

north deposit. Thence forward the north deposit ore will go to No. 4 shaft. No. 3, south deposit, is sunk to the twelfth level, and drifted, each way from the shaft, 35 feet; the ore is 30 feet wide. In No. 4, north deposit, the ore is 30 feet wide west of the shaft, and east the stope is 35 feet wide, in the eleventh level.

The winze is sunk to the twelfth, and all is in readiness to open there, 760 feet below the surface.

One of the best stopes is in No. 5, between the eighth and ninth levels. The ore at 70 feet west of shaft is 36 feet wide, a great improvement over what it was above. The shaft is sunk to the tenth level and they are opening out.

In the eighth level, on a rise east of the shaft, they are boring with a diamond drill, nearly vertically down, and were in ore; had already 40 feet of it, and still in ore. This is something new, probably a new lense, as it is east of any ore heretofore found in this shaft. They will go down into the ninth level and bore in horizontally to further prove this new find, which seems likely to be of importance. The mine has always been prolific in lenses, chimneys or pockets of ore. They are likely to be found at any time. The ore lengthens west in No. 5. In the eighth level it reached 150 feet west of the shaft, and was 20 feet wide. In the ninth they are now in 70 feet and the ore is 36 feet wide, and they are confident it will extend west a greater distance than it did above; and so on keep increasing in length in the tenth, etc., owing to the westerly pitch of the lense. Some further testimony is had to verify this conclusion from diamond drill borings.

The work of sinking a new shaft has just been undertaken, located 450 feet west of No. 5, being half way between it and No. 7. They are also sinking No. 7, which was 160 feet deep. The purpose is to strike a deposit of ore, which was found by diamond drill some years ago by two borings.

No. 6 will strike ore at 200 feet down; there are 15 feet of it as found by drill; also at a greater depth will be found the lense of ore that lies under No. 7, which is estimated as a body at least 20 feet wide.

Two-thirds of the ore taken from the mine is first-class—100,000 tons. They make three grades. The third grade is a 63% ore; the second a 65% ore, and the first is 68% to 70%. In phosphorus .040%, and silica 1.50%. In quality of ore it is the leading mine in the State—hard ore mine. The ore is about one-half magnetic and half specular slate; it is all bessemer. The walls are good and being so steep require less support than if they were flatter. It is an easy mine to work; dangerous places, passage ways into which there is a liability of the men falling, are provided with railing, and, apparently, the safety of the men is carefully looked after.

The company employs about 500 men, and it is stated that the miners earn \$2.00 to \$2.50 per day on their contracts. The management is esteemed as being liberal with the men it employs. Mr. A. Kidder has been agent of the mine for many years, he has made himself familiar with the geological features of the mine, as well as with all other matters that concern it. The other local officers are John Simpson, Mining Captain; W. Field, Assistant Superintendent, Champion, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1868.....	6,225	1877.....	70,883
1869.....	21,535	1878.....	73,764
1870.....	73,161	1879.....	93,203
1871.....	67,588	1880.....	112,410
1872.....	68,404	1881.....	144,025
1873.....	72,782	1882.....	157,516
1874.....	47,097	1883.....	104,960
1875.....	56,877	1884.....	208,156
1876.....	66,002	1885.....	173,914
Total number of tons.....			1,618,242

THE EAST CHAMPION MINE,

which is situated a little way east of the former, is opened in the same formation, but the ore deposits have proved small and irregular. The mine was started in 1872, but never proved profitable.

Under the first organization it was called the Keystone. About four years ago it was re-incorporated under its present title. The mine has been shut down for the past two years. They were working in two shafts, No. 2 and No. 3, the first of which is about 300 feet deep. In the bottom of this they did a considerable diamond drill work, and found small lenses or pockets of ore. All the deposits that have been found at this mine were small. The lense in No. 2 is about 150 feet long and 5 to 8 feet wide; the shaft is about 200 feet deep. No. 3 has a lense of ore 6 feet wide. The ore is scarcely first-class—magnetic and hard specular.

The record of the product of the mine for each year is as follows:

Year.	Tons.	Year.	Tons.
1873.....	12,701	1880.....	10,221
1874.....	4,880	1881.....	3,408
1875.....	3,348	1882.....	3,713
1876.....	7,715	1883.....	5,039
1877.....	14,496	1884.....	-----
1878.....	5,401	1885.....	-----
1879.....	4,029	-----	-----
Total number of tons.....			74,951

F. B. Spear, President, Marquette, Mich.

The mine is near the village of Champion, on the line of the M., H. & O. R. R.; description, S. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$, S. 32, T. 48, R. 29.

THE HUMBOLDT MINE

has not improved any in the past few years, on the contrary the line of its fortunes tends in the opposite direction. The Humboldt property has a pretty long stretch of ore formation, and a good many openings have been made at different points, but none of these have been in large deposits of ore. The best deposit is the one which the company is still working, which is reached by two shafts, Nos. 2 and 3.

At the time of my previous visit to the mine—two years ago—this pit was about 300 feet long. The shafts were at the bottom 280 feet deep, dipping northwest. Now the shafts are 350 feet down and the ore between them is practically exhausted. North of No. 3, 90 feet, a crossing cuts off the ore; this bar has been recently bored through and a body of black magnetic ore found beyond. They have opened into it and are hoisting it to the surface. Analysis shows it to be good in iron but high in phosphorus. The body is 14 feet wide. They are sinking a winze in it. This is the most encouraging thing in the mine now, as it may prove of considerable value.

The main ore lense lay in a bend, possibly the good ore will dip to the northwest, under the conglomerate.

At present they have only one stope of ore in the mine, which is southwest of No. 2, and is 14 feet wide. They have cut through a narrow part of the vein to reach it, and thus get rock mixed with the ore, but when hoisted the ore is carefully sorted; all poor ore and rock is picked out.

Thus they will have this new body to the north of No. 3 and the stope southwest of No. 2 for the future product. To reach this ore they are preparing to sink No. 1, and will fit it up and so abandon No. 2. The new deposit, if it turns out to be of sufficient value, will be reached by No. 3 shaft; they will change its direction so as to take it down into this ore. The length of the ore to the south and southwest of No. 2 is 190 feet, with an average width of 12 feet. No. 1 shaft will come down in the middle of this lense. The ore is more free of rock; it all has to be picked over carefully. There are now (Nov.) at the mine in stock about 14,000 tons of ore; it is very good second class, averaging about 60% in iron. No. 3 pit having become exhausted of ore the mine has reached pretty contracted dimensions. Unless there is an improvement the mine is not likely to be worked very long; it cannot be profitable as it is. There should be an improvement both in the mine and in the market. The ore is mainly, after being ready for market, first-class non bessemer, hard specular slate, with a mixture of magnetic. The second class is designated as Franklin—martite and slate.

The ore should dip to the northwest under the conglomerate.

It would seem that the ore formation should lie between the ridge on the east and south side and the conglomerate, which forms the opposite ridges on the northwest, and under which the formation dips. There is a valley between the mine and the conglomerate that has not yet been explored. The local management remains unchanged. J. B. Maas, Agent; Ed. Maas, Superintendent, Humboldt, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1865.....	4,782	1876.....	3,333
1866.....	15,150	1877.....	16,546
1867.....	25,440	1878.....	23,921
1868.....	35,757	1879.....	18,204
1869.....	58,462	1880.....	14,727
1870.....	79,712	1881.....	26,302
1871.....	43,725	1882.....	43,436
1872.....	38,841	1883.....	31,866
1873.....	38,014	1884.....	23,763
1874.....	27,890	1885.....	11,776
1875.....	9,642		
Total number of tons.....			606,338

THE ARGYLE MINE

is adjacent to the Humboldt; both of them are on the Republic branch of the M., H. & O. R. R. The Argyle is an old mine. It was the first of our mines to be worked wholly underground. It originally belonged to Judge Edwards of Marquette, now deceased, and was known as the Edwards mine. The shafts dip to the west, with the formation, and have attained considerable depth, No. 3 being 600 feet in length, and No. 2, 500 feet. The ore is magnetic and specular slate, and so mixed with rock as to require careful picking. It was never a profitable mine. The lenses of ore are too small and too much dead work is necessary. It is a good property to explore to the north in the level land. Some diamond drill borings should be made to test the property. The mine has been idle since 1883.

It has produced in past years as follows:

Year.	Tons.	Year.	Tons.
1866.....	2,843	1876.....	19,420
1867.....	4,928	1877.....	10,591
1868.....	17,360	1878.....	10,303
1869.....	21,450	1879.....	5,455
1870.....	24,232	1880.....	
1871.....	26,437	1881.....	4,584
1872.....	26,026	1882.....	12,461
1873.....	29,281	1883.....	15,700
1874.....	2,842	1884.....	
1875.....	12,804	1885.....	
Total number of tons.....			256,774

Don M. Dickinson, President, Detroit, Mich.

THE REPUBLIC,

taken all in all, is probably the best hard ore mine in the State; there is more ore to be seen in the mine now than there is any other, and then it is of better quality than that of any other, except the Champion. I might except the Boston ore, but that is a small mine and is not working. The Republic has also taken its place with the other great mines in the improvement of its mining plant. Its new hoisting machinery is probably not excelled in power or perfection of working by that possessed by any other iron mine in the world. In many respects the mine is improved, and thus altogether the visitor is greatly impressed with its magnitude and importance.

The ore deposits in this mine outcrop along the westerly slope of the high bluff that descends to the shore of Smith's Bay. The high jasper formation curves around conforming to the contour of the water, being at the south end of the bay nearly east and west, and on the east side of bay, running north and south.

The bay, which is a bayou from the Michigan river, that lies on a basin formed by the converging dip of the high jasper bluff which nearly surrounds it, is an exceedingly interesting location—scientifically, practically and aesthetically. Scientifically, from the excellent opportunity which this immense and varied outcrop affords for geological study; practically, from its great importance derived through the magnitude and richness of the ore, and aesthetically from the remarkable beauty of the scenery itself. It is one of the most romantic mining locations in the whole upper peninsula.

Many of the ore deposits in this mine, especially the slopes at the south end, are really chimneys of ore or lenses set up partially on end inclining towards the lake, and the shafts go down, following through the long way of these deposits.

These chimneys of ore also approach each other in their descent, and thus have the appearance of radiating from one body like the fingers from the body of the hand. This fact has led to a belief that is quite freely entertained that all these now separate deposits come together finally, forming one great body of ore underneath the bay. The theory is not an improbable one; there are many facts that tend to verify it and lead to the inference that this fine hypothesis may ultimately be found to be a pleasing reality.

Commencing with the Perkins shaft, the most southerly and westerly one, the ore is a red specular, not as much in favor as the best ores of the mine, and the shaft has been abandoned. Next east of it is the Morgan. The dip of this shaft is 38° to the north, and it is 800 feet long. The levels are 50 feet apart; they are working the three lower ones. The lowest is the twelfth. It may be well to state that the lower levels in all the shafts are not yet very near the bay; assuming a continuity of the present dip and rate of advance, the bay will not be reached under ten or twelve years.

In the Morgan shaft and Ely, etc., the levels are shaped like the section of a lense, with the long axis north and south, or in the direction of the line of the shaft. The Morgan gave more ore last year than ever before. There are bunches of jasper in the vein, but the rock is left in pillars. The pit is about 120 feet long—that is the levels are—and 20 to 30 feet wide. The ore is magnetic and specular slate, and is all first-class. The slate ore generally

overlies the magnetic. The former is friable, made up of glistening scales. The product is about equally divided between the magnetic and slate. They are sinking below the twelfth and apparently the pit is likely to afford as much ore the coming season as it did the last one.

The collar of the shaft is 75 feet above the bay, as is also that of the Pascoe shaft which is the next one east, and which is also of the same depth. There are three lenses of ore in this pit, two of them slate ore and one magnetic. They are parallel and are placed edgewise in the same manner. The shaft is sunk to the thirteenth level, which is just opening out, though there is a half year's stoping in the upper levels yet. The policy of course is to keep the mine well opened ahead of the stoping. The average angle of the shaft is 38° to the north, being very much flattened, since at the top it is 50°.

The shaft is in the middle lense; they are separated by banded jasper. These lenses furnish a small amount of second class ore against the walls. The body of the ore is first-class. The levels in the east vein are 50'x12', in the middle one 10'x30', and the west one about the same. It don't look very promising, and is thought not to be improving, at least. There are ore pockets for each shaft. Each pit is worked on separate contracts. The ore is mined by the ton, put into the tram car. Usually the contract includes 8 men. The men take the contract to do the sinking and drifting, break the ore, etc., for the year; leaving the pit in same condition at end of year as it was at beginning. It is so much per ton for breaking the ore; so much per foot for shaft; so much per foot for winze, etc. The contractors pay the fillers and the company hoists the ore and charges the men with the supplies.

The Morgan and Pascoe shafts are single skip. The latter used to be double; but the skips now are larger than were formerly used and one answers the purpose. They carry one and a half tons. This is one of the results of the new machinery.

The next pit is the Ely, which used to approach the Pascoe, but at a depth of 600 feet its direction was changed to run parallel with it. The Ely shaft is also 800 feet long and sunk to the thirteenth level and opened out for another year's work. In the eleventh level the Ely and Pascoe are connected by drift. In the Ely pit is one large lense, in which the shaft goes down the same as in the preceding, except that its direction was changed as above stated to keep it in the ore, the lense having turned a little to the east. The pit produced more last year than in any year before, and it is considered to be looking as well now as it ever did; pillars are left for the shaft in this and in the others also.

A new plant of hoisting machinery has been lately procured for the pits, placed in a large brick building—iron roof—erected for the purpose. This plant comprises 4 drums, each 12 feet diameter, 7 feet face, Merritt's external friction gear; it runs as smoothly and perfectly as the works of a chronometer. The Ely pit ore is all first-class slate ore, except about 3,000 tons on the side next to the Pascoe. All the ore from this west end pit is sold for bessemer. The ore is about 15 feet wide—average—and 100 feet long north and south. The water is taken to the Morgan by a Cameron pump, thence to the surface by a 12" plunger. There are two Cameron pumps in each pit, and occasionally a small one is used for some especial purpose, as in sinking a winze, etc.

The Republic has had, considering the state of the market, one of the most successful years in its history, which is probably due to this new contract system. The men work harder, because working for their own interest, and, it is stated, have made better wages than ever before, but there have been more men killed by accident than in any previous year. The men will, under the incentive of greater profit to themselves, take more chances than they will when working on company account. They require constant watching. It is also stated that the ore has cost the company less per ton than ever before.

The next pit, the Gibson, is a small one, 5 or 6 feet wide and 50 feet long; it approaches the Ely and will, in time, make another opening for the Ely. The ore is first-class slate ore. Six men are employed in it on contract. The length from surface down is 650 feet. The plant is the one formerly used at old No. 5. The Ely and the Gibson are 100 feet nearer together at the bottom than at the top.

From the Gibson north the pits were numbered from 1 to 10, but they are no longer all of them worked as separate pits. The ore from Nos. 1 and 2 is taken now out to No. 9 shaft. It will be remembered that No. 5 and No. 6 pits are upon either side of a double cage shaft. To reach No. 1 a skip road has been made going down to the eighth level, where it turns east, going on an incline of 24° for 200 feet, to No. 1 vein, where it bends to the right, making a horizontal angle of 50°, going thence down in the ore. They are preparing to make still another bend in the skip road, to the left, to comply with the conditions of working at the greater depth. I rode up in the skip around these curves and found it went very smoothly. No. 1 shaft is still lowered for a pump shaft and also used for timber. The ore in No. 1 is 8' to 10' feet wide; I found them stoping in the ninth level and sinking for a new lift. Coming up the curving slope to the eighth level and passing through No. 6 pit, we pass through a chamber 60 feet wide coming to No. 7. The ore body is 400 feet long. There is both black ore and slate ore; the lenses are parallel and have continued so from the surface down. The black ore lense runs out before reaching No. 7, leaving only slate. In No. 7 the black ore of No. 6 continues, and there is both slate ore and black ore on towards No. 8.

The water is taken up No. 1 by plungers, 200 and 250 feet lifts; large, well supported cisterns receive the water at each lift.

The ore from Nos. 3, 4 and 5 goes to No. 6, which makes No. 6 the largest producing pit in the mine. No. 5 is now called the inclined shaft. No. 7 pit is 270 feet long, 12' feet wide, the shaft dips 80° west. It is down to the tenth level, 700 feet deep. No. 6 shaft is 820 feet long. There are several minor pits working to the north of No. 7, which are similar to the Gibson, in which they hoist with bucket, one a small lense 7'x50', slate ore. It is trammed to No. 7.

No. 8, independent pit, is 200 feet long, mostly north of shaft, average width of ore 10 feet, slate ore, best quality, down to eighth level. No. 9, another independent pit, 6'x55'.

No. 8 is pitching towards No. 9, and they will probably come together. A small hoisting plant on top of the bluff is used with these shafts, working two drums, which operate No. 9 and a scam; No. 5 engine operates the No. 7 scam.

Three years ago the rock engine house was built, of stone, iron roof,

78'x89' inside. In it are four 12' drums, Merritt external friction gear, also electric light engine, and 3 boilers operate Nos. 5, 6, 7 and 8 shafts.

The new brick engine house, further south, is 58'x78'; also 4 12' drums, 7½' face, same make, carry 2,400 feet 1" rope, 2 engines each 20"x30". The machinery at the Republic, the Lake Superior, and a few others, is not surpassed, and probably not equalled by that found in any other iron mines in the world. The mining plant at our Lake Superior iron mines is said, on the authority of the best experts, to be the most effective and powerful possessed by any iron mining region on the globe; and of these there is none better than that at the Republic.

The Kingston pit away to the north of the river has been abandoned. The ore is not salable now.

The product of the several pits from Dec., 1884, to Nov. 1, 1885, was as follows; the average force employed being 700 men:

Mine.	Tons.	Mine.	Tons.
Morgan.....	37,117	Nos. 5 and 6.....	50,807
Pascoe.....	30,529	No. 7.....	26,942
Ely.....	31,719	No. 8.....	19,614
Gibson.....	2,535	No. 9.....	2,010
Nos. 1 and 2.....	25,112		
Total tons.....			226,385

The product for each year is as follows:

Year.	Tons.	Year.	Tons.
1872.....	11,625	1879.....	135,131
1873.....	105,435	1880.....	235,987
1874.....	122,639	1881.....	233,651
1875.....	114,726	1882.....	235,108
1876.....	120,045	1883.....	152,565
1877.....	165,536	1884.....	277,739
1878.....	176,221	1885.....	249,070
Total tons.....			2,339,666

David Morgan, General Manager, Republic, Mich.; Peter Pascoe, Superintendent, Republic, Mich.; W. D. Rees, Secretary, Cleveland, Ohio.

THE WEST REPUBLIC

mine is situated on the opposite side of the bay, and joins its important neighbor on the west. The workings thus far have only developed a small

mine instead of the large one that was hoped for. Some borings have been made with diamond drill to prove the property; the best results were obtained in a hole made near the east line, south of the bay, next to the Republic. The drill penetrated to a depth of 800 feet and passed through 60 feet of ore. Mr. St. Clair, the Superintendent, is anxious to sink here for this ore, feeling assured that the expense would, in the end, be amply compensated for.

The mine is all underground, reached by a shaft from the east side of the river, which is sunk in rock a little way from the ore. There were formerly two lenses of ore, an east one and a west one, the one running parallel with the river, and the other extending under it. The east lense has been abandoned. They have under the river and west of it a length of ore of about 80 feet, with a width of 12 feet. In the 181 foot level they have worked 30 feet west of the river. In the 225 foot level have not quite reached the river, and in the 385 foot level they have been driving west and have just reached the ore. The ore extends under the river and beyond it. The river runs south. It is contemplated to sink a shaft on the west side of the river, as the lense which they are now confined to is mainly on that side, and from the present shaft there is too much dead ground to go through to reach it. At the present time, November, the company employs 15 men in and about the mine. J. O. St. Clair, Superintendent, Republic, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1881.....	7,378	1884.....	19,623
1882.....	27,865	1885.....	12,674
1883.....	30,734		
Total tons.....			98,284

THE COLUMBIA MINE

is situated north of the Republic, about a mile from the river, which, where it crosses the line from the Republic to the Columbia, runs west, but immediately bends around to the south, which is the direction that it pursues where it crosses through the West Republic. The Columbia has been idle since 1882, and there is nothing to add to the descriptions which have heretofore been given of the mine. The mine has been quite largely worked, and is provided with suitable machinery, also dwelling houses and other buildings; but the lenses of ore are narrow; they have never developed into deposits of any great magnitude, and they have never afforded for shipment any amount of strictly first-class ore. It is a slate ore similar in appearance to the Republic, or rather to the Republic's Kingston pit ore, specked with birdsige quartz, and is too high in phosphorus for bessemer. In the summer of 1882 a good deal of work was done with the diamond drill, but nothing encouraging was found.

Yearly product of the Columbia mine:

Year.	Tons.	Year.	Tons.
1873.....	21,271	1880.....	6,636
1874.....	34,348	1881.....	11,158
1875.....	8,059	1882.....	12,066
1876.....		1883.....	714
1877.....		1884.....	
1878.....		1885.....	
1879.....			
Total tons.....			94,249

All along the south and east side of the river from the Republic to Lake Michigamme are the evidences of former explorations—test pits, exploring shafts, abandoned houses, etc. A number of companies were organized to mine at selected places in the line of this ore formation. Lenses of slate ore were found, but none of magnitude sufficient to make a mine of any commercial value, though a few rose to a sufficient temporary importance to cause the shares of this stock to sell at pretty high figures. Starting from the Republic and naming these locations in their order, we have, after passing the Kingston pit and the Columbia, the Metropolis, Windsor, Standard, Cannon, Erie, Magnetic, Northwest Republic, etc. THE MAGNETIC is an old location where the company that owns the property has explored off and on, with no very good results.

THE NORTH WEST REPUBLIC is a new development, and they have opened up a small body of ore, and have altogether favorable indications in the way of future mining.

The Erie is in the hands of gentlemen who have great faith in the mineral value of the property, and who have persisted in their endeavors to develop a paying mine, under great discouragements.

Two years ago the Messrs. Wright, who operated the Erie, succeeded in getting a branch railroad built from the Republic to the mine, a distance of six miles. Recently the company has been re-organized under the corporate name of

THE FREMONT IRON CO.

The mine is about 6 miles from Republic, with which it is connected by a good highway, also a branch railroad track.

The shaft is 200 feet deep; from the bottom to the northwest, 60 feet, the ore had been worked out and from the end three borings were made, after shutting down two years ago. These holes are to the west, northwest and west. The second hole was 94 feet long at an angle of 30° down. The ore shows a succession of seams of schist and martite ore in about even quantities. They have drifted out on this hole 35 feet, and sunk a winze to strike a deposit of clean ore 4 feet wide, which they propose to develop and mine.

The ore was found at 14 feet and the winze has been continued down and is now 33 feet, the last 18 feet in ore, in which it is still sinking. From the end of the drift they also went in west 21 feet, but found nothing. The plan is to continue the sinking to a sufficient depth and then to drift under the drill hole and cut the succession of lenses. The hole to the west was made 80 feet long, with a result very similar to the preceding—ore and soap rock alternating. The ore is slate and magnetic. The underlay is now in the north drift, dipping northwesterly; the first hole, apparently, cuts across the formation. Another hole cutting under, a little north of shaft, starting from off to the east, went down at an angle of 60°, 394 feet long, seeming to prove that the hanging is a little to the east and north. The formation bends around from the east side to the west as it goes north. West of the No. 1, 60 feet, another shaft was sunk some years ago 60 feet deep.

In the bottom of No. 1 shaft the ore has been mined out to the south 30 feet, leaving a breast of ore at the end 8 feet wide. A little south of this stope a drill hole from the surface at an angle of 54° passed through as follows:

Quartzite.....	43'	6"
Martite ore and soap stone.....	10'	0"
Slate ore and quartz.....	11'	5"
Slate ore, clean.....	27'	--
Soap stone.....	8'	0"
Slate ore, clean.....	3'	0"
Slate ore and quartz.....	18'	6"
Coarse grained slate ore.....	55'	2"
Slate ore, clean.....	8'	0"
Bl. ore, clean.....	6'	9"
Bl. ore and quartz.....	18'	3"
Soap rock.....	3'	6"
Bl. ore and quartz.....	24'	10"
Soap rock.....	7'	10"
Quartz.....	20'	--

It will be seen from the above table that there seems to be a body of black and slate ore 15 feet wide, and this they are also pushing to get into and are now within a few feet of it with the drift.

The whole length of the underground opening which was formerly mined is 100 feet, and about 5 feet wide. This is the lense which has furnished the ore that has heretofore been shipped from the mine. The bottom is still ore, and they have sunk for another stope. No pillars have been left, but as the mine is continued down they will be necessary.

The mine has very little machinery, a small engine and hoisting drum. Mr. Wright is negotiating to supply this want without delay. Analysis of the drill cores have been made, and the best show a percentage of 67% to 69% in iron; .015 to .119 in phosphorus; silica, 1.63% to 6.90%. Ore of this grade is certainly first-class. In making a sale of the ore the company guarantees that it shall not exceed .045 in phosphorus. The stock of the company is divided into 20,000 shares, par value \$25. One-half of this has been sold to secure a working capital.

E. H. Wright, President, Republic, Mich.; W. A. Wright, Secretary and Treasurer, Republic, Mich.

Shipments from the mine:

Year.	Tons.	Year.	Tons.
1882.....	2,730	1883.....	5,405
Total tons.....			8,135

THE MILWAUKEE MINE

is one of the so-called Negaunee hematites. In the south of this city there has been opened in the aggregate a good many small mines; some of them have had excellent ore and have proved profitable for a time, until they were, seemingly, exhausted; others have never shown much value, and were abandoned with loss, and still others are yet esteemed valuable, only awaiting the advent of better times to render them again active.

At present the most important of these south side mines is the Milwaukee, which is now working and under very favorable indications of prosperity. The Carmichael Bros., who are practical miners and were previously familiar with this mine, took the contract of mining the ore for the company, guaranteeing a certain amount, and finding themselves and paying all costs, receiving in compensation a certain price per ton for the ore. They began in April last to pump the water out of the mine, and were raising ore early in May. During the season they have worked 3 pits, Nos. 7, 8 and 9. The latter is a new shaft 60½ feet northwest of No. 8. No. 8 shaft dips southeast. No. 9, 52° southwest. The vein runs east and west. The shaft is 120 feet down. The ore body is 10' to 40 feet wide, and has been worked west 200 feet, where it is cut off by a bar of rock, though there is a leader of ore in the west side which they will drive on.

The shaft is mainly sunk in rock, though it started in ore; it is now, at the bottom, in ore, and the ore continues 50 feet east of the shaft. In the level above the shaft was just at the east end of the ore, thus showing that the ore is lengthening east.

No. 9 is the best showing they have in the mine, and it seems likely to be the main source of supply for the product for the coming year. No. 9 is wholly underground. The hanging wall is a jasper paint rock. The pits, Nos. 8 and 9, are connected by drift for air.

No. 8. shaft goes down to the south; the depth to the first level is 41 feet. This level runs off to the west with slight bend to the north, for a distance of 240 feet from the shaft, when it goes west 50 feet, bringing the end of the working near to No. 9. There are two levels below the first, which conform in direction with the first, except that they do not extend so much north. The shaft is sunk to the fourth level, and on its way to the fifth. The plan is to sink to the sixth to be ready for next season's stoping. The ore to the east of No. 6 has been mined and taken to No. 7, but now No. 7 will go to No. 8, drifting east and west at each level to the end of the ore, and then stope towards the shaft.

The ore body varies in width from narrow to wide; it makes out into pockets, and from these the most of the ore is obtained.

The plan for the winter is to open in each pit three levels in advance, for next season's stoping, and to mine and put into stock about 5,000 tons of ore ready for early spring shipment.

No. 8 shaft is in the body of the ore, thus necessitating the leaving of a good deal of ore for shaft pillars, which may be removed when they are ready to abandon the shaft, as may also the floor of the levels.

No. 7 was thought to be the best part of the mine in the spring, but contrary to their anticipations the ore pinched out, and had it not been for No. 9 they would have been short in their estimated product. They will drift under No. 7 pit from No. 8, working east, and thus prove the ground. The depth of No. 8 is about 300 feet, all underground. The ore occurs in loose jasper, in pockets and lenses, etc., in a similar manner as it is found in all this south side range. During the summer the openings had to be carried forward at the same time with the stoping and hoisting of the ore; as the men could not, with safety, work in the bottom of the shaft, sinking it, while the work of dumping ore into the skip and hoisting it, etc., was going on above them, it led to the adoption of a neat arrangement for accomplishing this work. They drifted out the requisite distance and sank a winze so that the bottom should be in the line of the shaft, and in the next level, then they rose up in the shaft, hoisting the dirt up through the winze, thus continuing the shaft by rising instead of sinking. The shaft, the drift, and the winze form the three sides of a right angled triangle, of which the former is the hypotenuse. Of course this made the work of sinking the shaft doubly expensive, but under the circumstances was an excellent plan.

Between May and November they have mined and shipped 38,000 tons, all taken from the 3 pits, $\frac{1}{3}$ of it coming from No. 8, $\frac{1}{3}$ from No. 9, remainder from No. 7. No. 9 looks very favorable, in fact it improves as it is developed; the ore body is lengthening, as before indicated, by extending further east. But No. 8 is not looking as well as it did, rock is showing in bottom level. In drifting west in the fourth level they encountered rock at 60 feet from the shaft; instead of attempting to push through it they are sinking a winze from the third level, further to the west, to see if this rock continues, or if it is only a temporary bar and ore will be found beyond. The Milwaukee mine ore is a very fine quality of hematite, not exactly bessemer, but very near it.

All the ore averages above 60% in metallic iron—is about 2 to 3% silica, and .065 to .070 phosphorus, and brings \$2.20 to \$2.25 at the mine.

The average force employed was 100 men, but during the winter 25 will suffice. The men work on contract altogether, in departments of the work.

Mr. Alfred Kidder, Agent, Marquette, Mich.

Annual products:

Year.	Tons.	Year.	Tons.
1879.....	941	1883.....	805
1880.....	13,142	1884.....	25,000
1881.....	31,254	1885.....	38,466
1882.....	41,200		
Total tons.....			150,808

THE WHEELING MINE

joins the Milwaukee on the west. The workings are contiguous, so that each company has claims against the other for mining over the line.

The Wheeling mine shaft is 150 feet deep. They have a good body of ore, though somewhat broken up, and interspersed with rock. The hoisting plant is the same that was formerly at the Chicago mine. They have taken out, all told, 10,000 tons of ore.

The product for 1885 was 6,383 tons. Captain Foley says there is no profit in the work, paying 50 cents per ton royalty, and selling the ore for \$2.00 per ton. The mine will probably be pumped out and work resumed in the spring.

J. C. Foley, Agent, Negaunee, Mich.

THE McCOMBER MINE

has remained idle since 1883; in fact no ore has been mined in it since 1882. Everything remains about the location in readiness to start up. It is understood that the lease by which the property was held by the company has been cancelled, and the mine is now in the hands of owners of the fee—the Pendlill estate. The mine has been fully described in previous reports and there is nothing to add or to modify. It is somewhat doubtful if the mine could be made to yield as large a product as it has done, and also it is a fact that the ore does not give as good satisfaction as it did at first. It was fair in iron, sufficiently low in phosphorus for bessemer, and had also from 1% to 10% of manganese. It is now non-bessemer, which greatly lessens its value.

It is stated that the mine will be worked the coming season.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1870.....	4,866	1878.....	30,180
1871.....	15,442	1879.....	28,962
1872.....	25,030	1880.....	31,028
1873.....	38,332	1881.....	28,230
1874.....	2,642	1882.....	40,390
1875.....	10,357	1883.....	14,676
1876.....	17,282	1884.....	
1877.....	19,691		
Total tons.....			307,608

The McComber company met with serious losses which greatly crippled its resources, and probably were the occasion of its suspension of mining work. The losses were through the failure of the Union Iron and Steel Co., of Chicago, to whom it had sold its ore, and which was indebted to the McComber Co. to a large amount.

THE MANGANESE MINE,

operated by Messrs. Shadt and Breitung, has furnished 3,112 tons of ore the past season, taken from a pit east from the McComber. But nothing has been done during the past two years of any note at the ETNA, ROLLING MILL, NEW YORK, CHICAGO, and other locations situated in this south side range of mines.

BAY STATE.

They propose to do some work at the Bay State location the coming winter to test the ground a little further. A few years ago on the north side of the bluff where they had test pitted a good deal, they found indications which they deemed it best to develop further, and to this end they put a party at work the past summer to sink a shaft in a loose ore; but after getting down about 20 feet they concluded to wait until the ground should be well frozen. They claim to have got into good ore, and will open it up this winter and find out about it.

East from Negaunee, about a mile, on the Mitchell farm, the

SAGINAW MINING CO.

is engaged in opening a mine which promises to be an important one. They are now sinking two shafts which are 400 feet apart, one of which, at the time of my visit in November, was down 18 feet. The total depth of drift to be gone through to strike the ledge is 115 feet. They were using a Ney pump to sink the shaft. The pump being suspended in the shaft throws out the sand and gravel with the water. The shaft is strongly built with square timbers and heavily weighted; size of shaft 12'x12' inside of timbers. From the surface to the ore is 385 feet, as determined by diamond drill; at each point a 100 feet of ore was gone through. A great many of these vertical borings were made at different points in the fields, but those points were chosen for sinking as there was less drift covering the ledge. The shafts are sinking in the side of the hill bordering on the swamp and sloping to the south, at other places, upon the hill, in the meadow, south of the railroad, the ledge was found to be covered with 200 feet of soil, etc. At the other shaft—the west one—they were just to the ledge, 40 feet below surface; they had experienced considerable difficulty in accomplishing the task, but it was anticipated that the experience acquired would be of practical value in the work of sinking the other one.

An engine house has been built, and the machinery formerly at the National mine placed in it, and it is now in working order. Captain Samuel Mitchell, who directs the work, states that ore was found in most of the holes bored, and that it is bessemer. Analysis of all the ores show 60% and upwards in iron, and within the bessemer limits in phosphorus.

They expect to be ready to ship ore in the spring. They are laying a side track to the mine from the main line of the M., H. & O. The land is owned by Mitchell, Maas and Longstorf, who lease it to the Saginaw Mining Co., at 25 cents per ton royalty for the ore. The fact of the existence of the ore here was made known years ago, but the work of development was not undertaken because the owners wanted too high a royalty—50 cents per ton.

Samuel Mitchell, Agent, Negaunee, Mich.

THE SALISBURY MINE

is the property of the Iron Cliff Co., and is justly esteemed as a valuable mine. It was opened in 1872, and after 14 years' working is looking as well now as it has at any time in its history. Formerly the ore was mined by stripping the surface, and a very long, deep cut has resulted, from which the ore has been taken. More recently the workings have been mainly underground, and the greater portion of the ore has been raised through a single shaft situated at the southeast point of the open pit. This shaft extended down into what was called the south vein, a fine body of ore lying south of the lense that had been previously worked in the open pit; connection was also made by drift extending from the underground pit to the south beneath the ore in the open pit. The strike of the formation is east and west, and the dip of the ore bodies to the south.

The railroad track and ore pockets are south of the workings and hence the open air descent of the skip road from the ore pocket and elevated track running to the stock pile is to the north down to the collar of the shaft; thence downward from the surface it is vertical for a considerable distance, but finally bends to the south, going thenceforward at a sharp inclination in that direction.

This change in the direction in the movement of the skip is very readily effected by means of a fixed pulley, with grooved contour for receiving the rope, placed at the angle of the road; the wheels of the skip will of course follow the rails in their inclination to the south.

The change in the direction of the skip road was rendered necessary in order to follow the ore which was found to dip to the south more rapidly than was anticipated through another important fact due to the recent discovery of a valuable deposit of ore situated south of their former workings.

Captain Buzzo started a drift in the fifth level to explore the ground to the south, and at a distance of 90 feet from the shaft the drift came into ore which, on further investigation, proves to be a valuable "find." This discovery was made in May last, and in the fifth level the new deposit has been opened for a length of 200 feet east and west, and is found to have a width of 50 feet. They have also "cross-cutted" to it in the fourth level, and find the deposit to be, apparently, equally good as it is in the fifth. Drifts to this new deposit are also in progress from the levels above those mentioned, and it is thought to be certain that the ore reaches to the surface drift.

At the sixth level, which is the bottom of the mine, the newly found deposit and the old south vein come nearly together, due to the greater southerly dip of the latter. In fact I should judge that the foot wall was cutting out the old deposit, and that they have found about its limit. Still the old openings hold yet a good deal of ore, but it contains a higher percentage of phosphorus than analyses show the south vein ore to possess. The latter is equally high in iron and sufficiently low in phosphorus to be rated as bessemer. The plan for the coming year is to mine only in the south deposit, as this is an ore for which there is a market, and also from the fact that as much ore can be mined in the new opening as can be hoisted in the shaft.

The ore deposit is very clean, entirely free of rock; it is a soft hematite, yielding 60% and upwards metallic iron, and .05% in phosphorus.

Heretofore the ore has been the same in iron and higher in phosphorus. The openings are timbered after the Nevada system, and the mine being

The following analyses of the ore, made within the past two months, by Mr. C. E. Wright of Marquette, show the quality of the ore in:

	No. 1.	No. 2.	No. 3.	No. 4.
Metallic Iron.....	65.47	66.90	63.40	63.10
Phosphorus.....	.063	.067	.065	.063
Silica.....	2.81	1.83	2.78	4.25

No. 4 is the analysis of a diamond drill core. It will be seen that this ore is bessemer, a quality it has not heretofore possessed.

The mine is in poor shape to work. There are four skip roads going down to the east into the pit, but only the north one is used, and they are working a considerable distance north of this. The skip road is 375 feet long on an angle of 45°. It would be better to abandon them all and sink from the surface a vertical shaft, from which all the ore in the mine could be reached. In fact not much can be accomplished until this is done.

The company is sinking two new shafts 1,100 feet distant northeast from the old mine. The shafts are 385 feet apart. The east shaft will be 224 feet to the ore, and the west one 206'. The former is now 86' down, and the latter is 165 feet. They pay \$31 per foot for the sinking, the company finding the steam power and the timber. They are following diamond drill borings in the sinking. The east boring disclosed 21½ feet of ore, and the west 17½. Five other borings have been made, and the drill is now working, the boring being, at the time of my visit—February 28—565 feet deep. The purpose of the present boring is to catch the ore on its underlay from the high ground where the shafts are sinking. The entire cost of the boring is but \$1.80 per foot. Two years ago it cost \$5.00 per foot to do the same work.

The company has a large estate, but the trouble has been to obtain ore in quantity of a quality sufficiently good to be merchantable.

The following table shows the product of the mine to date:

Year.	Tons.	Year.	Tons.
1871.....	4,171	1879.....	24,141.
1872.....	34,495	1880.....	38,597
1873.....	41,204	1881.....	34,273
1874.....	16,106	1882.....	40,590
1875.....	4,070	1883.....	19,414
1876.....	15,324	1884.....	11,747
1877.....	20,211	1885.....	5,679
1878.....	4,704		
Total tons.....			324,727

Joseph Kirkpatrick, Agent, Palmer, Mich.

The mine is usually known as the Palmer, and is in what has long been known as the Cascade Range. There have been a great number of mines opened in this range, but none have recently been operated except

THE WHEAT MINE,

which is still worked with good results. They are only mining a brown, soft ore, working the hematite deposit that was first opened in 1881.

No hard ore has lately been mined. The hematite ore is mined from an open pit situated on the opposite side of the valley, south of the hard ore mine. It is a medium quality of soft hematite ore.

The out-put of the mine has been as follows:

Year.	Tons.	Year.	Tons.
1879.....	850	1883.....	6,625
1880.....	3,324	1884.....	6,824
1881.....	9,040	1885.....	9,200
1882.....	9,554		
Total tons.....			48,638

Thos. Prout, Superintendent; Daniel McGarry, President, Cleveland, Ohio.

THE TAYLOR MINE,

situated in section 9, N. E. ¼ N. W. ¼, T. 49, R. 33, was fully described in the report for 1881. Since that time no attempt has been made to work the mine. The aggregate product of the mine is 31,784 tons.

THE SWANZY MINE

has also been idle for two years past. The location is the S. W. ¼ N. E. ¼, S. 18, T. 45, R. 25, and is reached by a branch from the C. & N. W. R. R. at Cheshire Junction. It is said, on good authority, that the mine will be operated during the ensuing season. The ore is hematite of fair quality, and there has been mined since 1872 an aggregate amount of 143,372 tons.

J. J. Pierce, President, etc., Sharpsville, Pa.

THE MENOMINEE RANGE MINES.

The first one of these mines that is met with—the most easterly one—is the

EAST VULCAN,

one of the Penn Iron Company's mines. The mine has been greatly changed since it came into the hands of its present owners. Four years ago the shafts were simply lagged up with poles and only large enough for bucket hoist; now they are all finely made, large, double cage shafts. The underground workings are all systematically timbered, in the most substantial and effectual manner, on the Nevada system. In none of our mines is there such a good opportunity of studying this method of timbering as is here afforded; and in none would one be so likely to be impressed in its favor. From top to bottom, throughout the mine, it is the one system without modification, and it accomplishes all that is intended.

There are three separate shafts, the middle one of which, No. 1, is the only one which is at present worked.

No. 2 is the easterly one, 1,700 feet east of No. 1, and No. 3, high up on the hill, is 1,500 feet west of No. 1. The mines are upon the hill-side, north of the valley below, through which runs the railroad. No. 2 shaft is 255 feet vertically down, and has at the bottom a good body of ore 12 feet and upwards in width, and 160 feet long. The pit has not been worked for two years: it is proposed to start it again in the spring. John R. Wood sunk a shaft south of it 200 feet deep, in lower ground, and broke through into No. 2, taking the water out of it. The timbers all stood perfectly.

The shaft is double cage, each compartment $4\frac{1}{2}$ feet by 7 feet. The ore in the bottom dips west and pitches to the north.

No. 3 mine is 284 feet deep. There is a surface rise from the shaft at No. 1 to No. 3 of about 100 feet. This shaft also is vertical, with double cage, and complete. The bottom has not been opened out, but, it is claimed, it is in ore, and also that there are stopes of ore in levels above the bottom. This ore is high in phosphorus, and for that reason the shaft has been idle for two years past. During this period the work has been contracted in No. 1, which, like the others, is reached by a downright shaft, double cage, 500 feet in depth; from the surface, for the first 168 feet, it inclines slightly, thence down it is vertical. All the rock broken in the mine is left on the timbers, lagged in between the posts. The ore and rock are all taken up clean. There are no scattered heaps to be seen. Much of the roof has given way also in places and rests upon the timbers, so that there is immense weight of rock which the timbers support, without any apparent tendency to give way; tens of thousands of tons are thus upheld, but the most careful

scrutiny fails to find the least evidence of danger. Nowhere are the uprights out of plumb or the caps broken or pressed beyond their capacity to amply sustain their load. The timbering that was put in 4 years ago is as perfectly in place as is that just completed.

From the fourth level to the top, 425 feet vertically, there is a complete connection of the timbers, in some places of considerable width and length of opening; in the fourth level 100 feet wide and 190 feet long.

The uprights are cut exactly in vertical line and come up the one under the other with entire precision. A plumb line along one of these columns of posts shows entire exactness in vertical alignment.

All the timbering is on this system. The old ones which were in the mine when Captain Curnow took charge have been taken out and the present system substituted. This system I have previously described in the Commissioner's report for 1881, and need not here repeat the method; its application in this mine shows that it accomplishes completely the purpose required. The timbers are the only support; the ore is all taken out, every scrap of it, no ore pillars are left. I have scarcely ever seen a mine which is internally kept so clean. There is certainly no ore wasted.

Going down into the mine on the ladder, level by level, and coming up in the cage, affords an excellent chance of seeing the mine and having an easy exit from it. Taking up the levels in detail, in No. 1 they have started a cross-cut south in soap rock to reach what is called the new vein, which was found two years ago and has proved a bonanza for the mine. They expect to reach the ore in 100 feet. This estimate is based on the fact of its being cut in the second level and on the pitch of the ore. No other work is in progress in the first level; the ore has been all mined out.

Descending to the second level, 227 feet below the surface, we find the ore in the old mine has all been taken, leaving a chamber 165 feet by 55'.

A drift across the formation 260 feet west, with a cross-cut south 95 feet, cuts the new vein; this has been opened 125' in length, and of a maximum width of 55 feet. In the second level some stoping is still done east and west of the shaft; 102 feet up from the bottom of this level they opened a cross-cut south 118 feet, and struck No. 2 vein and worked it out 60 feet long and 12 feet wide, leaving a bottom of ore. Also a cross-cut starts from the shaft and goes south 128 feet, which cuts the ore formation at 100 feet, and thence for 20 feet lies in good ore. They are now raising here to intersect the cross-cut that is extending south in the first level. It is expected to intercept the ore in this rise and in the cross-cut, and that it will extend up to surface stoping. To the east an exploring drift was run 337 feet, and at the end of it a cross-cut south 26 feet and north 86 feet.

I should think it wise to continue this south cross-cut, as the ore, if found at all, probably lies in this direction. This long drift, made at considerable cost, has resulted in no appreciable benefit; on the contrary it opened at the extreme end a large stream of water whose constant flow added somewhat to the labor of the pumps.

At 200 feet in on this drift some ore was mined, leaving an open space 40'x37'. The ore is low grade and not at present valuable.

Going down to the third level, 350 feet below surface, we find the opening in the old blue ore vein reaches from the bottom of the level to the surface; only timbering and the rock filling occupy the space. A drift 260 feet long going west is all in rock, but a cross-cut north shows some ore.

There are two lenses of this ore which Captain Curnow calls the north vein and the south vein. Finding nothing further to inspect in the third level we descend to the fourth, which is 425 feet down. From the shaft they drove 50 feet south to strike the old blue ore vein, which was found to be 100 feet wide and 190 feet long. There is a little show of ore in the west end that may lead to something larger, otherwise the ore is all gone. Going down to the fifth level 502 feet, the shaft is 10 feet lower, we find a drift to north 86 feet; also one west 300 feet, and from the end of this latter a cross-cut has been made north 60 feet, and thence west again 83 feet, and thence a raise 78 feet high connects with the west end of the fourth level. This raise is all in ore. Another similar raise at 200 feet west of shaft, 78 feet up, is only in ore for the last 20 feet. Thus it appears, so far as developed, that the ore in the 500 foot level is of equal magnitude with the one above.

The East Vulcan is, perhaps, the deepest mine on the Range, and affords as good ore as any mine on the Range. The product the past season has been 27,000 tons, fine blue bessemer ore. This has probably been obtained at reasonable cost. But in the past this mine has been a source of more expense than profit to the Penn Co.

It was all out of repair. The former company had got to the end of their rope with this mine and it had to be made over new. Shafts, machinery, and timbering were all immediately required, and have cost a good deal. The mine is in admirable shape now; it is a small mine but admirably worked. Captain Curnow and A. C. Davis, the former agent, who introduced this system of timbering and persevered in its use against no little opposition, deserve much credit. It is the solving of a practical mining problem, and has afforded an illustration and result that are of much value. The maximum force is 100 men divided into four shifts—two day and two night. The same gangs who do the mining put in the timbers. It will be seen from the above description of the mine that a good deal of the work is in the way of exploration—cutting drifts. There are now 36 men engaged in this work.

Some new machinery will be added, a new engine, now on the ground, 12"x24", two new drums 5' diameter. Also pump, Frazer & Chalmer's. Use Cornish plunger—12"x12"—at 350 foot level, 150 feet down to bottom.

I should not recommend this method of timbering, nor indeed of any system of timbering, for all soft ore mines. But looking at it here, in this short mine, in which the walls are fairly good, it certainly answers admirably and there is nothing to be said against it. It is a system that requires perfection in its construction; all weak places must be guarded against, as has been discussed in the description of the Cambria mine. It is not always that so careful men can be found to do this work as Captain Curnow has proved himself to be. The ore is the soft, beautiful blue ore, peculiar to some of the Range mines, and which is so greatly esteemed by the furnace men. It is used by the Cambria Iron Co. at their works at Johnstown, Pa. Since my visit to the mine they have started work at No. 2, and are building a shaft house 75 feet high, and also an engine house, which will be furnished with new plant of machinery—hoisting and pumping—12" Cornish plunger pump.

Wm. R. Babcock, General Manager; John U. Curnow, Superintendent, Vulcan, Mich.

Going west about a mile, or a little upwards, we come to the

WEST VULCAN,

also one of the mines of the Penn Co., and situated in the hillside which slopes to the south. The West Vulcan has been from the beginning of its history, as it still remains, a valuable mine. It is a large producer of the best of ore. There is no prospect of abatement in its annual product. There is considerable improvement, made and in progress, apparent upon the surface, and underground the ore holds out. The mine, as will be recollected, is in two lenses, called the north vein and the south vein, both dipping south. They are about 530 feet apart on the surface, but only 350 feet apart at the bottom. This is due to the fact that the south vein goes down nearly vertically, especially for the last 300 feet, while the north vein preserves its inclination to the south. The lower levels are each 100 feet apart vertically. For the first 200 feet the ore dipped to the south at an angle of 45°, when it took a roll and has since gone down vertically. In the south mine the ore has a width of about 25', on an average, for a length of 600 feet. This shows that the mine is holding its own pretty well.

The west vein is higher up on the hill, so that the sixth level in the south vein corresponds with the eighth in the north vein. The mines are connected by cross-cuts running from No. 2 shaft in the south mine to No. 4 shaft north. The ore in the south mine is free of rock, a little redder in color than it was nearer the surface, but still passes for soft blue ore. The vein in the north mine is more split up and has been from the fourth level down a distance of about 300 feet; horses of rock occur, the ore is clean, but the rock cuts it out. The dip is pretty uniform, about 60°, southerly. The limestone is to the north, underlying the ore, while at Iron Mountain the ore dips north, and the limestone is in the overlay. The south mine furnishes four-fifths of the product, coming out, mainly, from No. 2 shaft. Descending No. 4 pump shaft, which is near the west end of the north vein, we find it pretty uniform down to the fourth level. The vein was short, but of good width. It is unfortunate that the shaft goes down in the vein, as too much of the ore is taken up in pillars. Between the fourth and fifth levels, 200 feet below the surface, a horse of rock comes in from the foot wall and splits up the vein. In the sixth and seventh levels were good deposits 50 feet long. This north mine is short and pockety, affording excellent ore, wide in places, but cuts out from the foot wall.

Going through a long cross-cut in the fifth level we come to No. 2 shaft in south mine, to which the cave reached; the mine is to the seventh level. They are engaged in stopping the ore in the floors and pillars and filling with sand and rock. The floors above the sixth level have been taken out. In this work they fill up the rooms, leaving a "mill" at each 50 feet for running down filling. They have filled in up to the fifth level. In removing the pillars they will rise up through the center for a mill for running down the ore and then cut away the pillar, drawing in the filling from the rooms to replace the ore that is taken away. These pillars are about 30 feet wide. Much of the timbering is excellent, built, in late years, on the Nevada system. But it is apparent that this timbering will not suffice to hold up the West Vulcan now. The immense pressure is, in places, crushing the timbers. The hanging is slate, sometimes jasper lies between the slate and the ore. In October, 1884, a large space in the mine caved in, from surface to bottom, due to the pressure of the hanging and the insufficiency of the timbers to support it. At that time the bottom was at the fifth level, now it is

200 feet lower. No floor had been left in No. 4 level, so there was a stretch of 200 feet with nothing but timbers to hold up the mine, and they proved inadequate.

The company has begun the work of some important changes that will, when completed, be of great advantage. At present the machinery is all upon the hill, above the mine, while the mine is under the level ground at the foot of the hill; thus the ore and water must be elevated through the extra height; a matter that is no longer necessary. To avoid this the company is sinking a downright shaft in the hanging wall, south of the mine; it is now down to the fifth level, 380 feet from surface, and connected with the mine by cross-cut. The shaft is 10'x16' inside the timbers; will have double cage, also ladder way, timber and pump space. A new building for machinery has been constructed in which will be placed the hoisting plant lately at the Quinnesec mine. The yare laying the foundation for the new pump bobs, 16" plunger pump, 10 foot stroke, first lift to sixth level. This shaft will soon do the main work of the mine. No. 2 will still be used for a time as now. The new engine house is 72'x44', is placed near the shaft.

When the mine is adjusted to the new shaft the old ones will be gradually abandoned, and the ore in the mine left in the pillars will be taken out and the mine left to come together.

The work of filling this mine—wrecking it—can be easily carried out by reason of the nature of the hanging wall, which is a "demoralized" slate, that will, in places, almost run like quicksand; it will crush up in the sand and may be thus manipulated into mud. Left to run it will fill the mine. Under the circumstances it is doubtless the economical way to mine the ore. Do away with the timbering. Let the mine fill up above and work down under the filling; as fast as the ore is taken out, let the hanging wall run in and fill up. This hanging wall is kept in place now only by the timbers and lagging; it crowds and squeezes the timbers out of place as it is.

The working force is 380 men, 120 of whom are miners, and 40 timbermen, 225 men work underground; 200 of the men are Italians. The company has had them for several years and likes them; they are industrious, frugal and peaceable. The average wages paid is \$1.65 per day. Contract men make more, usually; day laborers receive \$1.40 to \$1.50 per day, timbermen by the day get \$1.55. The mining cost of the ore is about \$2.90 per ton, about what it would sell for, especially if royalty be added, which is 25 cents per ton on this ore.

They will have a fine ground for stock pile at this new shaft.

The Vulcan mines have produced as follows:

Year.	Tons.	Year.	Tons.
1877.....	4,543	1882.....	94,042
1878.....	31,239	1883.....	79,874
1879.....	57,350	1884.....	101,722
1880.....	72,405	1885.....	124,120
1881.....	85,671		
Total number of tons.....			650,906

Wm. R. Babcock, General Manager; E. S. Roberts, Mining Captain, Vulcan, Mich.

THE CURRY

is a small mine a short distance west of the Vulcan. It is worked in a limited deposit of soft blue ore, which pitches pretty rapidly to the west, while the shaft is at the east end, and goes down to the south. The mine is thus in very inconvenient shape to work. The Briar Hill mine lies west of it and the underground workings of the Curry are not very far from the line. There is some talk of a consolidation, which would seem to be a good plan, and then sink a shaft near the line to reach this deposit.

The Curry has produced as follows:

Year.	Tons.	Year.	Tons.
1879.....	13,010	1883.....	3,676
1880.....	21,741	1884.....	10,079
1881.....	17,504	1885.....	4,897
1882.....	13,374		
Total tons.....			84,281

The mine is now idle. N. E. $\frac{1}{4}$ N. E. $\frac{1}{2}$, S. 9, T. 34, R. 29.
J. H. Outhwaite, Agent, Cleveland, Ohio.

THE BRIAR HILL MINE

adjoins the Curry on the west. The mine is held by the celebrated coal company of the same name of Youngstown, Ohio. The company has explored a good deal with the diamond drill, hoping to find ore in quantity that would pay to work. They have spent considerable money in this way, but without success; the mine has not paid its way. There is a small lense of ore in which the shaft is sunk, but it costs as much to get the ore, at present prices, as it is worth. The company shut down two years ago and no work has been done since. In 1882 and in 1883 the mine yielded the aggregate product of 14,982 tons.

Analyses of the ore give

Metallic iron.....	61% to 67%
Silica.....	3.60%
Phosphorus.....	.05%

THE PERKINS MINE

is the next one west of the Briar Hill, situated on the outskirts of the village of Norway. The Perkins has been a good mine, though a small one. It had a fine body of excellent ore, close to the east line of the Norway mine. The ore was dipping south with the formation and pitching west. The underlay

is limestone, and it has run flat and cut out the ore. For two years all the ore obtained at the Perkins has been from the pillars. They have been mining them out and letting the walls fall in, so that now the mine is a wreck. The machinery has been taken away, removed to Negaunee. There is said to be a little ore somewhere down under the debris, which Captain Perkins says he is going to try and mine, but it looks like a dubious undertaking.

The mine has been worked since 1879, and has produced 329,936 tons of ore.

In close proximity to the Perkins on the west is

THE NORWAY MINE,

which of late has met with some misfortunes, and has been somewhat under a cloud. The east end of the mine has collapsed, caved in from the surface down to the fourth level, leaving the bottom level, which was well sustained by pillars and timbers, intact, as is supposed, though there has not been much investigation in the bottom, there being a wholesome apprehension entertained regarding its safety. The mine has been filled with water for a long time to the fifth level and no work has been done below the third. No. 3 shaft is open down to this level. Nos. 1 and 2 to the west are in the crushed part of the mine. The fall of the mine only extended as far west as No. 3, on the surface, leaving the shaft intact down 200 feet to the third level. Men are now engaged cleaning about the shaft in this level preparatory to pushing through the collapsed ground to No. 1. This work has been delayed, waiting until the new pump should be working and the mine freed of water so that it can be inspected below and ascertain if all is secure. It is not certain now but the floor may be "swinging," and liable to give way at any time. There are 300 feet of the mine from the Perkins line west that are included in the "cave."

All the east part of the Norway is underground and has been worked out pretty extensively, leaving very large chambers; the roof being wholly sustained by the pillars of ore or rock. Very little timbering has been employed. The ore occurs in the broken jasper formation, in pockets, some of them of great size, and when the ore is taken out the walls stand extremely well.

The foot wall of the ore formation is hard, crystalized limestone, which lies very irregularly, sometimes dipping at a sharp angle to the south, and again lying flat or pitching to the west, or making a roll, forming troughs in the ore formation, wherein, if the ore occurs, the limestone forms two foot walls or is both foot and hanging. This condition exists at the west end of the mine in No. 8 pit.

The present company has owned the Norway four years, and has not extended the openings at all. All the east part of the mine, the underground portion, is no deeper now than it was then. A large amount of ore has been mined annually, but all taken from the old stopes. It seldom occurs when a mine of the size of the Norway is so fully opened as it was at the time of the purchase. I went through the mine carefully in the spring of 1881, and was impressed with the amount of ore in sight; since that time they have been working at the same stopes, and have done no exploring, sinking or drifting. The mine has kept up its annual product from what was already developed. But the result is nearly ultimate depletion. This process can-

not be carried any further. There are no more stopes to exhaust. The ore, the good ore is practically gone; 200,000 tons of ore is a good deal for a comparatively small mine like the Norway to furnish from openings previously made. They have reached a point where the mine must be further opened to secure a product.

There is plenty of ore in the mine now but not of a quality to be merchantable; it is mixed with rock, rather high in phosphorus and not high in iron. The ore formation is peculiar; it is broken jasper and ore, sometimes all ore, but never quite all jasper. Some of it, if picked, will give good ore, but that work makes an additional cost, which the price will not bear.

There are two veins, so called.—the old blue ore vein and the B. B. vein. All the non bessemer ore is sold as B. B. grade, that is its trade mark. The south vein is bessemer, and the bessemer ore is what the company wants. They have plenty of B. B. ore that could be easily mined, but there is little or no sale for it. The rock is all left in the mine, none is hoisted, or if it is it is dumped back to fill some other place. They do not seem to regard the cost of hoisting very much, as it takes only nine cords of wood per week, it is claimed, to do all the hoisting of the mine.

The inadequacy of timbers to support a mine is plainly to be seen here in the timbered drifts that were crushed in. Sound, stull timbers two feet and upwards in diameter are snapped in two like a pipe stem. Uprights are crushed down completely in direction of the fiber. No doubt the falling in of the Perkins had much to do, as they claim it did, with the disaster at the Norway.

In order to reach the underground workings with more facility, and to extend the openings in future with greater safety and economy of working, the company has undertaken the sinking of a downright shaft, which is already to the depth of 380 feet, or 100 feet below the present bottom of the mine. The collar of the shaft is 100 feet lower than the surface of the mine, on the hill above, so that if the shaft were started from the same horizon it would be just at bottom. The shaft is started in the lower ground. It will be sunk still another 100 feet. The main value of the shaft now is to furnish an avenue to get the water from the mine; ultimately it will be furnished with double cage. They will raise the water with two 16" plungers to the mouth of a tunnel, which will intersect the shaft 100 feet below the collar. They are driving up this tunnel now from the swamp, starting 1,200 feet south, and are already 600 feet on the way, giving fall sufficient to secure discharge.

They have a new pumping plant at the Norway which was nearly ready to work at the time of my visit. They claim it to be the best in the mining region, and I see no reason to dispute the claim, for I admire it very much. The pump is similar to the one at the Barnum mine, 10 feet stroke. Two bobs and two plungers with discharge pipe between them, one plunger rises as the other descends, and the flow of the water is constant, instead of being intermittent, as is the case with only one plunger. This doubles the amount of water raised in a given time without any increased expenditure of power. The capacity is stated as being 116 gallons per stroke, with four strokes per minute. The best of stone foundations have been laid for the bobs and rods and the new engine house of stone, which is 100'x40'. It will be seen that the rods are so fastened, on opposite sides of the wheel, that one pulls in as the other pushes out, thus balancing and saving the use of the weighted bob so commonly employed.

The big gear wheel to which the rods are attached is 34' 4" diameter, made at Riverside works, Detroit, as was the rest of the new machinery, except boilers. The engines are low pressure, each 28'x38', built in 1884, and were ready to work October 27 last. When I saw them they were running on 27 pounds of steam and running one plunger, the other not being ready. The machinery was designed by James B. Lyon of Marquette. There are two new boilers, each 72"x18', built at Johnstown, Pa. These boilers seem to require but little fuel. Captain Oliver has designed a grate which works admirably. The ones that were in soon twisted out of shape so as to be worthless. Oliver's design meets with no such difficulty. The boiler front is also unusually convenient, being arranged so as readily to get at the flues, revolving doors to supply fuel, etc. There is space for two more boilers to be put in when required. This machinery will suffice for the mine for many years.

Up on the hill, at the west part of the mine, are the large open pits in which the men are still at work. They are down pretty deep, but in places there is still ore in the bottom; in others the roll in the limestone cuts off everything. There are a good many geological peculiarities at the Norway, which require time to study and unravel. In fact the whole range through to Iron Mountain is little understood. The limestone, the ore formation, and the sandstone are in different relative positions at different points, and it is not perfectly certain what are their true positions. Sometimes the limestone has been so folded as to give the impression that it overlaid the ore, but its position here is under the ore and no ore has been found north of it; though I think it by no means improbable that there will be, basing the impression on the character of the rocks.

What has helped out the Norway the past year is the new pit, which is divided between it and the Cyclops, each mine taking about half of it. This pit is at the foot of the bluff, is about 300 feet long, 100 feet wide on top, and 50 feet deep. The ore is the best soft blue ore that is not surpassed by any found on the range. The width of the ore is about 30 feet and dips to the south. Test pits have been sunk south which bottomed in this ore, showing that it continues under the surface. It was a very valuable find for the Penn Co.

The Norway mine employs about 250 men, and the annual product is shown in the following table:

Year.	Tons.	Year.	Tons.
1878.....	7,533	1882.....	165,084
1879.....	73,540	1883.....	114,836
1880.....	198,765	1884.....	71,515
1881.....	137,558	1885.....	57,741
Total tons.....			825,742

Wm. R. Babcock, General Manager; John Oliver, Superintendent, Norway, Mich.

THE CYCLOPS MINE

has proved the most profitable, comparatively, of any of the Penn company's mines. It was not rated very high at the time the purchase was made four years ago, but it has annually given a good product of the best blue ore, and has cost less than any other that the company has mined. Nothing could be more fortunate than the discovery of the new pit on the line between it and the Norway. It has already given at least 50,000 tons of valuable ore, obtained at the least possible price. There is but little to be said of the mine; there is little of it except a great irregular excavation made by mining out the pockets of ore, which were found in the sandstone and beneath it. There is still ore in the old workings, as good likelihood of finding it as there was two years ago. But of course the best deposit is the new find to the east. I should estimate the product at 50,000 tons for the ensuing year.

The mine has given each year as follows:

Year.	Tons.	Year.	Tons.
1878.....	6,275	1882.....	18,287
1879.....	46,442	1883.....	22,675
1880.....	14,368	1884.....	24,099
1881.....	12,214	1885.....	49,897
Total tons.....			194,287

William R. Babcock, General Manager; John Oliver, Superintendent.

THE STEPHENSON MINE

lies north of the Perkins, that is the property does, but the mine comprises a narrow lense of ore lying in the foot wall of the Perkins. It did not extend down very far. The ore was near the surface, between the Perkins ore and the limestone. They worked it out and when it fell in it took down part of the Perkins also.

The company continues to explore in a small way and it is rumored that some mining work will be done next year. It worked three years and produced a total product of 34,995 tons. The property comprises 320 acres of land owned by Lumberman's Mining Co.

Going west from Norway we reach in a few miles the

INDIANA MINE.

of which there is not very much to be said in addition to what has been stated in previous reports. The mine is somewhat deeper but the ore deposit has not increased in size, and there is no more promise of a good mine now than there was several years ago. The company has added a new hoisting plant recently and also new pumping machinery, Cornish 17" plunger put in in October last, which will insure them the mastery of the water. The location

is a wet one, and the water has been a serious obstacle to development. The mine has reached a depth of 175 feet, and remains, in the shaft, as heretofore, a small lense of blue ore; but quite lately another small deposit has been found, also blue ore, 5 feet wide, a short distance east of the mine. They have opened into it and it is increasing in size and bids fair to be of value. The maximum force is 60 men, and they raise about 80 tons of ore per day. The ore is not rich, medium in iron, but low enough in phosphorus for bessemer, so that it is in demand. A branch railroad reaches the mine.

R. P. Travers, Agent, Chicago, Ill.

Product:

Year.	Tons.	Year.	Tons.
1882.....	4,280	1884.....	636
1883.....	4,362	1885.....	2,738
Total tons.....		12,116	

N. E. $\frac{1}{4}$, S. 27, T. 40, R. 30.

No ore was found at the Illinois adjacent to the Indiana; but there are other explorations in that vicinity which promise better results. On Sec. 22, west of the Indiana, the Cuff Bros. are exploring, and have several good "shows" of ore. Further work may develop enough for a mine.

THE QUINNESEC MINE

was considered exhausted 18 months ago. Captain Morcom, the Superintendent, so reported, it is said, to the company; the machinery was removed, the pumps taken out, and the mine was suffered to fill with water up to the point of surface drainage. Subsequently Captain Oliver, of the Norway, went in and examined it and found indications of ore that was left in the mine in sufficient quantity to pay for further mining, so that effort was made to pump out the water; the lower part of the mine caved in so as to preclude any work being done at the bottom. However, 14,110 tons of ore have been taken from the upper levels in the past year. It was found behind the lagging, where it had been covered up, and in the pillars.

They were obliged to sink in the foot wall to reach the ore, as the shafts had become useless. The company is still at this work of scrambling ore. They have a Rochester engine and hoisting drum. The old machinery has gone to Vulcan. The mine employs about 50 men. The Quinnesec is one of the mines owned by the Penn Iron Co. The company is also exploring for other deposits of ore, but as yet with no marked success.

Major Harry Pickands, of Chicago, is sinking a shaft in the east part of the village, where it is claimed a good body of ore exists. It is sincerely to be hoped that such may prove to be the case; Quinnesec is too pretty and substantial a village to be left wholly without the support of active mining interests.

THE CHAPIN MINE

continues to be one of the mining wonders of this remarkable country. The ore deposit still holds its phenomenal magnitude and excellence without diminution in quantity or purity, as greater depth and extent of working are attained. But some of the difficulties that have long been apprehended as liable to occur from the system of mining pursued are seriously realized.

The deposit is of immense extent, reaching a maximum width of 128 feet, and averaging 90' for a distance of 400 feet in length, from the west end of the mine, and continues with variable but diminishing width for a further distance of 1,800 feet. It is a magnificent deposit of mineral—soft blue specular ore, that is easily mined, but has little value as a support in pillars.

The mine is wholly underground; contrary to the custom that formerly prevailed, no open cut work was ever pursued. Ten shafts have been sunk in the ore on or near the foot wall, and the method of extracting the ore has been in accordance with a system that has been followed from the beginning. It consists, essentially, of opening a drift for passage way along the foot wall, or from shaft to shaft in each level, thus connecting them. This is done in advance of and preparatory to stoping. At each 18 feet along the main passage way and at right angles to it, cross drifts are cut through the ore to the hanging wall. These openings, rooms, or headings are 20 feet wide and are thus separated by pillars of ore 18 feet wide left standing for the support of the mine; but as the ore is soft and friable, it would readily disintegrate and crush down if it were not itself sustained by lateral supports, this is sought to be accomplished by timbers, which are framed and placed in the rooms between the pillars in accordance with a uniform system.

A mud sill is laid on the floor of the level against each pillar, and kept in place by cross sills laid on the bottom and extending across the rooms, 7 feet apart. The uprights are 7 feet long, and are set in mortices 7 feet apart along the main sills and at equal distances apart on the cross sills; on these uprights caps are placed, lengthwise and crosswise of the rooms. The cross caps thus rest on four posts.

This "set" forms the foundation for a similar one that in time is made above it and so on to the end.

These successive bents continue to the hanging wall and are placed as fast as the ore is taken out to the height of the post. When one "set" is completed a covering is made with plank, or poles split in half, thus making a floor on which the miners can stand to stope the ore from the back of the room, causing it to fall upon the floor, whence it is run down through apertures into tram cars below and thence out to the main drift and to the shaft. The ore having been stoped out to the height of 7 feet, or as fast as it is done, a "set" of timbers is carried forward as the stoping advances; and so on in succession one "set" above another, the uprights carried up in vertical line until the level above is reached and the final timbers connect with those in the bottom of the preceding level.

Openings are made through the pillars for longitudinal drifts, and these openings are timbered in the same manner. Thus the pillars of ore stand between the openings 20 feet wide, filled with these timber sets. To prevent any danger of kuckling, as far as may be, and also to guard against the dis-

integrating tendency of the pillars, and of the friable, slaty hanging wall, lagging or sheathing is firmly placed between the uprights and the ore and rock. The timbers are fitted in the company's mill, and are lowered into the mine through the timber shafts.

When completed there is nothing left in the rooms but the timbers. The hanging wall and the overlying burden are sustained by these pillars of ore reaching from wall to wall, and from the bottom to the top of the mine—sections of ore 100 feet in length and 400 feet in height and that are kept in position by the timbers which are placed between them.

It will be seen that a large percentage of the ore is left in the mine; that great expense in timbering is incurred, and that, after all, by reason of the great width of the ore deposit, the slaty, friable nature of the including walls, the want of stability in the pillars, due to their great height and tendency to disintegrate, the weakness and uncertainty inherent in any system of timbering however well devised and carried out, render this method of extracting ore unsatisfactory. There is more than the usual element of danger in the long run, that cannot be eliminated from this system of mining. However apparently secure there is ever the liability through, possibly, unforeseen weakness, of collapse in some point of the mine. The fact that there are serious grounds for apprehension of danger is verified by the several catastrophes that have occurred when portions of the mine have caved in, a matter not confined to the Chapin alone, but a disaster that has been experienced at other mines on the range. The most serious caving in that has happened at the Chapin occurred a few days since, on October 23, last, which reached from No. 8 to No. 10 shaft, a length of about 400 feet; but while the mine caved in on both sides of No. 9, the shaft itself is left intact, and will hereafter be used as a rock shaft. The shaft pillars kept it from injury. All the mine between No. 9 and No. 10—between the shaft pillars—went in, down to the bottom, to the fifth level. The shafts are to the sixth level but the ground is not opened between. East of No. 9 shaft pillars two rooms went in to the fifth level, and above the third level to the pillars of No. 8 shaft. Another caving in between Nos. 5 and 6 happened the year previously and reached down to the third level. There was also a minor one at a previous period. The inherent weakness, which must inevitably lead to such results, and which must, in time, include the whole mine, has not been unforeseen by the management. For some years the officers have held under consideration plans for extracting the ore which should obviate the objections of the present method. It had been decided not to pursue the old plan to any greater depth, but to endeavor to fill up the rooms and to mine out the pillars above the bottom and below to begin a system of stoping and filling.

It has been found necessary to remove some of the buildings, elevated trestles, ore pockets, stock piles, etc., from the surface over the mine. The late collapse extended to near the office, taking down an ore pocket and a long stretch of railroad track.

The shafts are sunk to the sixth level, and from No. 6 shaft to No. 9 they are connected by drift, and also some stoping has been done between No. 6 and No. 7. The levels above the fourth have been opened into rooms and also including the west end of the fifth level. Between shafts 6 and 7 in the fifth and sixth levels they are mining out all the ore and filling the space with sand and rock, run down from the surface. In the fifth they are min-

ing the pillars, having selected this part of the mine because it is the safest and the best to acquire experience in this kind of work. In this space of 250 feet they have the pillars nearly all mined out up to the fourth level, and filled with sand and rock. In cutting away the pillars they rise up in the pillar, filling in as they go, and keeping a chute open through which to mill down the ore as they proceed upwards. Naturally there is settling of the ground. Some ominous cracks appear in the pillars of ore above where the men are cutting away.

Just how much of this work can be done is uncertain, but it does not appear that it can be carried out very extensively. The judicious plan will be to strip the dirt resting on the ore and run it down into the mine for filling, and, possibly, to underhand stope the pillars as far down as practicable, and also rise up in them from below and cut them away, when, if it gives way, it can go no further than the filling and the debris will be only ore and timbers, so that the ore will be clean, unmixed with dirt and can be mined and saved; the timbers mixed with it will be an obstacle in mining it, but not an insuperable one. But mixed with the sand and ground much of it would be rendered worthless. They are engaged in this work of stripping the ore and milling down the dirt into the mine to fill the rooms where they are now mining out the pillars.

In the sixth level, between Nos. 6 and 7 shafts, they are stoping all the ore, carrying the stopes lengthwise with the vein. They rise up in the back about 8 feet and back-stope the ore with the vein, letting the ore fall on the floor, whence it is loaded into the cars and trammed away to the shaft. The level is filled with rock up to near the back, and then another back-stope taken and so on.

In accordance with their new plans for mining, three new downright shafts are sinking in the hanging wall north of the mine, from which cross-cuts to the south will reach the ore. These shafts are designated as B., C. and D. The former is the one to the east, and is already 282 feet deep (November 1); it is 9'x12' inside the timbers. It is just to the fifth level, and the cross-cut to the ore is 30 feet. C. shaft is 755 feet west from B., and 287 feet deep.

D. is only a stand-pipe as yet, 1,100 feet west from B. It is 100 feet through quicksand, etc., to the ledge, and they apprehend considerable difficulty in sinking to the rock.

The management talk of sending to Europe to get the service of parties who sink shafts, etc., through soft ground by freezing it. These foreign parties have the machinery designed for the work, and by thrusting pipes down into the ground surrounding the shaft the influence is brought to bear to freeze the earth so that it will stand up while the space within for the shaft is excavated.

From the new shaft cross-cuts will be made to the ore in each level, and the south ends of these cross-cuts will be connected with drifts made in the hanging a little way north of the ore. These main drifts will be 8 feet wide in the clear, and will be laid with double track, T. rail, for the tram cars, which will be run to and from the shafts by endless rope. To this endless chain the cars going out will be attached; on the north track those coming toward the shaft will be on the track next to the ore. It will be simply an endless chain running all the while, and the cars may be attached or otherwise as desired. At each 60 feet of space along the main drift cross-cuts will

be made through the ore to the foot wall and extended into the foot wall a short distance to secure rooms for safety in case of accident. The ore will be mined in stopes 6 feet wide through the vein to the level above and filled with rock as fast as the ore is removed. Several adjacent stopes can be carried forward at the same time, in advance of one another, and the ore body can be attacked at different points. The stoping will of course be carried up to the filling above, no floors will be left, in fact no ore will be left anywhere. The method of mining for the future contemplates removing all the ore. Of course in advancing under the filling timbers must be employed after the manner well understood by miners engaged in this work. Uprights are set up at each few feet of advance, with heavy cap across on which the lagging of poles is thrust in ahead. In order to do this the lagging is pushed forward at an angle upward, so that while it rests on the front timber the farther ends are held up on a "false" cap, a cross timber that is placed above the true cap and free from it, leaving space between the two sufficient to insert the lagging poles for the next advance. In this way they can advance under the filling as well as under the ore. The settling that must ensue will be only gradual, and cannot be great in amount.

The ore will be run down in chutes into the cars standing on the track, which, as fast as filled, may be attached to the moving chain and sent to the shaft. The rock, for filling, will be run down in separate mills from the level above.

The shafts will be double cage, and the rock filling material will come down in cars to the level above the bottom and be run out to the mills to be dumped through and distributed over the filling. It is designed to build three rock mills of short round poles laid horizontally, radiating from the aperture as from the hub of a wheel; thus the rock, when chuted down, will impinge against the ends of the timbers.

The diameter of the chutes will be $2\frac{1}{2}$ ' , the lower end being made bell shaped, opening downwards to prevent choking up.

Of course all this is somewhat in the future; there are many details in the contemplated work into which it is not worth while at present to enter. Changes and modifications are liable to be made before the new work of opening is consummated. The rock for the filling will come from the sandstone bluff on the company's land situated a short distance northeast from the mine. It is very accessible, easily mined and admirably adapted to the purpose, and it is down grade to the shaft.

The mine at the west end is of variable width, but, as previously stated, the ore, for a distance of 400 feet, is on the average 80 feet to 90 feet wide, thence it narrows until it pinches out. At No. 7 it is about 30 feet wide. The dip to the north at the west end is 85° , and at the east end it is 60° . The ore pitches to the west at an angle of about 35° , but the mine has not shortened by reason of this westerly pitch of the main ore body, by reason of the coming in of the north deposit at the east and of its constant lengthening. It is about 40 feet north of the main deposit and has lengthened to the west in each level until now, in the fifth, it is 400 feet long, with an average width of 40 feet, being at one point 110 feet wide.

In planning the new mine it is designed to locate the ore chutes along the main drifts at 50 feet apart, each one to be provided with a ladder way for the convenience of the miners. The rock winzes will be further south in the ore body as they discharge on the filling.

The company in this work of opening a new mine is incurring a great expense. The labor and cost of sinking these three new shafts through the hard limestone is considerable. The driving of the cross-cuts and connecting tunnels in each level will be costly dead work. The railroad tracks are to be changed, new ore pockets built. In fact the work to be done is nearly fully equal to opening a new mine.

It may be objected that the shafts are in the hanging wall, and that the inevitable settling of the ground will in time seriously disturb them; but it is probable that the company was constrained to sink in the hanging for the reason that it has very little land on the foot wall side, and also that the surface of the foot wall is on the high ground and is rough and broken, while below the hill the land is level and they have plenty of room.

One of the palpable mistakes made was in the location of the new stone pumping engine house, which is at the east end of the mine, 128 feet above the surface level of the west end; through this additional height the water must be raised, as the pump shaft is just north of the building, and takes nearly all the water from the mine. The pumps are two 12" and two 17" plunger; each lift 200 feet. For the first 200 feet down there are a 12" and a 17" plunger placed side by side. In the second lift below this the positions are reversed. The pumps make 7 strokes per minute, 10 foot stroke, and raise 1,300 gallons per minute. There are also No. 12 Cameron and Wells pumps in the mine.

The extreme length of opening from east to west is 2,700', while the total length of the property in the same direction is $\frac{3}{4}$ of a mile; doubtless the mine will be opened the whole distance, to the Ludington line, as the ore is pitching that way and unquestionably reaches all the way.

The ore averages above 60% in metallic iron, probably 65%, and averages .070% in phosphorus; it is made all one grade. The company has a laboratory and employs a chemist at the mine, so that the ore at all points of the mine is being constantly analyzed.

Five million feet of lumber is annually used in the mine for timber, and nearly one-half of the underground force is engaged in the work of putting in the timbers. The new mine, when opened and at work, will save this expense, will save all the ore and will without any manner of doubt be found to be a far more economical method of extracting the ore, to say nothing of the saving of the ore which, in the present plan, is left in pillars, and which is in a fair way to be lost. If the mine had been filled from the first, it would now, with the same aggregate product, have been only a little more than half as deep as it is, it would be perfectly safe and all expensive changes would have been avoided.

The total number of men employed is 800.

The prices vary somewhat for the work done, but in November last they ranged as follows: For drifting, \$3.50 to \$7.50 per foot. For sinking winzes, \$6 per foot. For sinking shafts, \$25 to \$70 per foot, including timbering. For B. and C. shafts they have paid about \$30 per foot; for A. (an abandoned shaft) \$60 to \$70. For the small sand-shafts to the rooms they pay \$1.50 to \$2.00 per foot.

In the filling stopes, between No. 6 and No. 7, the company pays for breaking and filling 45 cents per ton, the ore to be divided in the chutes and the rock to be taken from the rock winzes.

For the first-class stopes west of No. 7, in the sixth level, they pay 35 cents to 40 cents for breaking ore only.

Mr. Per. Larsson, the company's accomplished mining engineer, visited some of the mining regions in Europe the past season, having been sent there by the company to inspect the methods of mining, especially of filling mines, in vogue, with the view to their application to the Chapin. The Chapin is held on a lease by the Menominee Mining Co., the company paying 50 cents per ton royalty for the ore. All the power for hoisting, pumping, etc., is furnished by compressed air, brought in pipes from Quinnesec Falls.

The Chapin was only opened in 1880, in which year the first ore was shipped. It has furnished annually as follows:

Year.	Tons.	Year.	Tons.
1880.....	34,556	1883.....	265,830
1881.....	194,717	1884.....	290,865
1882.....	247,505	1885.....	177,978
Total tons.....			1,151,451

G. D. VanDyke, Secretary and Treasurer, Milwaukee, Wis.; C. H. Cady, Superintendent, Iron Mountain, Mich.; Wm. Oliver, Mining Captain.

It shows the great care taken of the men when, in so large a force and in so large a mine, but four men have been killed in the past year, two by falling ground, two by stepping into shafts.

Since writing the foregoing the managers at the Chapin have found it necessary to modify the plan of stoping the pillars, and have for a brief period discontinued this work between No. 6 and No. 7 shafts. They are at this date (January) cutting a drift in the hanging wall, about 25 feet below the fourth level of the mine and about 15 feet north of the ore. This drift is in the same horizon with the points where the pillar work was discontinued.

Cross-cuts, south, will be made from this main shaft to each of the pillars, and when they have mined the ore out in the pillars from above down to about the second level the remainder of the pillars will be attacked from this new hanging drift. The cross-cuts will extend through the pillars to the foot wall and be timbered, and as the ore is taken off in slices longitudinally and the space filled with rock, the ore will be run down in cribbed chutes to this timbered level and trammed to the shafts.

THE HEWITT MINE,

situated south of the east end of the Chapin, still continues to work in a limited way. The mine has one or two small lenses of ore from which an annual product of a few thousand tons is obtained. The prospects of the mine have not varied for the better or the worse for the past three years. The ore is the same as the Chapin, soft blue ore.

The mine has produced as follows:

Hewitt Mine.

Year.	Tons.	Year.	Tons.
1881.....	4,352	1884.....	7,927
1882.....	9,667	1885.....	4,627
1883.....	7,516		
Total tons.....			34,089

W. P. Bice, Superintendent, Iron Mountain, Mich.

THE EMMETT MINING CO.

is still engaged in the work of sinking a shaft in the southwest corner of Sec. 30, T. 40, R. 30, close to the Chapin and Ludington lines. The shaft is vertical, and is now 820 feet deep, and is in ore, recently cut in the bottom; how extensive it will prove is not known. The purpose of the shaft is to find the Chapin and Ludington ore in the underlay in the Emmett land; but unless the ore flattens a good deal they are not likely to get into it largely very soon.

They have a fine shaft covered with a shaft house of great height.

E. P. Foster, Agent, Iron Mountain, Mich.

THE LUDINGTON MINE

increases greatly in importance; it is rapidly becoming a leading mine, both in the matter of its increased out-put of ore and in its plant of machinery; from its primitive condition of four years ago the Ludington has developed into a great mine. Inferior to few of the Range mines in the magnitude of its ore deposits, it is second to none in the quality of its ore. The ore is of the finest quality of soft blue specular, analyzing 66 $\frac{2}{3}$ % in metallic iron and .050% in phosphorus, and 2.00 in silica. The above was the analysis of an average sample of a shipment of 15,000 tons sold to the Joliet Steel Works Co. The Union Steel Co. spoke to me very highly of the ore. About half of the product is bessemer.

The encouraging feature of the mine is in the fact that the ore deposit is found to increase in magnitude as it is opened westward. The ore body pitches in that direction and there is every present indication of its indefinite continuance.

The total length of the mine is about 800 feet, and its depth 500 feet. There are three shafts from which they are hoisting. A shaft is in the hanging wall 150 or 200 feet north of the ore, and is sunk 500 feet deep, 10 $\frac{1}{2}$ x11 $\frac{1}{2}$ ' inside of the timbers, and will at no distant period be used for the main part of the work in this portion of the mine.

The ore body has an average width of 60 feet for a length nearly equal to the extent to which the mine is opened; at one point the ore is 90 feet in width.

The method of mining is similar to that practiced at the Chapin, with the exception that the rooms are larger and that floors of ore are left in each level 12 feet thick. The ore is mined out in rooms, across the vein, 22 feet wide, leaving pillars 15 feet to 18 feet wide, and on these latter rest the arches which form the floors. The timbers are left in the rough and are framed by hand instead of by machinery, as is done at the Chapin.

These heavy floors in each level constitute an important difference in favor of stability of the Ludington, and must greatly facilitate the ultimate removal of the residue of the ore when that matter is undertaken, as it eventually will be. The intention is to continue the present system of mining another year and observe the developments at the Chapin, with the view to profiting by the experience of that company. However, they have begun to do some rock filling in the Ludington; all the rock that is necessarily broken is kept in the mine and judiciously used in filling rooms. Another matter that tends to strengthen the mine is the fact of the existence of a great horse of rock that holds through the ore and aids materially in supporting the walls.

Some necessary changes have been made by the erection of ore pockets, ore dock trestles, etc., but by far the most important improvement that the company has instituted is in the new mine machinery.

A building has just been completed, built of sandstone with slate roof, in which a new hoisting plant has been placed, consisting of four drums, each 12 feet diameter, (W., C. & L. manufacture, Akron, Ohio,) three engines, two hoisting and one pumping engine, 24"x48".

This hoisting machinery is the most powerful to be found anywhere on the Range. It was not fully in place at the time of my visit (November), but it was the intention to use it to hoist from the old shafts next season and ultimately to abandon them and use only the A. shaft. They have also the machinery and are preparing to light the buildings and surface with electric lights.

The company employs about 450 men and mines and hoists 16,000 tons per month. The Ludington has been especially unfortunate in the matter of fatal accidents to men in the past year. It is stated that the number of men killed at the mine is considerably in excess of that at any other mine on the Range.

The Ludington is owned by the Lumberman's Mining Company.

A. A. Carpenter, President; Geo. E. Stockbridge, General Manager; A. D. Moore, Superintendent.

The mine joins the Chapin on the west and the mine is very near the east line of the property. Iron Mountain, the most flourishing village on the Menominee Range, has grown up and is maintained from the business of these mines.

All the power for operating this mine as well as the Chapin, is the compressed air brought in pipes from the compressor works at Quinnesec Falls on the Menominee River, a distance of about two miles. The air is brought in 24" pipe. The capacity of the water power is in excess of the present requirements, as there is a great volume of water and 40 feet head.

It is stated by the officers of the mine that the use of compressed air to operate the machinery has resulted in great advantage to the companies in the matter of mining cost, the compressed air furnished by the water power being much cheaper than steam power.

Similar works have for years been in use at the Republic with a like result; but at the Republic the water power is only sufficient to partially supply the necessary force for compressing all the air required.

The present Ludington mine was opened in 1881; previously the company worked further west.

The annual production has been as follows:

Year.	Tons.	Year.	Tons.
1880.....	8,876	1883.....	102,632
1881.....	3,365	1884.....	101,165
1882.....	52,519	1885.....	124,194
Total tons.....			392,751

Not far from Iron Mountain, near the margin of a beautiful lake, is the pleasant location of the once promising, but until recently abandoned

CORNELL MINE.

This mine was opened in 1879 and worked for a year or two, when the lense of ore in which they had been working became apparently exhausted, and the mine has since been idle. It is one of the most pleasant situations in the whole mining country, the picturesqueness being due in a great measure to the presence of a fine sheet of water, Lake Antoine, above which, about 90 feet, is the surface of the mine.

There is a good wagon road to Quinnesec and to Iron Mountain, and also the railroad makes a detour to take in the mine and the beauties of the lake, by branching from the main line west of Iron Mountain and connecting with it again beyond Quinnesec.

The old company worked out a pit 300 feet long, easterly and westerly, with a surface width of 75 feet, and a variable depth of 50 feet at east end, and 100 at the west. The strike of the formation is about south 55° east, and the average dip about 70° southerly. Overlying the ledge is a surface stripping of 20 feet of sand, gravel and boulders. The bottom of the pit, and apparently the whole formation, pitches in the direction of the northwesterly end of the pit, at an angle of 25 or 30°.

Last summer John Friedrichs, of Iron Mountain, commenced to explore the old pit. He cut two drifts into the south from near the northwest end of the pit, which ran all the way in ore; in fact the ledge on the south side appears to be ore; not exactly clean ore, but a greater percentage of ore than rock. In the northwest corner of the pit is a body of ore 12 feet wide, apparently pretty good ore, and in the bottom pitching under the hanging in the northwest corner, is the ore, the same that is found in the cross-cuts higher up and further southeast.

Upon the north side of the pit they have explored the ore by removing a narrow covering of soap rock, and across the bottom are lenses of ore, sepa-

rated by seams of jasper and schist, and pitching to the northwest. Also the ore appears at the southwest end of the pit in considerable body. In fact, there appears to be the same lenses of ore now that were originally worked. The ore has become, perhaps, more mixed with rock, or the ore body split up and separated.

But Mr. Friedrichs and his party have found indications enough to insure the existence of ore in sufficient quantity for commencing systematic mining work.

The analyses of the ore that have recently been made show well in iron, but high in phosphorus; it is not likely to prove a bessemer ore. There are a number of dwellings, engine house, store building, office, etc., already at the mine, and a new plant of machinery is to be speedily supplied. A company is to be organized to operate the mine, the lease of the mine having been relinquished by the old company, and one secured by the parties now in charge.

They already have a few hundred tons of ore ready to hoist, and working about a dozen men. There are a number of gentlemen at Iron Mountain interested in the matter, but the work is in charge of John Friedrichs.

The description of the property is the E. $\frac{1}{2}$ of N. W. $\frac{1}{4}$, Sec. 20, T. 40, R. 30, and the mine was worked two years, 1880 and 1881, producing 42,672 tons of ore.

THE KEEL RIDGE MINE.

The Keel Ridge mine, which was the scene of the fatal catastrophe a few years ago, whereby eight men were buried in the mine, and in which their bodies still remain, is lately being explored by parties who claim to have found ore in apparently sufficient quantity to insure the opening of a new mine. Analysis shows the ore to be of the best quality.

Going westerly from Iron Mountain the railroad crosses the Menominee into Wisconsin, and brings us to the

COMMONWEALTH MINE,

a mine which has greatly improved in the last year or two; showing as much ore now as it has at any time since the mine has been worked. But it is an "off ore," medium in iron and high in phosphorus; an ore for which there is no great demand; still the company has shipped the past season 41,472 tons, and its shipments since 1880 amount to 300,000 tons. They are preparing to work the mine wholly underground in the future.

W. E. Dickenson, Superintendent, Commonwealth, Wisconsin.

Two miles further west, in the outskirts of the pleasant city of Florence, the capital of the county of the same name, is

THE FLORENCE MINE,

one of the properties of the Menominee Mining Co. The mine holds a great deal of ore, but it is low grade. A full description of the mine is given in the Commissioner's report for 1882, during which year the mine shut down, and has ever since remained idle. There is also a blast furnace at Florence, which, too, is idle. The Florence Iron Works, however, are in active operation, and turn out excellent work.

Beyond Florence about two miles, the railroad forks, one branch continuing west along the west side of the Brulè to Iron River, and the other, turning north, extends to Crystal Falls. This latter branch was completed in the spring of 1881, at which time there was a great deal of activity throughout that section. At the terminus of the railroad, near the falls in the Paint River, the village of Crystal Falls was built up; lots sold readily, and houses and stores, etc., were erected with great rapidity. The Paint River is a stream of considerable volume, and from the beautiful falls, not far away, the village takes its name. These falls, or rapids, constitute a fine water-power; the fall is 17 feet, in a distance of 600 or 800 feet, extending along a narrow island, which divides the stream, having a main channel on the west and a minor one on the east. Through this smaller channel as much of the water could be drawn as desired, and a bulkhead at the lower end would give the full head of the fall, affording a great power, and one cheaply to be utilized. It is admirably adapted to operate a compressor plant, similar to the one at Iron Mountain.

In the vicinity of the falls are several mines. The Younstown, Paint River, Fairbanks and the Star, etc., all of which could be operated by the power running to waste over these rocks.

But as the mines are practically idle, and as there is no prospect of their being very largely worked in the future, it is probable that if the utilization of this water rests exclusively upon its application to the compressing of air for the use of these mines, it is likely to remain untrammelled, and to continue forever to foam over the rocks in all its primitive freedom.

The C. & N. W. R. R. Co. built branches to all the mines in this section; in the branch extending to the Paint River and Star mines, the river at the falls is spanned by a bridge, altogether making a monetary outlay for which the railroad company has failed to receive, as yet, an adequate return.

The commendable enterprise and liberality shown by the railroad company, have seemed to develop this section and to open the mines. If the demand for the ore had continued, a different outcome would have resulted.

The Crystal Falls district is a region of very fine timber. There are no better hard wood lands in the State than are to be seen here. The sugar maple, birch, basswood, elm, etc. trees are tall and large, affording a great abundance of the finest material for charcoal, for the manufacture of pig iron. The soil is excellent, and yields potatoes and other root crops, oats, grass, etc., in ample fold. Capt. Waters, at the Youngstown mine, raised rutabagas of enormous size, one specimen, symmetrical and perfect, weighed sixteen pounds.

Just now the lumbering business is the chief source of activity. There are lumber camps on the upper waters of the Paint River and its tributaries, and large numbers of men are employed in cutting pine logs and in hauling them to the streams.

Crystal Falls is the chief depot of supplies for this lumber interest. From here they are hauled with teams to the camps as required. There are several saw mills in the district, which manufacture lumber for local consumption and to ship away.

One of these is the Mastodon mill, four miles from the Falls, on the line of the railroad, where a branch runs off to the Delphic and Mastodon mines. It is contemplated that either Crystal Falls or Iron River—as the voters may determine—will be the seat of the new county of Iron.

Numerous deposits of ore have been discovered in this district, but generally it is low grade hematite, medium to a low percentage in iron, and high in phosphorus; kinds of ore for which there is but little demand, and if sold at all, it must be at a price which leaves little or no profit in mining it.

Nearly all the mining companies hold their lands under leases, paying a royalty for the ore. Until recently this royalty was 50 cents per ton; now it is generally modified to half that sum.

The largest and best equipped mine in the Crystal Falls district is

THE YOUNGSTOWN,

situated in the E. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 19, T. 43, R. 32, being about a mile from the village of Crystal Falls. The mine was opened in 1881, and is admirably equipped with everything necessary for operating a large mine. The ore deposit extends east and west across the property to the low, level land at the foot of the hillside which rises steeply to the south. The engine house is near the west line, and the hoisting ropes, etc., run east on "pulley stands" to the shafts and mine openings. A nearly continuous ore dock has been made in the hillside to the south, on a level with the top of the ore cars, where these are placed, ready for loading, on the track in front of the dock. Short elevated trestles extend from the shafts to the ore dock and also to ore pockets, to load directly from the mine in season of shipment.

But a limited amount of ore has been shipped from the mine. The work has been in the way of opening, getting ready to mine, after which it was found necessary to shut down, because no ore could be sold.

At the east end the magnitude of the ore deposit is evidently great. Here they have sunk two shafts 150 feet apart, and in the east one, known as the Nelson shaft, they have cross-cutted in clean ore 163 feet, only finding one wall, and have drifted east and west 300 feet, all in ore. The bottom of the shaft is in ore, and ore all the way up to the stripping; 100 analyses of this ore have been made, largely from this shaft. A typical analysis of the ore from Nelson shaft I have taken as follows:

Metallic iron.....	54.5 %
Phosphorus.....	.57%
Silica.....	3.00%
Manganese.....	4.50%
Lime.....	2.50%
Alumina.....	1.30%
Water.....	6.00%

The phosphorus varies from .35% to .80%, and some analyses show a percentage of manganese of from 20% to 36%.

On top of the hill above the mine are a number of good dwellings, large boarding house, etc.

For a year past no work has been done. John Stombaugh, President, Youngstown, Ohio.

Product of Youngstown mine:

Youngstown Mine.

Year.	Tons.	Year.	Tons.
1882.....	6,198	1884.....	8,343
1883.....	15,292		
Total tons.....			39,833

QUINCY MINE.

At the Quincy mine, so called, lying west of the Youngstown, no work has been done in the past two years. It is probable that the location has been abandoned by the parties who were working. The efforts were confined to getting a shaft down to the ledge through the quicksand, and it is doubtful if even this was fully accomplished.

At a short distance east of the falls in the river, previously described, is the

PAINT RIVER MINE,

where a small amount of work has been done in the past two years. In No. 1 shaft, 55 feet down, they run a cross-cut south 60 feet to the south vein; and in No. 2 shaft, 165 feet down, a cross-cut struck the same ore at 20 feet, showing that the two lenses are coming together at greater depth.

The ore is about 45% to 50% iron, and non-bessemer. They have just made a new discovery (Oct.) at a point 400 feet north and 600 feet west of old mine, and near the west line of the property; they sunk some test pits, and at 6 feet below the surface found a body of ore into which they have sunk 15 feet and drifted 40 feet, all in ore,—a light, friable ore, in appearance like rotten stone, and holding a large percentage of lime.

An analysis of samples gave:

Metallic iron.....	61 %
Phosphorus.....	.932%

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

Product:

Year.	Tons.	Year.	Tons.
1882.....	4,615	1884.....	11,546
1883.....	5,971	1885.....	2,374
Total tons.....			34,506

ANNUAL REPORT OF THE
OF THE FAIRBANKS MINE,

situated close to the former on the east, there is nothing new to record. No work has been done of any kind on the location during the past two years, neither is there any body of ore, so far as known, of any magnitude on the property. The deposits next to the Paint River was worked out, and the shaft next to the Great Western failed to develop any ore. Mr. S. D. Hollister has charge of the property. Product, 1882, 8,131 tons.

Adjoining the Fairbanks on the west is the

IRON STAR MINE,

formerly the Great Western. The only work done during the past year has been with the diamond drill, with which they are still boring and are obtaining good results. This work with the drill is to the east of the mine and not far away. Four holes in all have been made, and in all ore has been found. In one of them, a vertical hole, 90 feet of ore was found, and when still in ore an accident to the drill compelled them to abandon the hole.

The ore from this mine is better than that from other mines in this vicinity. If proper care is taken in selecting it, it is a very good quality of hematite, fairly high in iron, and only .25% to .30% in phosphorus. It is claimed that it is much lower than this in phosphorus, and possibly it may be. The reputation of the ore was injured during the first year or two that the mine was worked through shipping nearly worthless mineral; more care is taken now, and an effort is making to establish a good reputation for the mine. Sample cargoes of the ore were sent to the De Pere, Leland, Elk Rapids, Florence, and other furnaces, but the result was not such as to make a demand for the ore, so that it would pay to mine. The price is too low. It costs more to mine it than it will sell for.

The mine is in a swamp, and is thus a wet mine, and there is no surface drainage. The ground all about is higher than where the mine openings are.

The mine is wholly underground, with timbered openings; undoubtedly the better way would be to fill, for which there is abundant material to the east in the sand hill. The greatest depth is 145 feet. There are three shafts: the middle one for timber and the other two for hoisting ore. No. 1 is 170 feet east from the west line of the property, and is about 85 feet deep. No. 2 is 100 feet east from No. 1, and No. 3 120 feet east of No. 2.

Product:

Year.	Tons.	Year.	Tons.
1882.....	587	1884.....	20,722
1883.....	22,825	1885.....	
Total tons.....			44,134

The company has secured the services of Captain Wm. Hooper, formerly

in the employ of the Champion Iron Co., who is residing at the mine and devoting his time to the exploratory work.

J. S. Newbury, Treasurer, Detroit; D. K. Moore, Secretary.
About two miles from the village of Crystal Falls is the

SHELDON AND SCHAFFER MINE,

the estate comprising the N. W. $\frac{1}{4}$, S. 31, and S. W. $\frac{1}{4}$, S. 30, T. 43, R. 32, and held in fee by Messrs. Sheldon and Schaffer, who are at present operating the mine, or rather preparing to. The mine was formerly held by the Union Iron and Steel Co., of Chicago, under a lease from the owners; but through the failure of that company the lease has been cancelled.

No mining work has been done for two years past and recently the partners owning the property have undertaken to pump out the mine with the intention, as they stated, of mining ore. The mine is simply a narrow, open pit 200 feet long, 80 feet deep, 30 feet wide on top and 10 feet at bottom, running east and west with the formation.

No great amount of exploration has ever been made at this mine, some large test pits have been sunk on the line of the ore, but no cross-cutting has been done in the mine. The ore is of much better quality than is generally found in the mines in this district; it is lower in phosphorus; some analyses place the ore within the bessemer limits. The mine is certainly worth working thoroughly, and it may develop into a profitable mine. There is ore in the bottom of the pit and at the ends, and they have no true foot wall. The soap-rock, which was taken as the foot, should, of course, be gone through. They are also stripping the ground at the east of the pit, and it looks as if the ore would extend under the hanging, that is, as if the so-called hanging was only a slip of rock, and that the ore continues beyond it. There are a number of dwelling houses on the property.

The mine was opened in 1881, and has shipped:

Year.	Tons.	Year.	Tons.
1882.....	15,947	1884.....	6,774
1883.....	4,334	1885.....	
Total tons.....			2,955

Mr. C. Sheldon superintends the work.

Following the wagon road south from the last described mine, we pass several mining properties which have at least a name and location, in the woods, and at all of which work has been done and buildings erected, and some of which, if the times were more auspicious, would be actively working. Among these is the

ALPHA,

situated about two miles south from the S. and S. mine, in Sec. 12, S. W.

¼, 42-33. It is about one mile from the Mastodon mine, and an extension of the branch railroad from the latter mine will probably be made. No ore has ever been shipped from the mine, but some has been taken out and very much more could be if required.

Capt. J. B. Swartz has charge of the property.

A mile further south, to Sec. 13—42—33, and we reach

THE MASTODON,

where we find a mine that has been considerably worked, though it is now idle and filled with water. The mine is a large, open pit, from which the workings extended to the west and north under the hanging wall 100 feet. The ore seems to strike north and south, dipping to the west, and is overlaid by a coarse, granulated sandstone. The skip road runs down on the east side of the pit, and further to the east is the engine-house.

Capt. Roberts states that the bottom of the pit, underground, is all ore, and the stopes are good for 8,000 tons. In fact he says the ore is 100 feet east and west,—clean ore,—and 180 feet in length. It is hard hematite, yielding about 60% in metallic iron, but high in phosphorus. The company had a quantity on hand last spring, and as the times appeared so unfavorable, they resolved not to work the mine. However, it is stated that they could have sold a good deal more ore if they had had it out or had been in shape to produce it. The work now doing at the mine is exploring with the diamond drill to the north of the mine; one hole to the east, at an angle down of 60°, is 276 feet; found rock and mixed ore and rock; are now boring to the west at an angle of 65° from same place; are down 256 feet, but have not found ore. The description is the S. ½, N. E. ¼, Sec. 13, T. 42, R. 33 W. There are a number of dwellings on the location; also good school-house, and a public school is maintained. Ed. Breitung, Prest.; Jos. Austin, Sec. and Treas.; C. T. Roberts, Agt.

Product:

Year.	Tons.	Year.	Tons.
1882.....	5,477	1884.....	18,020
1883.....	18,577	1885.....	11,737
Total tons.....			51,811

THE MANHATTAN

is an abandoned location adjacent to the last described mine, adjoining it on the south. A shaft was sunk in the same trend of ore, but the work did not develop anything of value.

Continuing south to Sec. 24, N. E. ¼, S. W. ¼, T. 42, R. 33, we reach

THE DELPHIC MINE,

which is held by the parties now working it on a lease from the Delphic Iron Co. The mine is on a level table land covered with fine, hardwood timber, and scattered about among the trees are the miners' houses and the other necessary buildings. The mine is wholly underground, reached by three shafts, two of which are virtually down and are used for hoisting ore with small buckets worked with drums and wire ropes. The ore trend is west and south. In the west shaft the ore deposit is 54 feet wide, but narrows down rapidly to 6 feet in the south shaft, which latter is only used as a ladder way; but further exploration is contemplated with the view of using this shaft also for hoisting. The whole length of the underground workings is 400 feet, and depth 100 feet below surface. The mine is two miles south from Mastodon.

The ore is clean,—a hard blue hematite,—averages 58% in metallic iron. The mine has two stopes from which they are getting a maximum of 60 tons of ore per day; work about 20 men, and pay 40 cents per ton for mining the ore; the company hoisting it. A branch two miles long, from the C. & N. W. Ry. leads to the mine. W. W. Whittlesey, Supt., Florence, Wis.

The mine has produced:

Year.	Tons.	Year.	Tons.
1883.....	3,410	1885.....	9,843
1884.....	508		
Total tons.....			13,761

THE CALADONIA IRON MINING COMPANY

is an organization recently effected to operate a mine in Secs. 17 and 20, T. 43, R. 31, about five miles east of north from Crystal Falls. Here a deposit of ore has been found which seems to promise well, judging from the development of ore made, and from its quality as shown by analysis. According to analysis of the specimens taken, the ore averages above 60% in iron and is within the bessemer limits in phosphorus. It is a brownish red, soft hematite.

The work done comprises two shafts, one of which was sunk on the line between sections 17 and 20, 18 feet through earth to the ledge and 65 feet in the latter. The rock sinking was mostly in ore, it is claimed, and from bottom of shaft they cross-cutted 25 feet in ore. The property extends over one-half mile along the west bank of the Michigamme River. Along the river is the slate out-crop dipping west at an angle of about 80°; this forms the foot wall of the ore, the hanging is greenstone. From this shaft they went north 200 feet and west 100 feet and sunk a shaft 8'x16', 90 feet deep through mixed quartz and schist, and then drifted east 13 feet and struck clean ore in which they continued for 30 feet without finding any wall.

This work was done two years ago. An extension of the Great Western mine branch railroad could, probably, be made to the property.

The land is owned by Geo. Wilson, of the Republic, and is held on a lease by the company. Dr. D. M. Bond, Prest., Iron River; W. V. Northem, Sec. and Treas., Marinette, Wis.

On Sec. 14, S. E. $\frac{1}{4}$, T. 43, R. 32, seven miles west from the above is

TOBIN'S MINE,

where some good hematite ore has been found, also at the

BLANY IRON CO.'S

location, comprising 80 acres, one and a half miles southeast from Crystal Falls, some work has been done which resulted in finding ore. The company sunk 65 feet, and have a body of ore 12 feet wide.

Analysis of sample furnished gives 62% to 64% and low enough for bessemer, so Mr. McDonald tells me. John McDonald, Prest., Iron River; Joseph McKnight, Sec. and Treas., Milwaukee, Wis.

THE IRON RIVER MINE

was opened and the work of mining and shipping ore begun in the spring of 1883, and the result of the first season's operations was that 102,000 tons of ore were mined and sold. The average cost of mining was about 50 cents per ton, the situation having been very favorable for cheap mining. The main outcrop was along the side of a bluff that only necessitated the stripping off of the overlying dirt, when the ore could be directly attacked, dug out and loaded into tram cars and carts and run out to the railroad cars placed on the track in front of the mine. The whole cost of mining, which included loading into the cars, was at first but 20 cents per ton. No steam power was required the first season. In the meantime, however, while this comparatively inexpensive mining work was in progress, preparations were making for the future, when another order of circumstances should govern. In this preparatory work considerable difficulty was experienced and large expenditure incurred, as must be the case in all mines. The Iron River Mine is somewhat elongated, that is, the points of attack are at quite a distance apart. The ore is found along in the foot of the bluff that extends north and south on the east side of the Iron River, in Sec. 36, T. 43, R. 35, close to the west line of the section. The company also holds the land adjoining in section 35, in which ore has been found at several points and a limited quantity mined.

The principal mine workings are at the extreme north and south limits of the property, the main one being at the north end; or from a point 1,600 feet south from the northwest corner of the section, thence north 1,200 feet. An ore dock with a rise of one foot to the 100 runs the whole length of this part of the mine.

The fee of the mine is in several different hands. The lines of division crossing the ore, thus making it necessary to keep up the lines in the stopes, as separate accounts of the ore have to be kept to adjust the royalty with the

several owners. The several pits at the north end are called the Cyr, the Stegmiller and the Selden. The south mine is known as the Isabella.

The mining now is largely underground at the north end. In the large pit the horizontal section shows the ore body as an arc of a circle open to the west and dipping to the west. The whole length of this bow is 1,200 or 1,400 feet, and the extent to which it has been worked underground is about 760 feet. The lowest level is 200 feet below the surface and extends about 350 feet north of the shaft; a drift to the south has been opened 300 feet long. This underground mine is reached by a single shaft near the foot wall, starting in the S. W. $\frac{1}{4}$ N. W. $\frac{1}{4}$, but dipping to the northeast, so that its foot is now near the north line of this 40. Ventilation to the north of the shaft is secured by means of an opening to the surface, through which the rock is milled down to fill up the mine as the ore is extracted.

To the south but little has been done except drifting; a blower is used to force in air. In the bottom level exploring drifts have been made to the east and to the west with good results, one of 40 feet in length is all in ore, and on the same line to the south 15 feet the drift that is made is also in ore. The general width of the ore deposit at the bottom as mined out is from 20 to 30 feet; it is far from regular; as in most hematite deposits, slips of rock intervene, but the aggregate of the ore holds out very well. The ore at both ends seems to be reaching out under the river. The west end pointing to the Nanaimo mine and the south also is making easterly and does not seem to belong to the Selden pit further south on the section line.

There is a large amount of ore in sight, just south from the west line of the property. The open cut level has only been mined down to the level of the dock. This is here an ore bottom of a continuous length of 700 feet, and varying in width from 10' to 50'. This should afford 20,000 tons and upwards of ore that can be cheaply mined. The ore is uniform and clean, free from rock and needs no sorting; it is excellent ore for foundry purposes. Analyses are somewhat varied, but an average of a great many give as a result:

Metallic iron.....	60.39%
Phosphorus.....	.17% to .40%
Silica.....	2% to 5%
Manganese.....	.53%
Lime.....	1.20%
Water.....	2% to 5%
Magnesia.....	.18%
Alumina.....	1.05%

In the north mine the ore taken out has been mostly from north of the shaft, but a drift has been made in what is called the first level, 96 feet below the surface, which at 80 feet from the shaft encountered ore. They drifted in this ore 130 feet. At 48 feet from the point where the ore was met with, a cross-cut was made at right angles with the drift, 60 feet, which is in clean ore, as good as any found in the mine. In the bottom level, 200 feet below the surface, a drift was extended in the same direction and the ore is found in portions corresponding with that indicated above. A cross-cut shows it to be of equal magnitude, so that it would appear that there is here a large body of ore, found to a depth of 200 feet, a length of 130 feet, and a width of 50 feet as yet untouched.

It has been uncovered at one point on the surface and probably could be mined by open cut as cheaply as any way.

The method of underground mining that has been adopted consists in filling the mine as the ore is removed. The main drift through the ore is well timbered by placing bed pieces close together in the bottom; they are shouldered or cut down at the end to relieve the uprights. A cap made in the same manner is placed on top of the posts, leaving the bent 7 feet high 6 feet wide in the clear. Upon this a floor is laid to receive the ore, which is taken there from above and sides until space enough is made to require filling up. The planks are removed and rock is run down from the surface and the drift filled up. A floor is again made and the ore back-stoped away and "milled" down into the drift into the tram cars, and drawn to the shaft. These ore shutes—"mills"—are timbered and carried up as the level is filled. In this way the ore can be all taken out to the surface. They will again sink another level and rise up with the stoping and filling to the level previously filled and so on proceeding downward.

During the past year but little dead work has been done; there have been only men enough employed to mine the ore that has been shipped.

At the Isabella pit much improvement in the character of the deposit is apparent; heretofore the ore has been somewhat mixed with rock, giving considerable second class ore, for which there has been no demand. The overlapping mixed ore and rock has disappeared and they are down in clean ore of which there is a very satisfactory show.

The workings at this mine are in three open pits, about 100 feet apart, the main ore being to the south of the others. This is about 50 feet in depth and 40 feet in diameter. The bottom is ore, and on the sides are 3 stopes, there being no foot wall; yet on the east the ore dips to the west and there appears to be a further surface extension to the west; the ore will probably be found to continue to the south line of the property. Some pits sunk below the line in Sec. 1, a few years ago, were favorable to this supposition. A few hundred feet north of Isabella pit a line of test pits was made recently east and west across the formation, which discovered ore on the line of the continuation of the Isabella pit.

Isabella mine will furnish 25,000 tons next year, if so much is required, and this without much, if any, additional cost for stripping or other preparatory work. In the two north pits the ore can be run out in carts for some time yet, and in the south pit the bucket-hoist can be continued indefinitely or a skip road made down into the pit. A substantial ore dock has been built, and a side track from the main line of the railroad runs in front of it, the track having a down grade of 2 ft. to the 100 to run away the loaded cars and run down the empty ones. The same is true at the north mine, where the dock is upwards of 1,000 ft. in length.

Between the Isabella and the north mine there are several small pits where ore has been mined, but the work was undertaken simply for exploration.

Much expenditure has no doubt been incurred that doubtless would not have been, if the state of the ore market could have been foreseen. Above the hill, east of the mine, a village was platted—Stambaugh—and some fine, costly buildings were erected by the company; of these are the Superintendent's residence, and a hotel, both of which are among the best of the kind to be seen on the Range.

If the mine could be worked to its full capacity, and at a reasonable profit,

this would be a prosperous village and the expenditure incurred would not be seriously felt, but as matters stand the village and its buildings are of no value to the company, especially since Iron River is growing rapidly and is sure to be an important village and it is nearly as convenient to the mine as is Stambaugh.

If the company had wished to build a village it should have been laid out just west from the depot where it is level land, near the depot and near the mine and near to Iron River. Stambaugh is off the thoroughfare, it is to one side and is doomed to failure. It is a pleasant spot, however, in one respect, it overlooks a wide range of country.

The mine is well equipped for thorough and economical working; a substantial engine house has been built and supplied with a fine plant of machinery, capable of much more work than is required of it. It is situated in the line of the vein, south of the mine, and contains three hoisting drums made at the Iron Bay Foundry, Marquette. They are used to hoist the ore and to run it to the cars. The other buildings are, a fine office, barn, dry and the new building which is a store house, machine and blacksmith shop, carpenter shop, etc. It is made up of four portions built together, two of these are 80'x30', and two each 50'x30' to which is also attached an oil house. They are all so arranged as to be a model of convenience for the purpose intended.

The whole location has been thoroughly mapped out, so that everything may be systematically arranged for operating a large mine. Originally, four years ago, it was a wild looking place, now it is one of the pleasantest, most convenient locations to be seen. The cedar swamp that existed between the mine and the river has been cleared and filled up and on this ground the mine buildings have been erected.

Among others is a small laboratory supplied with apparatus for analyzing ores, etc.

It is expected that but a small force will be employed during the winter. The ore market is too much depressed to make it worth while for the company to put ore in stock. If sales are made in the spring, enough ore can be mined during the season of shipment to make a good season's output. Mr. F. P. Mills, the former Agent, recently severed his connection with the company to accept a position with the Union Steel Co., of Chicago. Mr. J. N. Porter retains his position, and now directs the affairs at the mine.

The mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1882.....	29,115	1884.....	52,583
1883.....	100,369	1885.....	55,693
Total tons.....			237,760

Robert McCurdy, Sec. and Treas., Youngstown, O.

A very little to the northwest from the Iron River mine and a mile and a half distant is the

NANAIMO MINE,

which is a small hematite mine, the ore being of about the same quality as the Iron River ore.

The pit which they were working in 1883, at the time I last described the mine, has since been suffered to fill with water and the mining work was transferred to a new "find" further up the hill from the river, to the south. No mining has been done the past year, both pits have been filled with water and were wholly idle until recently. In September last the north pit was pumped dry and the sinking of a shaft begun in the bottom preparatory to stoping ore. The old pit is about 140 ft. to the bottom and Capt. Luxmore states that the ore in the bottom remains as favorable as at any time previously. The new "find" was opened in 1884, and is about 500 ft. to the north of the former. The deposits are very similar—simply large, irregular pockets of hematite, lying directly in contact with the overlying drift. Each pit has a skip road running down into the bottom, and they have a good plant of hoisting machinery, also ore pockets by the railroad track, etc. The mine is on the south side of the Iron River and near the north line of the property, so that it is fortunate that the ore is found in the south.

The ore, a soft hematite, averages 58% to 60% in metallic iron, 2 to 3% in silica, and, 20% to, 40% in phosphorus; it also holds 5% of water.

The estate comprises 40 acres, which is held on a lease from the McKinnon Bros., and is held on a lease by the company. Mr. J. S. McDonald and other gentlemen, who control the mine, have also organized another important enterprise, to be operated in connection with the mine, which is

THE IRON RIVER FURNACE CO.

J. S. McDonald, President; J. T. Jones, Superintendent.

The purpose is to smelt the ore on the ground, and with this view they have built a charcoal furnace 1,700 feet north of the mine. The ore will be run over on an elevated tramway, extending from the mine across the river valley to the top of the furnace. The cars will be operated with an endless rope, worked from the engine-house near the furnace. The ore will dump from the tram-car to the crusher, passing over an inclined screen, which will admit of the passing through of the fine "dirt" into the ore bin below, upon the top of which the crusher rests, as does also a small engine to operate it.

The ore will be drawn from the bottom of the rock bin into the car standing on the scales, when the weight will be taken, and then it will be run up to the top of the calcining kiln, and its contents dumped into the kiln.

When roasted, the ore will be drawn out at the bottom in a condition heated to redness, the weight again taken, and then it will be again immediately elevated to the top of the furnace, and dumped into the stack to be smelted. The arrangement is known as Fayette Brown's calcining attachment to furnaces. The plan is said to be in use in a number of furnaces, and to give satisfactory results. The patentee charges \$1000 per furnace for the right to use it. The skip roads for elevating the ore will be operated by wire ropes from the engine-house, running up over the stack, on the top of which the pulleys are fixed. The arrangement is such as to make the

pressure as nearly vertical as possible, thus to prevent a horizontal thrust at the top of the stack. The rope runs from the engine-house to the bottom of the stack, thence up over the pulley at the top and down the skip road to the opposite side, thus in a measure making the resistance of the ascending car on one side counteract the pull of the rope on the other.

The height of the the stack is 56 feet, with 11 feet bosh. In the calcining kiln it is expected to use slabs for fuel, largely, to be brought from the Mastodon mill, together with the charcoal braze.

The furnace and other buildings essential to its working are at the foot of the hill that rises sharply on the north. Along the top of the hill a railroad track is laid on a level with the top of the kiln. To secure foundations, piles were driven in the soft ground, so that sufficient stability, it is thought, has been secured. Four boilers are in place to furnish steam, as also the blowing, hoisting and pumping engines.

The work is supervised by Mr. J. T. Jones, who has had charge from the beginning, and is an experienced furnace worker. Mr. Jones expresses great confidence in the success of the undertaking, and states that he shall be greatly disappointed if the furnace does not turn out, at a profit, 70 tons of pig metal per day. It will probably be in operation about February or March next.

This furnace is in a fine hard-wood region, affording in abundance the timber for any amount of charcoal. But unfortunately the region is in the limits of one of the contested railroad grants—a grant long since forfeited, though still claimed by railroad organizations—a claim that is liable to receive the sanction of Congress. Much of this land—the even sections—has been purchased by the government, and the same lands have been pre-empted by others under the pre-emption laws, or settled on by "homesteaders" under the homestead law, the last claiming a sort of "squatter sovereignty," hoping that finally the government would concede their right to the lands in preference to all other claims. Of the "homesteaders," there are several hundred in the vicinity of Iron River, and it was largely from these men that the company expected to obtain its coal. If the settlers were secured in their title, they would, in clearing their lands, turn the wood into charcoal, under contracts with the company, at such a price as would pay them for their labor in clearing their lands.

The company would thus secure its charcoal cheaply, and be relieved of much of the labor and of the investment of capital that would be otherwise required in operating the furnace. If the "cash entry" titles are confirmed, which includes very many of the even sections, and the railroad should secure the odd sections, the homesteaders would be thrown out and the furnace company will fail to realize their supply of charcoal from this source.

They will be compelled to buy lands or to buy the timber and manufacture their own charcoal. All this will necessitate the building of roads and houses, the keeping of a force of charcoal-burners, wood-choppers, teamsters, etc., etc. All these men will have to be brought on the ground and be supplied with work. They will mostly have no interest in the country except to get employment at wages; whereas, if there is a population of farmers—homesteaders—they are interested in clearing up a farm, in breaking roads, in improving the country. They raise products from the soil—potatoes, grass, oats, etc.—and the furnace and the mines afford a market for their

surplus, while in clearing their lands and getting them in condition to produce, the furnace company gives them support, that is, buys their wood or charcoal, and they make their living in doing the work, and in the end have their lands cleared. It is a region of not only good timber, but of excellent soil also, and would make a good farming country. Of course, it's cold in winter, and the summers are short, but they can raise good crops nevertheless.

The company has about 150,000 bushels of charcoal on hand, and has also a row of kilns on the bank above the furnace, where they are adding to the stock. All the arrangements seem to be excellently well made for economical working. The estimated capacity of this kiln is 150 tons of ore per day, which amount will suffice for the furnace.

I should judge the hot blast oven would scarcely suffice; it is one of the old ox bow pipe ovens that are too much out of date. The furnace was brought from Munising, where it once stood but was burned; it has been repaired and much new material and machinery added, but will certainly require an additional hot blast.

The working will be watched with a good deal of interest. The roasting kiln for the ore is a new thing in charcoal iron making and theoretically is an advantage. Not only will the ore go into the furnace in a heated condition, but with the moisture and oxygen driven off. So the ore thus prepared should contain only its silica and metallic iron—say 58% of iron and 3% of silica—thus its weight will be reduced, and the burden which would otherwise be a 100 lbs. would be reduced to 61 lbs. It should effect a great saving in coal and should also cause the iron to smelt more rapidly.

The fuel for roasting the ore will be slabs and charcoal braise, which possess but a nominal value.

On the north side of the river (the river runs east at this point) just opposite the Nanimo mine, Mr. John Schipkin has explored on his land with a churn drill and claims to have drilled in 20 feet in ore.

The McKinnons have also done some exploring on the south side of the village and state that they have discovered ore.

Nothing has been done at the

CHICAGON LAKE MINE

since the previous report on the iron mines was written.

A first class turnpike road has been made from Iron River to the mine a length of six miles east. However, there is no work doing at the mine and no one living there. There is hardly enough of the deposit, considering the quality of the ore, which is poor, to warrant the building of a railroad to the lake.

There is a small pile of ore in stock at the mine, and they have uncovered ore for a length of 100 feet, 10 to 15 feet wide, and even more in places. It is a low grade brown hematite, high in phosphorus.

THE FELCH MOUNTAIN IRON DISTRICT

has perhaps been the greatest disappointment of any mining section that has been opened in our State for a number of years. The early explorations there led to such promising results that public interest was greatly awakened.

The ore found was of excellent quality, soft blue hematite, like the Ludington ore, and judging only from surface indications there seemed to be plenty of it. A number of companies were organized and all claimed to have an abundance of ore. The C. & N. W. R. W. Co. built a branch railroad from Narenta, a point in the main line, to the new iron district, a length of 35 miles.

This road has had and seems very likely to have very little to do. The mines are all idle; no mining has been done in the region for the past year, and to all intents and purposes, as a mining section, it is practically abandoned. A good deal of expensive exploring was done during the season of activity but all to no avail, no ore was found. The ore deposits that looked so well when first uncovered proved shallow and evanescent. It was all on the surface and wanting in depth. The deposits are all a "wash of ore," mainly laying on the limestone, and were soon exhausted. In fact some mining companies were organized, having, it was claimed, a fine "show of ore," and the stock of which sold at a high figure, but which did no mining at all. In the summer of 1883,

THE CALUMET MINE

had as fine a showing of ore as would be necessary in other localities to insure the existence for a long time to come, but the ore had very little depth and was all worked out in one season. A few tons were scraped together in the following year, but nothing further has been attempted.

The total shipments from the mine in the three years that shipments were made amount to 38,709 tons. A. B. Cornell, Pres., Youngstown, O.

THE METROPOLITAN MINE

has some non-merchantable ore, especially of the yellow ocher variety, spread out over the limestone bottom, and lying near the surface. Two years and a half ago, when I examined the mine, I concluded that it would soon be worked out, as the limits of the ore deposit were clearly to be seen. I am not aware of anything more favorable having been found on the location and no ore has been shipped in the last year. The description is N. E. $\frac{1}{4}$, S. 32, T. 42, R. 28.

Product:

Year.	Tons.	Year.	Tons.
1882.....	23,854	1884.....	27,577
1883.....	36,643		
Total tons.....			88,074

Joining the latter mine on the west is the

ANNUAL REPORT OF THE
NORTHWESTERN MINE.

There is quite a body of ore sufficiently opened up to be mined. The shaft is 188 feet deep and they have cross-cutted from the bottom through the ore. Diamond drill borings have been made at three points west of shaft, so that it is claimed that the ground has been pretty well proved for a length west of 900 feet. The ore body has a width of 10 to 18 feet, improves from the east towards the west. The walls are good and single timbers would suffice in mining the ore. The deposit is probably a deep, narrow basin, like the one worked out at the Metropolitan—the ore analyzes below 58 % in iron and is non-bessemer. With facilities for getting rid of the water the ore could be mined cheaply.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1883.....	7,202	1884.....	10,004
Total tons.....		17,206	

At the time the railroad was built, and in anticipation of great mining activity in this section, several villages were plotted and the lots extensively advertised and sold. These towns, however, did not make a very large growth, and now there is little doing in that country except lumbering, there being a saw-mill at Metropolitan.

Contracts for the shipping season of 1886 have been made to some extent already, as also have contracts with some of the leading mines for the ore at prices somewhat in advance of those which prevailed last year.

Contracts for shipping from Escanaba to Cleveland.....	\$1 10
Contracts for shipping from Ashland to Cleveland.....	1 35
Contracts for shipping from Marquette to Cleveland.....	1 25

Gentlemen well informed in such matters predict that the above rates will be very soon advanced to \$1.50, \$1.75 and \$1.65, respectively, and even to higher figures if the ore business should become very active.

THE AGOGEbic IRON RANGE.

How little do those journeying north to-day in one of the palace drawing room cars of the Milwaukee, Lake Shore & Western Railway, through a hundred miles or more of primitive forests and dense swamps, that may now be complacently viewed from the car window, and stopping at sumptuous eating houses along the route where the cravings of the inner man may be fully satisfied, appreciate the hardships and privations endured by the early explorers of this range. When there were no roads or even passable trails; when the simplest necessities of life had to be carried in on the explorers' backs; when, too, many of them were men of limited means, and in some instances risked nearly everything they possessed on the result of the trip or season's work as the case might be. The courage and faith of such men in the future of this region cannot be overestimated. The credit due the capitalist who may have risked a few thousands of his abundant wealth is small in comparison.

Attention was attracted to this region by the report of the Geological Survey of Michigan, published in 1872. In that report is a brief description of a geological reconnaissance of this range by Professor Pumpelly and Major T. B. Brooks, and on the map of the Upper Peninsula accompanying the report the Huronian belt is, in a general way, laid down.

In 1879 F. H. Brotherton, Esq., and party located, for the Canal Co., very closely, the Huronian belt across ranges 44, 45, 46 and 47, Town 47, and the ore vein within this belt; in fact all the discoveries of iron ore made in the above towns are within a hundred feet or so of the line determined by Mr. Brotherton.

From section 10, town 47, range 45, Mich., just east of Sunday Lake, to the East Branch of the Montreal River, a distance of fourteen miles, the range bears nearly west-southwest, and the rocks vary in their dip from 40° to 80° to the north. All the workable discoveries of iron ore thus far developed on the Agogebic range in Michigan are within this section of the iron belt. East of section 10, town 47, range 45, the iron ore range bears to the east-southeast. Considerable exploring has been done on this eastern extension, but the drift appears to be deep and more springy than to the west. The exploring was done early in 1883, before there was a railway into this region; when facilities for doing such work were very limited, so much so that it was practically impossible to reach the ledge in the majority of the test pits. This statement applies more particularly to the first seven or eight miles east-southeast from the Sunday Lake mines, and is based on a personal knowledge of the same.

Since the railway reached this district from the south, a little more than a year ago, the villages of Bessemer, Ironwood and Hurley have sprung into existence and are still making rapid strides in their efforts to excel each other. The strife is now mainly between Bessemer and Hurley.

Bessemer is located on the south half of the southwest quarter of section 10, Town 47, Range 46, Mich. In some respects it has the advantage of Ironwood or Hurley. The Colby mine joins it on the south, and to the west, within two miles, and therefore tributary to Bessemer, are some very promising explorations. To the east are the Sunday Lake mines and some explorations that are at present dependent upon Bessemer for their supplies. The village of Bessemer now contains about 900 inhabitants. It has a fine, large hotel, the best on the range. There are also six grocery stores, two clothing stores, one hardware store, two drug stores, three hotels, and a full complement of saloons. The railway company has a round house here for several of its locomotives.

Ironwood is situated on the north half of the southwest quarter of section 22, Town 47, Range 47, Mich., and Hurley about half a mile southwesterly therefrom across the river into Wisconsin. On the Michigan side of the river, and therefore tributary to Ironwood, are several working mines. In regular order, easterly from the river, are the Ashland, Norrie, Aurora, Vaughn and Pabst iron mines that will employ the coming season not less than 700 men. Add to this number those that are exploring to the east of the Pabst mine and the number actually engaged will not fall short 1,000 men. Ironwood is at present about one-fourth as large as Bessemer, but if it is not compelled to share too largely with Hurley of what naturally belongs to it, it will yet rival either of them. Bessemer will make more rapid progress in the beginning because of the present natural advantages that the Colby mine possesses. Hurley has the Germania mine and there are said to be some fine veins of ore to the west of there. The Germania promises to be a fine mine, but upon the magnitude of these tributary western "finds" will greatly depend the future of Hurley.

There is another source of prosperity to Ironwood and Hurley, and that is the water power of the Montreal River that will eventually be utilized for mining and other purposes.

There is still another resource that would be well for the towns of the Agogebic range to look into, and that is the abundance of heavy hard-work timber all along the range, that could be made available for the manufacture of charcoal pig iron. With a constantly increasing demand for iron of greater strength the day is near at hand when the superiority of iron made from charcoal will again be more appreciated than it has been in the last decade and its comparative market value correspondingly enhanced.

The rapid development of the Agogebic district during the past season has been in part due to the prompt and efficient management of the Milwaukee, Lake Shore & Western Railway. This company, though unacquainted with the mining business or the ore carrying trade, has in many instances anticipated the requirements of the mines, and as far as can be learned has given thus far little cause for complaint from the mining companies. It has introduced to the mines of this State the large form of the ore car, first adopted, it is claimed, in the Vermillion Lake district, which gives good satisfaction, though at first the mining men were skeptical as to its practicability. The road bed, for a new one, is in exceptionally fine condition, and is laid nearly its entire length with steel rails. Twenty-five to thirty car loads of ore, of twenty gross tons each, can be hauled from Bessemer to Ashland. At Ashland the company has fine ore docks for handling the ore. The number of ore cars was rather limited this past season, but this will be remedied the coming winter.

The early history of the explorations and development of the mines will be given in connection with the following detailed description of them, and as the greatest development of the north and south veins has been made at the Colby mine we will begin our description of the Agogebic district with that mine.

COLBY MINE.

The "Mecca" toward which all mining men instinctively gravitate when visiting the Agogebic district, is the Colby iron mine. It is at present to this new iron field what the Calumet is to the copper district, or the Chapin mine is to the Menominee range. It seems as if nature, foreseeing the present and wishing to make amends for compelling the other mines of this new iron district, thus far opened, to delve in darkness underground, had gone to the other extreme and produced a mine of soft hematite ore in two veins of ample width for economic mining, and of good quality; of comparative light earth covering; from 100 to 200 feet above inexpensive drainage; easily attacked at one end, permitting of carrying forward at the same time stopes at different levels, thereby affording, under the most primitive mode of mining, a maximum amount of ore at a minimum cost.

It is not intended in the foregoing to convey the impression that the Colby is a larger mine, or even equals, the Chapin, the Lake Superior, the Republic, the Champion, or the Cleveland iron mines, for those mines have been mining for years and have given fair proof of their permanency. A comparison as to the greatness of the Colby, or any other mine of the Agogebic range, and those mentioned above can more consistently be made five or ten years hence.

The Colby mines embrace the N. E. $\frac{1}{4}$ of section 16 and the N. $\frac{1}{2}$ of section 15, T. 47, R. 46, Michigan. The former was leased January 15, 1883, by Jas. McDonald, John McKay, and Helen Moore to C. L. Colby, who assigned his lease to the "Penoque and Agogebic Development Co.," and by it was sub-let this season to Mather, Morse & Co. The latter described N. $\frac{1}{2}$ of section 15, was leased by the Canal Co. to Wm. Sedgewick, Alexander Maitland and others, and by the them transferred to C. L. Colby, and by him assigned and sub-let as above.

Ore in place and in quantity, it is said, was first discovered during the season of 1880, on section 15, by Capt. N. D. Moore; in fact it is claimed that this was the first ore found *in situ* on the Agogebic range. On section 16 Capt. C. P. Pease began exploring in June, 1881, for the Cambria Iron and Steel Co., and partially developed the ore veins of the present Colby mine.

At the time of a visit to these explorations, in June, 1883, I found a large number of test pits and trenches sunk on these properties. Those examined on section 15 were on the present site of mining operations. A shaft was sunk 43 feet to the foot wall quartzite, and a cross-cut at the bottom driven north showed 18 feet of ore; west of this 40 feet, was an open trench 115 feet in length that shows 36 feet of ore,—south end mixed ore. On west side of trench the ore was cut off by quartzite; east side was heavy surface. East of the shaft about 100 feet was a test pit 20 feet deep, with ore in the bottom. South of the trench for 400 feet were a dozen or more test pits sunk to the ledge, showing lean ore and iron slates.

On section 16 considerable more exploring had been done that had resulted in developing 600 feet in length of the south vein, varying in width from

30 to 40 feet. To the north of this, 450 feet on the north vein, a shaft had been sunk 50 feet; the last ten feet of it in clean ore. About 350 feet east of this a series of test pits were sunk with a view of cross-cutting the formation to the north and south of the "two veins," also the ground between them; but no first class ore was found. This, however, is not surprising, as some of the test pits were 50 feet apart.

With this brief description of the early operations of this now promising mine it will be in order to describe the more recent developments.

Actual mining was begun on the N. E. $\frac{1}{4}$ of section 16 early in October, 1884, by Capt. N. D. Moore, and the first shipment of ore was made on six flat cars over the Milwaukee, Lake Shore and Western Railway, that had just extended its line from the south to Bessemer. A test cargo of the ore of nearly 1,000 gross tons was shipped, via Milwaukee, to Erie, Pa.

The railway company, with commendable energy, completed, in July of this year, a branch into the mine.

The main line of the road passes through the northerly portion of the south half of section 10, T. 47, R. 46, on a course a very little north of west, but at the west line of section 10 it curves to the southwest, and within 200 feet southwest of that point a switch leads off S. S. W. to the mine workings, obliquely ascending the north slope of the range on a grade of two feet to the hundred. About a mile from the switch, on the branch to the mine, is another switch connected to a "Y" that leads northeasterly on a still ascending grade to the mine workings of the south and north veins of section 16; also curving around to the right to those on section 15. The "Y" branch crosses the south vein about 1,425 feet west of the east line of section 16 and 100 feet north of the south boundary of the N. E. $\frac{1}{4}$; and the north vein at 1,125 feet west of the east line, and 580 feet north of the south boundary of the N. E. $\frac{1}{4}$. The veins now worked on section 16, as far as known, are nearly parallel and have a trend of N. 80° E., and a dip to the north of about 70°. The veins are about 400 feet apart and are separated by a gray quartzite that is intersected by veinlets of iron ore and vein quartz; also small pockets of ore and bunches of jaspery looking quartzite.

The railway branch, where it crosses the south vein, is about 155 feet above the main line at Bessemer, or 75 feet above the center of section 16, near which point the south vein is supposed to cross the west boundary of the east half of the section. As the ground is wet and springy at this place, it will probably determine the natural drainage level in the mine workings, though local springs and permeable rocks or impervious material may raise or lower that level.

Abreast of the mine is a long ore dock for running over the tram-cars in loading ore into the railway cars; also for stocking ore during the close of navigation. Within 75 feet of the outer edge of the ore dock, and easterly therefrom, begins the open cut of the south vein into the westerly end slope of the hill, formed by a depression in the range. The bottom of the cut descends as the hill is entered, and is drained of its water by a drift driven in from under the railroad track to beneath the pit. Two hundred feet from the outer edge of the dock the line of the foot wall bends outwardly into the foot wall, and opposite this point the hanging wall is said to do the same, thereby affording a maximum width of vein. I measured the vein at this point, and made it 75 feet. This measurement, however, does not include the depression into the hanging wall, that had been determined

by a cross-cut that was covered over at the time with loose ore. The existence of the cross-cut was made known to me after leaving the mine.

The stopes of ore across this line were 25 feet high. Fifty feet farther east is the west end of a "horse of rock." The ore makes around the south side of it, and is from 10 to 12 feet wide; the main body of the ore, however, is on the north side of the rock. The extent of the "horse" has not been determined. The ore has been mined out on the south side of it for 30 feet to the east; the stope at this point was 30 feet high, and above this, or on top of the stope, another one was going east. The ore from this upper stope is trammed to an ore pocket, alongside of the railroad track, over a trestle erected on the north side of the pit. The foot of the upper stope was about 60 feet east of the top of the lower stope. East of the upper stope about 35 feet is the shaft of the south vein. The collar of the shaft is about 64 feet above the railroad track, where it crosses the vein. The shaft is 35 feet deep, and from the bottom of it is a cross-cut to the south of 18 feet in ore, and to the north a short drift of five feet, and then a chamber of 24 feet in diameter by 10 feet high, that was mined out last fall by Capt. Moore. This chamber was all in ore, with no hanging wall in sight, which gives at least 47 feet of ore. If the "horse" of rock noted to the west in the open cut extends east, it probably pitches down to the east and passes somewhere beneath the bottom of the shaft or cross-cuts therefrom. This is as far as any mining has been done to the east on the south vein. The total length of the workings of the south vein is about 400 feet. The ore contains a variable amount of manganese, ranging from 2 to 15 per cent. The percentage of iron fluctuates, averaging about 60. In phosphorus some of the cargos have come within the bessemer limit.

To the east of the shaft the ground gradually ascends, and at the section line it is 60 feet higher than the collar of the shaft; just east of the section line is another shaft in ore.

The plan of working the north vein is nearly the same as that of the south vein. A tram-road leads from the ore dock into the open cut driven easterly in the vein, and at 370 feet meets the foot of the main stope. This stope is about 35 feet high, and is very free from rock. There is a fine chance here of mining ore very cheaply; after greater depth is attained, the walls will have to be sloped back and supported, or underground mining resorted to, when the cost of taking out the ore will be materially increased. About on the same level as the bottom of the open cut is a large tunnel driven 80 feet easterly in the ore to what is known as the No. 1 shaft of the north vein. This shaft is one of those sunk by Capt. Pease over three years ago. The collar of this shaft is 63 feet above the railroad track, and the floor of the tunnel is 49 feet below the collar of the shaft. Easterly of the shaft the tunnel has been driven 230 feet. Immediately south of the shaft a branch from the tunnel has been driven easterly along the foot wall side of the vein. The branch tunnel was in about 100 feet, and at intervals of 40 feet cross-cuts to the north connected with the main tunnel to test the vein and provide better ventilation. The ore in these underground workings is very dry, and appears to "stand" well in the roof and on the sides. The ore from the underground workings is "raised" through the shaft, and thence trammed over a trestle to the ore pockets.

It may be seen from the foregoing that the open cut and underground workings afford a total length of vein of 680 feet, with an undetermined extension to the east and west, and a width varying from 40 to 70 feet.

The Colby attained a product of 1,000 gross tons per day very soon after it began shipping and could have increased it to 2,000 tons, with ample shipping facilities, had it been desired, a record that the management may well feel proud of after giving the mine credit for the natural advantages it possesses.

The mine workings on section 15 are located about 300 feet east of the center of the N. W. $\frac{1}{4}$. The railroad siding passes about 140 feet north of the mine opening. The vein of ore, before noted in the long open trench, was very soon cut out by converging walls of quartzite. The vein has the appearance of a fissure vein or leader from a main vein. It may prove more regular as greater depth is reached. It looks no worse than did the Germania at one time during the present season.

It is not the intention of the management to make a business of mining ore the coming winter or during the close of navigation, but to devote their entire attention to the "opening out" of the mine for a large product the coming season. I can see no reason now why Capt. D. H. Bacon's estimate "that 1,000,000 tons could be mined within the next three years, provided the present size of the veins be maintained." This statement, though made after a careful examination by Capt. Bacon, who has had a large experience as Superintendent of the Cleveland Iron Mining Co's. mines, to Mather, Morse & Co. before actual mining at the Colby was begun this season, seemed hardly credible; in fact Capt. Bacon's report to Mather, Morse & Co. was seriously questioned by them, but the results of this season's work seconded by the present able management bids fair to confirm it.

The product of the mine for the season will be given in the table at the end of this report.

Capt. Joseph Sellwood is General Superintendent and Agent at the mine. His long experience in mining matters bespeaks for the mine good management. Capt. Sellwood is ably assisted in his work by Capt. Samuel Harvey, another of Lake Superior's able mining men.

SUNDAY LAKE MINES.

Sunday Lake is a very pretty inland sheet of water, one and a half miles east and west by half a mile wide. The land immediately to the south of it is flat, but the ground along the north shore gradually ascends to the north and within half a mile attains an elevation of three hundred feet above the lake, or about 1,230 feet above Lake Superior. The slope is heavily timbered with hardwood and the land bordering the south shore is covered with spruce, tamarack, some pine and hemlock, the greater portion of which is suitable for mining purposes. A reef of rocks crosses the lake in a north and south direction about midway east and west. To the east of the reef the water is quite shallow, but to the west the bottom of the lake drops suddenly away into deep water.

The inlet of the lake comes in from the south about half a mile from the west end; the outlet is at the west end.

The quarter post between sections 9 and 10 is on the trap range. To the south of the quarter post for 100 rods or more is a broad descending ridge, along the crest of which are a large number of test pits. The formation has nearly an east and west trend across section 9, but to the east, through section 10, it bends a little to the south of east. The trap extends south of the

quarter post for 270 feet, and south of the trap for 300 feet is a banded jasper and lean ore, with occasional narrow veins of iron ore; then comes the so-called north vein, and underlying it the foot wall quartzite that is intersected, as noted elsewhere, by narrow seams and veinlets and pockets of soft hematite ore. The south vein, if it exists here, has not been found.

The first exploring for iron ore near Sunday Lake was done by Geo. S. Fay, Esq., in 1881 and 1882, for D. H. Merritt, Esq., and others of Marquette, Mich.

The ore belt extends through the south half of sections 10, 9 and 8; and as noted above, its course across section 9 is nearly east and west, but westward through section 8 it turns to the southwesterly.

In section 10 the vein dips to the north from 70 to 80 degrees, but westward through section 9 the dip is as low in some instances as 50° to the north.

Early in 1883 Messrs. Vaughn & Moore, of Ashland, began exploring on the west half of the southwest quarter of section 10, under an option from George M. Wakefield and others, of Oskosh, Wis.; and about the same time F. H. Brotherton began on the north half of the southeast quarter of section 9 under an option from the Canal Co. Their explorations soon proved that the work of their predecessors had, in many instances, been too superficial.

BROTHERTON MINE.

In the first shaft put down by Mr. Brotherton, located 175 feet west of the east line of section 9, he sank through 30 feet of loose ledge before meeting with anything "in place," when the ore vein was found dipping regularly to the north at an angle of 70°. The shaft was sunk 51 feet, the last two feet in a lean, soft ore. A 36 feet down a cross-cut was driven south 13 feet, the first 10 feet of which was in good soft ore; the remaining 3 feet was a lean soft ore similar to that found in the bottom of the shaft. Opposite this cross-cut is another drift driven to the north 11 feet. The first nine feet of it is through the lean, soft ore, and then is cut about two feet of good soft ore; the end of the drift is in banded jasper. The past season the shaft was sunk to 59 feet. The lean, soft ore in the bottom of the shaft proved to be only five feet thick, as first-class soft ore was found beneath it; but after sinking in this for four feet the water came in too fast for the bucket.

Samples taken from the upper vein and bottom of shaft afforded, on partial analyses, respectively as follows:

	No. 1. (Upper Vein)	No. 2. (Lower Vein.)
Metallic iron.....	64.15	63.21
Alumina.....	-----	.76
Lime.....	-----	1.66
Magnesia.....	-----	.41
Manganese oxide.....	-----	.68
Silica.....	-----	5.76
Phosphorus.....	.026	.027

Mr. Brotherton sank two other shafts, one 900 feet west and the other 1,100 feet west. First-class soft ore was struck in the first one at 21 feet below the surface that continued down for 5 feet, then followed 10 feet of

quartzite and below that good soft ore to the bottom of the shaft, 44 feet from the surface; at that point they were compelled to stop sinking on account of water coming in too freely for the bucket and windlass. The present season the shaft was sunk 8 feet more in the ore, when the water again proved too much for the bucket. The west shaft struck good soft ore at 27 feet from the surface; at 39 feet cross-cuts were driven to the north and south each, 12 feet in length, and in good soft ore, with the exception of an occasional boulder of quartzite. The cross-cuts with the shaft give a thickness of vein, measured horizontally, of 30 feet.

Analyses of the ores of these two shafts afforded respectively as follows:

	No. 1.	No. 2.	No. 3.
Metallic iron.....	66.62	63.96	64.68
Silica.....	2.54	3.47	2.74
Phosphorus.....	.006	.039	.024

No. 1 is from top vein of shaft 900 feet west, and No. 2 from lower vein of same shaft. No. 3 is from west shaft.

The parties holding the lease of this property are Messrs. Pickands, Mather & Co., F. H. Brotherton and Chas. E. Wright. These parties have on the ground a steam boiler, pumps, and one of Merritt's small external friction hoisting machines that gives the very best of satisfaction.

A shaft is now being sunk at 60 feet west of Brotherton's west shaft in the foot wall quartzite. It is the intention of the above parties to open the property this winter for active mining.

SMITH MINE.

This property is immediately east of the Brotherton Mine and embraces the west half of the southwest quarter of section 10. It was leased by Geo. M. Wakefield, Esq., March 3, 1883, to Messrs N. D. Moore & S. S. Vaughn, of Ashland. About the first of June of the same year they began exploring on this property. Their first shaft was located 175 feet east of the west line of the section, or 350 feet east of the Brotherton's east shaft. A fine quality of soft hematite ore was struck in the shaft at 30 feet from the surface, and at 42 feet a cross-cut was driven south, showing in all 11 feet of ore that dipped at a high angle to the north; the north side of the shaft was rock. One hundred and twenty-five feet east of this another test pit was sunk 25 feet and then bottomed on the foot wall quartzite. One hundred and fifteen feet still further east another test pit was sunk 40 feet, and then cross-cutted to the north, cutting a narrow vein of ore. Other test pits were put down to the south of this that bottomed on the foot wall quartzite.

In October, 1883, the Sunday Lake Iron Co. was organized; capital stock \$500,000 in 20,000 shares. N. D. Moore, President; C. T. Bowen, Vice President; Angus McKinnon, Secretary; S. S. Vaughn, Treasurer.

Mr. Vaughn sold out his interest, and H. D. Smith, Esq., Appleton, Wis., now owns an 8-15th interest in the lease.

Early the present season J. Wells Smith, Esq., resumed work in No. 1 shaft; at 72 feet down Mr. Smith drifted east 30 feet, all in a fine quality of soft hematite ore, but the water flowed in so freely that they came up in the shaft 12 feet, or 62 feet below the collar of the shaft, and then drifted east

90 feet. Forty-two feet east of the shaft, at that level, the vein was cross-cutted and showed a width of 13 feet, though it is questionable if the true hanging wall was struck in the north drift, for only 23 feet farther east a cross-cut shows 23 feet of ore on the north side of east and west drift, and five feet on the south side. Twenty-four feet farther east, or 86 feet from the shaft, the vein was cross-cutted again, showing a width of 22 feet. After this nothing more was done until this fall when Mr. Smith began mining operations. He built a regular mining camp, large enough to accommodate from 25 to 30 men; erected a long, high trestle from the shaft to the railroad track; also a building over his engine and boiler; and has nearly completed a test cargo of the ore of 1,400 to 1,500 tons. The ore is an excellent quality of hematite very low in phosphorus and above 60 per centum in metallic iron. It is the intention of the company to thoroughly open the mine the coming winter and be prepared for next season's work; also to do some exploring to the south in order to test the south vein.

ASCHERMAN MINE

embraces the east half of the southwest quarter of the same section as the Smith mine. Considerable exploring has been done on this property. Carnegie Bros. & Co., of Pittsburgh, Pa., held an option on the property the latter part of this season. They continued one shaft to 105 feet below the surface, besides doing considerable other work, but were not altogether satisfied with the prospects and surrendered their option.

The deep shaft is located about a hundred rods south of the east and west center line of the section and ninety rods east of the west line of the section. In this shaft, at 60 feet down, a vein of soft hematite ore was cut.

After the abandonment of the property by Messrs. Carnegie Bros., Capt. James Tobin began exploring the upper vein of the shaft for Geo. W. Wakefield, Esq., the owner of the lease; and at the time of a recent visit—Oct. 25—they were cross-cutting south into the vein; the ore is a fine looking soft hematite, though mixed with an occasional boulder of quartzite. Mr. Wakefield writes Nov. 17, that they had then drifted "65 feet west in clean ore and 97 feet east," and the following is an analysis of the ore contained in the same letter:

Metallic iron.....	65.075
Silica.....	4.230
Phosphorus.....	.031

This analysis, Mr. Wakefield claims, is an average of the vein.

Mr. Wakefield purposes to keep at work this winter from 35 to 40 men; he intends also to thoroughly explore the southeast quarter of the above section that is now included in the same lease; he will also explore for the south vein, though the earth covering is from 40 to 50 feet in that part of the section. Mr. Wakefield now considers the prospects very flattering for developing a good mine on this property, and his statements certainly warrant the belief.

To the west of the Brotherton mine, on the southwest quarter of Section 8, J. H. Alward, Esq., is exploring. He has found some very fine ore, but not in sufficient quantity to pay for mining.

Farther west on Sections 7, 18, T. 47, R. 45, and Sections 13 and 14, T. 47, R. 46, considerable exploring has been done during the past three years.

In Sections 7, 18 and a part of 13, deep drift and water has heretofore seriously interfered with the work; but now, with transportation facilities at hand, when it is comparatively an easy matter to make use of steam pumps, the question as to whether large deposits of iron ore exist on these sections cannot long remain in doubt.

On the northeast quarter of Section 14, known as the "Hart & Shores mine" I understand is looking very favorable. The ore is an excellent quality of bessemer, very low in phosphorus and rich in metallic iron, but was formerly somewhat mixed with rock. In next year's report there will no doubt be some shipments of ore to report from these sections.

LONGYEAR MINING CO.

The explorations of this company are located a short distance west of the mine workings of the Colby mine, and are in the northwest part of the N. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Section 16. About 130 feet southeasterly from the northwest corner of this forty are two test pits in the ore; the surface here is about 22 feet deep. From the bottom of one test pit, 33 feet down, a cross-cut is driven south that cut ten feet of ore. The strike of the formation is N. 70° E. and the dip is to the north. This, it will be seen, gives but a short run of that vein on this forty.

On the southwest quarter of Section 16, same town as above, Alexander Maitland, Esq., and Captain N. D. Moore had just started a small party of men to explore. The men had one test pit down on quartzite and were about starting another farther north. The property is considered a good one.

Farther west on the west $\frac{1}{2}$ of the S. E. $\frac{1}{4}$ of Section 17, T. 47, R. 46, are the explorations of the

IRONTON MINE.

In 1882 Messrs. Vaughn, Moore & Co. had a lease of this property from the Canal Co. and did considerable exploring.

At the time of my first visit, June, 1883, there were two shafts down into the ore. No. 1, located near the west line of the eighty and about 70 feet south of a point midway between the center of the section and its north quarter post. No. 1 shaft was down 70 feet, 60 feet in dirt and loose ore and then 10 feet in the ore. From the bottom was a cross-cut north of 28 feet in ore and then 7 feet in quartzite and mixed ore. These shafts are in the south vein. Nothing more was done here until October of this year, when Messrs. Carnegie Bros. took an option on the property. They had just begun working under the direction of Captain William Ross. It is their intention to "show up" the south vein and to explore for the north vein. The ground gradually ascends from near the east side of the property to the west, and at No. 1 shaft attains an elevation of about 150 feet above the ore low land.

Adjoining the Ironton on the west are some explorations made by Geo. S. Fay, Esq., in 1882, for Messrs. Merritt & Co., who held a lease from the Canal Co. Mr. Fay proved the vein for 650 feet in length.

The present season J. H. Alward, Esq., continued the explorations and tested the south vein from No. 1 shaft of the Ironton mine westward for 1,600 feet; the vein varied in width from 5 to 35 feet. The earth covering in most of the test pits and trenches was very light. The ground ascends slightly to the west and lies well for mining purposes.

This fall the above parties sold their lease to Hon. J. H. Chandler and others of Houghton, who will soon begin operations. They purpose to explore the north vein and will "open out" on the south vein this winter. Section 17 is a very promising one for iron ore, and it will greatly surprise me if a good mine or so is not developed on it.

Farther west on the S. $\frac{1}{2}$ of Section — and the N. $\frac{1}{2}$ of Section 19, T. 47, R. 46, considerable exploring has been done, and it is claimed with encouraging results. None of the properties were being worked at the time of my visit, except the N. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ of Section 19, therefore but little can be said regarding them. On the above described eighty J. H. Alward, Esq., has just "started in" three men who had struck hematite ore in a trench.

On the N. $\frac{1}{2}$ of section 24, T. 47, R. 47, N. D. Moore and others had just finished a regular mining camp and were beginning to sink some test pits on the eastern and western portions of the property, but at that time had not "bottomed" any of the eastern pits, and only one of the western ones had struck the vein. Since then I learn that they have partially developed a promising vein of ore.

ASHLAND IRON MINING CO.

This company filed articles of association October 9, 1884; capital stock, ,000,000, divided into 40,000 shares of \$25 each; cash paid in, \$10,000.

The officers of the company are: J. O. Hayes, President; E. A. Hayes, Secretary and Treasurer; Hugh Richard, Vice President.

The property embraces the N. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$, Section 27, and the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$, Section 22, Town 47, Range 47, Mich. The first described eighty is leased from the Canal Co. and the latter from the J. C. Ayer estate.

There are two working shafts 245 feet apart; No. 1 is the westerly one and is S. 70° W. of No. 2 shaft. It is 102 feet to the bottom of the "sumpf" and 87 feet to the first level. A cross-cut leads to the north 18 feet, through soapstone, and meets a hard, steely specular ore. This ore is exceedingly hard to drill and therefore expensive to drift in. From where the cross-cut intersects the ore are wide drifts or chambers leading to the east and west. To the east for 50 feet the drift is 15 feet or more wide. It is in specular ore, with here and there bunches of reddish quartzite. The soapstone lies on the foot wall or south side. At 50 feet east from the cross-cut a decomposed felsitic vein of light pearly gray to pinkish white kaolinite obliquely crosses the opening on a northeast and southwest course. To the east of this fissure vein is a purplish brown to bluish soft hematite ore. The chamber here widens to 38 feet, cutting away to the foot and hanging wall sides of the soft ore vein, with no hanging wall yet in sight.

The quartzite on the foot wall side is in places more like a hard-pressed sand bank, caused apparently from the decomposition of the matrix or cementing material of the quartzite. This is not to be wondered at, as the water forcing its way downwards naturally follows the junction of the strata, fissures and joints, dissolving a portion of the mineral ingredients of the

rocks it traverses and again replacing it with others. It is highly probable that the purity of some of the soft hematites is due to this very process, as has been noted in previous numbers of this report. Many of the soft ore veins were originally, no doubt, very siliceous, but "alkaline" water filtering through them under pressure, especially if by any means they had become broken or shattered, would in time carry away the silica in solution and leave the iron oxide and other bases behind.

The foot wall, as noted above, drops away to the south about 15 feet, but at 50 feet to the east it turns sharply to the north for 15 feet and again takes its regular course to the easterly. No true hanging wall was seen, but within 20 feet or more of No. 2 shaft is a large mass of rock in the ore vein. It is probably only a "horse," as the ore appears to be making around on the north side of it, and then, about the same distance easterly from the shaft, the ore is cutting it out to the north. They were "breast stoping" some 15 feet high by 35 feet wide, and were in 54 feet easterly from No. 2 shaft. The vein on this side of the shaft was 38 feet wide, with no hanging wall in sight.

One interesting feature is the presence of occasional rounded boulders of quartzite in the ore. Whether these boulders will disappear in depth is a problem that may throw some light on the origin of these hematite veins.

The Nevada system of timbering has been adopted here, but it will probably prove too expensive for the present price of ore to be long continued.

The plan now being adopted by some of the older hematite mines of the Marquette and Menominee districts for supporting the walls of the underground workings is to sink the shafts a number of levels below where the ore is mined out and then drive longitudinal drifts along the foot wall to either side of the shafts, thereby drying the "ground" above that will enable it to stand better during the course of mining; then to begin and back-stope the ore towards the shaft, the width and height of the stopes depending on the character of the ore and width of the vein; then to mill in dirt or other material to replace the ore. The cost of putting in loose material, such as sand or gravel, with proper appliances, where it is convenient to the mine, should not cost more than 30 cents per cubic yard. A cubic yard of hematite ore will weigh in the ledge about $2\frac{1}{2}$ tons, or say $12\frac{1}{2}$ cents per ton; now if $2\frac{1}{2}$ cents be added for the sinking and maintenance of the dirt shafts, we have a total cost of 15 cents per ton of ore mined. By this method all or nearly all of the ore is taken out, and there is no danger of caving in from defective timbering and the mine is always practically safe. This system is no experiment, as it has been in operation for several years in Europe. An occasional stoll is needed to support temporarily any loose ground.

To the west of the cross-cut from No. 1 shaft is a drift leading westerly, from five to seven feet wide. The first few feet of it is in hard ore, but the most of it is driven in soapstone. At 70 feet from the shaft is a cross-cut branching a little to the right for 35 feet. The branch follows a narrow lense of ore. From the branching off point another drift leads to the south, and at 18 feet intersects another lense of soft ore 18 feet across. The lense has been mined out for 50 feet along its length. It appears to have a pitch of about 25° to the east. Its extension east would then pass somewhere beneath the shaft. Should the larger lense between the two shafts have a similar pitch, as is highly probable, No. 2 shaft will eventually become the main working shaft. The ground in the heading of the drifts is quite wet, but it very soon drains out as the work advances.

The plan is to sink two or three levels the coming winter and to drive drifts to the east and west that will obviate the "wet headings" in the levels above.

On the surface, 150 feet westerly from No. — shaft, is a test pit 57 feet deep, the last ten feet of which is in ore; a cross-cut at the bottom of it, said to be 21 feet deep, all in ore and no walls. This is probably the same lense of ore described in the main workings below, as a pitch of 20° or 25° would adjust the two nicely. Another test pit was sunk 200 feet to the west in the low ground that bottomed on ore, but it was too wet to cross-cut. It is the intention of the company to put down a working shaft this winter and develop this westerly lense of ore. They will also add to their mining machinery.

The officers at the mine are: E. A. Hayes, Manager; J. A. Wetmore, Assistant Manager; J. H. Taylor, Mining Captain; Daniel Sullivan, Second Mining Captain.

The ore is a fine quality of bessemer, and I understand has given excellent satisfaction.

For the shipments of ore see table at the end of the report.

About half a mile easterly from the Ashland is the

NORRIE MINE.

This mine is located in the S. $\frac{1}{2}$ of the S. E. $\frac{1}{4}$ of Section 22, T. 47, R. 47, Mich. The first exploration for iron ore was made on this property by Capt. Jas. A. Wood for A. L. Norrie, Esq., about the middle of July, 1882. Mr. Norrie holds a lease of the same from the J. C. Ayer estate. Ore was found very soon after they began work, and within two months Capt. Wood reported "a length of vein of first-class hematite ore of 660 feet and a width of 24 feet." An analysis of the ore taken at that time afforded: Metallic iron, 63.65; phosphorus, .040; silica, 2.59.

The exploratory work was continued until late in the fall of that year, and resulted in showing an apparent length of 1,200 feet and width varying from 6 to 60 feet.

Early this season Mr. Norrie entered into an agreement with the Metropolitan Iron and Land Co., whereby it mines the ore and gives Mr. Norrie a certain share of the net profits. The officers of this company are S. S. Curry, President; H. S. Hazelton, Secretary; R. H. Hanna, Treasurer; J. D. Day, Superintendent; Wm. Treblecock, Mining Captain.

The present mine consists of three shafts and an open trench. No. 1 shaft, the middle one of the three, is located in the center of the property. It is sunk 90 feet; the first 25 feet is through surface, and the remaining 65 feet in ore. The shaft was sunk vertically for 60 feet to the foot wall and then to the bottom on the foot wall. The foot wall dips to the north about 50° and has a strike of N. 70° E. No. 2 shaft, the easterly one, is 190 feet from No. 1, and is sunk 120 feet. The first 90 feet of it is vertical, and from there down on the foot wall. The underground workings of Nos. 1 and 2 shafts are connected, and may be briefly described as follows:

From the bottom of the middle shaft is a large drift driven westerly along the foot wall for 210 feet to what is apparently the west end of the lense of ore, the ore in the west end of the lense becoming much harder; in fact much

of it is quite steely and hard like that of the west end of the Ashland mine. To the east of the shaft a large drift extends along the foot wall to No. 2 shaft. At 25 feet east of No. 1 shaft is a cross-cut ten feet wide by eight or ten feet high, driven north 110 feet, through soft hematite ore, to the hanging wall of lean ore and soapstone. At 55 feet east is a 75 foot cross-cut to the north, all in ore; at 95 feet is a 75 foot cross-cut to the north; at 105 feet is a 45 foot cross-cut to the north; at 135 feet is a 35 foot cross-cut to the north; all of the cross-cuts are 10 feet wide and 10 feet high, and arching at the top. The object of opening the mine in this manner was to get ore for this season's shipments. To the west of the middle shaft a similar plan was adopted. Twenty-five feet west of the shaft is a cross-cut driven 78 feet north, with quartzite in the breast of the drift. This is probably a "horse of rock," as the 110 foot cross-cut, only 50 feet east of this point, met with nothing but first-class hematite ore, and again from the north end of the long cross-cut is a drift leading to the west that is nearly opposite and north of the 78 foot cross-cut. As at the Ashland mine, there are large rounded boulders of quartzite in the ore, and the quartzite next to the ore is frequently disintegrated into common sand.

The ore is apparently in a lense form, the horizontal section of which appears to be 400 feet long by 110 feet wide, north and south. The ore is a soft hematite and works well and free in the furnace. It averages about 62 per cent. in metallic iron and .047 in phosphorus.

The plan of working the mine has not been fully determined upon, though the "filling in plan" is seriously talked of. It is the present purpose to sink the shafts two or three levels and open out below, then can a system of taking out the ore be more intelligently devised.

The company intend to mine not less than 100,000 tons of ore next year, which can be easily done, provided the quantity of ore is what it promises to be and the mine be properly opened out this winter.

The west shaft is 350 feet westerly from the middle shaft. It is down 75 feet, the first 35 feet through surface and the remaining 40 feet in ore. From the bottom of the shaft is a cross-cut to the north of 68 feet in a steely, hard ore; the breast of the drift is in a lean, hydrated ore. West of the shaft, 30 feet, another cross-cut has been started north in ore. The longitudinal drift westward is driven along the foot wall and is now 90 feet from the shaft.

East of No. — shaft, about 600 feet, a shaft is being sunk and is down 19 feet, 14 feet of which is surface and 5 feet ore, foot wall on south side of shaft, and thickness of vein not determined. The plan is to sink the shaft to 100 feet and then cross-cut the vein; also to open out to the east and west from the shaft. East of this shaft and near the east end of the property is an open trench, from which some ore was mined this summer. The vein varied from 3 to 20 feet in thickness, but in the present bottom of the trench it has narrowed to 7 feet. It is possible that this narrowing of the vein may be only of a local character.

The local management of the mine cannot be otherwise than first-class, as Superintendent Day and Captain Treblecock are both able and experienced mining men.

The total shipment of ore from the mine for the season is 15,591 gross tons.

To the easterly about half a mile are the Aurora and Vaughn mines that are now consolidated under the title of the

AURORA IRON MINING COMPANY.

The original lease of the Aurora embraced the E. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Section 23, T. 47, R. 47, Michigan, but since the consolidation with the Vaughn it includes the N. $\frac{1}{2}$ of the S. E. $\frac{1}{4}$ of the above section.

The first described eighty was known in 1883 as the J. H. James option. Early in 1883 the Vaughn Iron Co. was organized on this eighty. Very little work had been done July, 1883, on the Aurora, but on the Vaughn the following notes were taken by myself at that date: "No. 1 test pit, 325 feet S. S. E. from the northwest corner of the eighty, is 26 feet deep, 11 feet of which is surface and the remaining 15 feet ore, vein said to be 17 feet wide; ore a soft hematite mixed with limonite and hard, steely blue ore. One hundred feet east are four test pits, 35 feet deep in clean ore and mixed ore, but improving in depth. One hundred feet easterly again is a test pit down in good ore; others not down on account of water. Easterly again 150 feet is a test pit down 30 feet, 10 feet surface and 20 feet in good ore; struck a grayish white foot wall of quartzite in the bottom; drifted north 17 feet, all in clean ore. One hundred feet again easterly is another test pit down to the ore. The trend of the ore vein is north 70° east."

It will be seen that even at that early stage of development there was a fair prospect for iron ore on this property.

Early the present season a syndicate of capitalists became interested in the above properties, with general office at Milwaukee, and have worked them vigorously ever since.

No. 1 shaft of the Aurora mine is located about 800 feet east from the west line of the property. It is 65 feet deep on the foot wall. At 60 feet is a cross-cut each of 85 feet; also drifts to the east and west, along the foot wall, of 65 feet each, all in ore. In the west drift, 40 feet from the shaft, they were cross-cutting north; were in 30 feet, all ore. The cross-cuts and drifts are all ten feet wide and high. This was done to get out this fall a few test cargoes of the ore. A No. 7 Knowles pump takes care of the water easily.

No. 2 shaft is N. 70 E., 150 feet from No. 1 shaft. It is sunk through surface and ore 30 feet to the foot wall, and then for 10 feet more in ore along the foot wall and still going down.

About 500 feet easterly from No. 2 shaft is No. 3 shaft. It is on the Vaughn eighty, and was down 28 feet with ore in the southeast corner. On the same course as above and 300 feet easterly from No. 3 is No. 4 shaft. This shaft is sunk 64 feet, with drifts east and west, each 20 feet.

The strike of the formation, as will be conjectured from the trend of the ore vein, is N. 70° E., and the dip about 60° to the northerly.

Nos. 1 and 2 shafts are located on the north side of a branch track that leads out of Ironwood past the Norrie mine, and Nos. 2 and 3 shafts are on the south side of the track. The ore a soft hematite; analyzes high in metallic iron and low in phosphorus.

The sinking of the shafts and driving of the drifts, getting out two or three test cargoes of the ore, erecting several buildings for the accommodation of the miners and many other improvements have all been accomplished since the middle of July of this year, a little more than three months; surely a good record and one that the management can refer to with pardonable pride.

The consolidation of the properties gives a length of vein of about 3,000 feet, with good workable mines to either side.

There were employed on the location, all told, about fifty men, and were shipping a hundred tons per day. Many of the men, however, were employed at "dead work." The officers of the company are as follows: N. D. Moore, President; M. J. Luther, Vice President; John E. Burton, Secretary; Alvin E. Tyler, Treasurer; George Brewer, Superintendent.

Adjoining the Vaughn mine to the east is the property of the

PABST IRON MINING CO.

This mine was known as the Albany mine until early this season, when the present owners came into possession, and named it the Pabst mine.

The property embraces the S. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$ of section 23, T. 47, R. 47, Mich. The workings consists of three shafts. No. 1 shaft, the middle one, is located 430 feet west of the east line of the section and 100 feet north of the south boundary of the property. It is sunk in the foot wall on an angle of 70° to the north for 35 feet and then 35 feet more at 60° to the bottom of the shaft. At 65 feet down is a large cross-cut, driven 68 feet to the north; the first 12 feet was in the foot wall and the remaining distance all in ore.

A short distance to the northwest is No. 3 shaft, located in the hanging wall. It is sunk through 27 feet of sand and 10 feet in the hanging wall of quartzite and mixed ore.

No. 2 shaft is located about 150 feet northeasterly from No. 1 shaft; it is down 23 feet in the foot wall; will sink it deeper and then cross-cut north.

The vein has been tested northeasterly from No. 1 shaft for 525 feet to the east line of the section.

This winter it is purposed to sink No. 1 shaft to a depth of 150 feet, and then drive drifts along the foot wall to either side of the shaft; also to cross-cut the vein at different points.

The ore averages well in metallic iron, some of the car loads of the ore weighing 22 gross tons each.

The mine has a plant of machinery that will meet all requirements for the coming season, especially the boiler portion of it—a desideratum of great advantage in the opening of a new mine.

Quite a change has been wrought in the appearance of this location within the past three months. A little berg has sprung up here in the wilderness and presents a cozy, comfortable outlook.

Captain Geo. Berringer, one of the pioneers from among the mining men of the Marquette mining district, is the superintendent and part owner of the mining lease. He is ably seconded by Richards James, Esq., the mining captain.

The mine has shipped a test cargo of 1,224 gross tons.

The officers of the company are as follows: Philip Best, President; Chas. Best, Secretary and Treasurer; Geo. Berringer, Superintendent.

This comprises, as far as I know, all of the mines and more prominent explorations of the Agogebic range in Michigan, except those in section 21, T. 47, R. 43, and sections 12 and 13, T. 46, R. 42, Mich., that were described in the commissioner's report for 1883. As nothing has been done on these properties for some time I did not visit them this season.

GERMANIA IRON MINING CO.

Westwards, just across the Montreal River into the State of Wisconsin, and therefore not properly within the limits of this report, is the Germania mine, operated by the same parties as the Ashland mine.

This company was organized in 1884; capital stock, \$1,000,000, divided into 40,000 shares of \$25 each. It embraces the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Section 24, T. 46, R. 2 E., Wis., and is leased from the Northern Chief Iron Mining Co.

The mine consists of three working shafts, Nos. 1, 2 and 3. No. 3 shaft is located near the centre of the "eighty." It is down 65 feet, and was just into the ore. No. 2 shaft is about 300 feet westerly from No. 3 shaft.

The first ore mined from this property was taken out of an open pit, from the bottom of which the shaft is sunk. In July of this year they had reached in this open pit, at 25 feet down, what appeared to be the lower side of the lense of ore; that is, the foot and hanging walls were in contact. This was caused by what seemed to be a longitudinal fault or slip. The formation dips to the north, and the plane of the fault apparently to the south, while the direction of the throw or slip is that the north portion or side of it moved downwards. I didn't have time to examine into this as thoroughly as I would liked to or hope to the coming season, but this hypothesis of structure best accounts for the above conditions.

At the bottom of No. 2 shaft is a cross-cut to the north; the first few feet of the drift was through quartzite, then comes 22 feet of hematite ore; the hanging wall is a lean limonitic ore. Along the foot-wall side of the vein a drift was driven east 85 feet and west 40 feet, all in ore of a superior quality of soft and hard hematites. As no cross-cuts have been driven to either side of the shaft it is impossible to give the thickness of the vein. No. 1 shaft, 295 feet westerly from No. 2 shaft, is sunk 50 feet to the ore. From the bottom of the shaft is a cross-cut 13 feet in ore, but the water coming in too freely compelled them to stop work for the time being. The coming winter they will sink all of the shafts two or three levels, and if the ore proves continuous will connect them by drifts.

They purpose also to continue exploring on the north vein of the property. They have already tested the north vein for 600 to 700 feet in length, and at one point have an apparent thickness of 70 feet of a hard, steely hematite, that is very rich in metallic iron and low in phosphorus.

The officers of the company are: E. A. Hayes, President and Manager; Hugh Richard, Vice-president; Louis Cheynoweth, Secretary; J. O. Hayes, Treasurer; J. A. Wetmore, Assistant Manager, and J. H. Taylor, Captain.

To the west of the Germania are several very promising explorations, some of which will probably be shipping ore early next season.

In regular order, westward from the Germania, and in town 46, range 2 east, Wisconsin, are the Nimekon, of the N. $\frac{1}{2}$ of the N. E., section 26; the Kaukagon, E. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ of section 26; the Wood, the W. $\frac{1}{2}$ of the N. W., of section 26; the Superior, the S. E. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ and the N. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of section 27; the Kennan, the N. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of section 27; the Ryan, the N. E. $\frac{1}{4}$ of section 33; the Section 33 Co., the E. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ of section 33; and the Montreal, the S. W. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ of section 33.

FURNACES.

L'ANSE AS A FURNACE SITE.

It seems to me to be one of the best points imaginable for the manufacture of charcoal pig iron. In nearly all directions there is a world of the best hardwood timber, and it has become accessible. The lands bordering upon the bays—Keweenaw and Huron—are heavily wooded, and cord-wood cut along the margins can be taken to L'Anse by water. From Michigamme to L'Anse, 25 miles, the railroad passes through nearly unbroken forest. Along the railroad, kilns could be built and the charcoal or the wood taken to the furnace by rail. West from L'Anse the new State road through to Ontonagon, 30 miles, is through the finest hardwood lands, good hardwood timber and good soil. Swedes are beginning to settle along this road and to clear up farms. A charcoal furnace at L'Anse would be of great advantage to them, as it would give them a market for their wood and help them to clear their lands. The immense area of accessible hardwood lands, the adaptability of the soil to general farming insure to a company its charcoal for an indefinite period and to any required amount. L'Anse has one of the best harbors on the lake and is also connected with the iron mines by rail; it has an extensive ore dock, and is a shipping point for iron ore. There is an abundance of room for dock for holding ore, for stacking iron, coal, wood, etc. It affords the best possible building sites for a furnace on the level ground adjacent to the water and against the high clay bank which rises abruptly in the rear. The kilns and charcoal sheds can be on the high ground on a level with the top of the furnace, as can also the crusher, etc., thus saving the hoisting of the stock. Hot blasts, boilers, etc., can also be on a level with the top of the stack if deemed advisable.

I have previously spoken of other points in connection with this subject of charcoal pig iron making. Particular mention has been made of the Iron River district and the Crystal Falls district; of the advantages which they possess for the manufacture of charcoal pig iron. The new furnace enterprise at Iron River has been described, and I might as well complete the subject by mentioning those Michigan furnaces which are in actual operation.

In citing these it is proper to begin with the

PIONEER,

built at Negaunee, since it is the oldest furnace operated in the State. The Pioneer furnace went into blast in February, 1858, and has been continuously operated since, saving only such stoppages as necessarily occur. It was origi-

nally the property of the Pioneer Iron Co., which company was subsequently, in 1866, absorbed by the Iron Cliff Co., that now owns and operates the furnace. There are now two stacks, each 45 feet in height, with 9½ feet bosh, and have an average capacity of 45 tons of pig iron per day, using 100 bushels of charcoal to the ton. No. 2 stack is the only one that has been operated the past year. It has turned out 15,718 tons of pig iron during year ending December 31, 1885.

THE DEER LAKE IRON CO.

operates a furnace situated 2 miles north of Ishpeming. This furnace has been in operation since 1868, and was originally a very small one, 7½ bosh and 33 feet high, driven by water, using an 18" turbine under 35 feet head of water. Subsequently, in 1874, a larger furnace was built in proximity to the former, with shell stack 9½ feet bosh.

The furnace produced during the year ending Dec. 31, 1885, 9,245½ tons. W. H. Rood, President, Ishpeming, Mich.

THE FAYETTE FURNACES,

situated at Fayette, in Delta county, are owned and operated by the Jackson Iron Company. The company owns a large body of hardwood lands—16,000 acres—and the furnaces were put into operation in 1867, and in 1873 were making on an average of 25 or 26 tons of iron, each, per day, using 94 to 100 bushels of charcoal to the ton of iron made. This was at that time extraordinary good work, and was not exceeded, nor even equaled by any charcoal furnace in the State. The furnaces have always been well managed and have run on the best of Jackson mine ores.

In 1883 the furnaces were burned, but were soon again rebuilt and put into operation. A large amount of pig iron has accumulated at the furnaces, so they have run but a small portion of the past year, only from January to July, during which time 8,456 tons of iron were made in No 1 stack.

No. 1 stock, in blast from July 1 to July 3, 1885, tons	
of iron made.....	8,456
No. 2 stock (idle).....	-----
No. tons limestone quarried, etc.....	1,319
Average No. of tons of iron made per day.....	45½
No. of bushels of charcoal used per ton of iron.....	123 56 lbs.
Average yield of ore in furnace.....	61%
Height of furnaces.....	54 ft.
Diameter of bosh.....	9½ ft.
Kind of ore used, soft hematite. Quality of charcoal,	
50% soft, 50% hardwood.....	-----

H. G. Merry, Superintendent.

THE VULCAN FURNACE,

Lee Burt, manager, is situated at Newbury, on the line of the D., M. & M. R. R., is a new furnace, in the midst of a fine hardwood region of excellent soil.

and excellent timber. The company holds a great body of these farming lands, which are for sale at moderate prices to settlers, who in turn, in clearing their lands, will supply the company with charcoal for its furnace.

All the buildings connected with the furnace are substantial structures. The same company owns also the Martel furnace, situated at St. Ignace, the eastern terminus of the D., M. & M. R. R., in which line the owners of these furnaces are greatly interested. These furnaces are among the best built furnaces in the State.

Vulcan furnace was in blast during 242 days in 1885, and turned out 11,426 gross tons of pig metal. Number of bushels of charcoal used was 1,118,258, reckoning 20 pounds to the bushel. Height of stack, 53 feet; diameter of bosh, 10 feet 6 inches. Number of pounds of iron obtained from each 100 pounds of ore smelted, was 59; using a mixture of specular, magnetic and hematite ores.

Number of pounds of limestone used per ton of iron.....	101
Pressure of hot blast, (lbs).....	3½
Temperature of hot blast, degrees.....	1,000°

THE EUREKA IRON AND STEEL WORKS CO.

has operated its furnace during nine months of the past year, to-wit: From April, 1885, to December 31, producing in that time an aggregate of 10,904 tons of pig iron.

Height of furnace stack.....	56 feet.
Diameter of bosh.....	11 feet.
No. bushels charcoal used per ton of iron made.....	96,097
Ore used, Lake Superior hematite and hard specular, yielding in furnace.....	60.25%

Office Wyandotte, Mich.

THE DETROIT IRON FURNACE,

situated at Hamtramck, was in operation 282 3-4 days during the year 1885, in which time it turned out:

Of pig iron.....	13,614.820 tons.
No. of bushels of charcoal used per ton of iron made.....	94
Average furnace yield of the ore used (using magnetic, specular and hematite ores from Lake Superior mines).....	59½%
Height of stack.....	50 feet.
Diameter of bosh.....	10 feet.

E. C. Wetmore, Agt., Detroit, Mich.

THE UNION IRON CO'S.

furnace in Detroit has turned out during 1885, a total of 3,343 tons of pig iron. I am unable to give any further particulars. Lee Burt, Manager.

THE BANGOR FURNACE,

situated at Bangor, Mich., W. H. Nelson, Supt., after having been idle for several years, went into blast again on the 9th of July last, and up to the close of the year produced

Gross tons of iron.....	6,891½
Average bushels charcoal used, per ton (2,748 cubic inches).....	90
“ Yield of iron from the ore used.....	60%
“ No. of tons of iron made per day.....	44

The Company uses Lake Superior ores brought from Escanaba to St. Joseph, thence 27 miles by rail. The furnace is in a fine farming country, which is largely under cultivation and the charcoal and wood are largely obtained from the farmers. The daily product is about 44 tons of iron average. Stack 51 ft. high, 10½ ft. bosh.

The furnace was built in 1871 and for the first few years made 15 to 20 tons of iron per day. A few changes subsequently made, run the product up to 40 tons per day, and 106 bushels charcoal per ton. The improvement was due to increasing the blast and using a “Bell-hopper.”

THE ELK RAPIDS IRON CO

operates a charcoal blast furnace at Elk Rapids, Mich., which is one of the largest producing furnaces of its kind in the country. During the past summer the company filled a large order for pig iron from England. Elk Rapids is near the east shore of Lake Michigan,—in the northern part of the lower peninsula—and the company possesses important advantages for obtaining an abundance of hard-wood and charcoal, through the fact that the furnace site is accessible to a chain of inland lakes opening into Lake Michigan. The furnace was built about 1870 and of late years, at least, has been very successfully run. Fifty-three tons of iron per day, as an average for a whole year, is pretty good work for a moderately sized furnace; 60 tons and upwards per day is not an unusual product, and is three times as great as was turned out 12 or 14 years ago in this same furnace. The greatly increased product of this furnace, in the Pioneer, Bangor, Fayette and other charcoal furnaces, illustrates the progress that has been made in iron making in the past decade.

In 1873, 25 or 26 tons per day was extraordinary work, and not exceeded by any furnace in the State; now twice that amount as an average daily yield is not unusual work in the same furnaces. And in accomplishing this result there has been no increase in the average consumption of charcoal, on the contrary, really less is used. Iron is now made with a less number of bushels per ton than heretofore. In the Bangor furnace, the first year it run, they used 140 bushels of charcoal per ton of iron, and in 1875, when the average number of bushels was reduced to 106 per ton of iron, it was counted extra good work.

And the Elk Rapids Co., in raising the product of the furnace to an average yield of 53 tons per day, has also reduced the number of bushels of charcoal per ton to 93. Certainly the cost of iron making has been greatly lessened, as well it should be, when the market price in Chicago is below

\$20 per ton. The following shows the year's work of the Elk Rapids furnace, for year closing Dec. 31, 1885:

No. of days run.....	304
No. of bushels charcoal used (hardwood—beech and sugar).....	1,512,5000
No of tons of pig iron made.....	16,077½
Average No. of tons of pig iron made per day run.....	52 tons, 1982 lbs.
Height of furnace stack.....	47 feet.
Diameter of bosh.....	11½ feet.

Edwin S. Noble, Sec., Elk Rapids, Mich.

THE SPRING LAKE IRON CO.

has a furnace at Fruitport, in Muskegon county, on the east shore of Lake Michigan, which has been from the time it first went into blast extremely successful. It probably has the best record of any furnace in Michigan, and I do not think that the record of the furnace for the past year can be equaled by any other furnace of its size in the country for the same length of time. If the record was ever equaled in a charcoal furnace the fact has not come to my knowledge.

It will be seen that the ore used did not give an extra yield in the furnace, it having been largely soft hematite, Milwaukee mine and Lake Superior mine ores.

The wood used for coaling was not what would be termed extra, but certainly good, 30% hemlock and 70% mixed elm, birch and sugar maple. The stack is 46 feet high, and the diameter of the bosh is 10' 8", not by any means a large furnace. The limestone was from Kelly Island, used for fluxing.

Statement of the working of the Fruitport furnace for year ending December 31, 1885:

No. of days run.....	321
No. of tons of charcoal used.....	1,444,675
No. of tons of ore used.....	28,684 tons, 1870 lbs.
No. of tons of limestone used for flue.....	386 tons, 1220 lbs.
No. of furnace charges run.....	57,787
No. of tons of pig iron made in 321 days' run.....	17,217
No. of bushels of charcoal per ton of iron.....	84
No. of pounds of limestone per ton of iron.....	50
No. of pounds of ore smelted per ton of iron made.....	3,732
Average No. of gross tons of pig iron made per day.....	53½
Per cent. of yield of ore, i. e., No. of lbs. of iron from each 100 lbs. of ore smelted.....	60¼
Per cent. of soft hematite ore used.....	70%
Per cent of hard specular ore used.....	30%
Size of steam cylinders.....	20" diameter, 4' stroke
Size of wind cylinders.....	60" diameter, 4' stroke
Average No. of revolutions per minute.....	27
Average pressure of blast.....	3½ lbs

There are two ovens, one on Player plan, having 24 upright pipes each 12 feet high, giving 850° to 900° temperature of blast.

The other oven is small, old style of horse-shoe or "U" pipes 3¼" x 6½" diameter and 8 feet high. These give a temperature of same as the other. The average hot blast temperature is 875°.

The charcoal is measured, 2,748 cubic inches making a bushel; when made from dry wood a bushel weighs 20 pounds as an average. The furnace is advantageously situated on Spring Lake, so that the ore vessels unload expeditiously in stock house of the furnace. The freight of the ore from Escanaba, put in the stock house, is but 75 cents per ton. Kelly Island limestone, cost, laid down at the furnace, \$1.25 per ton. Freight to Chicago on the iron is 75 cents per ton. Same to Cleveland.

The company has 45 coal kilns, 20 rectangular and 25 round ones. The former holds 80 or 90 cords of wood, and the latter 60 cords. The wood costs \$1.25 to \$1.75 per cord. Wages paid, \$1.25, \$1.40, \$1.50 and \$2.00 per day.

The ore used in 1885 was ¼ Lake Superior mine No. 1 specular, ½ L. S. mine hematite, and ¼ Milwaukee mine ore. The ores bought for 1886 are Colby, Lake Angeline and Cleveland No. 1 hard ore.

From January 1, 1885, to July 1, 141 days, the furnace made 55 tons of iron per day, average, using an average of 80½ bushels of charcoal per ton. For the week ending April 4, 1885, 7 days, the total product was 441 tons, using an average of 68½ bushels of charcoal per ton. The ore yielding 60¾% in iron. The product runs up to 68 and even to 73 tons of iron in a day. These statistics I have taken from the books of the company myself, which were submitted to my inspection.

Mr. J. C. Ford, the manager, and Robert Lameraux, the foundryman, it need not be said are skilled in their work.

THE DETROIT AND LAKE SUPERIOR IRON MANUFACTURING CO'S

furnace at Detroit has been in operation eight months of the past year. It was out of blast from August 15 to December 23.

No. of tons of pig iron made in year 1885.....	4,803
Height of stack is.....	40 ft.
Height of stack from bottom stones to cover of bell and hopper.....	44 ft.
Diameter of bosh.....	9½ ft.
No. of bushels of charcoal used per ton of iron made.....	99¼
The charcoal is weighed and 20 pounds taken as a bushel.	
Average yield of ore in the furnace.....	58 6-10 %

W. M. Gaylord, Treasurer, Flint.

THE PENINSULA IRON COMPANY

manufactured the past year 7,439 tons of pig iron.

Office, Detroit, Mich.

The following table shows the product of Michigan furnaces for the year 1885, and of the five furnaces situated in Wayne county, for 1884 also:

By C. D. Lawton, Commissioner of Mineral Statistics.	1884.	1885.	
	No. Gross Tons.	No. Gross Tons.	Lbs.
Eureka Iron Co., Wyandotte.....	6,000	10,904	
Detroit and Lake Superior Iron Manufacturing Co., Detroit....	7,200	4,803	
Detroit Iron Furnace Co., Detroit.....	6,205	13,619-820	
Union Iron Co., Detroit.....	8,000	3,393	
Peninsular Iron Co., Detroit.....	7,200	7,439	
Bangor Furnace Co., Bangor.....		6,891-1,120	
Elk Rapids Iron Co., Elk Rapids.....		16,077-1,368	
Spring Lake Iron Co., Fruitport.....		17,217	
Jackson Iron Co., Fayette.....		8,456	
Vulcan Iron Co., Newberry.....		11,426	
Deer Lake Iron Co., Ishpeming.....		9,245-1,120	
Iron Cliff Co., Negaunee.....		15,718	
Total No. of gross tons manufactured.....		125,190	

The present tariff on English and Scotch pig iron is \$6.72 per ton.

The foregoing are all the blast furnaces in the State which have been active within the year past.

There is talk of putting the Grace furnace at Marquette into blast. It is an Anthracite furnace, built in 1873, and was only worked a short time. There are a number of idle furnaces in the State, a few of which will never be started again in their present location.

It may be noticed that the furnace yield of ore is less than might be expected, judging from analysis of the ores of many of the important mines, but this result is due to the fact that a large percentage of the ores now used in the furnaces are the soft hematites. In the Michigan furnaces enough of the low grade varieties were used to bring down the per cent. in the furnace. Many of the hematites average below 60% in iron, and then the furnace yield of the ore is always 3 to 5 % less in iron than what the ore yields by analysis.