.

A person may go to some of the mines, or locations where good results have been attained, and may find particles of gold, perhaps, after a blast, or pieces of rock containing it, or, at any rate, he can crush a small portion of the vein matter in a mortar, and by suitably washing it he will be nearly certain to discover a trace of gold. I have tested the rock in this way both on the ground and have carried away pieces that I have subsequently manipulated, and nearly always with the result of finding at least a trace of gold in the pan.

It is certain that gold exists in our rocks, that we have gold bearing veins that yield a fair percentage of this metal as an average of the rock, and which also contain occasional small pockets that are exceedingly rich. It remains to be found if these veins are persistent in depth and in lateral

extent, and if the gold disseminated in them may not occur in larger percentage than as yet found; and also if the few rich pockets, thus far so aggravatingly small and far between, may not exist at greater depth or in other locality in larger magnitude and with greater frequency.

In all scientific investigations, especially in geology and in exploration for minerals, enough caution can scarcely be exercised against too great generalizations from too small basis of fact. This principle is illustrated constantly; every mining district has its instances, and very recently in our own State we have had an ample verification of its truth. And yet, if discoveries shall be made, if there shall be any progress in the world's knowledge or the world's material wealth; if the places of concealment of the earth's minerals shall be pointed out, and these stores of wealth be added to increase our prosperity; if the varied and innumerable industries, the multiple avenues for the employment of labor and for liberally rewarding it, so dependent upon mineral discovery and production, shall be met, the nation be developed and the people rendered prosperous and happy, it follows inevitably that some men *must* have enthusiasm—some men must have zeal and faith, and must hunt, and explore, and dig, and labor, and endure privations, and spend time and money, perchance, in hopeless work, haply with most beneficent results. These men are the pioneers—the men who carry their food and tools into the woods, and search, and delve, and endure; who have crudely learned, sometimes skillfully, to read the teachings of the rocks, and who possess the nerve to take the risks to attempt to verify their interpretations.

The world owes much to its pioneers and enthusiasts in every department of human endeavor. And to the men who earlier braved the hardships of this peninsula of northern Michigan, who penetrated its endless forests and interminable swamps, and risked health and their limited hard-earned capital on the uncertainties of discovery, our meed of praise cannot be too freely awarded. They led the way for capital by first demonstrating the safety of investment.

Of the explorers on Lake Superior nature exacts her full dues. On the other hand, to aid them in their efforts she has afforded ample indications, in the rocks, of the minerals which are sought, and has abundantly rewarded, on the average, the labor which has been expended to obtain them. The first explorers searched only for gold and silver, and little cared for the grosser metals, for the production of which the region has since become so widely celebrated. May it not be possible that the dream of the early *voyageurs* and explorers, who skirted the shores of the great lake in their canoes and penetrated the trackless forests to eagerly scan the rocky exposures for precious minerals, shall be ultimately realized, in so far, at least, as

to place the production of gold in Michigan in the list of its profitable mining industries? Certainly the indications point to such a result. There has been lately a greater amount of exploration for gold than at any former period, and a greater corresponding degree of encouragement has been given to the work. More effort has been made and greater success has waited upon the increased exertion.

The Upper Peninsula is a remarkable mineral region; it is full of anomalies, and while it is but natural that gold, being the most universally disseminated of all metals, should exist in some degree in the rocks of Lake Superior, still there is enough in the character of the rocks when exploration is made, and enough of the metal actually found in reward of the search that has been made to justify a reasonable expectation that at no distant day gold mining will be one of our established industries.

The portion of country which is now receiving the attention of explorers for gold, and in which all the recent rich "finds" have been made, lies northwest of Ishpeming, commencing with the Ropes, which is the most easterly of the gold developments, and which is three miles in a right line from the city. The others are west, within the extent of three miles from the Ropes. The region is desolate in the extreme—a surface of bare rocky knobs, with small cedar swamps between. Mainly these rocks are eruptive, interspersed with those of very ancient sedimentary origin. Originally sedimentary, they were subsequently greatly metamorphosed—altered and dislocated by the protrusion of the serpentine and diorite, which now constitute the most characteristic rock features of the locality. This serpentine, at the Ropes, and the associated diorite, which chiefly occupy the country for many miles, are of unquestioned eruptive origin. They are traversed by dikes which also contain veins of quartz that doubtless have their origin in the same deep seated sources as the rocks which enclose them.

The most important "finds" are in the south part of section 26 and north part of Sec. 33, T. 48, R. 28; being two miles west and one-half mile south from the Ropes. Veins occur in the diorite and in dikes in the diorite, that has protruded through the ancient sedimentary rocks.

The exploration that just now, March 10, is occupying the principal share of public attention is the Finn, to be held and operated by the Grayling Gold and Silver Co., Maurice Finn, general manager. The location is the S. E. $\frac{1}{4}$ S. E. $\frac{1}{4}$ Sec. 26, though he holds also the adjoining 40 west, and with Mr. J. M. Case, of Marquette, Mr. Finn has an option on and is exploring the S. $\frac{1}{2}$ of the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 26, where they are tracing and examining a quartz vein in granite. The Peninsula Gold Co.'s location is the S. W. $\frac{1}{4}$ of Sec. 25, owned by Peter Gingrass, of Ishpe-

ming, and held on a lease by the party exploring it. Mr. Gingrass receives a bonus for the lease, $20,000 he informs me, and ten per cent of the net proceeds of subsequent work. The parties holding it are from Detroit; they have sunk 50 feet vertically, and have a well-defined vein and get some free gold. A test of the rock, 70 tons, is to be made at the Ropes mill soon. Mr. Finn, coming into the country last fall (1888) and becoming interested by what he heard and saw in regard to the finding of gold, began to explore for himself. He traced the Peninsula vein west as well as he could, and sought to uncover it, and so far succeeded that he has found rock equal to any in richness that has yet been discovered. The land is owned, I think, by the Breitung Estate, of Marquette, and is now secured by a lease to Messrs. Finn & Mickilson. The point where the exploration is carried on is about midway of the 40, north and south, and 150 feet west of the east line. The opening is about 50 feet east and west; quartz vein three feet wide, dipping south 70°. The vein is in diorite, but the contact rock is of a schistose, argillaceous character, which contains fine gold, as I personally ascertained while on the ground. Mr. Finn has opened in two veins, about 50 feet apart; but has begun to sink a shaft in the north vein.

He contemplates erecting a 5-stamp mill to work up and test the rock obtained in the exploratory and opening work.

THE SUPERIOR

is directly south of the Finn. The company is working in the same vein as the Michigan and the Lake Superior, being in the 40 joining the Michigan on the east. The description is the N. E. ¼, N. E. ¼ Sec. 35, 48, 28.

Dr. Van Devener, President, Ishpeming, Mich.; C. R. Ely, Secretary and Treasurer, Ishpeming, Mich.

THE MICHIGAN GOLD COMPANY

holds the adjoining 40 west. A small lake takes up about one-quarter of the land and will afford water for the stamp mills for this and other contiguous mines. In my last report I fully described this property and all that had been done. Since then a shaft has been sunk to a depth of 53 feet, and cross cut south 21 feet made. They are now driving west. In the cross cut a portion of the rock passed through is porphory. The vein rock obtained in sinking this shaft, exclusive of all rock in which any free gold could be discovered, 73 tons in all, was stamped at the Ropes mill and was found to crush easily as compared with that of the Ropes mine. It yielded

$6.00 to the ton, I was informed. But aside from this, the richest quartz yet obtained was found in this shaft; specimens that yield an average of $100,000 to the ton. Not much of such rock was found, however. A six ounce piece was used to make the above cited assay.

The fee of the land is held by Peter Gingrass, who leased to a party that allowed the contract to expire and who paid no bonus and did no work. Afterwards Gingrass gave a lease to the men who formed the Michigan Gold Company, and who have done the work and discovered the value in the property. The former lessee brought suit on the ground that he had not been legally dispossessed, and this matter, as to which party is the rightful lessee, is awaiting decision in the State Supreme Court. If decided in favor of the Michigan Company, a stamp mill will be erected and the work of mining it pushed vigorously. At least such is the declared intention.

F. P. Mills, Agent, Ishpeming; Richard Trevarethen, Superintendent, Ishpeming.

THE LAKE SUPERIOR IRON CO.'S

gold mine is directly west of the Michigan, but a short distance. Here, also, very rich vein rock was found, as described in my last report. The company has a small hoisting plant and is working quite systematically. It has a well made shaft 100 feet deep; some drifting has been done, at bottom and at 40 feet from surface. The vein is well defined quartz, two feet wide. The company is making a stock pile of the best of the rock broken, working only a few men.

THE GITCHIGAMME

comprises the west half of the N. W. ¼ Sec. 36, south of Peninsula. East of this are the Grammet and the Giant, the former, the north 40—the latter the south 40. The two making the E ½ of N. W. ¼, Sec. 36.

The Brown and the Case properties, so called, comprise the W. ½ of N. E. ¼, Sec. 36—the Brown the west 40, the Case the east.

There are many other places where prospecting is going on, but so far the Lake Superior, Michigan and Finn are the only ones that have shown much gold.

IN SECTION 33,

but a short distance northwest of the city, has more recently been made what is considered a very favorable showing, samples of the rock assaying $43 and $179 to the ton, though it is not, I believe, thought that these

samples represent an average of the rock. The sample did not show free gold. The vein is, so far, two feet in width.

Mr. C. R. Ely and others at Ishpeming are the parties conducting the work, etc.

THE ROPES MINE,

in the N. ½, N. W. ¼, Sec. 29, 48, 27, is looking well. I went through it about the 1st of March and was pleased with it. Everything seemed to be moving systematically. The new mill and the new shaft house are important additions to the mine. They are running now 45 heads of stamps and treating 60 tons to 75 tons of rock per day, and work a force of about 60 men. There is room in the new mill for 20 more stamps. The new stamps weigh 850 pounds; the old ones, 750 pounds. Also the new vanners have amalgamating plates while the old ones have not. The engine for running the mill is 235 horse power. There is a separate engine for the hoisting and an engine in the rock house runs the Gates crusher. The rock is dumped from the skip into the hopper and passing through the crusher is discharged directly into the tram car and thence goes to either of the mills.

The shaft is 450 feet deep, down to the 9th level, at which point they have begun to "open out" both east and west. I descended to the bottom and found the size of the vein at that point in no wise diminished. It is 8 or 9 feet in width and uniform throughout. It appears to be mineralized, to some extent, throughout its section; that is, holds particles of sulphuret, a good indication.

Since I went through the mine Mr. Ropes, the President of the company, has made his annual report and I find that my notes so closely accord with his statements that I cannot do better than to give the further description in his words. However, I may add that the company has since decided to provide 20 additional stamps.

The work of sinking the main working shaft has been prosecuted five and one-half months during the year, and the shaft has been sunk 65 feet, and now at the depth of 441 feet is at the 9th level. Work was suspended May 1st, pending the decision of the syndicate which desired to take a large block of stock in the company. Work was resumed August 15th, but was again suspended during the construction of the shaft house, enlargement of the shaft and putting in of the skip-way.

The sinking of the shaft should be pushed night and day with all possible dispatch, with power drills, as is being done at the present time. A station has been cut in the foot wall at the 8th level in which a steam hoist has been placed that will raise all the ore mined down to the 10th level, thus guarding against interference with the other work.

The Ely shaft, 350 feet east of the Curry shaft, has been sunk 25 feet; sinking having been prosecuted 52 days, and the shaft is now 100 feet deep. It is entirely in the

mineral dike, which is 50 to 60 feet wide, as is shown by the crosscuts, 30 feet north and south respectively. Twelve to fifteen inches of typical gold bearing quartz was cut near both contracts, but was of low grade. Drifting each way will doubtless show pay ore bodies, and at further depth as well, judging from general indications. To curtail expenses work was suspended here on the first of July.

The number of feet of sinking done during the year was 90; drifting, 226; crosscutting, 165; winzes, 134. The developments of the year have added very much to the knowledge of the ore bodies and formation. Special attention, aided by numerous assays, has been given to determining the position of the pay chutes. There are ample reserves in sight to furnish milling rock for a long time to come.

Surface improvements during the year include the building and fitting up of a laboratory, 12x20 feet, the remodeling of the office, 12x16 feet, the building of a new shaft house, 30x32 feet and 45 feet high, the construction of a skip-way to the 8th level, and the purchase of a No. 5 Gates rock breaker and a 50-horse power engine to drive the same, and a small Gates crusher to break samples for assaying. The large crusher and engine were placed in the shaft house. This was rendered imperative by the destructive effects of the dust from the breakers on the wearing parts of the mill machinery when the crushing was done in the mill proper. The advantage in this and other respects more than compensate for any extra cost incurred in arranging for a separate equipment. To complete these several improvements enumerated above the mills were shut down on October 19th. The old shaft house taken down and the new one built and machinery placed in time for resumption of work on November 28th, since which time the mills have been in continuous operation, the whole moving along without jar or conflict, crushing 70 to 75 tons per day. In this connection it may not be out of place to refer to the criticism that obtained regarding the amount of rock crushed per stamp in 24 hours. In the test of 70 tons of the Michigan Gold Company's quartz made on January 19th, 11 to 12 tons readily passed the battery, while but 7 or 8 of our rock passed, all the conditions of the batteries being the same, this showing conclusively that the cause of the slow crushing of our rock is to be found in its obdurate nature. Much of our rock is talcose in character and obstructs the screens.

We note changes of management during the year as follows: The resignation of Capt. Mose Williams, September 1, after being in charge of the mine for a year; the appointment of W. H. Rood, general manager, in October, and the succession of Capt. Williams by Geo. Weatherstone, superintendent.

The new mill was got in shape to run continuously on the 16th of May. Counting out the stoppage of October and November, it has run eight and one-fourth months. Deducting the stoppage from April to June, to make repairs and connect with the new mill, and the stoppage in October and November, the old mill has been in operation nine and one-half months.

The number of tons of rock crushed during the fiscal year ended February 28th was 16,855, giving an average yield in mill of $3.42 per ton. Tailings have ranged in value from 60 cents to $1.40 in gold. and from 15 cents to 48 cents in silver, varying according to grade of ore.

Division of opinion has existed about the treatment of the higher grade of ores, some thinking that they should be shipped to smelting works. To settle definitely this question, 7½ tons high grade ore was selected and milled in one battery. The ore assayed, as near as it could be sampled, $10.50 in gold and $32.64 in silver—total, $43.14 per ton.

The tailings of this rock assayed $2.16 in gold, and $6.33 in silver per ton. To have shipped this ore to the smelting works would have cost at least $25 per ton, and the milling at home therefore showed a saving of 16 per ton. This ratio will apply to ores worth up to 100 a ton.

In the matter of treating the concentrates on the spot, the product is so complex that no method seems applicable except smelting, and to import the necessary lead ores would cost quite as much as the present expense of shipments to the smelting works. Parties have written of having a process for quickly and cheaply reducing the concentrates, but they have not reported their results, or what they can guarantee, as yet. Continued efforts will be made to solve the problem.

The number of men at present employed is 62, which is about the force required for the volume of work now going on. The force is divided as follows: In the mine 40; in the mill, 15; on surface and at other work, 7. A chemist is employed to do the assaying, time-keeping and other clerical duties.

For a statement of the receipts and disbursements for the year, you are referred to the Secretary's report, presented herewith.

J. ROPES, *President.*

ISHPEMING, MICH., *March 11, 1889.*

On hand, March 1 statement	$1,277 37	
Received on 50c. assessment called Sept. 4, 1888	40,000 00	
for interest	111 57	
for bullion 1½ months	45,183 78	
for concentrates	5,047 95	
for wood, rent, etc.	270 75	
from Ishpeming National Bank	9,000 00	
		$100,891 42

Contra.

Prid Ishpeming National Bank	$15,000 00	
insurance, taxes, etc.	2,689 21	
assaying	511 71	
mining and labor	23,045 07	
supplies	14,559 78	
general expenses	877 97	
freight	594 94	
superintendent	1,800 00	
wood and coal	9,610 45	
office expenses	928 20	
machinery	4,463 74	
explosives	3,486 15	
mill and labor	10,991 97	
interest	1,187 45	
machinery repairs	1,923 95	
improvement account	4,452 13	
On hand	4,793 69	
		$100,891 42

ASSETS.

Available Assets.

Cash	$4,793 69
Supplies at mine	2,910 39
Horses, sleighs, etc.	975 00
1,757 cords wood, $2.00	3,514 00
Accounts receivable	735 42

Laboratory	$150 00	
Office supplies	165 00	
Concentrates at works and mine	2,530 00	
		$15,773 50

Unavailable Assets.

Old mill machinery, buildings, etc.	$49,495 63	
New mill machinery, including building cost	25,388 10	
Water works, cost	4,048 78	
New crusher, shaft house, etc.	6,602 13	
		85,534 64
Total assets, exclusive of mine		$101,308 14

Liabilities.

Notes	$260 00
Accounts payable	2,485 04
Fuel account, wood and coal, not due	1,929 50
February pay roll	2,888 86
Total	$7,563 40

Product of Mine to March 1, 1889.

	Gold.	Silver.	Total.
Gross bullion	$41,148 11	$1,621 39	$42,769 50
Gross concentrates	11,205 83	3,709 42	14,915 25
Total	$52,353 94	$5,330 81	$57,684 75
No. tons quartz treated for the year			16,855
Average yield per ton for year			$3 42
Average yield per ton for last 5 months			4 18½

C. R. ELY, *Secretary.*

THE WASHBURN MINING AND MILLING CO.

has made considerable progress in the past year at its location southeast of Wakefield in the Gogebic range in Sec. 23, 47, 45. The work done has been more in the way of exploration than of development and entire satisfaction in the results is expressed by those interested. They claim an abundance of rock that will afford an average yield of $9 per ton. Estimates made by Dr. N. Lehnen are very favorable. A mill has been built containing crushing and other machinery and it is further proposed to erect an additional one to hold a hundred stamps; to also add compressors, air drills, hoisting machinery, etc.; to sink a shaft 400 feet deep and push the underground opening work accordingly. If all is done that is contemplated, and the results of the work accord with the estimates, the Washburn will become one of the most important mines in the State. They are working in a vein of quartz and schist, inclosed in a formation of chloritic and mica schist. The rock varies, being nearly a mica shist or a chloritic schist. The directors of the company, etc., are residents of St. Paul and Minneapolis. D. F. Strobel, Superintendent, Wakefield, Mich.

The Comstock, South Washburn and other companies have been formed and locations made in the vicinity of the Washburn. The assays of the rock as reported to me are sufficiently favorable and great hopes are entertained of final success.

GOLD IN THE MENOMINEE RANGE.

Hon. John L. Buell is exploring near the bank of the Menominee River south of Quinnisec in lot 4, Sec. 7; also in lot 1, Sec. 8, T. 39, R. 30, W., lands owned by the Menominee Mining Company. An assay of some of the rock recently made by Mr. Ropes gave a very large percentage of gold. I have been to the place, but not much work had been done when I saw it. More recently it is highly spoken of.

STONE.

for building purposes that is found in the Upper Peninsula is unsurpassed in beauty and in durability. The beautiful brownstone of Marquette, such as the Episcopal church in that city is built of, cannot be equaled in richness and uniformity of color by any other product in the country. Unfortunately there is too little of this variety; now that the supply is so nearly exhausted people have learned to appreciate it. They get at the Marquette quarry a variety that they designate "rain-drop stone." It is mottled sandstone having the appearance of having been spattered with rain-drops when in condition to receive the impressions.

Sandstone suitable for building is not confined to any locality; there are many places where it occurs and is of the best quality. It is found at Marquette and in its vicinity, at Grand Island, L'Anse, Portage Entry, Isle Royal and other places. The quarry at Marquette is owned and operated by

FURST & JACOBS.

who quarried at Marquette 20,000 cubic feet of building stone in 1888. They also operate a more extensive quarry at Portage Entry at the end of the peninsula, which separates Portage river and Keweenaw bay. Here they have 1,200 feet of dock and all the facilities for handling blocks of stone of any size. The company sent out from this quarry last year 340,000 cubic feet of stone. It is red sandstone, uniform in color, and of excellent texture. The rock is horizontally bedded and covered with 16 to 24 feet of soil and worthless rock. The description of the land is lot 1, Sec. 19, T. 53, R. 32. Postoffice, Jacobville, Mich. They convey stone from here to their dock at Marquette where they have machinery for working up and dressing the stone as may be required. The cutting machinery is of new design and the cutting up is now done in this shop with great comparative rapidity. The stone is worth about 50 cents per cubic foot at the quarry "in the raw."

PORTAGE RED SANDSTONE COMPANY

holds the S. E. $\frac{1}{4}$ Sec. 18, 53, 32, joining the Furst & Jacobs quarry at Portage Entry. The rock is the same in both, and each has about equal facilities for quarrying and handling the stone. This company produced in 1888

250,000 cubic feet of stone. The new Mining School building at Houghton is built of this stone. The following is an analysis of the Portage Entry stone:

Silica	94.73	per cent.
Piroxide of iron	2 64	"
Alumina	0.36	"
Carbonate of lime	0.69	"
Carbonate of magnesia	0.75	"
Water	0.74	"
Loss, etc	0.09	"
Total	100	per cent.

LAKE SUPERIOR AND DETROIT BROWNSTONE QUARRY,

also known as David's Quarry, is on the south slope of Mt. Mesnard near the prison in Marquette. They are at work near the top. Thus far the work is mainly exploratory. It is also near the mouth of the Carp river.

BROWNSTONE ON THE BURT FORTY,

which is held on an option by parties in New York who are represented in Marquette by R. B. Moss. Mr. Moss has a few men at work under Anthony Pings and they have so far succeeded well, having discovered a deposit of brown sandstone 25 feet in width and so far have proved it a distance of 75 feet. Test pits elsewhere find the same layer of rock, they say, so that it seems likely to prove a workable deposit of brownstone. They are getting ready to increase the force of men and develop the property.

THE GILLETTE QUARRY

is another exploration for workable sandstone that is in progress on the lake shore, six miles from Marquette. J. H. Gillette, Marquette, Mich.

SANDSTONES IN LOWER MICHIGAN.

There are deposits of sandstone in the coal measures of southern Michigan, which are of very fair quality for building purposes. The best quarries of this rock are in Jackson and in Eaton counties—in the former at Parma and in the latter in Ionia township a few miles from Grand Ledge. Several edifices are built of this stone in Lansing, Mich.

The sandstone in the Upper Peninsula belongs to the Pottsdam period and is pretty well distributed over the country south of Lake Superior. It is generally horizontally bedded and, as before stated, in many places affords workable deposits of building stone.

BARAGA GRAPHITE MINING COMPANY

is a Detroit organization formed to work a graphite vein that outcrops in the bank of Plumbago creek; Sec. 33, T. 50 N., R. 33 W. I have not been on this ground since 1873, when I spent several weeks in the vicinity making a geological examination of the region and exploring for iron ore on Sec. 9, 49, 33. The occurrence of plumbago in this locality is well known, but it has not heretofore been found in quantity sufficiently pure to be of any commercial value. It is claimed that the Detroit company have a vein of the best quality. I have been so informed by persons who have seen it. There is a water power in the creek that will suffice for the purposes of grinding. The location, I think, is seven miles southwest of L'Anse.

GYPSUM.

GYPSUM.

For description of the plaster quarries and deposits of Michigan, and other particulars relating to this important industry, reference is made to former reports, particularly to the Commissioner's report for the year 1881, wherein I have described the deposits, quarries and mills, etc., quite fully.

TABLE showing the amount of Land and Calcine Plaster produced in Michigan, in each year since 1866, and the aggregate in previous years by C. D. Lawton.

Years.	Land plaster, Tons.	Stucco—Barrels. 300 lbs. each.
Years previous to 1866	100,000	30,000
1866	14,604	.....
1867	17,439	.....
1868	28,837	34,996
1869	29,996	41,187
1870	31,437	46,179
1871	41,126	8,685
1872	43,536	59,768
1873	44,972	82,457
1874	39,126	82,449
1875	27,019	61,120
1876	39,131	64,386
1877	40,000	55,000
1878	40,000	48,346
1879	43,658	50,800
1880	49,570	106,004
1881	33,178	112,813
1882	37,821	135,655
1883	33,225	201,133
1884	27,888	156,677
1885	28,181	141,576
1886	29,398	153,274
1887	28,794	170,145
1888	22,177	196,689
Totals	871,113	2,053,303

TABLE Showing the amount of Land Plaster and Stucco produced by the different Companies in Michigan, in the years indicated.

Name of Company.	No. of Tons of Land Plaster produced by Michigan Companies.										No. of Barrels of Stucco produced by Michigan Companies.*									
	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Godfrey & Bro.	9,117	9,000	6,422	6,080	5,682	4,593	4,467	4,560	3,937	3,157	.....	23,000	27,500	30,274	37,000	30,433	30,942	28,273	30,284	36,656
Grand Rapids Plaster Co.	8,970	12,000	6,375	7,512	5,013	3,044	4,143	3,832	4,517	2,745	.....	23,500	20,400	32,854	40,000	24,390	26,498	28,627	32,386	34,751
Wyoming Mills	7,000	10,000	6,093	6,801	4,400	3,052	4,059	3,714	3,585	2,950	.....	.....	.....	.....	12,000	13,108	11,193	11,327	15,175	13,997
Union Mills	4,500	7,500	6,716	8,298	5,500	3,185	3,663	3,687	3,102	2,650	.....	37,000	34,913	23,074	30,000	23,176	15,654	18,027	21,979	30,971
D. Noble & Co.	10,585	9,570	6,572	6,037	4,000	3,202	3,900	1,947	3,106	2,640	.....	21,504	31,000	27, 93	38,000	30,288	26,344	28,760	34,235	33,121
Smith, Bullard & Co.	1,586	1,500	1,000	2,993	4.600	4,122	4,346	6,039	5,589	3,750	.....	.....	.....	11,817	30,961	23,961	20,797	27,113	21,152	25,036
Alabastine Co.	.....	.....	.....	.....	4,032	6,690	3,606	5,608	4,958	4,278	.....	.....	.....	.....	13,172	11,321	10,147	11,147	14,934	17,157
Geo. H. White & Co.	1,900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	43,658	49,570	33,178	37,821	33,225	27,888	28,181	29,398	28,794	22,177	.....	106,104	112,813	135,655	201,133	156,677	141,575	153,274	170,145	196,689

* Stucco is now reckoned at 7 barrels to the ton.

COAL.

STATISTICS OF COAL PRODUCTION.

I have heretofore described the coal formation of this State and this, with the details of the mines, will be found in former reports. Coal mining in this State has fallen off. There is less produced than there used to be many years ago. The business is less profitable now, they tell me, for the reason that coal is cheaper. Ohio and Pennsylvania coal is sold in the markets where our coal mines exist at a less price than Michigan coal can be mined for. Besides, outside coal is of better quality for most purposes. Again I am told by those who have engaged in the coal mining business in Michigan for a long time, that they do not succeed in finding coal at Jackson now in as large quantity and in as favorable situation for mining cheaply as they did formerly. R. H. Emerson & Co. continue to be the largest producers. Mr. Jesse Hurd, a veteran in this work, has been doing a good deal of exploring with a drill and as a result of discoveries which he has made is sinking a shaft on the Poole farm, two miles northeast of the city.

There are a number of small mines at Grand Ledge in Eaton county, which produce annually a few hundred tons each for local consumption.

These parties or mines are H. J. Starke, the Star Coal Co., D. D. Shane, proprietor; the Grand Ledge Coal Co., W. F. Ward, proprietor; Eureka Coal Co., Thomas & Quinn, proprietors.

The following table gives the coal production of the State. Those marked with a star did not report and the product given is estimated for the year.

Name of Company.	Years previous to 1877.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Williamston							10,454	884			1,000	100	
Jackson mine		67,147	61,785	65,000									
Corunna Coal Co.			22,537	16,215	12,252	7,060	8,624	9,000	8,000	10,000	15,975	8,000	14,735
Other mines		1,500	1,000	800							1,000		
R. H. Emerson & Co.					66,780	61,666	60,103	40,412	13,712	15,553	21,363	13,230	30,183
Eureka Coal Co.					30,000	37,477	25,000						300
Michigan Coal Co.					20,021	23,987	25,000						
Porter Coal Co.							6,158	21,000	15,000	13,000			
*Star Coal Mining Co.										5,123	5,821	7,333⅓	7,000
*Standard Coal Co.										15,000	4,734	5,000	1,000
*Spring Arbor Coal Co.												500	600
Bennett Sewer-pipe Co.												2,317	4,663
H. J. Stark, Grand Ledge												64	250
Star Coal Co., Grand Ledge													300
Grand Ledge Coal Co.													200
Total	350,000												159,231

SALT.

SALT.

The salt producing area of Michigan is the largest known in the world. The manufacture of this valuable product began in this State in 1860, in the Saginaw valley, to which section the mineral was supposed to be confined; but the discovery of salt in the valley of the St. Clair river, at Manistee and at Ludington, has extended the area in which it is produced.

The production of salt is auxiliary with the manufacture of lumber in this State.

THE SALT DISTRICTS.

The salt producing territory of the State is divided into nine districts, having a manufacturing capacity as follows:

District No. 1, Saginaw County--

Has 52 salt companies, with 45 steam, twelve pan blocks, and 4,000 solar salt covers, having a manufacturing capacity of 1,400,000 barrels of salt.

District No. 2, Bay County—

Has 29 salt companies, with 32 steam blocks and 500 solar salt covers, with a manufacturing capacity of 1,300,000 barrels of salt.

District No. 3, Huron County—

Has nine salt companies, with four steam, five pan blocks and with a manufacturing capacity of 250,000 barrels of salt.

District No. 4, St. Clair County—

Has 12 salt companies, with 10 steam and two pan blocks, and with a manufacturing capacity of 600,000 barrels of salt.

District No. 5, Iosco County—

Has nine salt companies, with nine steam blocks, having a manufacturing capacity of 300,000 barrels of salt.

District No. 6, Midland County—

Has three salt companies, with two steam and one pan block, having a manufacturing capacity of 100,000 barrels of salt.

District No. 7, Manistee County—

Has nine salt companies, with 10 steam and one vacuum pan block, having a manufacturing capacity of 900,000 barrels of salt.

District No. 8, Mason County—

Has three salt companies, with two steam blocks, one vacuum pan, having a manufacturing capacity of 300,000 barrels of salt.

District No. 8, Gratiot County—

Has one salt company, with one steam block, having a manufacturing capacity of 15,000 barrels of salt—did not run season 1888.

RECAPITULATION.

From the above we find there were 137 firms engaged in the manufacture of salt during the inspection year of 1888, operating 114 steam and 17 pan blocks. Total number of blocks, 130, and 4,500 solar salt covers, with an estimated manufacturing capacity of 5,165,000 barrels of salt.

The following table shows the amount of various grades of salt inspected in Michigan since 1869, the first year of the establishment of the State inspection law.

Comparative Table.

Year.	Fine.	Packers.	Solar.	Second quality.	Common coarse.	Total.
1869	513,908	123,908	15,264	19,177	.....	516,288
1870	568,326	17,869	15,507	19,650	.....	621,352
1871	655,923	14,677	37,645	19,930	.....	728,175
1872	672,034	11,110	31,461	19,876	.....	724,481
1873	746,702	23,671	32,267	20,706	.....	823,346
1874	960,757	20,090	29,391	16,741	.....	1,026,979
1875	1,027,866	10,233	24,336	19,410	.....	1,081,856
1876	1,402,410	14,233	24,233	21,668	.....	1,462,729
1877	1,590,841	20,839	22,818	26,818	.....	1,660,997
1878	1,770,361	19,267	33,541	32,615	.....	1,855,884
1879	1,997,350	15,641	18,020	29,027	.....	2,058,040
1880	2,589,037	16,691	22,237	48,623	.....	2,676,588
1881	2,673,910	13,885	9,683	52,821	.....	2,750,299
1882	2,928,542	17,208	31,335	60,222	.....	3,037,317
1883	2,828,987	15,424	16,735	33,525	.....	2,894,672
1884	3,087,034	19,308	16,957	38,508	.....	3,161,806
1885	3,230,626	15,480	19,849	31,428	.....	3,297,403
1886	3,548,731	22,221	31,177	71,235	3,893	3,677,257
1887	3,198,070	19,385	13,903	73,905	173,378	3,944,309
1888	3,720,319	18,126	26,174	87,694	13,915	3,866,228
Total						41,907,006
Salt manufactured prior to 1869						3,282,117
Total amount of salt produced in Michigan to date						45,189,123

The following figures show the average net price received by manufacturers for salt:

Average price per barrel,	1866	$1 80	
" " "	1867	1 77	
" " "	1868	1 85	
" " "	1869	1 58	
" " "	1870	1 32	
" " "	1871	1 46	
" " "	1872	1 46	
" " "	1873	1 37	
" " "	1874	1 19	
" " "	1875	1 10	
" " "	1876	1 05	
" " "	1877	85	
Average price per barrel,	1878	$ 85	
" " "	1879	1 02	
" " "	1880	75	
" " "	1881	83⅜	
" " "	1882	70	
" " "	1883	81	
" " "	1884	75⅝	
" " "	1885	70	
" " "	1886	66	
" " "	1887	57 4-10	
" " "	1888	58 5-10	

The charge has been broadly made that the Michigan salt product is unfit for curing meats and for dairy purposes, notwithstanding the fact that more than three-fourths of the beef, pork and butter packed in the United States every year is cured with domestic salt. As to the quality of this domestic salt, it is guaranteed to be equal to any salt in the world, either for salting pork, beef or butter, and the Salt Association have $10,000 to meet this guarantee, and stand ready to deposit that sum with a like sum to be put up by any other organization or individual in the world to enter into a series of tests with competent judges to be agreed upon to determine the superiority or otherwise of the high grade of Michigan salt over all other salts, either as to flavor or "staying qualities."

For further details of the salt production, reference is made to the report of George W. Hill, late Salt Inspector, from which the foregoing statistics have been extracted.

SLATE.

SLATE.

The slate production in Michigan is confined to the Michigan Slate Co. at Arvon, near Huron bay, Baraga county. The operations of the company have for the past year or two been chiefly confined to exploration and to producing a small amount of slate for market; about enough, they inform me, to pay expenses. In former reports full descriptions of the slate interests will be found, especially in reports for 1877-81-85, etc. I find nothing to add to what has heretofore been said. C. M. Turner, Superintendent, Arvon or L'Anse, Mich.

PIG IRON.

PIG IRON.

Statistics of Production of Pig Iron in Michigan Blast Furnaces, 1888 and several previous years:

Name of Company.	1884.	1885.	1886.	1887.	1888.
Eureka Iron and Steel Works, Wyandotte	6,000	10,904	11,668½	12,484	10,765
Gaylord Iron Company, Detroit	7,200	4,803	8,093	6,760	8,858
Detroit Iron Furnace Company, Detroit	6,205	13,619½	6,741	15,272	17,466
Union Iron Company, Detroit	8,000	3,303	6,000	8,753	8,782
Peninsular Iron Company, Detroit	7,200	7,439	5,263	9,207	9,303
Bangor Furnace Company, Bangor	----------	6,891½	12,941	8,361	7,686
Elk Rapids Iron Company, Elk Rapids	----------	16,077½	17,434½	14,888	15,726
Spring Lake Iron Company, Fruitport	----------	17,217	17,768	18,381	14,811
Jackson Iron Company, Fayette	----------	8,456	10,581	13,325½	14,706
Vulcan Iron Company, Newberry	----------	11,426	17,360	11,854	16,580
Deer Lake Iron Company, Ishpeming	----------	9,245½	10,898½	10,165½	8,717
Iron Cliff Company, Negaunee, Pioneer	----------	15,718	11,079	18,787	23,235
Antrim Iron Company, Mancelona	----------	----------	9,414	16,240	18,158
Pine Lake Iron Company, Ironton	----------	----------	5,070	10,342	12,320
Martel Furnace Company	----------	----------	7,666	10,830	9,552
Gogebic Furnace Company	----------	----------	----------	3,700	----------
Total	----------	125,190	148,952	----------	----------

The Gaylord Iron Co.'s furnace was in blast 355 days. W. M. Gaylord, Treasurer; N. Woods, Clerk, Detroit.

Union Iron Co.'s furnace was in blast 291 days, making an average output per day of 30 tons using an average of 88 6-10 bushels of charcoal to the ton. The total number ef tons of ore smelted was 14,572 which gave an average yield of iron of 60 %. William Gerhauser, Secretary, Detroit.

The Pine Lake furnace was in blast during 1888 192 days, making in that time the product of 12,320 tons. Location of furnace Ironton, Mich., and office Chicago, Ill. H. C. Dolph, Treasurer, Adams and La Salle streets.

The Elk Rapids furnace, situated at the place of the same name, was in blast during 1888 288 days. E. S. Noble, Secretary.

The Deer Lake furnace was in blast 330 days. W. H. Root, President, Ishpeming, Mich.

Martel furnace, St. Ignace, Mich., W. B. Vance, Secretary, was in blast 212 days in 1888.

Antrim furnace, situated at Antrim, Mich., E. Fitzgerald, General Manager, was in blast 360 days.

Peninsular Iron Co.'s record for 1887 is: Number of days run, 365; gross tons of iron made, 9,207; number of tons of ore used, 16,038; pounds of charcoal consumed, 16,373,030; pounds of charcoal used to ton of iron made, 1,780; average per cent of iron in ore, 57 4-10%. Record of the same furnace for 1888 is: Number days in blast, 366; gross tons pig iron made, 9,303; gross tons of ore smelted, 15,556½; number of pounds of charcoal used, 16,211,030; number of pounds of charcoal to ton of iron, 1,742; per cent of iron obtained from ore used, 59 8-10. Solon Burt, Secretary, Detroit, Mich.

Bangor furnace was in blast 180 days and made an average of 42¾ tons of iron per day.

Fruitport furnace was in blast 269 days, making 55 tons, average, per day. J. C. Ford, Superintendent.

Eureka Iron & Steel Co.'s furnace was in blast about seven months during 1888. J. S. Van Alstyne, Agent.

TABLE of Mine Products, 1888, and specific tax thereon as reported to the Auditor General, State of Michigan, by the Commissioner of Mineral Statistics:

Name of Company.	Tons of Ore.	Specific Tax.
American Iron Co.	13,669	$ 136 69
Aurora Iron Mining Co.	179,650	1,796 50
Ashland Iron Mining Co.	164,134	1,641 34
Anvil Mining Co.	24,677	246 77
Beaufort Iron Co.	8,282	82 82
Braastead Mines	88,636	886 36
Bessemer Consolidated Iron Co.	69,145	691 45
Buffalo Mining Co.	30,801	308 01
Brotherton Mining Co.	40,639	406 39
Champion Iron Co.	174,681	1,746 81
Cleveland Iron Mining Co.	182,733	1,827 33
Colby Mine	285,195	2,851 95
Chapin Mining Co.	290,872	2,908 72
Cambria Mining Co.	59,009	590 09
Dexter Consolidated Mining Co.	1,821	18 21
Detroit Iron Mining Co.	19,665	196 65
East New York Iron Co.	13,650	136 50
Federal Land and Iron Co.	3,182	31 82
Grand Rapids Iron Co.	11,612	116 12
Hamilton Ore Mining Co.	8,801	88 01
Humboldt Mining Co.	11,656	116 56
Iron Star Mining Co.	21,861	218 61
Ironton Iron Mining Co.	1,755	17 55
Iron Cliff Co.	185,329	1,853 29
Iron River Co.	109,952	1,099 52
Jackson Iron Co.	101,720	1,017 20
Lake Superior Iron Co.	240,225	2,402 25
Lumbermen's Mining Co.	61,883	618 83
Lucy Mining Co.	22,276	222 76
Lillie Mining Co.	32,692	326 92
Marquette Ore Co.	7,060	70 60
Michigamme Co.	36,448	364 48
Metropolitan Iron and Land Co. (Norris)	410,763	4,107 63
Metropolitan Iron and Land Co. (Iron County)	3,490	34 90
Milwaukee Iron Mining Co.	48,908	489 08
Monitor Iron Mining Co.	2,690	26 90
Millie Mining Co.	10,722	107 22
Negaunee Mining Co.	45,304	453 04

Name of Company.	Tons of Ore.	Specific Tax.
North Champion Iron Co.	5,685	$56 85
New York Iron Mine	11,480	114 80
Norwood Mine	3,553	35 53
North Republic	289	2 89
Nanarino Mining Co.	5,744	57 44
Paint River Iron Co.	12,506	125 06
Perkins Mine	16,684	166 84
Penn Iron Mining Co.	238,054	2,380 54
Pittsburgh and Lake Angeline Iron Co.	223,757	2,237 57
Palms Iron Mining Co.	23,184	231 84
Pabst Mining Co.	49,977	499 77
Pittsburgh and Lake Superior Mining Co.	56,321	563 21
Queen Mining Co.	5,527	55 27
Rolling Mining Co.	402	4 02
Republic Iron Co.	235,064	2,350 64
Republic Reduction Co.	20,846	208 46
Riverside Iron Co.	5,761	57 61
Ruby Iron Mining Co.	3,056	30 56
Sheldon & Shafer Mine	10,936	109 36
Sampson Iron Mining Co.	4,512	45 12
South Buffalo Mining Co.	24,707	247 07
South Mastodon Iron Co.	2,722	27 22
Sunday Lake Mining Co.	24,742	247 42
Titan Iron Co.	2,845	28 45
Youngstown Iron Mining Co	12,700	127 00
York Iron Co.	118,090	1,180 90
Wheat Mining Co.	4,982	49 82
West Republic Mining Co.	9,861	98 61
Wetmore Mine	2,115	21 15
Walpole Mine	870	8 70

Products of Copper Mines and Specific Tax thereon, reported to the Auditor General of Michigan—1888—by Commissioner of Mineral Statistics.

Name of Company.	Product.		Specific tax.
	Tons.	Pounds.	
Atlantic Mining Co.	1,987	972	$1,490 61
Allouez Mining Co.	157	198	117 82
Calumet & Hecla Mining Co.	25,147	1,721	18,860 90
Central Mining Co.	908	717	681 27
Copper Falls Mining Co.	580		435 00
Franklin Mining Co.	1,827	1,751	1,370 92
Evergreen Bluff Mining Co.	13	888	10 08
Hilton Mining Co.	7	631	5 49
Huron Copper Co.	1,187	1,147	890 68
Kearsarge Mining Co.	414	1,185	310 94
Osceola Consolidated Mining Co	2,067	320	1,550 37
Quincy Mining Co.	3,183	1,889	2,387 95
Ridge Copper Co.	25	890	19 09
Tamarack Mining Co.	5,704	1,217	4,278 46
Mass Mining Co.	35	944	26 60

Product of Coal Mines and Specific Tax thereon as reported by Commissioner of Mineral Statistics to the Auditor General of the State of Michigan, 1888.

	Tons of coal.	Specific tax.
R. H. Emerson & Co.	30,103	$150 40
Eureka Coal Co.	300	1 50
Corunna Coal Co.	14,735	73 67
Bennett Sewer Pipe Co.	4,663	23 31
H. J. Stork	250	1 25
Star Coal Co.	300	1 50
Star Coal Mining Co.	7,000	35 00
Grand Ledge Coal Co.	200	1 00
Spring Arbor Coal Co.	600	3 00

Statitsics of fatal accidents that have occurred in the mines in the Upper Peninsula during the year 1888, as reported to the boards of supervisors of the several counties by the mine inspectors thereof.

Houghton County, Josiah Hall, Mine Inspector.

Date.	Name of Man.	Name of Mine.	Cause of Death.
January 10	Richard Runkhald	Tamarack	Fall of rock.
January 19	Erick Niska	Osceola	Jammed by skip.
February 6	Kusto Launela	Franklin	Fell in shaft.
March 2	John Mahoney	Quincy	Fall of hanging wall.
March 2	Christian Yaas	Quincy	Fall of hanging wall.
April 20	John Murphey	South Hecla	Fall of rock.
May 5	Jacob Ginter	Osceola	Fall of hanging wall.
June 6	Thomas Jaukaneak	South Hecla	Fall of rock.
August 10	Mathias Porter	Tamarack	Fell in shaft.
August 24	Joseph Simmins	Tamarack	Fall of rock.
September 5	Thomas Anderson	South Hecla	Fall of rock down shaft.
October 19	Thomas Eagger	Franklin	Fall of rock.
November 6	Mike Keyjan	Calumet	Fall of hanging wall.

November 29, Antony Gattarara, Joseph Massoglia, Matt Rom, Joe Flek, Andrew Hansen, Gustav Tawa, Antony Kowalinsky, John Vanderbilt—all lost through the fire in Calumet & Hecla mine; bodies not yet recovered.

Keweenaw County, Joseph Rickard, Mine Inspector.

Date.	Name of Man.	Name of Mine.	Cause of Death.
October 10, 1888	William Connelly	Copper Falls Mine	Riding in shaft.
November 28, 1888	William Martin	Central Mine	Fall of rock.

Iron County, Elisha Morgan, Mine Inspector.

Date.	Name of Man.	Name of Mine.	Cause of Death.
June 7	Peter Mosier	Iron River	Fall of ore after blast.
June 18	John O. Westerburg	Iron River Mines	Fall of rock in open pit.
November 7	Joseph Negoa	York Mine	Fall of ore after blast.
December 15	Wm. Hockenger	Iron River Mines	Fall of ore in open pit.

From report of J. Parke Channing, M. E., Mine Inspector of Gogebic county, Mich., from Nov. 1 to Aug. 31, 1888:

Classification of Fatal Accidents.

Nationality.		Nature of Accident.	
English	7	Fall of ore	8
Swedes	6	Fell down shaft	4
Finlanders	4	Fall of rock	4
Italian	1	Explosion of powder	2
Irish	1	Fell down winze	1
Austrian	1	Fall of shaft house	1
Scotch	1	Fall of bucket in shaft	1
Total	21	Total	21

Occupation.		Mine.	
Miners	13	Colby	6
Trammers	4	Anvil	2
Timbermen	2	Aurora	2
Captain	1	Sunday Lake	2
Lander	1	Palms	1
Total	21	Ashland	1
		Iron King	1
		East Norrie	1
		Pabst	1
Surface men	2	Norrie	1
Underground	19	Explorations	3
		Total	21

Synopsis of Report of J. Parke Channing, Inspector of Mines for Gogebic County, for the ten months beginning November 1, 1887, and ending August 30, 1888.

	Actual ten months.	Estimated one year.
Number of iron mines in county	15	15
Number of iron explorations in county, approximate	30	30
Number of gold and silver explorations in county	4	4
Number of iron mines and explorations from which accurate statistics were furnished	19	19
Persons employed underground	2,171	2,171
Persons employed on surface	889	889
Total number persons employed	3,060	3,060
Number of fatal accidents underground	19	22.8
Number of fatal accidents on surface	2	2.4
Total number fatal accidents	21	25.2
Number non-fatal accidents reported	33	39.6
Number employed per fatal accident		121.4
Number fatal accidents per thousand men		8.23
Number gross tons iron ore mined	930,401	1,116.481
Number gross tons iron ore mined per fatal accident	44,305	44,305

Menominee County, J. B. Knight, Mine Inspector.—Record of Deaths by Accident.

Mine.	Date.	Name.	Cause of Death.	V'd't of Cor. Jury.
East Vulcan	May 22, 1888	Theophalis L'lord	Boss carpenter, timber slipped from lashing.	Accidental death.
West Vulcan	April 24, 1888	Frank Vitoni	Fell into winze or rock mill.	Accidental death.
West Vulcan	May 28, 1888	Guiseppa Padra	Fell into rock chute and died from suffocation before they could be extricated.	Accidental death.
West Vulcan	May 28, 1888	Goiseppa Bello		
Perkins	Dec. 6, 1887	John Contratto	Jamming giant powder into hole with iron bar.	Accidental death.
Chapin	April 17, 1888	Nils. Larson	Injured by fall of rock from back of drift. Died May 6.	No inquest.
Chapin	Aug. 27, 1888	Per. Persson	Crushed by giving away of timbers in back of crosscut.	Accidental death.
Ludington	Oct. 24, 1887	Chas. Anderson	Killed by fall of ore while putting in timber.	Accidental death.

Record of Accidents.

Name of Mine.	No. men employed.	No. fatal Accidents.	No. Non-fatal Accidents.	No. persons killed by fatal Accidents.	No. persons injured by non-fatal Accidents.	No. men employed to each man killed.	No. men employed to each man injured.
East Vulcan	217	1	1	1	5	217	43
Central Vulcan	27		5		1		27
West Vulcan	427	2	12	3	14	143	31
Curry	23						
Perkins	48	1		1		48	
Norway	255		2		2		128
Cyclops	50						
Quinnesec	30						
Pewabic	33						
Walpole	34						
Millie	28						
Chapin	950	2	11	2	11	475	86
Old Ludington	14						
New Ludington	187	1	1	1	1	187	187
Hamilton	43						
Smaller mines	55						
Totals	2,421	7	32	8	34	303	71

Marquette County, Anthony Broad, Inspector.—Total number fatal Accidents occurring in Mines in Marquette Co. during Year ending October, 1888.

Caused by explosions, 11; by riding in skip, 4; by falling into shaft, 7; by fall of ground, 9; by rail cars in yard, 1; by unknown cause, underground, 2; by fall of derrick, 1—total 34.

They are distributed as follows: At Cleveland mine, 6; Jackson, 4; Champion 3; Republic 2; P. & L. Angeline, 2; P. & L. Superior, 2; Salisbury, 2; Cleveland Hematite, 2; Braasted, 1; Barnum, 1; Cambria, 1; Lucy, 1; Buffalo, 1; Gillett's stone quarry, 1. The total average No. of men employed was 6,381. In iron mines, 6,120; in gold mines, 120; in stone quarries, 123.

Total average labor force employed in different mines was as follows: Michigamme, 200; Champion, 629; North Champion 74; Humboldt, 72; Sampson, 58; Republic, 695; Northwest Republic, 24; Riverside, 59;

American, 45; Dexter, 23; Braasted, 260; Saginaw, 13; Kenworth, 9; Fisher, 36; Salisbury, 109; P. & L. A., 450; Lake Superior, 720; Barnum, 195; Cleveland, 509; C. Hematite, 88; East N. Y., 38; Detroit, 82; Lillie, 88; Cambria, 140; Hartford, 16; Jackson, 530; Lucy, 80; Grand Rapids, 62; Milwaukee, 102; Rolling Mill, 32; West Rolling Mill, 9; Queen, 47; South Buffalo, 88; Buffalo, 95; Boston, 16; Negaunee, 160; Palmer, 142; Wheat, 42; Ropes gold mine, 62; Lake Superior gold mine, 9; Mich. gold mine, 7; Gold explorations, 40; Furst & Jacobs, stone quarry, 100; Gillett, 43.

IRON.

IRON.

The outlook for the ore mining business is more favorable, apparently, for 1889 than it was at the same season in 1888. The season of 1888 opened with much ore on hand in Cleveland and elsewhere, while now all of last year's product is sold. Prices for ore will remain, it seems, at about the rate of last year, and the cost of transportation will not be varied. At this writing—March, 1889—the feeling among the mining men of Lake Superior is hopeful—much more so than it was a year ago. They all seem to be making preparations for a maximum product. More ore has been mined and put into stock during the winter than usual. Last spring the prospect was so discouraging that as little as possible was doing. It was feared that only a small output could be sold. Later in the season, however, the market became active, and great effort was put forth to retrieve the previous delay. Every ton of ore that could be got out was mined, sold and shipped. Thus profiting by last year's experience, the mining companies are taking time by the forelock, and have made all due preparations for the coming season's work.

One industry depends upon another; in order that iron ore may be sold, there must be activity in iron making—the demand for pig metal must be active; railroad building, etc., must be prosperous. Unfortunately, just now, pig iron is sold very low; the market is dull; furnacemen, while hoping for better things, are stocking the iron, and there is a considerable accumulation that is added to constantly.

Thus there is no silver lining in the horizon of the iron mining industry, but the clouds have not become very dense yet. The sky is partially clear, and if our mining men can sell their ore at even a small margin they will be satisfied, and will try to make up for the small profit by greater skill and economy in working, and by increase of quantity of production.

THE CLEVELAND IRON MINING CO.

is manifesting its usual energy and thoroughness in its work; nowhere are all the details more completely systematized than here, and no mining loca-

tion is kept neater and in better trim than the Cleveland. The buildings and the machinery are of the best, and there is one feature of the surface arrangements that is worthy of observation and imitation, and that is the storage yard. I am not sure as to the name they give to it, but it is simply a large yard, enclosed by a high, tight board fence, against which on the interior is built a shed that extends around the entire perimeter of the yard. All old materials—pipes, machinery, etc., of all kinds—is brought into this yard and kept in its proper place, so that when anything is wanted it is known exactly where it may be found. I do not know of just such an arrangement anywhere else; but everything is in its place and put in order to be immediately used if wanted.

The work at Lake Angeline is progressing finely and the matter of opening a mine under the lake is well advanced. At the time of my visit a force of 150 men was working on the surface grading for stock pile room, yard tracks, etc. The ground rises very steeply from the margin of the lake up to the north, and they are cutting away the side of the bluff and putting the dirt into the edge of the lake, thus widening the flat. They were also framing the timbers for a large shaft house; also for ore pockets and rock pocket. The shaft is sunk in the north margin of the lake inclining down to the south at an angle of 50° with the horizon and is now, February 1, 1889, 350 feet deep and still sinking; at present is in diorite. At the depth of 250 feet, measured along the shaft, a drift has been opened and is still pushing on under the lake. Above this drift are 73 feet thickness of rock, 33 feet of sand, then 47 feet depth of water. In driving south from the shaft ore was found at a distance of 33 feet, and they went through 100 feet of it, the ore dipping south. A diamond drill was put to work from the south end of this drift and after going through 360 feet of rock came into a second deposit of ore, which proved to be of a width corresponding with the first. It is supposed to be the up-turn of the fold to the south, the bottom of the ore basin being away below the cross-cut.

The drift is now extending to reach this ore. The ore corresponds in appearance and quality to that of the Lake Superior Co.'s hematite, mined at the west end of the lake.

It is proposed to fill the mine as ore is taken out and elaborate preparations are making to handle the necessary rock at a minimum cost. One section of the shaft will be used as an ore chute and will be kept full of rock from the surface to bottom. The rock will be drawn out of this chute as required, and trammed to the place to be filled. It is proposed to bring the rock now in the old burrows at the mine in cars to be used for filling.

The mine undoubtedly will be a large producer, though it will be wholly under the lake. The extent of the ore east and west was proved by borings with a diamond drill as explained in my last report. Analyses of the ore, as also shown in the last report, determine that the ore is very nearly Bessemer. It is thought that the south deposit will prove to be a Bessemer ore. Analyses of the drill core all indicate such a fact, and that it is 65 per cent iron. The shaft house will be 46′ 4″x38′ 8″; height from sill to plate, 69′ 8½″—7′ total to ridge. The capacity of ore bin will be 364 tons, in three compartments for three grades of ore.

The Incline pit, once the great producer, now yields but little ore; a small force is kept at work exploring and sinking and at the present time the indications are more favorable. The ore appears to be dipping down and to be making more to the south. At the south end of the pit the ore is hard granular slate.

No. 3 pit contains a great deal of what they designate as "vuggy" ore, a peculiar looking low grade hematite, for which, in such a time as this, there is not much sale, at least not at a profit. It is found mainly in the eastern part of the pit and many thousands of tons could be readily and cheaply mined when there is a sale for it.

The mining in No. 3 is confined to the hard mixed specular and magnetic ore which occurs in the western end of the pit and trends westerly with a southerly dip. They are working in this ore in four levels and in addition a drift extending from the mine into the ground, between it and the Incline pit, is also in this ore. The ore just mentioned was found by the diamond drill. Several holes were bored; the first one between the pits was 405 feet long and cut only jasper, quartzite and soapstone. The second boring immediately under the first cut 30 feet of ore at a depth of 17 feet under the first hole, while a third boring passed through 56 feet of ore at a depth of 22 feet below the second boring where the ore was found. The drift that has been opened from No. 3 to this ore will be continued to connect with the Incline pit.

The Moro pit, the principal hard ore mine of the company, is now down to the ninth level and the shaft is sinking to the 10th, and they are stoping ore in the first, third, sixth, seventh, eighth and ninth levels. The ore is better quality as the mine becomes deeper; that is, it is freer of rock, cleaner. It occurs in lenses that extend into the soap rock and jasper and that ultimately give place to the inclosing rock. There is a rise in the ore 200 feet above the first level, but at this height the ore is not in large quantity. The lenses "pitch" to the northwest while the dip is slightly

northeast. Some of the lenses stand vertical. The mine is looking better, to use a common phrase, than it did a year ago. It is safe to assume an annual production of 100,000 tons with the present outlook.

There are 45,000 tons of ore in stock at the Moro now, and Mr. Mills tells me that during the year ending May 1 next the Moro will have produced 125,000 tons of ore, besides 15,000 tons of rock, all of which must be hoisted in a single skip shaft. Pretty good work, certainly, for one skip running down to a depth of 700 feet.

The ore is specular slate, medium soft, very suitable for "fix."

At the time of my visit they were preparing to finally wreck the old saw mill pit, which is just northwest of the brownstone engine house. It is estimated that about 30,000 tons of first-class Bessemer ore still remain in the mine in the "back" and pillars. This will be mined out. A hole has been made from the surface through the "back" into the opening and through this the dirt will be run down to fill up the mine when the pillars and roof of ore will be stoped away.

The Cleveland holds in common with the P. & L. Angeline Co. a "prospect" for ore that strong hopes are entertained of. It is south of the east end of Lake Angeline near the corner of Secs. 10, 11, 14, 15, T. 47, R. 27. The Cleveland Co. owns east of the north and south section line. Ore has been found of the best quality and they are preparing to make a vigorous effort to ascertain if there is enough of it for a mine.

The Cleveland Company is building two large steel steamers of 2,500 and 2,800 tons capacity respectively. They will be of the most approved design, with triple compound condensing engines that will secure a speed of 14 miles an hour. They are to be, especially, ore carriers and will make the round trip between Superior and Lake Erie ports in six days. The Cleveland is one of the oldest iron mining companies in the State and holds all its estate in fee simple. The officers are Samuel L. Mather, President and Treasurer; William G. Mather, Vice-President; Fred A. Morse, Secretary, all of Cleveland, Ohio. F. P. Mills, agent, Ishpeming, Mich.; Alfred Collick, Mining Captain, Cleveland hematite; Harry Wills, Mining Captain, hard ore mines.

The following shows the annual shipments:

Year.	Tons.	Year.	Tons.
1854	3,000	1872	151,724
1855	1,444	1873	133,265
1856	6,343	1874	105,855
1857	13,201	1875	129,881
1858	7,909	1876	145,661
1859	15,787	1877	151,554
1860	40,041	1878	143,320
1861	11,794	1879	113,108
1862	40,364	1880	187,234
1863	46,842	1881	197,843
1864	49,954	1882	204,341
1865	33,355	1883	218,219
1866	42,680	1884	224,479
1867	75,864	1885	218,632
1868	102,112	1886	203,386
1869	106,133	1887	204,828
1870	133,884	1888	182,733
1871	142,658		
Total			3,882,589

The mine produced more ore than was shipped, as will be seen by the following table:

The Product from Each Pit for 12 Months ending December 31, 1888.

Months.	Incline Pit.	No. 3 Pit.	Moro Pit.	Other Pits.	Hematite.
January	3,538	8,853	4,608	38	1,744
February	3,400	8,023	6,054	46	1,822
March	2,607	6,866	4,517	10	1,721
April	2,160	6,782	5,058		2,206
May	618	8,370	7,457		969
June	1,333	6,702	7,390		1,397
July	1,421	4,284	7,531		1,414
August	2,728	3,986	7,831	41	3,441
September	625	5,200	10,904	36	3,427
October	399	5,801	13,893	130	3,102
November	291	4,909	6,998		3,232
December	377	5,814	4,931		2,862
Total	19,497	75,589	87,172	301	27,337

Total hard ore mine	182,559 tons.
Total Hematite mine	27,337 tons.
	209,896 tons.

THE JACKSON MINE

is an anomaly. It differs from others of the old mines materially. It contains both hard and soft ore in the same pits. The formation is not so easily made out; it is broken jasper and chloritic schist limited on both sides of the basin, north and south, by diorite. The deposits, formerly, were large and of excellent quality of ore, but were comparatively shallow. The location is full of great yawning chasms open to the light and of chambers beneath the surface from which the ore has been taken; but they are all practically exhausted. There is not much ore in sight in the old pits, which were once the glory of the mine. No. 6 is gone and in No. 5 there is only one stope and of that the end is not far distant. Nos. 7 and 8, away to the east with underground workings extending beneath the city, still hold their own and produce about the usual quantity of ore. But No. 7 is non-Bessemer and thus, while good ore, it brings a low price and lessens the profit in mining it.

The South Jackson, over the hill away south of the old mine and west from the McCumber, is in good shape, and will afford its usual product. The mine is now all worked underground and they are opening it out in good shape for the ensuing year's work. There is nothing new about this or the other old pits. I have described them so fully heretofore, especially in my report for the year 1885 and previously, that I do not deem it necessary to dwell upon them further. But the new exploring work undertaken by Capt. Mitchell when he first came in charge of the mine and continued since, is turning out finely.

Some diamond drill borings made west of the old north pit disclosed the existence of ore in quantity and of the best quality, and Capt. Mitchell began the sinking of an inclined shaft to it. This shaft, begun two years ago, is just down to the ore. It proved to be a troublesome job owing to water and sand. A year ago however, at the time I visited the mine, he had just begun to sink a downright shaft which reached to the ore at a depth of 90 feet. Here they are mining in a fine deposit of ore, which is dipping to the west and southwest about 24°. They have gone up north on the foot wall from the shaft 65 feet and west 200 feet. The ore is 16 feet wide at shaft and west but grows thinner up the foot wall north. This ore continues west a long way, probably; since two drill holes made on the line of it west passed through the ore. The one farthest away was made by

Capt. Merry, and he told me himself, nine years ago, that he cut 30 feet of ore. Undoubtedly Capt. Mitchell has got into this same body of ore and is fortunately likely to have a good deal of it. It is, possibly, a part of the fold that underlies the whole basin to the south and the ore may continue with it. At any rate it continues west as proved by the drill holes and it continues north, for the inclined shaft to the north that has been so long sinking, is down to the ore, apparently the same body. This ore is first-class hard specular, Bessemer; 62.50% iron, .040% phosphorus, and proves a great acquisition to the company.

Heretofore no compressor power has been employed at the Jackson; it has been all hand drilling. They have now a Rand compressor at this new shaft nearly ready to work, when they can accomplish more and at less cost.

As before stated the mines of the Jackson Company are not deep. Nos. 5 and 6, the largest, are about 350 feet to the bottom; the ore formation continues and possibly at greater depth more ore may be found. The company employs about 300 men—160 in west pits, 80 at Nos. 7 and 8; Nos. 7 and 8 pits yield about 2,800 tons per month.

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	118,939
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	125,968	1886	89,525
1870	127,642	1887	109,947
1871	132,297	1888	101,720
Total			2,796,559

Samuel Mitchell, President and General Manager, Negaunee, Mich.

THE LAKE SUPERIOR IRON CO.'S

mines are now confined chiefly to No. 2 hard ore mine, the hematite and Sec. 16, west of the Pittsburgh and Lake Angeline. The No. 2 has formerly been the chief deposit of the company but they are to the bottom of the ore basin, they think, and no sinking has been done for two years. The project now is to take out the pillars and rob the mine. There are 15 levels, the lowest is the 720-foot; that is it is 720 feet below datum. The levels are quite uniform in length, 500 to 600 feet long east and west, and 20 feet to 50 feet wide, and in all of them are heavy floors and pillars of ore, the latter especially, at the shaft. In fact they estimate that 40% of the ore is still in the mine in floors and pillars. The shaft is at the east end of the deposit and descends S. 62° W., while the ore body runs S. 70° E.

In mining out the floors, etc., the plan is to fill the mine with rock, running it down from the surface through a chute that is made by connecting the winzes up through the mine from the bottom, as it so happens that these winzes are in the same line, the one under the other. Rock can be obtained from old waste pits and from walls of the open pits. They are also sinking No. 6 shaft which is just west of the mine, and are both sinking and raising in it at several places. When completed it will be used in hoisting the ore, etc., in this final work of exhausting the mine, that is in taking the pillars from No. 2 shaft. They have already begun to take out the arch of ore or floor in the 640-foot level. They do not begin at the bottom for the reason that it would interfere with the work of sinking, etc., No. 6. They will work from the bottom up, level by level, and make connection with No. 6 shaft at each level. No. 6 was only to the 280; it will go to the 720. The levels in No. 2 began to narrow at about the 560; above that the ore was 50 feet wide.

No. 3 shaft is sunk to the 520-foot level, where the ore terminates—goes into No. 2.

No. 7 is sunk to the 720 and they drove in the bottom from both shafts to connect, which they did exactly, an evidence of Mr. Sturtevant's good engineering. This drift is 920 feet long and a little good ore was found in it. The drift followed a drill hole, which gave in this case a great length of ore, but it proved to be in narrow seams. All the machinery at No. 7 is idle. The water now goes to No. 2 where the pumping plant is sufficient for this addition and the hoisting is done there for No. 7. It looks as if it will be difficult for the mine to make its usual product. There are not many stopes in any part of the hard ore mine and the proposed plan of

mining floors and pillars, one level at a time, will not furnish ore rapidly.

Section 16 mine is not very large yet, and so far as they have been able to determine is not likely to be of great magnitude. It is good ore, however. The deposit is in dimensions about 200 feet east and west, and 150 feet north and south. They bored two drill holes from the bottom south—one horizontal 600 feet, the other at 12° depression—one 500 feet long and had in it 29½ feet of ore. Borings made also to the north and west cut considerable ore, but except near the mine the ore thus found is low grade. The mine furnishes ore that gives a percentage of 68% in iron and is low in phosphorus. Still the product of this mine is not all Bessemer, but it is all specular ore. About 200 tons per week of Bessemer and 600 to 800 tons non-Bessemer. The mine is well equipped with machinery, placed in a stone engine house. The bottom level is 350 feet below surface, and the shaft is sunk 80 feet below that depth. The ore extends 70 feet west of shaft and 90 feet east of it. In the upper level the ore is all taken out, and the space filled with rock, except some necessary openings left. In the bottom level they have gone up 2 sets high. They will mine out all the ore and fill, following the same system as in the hematite. Thus far the rock for filling has been supplied by the shaft sinking and rock drifts, etc. Mine employs 40 men.

The exploring west of the old Lowthian on section 21 is still in progress. The shaft is 200 feet deep and in ore, but not a high grade ore—61 per cent and non-Bessemer. At a depth of 140 feet, they drifted 130 feet west, and also a lesser distance east. The exploring work will be continued.

The Lake Superior Hematite is the most valuable mine that the company possesses at present. I have fully described it in former reports and do not find much of anything new to offer about it. It will be remembered that the ore lies in a synclinal fold—in a trough of the formation—in a belt between the jasper underlay and the overlying quarzite. The deposit is all ore in the bottom, but as it rises up on each side of the fold it separates and becomes the north and the south vein. The deposit terminates at the west end against the foot wall, and the bottom of the fold inclines downward, slightly, as it extends east. There are two shafts, 360 feet apart, both to the 444 ft. level. But in No. 1, the east shaft, there is no ore below the 400. In fact scarcely any below the 360. The mine has been extended a long way east, clear to beneath the margin of the lake. The system of mining works admirably, and differs from that practiced anywhere else in the region. They mine the ore out in sections across the deposit, each section 21 feet wide, leaving pillars between. The rooms thus formed are timbered in "sets," after the usual Nevada system; but there is this peculiarity: the rooms are filled with rock as fast as the opening work proceeds. Each room

is three sets wide, the middle one of which in the lower sets is kept open for tracks to run the ore down into cars. When the lower sets of a room are in they rise up for the other sets on top of the first, and while the third rise is made the lower ones are filled. And when making the 4th, the 2d rise of sets are filled, and so on, the filling coming down from above and the ore going down through the mills into the chutes below. In this way the rooms are all filled wherever they are made, and the mine is as solid as before. No pillars have been taken, except west of No. 1 shaft where the deposit was comparatively small. When the pillars are attacked the work will proceed in the same manner as now and with the same facility and safety.

The management at the Lake Superior is unquestionably excellent and the company is fortunate in having so experienced and faithful mining captains as are Messrs. John McEncroe and James Trebilcock, of the hard and soft ore mines respectively, and it would be hard to find a mining engineer who performs his duties better than does Mr. H. B. Sturtevant. The company proposes to load its ore with a steam shovel.

Year.	Tons.	Year.	Tons.
1858	4,656	1874	104,311
1859	24,668	1875	119,335
1860	33,015	1876	110,570
1861	25,145	1877	127,349
1862	37,704	1878	104,674
1863	78,976	1879	174,747
1864	86,773	1880	204,094
1865	50,201	1881	252,235
1866	68,002	1882	296,504
1867	114,935	1883	200,799
1868	105,745	1884	204,796
1869	125,560	1885	226,040
1870	166,582	1886	268,035
1871	158,074	1887	302,909
1872	145,070	1888	241,225
1873	158,428		
Total			4,380,222

The product of 1887 is made up as follows:

Hard ore, No. 1	135,494 tons.
Hard ore, No. 2, (2d class)	3,540 tons.
Hematite	101,191 tons.
Total	240,225 tons.

Joseph S. Fay, Treasurer, Boston, Mass.; C. H. Hall, Agent, Ishpeming, Mich.; W. H. Johnston, Superintendent, Ishpeming, Mich.; H. B. Sturtevant, Mining Engineer; John McEncroe, Captain hard ore mines; James Trebilcock, Captain hematite mine.

THE PITTSBURGH AND LAKE ANGELINE CO.

has probably made more money the past year than any other iron mining company in the State. The ore is of such excellent quality that it brings the highest price in the market, and since the company owns the fee of the mine it has no royalty to pay and so whatever is left over and above the cost of mining, etc., is profit to be divided among the stockholders.

The west end of the mine is hard specular ore, the east end soft ore. The latter is opened to the sixth level and the former to the seventh. But in the east end not much opening has been done below the fifth. They started "to room out" in the sixth but the ground would not hold up. I went through the mine but it is all crushed down to the fifth level, so there is not much to see except the drifts and the places where they are "drawing the ore" from the pillars. The levels are 50 feet apart and the "opening work" consisted in cutting out rooms in the ore, from the main drifts in each level, three sets wide and six sets high and timbering them after the usual manner. Between the rooms pillars of ore were left of the same width as the headings and also an arch of ore over the timbers to form a floor for each level. In this way it was thought a sufficient stability was secured to keep the mine intact, but it proved otherwise; the ore is very soft and the pillars would not sustain much pressure. Added to this some poor engineering in the matter of laying out the rooms caused some of them to be so placed that they did not come under one another. Altogether it was found that the ground would not hold. Capt. Walters tells me that he mined out the floors between the pillars and allowed the overlying sand, etc., to come in and fill the rooms and is now mining out the pillars of ore that were left standing. He states that he is losing but very little ore. He says that the pillars are not spread out laterally; the sand, etc., in the rooms does not mix with the ore to any appreciable extent. There is no other mine in just the peculiar condition that this one is, but they understand it and have to adopt ways suited to each portion of the mine.

The mine in the second level is 1,900 feet long and goes to near the line west. The ore in the second level goes 200 feet west of C shaft, and in the third level 250 feet, and so on, each level lengthening west about 50 feet.

They hoist from four shafts, A, B, C and D; the latter is the one furthest east, being 1,700 feet east of the west line, the ore going 200 feet further east.

C shaft in the west end of the mine, is sunk in rock, and has two skip roads, ladderway and timberway. The hard ore is in two lenses, so called; a small one on the foot wall side is non-Bessemer. The hanging wall lense is larger and the ore is Bessemer. In the third level this lense is 400 feet east and west, and is 120 to 140 feet wide, greatest width, while the non-Bessemer lense is about 140 feet long by 100 feet wide. But in the fourth level the dimensions are smaller, the greater lense being about 280 feet x 120 feet. In the 5th level the ore is 130 feet long and 3 sets wide.

The diamond drill is boring in this end of the mine with varying results, not extremely encouraging so far.

A new "find" of ore has been recently made nearly a mile east, at south-east corner of the section, near the line between the P. & Lake Angeline Co. and the Cleveland Co.'s lands. The ore found is equal to the best, and it remains to discover how much there is of it—a matter that the company is taking steps to determine.

The Lake Angeline mine, owing to the quality of its ore, is regarded as one of the very best of our iron mines.

The ore, in 1888, sold for a higher price, I think, than any other in the market, and I have reason to believe that the company paid a larger dividend than did any other iron mining company in Michigan. The first class ore averages 67 per cent to 68 per cent in metallic iron, and not above .030 per cent in phosphorus.

The following shows the product of 1888:

Lake Angeline hematite (Bessemer)	89,197	tons.
South Angeline hematite (non-Bessemer)	14,870	"
No. 1 hard ore (Bessemer)	84,888	"
No. 2 hard ore (non-Bessemer)	31,675	"
Total	220,600	"

A pretty good showing for an old mine that was seemingly exhausted a few years ago. Fortunately it is in wholly new ground; in ore not far from the old workings, which was easily reached, and which has proved to be so very valuable, transferring the Lake Angeline from its former position as one of the poorest in the region to a foremost place among the mines that head the list.

The Pittsburgh & Lake Angeline Co. owns its mine in fee simple, and also holds in like manner other valuable lands near by.

Annual Products.

Years.	Tons.	Years.	Tons.
1864	19,500	1877	19,113
1865	20,151	1878	28,161
1866	24,073	1879	25,420
1867	46,607	1880	14,794
1868	26,651	1881	18,000
1869	39,644	1882	14,518
1870	53,467	1883	27,259
1871	33,645	1884	87,018
1872	35,221	1885	111,051
1873	43,933	1886	131,384
1874	30,499	1887	191,121
1875	30,281	1888	220,600
1876	22,589		
Total			1,314,761

A. Kidder, Agent; Thomas Walters, Supt., Ishpeming, Mich.

THE BARNUM MINE,

which for many years has been worked just north of the line which separates it from the Lake Superior Company's No. 3 mine, shows very little change for the better or worse. The company still follows the same deposit of ore west, and close to the line, and obtains from it annually the same product. The ore is of very good quality, first-class specular, non-Bessemer. The mine belongs to the Iron Cliff Company, one of the largest mining corporations in the State, that owns an estate of about 40,000 acres of land, being a portion of the original grant of the government for building the canal at the Sault de Sainte Marie and acquired by purchase of the grantees. On the opposite side of the valley to the north is the more important mine owned by the same company and now called

THE CLIFF.

This is now one of the best equipped mines in Ishpeming, for it is right in the city and the underground workings extend easterly, probably, as far as the Nelson House, which is in the central part of the city. There is no danger to be apprehended from this fact, however, since the openings east are not thus far very extensive and in any event they are 400 feet below the

surface, beneath the great body of overlying quartzite that is remarkably firm, entirely adequate, with suitable pillars, to sustain the surface.

I notice some changes at the mine that are of value; as for instance the sheaves over which the cage ropes were run in the shafts were seven feet diameter; these have been taken out and others of 12 feet diameter substituted, which are found to work far better—less wear on the ropes.

The old hoisting plant has given way for a new one and they now have new Merritt drums 10 feet in diameter that work excellently. A new boiler house has been built and three fine steel boilers added, making the entire number now nine. The shaft houses are kept warm by steam pipes so that I observed on a cold day when I happened to be at the mouth of "A" shaft that it was comfortable. Each shaft has a single cage and no counterbalance is used. A horse is employed at "A" shaft to draw the cars from the cage out to the stock pile.

The buildings at the Cliff mine are mostly of stone with iron roofs and are commodious and substantial. Among the changes in the past year is a new office, also of stone.

The empty car goes behind the cage and is moved sideways to stand opposite it and when the loaded car is drawn off an empty one follows it on and is lowered down the shaft. It is done quickly; there is little delay.

The Cliff is a safe, well ventilated mine, and is well managed; men who work there like the mine and the officers and there are few changes among the workmen.

It will be remembered that the mine is in a fold of the formation, the axis of which runs east and west. The ore deposit constitutes one of the folds of the formation and is underlaid by jasper and covered by quartzite. The shafts, which are 835 feet apart, are sunk vertically to a depth of 472 feet, to the bottom of the fold. The workings extend all the way between the shafts and to a considerable distance east of A and west of B. At these extremes the formation is less regular and the ore is displaced by jasper far too much to be profitable. Generally, throughout the mine, there is too much jasper in the ore. They have had trouble ever since the mine was opened with the jasper. It comes in to destroy the stopes or to injure the quality of the ore.

Thus far the stoping is all above the bottom in the upturn of the fold to the north. In the first level the ore, instead of continuing its inclination upward, goes off flat to the north and opening in this horizontal portion of the fold proves to be the best ground I have seen in the mine. I visited the mine in February, 1889, at which time I found that at a point 400 feet west of A shaft, in the upper level, they had begun to room out to the

north. The first room was in 300 feet, and the stope at the north end was 18 feet high. The ore is quite clean, hard specular. The sides, roof and angles of intersection are smooth and sharply defined like those of a room; in this respect the appearance is remarkable. Another room had been started and was driving parallel with the first and 30 feet west of it; in all respects it appeared to be a duplicate of the other.

They expect to mine a larger product this year than usual and that the ore will be of better than the average quality for this mine.

The old Barnum produced in 1888 10,211 tons of ore and the Cliff shaft 78,520, making a total of 88,731 tons.

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	1879	24,911
1869	37,503	1880	24,921
1870	44,793	1881	27,281
1871	45,939	1882	41,424
1872	38,381	1883	62,752
1873	44,368	1884	67,782
1874	40,255	1885	47,458
1875	40,914	1886	82,686
1876	37,750	1887	95,586
1877	38,314	1888	88,731
1878	26,680		
Total			973,060

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

THE PIONEER

is also one of the Iron Cliff Co.'s mines, situated in the N. W. ¼, S. W. ¼ Sec. 4, T. 47, R. 26, being east of Negaunee in the range with the Buffalo, etc., mines. It is simply an open pit mine near the section line and, I judge, has been practically exhausted. However there were shipped from it in 1888 8,712 tons of ore making a total of production of 13,852 tons.

THE FOSTER

is another one of the Iron Cliff Co.'s mines which has been operated since 1865. The mine is in the company's lands in Secs. 22 and 23, T. 74, R. 27.

The product is rather of a low grade non-Bessemer hematite ore, about 53% to 55% in metallic iron and .094% phosphorus. It is used at the Pioneer furnace, Negaunee, Mich. In 1888 there were mined 13,000 tons and the total product since 1865 is 167,336 tons. Alex Maitland, General Manager Iron Cliff Co., Negaunee, Mich.

THE NEW YORK IRON MINE

situated in the city of Ishpeming, and being close to the Cleveland mine, has not been worked for several years. The mine was formerly a very valuable one, and was the source of large profit to its owners, but so far as known now there is not, comparatively, much ore left in the mine.

There were shipped from the mine in 1888 11,480 tons of ore, and the aggregate product amounts to 1,051,149 tons.

L. McCloskey, Gen'l Supt; August Beerling, Supt. at mine.

THE EAST NEW YORK IRON CO.'S

mine adjoins the Cleveland and New York mines, being east of the latter and north of the former. The ore is hematite, and as far as I can judge, runs about northwest and southeast, lying between the two shafts, which are east and west of each other, about 500 feet apart. A knob of jasper that rises abruptly marks the point where much exploring has been done, and near which the ore is found. The shafts are just south of this knob—one near each extremity.

No. 1, the southwest shaft, is 90 feet deep, and the drift is north through the ore. East of the cross-cut drift they have cut out several rooms—each two to four sets high and three sets wide.

No. 2 shaft, on the southeast corner of bluff, is 100 feet to 1st level, and they have drifted from the shaft south 200 feet, first through 40 feet of rock, thence in ore. The shaft is 50 feet deeper, to second level—in all 150 feet deep, at which depth they are also drifting, both to south and to north. East of the bluff is a swamp, and south is a valley 600 feet wide, terminated by a diorite hill. The shafts are both small; only buckets are used. No. 1 being so far away to the south of the ore, will not be sunk any deeper, but a third shaft will be located and sunk. The drift from No. 1 north passes a length of 75 feet diagonally through the ore deposit and again reaches into ore north of the jasper, 500 feet from the shaft in the level land beyond.

The indications are favorable that at greater depth the ore will become cleaner—that is, be freed of the rock that to some extent is now mixed with it. I have seen no analyses of the ore, but am told that it is Bessemer, and

about 60 per cent in iron. As now mined the ore requires considerable picking over to make it merchantable.

The drift north at the 100 ft. level in No. 2 shaft was in ore at 60 feet north of shaft, probably the same ore cut in the end of the drift north from No. 1.

The machinery consists of two drums, each 3½ feet in diameter; a 16 horse power engine, a No. 8 Knowles pump; 2 boilers. Work now 55 men.

The mine produced in 1888, 13,650 tons of ore.

W. H. Johnston, Agent; Geo. Bodenne, Mining Capt., Ishpeming, Mich.

The force employed at present time—January, 1889—is 60 men. The estate consists of 160 acres, held on a lease.

THE AMERICAN,

formerly the Sterling mine, while not as yet a large mine, has such excellent specular slate ore that in any event the mine is worth every effort to explore. But in fact ore in fair quantity is known to exist in the mine, and they are sure to get into it in time. Even now the mine is looking well, and the ore deposit is increasing in size. An investigation into the cause of a bulge in the foot wall, recently, led to the discovery of a lense of ore, at first only a foot in width, but now, having been followed some distance, it is eight feet wide. This may be the same lense of ore that was cut with the diamond drill some years ago, further west, as explained in a former report.

The shaft is 300 feet deep, and they have gone west from the line 340 feet. The company has leased the Boston, which joins it on the west, and which has been idle for four years past. The mine is in the S. W. ¼, S. W. ¼ Sec. 32, T. 48, R. 28, being about two miles north of Clarksburg.

There were mined and shipped in 1888, 13,670 tons of ore, 860 tons of which were taken from the Boston mine, making the total output 28,812 tons.

The company has a sufficient hoisting equipment for all present needs, and the using of the Boston mine compressor and air drills makes the full complement of machinery. The formation here is a typical one, being identical with that at the Champion and the best hard ore mines.

The officers are: C. R. Ely, Secretary and Treasurer; Wm. H. Johnston, President, Ishpeming.

THE BOSTON MINE

which joins the American on the east, is owned in fee simple by the company; the estate comprising 80 acres. The mine has been so fully described in

former reports that no description will be given here. It is a well equipped mine—machinery, buildings, etc. The formation is very regular, and all the geological features are favorable.

The mine has been idle for several years, and is now leased by the American, which company took out of the Boston, through the American shaft, 860 tons of ore in 1888. So that the mine has yielded in toto, 62,575 tons.

S. L. Mather, President, Cleveland, Ohio.

THE NONPAREIL,

formerly the St. Lawrence, has not been operated in 1888. The ore is of poor quality and not worth mining at present prices. It is situated northwest of Ishpeming in the N. W. ¼ Sec. 5, T. 47, R. 27. John R. Wood, Agent. The mine has furnished 23,171 tons of ore.

THE DEXTER CONSOLIDATED MINE,

being in the E. ½ N. E. ¼ and W. ½ N. W. ¼, Sec. 3, T. 47, R. 28, is working still, but not with very brilliant prospects of mining success. The work is almost wholly exploratory, and as the rock is very hard, slow progress has been made; now that a new Rand compressor, 15x30, and four power drills have been added recently, much more can be accomplished. The mine holds lean hematite in considerable quantity and also some fine hard ore is found; but scarcely enough of it yet. The formation is jasper underlaid with quartzite or kindred rock, the reverse of their usual positions. The product in 1888 was 1,821 tons thus making a total to date of 26,360 tons.

F. O. Clark, Agent, Marquette, Mich.; Thomas Walters, Superintendent, Ishpeming.

THE NORTH CHAMPION IRON CO.

has operated its mine in the E. ½ N. E. ¼ Sec. 29, T. 48, R. 29, one mile north of Champion station, and produced 5,685 tons of ore. The quality is 55 to 59 per cent in iron and .18 to .21 per cent phosphorus.

The company restricts its mining work to its ability to sell the ore. No doubt a far greater amount of ore could be produced if a market for it could be found. The mine was opened in 1887, during which year 883 tons were sent out.

S. Brownell, General Manager; Henry C. Hart, President, Detroit, Mich.

THE MAT GIBSON,

N. ½ S. E. ¼ Sec. 29, T. 48, R. 29, has produced no ore in 1888. Total product in previous years, 16,357 tons.

Mat. Gibson, Superintendent, Republic, Mich.

THE PASCOE IRON CO.,

holding S. ½ N. E. ¼ Sec. 29, T. 48, R. 29, still remains idle. It was formerly the most conspicuous of the north range mines; has yielded in all 58,667 tons of ore.

D. H. Merritt, President, Marquette, Mich.

THE PHŒNIX IRON MINING CO.,

holding the lands next west of the Pascoe, has not worked its mine during the past year. Total production in previous years, 54,114 tons.

Peter White, Esq., Agent, etc., Marquette, Mich.

THE WETMORE MINE,

in the N. W. ¼ Sec. 25, T. 48, R. 31, west of the village of Michigamme, has been worked in a small way the past year, corresponding with the work in former years; 2,115 tons of ore were taken out. A very full description of this property will be found published in the Commissioner's report for 1886. Total production, 31,221 tons.

E. A. Wetmore, Agent, etc., Marquette, Mich.

THE WEBSTER MINE,

which joins the former on the west, presents nothing new to record. The mine has not been worked in 1888. Total shipments to date, 14,668 tons.

In my last report I described quite fully some exploratory work that had been done by Mr. J. C. Fowle, of Michigamme.

The properties in which this work was done are the S. ½ S. W. ¼ Sec. 23, T. 48, R. 31, and the S. ½ S. E. ¼ Sec. 22, T. 48, R. 31, owned by the Michigan Iron & Land Co., and held on an option or lease by Mr. Fowle. Since no further work has been done, my previous description covers all, I think, that is necessary to be said.

THE NORWOOD,

however, the next 80 west, being the S. ½ S. W. ¼ Sec. 22, T. 48, R. 31, being in a much more advanced state of development, is made to produce ore for shipment. There are two shafts, 50 feet deep. A total of 5,753 tons of ore have been mined and shipped. The ore is of the same kind and quality as is found in the other mines of this range—55 per cent to 60 per cent iron, and .15 to .25 per cent phos.

J. C. Fowle, Agent, etc., Michigamme, Mich.

THE BEAUFORT MINE,

lying west of the Norwood, in the W. ½ N. W. ¼ Sec. 22, T. 48, R. 31, has been so frequently described and so little worked of late, that there is not much of interest to mention beyond what has been formerly said. The mine produced in 1888, 8,282 tons of ore, making a total to date of 97,848 tons.

H. S. Hazelton, Secretary, 151 Insurance Building, Milwaukee, Wis.

THE TITAN

joins the Beaufort on the west. The division line passes through the workings. The mines are similar, and the ore is the same. If the ore were of salable quality a large amount could be mined. Both mines are well equipped with machinery and buildings. The Titan yielded in 1888, 2,845 tons of ore, making the total product 89,513 tons.

S. S. Curry, Secretary, Milwaukee, Wis.

THE SPURR MINE

remains idle. The company owns the fee of the land—N. ½ S. W. ¼, S. ½ N. W. ¼ Sec. 24, T. 48, R. 30.

SECTION 23

joins the Spurr on the west, and a mine in it, formerly known as the Stewart, was worked a little ten years ago. As explained in my last report, Mr. J. C. Fowle was then engaged in further exploring the property, in the vicinity of the open pit. He had found ore in the foot wall and had sunk pits further west and ascertained that the ore continued—hard, granular ore, 65 per cent in iron and and .27 per cent to .30 per cent phos.

Mr. Fowle, who holds the lease of the land, has a few men at work at the present time.

From section 23 east to Michigamme lake, a distance of three miles, is a strong magnetic ore formation.

THE MICHIGAMME CO.

may be congratulated on the improved appearance of the mine, for it is really looking better than it has at any time for several years.

The mine is situated in the southerly side of the hill north of the west end of Lake Michigamme.

No. 1 shaft, the most easterly one, is 500 feet west of the lake margin and thence to No. 7, the most westerly shaft, it is 2,800 feet; at about midway

is No. 4, which has always been the most important part of the mine. No. 4 has yielded the best ore and the most of it. At present the main part of the ore that is mined comes from No. 5, the next shaft west of No. 4. In point of fact the best stope is away west of No. 5, below No. 6.

No. 5, 6 and 7 shafts were the first ones made in the mine, but at a limited depth they were abandoned, as the ore was too jaspery and of too small quantity. But the workings that have extended west from No. 4 beyond No. 5 to No. 6 are at much greater depth than was ever penetrated through the shafts proper, and are in wholly new ground which at the present time is yielding well. What is now designated as No. 5 lies 120 feet north from the west end of No. 4 pit and is reached by cross-cuts from No. 4, also by a new No. 5 shaft sunk from the surface on the foot wall of this lense. The lense, unfortunately, proved to have too much rock mixed with the ore; it was impossible to get a stock pile wholly free of rock and for this reason the ore proved unsatisfactory. This has been the case since the ore was opened into in 1882; but now at 600 feet west of No. 5 shaft, 450 feet below the surface, the ore is 14 feet wide and entirely clean. In going west in the 450-foot level they encountered a crossing of soap rock that cut off the ore completely. The ore up to this point had not proven first-class, but on putting in a drill and boring through the barrier they found first-class ore. The stope in this level is 60 feet high and there is the most complete separation between it and the quartzite hanging. The hanging is smooth and sustains itself well. The dip is here about 50 degrees. In the level above they are 100 feet further west in this ore and it is seen to be equally good; as clean and good ore as they have ever had in the mine. The section of this body of ore is lenticular; it comes to an edge at the lower and upper limits, making the longer axis 130 feet, the shorter 14 feet. It laps the lense of ore that they have east of it. The two stopes furnish now (February, 1889,) 150 tons of ore per day. The levels are 100 feet apart; the lower stope goes up 60 feet and the upper stope thus begins 40 feet below the level and extends up to the limit of the ore. An inclined track extends down to the bottom of the stope and a skip running on it brings up the ore and dumps it into a tram car whence it goes to the shaft. A small drum at the head of the incline operates the skip. The drum is worked with a compressed air engine.

They need to make connection with No. 6 shaft to hoist the ore in it and save the long tram to No. 5, to which it all now goes. The ore analyzes 65 to 68 per cent metallic iron.

In addition, the outlook at the bottom of No. 4 is improved; that is, a diamond drill boring from above penetrated what is thought to be a body of

ore, 200 feet below and off in the hanging wall. The shaft has been sunk to this ore and they have crossed it, eight feet wide, and sunk a winze in it ready to stope. No. 4 shaft is now about 750 feet deep; it is a very crooked shaft, the irregular line having been brought about by reason that the ore has "made off" more and more into the hanging wall and the shaft has been "angled out" to reach the ore. The Michigamme mine has a good deal of second-class ore: that is, ore with a slight mixture of hornblende, which does not sell very well. In 1889 the mine will yield more first-class ore than it has in 10 years, in any single year.

At No. 3, is a pit, from the surface, from which ore was mined last summer and which is now sinking for further stoping.

They sunk 40 feet in the bottom of No. 2 and had some good ore but it pinched out. I think No 2 pit is a good place to put a drill to work.

The mining force employed is 80 men, and the cost of mining, tramming, etc., is, in No. 5, $1.75.

All the machinery, etc., remain as I have heretofore described them.

The company holds its estate, which is a large one, in fee simple. The affairs are well and economically managed.

J. C. Fowle. Supt., Michigamme, Mich.; Geo. Orr, Mining Capt.; W. H. Barnum, Pres., Lime Rock, Conn.; James Rood, Sec. and Treas., Chicago, Ill.

The annual products have been as follows:

Year.	Tons.	Year.	Tons.
1872	141	1881	57,115
1873	28,966	1882	43,712
1874	45,218	1883	42,533
1875	44,756	1884	28,757
1876	20,074	1885	12,372
1877	28,238	1886	48,805
1878	58,622	1887	51,975
1879	56,935	1888	36,448
1880	52,944		
Total			604,311

The estate covers 1,400 acres of land.

THE CHAMPION IRON CO.

It is pleasant to find the Champion mine looking so well. It is one of the best mines in the country, one of the largest producers, and the product is of the highest grade of hard ore—specular slate and magnetic.

The Champion ore has long been a standard of quality in the market—no ore sells at a higher price; in fact it is generally considered that the Champion ore heads the list, together with the Republic and Lake Angeline. These three mines, every season, head the scale of values of the ores produced in this State.

And that this high standard of quality shall be retained, no pains is spared at the mine in the sorting of the ore. All the grades are kept fully equal to the quality guaranteed, and there is no grumbling from the consumers.

The ore is all Bessemer, and is divided into four grades; but the greater portion, as it comes up from the mine, needs no sorting, being taken from stopes of a uniform quality of ore, it goes directly to the stock pile as first or second-class ore.

The ore that needs to be picked over is dumped near the shafts, on what are designated as "sorting floors," where it is skillfully sorted by men who have acquired experience in this line of work, and the several kinds run out to the stock piles representing the different grades. The first grade averages, from many analyses which I have seen, 67 to 68 per cent in iron and .040 per cent phos., 1.50 per cent silica; second-class, about 64 per cent; third-class, 61 per cent; fourth-class, about 58 per cent.

The Champion mine has long been a favorite with the people in the Upper Peninsula, as its ore has ever been a favorite one with the furnacemen. It is such surprisingly good ore, and the mine has been so long a uniformly regular producer, the formation is so comparatively regular, the occurrence of the ore from year to year so comparatively unvaried, the management so intelligent and popular, that the Champion has thus done much to establish and sustain the reputation of the district and to keep the good will of the people.

The Champion mine location is one of the pleasantest in the mining region. It has a neat, well kept, prosperous appearance. The streets and sidewalks are excellent. The dwellings, public buildings, yard fences, etc., are all in good repair, and the situation from its elevation commands a wide prospect over the surrounding country, which includes the large and beautiful Lake Michigamme to the west. A population of 2,500 people, living indirectly from this mine, enjoys almost every advantage that the most fortunate communities anywhere possess. There is a fine graded school build-

ing in which the best of instruction is provided. Three church edifices, a large and well furnished hospital, a public hall, public reading room and library and many minor things tending to promote the comfort and advantage of the people. And no employés of the mine, no persons living on the location, except the merchants, pay any taxes except the poll tax; the taxes are all paid by the company. The full and free enjoyment of such advantages ought to, and doubtless does, make a community patriotic, for nowhere else in the world, except in this our own broad land, are they meted out in such bountiful measure to a purely laboring population.

Heretofore, for two or three years past, in going down through the Champion mine, I have involuntarily contrasted the great empty spaces which have resulted from the removal of ore in past years with the comparative smallness of the more recent stopes, and have felt almost ready to conclude that this mine was nearing the end of its existence. But one receives a different impression now. The mine is more fully opened than I have seen it for a long time, and the development has given a far more hopeful aspect to its future.

There have been some new discoveries of ore down in the mine that greatly enhance its value and give the assurance that the mine can make an output the coming year fully equal to any it has ever yielded. These discoveries of ore have come easily, too. The company has not had to do as much of so called dead work in proportion to the results attained as is generally necessary in most other mines. They find the deposits near by to the north, or to the east or west by boring with a diamond drill placed down in the mine at the point to be explored, and when the ore is discovered a short drift through the rock reveals the hidden treasure.

The formation at the Champion is distinguished for its regularity. The strike and dip of the rocks at the mine are scarcely varied. The former being east and west and the latter about 80° to the north. The ore bodies consist of several lenses, so called, that lie one above the other and side by side, dipping north with the formation and lengthening to the west and shortening on the east. Those lying side by side are designated as the north and south deposits, on the foot wall of the latter of which the shafts are sunk, and at each level the deposits are connected by short cross cuts through the intervening rock. These deposits of ore in the upper levels, or in the main body of each deposit, were very wide but at greater depth, as the lower point of the lense was approached, the stopes grew narrower and sometimes of diminished purity, so that confined to the old deposits the mine has become smaller in a sense. To keep up the product and to secure a prosperous future to the mine it was necessary to probe the ground a little

more vigorously in advance of the stoping. For years it was only necessary to sink Nos. 2, 3 and 4 shafts a lift and the ore was at hand for the season's product. That time has gone by; they have had to explore the ground more fully and fortunately have been rewarded for their labor by finding ore in good quantity.

There are seven shafts, in all of which they were working. Commencing at No. 2, the most easterly one, and B shaft, immediately south of it, they are numbered in succession to the west. In all of these shafts, which descend to the north at about the same angle of 80°, the ore lengthened to the west and shortened on the east, so that in time No. 2 shaft was in rock and the ore had gone away so far to the west that it was all reached by No. 3 and No. 2 was abandoned. The same became true of No. 3—the ore was all west of it and east of No. 4, and No. 5 was sunk down and is now producing the most ore since they are stoping in all the levels from the 8th down to the 15th. The 8th, 9th, 10th and 11th are worked west so far as to be under No. 6, which latter is sinking to get into this ground and from which to explore and develop that which lies still further west, a still undetermined portion of the mine. It is of this ground lying west of and under No. 6 that great hopes are entertained—expectations to which, judging from the results that have obtained from sinking No. 5, I am willing to accord full credence. A fact worth mentioning, which I observed in my recent examination of the mine, is the occurrence of an eruptive dike which cuts the ore and was first encountered in the 11th level, 400 feet west of No. 5 shaft. The thickness of the dike is about 18 feet, and the ore is again found west of it. No. 5 is sunk to the 16th level but not much stoping has been done below the 11th. Nos. 3 and 4 are to the 17th, upwards of 1,000 feet deep. In the latter, in the 14th level, a "find" has been recently made—a body of black ore a little way in the hanging which proves to be important, since it has considerable width and is altogether new. In Nos. 3 and 4 there are stopes of ore in all the levels from the 11th to the 17th.

One of the most promising discoveries recently made in the mine is in the 13th level east of No. 3 shaft to the north in the hanging, where they have opened into a body of ore 30 feet or more in width, which extends eastward and apparently upward into the unexplored ground that lies under No. 1 and No. 2 shafts. It indicates that there may be ore in this ground which will cause the sinking of these shafts to reach it. Just now they are working in No. 2 shaft in ore that has been found in the upper levels in west and south of the shaft. Altogether the mine is looking exceedingly well. It is well opened, and there are many stopes of ore and some new finds that gild the horizon of the future.

One very important improvement has been made in the skip tracks. Above each rail, in all the shafts in the mine, has been placed a safety stringer; just far enough above—quarter of an inch—so as not to interfere with the wheels of the skips, but so that they cannot get off the track. The men can now ride in the skips with comparative safety, as they cannot get off the track nor dump in the shaft. But further than this the company has constructed a car to be run in No. 4 shaft in which to carry the men. It is 14 feet long, and will hold, it is estimated, 16 men. On each side of the rear end is a pair of safety clutches so fixed as to grip the upper stringers and stop the car if the rope should break or other similar misfortune occur.

I observed also an improvement in the manner of setting the gates at the levels. Formerly when the skip was up and it was desired to hold it at any level to receive its load, the "gate," consisting of a piece of timber placed across the shaft to support the skip and far enough down to have the mouth of the skip even with the platform, was swung into place by a long lever standing upright directly in front of the shaft; the man taking hold of it pulled backward towards the shaft; once a lever broke, and the tender barely saved himself from being precipitated down the shaft. This led to a modification, due to the ingenuity of Capt. Cundy, that makes the operation far simpler, and eliminates the element of danger. The gate timber moves over and back, describing the arc of a circle, and is counterbalanced with a weight that makes the operation of moving it easy. This is done by simply raising or lowering a lever that comes up through the floor. The company has now an independent pumping plant which brings all the water in the mine up No. 3 shaft, using simply an 8″ Cornish plunger pump. Formerly the pumping was made an additional task for the hoisting machinery to perform. The independent hoisting machinery for underground sinking, etc., which I mentioned in my last report, is liked very much, and is esteemed to be of great advantage in expediting the shaft sinking work.

The walls are so nearly vertical, and the overlying quartzite so firm, that comparatively few pillars are required, and so little timber is used as to be scarcely noticeable.

Wood is used altogether for fuel; it is obtained from lands south of Lake Michigamme, being brought in scows to the dock at the foot of the incline, when it is hauled up to the mine on cars propelled with rope running over winding machinery.

The Champion has produced as follows:

Year.	Tons.	Year.	Tons.
1868	6,225	1879	93,203
1869	21,535	1880	112,410
1870	73,161	1881	144,025
1871	67,588	1882	157,516
1872	68,402	1883	104,960
1873	72,782	1884	208,156
1874	47,097	1885	173,914
1875	56,877	1886	137,593
1876	66,002	1887	156,730
1877	70,883	1888	174,681
1878	73,764		
Total			2,076,896

W. E. Stone, Treasurer, Boston; A. Kidder, General Manager, Marquette, Mich.; Walter Fitch, Superintendent; James Cundy, Mining Captain.

THE HUMBOLDT IRON CO.

has been almost continuously exploring with a diamond drill, but the hoped for success has not been met with. The formation is a very peculiar one and it is difficult to satisfactorily interpret it. As mentioned in my last report they were then drilling near the county road, southwest of the mine. The drill was pointed southwest; are now boring at same place with the drill pointed east towards foot wall.

Only one shaft is worked, No. 2, which is down 500 feet deep, and they are in the same lense of ore in which they worked in the previous levels It is about 100 ft. long and 10 ft. wide. They are stoping in it southwest. They have some very fine black ore. I saw an analysis of a sample from this mine the other day, March 7, 1889—iron, 70.48 per cent; phosphorus, .064 per cent; sulphur, .021 per cent.

The mine produced in 1888 11,656 tons and will yield about the same amount in 1889.

The mine is owned by the Washington Iron Co. and held on a lease by the Humboldt Co.

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	1888	11,656
Total			656,075

THE SAMPSON MINE,

lately the Argyle, and previously, for many years, known as the Edwards, is working again in a limited exploratory way. The mine was pretty thoroughly exhausted before it was shut down in 1884, so that last season when the water was pumped out of it not much ore was to be had; even the pillars were gone.

There are seams of ore, small lenses and pockets of ore in the foot wall rock, but so far it is found in too limited body to be of any practical value. It costs more to get it than it is worth. There is too much jasper and too little clean ore.

I visited the mine a few days ago—Feb. 10—and found a force of 18 men employed, getting a little ore in the foot wall of the old mine, and in the Sellwood shaft, etc. Mr. Richard A. Parker, the agent, is directing exploratory work with the diamond drill with what he deems encouraging results. The mine is the S. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$ Sec. 2, and S. W. $\frac{1}{4}$ S. E. $\frac{1}{4}$ Sec. 2, T. 47, R. 29, and the company owns the land in fee simple. The formation runs slightly northeast and southwest, and the mine is near the south line in the jaspery hillside that slopes to the northwest, in which latter direction lies a long stretch of level land that has not been explored in.

Until more ore is found than is now known of on the property, the mine cannot be a paying one. Recently a building has been erected at the mine near the railroad track for the purpose of testing a process of separating the ore from rock. That is, the jasper, which holds about 30% of ore, is crushed and ground, and the ore separated by a magnet-electro machine. Thus far the work is simply experimental, and is carried on by Mr. Edison, the inventor. Mr. Mallory, the superintendent of the work, showed me the analyses of the ore resulting from the manipulating process. It is first-class Bessemer ore; the phosphorus seems to be contained in the rock, since analyses of the material before treatment and of the ore afterward show that the phosphorus goes with the residue, rejected.

The officers of the Argyle are Morris Sellers, President, J. M. Sellers, Secretary and Treasurer, Chicago, Ill.; Richard A. Parker, Agent. The Sampson company was organized under the laws of Michigan in March, 1888.

The product in 1888 was 4,512 tons, making an aggregate to date, since 1886, of 260,456 tons of ore.

THE SAGINAW MINE,

which has been abandoned since 1883, is now held on an option by parties who are exploring it. I do not know that anything valuable has been found.

The location is the N. W. $\frac{1}{4}$ N. E. $\frac{1}{4}$ of Sec. 19, T. 47, R. 27. The mine has produced 439,328 tons of ore.

Adjoining it are

THE GOODRICH AND THE ALBION.

The former is in the W. $\frac{1}{2}$ N. W. $\frac{1}{4}$, Sec. 19, T. 47, R. 27, and the Albion next to the latter. These are also being explored by C. R. Ely, Jos. Ames, P. Lundquist, *et al.* These abandoned mines are about three miles southwest from Ishpeming. The Goodrich has yielded 51,479 tons of ore, and the Albion 1,348 tons.

REPUBLIC IRON CO.

The most noticeable change at the Republic, recently, is the new compressor plant which has been lately added. The building is of brick and placed just west of the new office. The machinery consists of a duplex Rand with steam cylinders 48″x24″. The advantages are very apparent in the increased effectiveness of the drills; formerly they worked on about 35 pounds of steam; now they have 60 pounds. Heretofore all the compressors were at the dam in the river and the power was only sufficient with the size of the air cylinders to secure, much of the time, 35 pounds pressure. This, in such hard jasper as the Republic rock, is a very ineffective force. The compressors at the river are still used, but they have secured 60 pounds pressure in them by bushing the cylinders so as to reduce their interior dimensions. The same number of drills are used as formerly, but their

capacity is so greatly increased that it costs much less to accomplish drill work than formerly, there being a reduction of at least one-third in the cost due to the increase of air pressure. In fact Capt. Pascoe says that drifts that now are let for $18 per foot, cost, before the new compressors were in, $32 to $35 per foot. And there is a corresponding reduction in the cost per ton for stoping the ore.

The Republic mine is in a hard jasper formation and there is a great deal of rock broken that goes into the waste piles. The mine is peculiar in the fact that it is made up of a lot of independent lenses of ore lying transverse with the formation. These lenses in the west part of the mine are comparatively small and nothing but the superior quality of the ore has saved it from costing more than it sold for.

The Morgan, the most westerly pit, has fallen off in production slightly, and from present appearances will continue to do so. At present there is no magnetic ore in sight. The shaft has been sunk 60 feet and the usual amount of opening work has been done. The product for 1888 was as follows: Magnetic, 4,376 tons; Kingston ore, 6,678; specular ore, 20,259; total product, 31,313 tons. Its depth is about 900 feet.

The Pascoe pit is thought to look better than it did a year ago, in the bottom; but during the past year they have stoped the pillars in the upper levels to considerable extent. The Pascoe has two lenses of ore, the west one of which is specular ore, and is about 30 feet long and 17 feet wide; while the east lense is magnetic, and is 18 feet long and 5 feet wide. The Pascoe has also been sunk 60 feet deeper. It is a complicated, irregular formation. The product in 1888 was as follows: Specular ore, 11,000 tons; magnetic ore, 2,456 tons; Kingston ore, 4,370 tons.

The estimated product for 1889, is considerably less than this amount, to wit, 11,500 tons.

The Ely pit was thought to be, not long ago, nearly exhausted, but by using the diamond drill a lense of ore was found towards the Gibson pit 22 feet long and 14 feet wide, which has been drifted to and sunk in 60 feet. The products of the several kinds of ore from this pit in 1888: Specular, 8,172; magnetic, 483; Kingston, 3,893; total, 12,548 tons. In 1889 the product will be about the same.

No. 1 pit is much improved; that is, a body of black ore has been found that is 40 feet long and 6 feet wide in the hanging wall side. This deposit has been opened into in three levels.

No. 1 shaft has been sunk 100 feet during the year, and a large amount of drifting and opening work has been done. The pit yielded in 1888:

Specular, 20,787 tons; magnetic, 1,251 tons; Kingston, 1,936; total, 23,974 tons. The product in 1889 will be considerably in excess of this.

Nos. 3 and 5 pits present no new features; the ore obtained from them is taken from the pillars. From this source the product in 1888 was 27,696 tons, and they will mine about the same amount in 1889.

No. 6 pit, it is expected, will yield as much as it did last year, but the third level does not appear to be, as far as opened, as good as were the two above. A misfortune was met with in this pit, not long ago, through the fall of the roof about the underground shaft house. It made a serious crush that delayed the work of hoisting for a month. Of course it is all secured now. The product for 1888 was: Specular, 41,702; magnetic, 8,211; Kingston, 2,348; total, 52,321 tons.

No. 7 pit shows the most important change of any part of the mine. The magnetic ore has narrowed and shortened; the jasper has cut it out so that there will not be above one-third of the usual product in this pit, but on the other hand there have been found two large lenses of specular ore, which underlie the magnetic. The top one of these two newly found deposits is 90 feet long and 9 feet wide; the lower one was not fully opened when I saw it, but seems to be larger than the other; certainly it is much wider, as they had gone in across it 28 feet, and had no foot wall as yet. Thus the specular ore will fully make up for the falling off in yield of the magnetic. The product in 1888 was: Specular, 8,612 tons; magnetic ore, 32,239, Kingston ore 1,166; total, 42,017.

No. 8 pit does not show much change. It will afford the same product as it did last year. The shaft has been sunk 60 feet: that is, the Shenol shaft has been sunk; it is 210 feet northwest of the main shaft and the two are connected by a horizontal tram track.

The ore in Nos. 6 and 7 is reached in the same way: that is, by using in each an inclined auxiliary shaft to bring the ore up from the stopes to the level of the bottom of the main shaft. This method was introduced to save the expense of sinking the main shafts through rock and cross-cutting to the ore. These underground shafts are operated by machinery in the old No. 5 engine house, using the old drums that were formerly employed to hoist in the main shafts.

The product of No. 8 in 1888 was as follows: Specular ore, 19,291 tons; Kingston, 3,121 tons; total, 22,412 tons. The yield in 1889 will be the same, about.

No. 9 is a small pit, having a lense 20 feet long by eight feet wide, yielding Kingston ore. The product of 1888 was 2,036 tons.

Capt. Peter Pascoe has had entire charge of the mining work ever since

the mine first started and anyone interested in mining cannot but accord to him a good deal of credit. The mine is now and always has been in good shape.

Chas. Hickox, President, Cleveland, Ohio; W. D. Rees, Secretary and Treasurer, Cleveland, Ohio; George 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	1881	233,651
1873	105,435	1882	235,108
1874	122,639	1883	152,565
1875	114,726	1884	277,739
1876	120,045	1885	249,070
1877	165,836	1886	241,161
1878	176,221	1887	233,375
1879	135,131	1888	235,064
1880	235,385		
Total			3,019,266

THE WEST REPUBLIC MINE

has been abandoned. The pumps have been taken out and all work discontinued. There were shipped from the mine in 1888, 9,861 tons of ore, making a total to date of 131,986 tons. The mine joins the Republic on the west.

A. C. Saunders, Secretary and Treasurer, Cleveland, Ohio.

THE REPUBLIC REDUCTION CO.

has abandoned all attempts to manipulate the rock burrows of the Republic mine. They are now simply sorting the burrows, selecting out such of the material as will do to ship for ore. The only difference between it and the Republic ore is in the percentage of silica contained. The ore shipped is above 60 per cent in iron and is Bessemer. I am told it finds a ready sale for "fix." The product in 1888 was 20,846 tons.

D. H. Merritt, Secretary, Marquette, Mich.

THE RIVERSIDE IRON CO.

is a new organization to operate the mine found by J. O. St. Clair on the Michigamme river near Republic. The mine is situated on lots 1 and 2 in

section 35, town 47, range 30. The ore is black, magnetic, and 5,761 tons were mined and shipped in 1888.

The company was organized July 3, 1888.

Dennis McCarty, President, Ishpeming, Mich.

The company has 6,000 tons in stock now, and have made some important developments with the diamond drill that add to the value of the mine.

J. O. St. Clair, Superintendent, also Secretary and Treasurer.

THE WESTSIDE MINING CO.

is working across the river from the Riverside mine. Mr. A. Polderman and others are exploring at the old Standard mine and adjacent property with, as they state, good results. The ore which I have seen, however, contained too much rock to be first-class, especially as it is non-Bessemer.

A. Polderman, President. Capt. Harry Buddle has charge of the work.

NORTH REPUBLIC MINE,

situated in Sec. 19, T. 47, R. 30, is an exploration that does not show very encouragingly so far. A shaft has been sunk 125 feet deep, and three levels opened—at 60 feet, 115 feet and 125 feet depth respectively. A small extent of drifting has been done. There is a lense of ore about three feet in width. The work has been done under the direction of Mr. Terrance Moore, of Marquette. The parties interested are in Grand Rapids, Mich. Work has been suspended.

THE ATLANTIC MINING CO.

owns 5,000 acres of mineral lands on the Marquette range, mostly undeveloped. These lands once belonged to the Morgan Iron Co., and lie near Morgan, Negaunee and Champion. The North Champion, North Dalliba, Pascoe and Mesnard mines are on the property. It is now proposed to explore the lands carefully, grant options for iron, timber, etc., and encourage the development of the company's property.

The following are the officers: W. H. McCurdy, Pres., Cleveland, Ohio; Dan'l H. Ball, Vice Pres., Dan'l H. Merritt, Sec., M. H. Maynard, Treas., all of Marquette.

THE PITTSBURGH & LAKE SUPERIOR IRON CO.

has met with great good fortune by reason of the magnitude of its newly discovered ore deposit. As the mine is likely to enter upon a new era in its history, a somewhat extended description may not be out of place.

The Palmer mine, formerly known as the West End mine, is at the western extremity of the Cascade range, one of the earliest noted of the iron formations of the Lake Superior district.

The range is distinguished by a prominent outcrop or bluff of banded jasper that extends east from near the west line of section 31 for two miles and upwards, and which rests on the granite that appears to the south.

This broad belt of jasper holds so large a percentage of iron that in an earlier day it passed for ore and was mined as such, being designated as "flag ore," owing to the flag-like structure of the formation. The companies that were formed and worked in this jasper were the Cascade, the Emma, the Pittsburgh & Lake Superior, the Wilcox & Bagley, the Home, the Carr, the Gribbon, the Watson, the Howell Hoppock, the Grand Rapids, the New Mexican, the Laxey, the Wheat, the Richards, the Palmer, etc.

But the only ones mentioned that have ever obtained any considerable amount of merchantable ore, are the Wheat and the Palmer companies. The latter mine was opened in 1872, by the old Pittsburgh & Lake Superior Mining Co—the same parties that owned the Cliff and National Copper mines. Subsequently it became the property of the Palmer Iron Co., and more recently passed, by purchase, to the present owners, who succeeded to the franchises and corporate title of the older company of the same name.

The jasper belt, which continues its westerly trend across sections 28 and 32, and to near the north and south $\frac{1}{4}$ line of 31, makes an abrupt bend at this point, and extends north 1,000 feet, when it, apparently, again goes west; but as the bluff has disappeared, and as the rocks further west are covered with drift, the extension of the jasper cannot be readily traced, further than the fact that the overlying quartzite, having the uniform northerly dip, appears in the bluff opposite to the west.

At the Cascade range are found the salient geological features that characterize the best hard ore formations and for this reason it is a locality that has always been regarded as having great possibilities. This well defined jasper and the overlying quartzite are typical of our best hard ore mines. The early mining in the Cascade range was in the jasper, whereas at the Champion, etc., mines the ore occurs on the jasper with the quartzite for hanging wall and these are the conditions which exist at the West End mine and at the "New Find" further east.

The West End mine is just to the south of the line between sections 30 and 31 and near the north and south eighth line through the west half of the section. The mine was formerly worked open cut, but for some years past the ore has all been taken from away underground. The open cut runs north and south and the dip is to the east. There are five skip roads up the

side to the west, but the only one that is operated is at the north end, and here the mine is away under to the northeast and north; 600 feet away to the east and a little north a vertical shaft has been sunk to reach the same workings. This shaft is 300 feet deep and the lowest depth of the mine is 60 feet further down. They are only working in the north end of the mine and along east to the vertical shaft and working in a primitive way. With better facilities and greater effort no doubt a much greater product could be obtained at this mine. I went through the mine and carefully examined some fine stopes of ore. I judge there is ore enough in sight for a large product, but better working conditions are necessary.

In opening this article I spoke of the recent discoveries of ore that gave to the property entirely new and greatly improved prospects. This new "find" is designated as the Saw Mill shaft. It is about 1,800 feet east from the West End mine and 800 or 900 feet north from the jasper bluff. It is not far north from the company's old saw mill, hence the name.

The ore was found by diamond drill borings, of which this record was given to me: No. 1 hole passed through 70 feet drift, 136 feet quartzite, 21½ feet ore, into jasper; No. 2 hole, 370 feet west of No. 1, 40 feet drift, 162 feet quartzite, 19 feet ore; No. 3 hole, 400 feet west of No. 2, passed through 55 feet drift, 125 feet quartzite, 17½ ore; No. 4 hole, 400 feet west of No. 3, was bored at an angle of 50° south, and passed through 163 feet quartzite, 7′ 8″ ore; No. 5 hole is 410 feet north of Nos. 1 and 2 and passed through 40′ drift, 34 feet quartzite, 22 feet of soap rock and penetrated ore to a depth of 24′ 7″, when the bit was lost while still in ore.

It will be seen that these borings indicate very favorably and since a shaft has been sunk the inference has been verified. Two shafts were started, one, following No. 1 hole, was sunk 106 feet only; the other, following No. 2 boring, was sunk to the ore, 300 feet down, and is now used as a working shaft. They have opened in this ore 400 feet east and the same distance west and gone up to the south perhaps 50 feet. The ore is all clean. It lies between the jasper and the quartzite and may extend a long distance in all directions. I think there is, undoubtedly, a large body of it. It is opened a length of 800 feet, and a drill hole 400 feet still further west shows its continuance. It widens east and north. It is one of the belts of the fold that forms the synclinal of the valley. It lays pretty flat, dipping in the mine about 23° north, and is very regular. The ore breaks very easily. It is slate ore, not hard, and crossed by transverse planes of fracture that cause it to block out readily and break up easily into small fragments. But as yet they have only one shaft in which they run only a loose bucket. With two shafts, good machinery and skips, 200,000 tons annually could be

taken from this mine, and possibly it is capable of furnishing a still greater amount.

That the ore continues down to the north is proven by the boring—No. 5, 410′—north of shaft, where it is shown to have an increased width, and was found at 381 feet from surface.

The shaft is 6′ x 10′inside the timbers, and divided into two compartments, one for hoisting and one for pipes, etc.

The quality of the ore is good, but averages non-Bessemer. An average of seven analyses of samples collected by myself from the old mine gives 61.40 per cent metallic iron, .085 per cent phos., 3.80 per cent in silica, and .007 in sulphur.

An average of four analyses of samples which I collected in the Saw Mill mine gives: iron, 62.53 per cent; phos., .105 per cent; silica, 3.74 per cent; sulphur, .004 per cent.

A second lot of samples from the Saw Mill mine gave as an average of six analyses: iron, 63.68 per cent; phos., .084 per cent.

The Chicago & Northwestern, and the Duluth, South Shore & Atlantic R. R. Cos. have both branches to the mine, and the brook that courses through the land south of the old saw mill will furnish water for steam purposes. There are a large number of miners' dwellings on the property, and a fine $25,000 agent's house, etc.

The company owns a large estate, and since I saw the mine it is reported that a portion of it—1,840 acres— which includes the mine, has been transferred to a new corporation, to be known as the Volunteer Iron Co.; the mine to be under the supervision of Capt. Thomas Walters, Supt.; James Broad, Mining Capt.; A. Kidder, Agent.

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	1888	56,321
Total			452,536

THE WHEAT MINE,

which is situated in the Cascade range, east of the Palmer, continues to be operated in a small way. The ore is soft hematite of good quality when it is clean. In portions of the mine the ore requires careful sorting to keep out the rock. When clean it averages 63 per cent iron and .040 per cent phos. The following is the table of production:

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	1888	4,982
Total			87,008

Capt. Thomas Prout, Supt., etc., Palmer, Mich.

THE SWANZY MINE

was not operated the past season. The aggregate production to date, which includes also the Cheshire, is 154,942 tons. I am informed that work will be resumed in 1889. Capt. J. S. Wood will take charge of it.

The location is the S. W. ¼ N. E. ¼ Sec. 18, T. 45, R. 25.

J. J. Pierce, Manager, etc., Sharpsville, Pa.

THE BRAASTED MINES,

which were formerly known as the Winthrop and Mitchell mines, and had been operated for a number of years past by the St. Clair Bros., under the corporate title of the Winthrop Hematite Co., but are now held and operated by Mr. F. Braasted, of Ishpeming, Mich.

These mines are contiguous properties and are situated about two and one-half miles southwest of Ishpeming. They are both among the oldest of the soft ore mines of the State and the Winthrop especially, has always been considered as a good property. The ore is of good quality, 60 to 64 per cent in metallic iron, and, though not Bessemer, the percentage of phosphorus is not far above the limit.

Under the superintendency of Capt. W. J. Officer, formerly of the Detroit mine, there has been great improvement at the Winthrop. The

engine house, which stood on the center of the section, has been moved to the south side of the large open pit. The cumbersome, unwieldy pumping machinery has been done away with, and a new steam pump—compound Worthington—now takes care of all the water. A new skip track has been made up the foot wall, south side of the open pit, and the large vertical shaft that was begun some years ago and sunk 225 feet, has been continued down to 400 feet in depth. They have repaired the old boilers and added new ones to give the mine plenty of steam power; and three new drums have been provided so that they now have six all in the one building; Merritt drums, each five feet diameter, and will suffice for both mines.

The bottom of the open pit is 205 feet below the surface and the former company worked down to the 280-foot level east to the Mitchell. The bottom level is now the 330 foot, and they have opened west from the downright shaft 400 feet, in six levels, all in ore, 40 feet apart, one above the other, so that the upper level is within 90 feet of the surface. The ore is 40 feet wide and a drift south in the mine has cut still another body lying back in the foot wall. East of the shaft the ore extends 300 feet to the Mitchell line, giving a total length of ore opened up of 800 feet or more.

They are driving west to intersect an old shaft, sunk some years ago, to a depth of 135 feet.

East of the downright shaft is the great open pit; west of it the surface is intact. They are mining now (February) 2,000 tons of ore per day and expect to ship during 1889 upwards of 100,000 tons from the Winthrop side.

They work out the ore in rooms 16 feet wide across from foot wall to hanging, timbering the open space with "sets," posts and caps eight feet long. All the work is proceeding systematically.

The ore from below the bottom of open pit and east is hoisted up the skip road, No. 4, and run out to a stock pile south. The ore from the new openings on the west goes up the vertical shaft and is stocked north of it. As the foot wall is soap rock there is probably ore to the south of the present opening. In fact they are sinking an old shaft begun years ago, which is a few hundred feet south of No. 4 skip road. South of the present engine house it is now (February) 35 feet deep. They are working about 225 men. Capt. Officer states that the total cost of all the improvements and new opening work will not exceed the previous estimates.

Altogether the mine is looking extremely well, but it is rather an expensive mine to work, and the ore being non-Bessemer will not sell at a fancy price. The profit after all costs are paid, including royalty on ore, will not be large.

Nothing has been done at the Mitchell by the new proprietors, but preparations are making to pump it out with the purpose of working it.

The Mitchell mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1872	197	1881	20,964
1873	8,552	1882	33,394
1874	7,699	1883	----------
1875	----------	1884	29,883
1876	5,596	1885	7,415
1877	3,897	1886	42,044
1878	4,259	1887	53,592
1879	11,450	1888	36,396
1880	12,750		
Total			278,094

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	1880	45,247
1871	7,314	1881	43,900
1872	14,239	1882	23,259
1873	31,150	1883	50,143
1874	8,248	1884	53,077
1875	8,642	1885	63,915
1876	27,236	1886	44,274
1877	12,549	1887	44,486
1878	23,740	1888	52,240
1879	27,050		
Total			584,063

THE SALISBURY MINE

holds the even tenor of its way, and is neither worse nor better than it has been for years, although it is furnishing more ore than formerly, probably due to increased effort. The main lense of ore is getting further and further south each year, requiring a further extension of the crooked shaft each year to reach it. To obviate this difficulty the long talked of downright shaft has been finally begun and is now 100 feet down. Its location is 600 feet

south of the present shaft, and the bottom level is now about midway between them. This new shaft is 9′ x 20′, outside measurement, and will be 500 feet deep to reach the ore. The mine has both Bessemer and non-Bessemer ore, about equal quantities of each; the deposits being parallel east and west and separated by rock. The ore is irregular and there is rock enough for pillars to support the roof, so that not much timber is required. They expect to have the new shaft completed during the present year—1889.

Considerable ore is yet obtained beneath the old open pit to the north, adjacent to the steep diorite bluff, but there is nothing of added value.

The Salisbury is in the city of Ishpeming, just south of the steep diorite ridge that borders the south side of Lake Angeline. It is the property of and is operated by the Iron Cliff Co.

Alex. Maitland, Gen'l Manager; Thomas Buzzo, Supt. and Mining Capt.

The following table shows the yearly product:

Year.	Tons.	Year.	Tons.
1872	545	1881	41,888
1873	11,023	1882	42,019
1874	6,730	1883	17,028
1875	4,571	1884	23,171
1876	20,510	1885	29,503
1877	37,868	1886	51,231
1878	52,155	1887	49,229
1879	39,770	1888	74,886
1880	22,387		
Total			527,849

THE HARTFORD MINE.

situated south of the east end of Teal lake, in the city of Negaunee, shows very little change for the better or worse. The holder of the lease of the lands, Mr. Ben Neely, has continued working in a moderate way, but nothing new or important has been developed. The shaft is sunk in the foot wall, and the ore is so far south of it that pretty expensive cross cutting is required to reach the ore.

There is an excellent hoisting plant at the mine, and a good engine house, etc., but not enough ore has yet been found to make a valuable mine.

THE CAMBRIA MINE,

in the Teal lake range, being south of Teal lake and about one mile from the city of Negaunee, continues to keep up the magnitude and reputation of its product. The mine is now, all of it, away north from the former workings. Years ago the mine was in deposits of ore that began at the west line of the property and extended in succession to the east boundary; but these are all worked out. They held excellent ore but became exhausted, and now the mine is north of all these—in about the center of the land east and west and nearer the margin of the lake. There is plenty of ore in sight to make as large a product as last year; in fact they expect to ship in 1889 80,000 tons, and have already (March 1) 19,000 tons in stock.

There are two shafts, designated as 2 and 3; the former is southeast of the latter, near the highway, and just east of the engine house; it is 350 feet deep vertically down. No. 3 is 400 feet northwest from the former and is 300 feet deep. This latter furnishes the greater portion of the ore. The ore extends north of this shaft 200 feet, and there is ore between the shafts and east of No. 2. The deposits are very irregular; they constitute pockets of ore in a mixed formation. They work out and others are found. Sometimes, in places, the ore is wide and again it narrows or cuts out altogether. A few years ago they had a large "cave" in the mine: that is, the ground sunk down and filled the mine, all of it, north of No. 2 shaft. The ore was very soft and the pillars would not hold up. Since then they have worked out two levels under this crush and have the bottom still all ore. The ore now is somewhat higher in phosphorus than it was in the pits further south. The percentage of iron remains the same, and it is still sold as Bessemer ore. The mine is excellently well worked and proves to be profitable. Mr. Maitland, who has always been the manager, is scarcely surpassed in that capacity, and the superintendent, J. B. Jeffrey, is a man of unusual intelligence and has had long experience as a practical miner. He gives close attention to the work and achieves the best results. Everything indicates it about the mine and in the condition of the mine underground. The force employed is 135 men. The mine is now opened up well ahead.

Table Showing Yearly Product of the Cambria Mine.

Year.	Tons.	Year.	Tons.
1876	6,324	1883	47,508
1877	10,082	1884	59,740
1878	3,754	1885	50,796
1879	6,860	1886	59,406
1880	7,232	1887	41,138
1881	18,837	1888	59,009
1882	47,545		
Total			418,295

THE LILLIE MINE,

as is well known, joins the Cambria on the west, and for a played out affair, as it seemed to be when the present company took hold of it, a few years ago, it is an exceedingly productive mine. Apparently no mistakes have been made in renewing the work here. They have got to the ore, and have got into it in good shape.

The old mine consisted solely of open pits, where the ore had been taken out. The pits having become very deep, and the sides having caved in, burying the ore in the bottom, the new company sunk below all this accumulation of debris and drifted into the ore beneath, which it has since been mining out.

Also it sunk a vertical shaft south of the west pit, away from the influence of the unsettled ground; and in this shaft is found the main body of ore—off in the hanging, south of the old deposits. This shaft is 315 feet deep, 283 feet to bottom level. The length of the body of ore is about 150′ east and west, and 100 feet wide. The dip is to the southeast. The ore pockets here, as in all the mines in this range, are in a formation of schist and broken jasper—a ferruginous schist. When speaking of foot wall or hanging, these terms apply simply to the particular pocket or lense of ore under consideration. The hanging wall of one pocket may be the foot wall of another, and so on.

They timber the rooms in sets, in the usual manner; but in the north shaft, working under the old pit, they take the ore all out, letting the ground above settle down. To do this they drift to the extreme end furthest from the shaft, and stope towards it, cutting a horizontal section from top of the ore, and letting the ground down behind them as they advance.

It is a good mine, though of course not a large one. The ore is clean, above 60 per cent in iron, but slightly non-Bessemer. It is well opened up now, and will make as large a product in 1889 as it did the previous year. The south shaft is at the northeast corner of the ore body, and is in rock, but close to the ore. The company works sixty men.

Statement of Annual Product.

Year.	Tons.	Year.	Tons.
1875	144	1882	28,221
1876	6,801	1883	2,172
1877	10,127	1884	2,683
1878	8,586	1885	708
1879	21,681	1886	3,957
1880	18,347	1887	23,041
1881	16,718	1888	32,692
Total			178,240

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

THE CLEVELAND HEMATITE

is the next mine west of the Lillie that is now operated. The surface at this mine also presents some immense cavities from which ore has been removed in times past. The mine is now and has been for eight years wholly underground. The system of mining practiced here has been adopted to a considerable extent at other mines in the State. It has been adhered to here ever since the mine went underground.

The shaft is in rock, sunk to a depth of 726 feet, vertical, and unfortunately the ore body, which is a long irregular chimney, has constantly inclined downward away from the shaft, so that the present bottom is 640 feet distant, making it necessary to drive this long cross-cut to reach it. Thus at each level it has required this additional expensive work to be performed, after the shaft was sunk, before the ore could be attacked. The method of mining here is sometimes designated as the Cleveland hematite system. It is very simple. In proceeding to stope a level to which the shaft has been sunk and the cross-cut run, they keep a winze open to the level above through which to let down timbers and sink one from the top of the ore to the bottom below, or make a raise in the ore near the end of the cross-cut to the level above. They open a drift around the ore or from the point nearest to the shaft on two sides and on top of the ore under the dirt, after which

they cut off a horizontal section of the ore by commencing at the extreme end and stoping off a portion, transversely, eight feet wide and eight feet high, working from each drift towards the center. Thus by a succession of stopes from the farthest end they advance towards the shaft. The ore is run down through the winze to the cross-cut below and thence is trammed out to the shaft. The timbers that are used are light so that they will crush down when the ore is removed. They are made to hold up just long enough to get out the ore while the opening to the shaft is kept all the while intact. The ore is thus mined from the top down and everything over it is "allowed to come." If it does not crush fast enough, a blast is put in to bring down the over burden. The cross-cut from the shaft to the ore at the 725-foot level has not been driven yet.

They are obtaining the ore now between the 500 and 625-foot levels, the ore being "milled" down to the 625-foot level, from whence it is hoisted.

A cross-cut is driving in the 625-foot level to the "west deposit" which will soon be intercepted and will give additional ore. The mine is producing at the rate of 40,000 tons for the year's product.

It is the same depth as the Lake Superior No. 2 mine, the two being the deepest in the Ishpeming basin.

THE DETROIT MINE

is the next one west of the Cleveland Hematite, and is the only one in the Teal Lake range that is not looking as well as a year ago. Unfortunately for the owners there is very little ore in sight at the Detroit. The old mine, which runs the whole length of the property east and west, has some ore yet in the bottom, in places, but as the mine has crushed in, it is not easy to get.

The body of ore away south of the shaft, 600 feet, that they had just opened into a year ago, did not prove as large as was anticipated, and is practically all worked out. Just now they have a small body of ore in south which they are hoping will turn out to be much larger.

Capt. Joseph Thomas, the new superintendent, has the reputation of being a good miner, and will undoubtedly do all in his power to develop a better state of things.

The mine has had a somewhat chequered history. This is not the first time that they have been greatly short of ore. The old mine: The one near the shaft is non-Bessemer ore; the south deposit is Bessemer. The shaft is 350 feet deep and the cross-cut south 500 feet to the ore. Extreme distance

south from the vertical axis of the shaft, 650 feet. The product in 1888 was 19,665 tons, and the mine has yielded in all, 121,956 tons of ore.

James McMillan, Pres., Detroit, Mich.

THE MILWAUKEE IRON CO.

has so nearly reached the termination of its lease of the mine situated away up in the hills in the south part of the city of Negaunee, that unless a renewal is made there is not likely to be much exploring done for additional ore.

As it stands now the company can see the limits of its ore. No. 9 pit, at the west end of the property, adjoining the Grand Rapids mine, contains all there is in sight, and in this pit they are to the bottom—in fact have little left except the pillars. Still they mined 60,000 tons last year, and will make an equal product, they say, the coming year, and even then will have ore for a product in 1890—the last season of the lease.

One lift was sunk in 1888, and several thousand dollars expended in exploring work, but nothing new was found. The mine is still worked on a lease, by the Carmichael Bros., who mine the ore for the company, by the ton and furnish everything. They are good miners and faithful men. The company once paid, I am informed, 85 cents per ton royalty on the ore. A subsequent change was effected in the lease, by which a reduction of the royalty was made, but still it is too high. The surface at the Milwaukee is all cut up with open pits, from which the ore has been mined. There are none of them very deep. The ore formation is loose jasper and "soap rock," between the steep diorite bluffs which are to the north and the south. It is not considered that the possibilities of the location have been exhausted.

The mine yielded, in 1888, 48,908 tons, and the aggregate of the yield of the mine is 296,880 tons.

A. Kidder, Marquette, Mich., Agent; Carmichael Bros., Miners of the ore, etc.

THE GRAND RAPIDS IRON CO.

operates the mine, which lies adjoining the Milwaukee on the west. Nothing important has been developed in the past year. The mine can probably furnish double the ore than has been taken from it in the given time, since they have the new shaft completed and now have two shafts to hoist in. The old shaft, which is vertical, is 217 feet deep while the new one on the north side is 240 feet long; but as it descends at an angle of 45° it does not reach so great a depth as does No. 1. This new shaft is a good one, sunk

all in rock, and is well timbered. It is operated with a skip. Cost $28 to $32 per foot to sink it. At a depth of 160 feet from the surface is an exploring drift made to the west 60 feet all in rock. The ore opened out is irregular but it has a length of 140 feet, varying in width from 18′ to 30′ and the bottom is ore. They have two rises that come to the surface, through one of which they run down the timbers used in the mine. In a portion of the mine they put in square "sets." They tried the experiment of running down dirt for filling, but have not continued to do so. Are well opened out for the ensuing year's work.

The chief owners are residents of Grand Rapids, Mich. L. H. Withey, President, Grand Rapids, Mich.; J. C. Holt, Secretary and Treasurer, Grand Rapids, Mich.; Henry Warner, Agent, Marquette, Mich.; William Pascoe, Mining Captain, Negaunee, Mich. Work 60 men. Product, 1888, 11,612 tons; total production of the mine, 19,145 tons.

THE ROLLING MILL MINE,

also in section 7, south of Negaunee, furnishes a small amount of ore each year, but is not much worked. The mine is chiefly owned by Mr. Luther Beecher, of Detroit, and his son, George L. Beecher, resides at the mine and superintends the work, etc. The mine has produced 228,873 tons of ore

THE EAST JACKSON,

formerly the Pendill mine, has been idle for some years, but now the company has commenced repairing the machinery and will proceed, it is said, to pump out the water in the old mine and do some further exploring, possibly attempt to drift to the ore that was found with a diamond drill boring made a few years ago and described in a former report. The property is favorably situated adjoining the Jackson mine, in a strong ore formation, and thus has good possibilities for the occurrence of ore. The work will be in charge of Capt. J. F. Foley, of Negaunee, and the owners are residents of that city.

Wm. Condon, President; J. E. Scallon, Vice-President; W. B. Northrop, Secretary and Treasurer. Office at Hancock, Mich.

THE LUCY MINE

is another of the so-called south side mines and is one of the oldest and one of the best of them. It was formerly known as the McComber; and after the failure of that company the mine remained idle for a time until operations were begun two years ago by the present corporation. The hoisting is confined to two shafts, Nos. 3 and 4, from the former of which some Bessemer ore is obtained—about one-half the amount hoisted. These shafts are respectively 235 and 254 feet deep; they are 300 feet apart, No. 4 to the southeast of the other. In the bottom from this shaft they are working to the northeast beneath the old open pits that lie in that direction. They have a length of 100 feet of ore of varying width, all non-Bessemer. No. 3, the northwest shaft, has ore mostly in the direction of No. 5, but also west of it there is a line of pockets of ore quite irregular. All these hematites are irregular and uncertain in this formation and the methods of mining and plans must conform to conditions that cannot be always very clearly foreseen. There will be no difficulty in making as large a product in 1889 as was obtained the previous year.

The company met with the misfortune of the loss of its engine house by fire in January, 1888, but it was rebuilt and is now better than before.

The Lucy is one of the properties (held on lease) of Mr. W. H. Barnum, Lime Rock, Conn.

Mr. A. Maitland, of Negaunee, General Manager; James Lowe, Mining Captain.

Year.	Tons.	Year.	Tons.
1870	4,856	1880	31,028
1871	15,442	1881	28,230
1872	25,030	1882	40,390
1873	38,332	1883	14,676
1874	2,642	1884	.....
1875	10,357	1885	.....
1876	17,282	1886	.....
1877	19,691	1887	11,584
1878	30,180	1888	22,276
1879	28,962		
Total			341,478

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 QUEEN.

Going east from section 7, we come to the new hematite mines that have been found in the vicinity of Negaunee in the past few years and which have

given fortunes to a number of enterprising men in that city. Chief of these new mineral deposits just now, and the one most recently discovered, is the Queen, which is one of the largest "showings" of ore for the amount of development made, that is to be seen anywhere. The shaft is 140 feet deep and they have two levels—the upper one 100 feet from surface. They have opened a width of ore 200 feet, and length of 100 feet. There are several seams of soap rock, which separate the ore into different lenses, and this rock has an aggregate width of 20 feet, leaving 180 feet of ore. But I do not see that they have, necessarily, reached the limits of the ore, either north or south. Of course they have not yet gone the length of it. The three deposits crossed, separated by soap rock, are, respectively: north vein 60 feet, middle vein 80 feet, south vein 40 feet. In the upper level analysis of these deposits gave for north vein, iron, 63.01 per cent; phos., .274 per cent. In the bottom level an analysis of the same deposit gave, iron, 64.93 per cent; phos., .078 per cent. In upper level analysis of south vein, gave, iron 63.14, phos. .174.

Other analyses of same gave, for north vein, iron, 63.07 per cent; phos., .047 per cent; iron, 65.06 per cent; phos., .046 per cent.

Of the blue ore—south vein—analysis by same chemist gave, iron, 61.23; phos., .098.

These latter samples were taken in the bottom level, and indicate a great improvement in the ore. The north ore is soft and contains a good deal of magnesia. The south lense is hard blue hematite. The formation, including the ore, has the appearance of schist, being a flag or schistose structure. It has all the appearance of having been a ferruginous schist transformed into ore.

The land is owned by the estate of Ed. Breitung and W. P. Ely, and is held on a lease of 40 cents per ton royalty by the Queen Mining Co.

Edward Lobb, Pres. and Gen'l Manager; S. P. Kline, Sec. and Treas., Negaunee, Mich.

The estate consists of the east 35 acres of the S. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$ of Sec. 5, T. 47, R. 26. Company organized Jan. 31, 1888. Articles filed Feb. 20, 1888.

The ore is very clean—that is, no rock in it.

The fortunate owners of this lease will realize a handsome fortune doubtless. The shaft is vertical with skip, and is near the northeast corner of the 40. About 50 feet from it the dip is north.

It was formerly called the Swan.

THE PRINCE OF WALES MINING CO.

is the corporate name given to a newly-organized Co. holding the N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$ Sec. 5, a 40 acre parcel which joins the Queen on the north, and held on a lease by the company. The body of ore found in the Queen, no doubt extends into the land north of it.

The officers are, Ed. C. Anthony, Pres.; John F. Mack, Vice-Pres.; Sidney P. Kline, Sec. and Treas; Ed. Lobb, Supt., all of Negaunee, Mich.

THE SOUTH BUFFALO MINE

is in the S. W. $\frac{1}{4}$, S. E. $\frac{1}{4}$ of Sec. 5, thus placing it directly east from the Queen, which it joins. In fact the shafts are very near together, and underground the Queen people have in one place worked up to the line, so that the same bodies of ore, to some extent, lie in both properties. The South Buffalo, as well as the Queen, has a large amount of ore in sight. The main advantage that the Queen has is the fact that it seems to have some ore of a better quality than any of the others joining it. Apparently the South Buffalo could be so worked as to produce a great amount of ore. Not very much has been done since I last saw the mine, a year ago; it is no deeper, but they have drifted further, and one can see now what then he could only infer. The first level is 90 feet below surface—80 feet of distance through rock. Second level is 160 feet. They have opened east from the shaft, in bottom, 400 feet, two sets wide, and in the first level have raised up three to four sets high. They have a great width of ore as well as length; have gone west 160 feet, to the Queen line, making 560 feet in length opened, and more than 200 feet north and south in one place. On east have not crossed the ore only at the shaft.

No. 2 shaft, begun a year ago, is to the ore. The ground is low and wet. The exploring—of which there was considerable—heretofore done was in the hill south, and only lean ore found. When they came down into the swamp among the alder bushes the ore was discovered.

An analysis recently made of this ore by Mr. Uddenberg, of Marquette, gave, for two samples furnished him: Iron, 63.98 %; phos., .086 %; iron, 63.88 %, phos., .076 %.

The force employed now is about 40 men.

Peter Ranquist, Mining Capt.; Wm. Anderson, Pres.; Chas. Sudbury, Sec. and Treas., Negaunee, Mich.

Product 1887, 4,914 tons; product 1888, 24,707 tons.

THE BUFFALO MINE,

being in the N. W. ¼ S. E. ¼ Sec. 5, makes the fourth of the mines which corner at the middle of the north and south center line through the south half of Sec. 5. The Buffalo is the first one discovered and its success gave the stimulus to all the subsequent exploration that has led to such excellent results. There are four mines cornering at this 40 post and two of them have shafts near the common corner and the Buffalo is sinking another, so that soon there will be three of them all working within a stone's throw of one another and operated by different companies. The purpose of the Buffalo people is, of course, to get into the ore which has been found just south of their land and which, probably, extends into their own territory. The new shaft is 80 feet from the south line, 250 feet from the west line and 400 feet southwesterly from No. 2 shaft. The Prince of Wales joins on the west, the South Buffalo on the south and the Queen "corners" at the southwest.

When the new shaft is completed the company will have three. No. 1, the most easterly one, is 135 feet deep and from present indications will not be sunk further. They are boring with a diamond drill to prove the ground at the east end at greater depth, and if no more ore is found I understand that they will mine out the pillars at No. 1, which will yield about 5,000 tons of ore. They are now sinking No. 2 and the new shaft and are mining about 130 tons of ore per day. The body of ore at No. 2 continues to be about of the same magnitude as heretofore and will yield as large a product as last year. The best outlook for the mine is the anticipated results at the new shaft. The ore in the South Buffalo—Anderson as the mine is locally called—dips to the northwest towards the Buffalo and will, undoubtedly, be found north of the line. These mines are so near together that the deepest one will have to take the drainage of the others. The Buffalo shipped last year 30,801 tons, sold, mostly, to the Fond du Lac Furnace Co. It is soft hematite, 60 per cent iron, and non-Bessemer; when royalty is paid there can only be a small profit to accrue.

The mine has yielded as follows:

1886	10,860 tons.
1887	24,686 tons.
1888	30,801 tons.

The officers are John Paulson, President, Minn.; C. A. Avery, Secretary, Milwaukee, Wis.; Charles McGregor, Superintendent, Negaunee, Mich.

THE BLUE, LUCKY STAR, GEORGE MITCHELL, DELAWARE AND LACKAWANNA,

which are contiguous mines, all in section 5, are idle, nothing very valuable having been developed.

THE NEGAUNEE MINE,

which is also in Sec. 5, N. W. ¼ T. 47, R. 26, is a very interesting and valuable one. Interesting from the manner of occurrence of the ore, its peculiar structure, the way in which the ore is mined, etc., and valuable from the fact that the ore is rich in iron and sufficiently low in phosphorus to be Bessemer.

The mine has but one shaft, which is vertical and operated with a cage, and is now to the foot wall rock, having been sunk 16 feet the last year, making the total depth 438 feet; 12′x12′ inside timbers part of the way down, rest of the way, 10′x10′. The ore lies in a flat bed dipping towards the shaft from the south at an angle of 24°. The mining so far is all above the shaft to the south where they have drifted and roomed out to the boundary of rock on the three sides. A year ago it was thought that the ore might continue on up south to the sand and it was contemplated to start a winze from the surface at the point where the ore might be expected to come up; but the work has demonstrated the fact that the ore only continues up south about 400 feet, where it abruptly and completely terminates at a wall of rock. It does not wedge out gradually as is generally the case, but preserves its full thickness up to the rocky boundary which limits it. Thus we have here a low lying lense or deposit of ore the top of which is 260 feet below the surface. The deposit has a depth of ore between the walls of 15 feet to 35 feet and a width east and west of 350 feet and length up the foot wall of 400 feet. No opening work has yet been done to the north, below the shaft, though the ore continues all right in that direction.

The ore is a flag or schist structure, precisely the appearance of a wall of thinly bedded flag stone—a ferruginous schist that has been changed into ore.

At the south end of the deposit and along the east wall the ore is hard and compact, differing materially in appearance but affording the same results on analysis. The cut-off of the ore is caused by the foot wall turning squarely up and connecting with the hanging. In mining they have cut out rooms extending from the main level up south, leaving pillars of ore between; no timbers are required, the hanging wall being naturally firm

and secure; both walls are well defined. The rooms are numbered from the east side, there being seven in all, though 1 and 2, further up, are one and the same. In 1 and 7 they mine diagonally up to the side walls. To get down the ore to the main drift they employ a succession of chutes with short trams between: that is, they make a chute which starts on the foot wall, the upper end being gradually raised as the stoping proceeds, until finally, at a length of 60 feet, it is near the hanging. From the top of this chute a horizontal tram road is laid through the ore to the foot wall side into which an opening is cut sufficiently capacious to admit a car to stand under the end of the next rising chute. Three of these chutes, one after the other, suffice to reach to the end south. They back stope the ore, mainly, to the hanging, standing on the broken ore—"dirt"—that is left to lie on the foot, so that scaffolding is not necessary. Now, where the rooms are done with, they are beginning to cut the pillars, also working from the south end down and will let the roof fall behind them; thus all the ore will be obtained. The mine, naturally, is very dry, since all the water easily finds its way to the sump at the foot of the shaft, where it is thrown to the surface by a large steam pump.

How they will mine the ore below, going north from the shaft, I do not know; no work has been done in it as yet. They might make an inclined shaft in the foot wall and pursue the same method as now—running the ore down to a main level below and hoisting it up the inclined to the vertical shaft. Though having but a single shaft there is an abundance of air. It seemed to me to be as well ventilated as a mine need be.

In 1889 the mine ought to be profitable. By taking the pillars on the south side they will get a product that will be cheaply mined.

Product 1887, 5,359 tons; 1888, 45,304 tons.

Capt. Samuel Mitchell, Agent, etc.; Capt. Albert Newcome, Supt.

THE MENOMINEE RANGE

lies about 50 miles south of what is designated as the upper or Marquette range. It extends from town 39, in range 28, Michigan, northwesterly along the border of Mich. and Wis., to about township 41, range 34.

It is bounded on the south by the Huronian granite, which is readily traced south of the Menominee river for the whole distance, where indications of the iron-bearing rocks have been observed. The eastern portion of the range is limited on the north by the Laurentian rocks, which may be found as far west as range 31. North of the Laurentian and west, are the Huronian rocks, connecting the Marquette and Menominee ranges.

The Menominee range is understood to mean the series of mines along the boundary between Mich. and Wis., adjacent to the Menominee and Brule rivers. In the list are many good mines; some of the largest and most valuable deposits of ore in either Michigan or Wisconsin, are found in the Menominee range. All the ore in the Menominee district is so called hematite or soft ore. No magnetic or specular hard ores have been discovered.

No longer ago than 1872, this whole region, now known as the Menominee range, was a dense wilderness, penetrated by neither railroad nor highway. In fact, up to 1873 it was not certainly known that good ore existed, in quantity, in this district. The country had been traversed considerably by explorers, much mineral land had been purchased from the government, outcrops of lean ore had been observed, but until '73, '74 no first-class ore had been found. From that time on, however, the district developed rapidly, and has since become one of the most prosperous sections of the entire country, having numerous mines, rich ores, prosperous cities and villages, two lines of railway, excellent highways and an intelligent, industrious population.

Commencing at the eastern extremity of the range, I will refer to the mines in their order of occurrence to the west.

AT THE BREEN MINE,

at Wauceda, exploration has been going on for nearly a year, but in talking with Capt. E. S. Roberts, a few days since—March 1—I find that no important success has been met with. Capt. Roberts has conducted the exploratory work. The location is the N. W. ¼, N. E. ¼ Sec. 22, T. 39, R. 28, and also the N. W. ¼ of same section.

THE EAST VULCAN MINE

has been the scene of much active opening work the past year. The plan of operations as described in my last report has been carried out. The new shaft that was for so long held under contemplation has been sunk. The long drifts connecting it with the old mine have been made; new machinery has been added, other shafts have been deepened, and although the total expenditure has been necessarily large, the work has been pushed so vigorously and with so much skill and economy that the cost is much less than it might have been. It has been the endeavor, since the new plans were determined on, to accomplish in the best manner, in shortest possible period of time and with the utmost economy.

It will be remembered that this new shaft is midway between No. 1 and No. 3 shafts, 800 feet from each, and it was sunk 660 feet deep in nine months' time, certainly a remarkable record. The size of the shaft is 16′ 1″x6′ inside of timbers, the shaft timbers are 12″x12″ and are in sets 4′ apart. It is, like all the other shafts at the East Vulcan, divided into three compartments, the dividers being 6″x12″. The two end compartments hold the cages and each is, in size, 4½′x6′, the middle compartment being 6′x6′ and used for the pipes, etc.

The work of sinking was begun in November, 1887. The first 40 feet of sinking was in sand when the ledge was struck and the sinking continued for the next 60 feet in sandstone, coming thence to red slate which held for an additional 118 feet, when hard, black jasper slate succeeded, in which the shaft was sunk a further 321 feet, and thence the remaining 121 feet was in red slate.

The minimum number of feet sunk in any one month was 65 feet and the maximum progress in any month was 107′ 10″ and the average number of feet sunk per month was 73′ 4″. In sinking the first 72 feet only a windlass was used, but subsequently two 12″x16″ Rochester hoisting engines were used, operating two 4′ drums.

The cage compartments were completed as fast as the shaft went down and the cages were operated in doing the sinking, the buckets being attached to the bottom of the cages are carried up with their filling of rock above the landing, by the ascending cage, and then made to rest upon a car that is run over the mouth of the shaft and under the buckets, whence the load is trammed out through the tunnel and dumped.

As described in a former report, the bucket is made to discharge automatically.

The cost of sinking the shaft was as follows:

Labor, sinking, handling and timbering	$10,993 67	or	$16 65	per foot.
Labor, hoisting and pumping	1,437 74	"	2 18	"
Timber	3,834 17	"	5 81	"
Fuel, iron, steel, explosives, oil, etc.	10,690 97	"	16 20	"
Total cost of shaft completed	$26,957 15	or	$40 84	per foot.

The average rate of sinking per day was 2 feet 10 inches, and the average rate of wages paid $1.683 per day.

The first 307 feet was sunk by hand drilling, then by two Rand slugger drills, until the last month of sinking, when three Rand slugger drills were used. The Rand slugger drills have proved to be the best drill ever used here, and all other drills have been abandoned.

The men employed to do this work were Italians, Swedes and Polacks.

This system of sinking has never been employed by any other mine in this part of the country, neither is there another shaft timbered after this pattern.

An engine house has been built at this shaft and two engines, respectively 12″ x 24″, and 14″ x 24″, and also two boilers and two 5′ drums provided.

Two long drifts have been made to connect the new shaft with old No. 1. They are in different ground, and together make 1,000 feet of drifting—425 feet of it, however, were driven in 1887.

The south vein drift is 425 feet below surface, while the other is at the bottom, 533 feet down and 125 feet south of shaft. This drifting cost, all told, $10 per foot. In addition a good deal of drifting was done in No. 1 in first level west and north, distances of 200 feet. They are driving east from the shaft in the 633-ft. level, to reach the ore in No. 1. At the time of my visit at the mine they had just struck in the cross-cut from the shaft in the line of the ore, a new body of ore, which they were following east and west from the cross-cut. It was about four feet wide and very rich ore, an analysis giving 69.62 per cent iron, and .026 per cent phos. Capt. Curnow was much elated at the occurrence of this ore, as it was wholly new and unexpected, and bid fair to become a fine addition to the ore deposit of this shaft. No. 1 deposit is a chimney of ore that went down nearly vertical at first and then inclined to the west at a very low angle until it had become a matter of great expense to reach it from the shaft. To get at this ore was the reason that determined the sinking of the new shaft. This shaft has been sunk upwards of 100 feet below the bottom of the mine, and they are now drifting east from the new shaft to reach the ore, and in doing this they unexpectedly encountered the vein of ore as explained above. This preparatory work has cost, probably, $50,000.

The No. 3 shaft produced finely last year 24,000 tons, and it was cheaply obtained. No. 3 shaft ore has cost the least of any at the East Vulcan. A year ago they opened into a large deposit that has been nearly worked out and the bottom of it is rock. Just now it does not appear that the shaft will yield as well as it did last year. The East Vulcan mine is a pockety concern; I think there has been more drifting done in it than in any other mine of its size in the State. If it were not the best of ore, if the company and its local management were less able and persevering, the mine would have been abandoned long ago; but now, if expectations are fulfilled, it will be more profitable.

The depth of No. 3 shaft is 450 feet. Among the improvements is a new shaft house and two new cages in the shaft; also have the plant of

machinery formerly used at the Quinnesec, two 5′ drums, W. C. & L. pattern. There are now in stock at No. 3 16,000 tons of ore.

No. 2 shaft is 350 feet deep vertically down; is also a two-cage shaft. A world of drifting was done but only 524 tons of ore obtained. Capt. Curnow thinks, however, that the mine will yield 10,000 tons in 1889. There is a chimney of ore 104 feet high and they have sunk a winze in it 70 feet, so that from this showing the estimate is made.

They have fine stock grounds now at all the shafts. The company has well earned all the success at the East Vulcan it is likely to get. It will be a matter of much satisfaction to have it turn out well.

Sec. 10, joining East Vulcan on the west, has been added to Capt. Curnow's dominions and he is conducting an exploration near the west line of the section in the side hill, in the line joining East and West Vulcan mines. Here he has sunk 75 feet in soap rock and cross-cutted south 30 feet in soap rock, 123 feet jasper. Also drifted west 50 feet, along the north soap rock, and east the same distance along south soap rock. The drift is mixed ore and rock.

The product of the East Vulcan, 1888, was 24,401 tons.

THE WEST VULCAN

seems hardly to be holding its own. The company has just completed its preparations for operating the mine at its increased depth and on the assumption that the deposit would retain its magnitude. When I went through the mine a year ago, it was looking finely; they were then opening the ninth level and it showed an increased length and no diminution in width. The ore averaged about 30 feet wide for a length of 300 feet and for the remaining 300 feet in length it averaged about 10 feet wide. But the 10th level, recently opened, shows a quite different appearance. The ore is not above 18 feet wide in the widest place and narrows down each way to three or four feet. Besides this, the ore is mixed with limestone so that some of it is worthless. The downright shaft is sunk to the 11th level, 855 feet deep. They have been pursuing the new plan of mining: that is, taking out all the ore and substituting rock, etc., in its place. To accomplish this a drift in the foot wall in each level from the sixth down has been made and the ore has been attacked through cross-cuts from these main drifts and the ore has been cut out in sections across the deposit, rising up by successive stages from the ninth to the eighth level. In the 10th the foot wall drift was started but discontinued when it was found that the ore had diminished so greatly.

There is about 30 feet in height of ore standing in the ninth level, between it and the eighth. Also there are four pillars of ore in the eighth level. The ground is opened from the 10th to the 9th; winzes all sunk for running down the rock for filling.

At No. 2 shaft they had cut out the pillar in the eighth level and had timbered it well, ready to fill up with rock; but the ground suddenly crushed in from the seventh level down to the ninth, making a troublesome job to restore the shaft. It has been done, however, and No. 2 shaft is better than ever. It is in the foot wall 375 feet east from the downright and is a double skip shaft. The mine is in admirable shape in every particular, except in the contraction of the ore deposit, and the limestone occurring along the foot in the bottom. The ore has thus become poorer in quality and less in quantity.

It will be seen that the new shaft has been sunk 200 feet and No. 2 100 feet in the past year, besides the work of reopening the 200 feet of No. 2 that caved in.

There are about 30,000 tons in stock, and the product for the year 1888 was 94,958 tons.

THE CENTRAL VULCAN,

so called, because it lies between the East and West Vulcan, is about exhausted. There are 3,000 tons of ore in stock and 9,411 tons were shipped from the mine in 1888.

THE CURRY MINE,

which joins the West Vulcan on the west and which came into the possession of the Penn Iron Co. about a year and a half ago, is proving to be a promising property. It yields the best ore the company has. They are working in several places, some of them old pits and some new discoveries, but the best one is the shaft at the foot of the hill close to the highway, which I mentioned in my last report, and which is proving valuable. A recent analysis of this ore gave 63% in iron, .006% phosphorus.

The old Curry shaft has been freed of water, and they are now—March—hoisting 40 tons of ore per day from it. The shaft is 238 feet deep and the drift west to the breast of ore is 358 feet. This stope is 18 feet wide and 50 feet high. It is contemplated to sink a shaft to the west, near the west line of the property, since the ore, probably, goes into the Briar Hill lands, held also by the Penn Co. The company secured with the lease of the mine a good plant of machinery—2 Lowe drums, 4′ diam., etc.

Further up on the hill and to the east is an old pit, on the east of which the company has found a flat deposit of ore, which will yield 5,000 to 10,000 tons. It lies on jasper and has slate covering. It is 200 feet above the lake that lies 350 feet south beyond the railroad. It will be some trouble to get this ore to the cars. Some sort of an incline will be resorted to, no doubt.

The Curry will yield 25,000 tons in 1889—that is Mr. Hagey's estimate; and it is all rich Bessemer ore.

THE BRIAR HILL MINE

is also now one of the Penn Iron Co.'s properties. The company is simply exploring it. It does not produce any ore at present, but they have sunk a shaft just south of the highway and railroad 100 feet deep, and have drifted north in the bottom 60 feet, and are now drifting south; are about the same distance in mixed ore and rock. The prospect does not seem to be very good. I think that boring with a diamond drill across the formation, at greater depth, would be more satisfactory. Since the above was written the company has begun to sink a winze at the south end of the cross-cut, and finds much better looking rock.

THE NORWAY MINE

presents no new features, except that the outlook for future products has become somewhat more dubious. The good ore at this mine—"The Norway ore"—is nearly exhausted. There is a good deal of B. B. ore still in the mine, but not much, comparatively, of the other. Their plan now is to strip the mine in the extreme east and west ends, where it is all underground, and let the surface dirt run down into the openings, and then to mine out the pillars. The east end is completely honeycombed with drifts. There are many large rooms supported by pillars of ore, with wide stretches of roof between, that stand remarkably well. I scarcely know of a formation that is so self supporting as this. The ore is cut out by the underlay of limestone that dips in irregular folds to the south. In the wrinkles in the folds of this limestone the best ore has been found for several years past. The bottom is becoming pretty well cleaned up now. They are making three grades of ore now, to wit: Norway, B. B. and a mixture of the two latter grades, which I think is called B. ore. Norway goes 55 per cent iron, .040 per cent phos.; B. B. 60 per cent iron, .120 per cent phos.

The mine is 450 feet deep—400 feet to bottom level. Of the ore shipped in 1888, 75,000 tons were straight Norway. The mine has been very fully

described heretofore, and I find nothing new to add. It looks now as if there were little further to do at the Norway but to "scram the mine"—get out the pillars, etc., in the cheapest way.

The following analyses of the ores of the several mines of the Penn Iron Co. may be of interest.

Average of samples from the stock piles of Penn Iron Co., April 21, 1888:

Name of Mine.	Iron.	Phosphorus.
Nos. 3, 5, 8 and 9 stock piles, Norway mine	55 05	.069
New shaft stock piles, Norway mine	61.37	.097
Nos. 3, 5, 8, 9 and New Shaft together, Norway mine	55.73	.073
Vulcan stock piles	55.25	.042
Central stock piles	60.96	.075
East Vulcan stock piles	53.75	.043
Vulcan Central and East Vulcan together	55.67	.045
Cyclops stock piles	57.81	.019
Quinnesec stock piles	58.43	.016

The following is the amount of ore shipped from the Penn Co.'s mines in 1888:

Norway	87,164 tons.
Cyclops	14,662 "
West Vulcan	94,959 "
Curry	5,376 "
East Vulcan	24,401 "
Central Vulcan	9,472 "
Quinnesec	2,020 "
Total	238,054 tons.

The Quinnesec mine has been abandoned by the Penn Co., and no one is now exploring it. The total force employed by the Penn Co. in all its mines is 850 men. An important improvement which has been made in the last year is the pumping of water from the lake below the mine up into a reservoir on top of the hill above the West Vulcan mine. It supplies water for the boilers and a head of water to extinguish fires.

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	124,120
1880	72,405	1886	143,930
1881	85,671	1887	205,127
1882	94,042	1888	128,832
Total			1,128,805

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

Year.	Tons.	Year.	Tons.
1878	7,533	1884	71,515
1879	73,540	1885	57,741
1880	198,765	1886	93,878
1881	137,558	1887	95,558
1882	165,084	1888	87,164
1883	114,836		
Total			1,102,342

The officers are J. E. Hagey, General Manager, Penn Iron Co.; John Oliver, Superintendent Norway and West Vulcan; John U. Curnow, Superintendent East Vulcan.

THE CYCLOPS

is the only remaining mine of the Penn Co. to be mentioned; it is west of the Norway and is worked in connection with that property. They are mining in only one place and that is in a pit away up on the hill north of the west part of the village, where they had, in an open pit, a deposit of ore 6′ wide and 75 feet long.

THE PERKINS MINE,

which is also in the village of Norway and joining the Norway mine, is still worked, though its final abandonment cannot be long deferred. Undoubtedly Capt. Perkins finds it profitable, as he has no water to pump. The Norway being deeper drains the Perkins. The ore obtained in the Perkins is mainly from the pillars that could not be got until the mine had caved in, as it has done.

The mine has produced in all 376,300 tons of ore.

John Perkins, Proprietor, Norway, Mich.

THE ARAGON MINING CO.

is the corporation that has been organized to develop the Smith-Butler property at Norway, Mich.

The property consists of four forties, in a row east and west, commencing at the Briar Hill and extending west one mile. It embraces the Norway town site, joining the Norway mine on the south, and consisting of the N. ½ of the N. ½ of Sec. 8, T. 39, R. 29.

A year ago when I described the property the association was engaged in endeavoring to sink a shaft near the west line of the N. E. ¼, N. E. ¼ of Sec. 8, but after repeated effort they failed to get to the ledge, and the attempt was abandoned, finally. The location is in a cedar swamp, originally very wet and of course, in such a situation, sinking to the ledge through sixty feet of quicksand and associated material, becomes a difficult matter. It may seem to be easy enough to the uninitiated, but observation, or a little actual experience, will soon develop to his satisfaction enough of perplexities to tax the greatest skill.

Per Larsson, mining engineer at the Chapin Mine, was placed in charge of the work at the Aragon, and has got matters in shape so that the shaft is sinking without any delay. At the time I was down—about March 20—it was 52 feet deep, thus there were 8 feet further to sink. Mr. Larsson started from the surface, in about the center of the forty, and has no less than eleven pumps at the other shaft; the purpose being to drain the ground by pumping the water from the other shaft and running it away to the west in a launder. He is sinking a water-tight timber shaft, 6′ x 14′ inside top dimensions, and 8′ 4″ x 17′ 4″ bottom area; thus the shaft will have a downward, outward batier of 1″ to 1′. The shaft is lowered by adding the timbers and also weighting it at the top and digging and excavating in the bottom and under the timbers.

The bottom timbers are oak and are beveled on the inside face so that the under edge is sharp. Sheet piling is kept driven all around the timbers at the bottom to prevent the influx of water and sand.

I witnessed the raising of one of these plank piles and the quicksand came in with a rush. The shaft is supposed to be in the foot wall of the ore. The discovery of the ore is explained in my last report, and there is nothing

to add in that respect, beyond the fact that Mr. Larsson has begun to explore further with the drill. There seem to be two lenses of ore. The main boring passed through jasper, slates, then 140 feet of ore and into jasper again. Further east was found, in a boring 9 ft. of ore, but north of the former, apparently separated from it by a large body of jasper and slates. They are exploring with the drill, the ground between these holes, east and west.

In the shaft now sinking, at a depth of 20 feet from the surface, the fossil remains of an animal were found. Only the skull and one tooth were saved. The remainder of the skeleton, if it existed still, was outside of the timbers and difficult to reach. It appears to be the skull of an elk, and was found just under the marl—first, 10 feet of muck, then marl.

They are adding a second boiler and inclosing it in with brick.

Considerable local interest attaches to this mine. The ore is shown to be, from analyses of the drill cores, of the best quality—65½ to 69 per cent in iron and .012 to .033 per cent in phosphorus. Its success is an important consideration to the people of Norway. Since writing the above, the shaft is now, April 15, two feet into the ledge which is slate. Still more recently, the ore has been reached in a cross-cut north.

Angus Smith, President, Milwaukee, Wis.; Per Larsson, Superintendent, etc., Norway, Mich.

HAGEY & PORTER MINE

represents the exploration making by Messrs. General Managers Hagey and Porter just south of the Aragon shaft. These gentlemen hold a lease of this land and have begun to explore it for ore. The situation is favorable for such an undertaking and I see no reason why they should not meet with success.

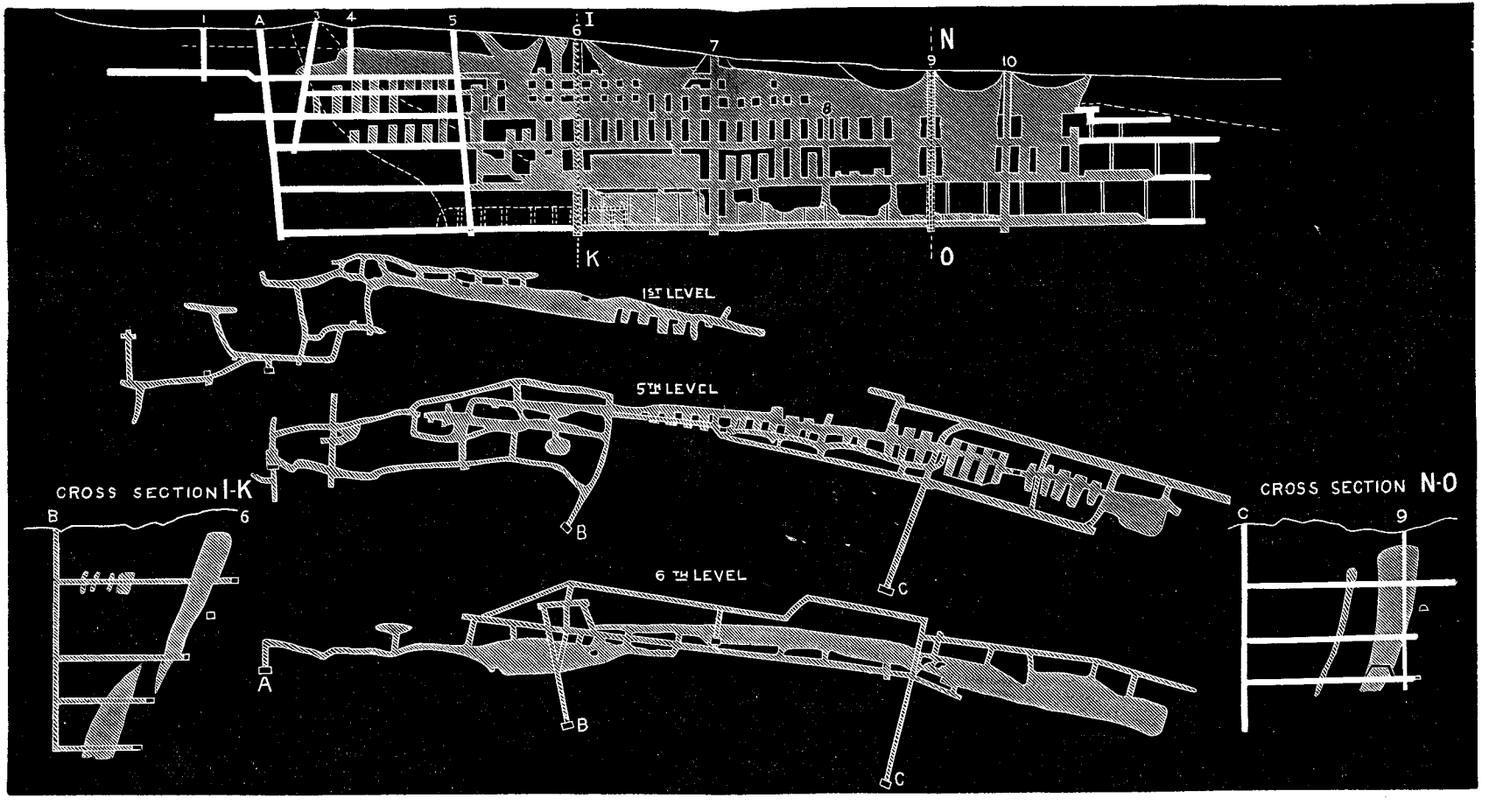
THE CHAPIN MINE.

Quite a sensation was awakened recently by the announcement that the Chapin Mining Co. had sold its franchise and interest in the mine to a foreign syndicate, through representatives in this country, for the sum of $2,000,000. However the report was the announcement of a fact; the sale has been made and there are other ultimate proprietors than formerly of the Chapin mine.

No difference is apparent at the mine; there is no change in the local management; everything goes on as heretofore and I hear of no likelihood of any interference, fortunately.

MAP OF THE CHAPIN MINE, 1889.

Scale: 300 feet to an inch.



It will be remembered that for a year and more past the Chapin company has been pursuing an entirely different system of mining than it had previously. They have been filling the mine, recently, as the ore was removed. The method by which this work was accomplished I have endeavored to explain in previous reports—'86-'87. But now, after a trial, the management has about decided to abandon the system thus inaugurated and to proceed upon a quite different plan.

The shafts—B and C—are on the hanging wall side of the ore; at first the attempt was made to drive tunnels in the hanging wall north of the ore and so to reach the ore from these drifts. But this was speedily found to be impracticable, as the drifts crushed in and could not be kept passable. Then a further modification was made by driving the main cross-cuts from the shafts through the ore into the foot wall and making the main longitudinal drifts in this rock, 40 feet and upwards south of the ore. These foot wall drifts are shown in the accompanying plans of the fifth and sixth levels. They are cut in the slate foot wall, seven or eight feet high and 9 or 10 feet wide, and I was greatly surprised the other day, on going through the mine, to find that this foot wall drift in the fifth level, as well as many of the cross-cuts leading from it to the ore, had crushed in; crushed down so as to make it difficult or impossible to get through them. They are now making a new tunnel in the fifth level, 100 feet and upwards, in portions from the ore; so that it will be seen that this drift and the cross-cuts to it from the ore, together with the "rises" in which to run the ore down into the cars, have all to be made anew. All this reëxpense must be incurred by reason of the non-stability of the foot wall.

But in truth, they are miserable walls anyway—a soft, friable, unstable slate, that crumbles and disintegrates on exposure, so that the walls even of a drift will not stand.

I have observed slips or seams of clay in the foot wall drift. Such rock can have little sustaining power. Thus far the foot wall drift in the 6th level remains intact, and all the ore mined out in the 5th level goes down to the 6th, and thence to the surface.

The endless rope system that runs in the 6th level, to and from C shaft, works admirably. The tramming is thus done by machinery. The handling of the cars at the shaft is accomplished with much celerity. The loaded cars go directly on to the cages from the front, while the empty cars are pushed off to the rear and around the shaft into the line of the track in which the wire rope is constantly running. There is no delay; the cars are hoisted very rapidly; the changes are quickly made.

It is rather pleasant to sit here in this dry, commodious shaft yard in the 6th level and observe the loaded cars constantly arriving and the empty ones going away, and to see how rapidly they are sent to the surface, discharged, and the cars returned and sent back to the stope for another load.

The unloading of the cars is something different from that seen anywhere else. The tram car, with its load as it comes up out of the mine, is run out over the trestle on an iron-frame, skeleton car, and everything so adjusted that when the place for the discharge is reached the car is made to revolve, casting out its contents and immediately returning to the shaft. The entire operation is performed quickly; no one goes out with the car.

The company has built a long trestle, nearly a third of a mile, from the shafts to the Milwaukee & Northern R. R. track, where they have made two ore pockets. There are two tracks operated with an endless rope. Last fall they run from the shafts to these pockets 80 cars in an hour—two tons to a car—160 tons of ore hoisted from the mine and run one-third of a mile and discharged in an hour. The cars are made to discharge at the pockets automatically, the instant they arrive; go down on one track and back on the other. They pass right around without scarcely stopping, revolving and discharging as they go.

I stated previously that the company was about to greatly modify its system of mining. The plan under contemplation now is to abandon the foot wall drifts in the lower levels, and their present method of taking out all the ore, but to further sink the shafts to the 8th level, 200 feet below the 6th, and to open a longitudinal drift through the center of the main ore body, and from this to make "headings" or rooms each way from it to the foot and hanging 18 ft. wide, leaving pillars of ore of equal width, and to back stope the ore in these rooms to the full height of the level—that is up to the 7th, by successive rises or horizontal sections, and to fill up the space below, as fast as a rise is made; so that when the room is stoped out it will be filled with rock. No timber will be required, as it is known by former experience, before any filling was resorted to, that the roof for a space of 18 ft. will stand without support for a length of time necessary for mining out the ore. It is the intention to leave the 7th level—100 feet high—up to the 6th undisturbed. In this way it is thought that all movement of the ground will be avoided, and that the ore will be more cheaply obtained.

They are sinking a shaft in the foot wall about opposite the west end of the underground opening, 700 feet from C shaft. It is 200 feet from the ore in the foot. It is a five-compartment shaft and will be used for timber, rock and ore.

The sinking of D shaft in the low ground, 1,100 feet west of C and 600 feet east of the west line of the property, by the freezing process, has progressed rapidly until now, March 10, when, it is thought, through the fact that one of the pipes is not to the ledge, and the ground under it not being frozen, the water and quicksand is admitted beneath into the shaft and the work of sinking has come to a standstill.

The pipes, 27 in number, were driven in a circumference, the diameter of which is 29′ 6″. The shaft sunk in this circle is 24′x26′, to be a four-cage shaft. The excavation is accomplished by first freezing the ground, done by the Poetsch-Sooysmith freezing process. The original pipes are 10″ diameter, sunk 98 feet to the ledge. Within these are placed 8″ pipes, closed at lower end, and within the latter 2½″ extending to the bottom and through which the liquid is forced. All these interior pipes are connected in one system—the inflow of the freezing mixture—and the exterior 8″ pipes are all connected in one system—the return system of the fluid. In the temporary building adjacent to the shaft are a condensing engine, pump, and two large tanks, one containing cold water, the other liquid, chloride of calcium. The condensing engine forces liquid ammonia through a small pipe coil placed in the cold water tank: the purpose being that the latent heat generated by the condensation, is absorbed by the water. Thence the ammonia circulates through a similar coil, but of larger diameter of pipe; the sudden expansion securing a low degree of temperature by reason of which the cooling of the fluid, calcium chloride, through which it circulates, is effected. The temperature of the calcium chloride is thus reduced to 19° Fahr., in which state it is sent forward to circulate through the pipes in the ground and back again into the tank. The heat of the ground is absorbed so greatly that it is frozen hard, in which state it is excavated. The shaft is down to the ledge on one side but, as before stated, the water comes in at another point, and they are temporarily stopped.

The company is no doubt anxious to complete this shaft, not only to get into the ore in this part of the mine, the existence of which has been shown by diamond drill boring, but also it is wanted for a pump shaft. It is in the low ground at the west end of the mine and will be made to take all the water. As it is now the pump shaft is at the east end of the mine on the top of the hill and there is no occasion for sinking it any deeper. When D and the one between it and C are sunk the mine will have four shafts, besides No. 5 shaft and A shaft.

The Chapin is a great deposit of ore, undoubtedly the largest of any in the State, but it is a weighty mining problem how to handle it the most economically. If the inclosing walls were jasper and quartzite, instead of

the soft, friable slate that they are, it would be much easier. There is one thing, however, to be considered in the matter of rock drifting in this mine: it don't cost much to do it, about $3.40 per foot. Such work in hard jasper would cost three times as much. I think that the cost of the ore, even with the crushing in of the drifts, and the added expense of making new ones, is much less than one might imagine. It is doubtful, in my mind, if the proposed plan, if carried out, will be found to be, on the whole, in the long run, better than the one now pursued.

The Chapin is one of the best equipped mines in the country. One sees very much that it is of interest there. Persons who are studying mining work or who take an interest in it cannot do better than to visit the Chapin.

The accompanying map is the same as printed in my last report. There is little change to be observed in the map except that B and C shafts have been sunk each 100 feet deeper.

The company works 900 men. The ore is about 63 per cent in iron and .073 per cent phosphorus. The ore in east end of mine is Bessemer.

The Chapin, the Norrie and the Minnesota are the three greatest iron mines at present on Lake Superior. All of them can send out a large product the ensuing year, but whether the Chapin management will endeavor to compete for the leadership I do not know. Of the three, however, I think that the Minnesota can at present produce more ore than any other mine on the lake. I have been there recently. There is a great deal of ore in sight available for stoping.

The annual product of the Chapin has been as follows:

Year.	Tons.	Year.	Tons.
1880	34,556	1885	177,987
1881	134,717	1886	198,871
1882	247,505	1887	334,026
1883	265,830	1888	290,872
1884	290,865		
Total			1,975,220

The capital stock is $2,000,000, divided into 80,000 shares, and the recent purchasers took the stock at its par value, $25 per share.

C. H. Cady, Agent, Iron Mountain, Mich.; Wm. Oliver, Mining Capt., Iron Mountain, Mich.; Ferdinand Schlessinger, President, Milwaukee, Wis.; William Schlessinger, Treasurer, New York, N. Y.; Adolph Wagner, Secretary.

Mr. Thomas, the superintendent of the work at D shaft, showed me some statements, sketches, etc., of the ground passed through in sinking. It is an interesting record, more especially the boulder deposits. It is astonishing the quantity and size of boulders encountered in this swamp many feet beneath the surface. Boulders of 14 tons weight were removed. The monthly product of the mine is now 35,000 tons.

THE WALPOLE MINE,

which is close to the east end of the Chapin, continues to be explored by the Menominee Mining Co., the former owners of the Chapin. The prospects of developing a paying mine do not seem to be very flattering, although some ore is found.

The shaft is down 300 feet deep, and they have three levels. The secret of the reason of keeping up the effort is that it is good ore—66 % in iron, and .006 % to .015 % in phos. The shaft is about 500 feet east of the Chapin.

The work is done by Pickands, Mather & Co., Cleveland, Ohio. C. H. Cady, Agent, Iron Mountain, Mich.

The lands are, E. ½, N. E. ¼ Sec. 31, and the S. E. ¼ Sec. 30, and S. W. ¼ Sec. 29, all in T. 40, R. 30.

No ore was shipped in 1888, but there are 5,000 tons in stock now, and they hope to increase it to 10,000 during the year.

THE MILLIE MINING CO.

operates the old Hewitt mine, south of the Chapin. It has never been a large mine, and there is little prospect of it ever becoming one. Up in this side hill at the east end of the Chapin, the ore lenses that have been found have all been small—always the best of ore but never much of it. This is the case with the Millie, as it was with the Hewitt—they are taking out good ore, but work in a small deposit. The new shaft is 170 feet deep, and the company employs 50 men. The officers remain as heretofore, except that Mr. C. W. Kennedy is the Supt., and there is a change in mining captains.

The amount shipped in 1888 was 10,722 tons, and there will be an equal or greater amount in 1889. The aggregate of shipments from this property is 51,491 tons.

John Corbis, Mining Captain.

THE PEWABIC MINING CO.'S

location is southeast from the Chapin, in the N. ½ Sec. 32, T. 40, R. 30. I visited the location March 16, and found a fine cage shaft sunk to a depth of 350 feet, and at the bottom a cross-cut north 800 feet. Near the end of this they find a seam of ore in which a winze has been sunk, and it seems to be of sufficient size to make quite a mine. Good blue ore, 63 %, and low in phos. Have already begun to make a stock pile from it. They use power drills, bringing the air from the main hydraulic works air pipe, that runs over the surface between the mine and the Chapin.

North of the shaft the ground rises, making a smooth, high, broad side hill, covered with pine and mixed timber, and made up, below surface, of jasper slates. The company is working about 30 men.

Jim Holland, Mining Capt., and Mr. Brown, former clerk at the East Vulcan mine, Supt.; N. P. Hulst, General Manager, Menominee Mining Co.

HAMILTON ORE CO.

has increased the depth of its shaft 336 feet since I last went down in it, a year ago. The shaft is now 1,256 feet deep vertically down. It has pre-ëminence in one particular at least: it is the deepest vertical iron mining shaft in the State. For the last 500 feet it is sunk in ore. The bottom of the shaft has reached the red slates that belong to the foot wall in the Chapin.

The dip of the formation remains unchanged. The pump is successfully doing duty at the 920-foot level.

The following are analyses of the ore:

Iron..... 61.53 per cent.	Phos..... .057 per cent.	Iron..... 65.00 per cent.	Phos..... .076 per cent.
" ..... 61.52 " "	" ..... .026 " "	" ..... 65.50 " "	" ..... .105 " "
" ..... 59.21 " "	" ..... .057 " "	" ..... 61.56 " "	" ..... .053 " "
" ..... 60.36 " "	" ..... .068 " "	" ..... 67.90 " "	" ..... .045 " "

In the winze now sinking the ore analyzed: Iron, 65.15 per cent, phos., .074 per cent; shaft at depth of 1,195 feet, the ore went: Iron, 66.40 per cent, phos., .062 per cent; at depth of 1,200, ore sample gave: Iron, 67.60 per cent, phos., .073 per cent, and at 1,225 feet depth sample of ore gave: Iron, 64.90 per cent, phos., .060 per cent.

The shaft is in the corner of the property and is so placed that the diagonals of the rectangle of the cross section of the shaft are more nearly

parallel, respectively, with the boundaries of the property than are the sides of the shaft. They have not cross-cutted the ore north, but at the 1,025-foot level they have drifted east in ore 75 feet and sunk a winze 100 feet and come back to the shaft at the 1,125-foot level. This is all the opening work that has been done. They think that the ore goes east 150 feet anyway and must extend north the width of the deposit. They have no room west, as they are cut off there by the boundary of the property.

If they succeed in finding ore enough for a good mine it would hardly be safe to operate very largely with one shaft. The force employed is 60 men, and they have now—March 15—4,000 tons of ore in stock.

They are now putting in a Rand duplex compressor, 30″x18″, and two new steel boilers, 66″x16′, duplicates of the other two already in use.

The officers are: Norman Hall, President, Sharon, Pa.; P. L. Kimberly, Vice-President, Cleveland, O.; R. Williamson, Secretary and Treasurer, Chicago, Ill.; Frank Corbis, Mining Captain.

J. T. Jones, until now Superintendent, has severed his connection with the company. Since writing the foregoing this Co. has begun to sink another shaft.

The mine has sent out as follows:

1886	872 tons of ore.
1887	514 " "
1888	8,801 " "
Total	10,187 tons of ore.

THE LUDINGTON MINE

is just now—March 16—looking a little dubious in the bottom. A year ago when I went down into the mine the A shaft was sunk 60 feet below the eighth level and they were opening up the eighth. Now, A shaft is sunk to the tenth level and they are opening up the ninth, and where they expected to find ore is rock. That is, in going from the cross-cut south and east towards the main deposit jasper is encountered all the way where in the levels above was ore. What the outcome will be it is impossible to declare. They found some limestone in the ore in the eighth level.

The plan is to sink the shaft to the eleventh level, 1,007 feet deep, 100 feet below its present bottom, and ascertain if the rock will not cut out.

In the ninth, 907 feet below surface, the first 20 feet east of the cross-cut was ore, since which the whole drift, 125 feet, has been in rock. Mr. Moore expresses the intention of working with a diamond drill in the bottom to explore it. A shaft is 261 feet west of the Hamilton shaft, and it would seem that the ore which is found in the latter must extend into the Luding-

ton land, and inasmuch as the Hamilton shaft, close to the Ludington line, is still in ore 1,256 feet down, and has been for 500 feet, it would indicate that the Ludington has still undeveloped ore, possibly a good deal of it. The drift which they are opening to connect with the old mine, 1,000 feet west from No. 5 shaft, is now 900 feet long. No ore has been cut in this drift. The old mine and No. 5 shaft, both yield all Bessemer ore. The large body of ore next to the Chapin line is non-Bessemer. The former is designated as Ludington ore; the latter as Star ore. The company works 240 men.

The Ludington ore goes 67.7 per cent iron, .021 per cent phos.

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

The Ludington mine has annually produced as follows:

Year.	Tons.	Year.	Tons.
1880	8,876	1885	124,194
1881	3,365	1886	76,983
1882	52,519	1887	104,289
1883	102,632	1888	61,883
1884	101,165		
Total			635,906

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.

Of the

CORNELL, TRADERS', CANADIAN, INDIANA, ETC.,

mines, in the vicinity of Iron Mountain, there is nothing to mention beyond the fact that all work and exploration has ceased for the present, at least. They are all idle.

But going west on the C. & N. W. R. R., we cross the Menominee river and get into Wisconsin, and are brought first to

THE COMMONWEALTH,

which is a valuable mine, held in fee simple by the company, and which produces a good quality of non-Bessemer ore.

Capt. W. E. Dickinson, who has been Supt. of the mine since 1883, resigned about the close of the year 1888, to assume the charge of the Colby. Mr. O. C. Davidson has been appointed in his stead. The company employs now 120 men, and the mine is looking fully as well as usual.

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	1888	61,818
Total			482,794

THE FLORENCE MINE

is also in the State of Wisconsin, but as it and the Commonwealth are the only two producing mines in the Menominee range in that State, and as they have the outlet for their ores at Escanaba, I have always included a description of them with the others, especially of the Florence as it is an interesting and valuable mine. The company owns three-quarters of the fee, the remaining fourth being held by D. H. Fisher, Esq., of Florence, to whom the company pays 6¼ cents per ton royalty. The Florence is a well managed and well worked mine and it contains a great amount of ore that is cheaply obtained.

Not much is done in the old mine, the ore is low grade, but for the past few years, since the mine came into the possession of the present Co., the work has all been off to the west in the new deposits known as No. 4 and No. 5 shafts. Here they have opened a length of ore 200 ft. and still continuing in No. 4 shaft in the 300 ft. level in the south lense. At the east end the stope is 18 feet wide, and at the west end it is 40 ft. and 70 feet high. It is clean ore, no rock in it. The north lense in No. 4 shaft is harder ore, about the same in quality as the other, all of it yielding 61½ to 62 per cent in iron and about .20 per cent phosphorus. Are sending 200 tons daily to Chicago Furnace Co., and have 25,000 tons in stock.

No. 4 shaft is 350 ft. deep and No. 5 is 300 and sinking to the 350 ft. level. The hoisting is mainly in No. 4, but are beginning to send up ore in No. 5. The walls in the mine stand remarkably well, like those in the Norway.

In July last the engine house was burned, but the utmost exertion was expended and it was speedily rebuilt and is now much better and better arranged than before.

In the old mine, No. 2 shaft, they are preparing to mine out 25,000 tons of ore that is contained in pillars and in the back or floor between the bottom of the open pit and a level beneath it. This will be very cheap ore.

Two Norwalk compressors have been added to the machinery. The mine is situated in the west part of the city of Florence and is lacking in nothing essential to vigorous and economical work. The company employs now (March 19) 200 men, but soon the force will be doubled or greatly increased.

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	1888	142,586
Total			537,856

Henry Tod, President, Youngstown, O.; J. N. Porter, General Manager, Stambaugh, Mich.; J. E. Gilbert, Superintendent, Florence, Wis.; Edward Ball, Mining Captain.

THE IRON RIVER MINE

has never looked better than it does now. It shipped last year 110,000 tons of ore and worked very light until late in the season. The mine could as easily yield 200,000 tons.

The south part of the north end of the mine is somewhat irregular but north of it, to No. 3 shaft and beyond, the deposit is regular. It is to the 200-foot level and all the ore is extending from that depth 80 feet up. Between it and the 120-foot level at each 50 feet a winze is made for sending down rock to fill up with. They back stope the ore and fill up with rock, rising up on the filling.

The ore has a uniform width of 40 feet for a length of 500 feet. It is reached from No. 1 shaft, which is sunk to the 300-foot level, and is a double skip shaft. The mine is opened for all the product that can be disposed of. They hope to sell 200,000 tons. No. 3 shaft is west of the ore towards the river in the hanging wall, 123 feet from the ore. But in driving the cross-cut from this shaft at the 200-foot level they have cut 60 feet in width of ore—an entirely new body of whose existence they previously knew nothing.

In mining out the 80 feet in height of ore that I before mentioned, the rock for filling will come down through the winzes that have already been made; and as they rise up, "mills" in which to run down the ore into the drift will be kept open through the filling. The material for filling comes from the sides of the open pit. The only timber used is in the drift to be

kept open for tramming ore. It looks very much as if the ore will finally be found to extend under the river. They are preparing to bore with a diamond drill in the swamp by the side of the road south of the shafts.

The Isabella pit, away to the south end of the section, is also holding its own. The pit is becoming very deep for an open one—200 feet. The ore has taken a pitch south and gone under the south wall of the pit. It will give as large an annual product as ever. This pit is in the S. W. $\frac{1}{4}$ of S. W. $\frac{1}{4}$, Sec. 36, T. 43, R. 35.

Isabella pit product, 1888	43,570 tons of ore
North End mine product, 1888	66,382 " "
Total	109,952 tons of ore.

The annual product has been as follows:

Year.	Tons.	Year.	Tons.
1882	29,115	1886	78,591
1883	100,369	1887	82,464
1884	52,584	1888	109,952
1885	55,693		
Total			508,768

The North End ore averaged 57 per cent to 58 per cent in iron and the South End, or Isabella ore averaged 60 per cent iron; phos., .33 per cent.

Everything at the Iron River mine shows the best of management and care.

J. N. Porter, General Manager; Otto Riebel, Superintendent.

The Iron River mine is at Stambaugh, Mich., in Secs. 35 and 36, T. 43, R. 35, Mich.

THE NANAIMO MINE

was closed down last summer, mainly, I believe through the failure of the company to meet its pecuniary obligations. I happened to be at Iron River in June when work was suspended at the mine. The pumps were pulled out, etc., and the sheriff was attaching property to secure payment for debts, particularly labor accounts.

The ore on hand was taken by Todd, Stambaugh & Co., of Cleveland, to whom it had been sold to pay advances of funds.

I do not think that the mine is likely to be opened again soon. There is ore in the bottom still. How much could be found cannot be said as there is no advanced opening work, but it is a quality of ore that must be mined

very cheaply and in large quantity to make any profit. It is the same practically, as the Iron River mine ore (57 per cent, 58 per cent) and there is not nearly as much of it as at the Iron River mine, and the Iron River Co. cannot sell enough ore to keep the mine working throughout the year.

The Nanaimo is in the village of Iron River, Mich., in the N. W. ¼, S. W. ¼, Sec. 25, T. 43, R. 35, held on a lease by the Nanaimo Co. and owned in fee by the McKinnon Bros., Iron River, Mich. I understand that the Co. has relinquished its lease of the land. The mine was opened in 1882, and has yielded an aggregate product of 110,915 tons of ore. The product in 1888 was 5,744 tons.

THE BETA,

which is a small pit close to the Nanaimo, has not been worked the past year. They worked out a pocket of ore in 1886 and 1887 that yielded 2,811 tons. Mr. D. C. McKinnon, Iron River, Mich., is the owner of the fee of the land.

THE SHERIDAN

joins the Beta. Mr. P. Sheridan has been exploring the proporty several years and proposes to continue to do so in 1889. He has not sent away any ore yet, but thinks he will be able to ship some the coming season. Work will be prosecuted under direction of Capt. Wm. Morgan.

These are all the mines to mention in the vicinity of Iron River, but further east 12 or 15 miles in township 43, R. 32 and 33, is

THE PAINT RIVER DISTRICT,

where are a greater number of mines and considerable mining activity. New developments are constantly made and deposits of ore found, some of good quality; but no Bessemer ore, in quantity, has been discovered west of Iron Mountain. What is called the east range at Crystal Falls, in Secs. 13 and 23, etc., T. 43, R. 32, will contain, in 1889, mines that will be shipping ore, and thus more will be known about the quantity and the quality of the ore in these new "finds." The Chicago & Northwestern Railway Company has built a branch to the Smith that will be extended to the other new mines as they may require for the purpose of shipping ore.

Further north in T. 44, R. 31, Sec. 4, considerable exploring work has been done and is still in progress. Messrs. Wilson and Pascoe, of the Republic, who own an interest in the fee of the land and who are directing the work, tell me that they have an abundance of hematite ore that averages

above 60 per cent in iron but is non-Bessemer. The ore is 60 feet wide and they have sunk 120 feet. Capt. E. S. Roberts now has charge of the work.

Other explorations in this locality are said to be also showing well. I have seen analyses of ore found here that indicated good non-Bessemer ore.

THE HOLLISTER EXPLORATION,

being the W. ½ of the W. ½ Sec. 13, T. 43, R. 32, which I examined a year ago and described in my last report, has been further developed with good results.

Mr. Hollister has begun the work of "stripping" the ore; that is, removing the covering of dirt, preliminary to mining the ore. He hopes before the end of the season to have sent out a considerable product. Judging from the indications so far, the prospects for realizing his expectations are good.

Mr. Hollister has explored quite systematically and thoroughly, by test pits and shafts, and the showing justifies the further work which he has determined on.

Capt. John Morrison superintends the work.

THE ARMENIA MINE,

as the Smith is hereafter to be called, in the E. ½ of the S. E. ¼ of Sec. 23, T. 43, R. 32, has changed owners, the lease having been purchased by the same parties who own the York mine.

I went out to the mine a few days ago—March 25—and found that the new proprietors had made a great alteration in the appearance of the location. Where but a few months ago was unbroken forest, a log shanty or two and a few freshly made test pits, is now a busy mining location—boarding houses, dwelling houses, shops, engine house, machinery, shafts started, skip road operating, railroad built, and all the noise and bustle of active work.

The company has stripped the ore for a length of about 150 feet and a width of 80 feet. The covering is heavy, and now that it is removed for quite a space it is, even yet, not easy to form a judgment as to the prospects of the mine. The bottom is not all ore. The formation is irregular. It is impossible to give the strike and dip from the appearance of the rocks in the pit. It is supposed that the ore and the formation here lie north and south; and probably they do, still the development so far does not determine. All that was known previously was that a shaft, 60 feet deep, was

all the way from the ledge down in ore, and that they had drifted east and west—cross-cutted they called it—80 feet and upwards in ore. It was on this showing that the property was sold; nothing more was known. It was assumed that there was a body of ore 80 feet or 100 feet wide and of indefinite length, but I confess to a little of disappointment in the appearance of the opening—there was more rock than I expected to find. But as I said, one can form a judgment of the value of the mine better by and by, after it has been developed more.

Mr. Florada and the other gentlemen in charge express entire confidence in the mine. Certainly they are making every preparation for a large mine. South of the open pit a shaft is sinking, and is nearly down to the depth proposed—100 feet. The purpose is to drift north from the bottom of the shaft, under the open pit, for a stope. They have a 100-horse power engine and two 5′ Lane drums, well placed in an engine house, also capacious ore docks, and are building ore pockets. The company has a dynamo machine and lamps for electric light illumination. The force employed now is about 75 men, and a big product is talked of outside, though I do not know that the officers express any opinion as to the amount to be shipped.

I am informed that the "Smith" is not a corporation, but is worked by the York Iron Co. management. F. Schlessinger, President; Edward Florada, Gen'l Manager; —— Wilcox, Supt.; A. J. Carlin, Mining Capt.

The same gentlemen own the Smith, it is said, who have recently purchased the Chapin, and who also own the York—formerly the Dunn.

There are other explorations in this east range that have more or less promise, some of which will, no doubt, develop into mines if the Hollister and Smith turn out well. But as yet they are only explorations—in Secs. 13, 14, 23, 26, etc., T. 43, R. 32.

The Dunn mine, as it is universally called, but owned and worked by

THE YORK IRON CO.,

has made an unusual record in 1888 and the year's work has no doubt resulted profitably to the owners. The mine is in Sec. 1, S. W. ¼ N. W. ¼ and N. ½ S. W. ¼, T. 42, R. 33, two and one-half miles south of the village of Crystal Falls. For a new mine, open cut, 118,091 tons is a large product. The ore is non-Bessemer and so must have sold at a low price to have marketed so great a product.

The Dunn last year presented one of those fortunate conditions that sometimes occur, as did the Iron River mine in 1883: That is a wide deposit of clean ore all stripped ready for stoping and presenting the most favorable

conditions for the cheapest mining. But while the mine is in good shape and well handled I do not think it likely that as large a product will be obtained the coming year or that the ore can be mined as cheaply as it has been. The mine is deeper and there are more difficulties to encounter that add to the expenses to overcome. The mine is near the east line of the land and the ore runs north and south. So far it appears to be in two lenses, the one lapping the other, separated by jasper. The north lense is open cut and the south one is worked underground, but the intention is to strip this also after they have moved the engine house from its present site partially over the ore to the foot wall side of the mine. The dip appears to be to the west, though there is little indication of dip. They were stripping from the east wall of the north pit partly for safety. The ore has a maximum width of 100 feet and an aggregate length north and south of 600 feet. The walls are schist, quartz schist, jasper schist, and need looking to for safety of the men. The company is erecting additional ore pockets and also building some additional dwellings.

The product: 1887, 25,470 tons; 1888, 118,091 tons.

The officers remain as heretofore: Ferdinand Schlesinger, President; H. Schlesinger, Secretary; Edward Florada, Superintendent, Crystal Falls, Mich.; F. C. Bennett, Mining Captain.

THE MASTODON MINE,

situated about two miles south of the Dunn, in the S. ½ N. E. ¼ Sec. 13, T. 42, R. 33, is a peculiar affair. Standing on the surface and looking down into the deep yawning chasm from which the ore has been extracted one can scarcely persuade himself that is quite safe. The mine is unlike most open pits, however wide and deep, they are all open to the sky. The Mastodon is open to the sunlight, but also there is an immense chamber to the west with a wide expanse of roof that rests partially on the pillars that buttress the high portal separating the rooms. The great roof arching this chamber must awaken apprehensions of danger in the breasts of timid persons standing under it.

When I was at the mine—the last of March—they were stripping south a heavy depth of surface, 30 feet I should judge, for the purpose of uncovering a back of ore that forms the roof to a flat chamber that was mined out a few years ago.

The shaft is north of the pit, and between it and the winze at the south end of the chamber where the stripping is going on, is 500 feet, ore all the way. The bottom is all of ore, and the pillar, north, which separates the

open pit and the west chamber, is 120 feet long, 20 to 40 feet wide. The shaft is sunk one lift below the bottom of the open pit, and a drift has come south under the bottom for a stope. This, with the pillar and the back in the south chamber, suffice for a large product of ore. In stripping they are running the dirt below to fill the room, at bottom of which is a "horse" of jasper. The ore went up over it, between it and the sand.

The shaft is 200 feet deep, in rock—cross-cut to the ore. Recently have discovered a new lead of ore, east of the bottom of the shaft, that is going off to the northeast—an entirely new find, and in a different course from the other ore. A new cage will be put in the shaft, one having just arrived for it. The mine is well provided with machinery—two 5′ drums, Marinette make, in a new building. The old engine house is used for duplex compressor.

The company paid $2.00 per share dividend in 1888.

C. T. Roberts, Agent, Crystal Falls, Mich.; Joseph Austrian, Secretary and Treasurer, Chicago

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882	3,477	1886	41,640
1883	18,577	1887	49,115
1884	18,020	1888	51,293
1885	11,773		
Total			193,859

THE SOUTH MASTODON

shaft is but a short distance south from the Mastodon open pit. I descended to the bottom of the shaft a few days since—March 20—and examined the drifts, etc. I found a drift going east 20 feet and one west 40 feet; also drifts at 130 feet down. Both shaft and drifts are in mixed ore and rock. There don't seem to be any change in it. There is clean ore in places, but it don't hold out, rock comes in again speedily, not all rock, but enough to spoil the ore and to make it valueless. Mr. Blake was in something of a quandary as to what to do, whether to go deeper, which way to drive, etc. I think it likely he will conclude to start in a winze at the south end of the Mastodon, and drift from the bottom of it southeast into the low ground on his own property, and perhaps also put a diamond drill at work in the bottom of the shaft.

The success has not been as good as was hoped for a year ago when the ore was first found in the shaft. The formation is banded jaspery schist, with mixture of quartz in places. The surface on the west rises into a hill and east of the shaft and north is low level ground.

The mine is near the south end of the valley where the opposite ranges of hills have approached each other until they have nearly terminated it.

It was expected to find a lense underlying the Mastodon, possibly it may be found lying deeper or further east. The indications seem favorable for ore.

Edward Blake, a gentleman long connected with the Jackson Iron Co., has charge of the work and is pecuniarily interested in the enterprise. I should say he is working very judiciously and has done nothing amiss. The description of the land is N. ½ of the S. E. ¼, Sec. 13, T. 42, R. 33.

Daniel H. Ball, President; Edward Blake, Secretary, Mastodon, Mich.

The product 1888 was 2,722 tons.

THE YOUNGSTOWN MINE,

in the E. ½ Sec. 19 and S. W. ¼ Sec. 20, T. 43, R. 32, is idle, and the General Manager, Mr. J. N. Porter, tells me that it will not be worked the coming year. In fact the company has relinquished the lease which it held on Sec. 19, the west part of the mine, having decided that it had as much of this class of ore in the Nelson shaft, or in the land in Sec. 20, which it holds on a lease from Robert Nelson, Esq. The portion of the mine in Sec. 19 was the first explored and the part from which all the product was taken in 1881-2-3. The large engine house and machinery are also at the west end of the mine which the company will sell or remove.

The mine, that is all the shafts and ore deposits are in what was originally a wet, cedar swamp, bounded on the south by a side hill, parallel with which are the shafts. The ore runs nearly east and west and north of it 40 rods is Butler creek that crosses east and into the Paint river, a quarter of a mile away. The railroad track (C. & N. W.) runs along south of the shafts and the long ore dock is made by building up the crib work beside the track and digging out the hill and leveling off sufficiently to give the requisite room for stocking a great deal of ore. The fact is the Youngstown was laid out for a large mine. The fact of having very much ore was ascertained and the plans were made for handling it to advantage. But the ore is of poor quality and under the conditions of the market for the past few years it has been impossible to sell it at a profit, for which reason the mine has not been much worked.

In the Nelson shaft, near the west line of the section, the company has a width of ore of 200 feet or more. The shaft is 160 feet deep and the mine is well opened ready to take out ore in abundance.

The ore averages about as follows:

Metallic iron	54.50 per cent.
Phosphorus	.57 " "
Silica	3.00 " "
Manganese	4.50 " "
Lime	2.50 " "
Alumina	1.30 " "
Water	6.00 " "

It is reported that Mr. C. T. McElroy, of Norway, Mich., has leased the Sec. 19 part of the mine and is making an effort to interest capital to work it. The Youngstown was opened, etc., by the Briar Hill Coal & Iron Co., Youngstown, Ohio.

J. N. Porter, General Manager, Stambaugh, 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	1888	12,700
Total			102,587

THE QUINCY

being in section 19, joining the Youngstown on the west, is also being explored by Mr. C. T. McElroy, of Norway, Mich. The same was explored in 1881-2, etc., by Mr. Jos. Ames and others and abandoned. They experienced much difficulty in getting to the ledge and failed to find much ore.

THE MONITOR IRON MINING CO.

is working lot 6, S. E. ¼ of Sec. 20, T. 43, R. 32, being east of the Youngstown, in the same section, on the opposite side of the river. The ore is of the same quality as that found in the Nelson shaft, an analysis of which is shown on the previous page. But there is a fine body of it and they are getting it out very cheaply. The shaft is close to the east line and is in the same ore that extends across the line and is also worked in the Paint River mine. It is 87 feet deep and the opening west is 200 ft. all the way in ore, which has a maximum width of 67 ft. The axis of the ore deposit seems to

be towards the old shaft that was worked in 1880-1 at the falls by the Crystal Falls Mining Co. This body of ore is in the low land.

The company is working 30 men and raising 110 tons per day, dumping it into cars, as there are no pockets or room for stocking it about the shaft. It goes to the Chicago Furnace Co. It is a body of clean, low grade, non-Bessemer, hematite ore. The machinery is very simple, a small exploring engine and hoist, using a wooden bucket—one-half of a kerosene barrel.

Capt. Frank Rahrer, who has lived on this land a number of years and spent time and money in exploring it, has charge of the mine.

W. S. Coffman, President and Treasurer; Frank H. Rood, Secretary, 185 Dearborn street, Chicago, Ill.

Product 1889—2,690 tons.

THE PAINT RIVER MINE

has been idle all winter, but now—March 10—they are preparing to work again. The work that was doing when I was at the mine was in the lower portion of B shaft, the one next to the west line, close to the Monitor. This shaft is 150 feet deep; for 110 feet of which distance it is straight. The remaining 40 feet is the portion that they are straightening, making it line with the upper part—that is, making it vertical.

East of B is an open pit now, caused by the sinking or "caving in" of the ground around A shaft two years ago. A skip track goes down on the north side of this pit, 180 feet east of B.

From the line east they have a length of 200 feet and upwards of ore, 26 feet to 57 feet wide; the latter width is found at A shaft, 50 feet east of B. When B shaft is in readiness they will open up a level below the former workings and "room out." There is no ore in stock. Capt. C. T. Roberts has the contract for mining the ore at 90 cents per ton, and has Capt. Robert Phillips on the ground to look after the work. Also his assistant, Mr. Frank Scadden, gives to it a more general superintendence. The other officers are: Madison LaMonte, 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	1886	13,933
1883	5,971	1887	10,240
1884	11,546	1888	12,506
1885	2,374		
Total			71,185

THE GREAT WESTERN MINE

was closed down on the 26th of June last and remained idle until February 5, when the pumps were again started and the effort begun to pump out the water. It has proved to be a difficult matter for now—March 21—the work is not yet accomplished. Capt. Hooper states that he is pumping 1,100 gallons per minute, using a No. 11, a No. 10 and No. 9 Cameron pump, and are just holding the water. There will soon be at work in addition a Worthington pump which, it is assumed, will soon get rid of the surplus water. They did have at work two Knowles and one Dean pump until the No. 11 Cameron was reached. Just now the spring break up is on and as the mine is in the hollow it gets much surface water. They have a long plank launder to carry off the water down by the railroad track to the west.

As I have described in former reports, the Iron Star is a very wet mine. Twelve days after the pumps stopped last June the mine was full of water. It was closed down, it is said, on account of the state of the ore market during the early part of the season in 1888, but later, when the outlook became more favorable, the fact of having stopped was regretted.

Capt. Hooper assures me that the mine is showing as well as usual. It is not greatly opened for the ensuing summer's work, but there is every prospect that when the opening work is done there can be as much ore or even more than has ever been taken from the mine, in a given length of time, obtained.

The shafts are to the fifth level. No. 1, the west shaft, is 275 feet deep. North of the shaft is a drift 70 feet and east 40 feet, all in ore. The bottom level of the mine is at the horizon of the ore, which was found with a diamond drill several years ago in the east part of the mine, north of the other lenses. This ore was struck at 237 feet down and the drill went through 90 feet of it. The hole is 240 feet east of No. 3 shaft. It is also west and north of No. 7 room, the one under the engine house.

East of No. 3 100 ft. is a pocket of ore that is good both in the fourth

and in the fifth levels. The mine is made up of a number of independent pockets of ore on which not much dependence can be placed as to their continuance. They may be good in one level and greatly diminish or play out in the next, so that it is difficult to base predictions of future results on present appearance of the mine. But as Capt. Hooper says the old pits average all right, the new deposit will also come in, and so quite likely Capt. Hooper's estimate of 35,000 tons for the product of 1889 may be realized.

The mine yields some very valuable ore. I have just seen several analyses of samples of it that gave 68.40 %, 67.30 %, 61.50%, etc., in iron and nearly within the Bessemer limit in phosphorus; but the mine is so wet, the pockets of ore are so small that it is rather an expensive mine to operate, and the constant and universal dripping of the water makes it disagreeable to the men.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882	587	1886	25,725
1883	22,825	1887	23,239
1884	20,722	1888	21,861
Total			114,959

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

The mine still retains its old name, though it is operated by the Iron Star Co.

V. K. Moore, Secretary and General Manager, Detroit, Mich. Wm. Hooper, Superintendent, etc., Crystal Falls, Mich.

THE FAIRBANKS MINE,

which lies between the Iron Star and the Paint River mines, remains idle, as does also

THE SHELDON AND SHAFER,

in the N. W. $\frac{1}{4}$, Sec. 31 and the S. W. $\frac{1}{4}$, Sec. 30, T. 43, R. 32. The Messrs. Sheldon, of Houghton, and J. F. Shafer own the fee of the land and, I believe, wish to sell or lease it. I have described the mine in former reports and there is nothing to add that I know of. There has been shipped from the mine as follows:

Year.	Tons.	Year.	Tons.
1882	15,947	1886	14,282
1883	4,334	1887	2,379
1884	6,774	1888	10,936
1885			
Total			54,652

I am informed that Mr. Shafer has leased the half owned by the Messrs. Sheldon and will operate the mine in 1889.

THE JUNIATA,

Dr. H. C. Kimball's mine, in the S. E. ¼, S. E. ¼, Sec. 28, T. 43, R. 32, has been idle during 1888. I described the mine in my last report, and can add nothing of interest.

THE CALEDONIA MINE

in Sections 17 and 20, T. 43, R. 31, is simply an exploration which I have heretofore quite fully described. It is reported that work on this property will be resumed by Messrs. E. E. Keyes, A. E. Guensburg, W. R. Calhoun and others.

Some good ore was formerly found in the drift from the shaft sunk here. It is perhaps worth further exploration.

THE LEE PECK,

owned by J. M. Case, of Marquette, has not been worked since the date of my last report. It is in the S. W. ¼, N. E. ¼, Sec. 26, T. 43, R. 32, in the center of the land, and though a favorable, is not a large showing of ore.

Mr. H. B. Swain had charge of the work.

THE WAUNETA,

heretofore the Blany, of which Mr. Swain also had charge, has not been further worked in 1888. As I before stated, the future of these and other properties lying east of Crystal Falls, will depend much upon the outcome of the work at the Smith and Hollister mines, where they are developing more largely and will soon be shipping ore.

THE FELCH MOUNTAIN DISTRICT

has nearly ceased to be the scene of any mining work; 3,490 tons of ore were sent away from the Metropolitan mine in 1888 and none from any other. Some work was prosecuted at

THE GROVELAND MINE,

in the S. ½, S. W. ¼, Sec. 32, and other lands held by the company, constituting what they call the East Groveland, Groveland and the West Groveland. I have not been to the property lately. I do not think it is likely that any of them will be shipping ore very soon.

THE GOGEBIC IRON RANGE.

In no mining district of the State has the development ever been so rapid and remarkable as in the Gogebic range. The occurrence of the iron bearing rocks in this portion of the State was only first mentioned in the State geological report, 1873. But not until 1880 was there any actual searching for iron ore, and then to a limited extent. In about 1883 ore was found at the Colby in sufficient quantity to insure a mine of large proportions, and elsewhere the indications were found to be such as to warrant the building of a railroad from Ashland to the range and thence to Milwaukee, over which the first shipment of ore was made in October, 1884. Up to 1885 the work done was mainly exploratory; only test pits had been dug, and except at the Colby scarcely any regular mining work had been begun. The years 1885 and '86 were very active ones in this range. A vast amount of exploring work was done, some good mines opened, and a great deal of substantial progress made. It is astonishing to visit that range now, after so brief a period and to note the change. Where but four years ago was an almost unbroken wilderness is now a region abounding in activity, evidences of wealth and of present and future prosperity. The cities of Ironwood and Bessemer cannot be surpassed in the State for size and substantial growth in the period of time since they were started. Fine school, church and other public buildings, graded streets, sidewalks, water works, electric lights, four lines of railroads—in fact everything is here that is found in the long settled and wealthy portions of the country.

The facilities for shipping ore from the mines of this range are good. Ore is sent by the Milwaukee, Lake Shore & Western and the Wisconsin Central to Ashland and by the Chicago & Northwestern to Escanaba. Over all

these lines ore is sent to other points by all rail shipment. Complaint is made, however, that the rates, both rail and water, are too high—70 cents per ton to Ashland and $1.25 thence to Cleveland. To this add 50 cents per ton royalty, which some of the mines pay, and nearly one-half of the amount received per ton for the ore is accounted for.

Early in the work in this section very much was claimed for the extraordinary richness of the ore and more especially for the cheapness for which it could be mined. The ore is certainly good and there is no falling off in this respect, but as for cheapness in mining this range corresponds with others in this particular. The Colby, the earliest opened of the mines, presented exceptional facilities for cheap mining. An extraordinary large body of ore that came to the surface at the western end of a bluff so that for the first season the ore was loaded directly into the railroad cars from the stopes; the cars taken into and out of the mine by the locomotive. On the basis of what was done at the Colby the impression was created that ore could everywhere be found in this range and could be mined far more cheaply than elsewhere. However, it is well enough understood now that it is as much and as expensive work to find ore here as it is anywhere and that in the long run it costs the same to mine it. The mines become deeper and more powerful machinery must be provided and other expensive changes made. Such is the condition now at several important mines.

The Gogebic range, in one particular, at least, is exceptional: the formation is far more regular than in the other iron ranges of the State. Commencing at Gogebic lake and going slightly south of west a distance of 80 miles, the range presents nearly the same regularity. The Huronian series rest upon the granite to the south and are overlaid by the Keweenaw series on the north. It is made up of schist, fragmental quartzite, cherty ferruginous schist and ore bodies; slates, quartzite, gray wacke, schists, etc. North, in the slates and gray wacke, occur protrusions of granite—sienitic granite. These latter I have observed at several points north of Marenisco, in T. 47, R. 43. From the east line of T. 47 N., R. 46 W., where the range is cut through by the Black river, west to Penoka Gap, Wis., the formation is unchanged: that is, the fragmental quartzite belt extends the entire distance, and on it, or near it, all the workable bodies of ore that have been found rest.

Within the limits above mentioned the ore in all the mines lies on the quartzite, except at the Iron King, Pabst and Colby mines. From the fact that ore was found on the quartzite and again at about 400 feet north of it, at the Colby, and also at the Iron King mine, arose the theory of two ore veins; and even yet it is customary to speak of the north and south veins.

At the Colby, however, the so-called north and south veins were ultimately found to be one and the same. The deposit was divided by the "cap rock" and a roll in the underlying dike which allow the ore bodies to come together lower down.

West of the Black river no workable deposit of ore has been found at a greater distance north than 400 or 500 ft. from the foot wall, and this at the Iron King and Pabst, contiguous mines working in the same deposit, and at the Colby. The rock in which are the mines, immediately overlying the quartzite, is a ferruginous, cherty schist, and north of this is black slate, etc. The formation dips at a high angle 60° to 70° north, and is nowhere folded. It is cut, adjacent to the foot wall, by dikes that so frequently occur that they are found in all the mines. With a single exception they all dip to the southeast. The exception is the main dike found in the Iron King and Pabst mines, in the north vein that dips to the southwest. They were originally diorite, but have been so changed that almost none of the original material is left, but they still possess the diabasic structure.

The dike rock is generally soft, sometimes soft and of a greasy feel like tallow or hard soap. Occasionally it is found somewhat hard and approximating to greenstone, which it originally was. The miners call it soap stone. These dikes are an important factor of the Gogebic range, inasmuch as the ore deposits of every mine west of Black river rests on one. And it remains to be shown to what extent they limit or cut off the ore. So far it is pretty certain that ore does not exist immediately under any large dike. In several of the mines, as will be more fully explained further on, shafts have been sunk through the underlying dike and borings made also with diamond drill, but in no instance has ore been found. The rock found under the dikes is identical with that occurring above, designated as "cap rock."

Since along the range for the whole distance west of Black river, there is a succession of dikes, and where the ore exists it is found lying on them, the belief is entertained that ore will be found under the dikes; that in each case if they only go deep enough the lense of ore will be reached, coming in from the west and carried above the dike which limits it. The theory is held that the deposits of ore resulted from precipitation, the iron being derived from the carbonates, etc., contained in the formation and carried in solution by the percolating waters through the porous rocks until reaching the hard quartzite belt and the compact dike which the waters were unable to penetrate, and thus coming to a rest the iron held in suspension in these places was precipitated, resulting in the process of time in the accumulating of the deposits of ore as we now find them.

If this is the true theory of the formation of the ore deposits, it would seem, contrary to the expressed opinion, to render it improbable that the ore should continue to great depth. Since water being the indispensable agent is cut off from percolating below, by reason of the imperviousness of the dike which it reaches and which it follows until brought to rest where it deposits the iron held in suspension or solution. Thus the rock beneath this dike, receiving little or no water, could not be acted on by this dissolvent, and hence can contain no deposits of ore. There are small dikes in several of the mines which do not cut out the ore, but they make more or less difference in its character. Generally the ore or rock in contact with a dike is hard, however soft the deposit may be further away, and if ore occurs under the dike it is harder and contains sand boulders, "nigger heads," concretions of ore, etc., while above, the ore will be soft and uniform except very near the surface of contact.

East of the Black river there are no working mines except at Sunday lake. The quartzite foot wall, so important a feature of the formation further west, is here wanting; there are also no dikes. The dip and regularity of the formation remain the same.

There is a much wider belt than further west, of the ore, containing sediments, ferruginous schists, etc., but only two or three workable deposits have been discovered, which are at the east side of Sunday lake.

There has been a great deal of exploring done in the Gogebic range; throughout the entire distance from Gogebic lake to Penokee Gap there is almost a continuous line of exploring camps and mines. Most of the pits, which are dug, did not reach the ledge, but where they did are bottomed in slate. Nearly all of these explorations have been abandoned, or at least are now idle. Further effort made at some future time may result more fortunately.

The best mines in the range are in this State between the Black and the Montreal rivers, and commencing at the latter point, the western boundary of the State. I will describe the mines in succession to the east, thus beginning with the

ASHLAND,

which is greatly improved since a year ago. The mine is now in admirable shape, well opened, and the improvements, which are making in the way of machinery and shaft houses, etc., will soon place the Ashland in the lead in the matter of equipment among the mines of this range. A great change for the better has been made on the surface. Everything has been transferred to the foot wall side of the mine; a new engine house and boiler

house have been built and a new plant of machinery procured, consisting of three 10-ft. drums and engine, Webster, Camp & Lane manufacture. They are all on the best foundation, and room is made for the fourth drum, to be added when required. There will be six boilers, though they are not all in yet. They are now building—June 1—new shaft houses at No. 4 and No. 6 shafts, very large and strong, 80 feet from sill to plate. At each will be ore pockets with capacity of 300 to 500 tons each. The railroad tracks are also on the foot wall side and they have thus plenty of room and entire security. There is a stock pile of 50,000 tons of as fine looking ore as can be found on the range. Averages 65 per cent in iron, .040 per cent phosphorus. In the fifth level of the mine, in the east end, the ore is of still better quality, showing 67 per cent iron and as low as .012 per cent phosphorus.

At the close of last season's shipments the stopes in the mine were all exhausted; the report showed only about 9,000 tons of ore available for stoping! But the opening work has been pushed forward during the winter, so that when the new shaft houses and machinery are ready they can produce ore rapidly. The mine has eight shafts in all, being at intervals along the foot wall for half of a mile. No. 1 is at the west end and is sunk to the dike and is exhausted. Thence it is 300 feet to No. 2, and in succession they are apart 2 to 3, 230 feet; 3 to 4, 280 feet; 4 to 5, 450 feet; 5 to 6, 370 feet; 6 to 7, 300 feet; 7 to 8, 380 feet. They are all on the foot except No. 4, which is sunk vertically in the hanging wall, but reaches the ore at the third level. Shafts to the west of it are to the dike and the ore is practically worked out, and in No. 4 is just about to the dike as it appears a little west from the bottom of the shaft. The dike pitches down steeply to the southwest and the ore follows it down. Thus the levels shorten on the west and lengthen to the east. Also as depth is reached the ore becomes necessarily narrower if the dike keeps the same pitch to the south. The foot wall dipping north and the dike south they recede from each other as they go up. The third level and above have been worked out except shaft pillars. In No 4 shaft the third level is 300 feet long—150 feet each way from the shaft, east and to west, and 120 feet wide. The ore has all been taken out clear up to the capping and the timbers do not show any strain. They stand as perfect as when first put in. It is the intention to do the same in the fourth level, leaving a floor between the levels of about eight feet thick. The cap rock is very firm and hard. The fourth level extends east nearly to No. 6 shaft, having a uniform width of 10 sets, 75 feet, and a total length of 550 feet. They are mining now in several rooms in the fourth level. The ore has gone under the capping more than 200 feet east,

beyond the end of the third level. Both No. 4 and No. 6 are sunk to the fifth level and it is opened, thus far, 150 feet east of the latter. The breast, of course, still in ore and the opening work going forward.

Between the main foot wall drift and the ore north of it is a barrier of rock, 22 to 35 feet in width, which has to be drifted through to open the rooms. They open rooms three sets wide, leaving three set pillars. At the time of my visit, June 1, they had opened east to room 23. A little singular was the fact that room 21 is not separated by rock but the ore extends across from foot to hanging.

There is one main dike that underlies the ore from the west line which from its pitch at No. 4 shaft is a long way below the bottom at No. 6 and will be still far deeper at the east line; but nearly all the shafts have cut small dikes, which are probably branches from the main one; they have not materially affected the ore. Nos. 7 and 8 both bottomed in a dike at a depth of 130 feet. The ore was all worked out above the bottom and penetrating below the dike did not discover any ore. This dike is above the one which holds the ore at the west part of the mine and underlies the ore in the Norrie mine. The Norrie people are taking the ore above this dike in their shaft over the line. It remains to be seen if the ore follows the main dike east and continues on under this one at No. 7, etc.

At No. 3 some effort has lately been made to find ore below the dike through which the shaft was sunk. A diamond drill has also been used and borings made to a depth of 200 feet below the present bottom, but no ore was found. It is contemplated to sink the shaft several hundred feet deeper or until ore is found and to explore the ground.

No. 4 shaft is 350 feet deep and No. 6, being in lower ground, is 320 feet to the same level. No. 5 is sinking and rising and will be soon, also, to the fifth level, when the three will be the hoisting shafts to which the new machinery will be applied.

The fifth level is already more than 800 feet long and is likely to extend to very much greater length east. The water will all go to No. 6, which will have a Cornish pump to take it to the surface.

Mr. Alton L. Dickerman, M. E., the new Superintendent, who has been in charge since last November, has pushed things with energy and success. He is a highly educated gentleman and possessed of a large and varied mining experience. The Ashland company are fortunate in securing so reputable and efficient a manager.

Chas. C. Colby, President, Milwaukee, Wis.; John A. Taylor, Mining Captain; W. J. Olcott, Mining Engineer; E. A. Hayes, Manager.

The estimated product for 1889 is 175,000 tons.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885	6,471	1887	175,561
1886	74,015	1888	164,134
Total			420,181

THE NORRIE

leads all the mines in the State in the matter of product. Its output in 1888 of 411,000 tons was the largest ever made from any mine in this State, and the estimated yield of 500,000 tons for 1889 is also in excess of any other. The Norrie proper consists of 80 acres S. ½, S. E. ¼, Sec. 22, joining the Ashland, and with the East Norrie, which is also 80 acres, W. ½, S. W. ¼, Sec. 23, the Co. has three-quarters of a mile east and west on the range, and they are mining almost the entire distance. There are 11 shafts and they are hoisting ore from ten of these, while the remaining one will soon also be a main working shaft. It is a long mine and the bodies of ore are exceedingly wide. The stock piles are very large and the ore is coming up with great rapidity. A half million tons of ore from a single mine in one year, that last season produced nearly a like amount, is an enormous yield, that, too, from a mine that is barely four years old; for the first blow was struck in the spring of 1885, and the location was then all forest. Withal it is good ore, averaging—the entire product—62 per cent and upwards in iron and about .040 per cent phos. When work was begun at the Norrie not much was known about the situation or magnitude of the ore. The rocks are deeply covered with drift, so that the line of the quartzite was not sufficiently well known to locate the shafts on it. They were started vertically down until the foot wall was reached, when they are sunk on an inclination to the north in the quartzite. Thus there is not much system or regularity about the arrangement of the shafts. They were started haphazard, possibly exploring pits that were continued down and made into working shafts. Thus, unfortunately, there is a triangular prism of ore lying south of the shafts in the main part of the mine. On this, in a great measure, are the railroad tracks, stock piles ore pockets, etc. They should be south of the ore wholly, on the foot wall, and must be, ultimately. There is a peculiarity in the foot wall in the Norrie that I have observed in no other mine on the range, which is the fact of its flattening out to the north in the west part of the mine. As, for instance, No. 3 shaft was sunk vertically to the foot wall

which it follows to the third level, where the wall goes off flat 100 ft. to the north, and in the fourth and fifth levels they have cross-cuts in the foot wall to the ore, 140 ft. in the latter, from the shaft. The mine is all opened and worked after one uniform system of pillars and rooms, each made three sets wide, about 21 ft. From about No. 3 shaft to No. 6, which are 850 ft. apart, the surface has sunk down, filling the rooms to the fourth level with dirt, etc., and the ore pillars in the upper levels in this portion have been, in a measure, mined out.

There is a world of ore in the mine in the pillars that it is policy to stope away as fast as possible, while the timbers are sound and well in place. The ore has gone off so far to the north owing to the peculiar flattening of the foot wall that at the bottom it is well over towards the north line of the property. The lease of the land to the north has been secured, so that if there is ore in it the company can arrange to mine it. In fact No. 8 shaft is north over the line of the Norrie 80 and just west of the East Norrie it is vertical, 315 feet deep to the fourth level and from the bottom both mines are reached. The ore that is hoisted in it comes from the Norrie. No. 1 shaft is on the west side near the Ashland line and they are mining on the dike both in this and in No. 2—the same dike that cuts out the ore in the east end of the Ashland. They have worked up to the line. The ore in bottom lies in a trough on the foot wall and dike and each level is limited to west by the "cap rock," that also inclines down about parallel with the dike owing to the foot wall being very flat and also the dike that cuts it. The ore is wide—100 feet, 160 feet, 200 feet, varying from No. 1 shaft to No. 6. The mine is one great lense, that is worked in, the whole length of the property. It is underlaid by the dike and the foot wall and is very wide all the way. It is opened the entire distance, except for a short space west of No. 7, which latter will be to the fifth level soon, as they are rising and sinking in it to connect. It is on the foot wall. There are occasional bunches of rock in the ore but the ore itself is clean. Besides the underlying dike, which forms the bottom of the ore deposit, there is a small dike extending through the mine; it occurs in all the shafts from No. 2 to No. 6 and is about five feet thick. Immediately under it the ore is harder but does not cut out.

The water is taken up No. 6, where, at fourth level, is a No. 10 Knowles pump capable of hoisting 600 gallons 1,000 ft. per minute. A fire caught here Christmas night, which threatened to be a serious affair for a time, but fortunately was extinguished in a few days and not much damage done. The mine is one level deeper than a year ago, being now to the fifth, 420 ft. down as the shafts go.

In the East Norrie is a fine body of ore coming from west of the line and in the fourth level it gives a working length of 450 ft. and width of about 70 or 80 ft. The fifth level will be longer; they have not reached the cap rock east yet in the fifth level. The first level is worked out to the sand and the second has only pillars left; the others are stoped in. No dike in the bottom, but there is a crossing of dike material mostly. It is about 18 ft. wide and dips steeply to the east.

Apparently the Norrie and East Norrie are one continuous body of ore underlaid by the same dike that dips southeast and extends through the property. No ore has been found under this dike as yet, but the Norrie owners express great confidence that it exists. They expect to find, by going deep enough, the Ashland ore, that is that the Ashland ore underlies the lense that they are working in. Mr. Curry speaks of sinking a deep shaft to reach this supposed underlying ore.

The Co. will soon have a new plant of machinery, 12 ft. drums, to operate Nos. 4, 5, 6 and 7 shafts. The machinery now is inadequate for the work. The mine has outgrown the equipment which sufficed for the earlier development work.

Notwithstanding that the machinery is too light and that the shafts are not well located, one can see that the mine is well handled. Capt. Trebilcock attends to the underground work and Capt. Day to the surface and to matters generally.

The fact that in so large a mine, working 900 men, only one fatal accident has occurred in four years shows how carefully matters are looked after.

The Norrie is operated by the Metropolitan Iron and Land Co.

The officers remain as heretofore: S. S. Curry, President, Metropolitan Iron and Land Co.; H. S. Haselton, Secretary; R. H. Hanna, Treasurer, Milwaukee; Jeff. D. Day, Superintendent; Wm. Trebilcock, Mining Capt., Ironwood, Mich.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1885	15,420	1887	217,384
1886	124,835	1888	410,763
Total			768,402

In the above is included the product of the East Norrie, which produced in 1888, 55,144 tons.

THE AURORA MINE

joins the East Norrie. The property is in similar form as its neighbors on the west, that is one 80 the long way, north and south, and another 80 similarly east and west, making three-fourths of a mile in length on the formation. They had a continuous run of ore the whole distance, but it is worked out in the west part. The ore did not extend to great depth, being cut out by a dike that underlies all the ore in the mine. The mine now is in the east 80, N. ½, S. E. ¼, Sec. 23, what was earlier known as the Vaughn. In this they are within about 200 feet of the Pabst line in the bottom level. The mine shortens rapidly on the west and lengthens on the east. The dike under the ore lies much flatter than the corresponding ones do in the Ashland or Norrie.

The mine looks about the same as it did last year; it is one level, 80 feet, deeper, but has the same characteristics. Nos. 4 and 5 are to the fifth level and No. 6 shaft is sunk to the sixth. It is about 300 feet from surface to the fifth level. At No. 3 shaft in the fourth level the ore was 16 sets wide —120 feet—but the dike was reached in the bottom and the fifth level does not extend so far west and the ore is of less width. The ore rises up on the dike west and north, and as the foot wall is regular the ore will naturally tend to grow narrower in the lower levels. The shafts are numbered from the west; from near the west line to No. 2, 600 feet, is open pit. Thence to No. 3 is 500 feet. From No. 3 to No. 4 is 286 feet. No. 5 is 146 feet; further east is 300 feet deep, and thence east to air shaft is 177 feet and 266 further to No. 6. East of the latter the ore is narrow, varying from a few feet to 20 feet in width, averaging for a considerable distance about 10 feet. They take the ore all out here and use stull timbers. It is about 500 feet from No. 6 to east line; more than half the distance is opened and they are still going east; but the vein continues narrow. Possibly there may be ore off in the hanging. Unless more ore is discovered than now appears a few levels more at the east end will wind up the Aurora. However, they hope to find underlying ore. No. 2 shaft has been sunk through the dike 30 feet and 15 or 20 feet further of cap rock material where ore is found. Thus far it is only 10 or 12 feet wide. No. 2 is 200 feet deep. If another lense is found beneath the bottom dike it will be very fortunate for the company and will be valuable otherwise.

On the 28th of April, 1889, the mine took fire underground, in the vicinity of No. 4 shaft. As the mine is open at the ends the draught came from both ways and went up No. 4 with great intensity of heat. The timbers in this shaft were all burned out, but no injury was done otherwise. They are

now re-timbering the shaft. The ore in the Aurora is quite firm and hard; it stands well in the pillars as does also the overlying rock. The company works 350 men.

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.; —— Brewer, Mining Captain.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1886	101,037	1888	179,650
1887	154,095		
Total			434,782

THE NORTH AURORA

is an exploration north of the Aurora and west of the Pabst. The work has been going on for three years and Mr. Paulson, who I am told furnished the money, lost all faith in the enterprise and abandoned it. The machinery was sold, etc. But Capt. Matt Fitzsimmons, who has conducted the work, not wishing to relinquish the lease, continues to explore. Test pits have been sunk clear across the property, generally in slate. The main shaft is 264 feet deep and they drifted north 274 feet, also west 70 feet. The dump pile shows considerable lean ore. The ore found was not good enough to be salable. Work at this shaft was discontinued and Mr. Fitzsimmons began another one 200 feet further west which is now about 40 feet deep and in a cherty schist that outwardly looks like slate ore. Across the fracture, however, it shows mostly rock.

THE PABST MINE

is one of those that shows great improvement. On the foot wall—quartzite —where the ore is generally found, the Pabst Co. did not succeed very well. They found ore, but not in large body. A shaft was sunk 360 ft. north of the foot wall near the east line; it was placed to find the Iron King north vein ore, that was mined in a little way to the east. The undertaking was a success, the ore was found, but at first was too sandy. Now, however, at the fourth level, 50 ft. lower down, the ore is all right. The ore is reached by cross-cut 60 ft. north through rock and thence the ore is opened east to the

line and west they are still advancing in ore. The level—fourth—is about 550 ft. long, and the ore attains a maximum width of 130 ft. and a minimum of 35 or 40 ft.

The fifth level does not open so well. It is 360 ft. from surface and the cross-cut from the shaft meets the dike and the ore going west is narrow, about the width of the drift. East is the dike and they are rising up on it in ore one or two sets wide.

The peculiarity of the dike that underlies the ore in the Pabst and in the Iron King mines is that it dips to the southwest. It lies pretty flat, but with a slight dip southwest. Here in the Pabst it is 360 feet from the surface, and at No. 5, east end of the Iron King, it is 150 ft. In the bottom of the Pabst the schist stands edgewise on the dike, plainly showing how the latter cut through the formation. They are boring with a diamond drill in the bottom. The drill is turned to the north, horizontal; is in 200 ft. in rock.

They are also sinking another shaft—B—which is 500 ft. west from the A shaft. It is now 175 ft. deep. They expect to find the same ore at a greater depth. The shaft is in the schist, designated as "cap rock," that contains the ore.

Nothing is doing in the foot wall shafts, except in No. 2, and not much in that. It is 364 feet deep. The company work 180 men and have 40,000 tons of ore in stock, or rather have mined that amount so far this year—June. Eighty thousand tons have been sold and they expect to get out 100,000. In A shaft the ore runs up to the sand in the third level.

It is possible—in fact it is quite probable—that the dike in the Pabst is the same one which underlies the ore in the Aurora, as it certainly does in the Iron King.

Since I went through the mine a few days ago it has been sold, so reported, to the Norrie people—Metropolitan Iron and Land Co., consideration being $400,000. The lease only, not the realty. This mine, as are the others in the Gogebic, is held on a royalty; the companies pay the owners of the fee 50c. per ton for the ore mined. The Pabst yields both first and second class ores. The latter is found along the foot and is but a small portion of the entire product.

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	19,906
1886	17,925	1888	49,977
Total			88,961

Adjoining the Pabst is

THE IRON KING,

which like the former has both foot wall ore and north ore. There has been considerable surface improvement within the year past. The main engine house has been removed to the solid ground south of the quartzite, and also the machinery and engine house from the Valley location have been removed from there and placed at the Iron King and connected to operate the south vein shaft. This (A) shaft is 255 ft. deep, sunk a little way in the quartzite; it is in good shape, skip, etc. The ore in bottom is opened 100 ft. each way from shaft, east and west, and is 65 ft. wide; about 75 ft. high, all roomed out one set high. The ore is about 58 per cent to 59 per cent iron, 4 per cent manganese and .040 per cent phosphorus. The mine is all opened to work, no water; the north mine drains it. There is a dike at east end, which dips southeast so that the ore is under it. The dike is 14 ft. wide. They have cut through it. A new shaft, No. 4, has been sunk recently; it is in the north vein. I like the plan of Capt. Jones' shafts, skip way, timber way and ladder, each separate and independent of the others. The shaft is 250 ft. deep to the dike and are drifting west on the dike to connect with No. 3. The bottom is narrow. The foot wall and dike come together forming a trough, in which is the ore. Higher up the ore widens out. Near No. 3 it is 75 ft. wide. There are about 50 ft. more to drive to connect.

No. 1 shaft near the west line is 360 feet deep down to the dike to the limit of the ore. Rising up, however, the ore becomes rapidly wider—75 feet—but it is pretty well exhausted. The dike lies so flat that in the upper sets tram tracks are used to run the ore out to chutes that take it down to the main drift. All there is of the bottom of the lower level is a drift. The ore goes up to the north and to the south on the dike and on the foot wall and must be run from above to the main drift. Capt. Jones is managing this work with skill and economy. No. 1 is 191 feet east of the Pabst line. No. 2 is 356 feet deep, 209 feet east of No. 1. Like all the others it is to the soap rock and apparently to the limit of the ore. Since No. 3 was

sunk to a depth of 405 feet, 50 feet below the ore, through the dike, but no ore was found below. The dike was 17 feet thick. They talk of using a drill. Between Nos. 2 and 3—202 feet—the ore is all worked out except three pillars.

Apparently the mine cannot last very long unless more ore is found than now appears. From No. 3 west to the Pabst line the ore is pretty well exhausted. This portion of the mine has furnished the product for the last two years. The ore is all, throughout the mine, cut off by the soap rock. No. 5, away to the east, is 150 feet deep to the dike.

A day or two after I went through the mine the large mining boarding house burned. And since then I also learn that the mine has closed down owing, it is said, to the financial affairs of the company.

There is no ore in stock at the mine; it has been sent to Chicago as fast as mined.

The mine is now held and operated by the Bessemer Consolidated Iron Company. M. W. Burt, Assistant Manager, Ironwood, Mich.; E. H. Jones, Mining Captain. More recently still the mine has been taken possession of by the bondholders, and is thus no longer operated by the Bessemer Consolidated.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886	27,343	1888	69,145
1887	74,609		
Total			171,097

At the Bonnie, First National and Blue Jacket no work has been done in the past year. Mr. S. S. Curry and Capt. Day, of the Norrie, were examining the First National with the view to the production of manganese or of manganese ore.

THE RUBY

is a mine that has failed to hold out according to the expectations early entertained regarding it. I have described the mine fully heretofore and will not now enter into details. It is a property that affords abundant indications of ore but if any considerable bodies of clean ore exist on it they must lie deeper than they have yet penetrated; for the surface has been pretty well test-pitted and mainly mixed ore and rock found. The company has produced a small amount of ore the past year and has continued

the work of sinking No. 4 shaft, which is now—June, 1889—355 feet deep. At 320 feet a dike was encountered and they went through it and below it. As usual only the same rock was found below as above the dike. At the 200-foot level they had ore east of the shaft 60 feet long, but at the 300-foot level it is smaller; are working in it now. They are working 30 men.

The following is the product:

Year.	Tons.	Year.	Tons.
1886	16,388	1888	3,056
1887	42,065		
Total			61,509

Wm. Bice, Superintendent, Bessemer, Mich.; S. Hitchcock, Secretary, 101 St. Clair street, Cleveland.

THE IRONTON IRON MINING CO.

has sunk the shaft following the diamond drill boring that is described in Report of previous year. They sunk 100 ft. and made cross-cut of 17 feet north to ore. At the time I was at the mine they had not fully determined the magnitude of the deposit. They had just begun that day to hoist ore. It looked promising. Beyond this nothing has been done, and it is not necessary that I should enter into particulars that have previously been dwelt on.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1886	16,307	1888	1,755
1887	27,887		
Total			45,949

M. W. Burt, Vice President; Geo. H. Abeel, Superintendent, Bessemer, Mich.

THE FEDERAL LAND AND IRON CO.

holds the Tontine, which property joins the Ironton on the east. The new Co. has kept to work moderately with good success. The drifting has been extended east and at 400 ft. east from the shaft and in the foot wall are sinking a new shaft, which is now down 80 ft., inclining north 67° and is 6′x12′ inside the timbers; to be divided into three compartments, skip, timber and ladder way. The old shaft is 175 ft. deep and the drift east is 300 ft., all the

way in ore, but not all the way in good ore; in one place 40 ft. wide of pretty fair ore. Have opened out six sets wide and gone up two sets, and are still rising.

At about 240 ft. east of the shaft is the best ore, 60 feet in length of it, but have not cross-cutted to ascertain the width. This end of the mine will be developed from the new shaft. I went underground and examined the workings. The indications are favorable, certainly.

The officers are M. H. Branch, President and Treasurer; R. S. Dingwell, Secretary, Milwaukee, Wis.; D. H. Bennett, Superintendent, Bessemer; R. Stepan, Mining Captain, Bessemer.

The product in 1888 was 3,182 tons.

The lease of the Valley mine has been thrown up and nothing has been done there for a year and more past.

THE COLBY MINE

is now operated by the owners of the fee, the Penokee and Gogebic Development Co., the lease under which Pickands, Mather & Co. had worked the mine having expired last November. The officers of the mine are Charles L. Colby, President, James L. Colby, Treasurer, Milwaukee. Local officials are: W. E. Dickinson, Superintendent; John Gilchrist, Assistant Superintendent; James Piper, Mining Captain; N. J. Cavanaugh, Time Keeper; H. E. Williams, Chemist; George D. Swift, Book-keeper; James P. Smith, Ore Shipper; W. H. Colbate, Supply Clerk.

The mine had 80,000 tons of ore in stock at the opening of navigation and but a small force had been worked during the winter—300 men and less. Capt. Dickinson, the new Superintendent, is well and favorably known in mining circles on Lake Superior, having long been engaged in mining work in that region. He has already made great improvement in the appearance of the surface about the mine. The buildings, standing over the mine, have been removed to safe ground and some new ones built, in which are included a laboratory, warehouse, boiler house, etc. Among the important things done recently is the sinking of a shaft from the surface in the foot wall south of the ore 30 feet. The shaft is double skip, 22′x6′ inside timber, descending to the north at an angle of 60°. This shaft will take the ore in the east end of the mine. It will be remembered that the ore, at first worked in two deposits, called the north and south veins, was really one great body of ore resting on the quartzite foot wall on the south, and the intersecting dike that cuts it, that comes down from the

northwest, dipping southeast across the formation, and thus constituting the main floor of the ore.

The Co. began mining the ore at the west end at the surface in both deposits and have followed down in the ore on the dike. The rock above the ore is a cherty, ferruginous schist that dips with the formation; it is the same below as above the dike. As the dike inclines east at an angle of about 30°, it will be seen that the levels must lengthen in succession east and shorten west. The levels are about 600 ft. in length, but the total distance between the extreme east and west points of the mine is more than twice that space. The bottom level is the sixth, which has been sunk to and opened during the past winter. The ore is not as wide, but holds the same length as above. That the ore continues on east at greater depth has been proven with the diamond drill set in the fifth level, 360 ft. east of No. 4 shaft. The first boring at an angle of 20° depression from the horizon found the capping. A second hole descending at an angle of 45° is in ore all the way as far as the eighth level.

The foot wall mine is still held up by the ore pillars, of which there are some very large ones; as, for instance, in the fifth level there are three, which are 40 or 50 ft. wide and 100 ft. long. One pillar at No. 3 shaft is 80x120 ft. There are ore pillars in all the levels, which will be taken some time. The trouble with taking out the pillars is that the "capping" is so firm that it will not readily come down, so that they cannot run the surface to fill the rooms. The sixth level is at about 150 ft. from the east line of section 16. If the ore holds, the mine will be in section 15 in time.

The most improved showing found in the mine is in the second level east, where a drift was made east through the rock capping to reach the new—No. 5—shaft. After cutting through 20 ft. of rock a body of ore was found in which they had penetrated east 120 ft. and were still going on in ore at the time of my visit, June 1, 1889.

This indicates another overlapping lense of ore; certainly a very fortunate circumstance.

The East Colby, the shaft away east in Sec. 15, is to the fourth level, the shaft having been sunk an additional 60 feet.

The shaft descends on the south foot wall, 65° north. The old workings are all crushed in, but the new level is opened for a length of 80 feet, width of 40 feet ore.

The Colby mine ore contains quite a percentage of manganese but not enough to add to its value; in fact it holds just enough to make it less wanted, so that it does not sell readily at such price as the company holds it at. The mine could produce 1,000 or 1,200 tons daily now if there were sale

for the ore. The company owns three contiguous quarter sections of land. The mine is in the city of Bessemer, not far from the center of the city, at an elevation above it of about 200 feet. The outlook from the surface of the mine is very fine.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1885	84,312	1887	258,518
1886	257,433	1888	285,195
Total			885,458

Since writing the foregoing the labor force has been reduced to about 140 men, total of employés. The trouble is with the ore—too little sale for the grade of ore that the Colby produces.

THE PALMS MINE

continues to improve. Each successive level opens up a larger store of ore. At the beginning of 1888 there was scarcely a pound of ore in sight, and yet before the season closed the company had shipped 23,184 tons of ore, and I judge that 30,000 tons will scarcely be the limit of the output in 1889.

The work is mostly in No. 3 shaft, 300 ft. to the first working level, which furnished the most of last year's product. They have gone west 265 ft. and east 176 ft. Going west the ore was at first narrow, but opened out to four sets wide, 30 ft., and three or four sets high; but most of the way the ore was only one set high. Tbe bottom is all ore and they are coming in under it at 50 ft. further down, and it appears to be of equal dimensions with the advantage of being 50 ft. high. East the mine is greatly improved. Where above was all rock is below ore. There was a narrow vein of ore along on the foot wall about four ft. wide; now, below, the ore is 30 ft. wide, and they are east of the shaft 100 ft.—still ore. In this lower level only the drift is made and a cross-cut ready to stope both ways. It is good, soft ore, clean, and is Bessemer.

If the mine continues to improve in this way as they go down it will soon be an important producer. They are also sinking No. 4 shaft, which is 300 ft. west of No. 3, and is now 222 ft. deep—May 25, 1889. The Co. employs about 60 men and has about 10,000 tons of ore in stock.

Wm. Irvine, Treasurer, Chippewa Falls, Wis.; J. P. Christopher, Supt., Bessemer, Mich.

Product—1887, 1,600 tons; 1888, 23,184 tons; total, 24,784 tons.

THE ANVIL MINE

has a body of ore resting on a flat dike. In other words, the company has reached an underlying dike, which apparently limits the ore downward. Throughout the mine in the bottom, a little way under the ore is the soap rock. Away to the west end the dike shows a tendency to rise up to the west. No. 2 shaft is down to the bottom, 331 ft., and they have gone west under No. 1 and beyond it to within 150 ft. of the Palms line, 336 ft. in all. West in the bottom are two rooms in the ore, each five sets, 35 ft. wide, and 12 sets, 84 ft. long. There are also two pillars, each 28 ft. wide, and they are still going west, but beginning to rise on the dike. The ore next to the dike is hard. The body as a whole is very soft ore, and in the lower level, of good quality—62.70 per cent in iron, .040 per cent phos.

At 500 ft. east another shaft is sinking, which is now down 190 ft.—is 6′x10′ in size inside the timber; is on the foot wall, all the way in rock. It will be sunk to the fourth level, about 400 ft. deep, and then they will explore for ore.

The estate consists of a ¼ section of land, admirably located on the iron range.

The corporation is the anvil mining Co., W. H. Brand, President, Milwaukee, Wis.; R. S. Dingwell, Secretary, 377 Broadway, Milwaukee; D. A. Bennett, Superintendent, Bessemer, Mich.

Product of the mine in 1887, 10,076 tons; 1888, 24, 677 tons.

THE BROTHERTON MINE

shows very little change. It looks neither better nor worse than it did a year ago. It is simply 50 feet deeper, but the lower level is almost identical with those above. It is a long mine, extending east from the margin of Sunday lake across the property to the Sunday Lake mine. The ore is divided into two separate bodies which they call the south vein and the north vein; the former has improved somewhat. It is a "pockety" mine; the ore requires a good deal of looking for. Capt. Bawden states that he has done about 1,000 feet of rock drifting and cross-cutting in the past year, much of it in search of ore. The mine is well handled and the ore is, I think, economically mined. It is the best of Gogebic range ore; two recent cargoes averaged 62.50 per cent iron, .035 per cent and .037 per cent phos., 6 per cent silica.

There are 23,000 tons of the product for 1889 already mined—June—and it will be increased to 60,000 tons and more before the end of the season.

There are three shafts, all producing ore. The west one, No. 1, is 260 feet deep to the fifth level and is about 500 feet east from the margin of the lake, measured in the line of the ore. They have not ventured to go under the lake yet, but will do so at greater depth. There is a length of ore of 350 to 400 feet with a width of 20 to 40 feet. The shaft is in the south vein and they drift north to the ore. No. 2 shaft is in the rock between the two veins and is 210 feet deep. It is 500′ from No. 1 and the two are connected underground. The ore is about 200 feet long and 10 or 15 feet wide. No. 3 on the hill, 175 feet west of the east line, is also 500 feet east of No. 2; it has a "run of ore" of about 250 feet in length and 15 or 20 feet wide. In all these pits they mine out all the ore, letting the surface cave down.

The Brotherton, Sunday Lake and Iron Chief are the only mines east of the Black river that have produced ore to ship. The quartzite foot wall, so important a feature further west, is wanting here. Also no dikes have as yet appeared. The ore occurs in pockets in the cherty schist, making the foot, hanging, etc., rock, all the same. The formation west and east of these mines is identical with this, but notwithstanding no ore in quantity has been found at the other explorations.

Near the Brotherton, etc., is the village of Wakefield which so far as buildings go is quite a large town; but just now many of the dwellings and places of business are vacant. Much is hoped for in the future of the gold mines near here.

Joseph Sellwood, President, Duluth, Minn.; Richard Bawden, Superintendent, Wakefield, Mich.

The mine produced in 1886, 8,880 tons; in 1887, 21,721 tons; in 1888, 40,639 tons; total, 71,240 tons.

THE SUNDAY LAKE MINE

is idle, awaiting, I am told, the final settlement of legal controversy regarding the property. The only work doing is drifting cross-cut south exploring for ore. There are no stopes opened in the mine. It will be necessary to sink before ore can be mined. Everything remains as last year, the mine underground is not materially different.

Mr. Duncan McVichie still acts as superintendent. Geo. M. Wakefield, Milwaukee, is, I believe chief owner of the fee.

The mine produced in 1886 14,270 tons of ore, and in 1887, 18,138; total, 32,408 tons. No product in 1888.

The Iron Chief has been abandoned, and still further east are the Pittsburg, Commercial and Eclipse, of which there is nothing very much to be said. They cannot be said to be mines yet. They are still explorations.

Capt. Tallon is working a few men at the Pittsburg, and the prospects for ore are about as they have been for two years past.

West of the Brotherton there are several explorations where work is in progress, as for instance,

THE CROWN POINT,

which owns a narrow strip of land along the north margin of the lake, a fractional ¼ section. A new shaft was recently sunk 40 ft. and came into a deposit of ore 10′ or 12′ wide, in which they drifted west 60 ft. It is not clean ore, there is too much rock in it, but it is an improvement on any heretofore found on this property, or on the others near it.

AT THE ALPHA

I found them pumping out the water from the shaft, preparatory, it was stated, for further work.

THE SPARTA,

formerly the Chicago, which joins the Crown Point on the north, is sinking a shaft close to the line only 90 feet north of the shaft in which the Crown Point ore is found. Capt. John McLeod, who superintends the work, feels quite sure of finding ore at a depth of 150 feet; is now—June 5—115 feet deep, working 11 men; has pump and steam hoist; 80 acre tract.

Capt. McLeod is also conducting an exploration on the 80 west of the Chicago—E. ½ N. E. ¼ Sec. 8, T. 47, R. 45. A shaft, which is now 65 feet deep, is still going down. Capt. McLeod has ranged out the line of the Brotherton and Sunday Lake mine ore and got into the western continuation of this line and is thus conducting his exploration.

AT THE PILGRIM

exploration a good deal of perseverance has been shown. The shaft was continued down to a depth of 208 feet and a cross-cut driven south 400 feet. I have not been into this long drift as I intended to have done but I learned from Mr. George H. Abeel, the Superintendent, that it was all the way in schist—cherty schist, containing traces of ore, leaving off at south end in black slate. I judge that the gentlemen who have done so much here have become discouraged and are likely to abandon any further work.

There are other explorations, the East Anvil and the Mikado for instance, that are yet held to be of some value. Others still are worked a little, just enough to hold the option. A far greater number are hopelessly abandoned.

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