STATE OF MICHIGAN,

MINES AND MINERAL STATISTICS

BY

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COMMISSIONER OF MINERAL STATISTICS.

BY AUTHORITY.

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LETTER OF TRANSMITTAL

STATE OF MICHIGAN,
OFFICE OF THE COMMISSIONER OF MINERAL STATISTICS,
Ishpeming, Michigan, April 15, 1898.

HON. HAZEN S. PINGREE, *Governor of the State of Michigan.*

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

Respectfully, your obedient servant,

GEORGE A. NEWETT,
Commissioner of Mineral Statistics.

INTRODUCTORY.

Forty years ago little was known of the mineral resources of the State of Michigan. At that time copper, iron ore, salt and coal had been discovered, but little had been done in the way of their development. Much was hoped for, but the most sanguine never dreampt of such accomplishments as the period since that time has witnessed. The growth of the mineral industry has been little short of fabulous, and, while the achievements have truly been marvelous, the greatest height possible under existing conditions has not yet been attained. Each succeeding year not only reveals new deposits of marketable minerals, but with it also comes improved methods for the winning of the treasure from the bosom of Mother Earth that increase former products and so cheapen them as to permit of competition with the most favored of other countries of the world. Gradually our iron and steel is securing foothold abroad, our copper already has the foreign markets, and the keen-sighted capitalists of the Old World, recognizing our superior advantages in the possession of wonderful properties are coming here to take part in the great task of mining and manufacturing so as to be upon an equal footing with the enterprising American.

HIS FIRST TRIP.

No other country has made such strides in the producing of these metals which are so important in the up-building

of all civilized nations. Forty years is indeed a brief period as compared with the efforts of those of the old continent, but it has been long enough to make a name famous in all lands, and one that must redound to our future growth and good.

There are few residents of Michigan, however, who have anything like a proper conception of the greatness of their own State from a mineralogical point of view. Even those who live among the mines would be surprised at the volume of the business annually done. They see the train loads of iron ore going out day after day, but pay little heed to them. They see the barrels of copper piled into the holds of vessels, and glance carelessly at the barrels of salt that are being loaded for transportation to market, but they seldom stop to compute the amount or the value.

Illustrating the importance of the minerals of our State let me say that if all the iron ore produced in Michigan during the year 1897 was loaded upon one train that train would need to be 1,226 miles long.

If the barrels filled with salt produced during 1897 were stood upon end, one barrel touching the other, the line of barrels would have a length of 1,143 miles.

If all the copper produced by Michigan mines during 1897 were drawn into a 10-guage telephone wire, that wire would be long enough to encircle the globe 63 times.

The marketed value of the minerals of Michigan for 1897 was $37,375,000, about one-third of the value of the gold and silver produced in the entire United States during a similar period. The State is first in. the production of iron ore and salt and second in copper, having surrendered first place in the output of the latter metal to Montana. The value of the mineral product for 1897 was the greatest in Michigan's history. Important gains were made over the year previous in iron ore, copper, salt and coal, and there was also an improvement in the price of some of these minerals as well as in the amount mined.

In the mining of its minerals Michigan gives place to a large army of workmen, while associated with the transporting of the product to market thousand of people are employed upon land and water. The capital invested in the industry is enormous. It is not an easy matter to correctly estimate this feature because of the many changes constantly taking place, but the total is a great one. In the iron ore business alone there is an investment in mines, railways, docks and boats of over $200,000,000, while the present price of the shares of Michigan's copper mines, brings their total value to about $95,000,000.

There is yet a vast territory to be explored and thoroughly tested for minerals of marketable kind. In the copper-bearing formations of the Upper Peninsula there are large tracts upon which little in this line has been done, lack of railway facilities having been the principal drawback. Iron-bearing lands are extensive, and important additions to present productive areas will undoubtedly be made as soon as they are needed. For the past few seasons the amount of iron ore has been too great for the demand, but happily this condition has changed for the better. Much interest is being taken in the prospecting for coal, particularly in the vicinity of Jackson, and there are those who predict cokeing coal with which to smelt our iron ores. Should this prediction prove true, it would be a wonderful gain to the State. In salt, new wells are being sunk, and the Wayne district especially is receiving much attention. Michigan is rich in building stone, gypsum beds, and its clays suitable for brick-making are distributed generally throughout the State.

During the year 1897 labor and capital were better paid than in the previous one, and there were few labor disputes, these being of short duration and satisfactorily settled to both sides. In the mines where the most important minerals are obtained, I find the best of attention given to the safety of those employed underground. Excellent ladder-ways are provided, cages and skips used for lowering and hoisting the men are of the best to be had, and are daily inspected by competent men to judge of their condition. Ventilation in the mines is generally perfect, and every precaution is taken against the danger from fire. At each mine are found comfortable change houses, all of which have hot and cold water, are heated by steam, and some have baths. In nearly all the mining locations are mine hospitals in which the injured and sick are cared for, and for which service each miner contributes from 50 cents to $1.00 per month. For this he receives medical attendance and board during the time he is unfitted for work. At most of the mines there is also a fund to be used in case of injury or death. To this the miners each contribute 50 cents per month, and the company adds an amount equal to the total contribution of the men.

In nearly every mine examined I find the men underground working upon contract, they receiving so much per foot of ground sunk or drifted, so much per foot of ground drilled, and so much per car for ore handled between the stopes and the shafts. In many of the mines the tramming of ore underground and upon surface is done by steam, air or electricity, whereas in former years the cars were pushed by men, the work being very laborious and trying. Power drills have taken the place of the hand drillers in most of the mines. Improvement is also noticeable in the explosives handled. In the earlier history of mining there were many frightful accidents due to the nitroglycerine used. Then it was handled as an oil, poured into tin cartridges and lowered into the holes to be blasted. Now it is taken up by an absorbent, clay, sawdust or other material being used, the mixture is perfected by machinery, and accidents from premature explosions are rare. Mining is a precarious vocation at best, however, and accidents are bound to occur.

In the operation of the mines those who are at the head have shown great enterprise. The rapid growth of the

industry speaks for that feature. Nowhere else can finer mining machinery be seen. Michigan is at the head in the way of of fine equipment. It has the deepest shafts in the world, and skillful work is everywhere apparent. It has undertaken and successfully carried out problems that were never before thought possible. It has attracted the best miners from all portions of the world to wonder and profit by its enterprise and energy.

Fine towns have sprung up on all sides of these big mines, and a happy and contented people are enjoying the benefits made possible through the activity of these immense properties. The best of schools are open to the youth of these districts, the towns contain fine public libraries, have modern improvements of sanitary and other kind, and thrift and home adornment is to be seen everywhere. In my visits to the many mining locations throughout the State I have been attracted by the sobriety of the people. It used to be thought that a mining population must necessarily be an intemperate, rough one, but the opposite is the case with Michigan. I find the men and women well dressed, they live well, are progressive and educated.

In my investigations at the mines I have everywhere been courteously received and assisted by those in charge, an aid that has gone far in enabling me to present the pages which are to follow.

I have the same complaint to offer that was presented in my last report: the lack of a sufficient number of copies of the report to supply those who wish them. The demand is far in excess of the single thousand copies the State requires me to print. I have calls from all portions of our own country as well as from the mining districts of the old world, and of my last report, as well as of this, I have printed several hundred extra copies to meet the steadily-increasing demand.

GEORGE A. NEWETT, *Commissioner*.

IRON.

IRON ORE.

Michigan still retains her position as first in the list of states in the Union in the production of iron ore, having now a close second in the State of Minnesota. The place is one it has maintained for many years, and the output since the first shipment began reaches the grand total of 89,841,686 gross tons. For the year 1897 6,476,413 tons were sent to market, this exceeding the shipment of the previous year by 1,027,444 tons. The price was not so high as in 1896, but the demand was better, enabling larger forces to be worked and a corresponding decrease in the cost of production. There has to be nearly as many men employed upon surface when the mines are working decreased numbers underground, the cost of organization and other fixed charges are unchanged, and when the mines are running under check it considerably increases the cost per ton of ore raised. The lower price has demanded greater tonnages from the mines, and all these millions have left their scars at more than one property. Showing the great increase in production, over 16,500,000 of the total of 89,841,686 tons have been mined in the last five years, and Michigan has been producing ore for more than fifty years. When one million tons had been mined and shipped in a single season the producers, when the returns were in, looked aghast, and wondered what the country was going to do with it all. This million has been increased by five and a half millions in a single year from our own State, and there has been wonderful gains from Minnesota and Alabama, and yet it is being consumed. This serves to show the possibilities of our country and to satisfy us that the maximum has not yet been attained.

With each succeeding year, the demands of the furnacemen for higher grade ores have been more persistent. They insist upon lower phosphorous, and have repeatedly changed the rule as to what constituted strictly Bessemer grades, each new table making it more difficult for the miner. The change from iron to steel has demanded the purest ores, and their possession in such quantities is one of the reasons why steel rails and other manufactures of this metal have been exported to European countries in such satisfactory quantities during the year recently ended. But the low prices have not been without some cost to the mines. The high-grade ores are being rapidly exhausted, and at the present rate of consumption the furnacemen will soon have to pay dearly for ores of this class. Where ten years ago the biggest mines were content with an annual output of 200,000 tons, they now more than double that amount, and a million tons has been mined by a single property in one season. This enormous increase will soon have its effect upon the ores of finest quality, and the present big outputs will not be possible. With this point reached, the immense bodies of high-phosphorous ores will have to be given attention, and the making of basic steel will be general throughout the manufacturing districts. The consumption of ores will keep on increasing, and the rich ore deposits must necessarily be diminished in like ratio. Nature is not adding to her stores of this mineral. Time was when the consumers of our ores used to come here and beg for a few thousand tons to keep them running throughout the winter. Of late years the miners have had to sue for business instead of the smelters, but the time is coming when the miner will again be solicited for a few thousand tons of his finest grades, and that time is not so far in the future as many figure. One hears of immense deposits of Bessemer ores upon new ranges outside of our State, and while such ores have been found, and were needed in the market, their Bessemer proportions are not nearly as large as represented, and the ease with which they can be mined but hastens the time of their exhaustion. The miners of ores of this class have realized the actual condition, and have, for the past three years, succeeded in coming to an understanding concerning outputs and prices. This has resulted in

great good to the industry. At this time, February, 1898, meetings have been successfully held to continue this understanding between Bessemer ore miners. It is said that prominent Minnesota interests will not combine with Michigan, but prefer an open fight to secure whatever business can be had. Michigan miners have agreed to a certain price and product. The allotment to the mines will show 1,200,000 tons in excess of the amount apportioned last year, and the price will be 15 cents above that of 1897, which will be largely taken up by the increase in wages of miners. A suppositions ore having 62% iron .045% phosphorus and 10% moisture will sell for $2.80 delivered at Lake Erie ports. Michigan ores are the very best mined anywhere. The world offers no purer. They are both fine and lumpy, hard and soft, and the very fine-grained ores of the Minnesota fields cannot be satisfactorily smelted without admixture with them. They have been handled for years by the furnacemen who understand just what can be done with them.

Michigan excels all other fields in the proximity of her ores to lake shores and to the principal distributing centres of the country. Her mines are located from ten to forty miles from Lake Superior and Lake Michigan shipping ports, and several hundred miles nearer than her next closest competitor to the ports of Lake Erie, to which the bulk of the ores are sent. She has also the advantage of being able to ship ores by all-rail during the winter season, and is able to meet the keenest competition of her rivals.

Besides the ores high in iron and low in phosphorous now demanded by the consumers, there is call also for ores high in silicon, these being used in association with ores of the Minnesota fields lacking in this constituent. These silicious ores are also desirable for mixture with the Mesaba range ores because they are lumpy and serve to keep the finer ores from blowing over in the stack of the blast furnace. Michigan possesses immense deposits of ores of this class. They are being mined upon the Marquette and Menominee ranges, and considerable attention is now being given them.

While the year 1897 was the greatest in iron mining ever recorded in the history of the Lake Superior region, the total product for the three States engaged in the industry amounting to 12,463,783 gross tons, there is now every indication that its achievement will be surpassed in 1898. Large sales have already been announced, consumers report their works to be full of orders, and all look for an active season.

The present finds nearly all the principal mines in the several districts working. Many resumptions have taken place. Mines that were idle since the panic of ,93-4 have already resumed or are preparing to. No idle labor is seen. Every man who is able and willing, and who has had experience as a miner, is finding employment. In December of 1897 the mining companies of the Marquette and Menominee ranges increased the wages of their employes, while those of the Gogebic range were raised the first of February 1898.

In writing of the mines I bring many descriptions up to the time of publication of this report, making them as recent as possible and valuable upon this account. In the reporting of the ranges I will take them up in the order of their discovery, and describe the mines as they are found from the east to the west end of the ranges, locating them with reference to the towns in and near which they are located so that the reader may more readily follow.

THE MARQUETTE DISTRICT.

The Marquette iron ore producing range is one of the most important of the Michigan fields. It was the first discovered and for many years was taxed to its utmost to supply the demands made upon it. Its ores as compared with those of the East and South, the then other regions of supply, was greatly superior, and consumers were anxious to secure its product at almost any price, the best grades selling as high as $12.00 per ton. The original discovery of ore was made at the Jackson mine, located within the corporate limits of the present city of Negaunee, in 1844, but it was not until ten years later that shipments were made to Cleveland, Ohio. Since that time the range has sent to market 49,258,759 gross tons of the total of 89,841,686 tons contributed by the three ranges in Michigan. In 1897 the amount shipped was 2,717,505 tons, an increase over the shipment of the previous year of 106,353 tons. The principal shippers were busy throughout the year with the single exception of the Queen mines, at Negaunee, which were idle for a portion of the time. The ores of the Marquette range are hard and soft, Bessemer, and non-Bessemer, and silicious, all grades used in the market, and from which selections can be made to give any desired quality of iron or steel. The mines are located within fifteen miles of Lake Superior and within 65 of Escanaba, many are owned in fee, having no royalties to pay; they are generally managed by strong companies, having their own boats and in two instances their own railroad, and they are well located and equipped to meet the keenest competition in the market. All mines, with the exception of the silicious ones, are worked underground, which is true of all the mines of Michigan, and nowhere is more enterprise and skill displayed in the operating of iron properties than here. The mines are worked winter and summer, night and day, and give to labor steady employment the year round at remunerative wages. There is prompt meeting of all obligations, and the financial standing of the many concerns is excellent.

There is nothing to report that is new geologically. The district has so often been described that its formations are generally well understood. Briefly, the rocks arc Huronian, containing about thirty members. This series of rocks has been subjected to an enormous lateral pressure in line with its axis, causing foldings of the strata, tilting them sharply upward from their original position. Through this eruptive rocks have intruded. In the folds of the formation the ore is generally found in lenticular-shaped masses of varying size. They are generally of sedimentary origin, the places of reception

for the solutions being in the troughs caused by the folding of the formation. Generally the bottom of these folds are soapstone, impervious to water, and forming a natural place for successful concentration. The formation is often irregular, the ore bearing rocks cover an area having a width of from three to six miles, and the length of the ferruginous district is over 35 miles. It is less readily explored than other ranges in the State due to its greater extent and to the confusing twisting and contorting of its formations. Many places are also heavily covered with glacial drift rendering the task of the explorer tedious and expensive. The diamond drill has been generously employed and has been valuable in locating ore lenses both from surface and from the underground levels of the mines. The eruptive rocks have played a prominent part in making the footwalls of ore deposits and in the protecting of ore masses from the terrible glacial scouring to which this region was subjected.

Besides its red speculars, slate and magnetites, the Marquette range possesses vast deposits of limonite ores none of which are now being mined. They give about 56-58% iron and are high in phosphorous. Eventually these will be in the market. They can be cheapily mined, requiring little or no timbering, and are comparatively free from water. At present they do not command a price sufficient to pay the necessary transportation charges and leave a profit for the mining, and will have to await the time when better grades have grown scarce.

The present active portions of the Marqueite range is in that territory embraced within the south half of Town 47 and the whole of Town 48, and from the centre of Range 26 to the west side of Range 29. Exceptions to this is the Republic mine in the north half of Town 46, Range 29, and the Swanzy mine in the centre of Town 45 and the western tier of sections in Range 25. When all the mines are working place is given to about 4,500 men. There were 32 mines working and shipping ore during the year 1897.

Beginning at the most easterly active property is the possessions of

THE QUEEN MINING COMPANY

operating the Buffalo, Queen, Prince of Wales and Blue mines, now consolidated and worked under one management. These mines are located in the south half of Sections 5 and 6, Town 47, Range, 26. The ore occupies troughs formed by the folding of the siamo slates, these forming the foot wall. The trend of the ore is nearly east and west, and the pitch of the ore bodies is to the west. The Buffalo is about exhausted of ore, and the South Buffalo, the first mine to receive attention in this basin, has been surrendered to the fee owners because of the exhaustion of its ore bodies. The mine buildings which were located upon the South Buffalo have been moved west to the Blue property. The Blue was acquired in January, 1897, and is one of the most important mines of this group. The Queen is in the hands of Corrigan McKinney & Co., of Cleveland, Ohio, and has been operated spasmodically for some years past, this being due, I understand, to troubles with the fee owners. I am informed by representatives of the company that 40 cents per ton is exacted in royalty from the ores taken from the Blue. The product is wholly non-Bessemer. The last shut-down occurred in the latter part of December, 1897, since which time the mine has been idle with no prospect of immediate resumption at this time, February 15, '98. There is talk of a change of ownership and rumor concerning its future are many. Mr. T. F. Cole, who was local manager of the mines for several years has resigned and is filling an important position upon the Gogebic range with the Oliver Mining company.

The ore lenses of the Buffaloes, Prince of Wales and Queen pitch rapidly to the west, the angle of inclination being about 45°, and it will be only a few years more when the mining here will be west of the western boundary lines of these properties.

The Regent lens, the most southern of the Queen mine, has been the important one at this property for the past few years and the ore has been followed westward across the east line of the Blue property, two sets of timbers having been put in upon the new territory. This is from the 6th level of the Regent deposit. The latter, upon the 6th level, has a length of 350 feet and at the 7th, into which they are now opening, it will have a length of about 410 feet. At the east end of the lens the thickness is 160 feet, and at the west end about 170 feet. The water in the workings of the Blue mine is forty feet above the 7th level in the Regent, so that the latter level will not be opened near the east drifts of the Blue until the water has been cared for. They are observing the caving plan of winning the ore, the same as inaugurated upon the start, taking the ore of one level at a time, so that at the 6th they were doing but very little aside from the exploring of the ground upon the Blue mine side of the property. Upon the 7th level they have a drift west from the shaft to connect with a winze that goes down to the bottom drift of Queen No. 1 shaft, to the north.

At one time there was considerable ore of Bessemer grade secured from this Regent deposit, but none is now obtained. There are occasional streaks of Bessemer, but not large enough to be selected at a profit, so it all goes into one grade, their "Prince," which gives 62% iron and .070 phosphorous, it being very steady in its content of iron and phosphorous, and making it a favorite with furnacemen, especially those who arc making basic steel. The Tonowanda Iron & Steel company has used considerable of the ore from this mine and has been weir pleased with it. It is the intention to mine what ore may be found to the west of the Regent upon the Blue, so as to bring the work upon a corresponding level all through the properties. This is to give better chance for the settling of the surface.

The opening of territory to the west of the No. 1 Queen and Prince of Wales has been receiving considerable attention, the bulk of the work done by the company being at this point. The Regent, Queen, and Prince of Wales deposits all occupy a position in the valley running east and west, the lenses of the several deposits being separated by slate and jasper. The latter between the Queen and Prince of Wales was 180 feet thick, but at 100 feet from the Blue line it abruptly ended, the two ore deposits merging into one, giving a width of ore of 380 feet. The slate and jasper did not thin out gradually as is generally the case, but presented a squared end of 180 feet. The losing of this intervening rock makes a very fine deposit of ore which has been followed westward across the Blue line, and makes of the Blue the best property the company possesses, and that by considerable.

The diorite which makes the north food wall of the ore deposits of this valley inclines to the south, and has a decided swing to the southwest, this being clearly shown by the work underground. It shows that the Lucky Star mine just east and so much prospected for in the history of this field, has ore continuing westward from the Prince of Wales property. The curving of the formation also suggests that the properties to the south of the Queen group should be valuable for their holding of ore. It would be very surprising if a profitable continuation of the deposits were not found in that direction. The south wall of the trough holding these deposits observes an almost vertical position. In the ore opened up to the west of the Queen and Prince of Wales there is little rock mixture. Through the Queen Regent lens there has been a dyke of soapstone which has been persistent in every level thus far opened.

In the Prince of Wales deposit there is about a season's work upon pillars above the 5th level. There is a rope haulage plant in this mine as well as one in the Queen. It is the intention to soon abandon the Regent shaft and to use the Blue shaft for taking the ore from the west end of Regent, while the Queen No. 1 shaft will care for the ore from the west end of that side of the property, the two being ample to handle the product of the mines. The ore of the Queen and Prince of Wales gives the same percentage of iron as does the Regent, but is higher in phosphorous, holding .112%. It is like the Regent in structure, being so soft that it can be generally bored with an auger. The only work upon which power drills are used in the mine is in the slate, where drifts have been run connecting the several lenses, so that there is not a very high drilling cost, nor is the explosive cost per ton very heavy. The accomplishment per man, even with the last force worked of 200 men, was excellent, and it could be greatly increased were the property worked to near its capacity, which it is not. The caving plan, working of one level at a time, and putting in sub-levels, has succeeded well here. Few accidents have occurred, and they get the ore clean. Of course the deposit is wide and gives the very best chance for the system in vogue. There have been places where the hanging has proved stubborn, but it has finally been started, and no further trouble is anticipated from the ground hanging up above the ore.

There is a little ore still left in the 8th level of the North Buffalo, which may be sured the coming season, when the lease of that tract will also be surrendered to the owner of the fee.

The Queen presents an excellent appearance underground. There is a large amount of ore developed which can be readily mined when the market calls for it. Those in charge of the property have taken excellent care of it, giving attention to its future, and it is in shape for a big output the coming shipping season if one is wanted. It should be the most important mining property in the city of Negaunee. Its showing of ore is fine, and the chances for increase as they work west are certainly promising. In the absence of a general manager or superintendent, the property is being well handled. Thos. Carmichael is acting superintendent; Richard Roberts mining captain.

This group of mines has produced 2,711,889 tons since they were first opened, and shipped 242,493 tons for the season just ended.

ROLLING MILL MINE.

This property occupies the south half of the northeast quarter of section 7, south and west of the Blue. It is now the possession of Mr. Samuel Mitchell of Negaunee City, having been purchased by him in 1897, he securing both the fee and mineral right. The property was opened in 1871, and worked for some years as an open pit or cut, which gave 234,625 tons of ore. This pit was one of the deepest in this mining region being 220 feet below the level of the surface. A shaft was sunk just south of this pit and was carried down 150 feet. All mining was stopped in 1887 until Mr. Mitchell assumed ownership last year. The property was originally owned by Luther Beecher, of Detroit, who was as eccentric in his mining operations as in others. Captain Mitchell did some diamond drilling from the open pit in the hope of finding one of marketable quality. There is an abundance of ore of silicious kind giving about 40% in iron and of Bessemer grade but he wanted something better than this. Thus far he has been unsuccessful. During 1897 3,975 tons of ore were shipped, making the total produced for the property 238,600 tons. This was all of the silicious class. The property is well located. The Milwaukee mine, long since abandoned, but which during its activity, produced a fine grade of ore, is immediately west. The old Green Bay mine is to the east. Fine ore was also found upon that side. Upon all sides the lean ore is showing, and the formations are identical with that of the Blue. Mr. Mitchell will continue explorations in a systematic manner and if ore is there he will find it, being one of the keenest prospectors and ablest miners in this region.

THE NEGAUNEE MINE.

This property occupies the northwest quarter of section 5, and is north of the mines of the Queen group, and located in the same formations. It is one of the most promising properties in the Negaunee basin, and has the advantage of Bessemer ores, the principal portion of its product being of this desirable grade. It sent to market last year 181,181 tons, the greatest raised in any single year since shipments first began in 1887. The total product to date is 1,004,853 tons.

The Negaunee mine is peculiar in the flatness of its deposit, it dipping at an angle of from 31 to 34°, due to which the work has been carried rapidly from the shaft. The latter is vertical to the ledge to the third level from which point it conforms to the dip of the foot-wall, but the pitch of the ore has carried the work some distance to the north and east of the shaft, so that it the lower levels long distances must be traversed in handling the ore from the stopes to the shaft. Capt. Samuel Mitchell, who is the agent in charge, has been for some time past been trying to secure a favorable location for the sinking of a second shaft. It 13 needed; but it is first his desire to learn more of the ore body. During the past year they have been doing something in the way of opening up the new ore body to the northeast of the old one, to which reference was made in my last report. This gives promise of being a valuable addition. Caving ground shut them off from this new find for a time but they have connected it with a substantial rock drift from the third level, 486 feet from surface. Considerable ore is now being secured from this deposit, and they have raised in it to a height of 90 feet. A rock drift is also being run east from the third level in the direction of the old U. S. Grant property in the hope of catching the extension of the new deposit should it continue in that direction. This drift is in about 600 feet from the shaft, and the breast is showing lean ore, a change from the ground heretofore cut.

The Negaunee is to the ninth level, and its product is coming from the 6th, 7th and 8th levels. The ninth is being opened by preparatory drifts. They take the ore upon square timbers, drive their main drift upon the foot and work from foot to hanging with initial and wing drifts taking blocks of ground 21 feet wide and leaving pillars of the same size. In the course of the time they have been engaged in mining here, a large amount of ore hay been left to retain the flat hanging. Were it not for fear of the water they would cave the hanging, taking the ore upon the settling or caving plan. In the sinking of the shaft great trouble was had to penetrate the overlying quicksand, and the flow of water was a heavy one. The ground is swampy, and Capt. Mitchell believes this to be the outlet of Teal Lake, a body of water located about a mile and a quarter to the west and north. He hesitates about trying a plan that would cause the surface to become so broken that the water from above the ledge would find its way into the mine, believing the volume would be more than ordinary pumps could cope with. To prevent interfering with the hoisting of ore, they have put in raises upon each side of the shaft from the point where the latter begins to follow the footwall. Timber is sent through these, and they also serve as ventilators. In places the capping is flat, the ore showing no perceptible dip. Care is taken to prevent the back of the of the rooms from coming down, heavy timbers being employed in the sets. In front of the shaft there is a pillar of ore 120 feet long which insures the safety of the men and mine. With but one avenue the greatest care is taken to insure against accident. The shaft is kept wet so there is no danger from fire, and a fire pump with hose attached is always ready in case fire should break out in the shaft house.

The ore of the mine is generally soft, augers often being used, and all drilling is done by hand. The greatest care is observed in the mining to prevent mixture of high and low phosphorous areas. There are many variations in the ore body from one grade to the other and constant determinations by the chemist are necessary to keep the ores properly separated. Through the ore body there are frequent tongues of paint rock of varying thicknesses. These afford no protection to the hanging, being rotten, with no sustaining power. Wherever this rock is broken it is wasted in the levels, deposited upon long poles in the bottom of the level and lagged upon the sides to prevent mixture with the ore. In the lower levels the the formations are much weaker than in the upper where they mined out large rooms under the capping without the use of timber. The new hoisting plant of Webster, Camp & Lane, two eight-foot drums, is working satisfactorily.

The Negaunee Mining company pays a royalty upon the ore mined, the fee being owned by G. J. Lornstorf, of Milwaukee, and others. The principal office is in Cleveland, Ohio, Wm. Chisholm being president, E. S. Page, secretary. Samuel Mitchell is agent; Thos. Fellow cashier; Alfred Newcombe, mining captain; C. G. Mason mining engineer. The mine is now employing 230 men.

THE BARASSA.

A little east of north, and in section 32, is the Barassa property upon which considerable has been done in an attempt to reach an ore deposit found with a diamond drill many years since. An effort was originally made to reach the ore in a shaft sunk in the overlying quicksand, but after months of trial and the expenditure of about $40,000, it was abandoned. Then there was a few years of idleness during the panic. In the summer of 1896 the company went north of the swampy ground so full of surface water, and began a shaft in the outcropping slates. This was put down to a depth of 280 feet, when there was some financial obstacle encountered, and another stoppage took place. Resumption again occurred Nov. 9, 1897 the shaft being continued downward a few feet. In December a drift was stalled south from the bottom of the shaft. This is now in about 70 feet, and a change in the character of the ground is shown in the breast of the drift, it looking as if it would

soon strike ore. The company has received an air compressor of the well-known Rand manufacture. It has a capacity for supplying air for two drills, and with this aid the task of drifting and opening will be made much easier than under the tedious plan of hand drilling.

The Barassa certainly is well located, and recent discoveries in the Negaunee mine indicate that a large deposit of merchantable ore may be shown up. The drill borings found an ore of Bessemer quality, and I look upon it as a promising property. In going to the slates to the north of the ore to sink their shaft the company acted wisely. They will, in the case of developing a paying deposit of ore, have a substantial shaft through which to take it, and from which they can observe the settling plan of winning the product in case they can take care of the surface water. The latter is plentiful, the surface overlying the ore being swampy ground, with a heavy stratum of quicksand. The tramming distance would be little hinderance in these times of cheap and effective power devices for the handling of ore to and from the shaft.

Those who are principally interested in the company have shown great perseverence, and deserve a mine for their faith and effort. Mr. John J. Mack, Sr., of Marquette, has charge. The principal share-holders are residents of Marquette, Negaunee and Ishpeming cities.

THE U. S. GRANT.

Upon this property, which is east of the Negaunee, and upon the same section, considerable work was done before the property was abandoned. William Anderson, of Negaunee, was one of those who were principally interested. Considerable money was unsuccessfully expended in the effort to find clean ore bodies. The location is an excellent one, and it would not be surprising if a mine were yet developed here. In the same basin and further east the Blackhawk exploration was made and finally given up. The water was a troublesome obstacle to those who sought the ledge, and it will take money and proper equipment to explore this wet tract. It is a promising district and the City of Negaunee will yet derive considerable assistance from it.

There is considerable unexplored territory here as to the south of the Queen group of mines, and many promising places have yet to be tested for mineral treasure.

THE GRAND RAPIDS.

This mine is located upon section 7, east of the Rolling Mill and old Milwaukee. It has been idle for two years. There has been litigation in the courts concerning it that is not yet settled. There are two shafts to the 46o-foot level, and a plant of machinery capable of taking care of the ore. The property has produced 110,599 tons. A controlling interest in the fee is owned by the Breitung estate.

THE LUCY MINE

is located just north and west of the Grand Rapids. It has been idle for several years the royalty being considered too high to give a profit to the operator. A portion of the ore here obtained was maganiferous, running from 10 to 12% in that mineral. The mine has produced 494,280 tons. It is now full of water. The fee is owned by the Pendill estate, Marquette, Mich.

THE JACKSON MINE.

The Jackson mine, located upon Section 1, Town 47, Range 27, is the oldest iron mine in Michigan. It was here the first discovery of ore was made in 1844-5. Since then the mine has been wrought steadily, and has produced 3,540,786 tons of ore. The first work done was in open pits, the ore outcropping at surface, but these were finally abandoned and the work was carried underground. The mine produced both hard and soft ores, these occurring indiscriminately in the pockets or lenses. The ore had no great depth, the vein being flat, and as a consequence a considerable area was gone over in following the pitch of the ore to the west, so that the present workings are nearly to the west line of the section whereas the eastern openings are near the east line. In July, 1896, the company abandoned its underground workings, permitted the mine to fill with water, and since then has given its attention to the development of ore that was found just east of their old "Sand" shaft, and which has been mined in open pits. There are three of the latter each provided with a substantial derrick. The ore is massive, large blocks resulting from the blasts and requiring sledging to reduce to a size to permit of handling into the buckets. The ore is considerably mixed, necessitating careful selection to get rid of the soapstone and jasper with which it is associated, and the iron content is not high, giving about 54%.

On the first of February, 1898, work at the pits was abandoned for the winter, as it was not possible to earn any profit by continuing during the cold season, the ore being of too low grade to warrant stocking. It is probable that they will resume work the coming spring when the ore can be loaded directly from the pits into railway cars. Eighty men were employed here when the pits were being worked. The shops of the company are still kept running as work is done here for the Negaunee and Rolling Mill mines.

The pits are free from water, there is no timber required, and the company owns the fee of the property. With these advantages a neat margin of profit could be earned were the ore freer from rock. The pits are about 50 feet deep and there is a chance for an improvement in the ore at a greater depth. The arrangement for the handling of the ore from the pits to buckets and from the buckets to cars is a convenient one. Captain Samuel Mitchell, the president of the company and the manager, knows all about the iron mining business, and will make a mine here if it is possible. The company owns

valuable lands in this section, and there is a chance for other and valuable deposits upon them. It also has fine steel boats to carry its ores to market. Samuel Mitchell, president; Thos. Pellow, secretary, Negaunee, Mich.

TEAL LAKE MINES.

The Teal Lake mines are upon the north side of Teal Lake, a body of water two miles in length, crossing from east and west, sections 35 and 36, Town 46, Range 27. It also encroaches upon the western side of section 31 in Range 27. The mines are northwest of the Jackson.

The Teal Lake range has been worked upon for many years. It has witnessed the starting of mines that have since yielded all they possessed in the way of mineral treasure, and which were once looked upon as of wonderful size and value. As a range it has had many ups and downs. The Cleveland Hematite mine, the property of the Cleveland-Cliffs company, is one that has discontinued operations, having done no work for the past three seasons. There is, marking the scene of former activity, a stockpile of high grade ore containing 100,000 tons which has not yet been marketed. The ore narrowed to a few feet in thickness, extensive explorations with the diamond drill found no continuation of the larger lenses, the property was dismantled of its machinery, and there is no hope of anything more being done in the mining way at that location. The Detroit mine was once an active one, and sold for a good, round sum of money. Its ore deposits gave out at depth, and there is little likelihood of a resumption here. There has been considerable done at the west end of the range, and the chance for finding extensions of the ore deposits of the old mines further west ought to be good. There has been some exploring with the diamond drill, but it is very easy to miss a mine. Some day there will be ore mined to the west of the old Detroit mine. At the eastern end of the range

THE HARTFORD MINE

has been idle the past year. It has ore, but the company has not been sufficiently strong to do such dead work as is needed to reach the ores of better quality than those found near surface. There are two shafts the deepest being 450 feet on its incline. The mine is full of water. The fee is owned by the Teal Lake Iron Co. Benjamin Neeley, Negaunee, is president and manager; S. R. Bell, Milwaukee, secretary. In 1896 a little lean ore was mined from the upper levels. The total product is 14,480 tons.

THE CAMBRIA MINE

is the present most easterly active one upon the range. It has been operated in a quiet way for many years. Its annual product used to run from 20,000 to 40,000 tons, the excellent quality of the ore making it possible to gain a little profit even in the times when competitition was active and prices particularly low. The property has always been conservatively handled. A. W. Maitland, who is agent, has been most careful in his expenditures and under his guidance the work done has counted for the most. In its earlier history the mine was a most difficult one to follow, due to the irregularity of the ore formation. There was a great rolling and twisting of the enclosing rocks, ore deposits were generally small, and there had to be a large amount of dead work performed in the way of drifting from one lens of ore to another in order to secure a product. Upon the 6th level there is now evidence of the peculiar turnings of the ore, and the work that was necessary in order to follow it.

The Cambria differs from other mines outside of the Teal Lake range in this county in that its dip is to the south and its pitch is to the east. Its foot is saimo slate, affording safe ground for its shafts. For the year 1896 the Cambria's product exceeded the 100,000 ton mark, a great gain as compared, to its former achievements, and for 1897 it shipped 110,648 tons, making a total for all years of 959,186 tons. The reason for this increase is due to the better condition of the mine and a great improvement in the size and regularity of its ore deposits. The 9th level, from which the main portion of last year's product was secured, is by far the best which the mine has ever had. The deposits upon which they are now working was struck last year. It is located about 200 feet east of No. 2 shaft, and at the 9th level it has a length of 250 feet, and is 200 feet wide. They are still driving to the eastward in ore. In quality the ore is generally of Bessemer grade, yielding 62% iron and .050 phosphorous. In structure it is firm, brown to blue in color, and needs explosives to loosten it so it can be handled by the miners. It is due to its remarkable hardness, for a "soft" hematite, that they observe the Nevada system of timbering in winning it. It is not soft enough to use the caving plan, where constant drifting is necessary in the slicing of the ground. They work from the bottom of the level upwards. Where the ground will stand well they carry blocks of ground three sets of timber wide by two in height. Where it is not deemed sufficiently firm they take drifts two sets of timber wide. Those who follow after the first sloping gang are on top of timbers, breaking down the ground by the back stoping plan which here works to perfection. One gang is kept far enough ahead of their next nearest one to insure safety to both, and to get the best results in the way of breaking ore. At the time of my visit they had worked upward in the 9th level to within three sets of timber from the floor of the 8th level, the level being seventy-five feet thick, vertically. Pillars 25x25 feet are left as supports, and when the eastern end of the ore deposit is reached they will take these and the floor overhead, working back towards the shaft so as to protect the men.

In the hanging, upon the south side of this ore deposit, there is a large slip of rock that is evidently detached from the true hanging. At several places they have worked behind it, finding ore, and Captain John Deacon, who gives careful attention to things underground, is hopeful that considerable ore will be found still further south of this rock intrusion.

In the southern side of the deposit, and near the west end, there is considerable water coming down. Whether it is following the hanging, or comes from another ore deposit is a question that time will answer. The mine is generally a comparatively dry one. The ore is run through mills to the floor of the level, where it is loaded into tram cars holding one and five-eighths tons, all tramming being performed by hand. There are two winzes connecting the 9th level with the 8th, one of which is used for the handling of timber, an improvement upon the former plan of pulling timber from the bottom of the level upwards.

All mining is done upon the contract plan, the tramming being performed with "company account" men. The No. 2 shaft has been improved by an incline that runs to the third level from which point the shaft is vertical to the present bottom, 657 feet, to the 10th level.

There has been little done upon the 10th level. There is a drift from the shaft to the southeast, crossing the formation, and is evidently too far west to catch the continuation of the ore body now worked upon the level above. They have a little mixed ore in the breast of the drift, and have changed the course of the latter to the eastward. Should the ore be found upon this level as in the 9th, seventy-five feet above, it will be a promising deposit. The ore lenses here have been so erratic, however, that no one is predicting anything, but is awaiting actual developments. Other promising portions of ground have cut out between two levels, and this may also act so, although it is stronger and bigger than the mine has yet shown.

There are many determinations made daily to keep the Bessemer and non-Bessemer grades apart. Mr. B. LaLonde, mining engineer, also looks after the analytical department. The deposit has to be watched carefully, as it is erratic in its phosphorous areas and the latter can only be found by the most careful attention on the part of the chemist. In a few places we saw bunches of ore left upon the foot because they were too high in phosphorous.

Upon the eighth level there is a little work being done in the taking of pillars, and at the old No. 5 pit, to the southwest of the main workings, there is one gang of men scramming in the old levels and obtaining a few thousand tons annually of ore of excellent quality.

The company has a considerable distance to work before striking its south and east lines. To the south the land is owned by the Cleveland-Cliffs company and Jackson Iron company and to the east by the Hartford mine. All the companies operating upon this range pay royalty. At the Cambria about 180 men are employed.

THE LILLIE MINE,

located just west of the Cambria, is also owned by the Cambria Mining company, has the same local management, and has made considerable improvement during the past year. This is principally in the quality of its ore, a most important point, the product having formerly been of non-Bessemer grade. The ore of the Lillie is much softer in nature, and permits of being mined upon the caving plan. They observe the same method as does the Lake Angelina mine, Ishpeming, slicing from the top downward, lagging the bottom of drifts and permitting the "gob" to settle upon this. The plan has worked admirably here excepting in a few places where the ground is too wet, and where they had to wait until it was drained before attacking it. They are now devoting their energies to the 6th level, the 5th having been practically mined out. This level is 677 feet, vertically, from surface. The strike of the ore is northwest by southeast, the dip is south at an angle of 45°, and the pitch of the deposits is to the east. Through the central portion of the deposit to the west of the shaft upon the 6th level the quality of ore is excellent as compared to levels above, and considerable Bessemer is secured. West of the shaft they have opened upon ore for a length of 200 feet, and through its widest portion it is 140 feet, narrowing at either end. To the east of the shaft they have run a drift 300 feet in ore of fair quality, much of it being of Bessemer grade, but have done no opening upon this side of the property to determine its correct size. They have sunk a shaft for another level and will give attention to its opening as soon as the 6th has nearly been worked out.

There is but a single working shaft. This is in the foot, is sunk vertically to the 333 foot station, from which point it is inclined. An old shaft has been repaired so it can be used for ventilation and foot way.

The Lillie is now employing 180 men and its product for the year 1897 was 112,781 tons, the greatest for any single year in its history. Its total product is 704,338 tons. An air compressor was added to the plant during the year, it being one used at the Platt mine, Cascade range. The Cambria Mining company is now one of the largest labor-employing concerns in the city of Negaunee, and the satisfactory condition of its underground workings is fit subject for congratulation upon the part of Negaunee's citizens as well as by the shareholders of the company. Mr. Fred Nightingale, the cashier, will have considerable more money to pay to labor the present year than ever before if the signs of the times are read aright.

The Cambria and Lillie mines are located close to the south shore of Teal Lake, but the formation is dipping away from the lake, so the latter will not be interfered with, nor will the water of the lake bother the mines. It is very likely that ore exists under the lake bottom. A diamond drill boring made into the lake bottom might reveal a condition similar to that found at Lake Angelina, Ishpeming. It is the natural place for an ore deposit.

There is a wide ore-bearing formation here, and the Cambria and Lillie have yet considerable unexplored territory. Between the mines, on the strike of the formation, there is about 1,400 feet yet to be searched and to the west of the Lillie there is a chance for the finding of ore, although the western end of the lens now

being worked in the mine has been reached. The Jim Pascoe shaft, a big one, sunk upon the forty west of the Lillie, did not find ore, but it may not have gone deep enough. Nothing has been done at this location for many years. If the ore market warrants there may be a general revival of exploratory work at several points upon this range, to the east and west of the mines of the Cambria company.

THE CASCADE RANGE.

Four miles south of the Queen group of mines is the Cascade range, which have given support to the village of Palmer. The range has been doing nothing in the way of producing high grade iron ore since the closure of the Platt, two years since. The Platt mined some excellent ore, but the deposit "pinched" and the company transferred its operations from the Cascade to the Mesaba range, where they have a large deposit of hematite and a considerable quantity of water. The Platt was made up of small lenses of ore, the formation was irregular, the ground hungry, hard and expensive to get through, and with the giving out of the ore in sight there was not a great deal done in the way of exploring. There was no money in mining such lenses as the Platt possessed, particularly in the last year of their work, when prices fell to a point where such mines found no encouragement.

THE VOLUNTEER MINE

has been idle for two years. The ore is not good enough to meet the demands of the consumer who calls for Bessemers, and it does not run as high in iron as it should. The property has large stopes that are capable of producing a large product annually for many years to come, but there is no sign of resumption. The company owns a large tract of land located upon the mineral range, and at some other point may possess ore of Bessemer grade. A little exploring was done last year, but nothing of importance found.

There was shipped from stockpile in 1897, 1,617 tons, and the mine has credit for a total of 1,074,704 tons.

W. C. Colburn, Detroit, is president; J. C. McCaul, Detroit, secretary and treasurer; Alfred Kidder, Marquette, agent; Thomas Walters, Ishpeming, superintendent; Mark Elliott, Palmer, cashier.

It is upon the lean ores that work in the Cascade district is being done. Eastward from the village of Palmer, and immediately west of the Starwest mine, better known as the "Wheat," or "Prout," there is a range of hills extending east and west which contains millions of tons of ore of lean kind, these yielding anywhere from 35 to 50% iron, and generally under or near the Bessemer limit as to phosphorous.

The first of these properties met with in going east from the Starwest is

THE RICHMOND,

which is being operated by Negaunee parties, prominent among whom is A. W. Maitland, agent of the Cambria and Lillie mines of the Teal Lake range. The Richmond is working upon the southwest quarter of the southwest quarter of Section 28, Town 47, Range 26, and upon the eastern side of the section. The first work was done in 1896, when an open cut was run from the side hill to tap the ore so that the latter could be run out to the railroad track that skirts the northern side of the hill. In this cut a cargo of ore was mined, but the ground was badly mixed, and needed much sorting to properly clean of its objectionable jasper. Work was resumed the first of last July, the cut being continued southward until at this time they have encountered ore that is but little mixed and it averages about 50% in iron and .040% phosphorous. They are now fairly into this, and have a stope forty feet high by seventy-five wide, which they will carry forward as long as the quality continues to be as good as the present. The ore is of a schistose nature, is much jointed, and breaks finely in the blasting. Thus far they have used power drills, a pair of men making about twenty-four feet per day in drilling, which is excellent work, and gives all the ore that can be handled with the present force, which is twelve men all told, this including trammers and pickers. There is a man at each car to pick rock and one at the railway cars. The tramming from stope to the cars is done by hand over a single track, although there is room in the rock cut for a double track when one is demanded. They use dynamite for all the blasting.

The ore is found for the entire distance across the forty, and three hundred feet south of where they are now working is a shaft in the same kind of ground as they are now mining in, and the ore is continuous for this distance in that direction, although there are probably seams of jasper running through it. It would be surprising if this did not occur in such a formation. Should any of these be met with that possess troublesome proportions they can keep the product up by attacking the deposit upon its trend. They will probably open out the present stope east and west so that a large pit will be had from the three sides of which, east, west and south, the product will be derived. There is but little stripping, it not averaging two feet. With the small force now employed they are mining about seventy-five tons daily, which can be greatly added to as soon as room can be made in the pit for the working of more men.

To the north of the railroad track the hill continues sloping away, affording an admirable place for waste dumps in case they are needed. One could not imagine a better location in which to carry on mining. There will be no water for some time to come even if mining is conducted vigorously. 4,786 tons were shipped in '97, making a total product of 5,874 tons.

Mr. Joseph Richardson has charge of the men, and is doing excellent work. Next in order going east from the Richmond is

THE PRIMROSE VALLEY

at which some mining was done in 1896, and a cargo of ore sent out. It happened that the vein matter was considerably mixed with jasper, a seam of this rock running through the deposit, so that the ore ran very low in iron, due to this mixture. This could have been avoided with a little care in the mining. It may be possible that the company got a little the worse of the assaying at the other end of the line, which not infrequently happens with this class of ore. At any rate they have done nothing in the way of mining it this season. They have the same class of ore as the Richmond, and possess any amount of it, the natural condition as far as mining and loading is concerned being identical with their neighbors. Next east of the Primrose Valley is the property of

THE CONSOLIDATED,

in which Ishpeming people are interested, Mr. J. H. Quinn being president and T. J. Dundon, secretary. They operated two pits, and this is the third season in which they have been in the market. Upon the forty next to the Primrose Valley they did some work where mining was prosecuted many years ago. An old cut into the side hill that was filled with debris and in which second growth was thickly springing, was cleared out, a track laid and the old pit yielded ore equal to any in this range, and they have a vein seventy-five feet wide that can easily be opened out. In the eastern end of this pit is an old shaft that was sunk by Foley and others of Negaunee some years ago. A diamond drill boring was made to the south of this shaft and ore showing 62% iron was reported. This has not yet been sought by shaft or drift, although at some time in the future it may be. This pit is upon what is locally known as the "Gribben" forty.

Upon the forty to the east of the "Richards," there are two pits, the most southerly of which they worked last summer and where the most activity was shown. They stripped the surface, and blasted down the ore, power drills being used in the latter work. The clean ore deposit is not as wide here as upon the western forty, but there is plenty of ore to meet the wants of the company's customers. Some sorting of rock is necessary, as is the case at all of these properties. The north pit is not as rich in in iron as the southern, but it is more uniform and all the vein can be taken without selection. They talk of taking another stope from the bottom of this pit, first sinking a shaft from the sides of which the ore could be broken. In phosphorous it is considerably lower than the ore of the pit to the south. The ore of the pit being worked is run through a rock cut to the cars, but they are forced to transfer it as the cut is not sufficiently deep to run the tram cars direct to the railway. This adds something to the cost, and will probably be obviated another season in case there is an active demand for the ore.

The company mined about 250 tons daily and employed from thirty to forty men. The mining thus far done has been in the summer months, as it would hardly pay to stock an ore of this grade. Mr. James Ames, of Ishpeming, had charge of mining work here.

In marketing this ore a certain allowance per unit is made in case the ore exceeds the guaranteed point in iron, and a like deduction is made for each unit it falls short of the guarantee. In the case of the Consolidated, the shipment for 1897 was considerably under the guarantee so that the season's business profited them nothing. The amount sent out was 5,886 and the total for all years is 22,929 tons.

THE STARWEST MINE

located upon the southeast quarter of Section 29, Town 47, Range 26, was idle during the year. There was shipped from stockpile 942 tons, making a total for the property of 181,944 tons. All the properties upon this range with the exception of the Volunteer are royalty paying.

THE PITTSBURGH & LAKE SUPERIOR COMPANY,

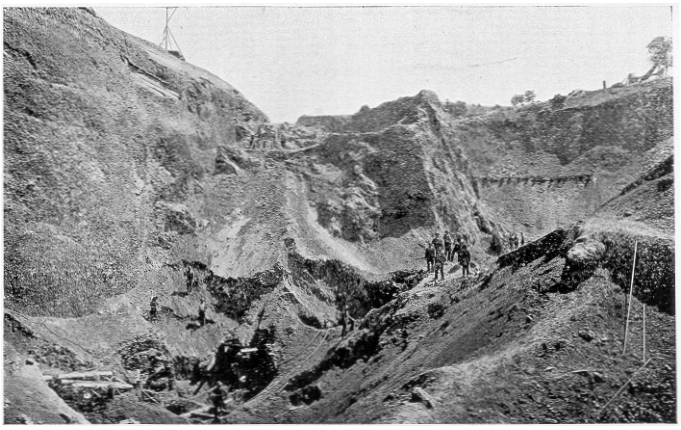
of which Joseph Kirkpatrick, of Palmer, is president, has found ore with the diamond drill upon sections 32 and 33, just west of the Volunteer, but as yet they have done nothing in the way of sinking for it. The company possesses important mineral lands that are well located.

MINES OF ISHPEMING.

Coming westward from Negaunee city the first active mines met with are those of

THE CLEVELAND-CLIFFS COMPANY,

the latter corporation being a consolidation of the Cleveland Iron Mining company and the Iron Cliffs company. This is one of the important mining concerns of the Michigan field. Its properties have produced 9,075,451 gross tons of ore, and are known as the Cleveland Hard Ore, Cleveland Lake Shaft, Salisbury, Cliffs Shaft, Foster, Tilden and Michigamme mines. The company possesses nearly 50,000 acres of land in the mineral ranges of this section, is progressive and important in the support of the city in which it is most active. It was the first to begin iron mining in the city of Ishpeming, and the second in the State, it closely following the Jackson in the development of its mineral treasures. At the present time it is doing much in equipping several of its properties, and will soon be in condition to add materially to its present healthy annual output of ore. The company is half-owner in the Lake Superior & Ishpeming railway, over which the bulk of its ores are sent to Marquette, it also owns the Pioneer blast furnace at Gladstone, Mich., and has a fine fleet of lake ore carriers.



OPEN PIT, CLEVELAND-CLIFFS LAKE MINE.

THE CLEVELAND HARD ORE MINES.

These are located on the eastern part of Section 10, Town 47, Range 27. It was here the company did its first mining in the early fifties, and where an immense outcrop of jasper attracted the attention of the early explorers who fought for possession of the big jasper knob to find at last that it was worth nothing. In the lower ground to the west and north rich discoveries were made, and from the pits here opened mining was carried on for many years. Now they are doing nothing but taking pillars from the old "Sawmill" pit from which 19,273 tons were obtained in 1897. To the south and west of these workings are the Moro and No. 3 hard ore mines. These have been idle for some years and are full of water. The Moro is 708 feet deep, the No. 3 is 635 feet. Upon the same section, and a quarter of a mile south is

THE CLEVELAND LAKE MINE.

This property has been prominently before the mining world for many years. The finding of the ore by diamond drilling from the frozen surface of the lake, the subsequent draining of the water and the opening up of the mine beneath the old lake bottom are all matters of history and have been repeated by the mining writers so frequently that all interested in such matters are familiar with the progress made up to within the past year.

After the water had been pumped from the lake the mine was opened by three levels. The first was at a depth from the surface of 150 feet, and the succeeding ones were 100 feet thick each. Upon the first level they opened out seventy-six rooms, representing a length of ore deposit of 2,760 feet. Upon the second level seventy-two rooms were opened out, and upon the third the length of deposit opened was 588 feet. The plan was to take the ore upon square timbers, the system generally used at that time in the iron mines of the country. The rooms were twenty-one feet, and pillars of the same size were left to protect the hanging. A timber mill was constructed and equipped for the accurate framing of the mine timber, the engineering work in the mine was perfect, and mining was commenced. Work was carried on for a few seasons when it was discovered that the overlying mud was a menace to the decided-upon plan of operation. It was plain that the ordinary method of winning the ore by rooming would be disastrous as the surface could not be retained in place so that the mud could be kept from the mine. The mining was conducted in a careful manner to prevent accident and it was hoped the mud might stiffen by evaporation of the moisture it held, but this was not realized. It was decided to cave the deposit, beginning at the top, as was being successfully done at the Lake Angelina and other mines in this region. Accordingly a sub-level was laid out in the northwest end of the mine, and the caving commenced. In putting the motor track upon the first level it was not carried to the western line of the company's property where it adjoins the Lake Superior's east line. The ground was not opened up because it was thought that the pitch of the ore body would carry the ore out of that level in the western end of the mine, and that sand would be met with as they proceeded west. Subsequent developments have shown the error of this, however, as the sand, after coming down for a short distance, took a turn upward, the ore rising to a considerable height above the level. Under the direction of the present agent, M. M. Duncan, the work of opening out to the west has been carried on until the entire length of the ore body in this direction, and upon the company's lands, has been reached, and they are beating out the ground from west to east. In several places the ore made up into the back, due to the rising of the sand, the capping of this material rolling considerably. It has been in these places where some of the difficulty experienced by sudden intrusions of mud has been met with. Trouble has also come from the giving away of the rooms in the levels beneath the sub-level, letting the mud in, and the greatest precaution has not prevented an occasional too-sudden coming in of the surface. The worked-out rooms have been filled as far as it has been possible, but certain portions of the mine have been shut off by caving ground, and it has not been an easy matter to protect the whole. Had the mine been started at the outset upon the caving plan, it would have been a simple matter to have brought the surface down evenly and without danger to the workings of the property. From the west end of the mine they have worked out a block of ground sixteen feet thick for a distance of about 400 feet, and have it nearly exhausted of ore. The next slice below the first level will have a thickness of twenty-eight feet, and they have the preparatory work done for this so they will be ready to begin active mining upon it as soon as the work above the upper level has been finished.

There will be three slices taken between the first and second level, this dividing the distance equally after figuring rooms for caps and protection to the motor line located upon the second level. It will require several years' active work to complete the task of mining between these levels. Where the surface has been brought in and the weight rests upon the timbers there is no trouble, and no sign of mud breaking through. It has

been in the sudden breaking away where the trouble has been experienced. All the mining being done is upon the north side of the deposit. Through the ore body upon its trend is a large core of rock, hematite jasper, resting upon the ore, and separating the upper portion into two parts. The north foot of the trough stands at an inclination to the south of about 45° at a point midway upon the length of the ore body, while at the western end it is nearly vertical. Upon the south side the enclosing wall is slightly overturned to the north, as is common in this district with diorite folds. This core of jasper has a thickness of 150 feet in places, and cannot be brought down until a large opening is made below it. It thins out going to the east. In the mining upon the north side they work from the north foot back towards this rock capping so they are protected against accident from any breaking away of this huge mass. In cutting up the blocks of ground they put in ordinary drift sets, (timbers just strong enough to take care of the ground safely while they are cutting through) and a little space is left between the lagging overhead so that the ore may be run between it, relieving the weight from the caps. The latter are frequently broken by the weight of the ground where room to take off the strain by letting a little ore run through has not been provided. The same plan is observed in the lagging of floors of the drifts as in other properties using the caving plan for the winning of the ore. The ore here is milled to the second level. One of the reasons for not attacking the ore upon the south side of the jasper capping is that it is the wettest portion of the old lake basin and they were afraid of the surface water, but now ample pumping facilities have been provided and they can begin work here whenever they are ready to do so without fear of the storm water.

The ore in the western end of the mine is considerably mixed with soap rock necessitating careful selection underground. To secure a safe motorway a drift of 1,100 feet has been put through the rock at the second level between the shaft and the west end of the mine. The The north foot makes many abrupt turns from the shaft going west, these being generally in a southwesterly direction. In front of the shaft there is a large block of ore that will not be touched for some time as it would endanger the foundations of the machinery, boilers, etc. These are upon a schist that lies upon the diorite foot, and if the ore were removed there would be a slipping of the "foot" which would be dangerous. No mining has been done for 200 feet upon either side, east and west, of the shaft. At some time in the future it is probable that the machinery will be removed to the south side of the mine. In the eastern end of the deposit they are working a large open cut having a length of 500 feet, and a width in the widest portion, of 250 feet. The ore outcropped here at the southeastern end of the deposit, but it pitches to the west and north as they follow it, so that at the north side of the pit they now have about twenty feet of stripping to remove. The top twenty feet of ore is silicious and beneath this is their "Ishpeming" grade. Both have to be mined in order to secure either one. The ore is milled to the first level and conveyed by electric motor to the shaft. They have worked underground at fifty-six feet above the first level, and have ore below the first level that will be taken by underground mining as soon as the open pit is exhausted. The pitch of the ore is rapidly carrying it to the west. They will take everything in the extreme east end before giving attention to the ore immediately west, as they wish to keep their motor track intact, and cannot cave ground that will interfere with the taking of ore from the present eastern end of the mine. The ore from the open pit, while not of high grade, has been readily mined, but little will be done here from surface after the coming season. The ore in this end of the trough is not as thick as originally estimated, and the pitch carries the deposit very rapidly to the west. However, in the western end of the mine the walls are nearly vertical and the ore may make to a greater depth than at first supposed. Should it also become more free from rock mixture at added depth it would please the management.

The property is one that will be in operation for many years to come and will be valuable to the people of the City of Ishpeming. Thus far it has yielded nothing to the company possessing it. Natural conditions have been against success, but gradually the obstacles are being overcome. The mine is being well handled, and the greatest care is observed in the prevention of accident to life and limb as well as in the protecting of the levels. Captain Thomas Buzzo, one of the oldest mining men in the district, has charge of underground affairs. T. H. Bargh is clerk.

THE CLEVELAND ANGELINE MINE.

This possession of the Cleveland-Cliffs company is located south of their Lake Shaft, being a portion of their Lake mine, 635 feet, and is connected with the latter by a rock drift. The ore is conveyed by electric motor to the Lake shaft. This property is now in litigation, being included in the territory claimed by the Pittsburgh & Lake Angeline company, and until the case is settled but little in the way of new work will be done. The case was decided favorably to the Cleveland-Cliffs in the Marquette circuit court, but has been appealed to the supreme court of this State. Work was begun near the Lake Angeline company's line, the ore making much higher in that end than further west, the pitch being to the west. In securing the upper portion of the deposit they worked upon timbers and were, at the time of a previous visit, about fifteen sets above the first level floor. Since then there has been a settling of the surface so that now they are slicing the ore upon the caving plan and are feeling much more comfortable than under the old order of things. The ore here is of exceptionally high grade, equal to the best found anywhere. As yet the extent of the deposit is not known. The eastern end, down to the first level, has been about exhausted of ore, and they should be preparing new ground to the west, but are awaiting the operation of the courts before doing anything in this line. The ore should make a very fine body further west, but this point can only be decided by actual development. The management is saying but

little about the mine until its legal trouble has been adjusted, but it gives every promise of being a valuable addition, and to help sweeten the lower grade ores of the northern deposit of Lake shaft.

Mr. Duncan and his assistants are doing excellent work under the lake. It is no small undertaking to change the former system and to perfect the many things that must be accomplished before the mine will be in shape to give reasonable returns for the capital and energy expened on the part of its owners.

The product of the Lake Shaft deposits for 1897 was 437,504 tons.

THE SALISBURY MINE.

This property is located upon Section 15, south and west of the Cleveland Angeline mine, and separated from the latter by a huge hill of diorite. Many changes have been inaugurated here during the past year, and the company has expended considerable time and money in bringing them to perfection.

The Salisbury ore deposit occupies a position in a fold of the diorite, (the common occurrence in this city) and the south wall of the trough is overturned in the upper portion of the ore lens. Upon the south wall the machinery for operation of the mine was located. At the time it was placed there the supposition was that the diorite bluff formed the foot wall and would incline north at such an angle as to give safe foundation for the plant. When the machinery was installed the ore of the mine was upon the north side of the shaft, but subsequently another deposit further south and west was discovered, and it was then found that the supposed foot wall upon the south was a hanging for a considerable distance at least. The mining of the ore underfooted the rotten schist upon which the machinery had been placed and the latter has been gradually settling, as has the whole surface of the mine, for several years past. Great cracks opened up along the surface, some of them being under the mine buildings, and this has caused much worry to the management who have taken every precaution to prevent accident, and who have thus far been successful in so doing. The main hoisting shaft, due to the gradual settling of the immense mass of ground, has needed constant attention. Four feet have been cut from the pump rods due to the settling of the surface. The stringers guiding the cage have many pieces cut from them so as to accommodate the track to the settling, and the sheeting of the shaft is forced outward occasionally and has to be repaired. The cage sometimes sticks and then there is prompt attention given to that difficulty, as it is a serious one. The rooms about the shaft have been filled as far as possible and every pains taken to made the avenue secure. A few caves have come to surface and these have been filled.

All of this is very annoying and has greatly handicapped the management in. the securing of a product. They are taking the ore to the north of the shaft, desiring to secure it all before the latter is abandoned, as a new shaft is soon to take its place. To the north of the old shaft there was a magnificent showing of ore in the upper levels. At twenty feet above the ninth level a dyke was encountered running with the trend of the formation that separated the ore into two deposits. At the tenth level this dyke was forty feet thick, and at the eleventh, forty feet below, its thickness increased to eighty feet. In the trough made by this dyke upon the north foot all the ore has been mined, and upon the south side and north of the shaft they are now working out a few pillars, these being between the ninth and thirteenth levels. Great care is observed in the task of robbing, and only the most experienced men are employed. No better lot of miners can be found anywhere than in the Salisbury. They are slicing the ore, taking it upon the caving plan. Everywhere is seen the great weight of the overlying ground. Immense timbers have been crushed and broken into small fragments. Constant attention in the keeping of drifts open is needed. A few months will suffice to finish the work of taking the remaining pillars. There is a considerable tonnage of ore surrounding the shaft which will be gotten when the new shaft is ready for hoisting.

The main deposit of the Salisbury is southwest of the old shaft, and separated from the original deposit by a north and south dyke, having a thickness of about 365 feet. The ore of this deposit is entirely different from that of the old, it being blue and brown whereas that of the old mine was ochreish in color. There are streaks of hard blue ore that are difficult to drill and are very high in iron, running 69% and low in phosphorous. The deposit has a length of about 400 feet and is 250 feet across, it occupying a bowl-shaped depression in the diorite. About two hundred feet on the trend of the deposit and a similar distance upon its width shows ore of excellent quality, a Bessemer, giving from 66% to 67% iron and well under the Bessemer limit as to phosphorous. This is upon the lowest level in the mine, the sixteenth, and 759 feet from surface. They have practically worked out the thirteenth, fourteenth and fifteenth levels, and have opened up the sixteenth so that the ore can be readily secured as soon as the new shaft can take care of it. Above the present lowest level there is considerable ore upon the tenth, eleventh, twelfth and thirteenth levels. Diamond drilling into the bottom of the basin from the sixteenth level shows a considerable body of ore, and bottom was not encountered when the drilling was suspended. The ore of the west deposit will be taken upon the caving plan.

To secure the ore of the west deposit as well as that about the old shaft, a new shaft was started last summer and at this writing has been holed from surface to the sixteenth level, and is sinking for the seventeenth. This shaft is in the diorite foot to the south of the mine, and is about 180 feet back of the ore so that its security is assured. It is 7x20 feet inside of timbers, has three compartments and its degree of inclination to the south is 53. It bears a very little west of south. A considerable portion of the distance is already timbered, from surface to the 8th and from the 12th to 16th levels. It is

connected with the ore deposit by drifts at the eighth, twelfth, fourteenth and sixteenth levels.

The foundation for the new buildings are upon the diorite hill to the north of the new shaft 300 feet. They have the solid ledge, and have made foundations for the machinery of concrete according to the United States government formula. The concrete was poured in immense moulds where it quickly hardened. The main engine, boiler and compressing room is 129' 6^x39' 3", and there is a wing for the pumping engine 22'x21'. The machinery from the old engine and boiler house will be removed to the new. There is a pair of 10-foot drums and all the necessary machinery to operate the mine vigorously.

The combined shaft house and ore pockets are completed with the exception of the introduction of the dumping apparatus. The house is a massive one 35'x35' and 83' high. It has four ore pockets with a capacity each of 225 tons. There will bean ore distributor worked in a circle which will deliver ore to any pocket by simply revolving the central hopper into which the skips dump.

It is hoped that the mine can be kept in operation while the task of removing the machinery from the old to the new building is under way. A temporary hoist consisting of two-six foot drums will be used, and every effort will be made to keep the work of mining going ahead. The principal thing being considered is the changing of the pumping plant. The water will be sent to the new shaft, and it will be necessary to have the water cared for while the change is being made.

The caving plan will work finely upon the west deposit, as already the surface has started. A large crack shows upon the point of the diorite hill to the northwest where the "drawing" ground has affected the rock as well as the soil. There will be no trouble in carrying out the system as planned, as the heavy burden over the ore is loosened upon all sides. In the old mine it was not possible to have operated under the caving system in many places. The capping often was very heavy and strong. There is today a great opening between the seventh and eleventh levels to the north of the old shaft where the roof is still intact, and shows no disposition to give way despite the great openings beneath.

Mr. Duncan and his associates have worked hard to bring the many changes about, and they are gradually getting the mine in excellent shape for the future. The first consideration has always been for the safety of the men. Numerous avenues by which they can escape in case of an accident have been provided. An air shaft was opened out for 500 feet, and many hundred feet of rock drifts to connect the levels with it have been put in. This has taken money, but it makes the miner safe, which is the all-important thing.

The Salisbury has always been a valuable property. Its ore deposits are not large, the lenses being much split up by intrusions of jasper. In the west end deposit the upper levels were much mixed with rock requiring great attention in selecting, but below the fourteenth the ore has been found much freer of mixture and will be more readily mined. Alfred E. Buzzo is mining captain; Walter Sterling, clerk.

THE CLIFFS SHAFTS MINE.

This property is located in Sections 9 and 10, Town 47, Range 27. It is a producer of non-Bessemer hard ore. It yields about 61% iron and .112% in phosphorous. It was shut down in the summer of 1894 having at that time about 175,000 tons of unsold ore in stockpile. In the same year two crushers were put in and the ore reduced so as to make it more salable. Crushing and shipping was kept up until the fall of '97 when all the accumulated stock had been treated, sold and shipped. It was decided to re-open the mine, and preparations for this were commenced in October. Since then much in the way of new work has been done.

There are two shafts, "A," at the east end, "B," at the west. They are to the 511-foot level, are substantial and each is supplied with a single cage. The first level is 348 feet from the collar of the shaft, and there is 40 feet between levels, the 6th level being the lowest. The third has been the most extensively wrought upon its length it covering a distance of 2,410 feet, the eastern extension running to a point not far from the Nelson House, Main street, Ishpeming city. The deposit is a wide one, several hundred feet in places, and it is often very flat. This is particularly true with reference to the northern, side, where they worked out under Lake Bancroft, near the north line of the section. Further south the formation assumes a sharper dip, about 45°. The ore lies in a trough made by a folding of the diorite, its trend is east and west. The quartzite overlies it and the jasper is underneath. The 5th and 6th levels have not been developed, the work consisting of driving the main drifts a short distance from the bottom of the shaft, this being at "A." At "B" the 4th is the lowest level.

The unwatering of the mine has proved a tedious task. They are using two bailers, with a combined capacity of 1850 gallons, and in addition have the Cornish lifts, one with 14-inch plunger, the other with 20-inch, both having 8-foot stroke. The second level in B shaft was reached the middle of February, '98, there being a difference in the level at the shafts of 5 feet. "A" has about five feet of water to lower before reaching the bottom of the level. Additional pumps are being placed in the shafts and the work of relieving the mine of water will be pushed with all vigor. During the middle of February the water was being lowered at the rate of about 8 inches per day.

With the water out the mine will quickly be gotten ready for production. There is no timber in the levels, the ground being sufficiently firm to stand without this protection. There are many magnificent stopes that are ready to attack, and the mine can send out 250,000 tons annually without detrimental crowding. With the water once "forked" the mine makes but little, the Cornish plungers caring for it by making three strokes per

minute. The levels are not thick enough for economical mining, and it may be that they will knock out the bottom carrying the stopes to twice the present height. With more room in height the ground could be broken to better advantage.

The location has been a busy one upon surface since work was resumed last fall. They have added 20 feet to the height of the shaft houses to permit of handling the ore from the shafts to the crusher house to advantage. Substantial trestles have been built between the shafts and the crusher plant the latter being a little south of the line of shafts and 300 feet from "A." The crusher house is finished and the machinery is ready to go upon the foundations which are ready for its reception. There has been a general overhauling of the hoisting, air compressing and other machinery, and everything will be ready to run as soon as the mine is free from water. The mine has excellent buildings, these, with the exception of the dry, being of stone, with iron roofs. The dry has been moved from its former site to the south shore of Lake Bancroft. The old ore pockets, which were substantial, have been moved to accord with the change in the crushing plant. There will also be a change in the railway tracks to accommodate the company's new order of things. A force of about 50 men are employed, which will be materially added to as soon as work underground can be started. J. H. Rough is mining captain; J. F. VanBrocklyn, clerk.

THE FOSTER MINE.

This mine is one and a half miles south and three-fourths of a mile west of the Salisbury, being on Sections 22 and 23, Town 47, Range 27. The mine is to the 8th level, not having increased in depth since my last report. There is one shaft, which is ample to take care of the product. The lenses that were large near surface have gradually "pinched" until at the present bottom they are too narrow to give a profit to the miner. The formation, lean ore and jasper, is a wide one, and the hanging wall of the ore deposits followed in the shaft has not been considered the true one. In my last report I mentioned that Mr. Duncan had an. idea that ore might be found in cutting into the hanging side of the deposit. This idea was given a practical test by the running of a drift into the hanging wall from the 9th level, the lowest in the mine. At a distance of 75 feet a lens of ore 25 feet thick was found. This has been followed upon its trend for 160 feet, and they have raised in it to the 7th level and are still going upward, being in ore. The latter is of the same quality as found throughout the mine at similar depth, a non-Bessemer giving about 54% iron. If the lens acts as did the one worked from surface it should increase in size as they go upward.

There is no timber needed in the mine, as rooms of any size to which the ore makes can be safely worked out. The mine produced 13,520 tons of ore in 1897. The product is suitable for the making of malleable castings, and was largely used for this purpose in the past. Alfred Collick is mining captain.

THE TILDEN MINE.

This property is located just east of the Foster. Something like thirty years ago there was considerable work done there in the hope of locating a merchantable quality of iron ore, but little of this class of mineral was found and the place was abandoned. Ore containing about 40% iron was plentiful, but in those days it was useless for commercial purposes, that being before the lean ores were demanded for mixtures. Indeed, it was not until very recently that a market has been had for ores of this class, they being needed for the silicon held as well as for the iron. Upon the Menominee range the Antoine Ore company has been producing ore of the lean-ore class for the past three seasons, and the Pewabic mine, of the same range, has been prominent as a shipper of excellent grade high-silicon ore for the past two seasons. Upon the Marquette range the Winthrop Iron company has been the heaviest shipper of such ores, and the Consolidated, Primrose Valley and Richmond properties, located upon the Cascade range, of the Marquette district, have done something in the way of supplying the demand for these ores. The Gogebic and Minnesota fields are too far removed from market to be able to sell such ores at a profit, due to heavier transportation charges than the Menominee and Marquette districts, so that thus far the two older districts have furnished the ores of this class. The price has been very low and the mining could not be performed at a profit were it not for the fact that Nature has assisted by placing the deposits where they can be worked as open pits and where no pumping is necessary or timbering required. Fifty cents per ton placed upon the cars at mine is about the price obtained, so that there must be advantages in the way of winning the product to permit of profitable operation.

At no other property of the several that are producing lean ores is there a better showing than at the Tilden, and at no other does the ore come easier to the miner. There is an immense outcropping for a length, east and west, of several hundred feet, the ground rising as it goes east to a height of eighty or ninety feet above the general level of the valley to the west. They began operations near the foot of the hill, opening out to the east, and are now in where they have a stoping face of between forty and fifty feet high. A second cut has been taken and in this the ore cars are run, the ore from the main stope being run directly into them. The second cut is made to permit of the bringing of the cars near the principal pit, and no ore is being taken from it other than is removed in making place for the cars and tracks.

There is little or no stripping to be done, it not averaging more than a foot. They are taking a cut of about fifty feet wide following an irregular roll of jasper upon the south that is evidently not the correct foot, while upon the north the ore widens as they go east and will soon be of great proportions in the pit. Thus far they have taken only the ore directly in the east end of the stope, but gradually, as they enlarge the pit, they will be mining from the north side of it, and will be in shape to largely add to their

product. It would not be a difficult matter, with more opening, and with a better car service, to mine 10,000 tons per month. There is an immense amount of the ore in sight, and a half mile north is another ore formation of about the same extent and quality. The ore is of flaggy structure, jointed and full of seams, and breaks up readily in the blasting and handling. So shattered is it in the work of mining that no crushing is needed. The ore seams are blue and sparkling, and at several places bunches of clean, blue ore are seen that run much above the general average. In iron the ore yields about 42% and in phosphorous .034%. In winning it they put in deep holes with the power drill from surface, shake the ground with dynamite and blast out with black powder. Owing to the broken condition of the ore, they put down a casing so that the powder can be gotten to the desired place, as otherwise the holes would cave, preventing free access of the charge. This consumes a little time, and the burdens lifted are not as great as seen at the Winthrop and other places, but the product is much finer, being ready for furnace, whereas at many mines there has to be much done in the way of reducing large masses by block-holing. Those who have used the ore are well pleased with its action in furnace, it smelting readily, and the iron and phosphorous are very regular.

Mr. Duncan, agent of the company, has arranged things most conveniently here, and at trifling expense. An old boiler and hoist has been set up that has been used in the task of preparing the pit for business, there is a small dry and blacksmith shop, the whole being of a very modest appearance, but ample to take of the work. Water level will not be reached for some time to come, and as work progresses the cost per ton will be gradually lowered as more room is had in which to put men.

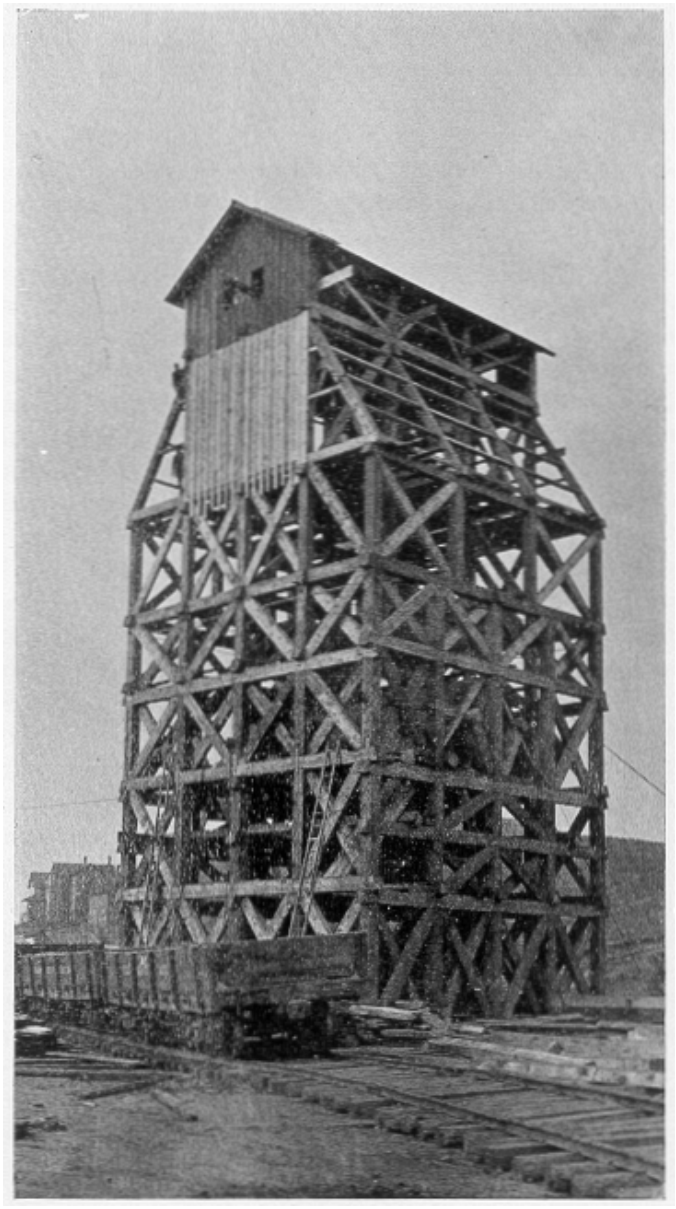
Thirty men are employed in the summer season. Capt. Alfred Collick has charge; 31,370 tons were shipped the past year, two shifts being worked.

The Cleveland-Cliffs company employs about 950 men, working eight-hour shifts in its soft ore mines.

M. M. Duncan is agent; A. J. Yungbluth, auditor; Jas. Jopling, mining engineer; J. N. Esselstyn, assistant; J. M. Vickers, master mechanic; Thos. Martin, clerk, F. J. Baker, chemist. The main offices are at Cleveland, Ohio. W. G. Mather, president and treasurer; J. H. Sheadle, secretary; R. C. Mann, auditor; Samuel Redfern is agent of mineral lands of the company with office at Negaunee, Mich.

THE LAKE SUPERIOR IRON COMPANY.

The Lake Superior Iron company has been operating in this place for forty years, and has sent to market 7,574,150 tons. It was the second to begin mining in Ishpeming city, following close upon the Cleveland. It has ever been a careful, conservative concern, has been one of the staunch supporters of the city of Ishpeming, and has kept its properties busy in winter and summer, night and day, never failing to pay its employes promptly every month. Its local representatives have been prominent in taking part in the affairs of the municipality and in assisting in the improvement of the condition of the city and its people. It owns many thousands of acres of land in Marquette county and has been enterprising in their mineral development.



NEW SHAFT HOUSE, SALISBURY MINE.

The product of the company is not a great one considering the time it has been doing business, but it must be remembered that for years it used hammer and drill instead of steam and air power, that horses and windlasses were employed for the raising of the ore in the place of the massive and fast-moving engines and hoisting drums of today, and that everything compared with the present was of the most primitive kind. For the year 1897 the company shipped from lake ports 376,761 gross tons of ore, this being only once exceeded in its history, a greater amount having been sent out for the year previous, 459,575 tons. The performance of the past two years proves the mines of the company to still be in healthy condition. There has been no wrecking, no

waste, and the careful management of all these years since work was first commenced has made it possible for large products for some in the future. It owns the fee of its mines.

THE HARD ORE.

This property, upon section 9, 47-27, which was the first to receive attention, is now idle. The bottom of the trough or fold in which the ore was deposited has been reached. There may be ore to the west of the old workings, but it has not yet been found. For several hundred feet upon the north side of the diorite bluff which divides the Lake Superior and Lake Angeline mine deposits the ore has been followed east and west to its apparent limits, and the diorite has been found in the bottom at a depth from surface of 950 feet. Nothing has been done in the hard ore for a year or more. Just now a few men under the direction of Captain John McEncroe are barring down loose ground and driving up wedges that are needed to hold the timbers tightly against the roof of the many openings. There is a large amount of ore remaining in the mine, particularly in the vicinity of No. 3 shaft. It is in the shape of pillars and floors, and will take many years to mine. In the work of opening throughout the time the property was active nearly as much ore was left as was taken. The hard ore deposits of this company were large ones in the early history of the mine, and it was from these that the company received its first real start and profit.

THE HEMATITE.

The Lake Superior Iron company is meeting with success in its mining of the new ore body found beneath the bottom of Lake Angeline, and located about 850 feet south of their No. 1 Lake shaft upon the north shore of the lake basin. They are observing the caving plan of winning the ore, and the first settling took place last spring, the work done previous to that time being of preparatory kind, opening the ground so that it could be relieved of moisture, and in getting ready for actual mining.

There is here a body of ore possessing a length of about 500 feet and a width of fifty or sixty feet. It occupies a position in a fold of the diorite that forms the rock of the lake basin. Running through the ore deposit is a tongue of paint rock that has a thickness of from twenty to fifty feet, being thicker in the upper level than at points below, and the miners refer to the ore upon either side of this as the "north vein" and "south vein." The south vein is considerably longer than the north, the south side of the ore body extending some two hundred feet further than the north.

The vein was first reached in the process of opening by a drift from the 300-foot level of the No. 1 Lake shaft above referred to, and to which all the ore thus far mined has been sent from the new find. Three levels have been opened, the first at a depth from surface of 175 feet, the second at 225 feet and the third at 300 feet. After the opening of these levels it was found that a timber shaft was a necessity and one was accordingly sunk near the west end of the deposit, it being-carried down to the 225-foot level the past summer, and is equipped with skip for the handling of timber and men. It is vertical, and will be deepened to accommodate the wants of the mine. The task of sinking was rendered difficult by the meeting of many large boulders, and a stratum of quicksand also gave considerable trouble, but the ledge was finally reached, since which time everything has gone on nicely.

As is generally well understood, there is a layer of mud in the bottom of the old lake that has a thickness of anywhere from fifteen to thirty feet. It is of the consistency of cream, and while the upper portion has stiffened considerably, due to the influence of the atmosphere, it is still a very active mass, and readily fills any opening beneath that is not well protected. A few years since one could not cross upon the old lake bottom, but it has hardened to such an extent that foot paths are found in many places. There is still a considerable yielding under foot, however, and one not accustomed to the trembling action of the bottom under a moving weight is somewhat nervous lest the bottom might fall out. The storm water, or that portion of it which is not taken up by launders and pipe lines that surround the lake basin, has a tendency to keep the lowest depression in the old bottom rather soft, but large pumps care for the water almost as fast as it comes in with the exception of a few weeks in early spring when the snows are melting rapidly.

The mud has been the bane of those who have ore beneath the old lake bottom, and how to best prevent its mixing with the ore when mining was once vigorously begun was a question that has been given no small consideration, and has brought out from far and near many suggestions on the part of mining men and mining experts. Of all who have given opinions from outside sources there were none who suggested the plan now in vogue here and one which gives promise of success. Those who advised pumping the mud figured little upon the expense. There was, besides, no place in which to deposit the mud once it were lifted from the basin. The price obtained for the ore permitted of no such expensive method. The only plan that could be considered from an economical point of view was to let the mud remain where it is, and this is what is now being done.

The successful conducting of such a system, using the caving plan of winning the ore, was to bring a considerable area of surface down evenly and at the same time. The prevention of having small areas breaking through to surface and letting the mud come in was a necessity. If the first slice could be taken from the top of the ore deposit letting the overlying burden of sand, mud and rock come down without breaking up too much, the succeeding slices could be readily handled. In most places the sand and gravel covers the ore body, and over this particular deposit at the western end there

is ninety feet of sand, hard-pan and gravel under the fifteen feet of mud.

From the first level they put in raises to the top of the ore body and opened out with drifts upon both walls. Beginning at the western end of the deposit they took an eight-foot slice across the vein, using ordinary drift sets, closely lagging top and bottom of the drift as well as the sides. This work having been continued from west to east some distance, a second tier was taken off, this also being eight feet high, and when this had gotten fairly well started the third slice was begun, so that in the west end of the mine there has been three tiers or slices cut off the deposit, representing a thickness of twenty-four feet. Upon the sides, where the ore has run up a thin sheet upon the diorite walls, there are places where a set or two has been put in, but the work thus far done in the western end of the mine consists of three tiers. It is the plan to keep the western end of the mine the lower, so when the surface settles the water from the east as well as the mud will be drained to the west end and through the heavy burden of sand met with. Up to the present time they have worked about 200 feet from the west end of the mine, and for this distance the overlying burden has come down evenly and finely. As the miners go in with their succeeding slices after the first has been cut they find the lagging above them which was laid in the bottom of the first drift nicely in place, and they have no trouble catching this up, every pound of ore being taken from it. The timbers plainly show the great weight to which they are subjected, the caps being bent and broken and the legs of the tier above sticking through the back of succeeding drifts. This is what is wanted, as when the whole area that is undercut follows down there will be no trouble with the mud. If one portion of the surface would come and another hang up there would be danger of the mud coming through at the juncture of such pieces of ground. Where the surface comes as it does here it also makes safe ground for the miner. With the weight of the ground always upon the timbers there is no chance for collapse such as would occur if the roof hung up and then came clown upon the timbers from a considerable height. The settling here is gradual. There is no sudden action of the ground. The miner knows just what to expect, and accidents here are rare.

The ore here is generally soft, brown in color and mines readily. In places there are bunches and seams of hard ore that the power drill cuts but slowly. Occasional seams of rock are encountered which are wasted in the level, and help to keep the mud from coming through. Winzes upon either foot are down to the 300-foot level. The ore is trammed by power to the Lake shaft to the north, four cars being taken at a train. The loaded cars run by gravity to the shaft and are drawn back by a small portable hoist, a reliable and economical device. Three grades of ore are made here, Hartford Bessemer, Old Mine Hematite and Non-Bessemer, the two first being considerably in excess of the last. The present mining force employed is 170 men and the daily output from the deposit is about 500 tons, which will be increased as soon as the work will permit of employing a larger force.

The "New Discovery," as it is locally referred to, is not a big ore body, but it is generally of excellent quality and takes the place of lenses which have been exhausted in the old mine to the north.

"CHICAGO."

East of No. 1 Lake shaft, and a continuation of the Old Mine hematite, is the portion of the company's property styled by the miners "Chicago." There is an ore body here some 300 feet long that has been worked out above the 320-foot level and eastward to the line of the Cleveland company's wrest line. In the upper levels the ore was manganiferous, and where they are now working at the 300-foot level it holds about 6% of this mineral. At greater depth the manganese grows considerably less. Below the 320-foot level they have opened levels at 380 feet, 444 feet and 513 feet. The ore above the 320-foot level was won upon the usual style of square timbers, rooming and leaving pillars, but below this they are adopting the caving plan, as practiced in the lake deposit. Instead of taking cuts of eight feet they are taking eighteen feet, which they can do with safety by reason of the very firm ground met in this mine. Very little timber is used, the ore being strong, and, while a hematite, is very hard. By taking eighteen feet they can back stope it, and secure some saving in cost as compared to a thinner slice. They divide the 60-foot levels into three parts by putting in sub-levels. There has been no ore taken out in the levels below the 320-foot except that removing in drifting. In the sub-levels they drive a drift along the foot and hanging, cut the ore into blocks with crosscuts, and work from the extreme eastern end of the deposit back towards the shaft. The block of ground is attacked from both the foot and hanging sides. While the capping over the ore is very thick and strong about sixty feet of it has shaled off so that there is enough material upon the timbers to protect the men in case of a heavy fall from the roof, which is not apt to occur. In taking the ore to the shaft they use the hanging wall drift which is here in jasper, firm and safe. Power is used to do the tramming. The ore body does not extend as far west as the shaft, the latter being in hematite jasper, and very substantial. The first slice is now being taken, and a start for the second sub-level has just been made. The first sub-level is now well cut up so that the ore will come readily and cheaply. The ore is milled to the 444-foot level, the mills having been put in when the mine was first opened many years ago.

The vein at the 320-foot level has a thickness of about fifty feet. Higher up it was considerably larger, and at the lower levels it increases in size again, being considerably over 100 feet in thickness at many places. In point of quality the greater portion of the product is non-Bessemer. They are working but a few men as yet, and are raising about 275 tons per day. The shaft has recently been lined with boards so as to effectually

prevent anything from falling back when the skip is in the act of dumping at surface. They use skips in the vertical shaft and there is sometimes a little waste in the act of dumping which the lining now takes care of. Every precaution is taken for the safety of men and property. The miners work eight-hour shifts at the properties of the company.

They have established a transfer station between the cage shaft and lake shaft, the machinery being taken from another portion of the mine. This is to handle the ore upon surface.

SECTION 16 MINE.

This property of the company, which is located immediately west of the Pittsburgh & Lake Angelina company's old mine, is being worked in a very quiet way. The ore deposits in the lower levels have not been as large or as regular as the company would like them to be. The vein flattened out to about 45°, the ore thinning to a few feet in places, but in the present lowest levels the dip has sharpened to about 65°. They are now drifting to connect the two lowest levels with the shaft. These are the 680 and 730-foot. Something better is expected from this portion of the mine than given in the levels immediately above this point.

In what is locally styled their "north vein," they are taking pillars, having reached the bottom of the ore lens at a depth of 430 feet. They are filling some of the rooms and supporting the ground near the highway crossing the property from north to south. Some excellent ore has been taken from this property, hard and soft, and the company is anxious for a continuation of the rich lenses. They have done considerable diamond drilling, and have also drifted and drilled towards the diorite hill to the north, but found no ore. It may be that success will be met with in lower levels, the exploring having been done from the 310-foot level. It certainly is the place where the ore should be found. The territory is a favorable one and it will be strange if marketable deposits are not located upon that side of the diorite hill.

SECTION 21 MINE.

This possession of the Lake Superior Iron company is located in Section 21, Town 47, Range 27, and is a comparatively new mine. While considerable has been done in the way of exploring and development the product has not been large, nor has the mine been operated to anything like its capacity. It was idle for the greater portion of the year, resuming Nov. l5th, and at this writing, they are employing 175 men, and the stockpile is growing rapidly. There are three shafts two being upon the company's lands and one "the Mitchell," upon the lands of the Pittsburgh & Lake Angeline company. The Lake Superior shafts are 1100 feet apart, are to the 640-foot level, and are finely equipped. The Mitchell shaft, located near the east shaft of the company, has been used in the mining of ore near the old Winthrop workings and extending north and east from that point. Here they are now working upon the 580-foot level, "drawing" ore from the back of the level. The ore makes upward into the capping to a considerable height in places, filling chimneys made by the irregularity of the overlying rock, which rolls or waves sharply in places. The amount of ore secured in a few of these chimneys has surprised the management, and it may be that they will do some exploring above this level to see if there may not be an extension of the deposit that will warrant following. This ore has come readily and cheaply. The capping here is very strong, needing no timbering, and the chances are that they will secure all the chimneys hold in the way they are now running. This work is in the extreme eastern end of the mine upon this level, about 500 feet east and 300 feet north of the shaft. A diamond drill boring was made to the north from the extreme eastern end of the level, and found ore. A boring from the 640 foot level also encountered the same deposit.

At the east shaft upon Lake Superior territory they are taking a big pillar in front of the shaft 200 feet on the 580-foot level, and are also driving crosscuts in the ore to the west of the shaft. The shaft is 200 feet back of the ore body at this level, but there is ore formation nearer than that. At 80 feet south of the shaft they are now opening upon an ore body recently discovered, driving upon the foot both east and west. In taking the pillar they fill from the bank near the edge of the old open pit of the Winthrop company abandoned some years ago, the dirt coming through the old Winthrop workings taking the place of the ore removed, upon the Lake Superior side of the line. To prevent danger from the water-filled workings of the old Winthrop pit, diamond drill borings were made from the Lake Superior into the latter, draining the water in this way.

Upon the 640-foot level at the east shaft is a mule barn, mules now being used to tram the ore. There is a heavy grade in this end of the mine toward the west to take the water in that direction to the main pumping station, so that the tramming of ore to the east shaft was heavy work, three men being required. Now a single mule takes two cars readily. Upon the 450-foot level the east and west shafts will be connected to save a long tram, this cutting off about 650 feet as compared with the present distance over which cars have to be handled. This work is now nearly finished. At the west shaft, and a short distance to the east of the shaft, they are putting in raises between the 400 and 350-foot levels. To the north of the shaft they are raising between the 350 and 300-foot levels. There is a large body of ore to the north of the shaft that has been developed in the past two years, and in its mining no timbers are needed. The raises being put up on the foot need no timbering. Unfortunately, the ore, like that of this mine in all places, is non-Bessemer, and this western deposit has pieces of quartz, very finely broken, which lowers the percentage of iron. It is hoped that this may lessen as they sink upon it. In the upper portion of this deposit the ore is split up by tongues of hematite jasper, but these thin out as the diorite is neared. There is every indication that a

large ore body will be found upon the diorite when the latter is reached. There are few ore bodies in the region showing better proportions than this in the western end of Twenty-one, but it lacks the chemical features desired by the makers of steel, and because of this it has been wrought but feebly up to the present time. The firmness of the capping is a point in its favor, and it is also dry. This point being considerably higher than the east shaft no water is found to bother. Ground opened here in 1896 and not touched since that time shows no sign of caving or disturbance.

The ore formation at this point is a very wide one, and there is likelihood of other and important lenses. The mines are finely equipped with pumping and hoisting machinery. The shafts are three compartment, and in the footwall. The west shaft is vertical for a distance of 300 feet from which depth is inclines to the dip of the foot-wall. Skips are used, and work finely. John Trebilcock is mining captain.

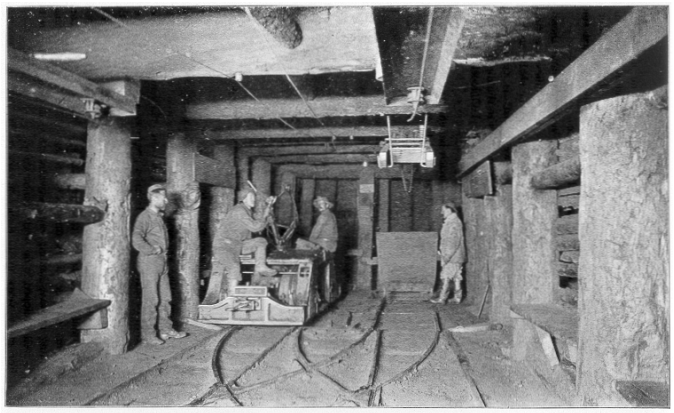
The resumption of this mine is or much benefit to the surrounding location, where there is a population of several hundred souls depending upon the mining vocation for a livelihood. The shutting down of the Winthrop pits during the winter months is made easier for the people of this place by resumption of the Lake Superior workings.

C. H. Hall, for many years agent of the company, has resigned. W. H. Johnson is superintendent; J. C. W. Chipman, cashier; J. D. Sliney, clerk; C. E. Hendrick, mining engineer; Jas. Clancey, master mechanic; W. H. Anderson, chemist. The number of men employed is between 900 and 950. W. D. Rees, Cleveland, Ohio, treasurer and general manager; W. G. R. Matteson, Boston, Mass., president. The company has a fine fleet of boats for carrying its ores.

THE PITTSBURGH & LAKE ANGELINE IRON COMPANY.

The present active property of this company is upon the north side of Section 16, in the renowned Lake Angeline basin. It is probably the best known mine amongst those producing iron ore in Michigan, having achieved a world-wide reputation for the excellence of its ores, and its return to shareholders. It has a progressive management, one that has joined with the people of the city in the up-building of the place in which they are doing business; that gives to labor its just share of the profits of the industry, and it was the first to give to its employes, and unsolicited by the latter, an eight-hour day. The company owns the fee of its mines, owns half of the Lake Superior & Ishpeming railway, hauling ore between Ishpeming and Marquette, and is well equipped to do work economically.

For many years in its earlier history it was far from attractive. They took the ore from an open cut some distance to the east and south of their present office. I well remember the old horse whims by which the little buckets filled with ore were raised to the surface, the annual product being only a few thousand tons. The entire force of men employed was about thirty. A great change has taken place since those times of primitive appliances for the getting of ore out of the mine. Modern hoisting engines now do the work of the old white horse, electric motors underground and upon surface facilitate the handling of the cars, and everywhere up-to-date plans have been perfected for the conducting of the business. The company is prominently represented by the firm of Jones & Laughlin, Pittsburg, makers of iron and steel, and a considerable portion of the annual product of the mine finds its way to their furnaces.



ELECTRIC MOTOR, LAKE ANGELINE MINE.

And, after all these many years of great success, it is pleasing to know that the Lake Angeline for the year just closed sent to market more ore than in any previous season, the total for 1897 amounting to 490,724 gross tons. This achievement speaks well for the care that has been given the mine, and suggests pleasing things for the future. The total product is 4,185,533 tons.

The old mine still continues to be operated, the company having followed the ore to their western limit where they meet the lands of the Lake Superior Iron company, but they are not yet to the bottom of the deposit. They are to the eighth level, 470 feet from surface, and are devoting their entire attention to the taking of pillars above the present bottom of the mine. Nothing more will be done in the way of opening additional levels in the western end of the property until the ore now standing in pillars is taken, which will require several seasons of mining.

To better secure this ore a new shaft has been started 1,300 feet from the west line of the property, which will bring it between C and D shafts, the location being near the company's blacksmith shops. The shaft will be vertical with two skip ways and a man way. It is being pushed rapidly, and has been holed between the 4th level and surface. They are raising from the 7th level. There is plenty of machinery on hand to equip this new station. The present pumping house will be used for an engine house, and the present Cornish lift will probably give place to a modern steam pump. The keeping open of C shaft has for some time past been an expensive work, a gang of men having been steadily engaged in its repair. From the new shaft, which is in the foot, a

substantial rock drift will be run to the western end of the mine, insuring a safe way, and through this the ore can be easily reached. The ore will be milled to two levels, and some form of power tram will be introduced to take it to the shaft. With these improvements completed it will greatly facilitate the taking of the ore still remaining in this end of the mine. When the latter has been secured down to the present bottom the ore below will be taken upon the caving plan. The pillars are secured as I have before described, by rising in one side, taking a slice one set of timbers wide, cutting through the floor overhead, taking the floor across the top of pillar and half way across the worked-out room adjoining the pillar. They then slice the pillar from the top downward, letting the top follow down. Rising in the next pillar they take out the floor above and the remaining portion of the floor over the room that was left at the first pillar, then slice the pillar from the top, following out this plan throughout the different levels. The ore comes readily, and the plan works successfully.

THE EAST END MINE

of the Pittsburgh & Lake Angeline company is one to which considerable attention has been devoted for some time. It is here that they expect to secure the bulk of their ore for many years to come, and it is now in shape to produce annually a large tonnage. They inaugurated the caving plan of winning the ore here at the outset, and it has certainly worked finely, and been viewed by mining men of the world with great interest. The ore here is partly beneath the old lake basin, occupies a fold of the diorite, and a capping of lean ore, V-shaped, divides the deposit in the upper levels, the trend of the intrusion being with the ore deposit east and west. Upon the first level this capping has a thickness of 340 feet, as shown by the cross-cut from the shaft, which is in the north foot wall. Upon the second level, seventy-five feet below the first, the capping is 180 feet thick, and at thirty feet under the second level it cuts out altogether at this place in the mine. The capping follows the pitch of the ore, which is to the west, so that in the third level at that end of the mine, it is still met with, but will cut out with greater depth.

One level is worked at a time, and the first has been almost exhausted of its ore, there being a few places in the extreme east and west ends of the level which will be finished in a few months. The ore of the eastern end of the trough is narrower and thinner than that of the deposit further west, it occupying the point of the trough, but in the extreme east end it rises to a considerable height above the first level, and some of it has here been taken upon timbers. The north and south deposits, as they are locally called, have a width of about seventy-five feet at the west end of the mine, and when the rock capping is lost in lower levels it will be considerably increased as the ore will probably occupy the place now taken by the capping. The product is now coming from the second level, and the third is being opened up ready to attack as soon as the second has been worked out. Upon the third the main drifts are single, while upon the first and second they were double with two lines for the motors. Instead of carrying two tracks they now have a main one with sidings at the mills. This is less expensive, and it also gives a stronger drift than where the ground is cut out for a double way. The mills are about 100 feet apart, are three compartment, and substantially made. There is a way for men and timber one for ore of Bessemer grade and one for non-Bessemer. The greatest care is taken in the sampling of the ore of this deposit. It is changeable in its contents of phosphorous and many determinations are daily made so as to keep the grade to the required standard. Were the ore mined without reference to result the product would be non-Bessemer, but they manage to secure about 75% of Bessemer of excellent quality. The ore is a blue hematite, considerable of it being of a hard nature, requiring power drills to cut and explosives to rend. This is particularly true of the upper portion of the deposit. As they go downward the ore often becomes softer. The lean ore capping that rests upon the ore contains about 40% iron, and even gives better result in places. If the market wants an ore of this kind it can be mined readily at the Lake Angeline. They can put any number of holes into this capping and run the ore down, attacking it from the lower side. Should this be done they would probably begin operations at the west end of the mine where the silicious ore is now encountered in the upper portion of the lens.

The electric motors continue to give excellent results upon the cost sheets. They are popular underground. They are fast, sure, and there have been no accidents through their use. They take all the cars that can be hitched to them, and one of the motors is rigged for the hoisting of timbers through the raises into the stopes. For this service the motor is credited with twenty-five cents per foot of stoping, this amount being cheerfully given by the miners for the pulling of the timber from the level to where they employ it in cutting out their ground. The motor, therefore, is self-supporting. All the contract work here is done by the foot. It is the plan that has for some time been observed and is satisfactory to the men and company. There are also motors upon surface that handle the ore from the shaft to the stockpiles. These I have before described. They give perfect satisfaction, and the management would not exchange them for any other power they know of. The timber shaft upon the south side of the deposit has thus far been of great value. The timber skip is counterbalanced by an iron dummy that runs upon the track laid under the skip track. The loaded skip raises the dummy and the latter returns the skip to surface. One man controls the machinery, and at the present depth of the mine it has worked to perfection. As the mine grows deeper they will probably put on a lighter rope or use other means to offset the increased weight of cable. The levels of the mine are seventy-five feet thick.

Upon the south side of the deposit there were numerous dykes shooting out from the foot and running transversely into the ore deposit, and with the strike of the latter, generally thinning out to nothing before the ore

body was crossed. Some of these had a thickness of twenty feet. Upon the lowest levels many of these dykes have cut out entirely, two of the largest not being found. A flat deposit of ore upon the side hill to the south of the mine which was found last year has not yet been mined. It is of excellent quality, and appears to be an isolated body.

Between the East End mine and the old mine workings there is a long stretch of ground upon which little in the way of exploration has been done. A diamond drill hole shows silicious ore. It is not improbable that other lenses will be found in this territory. The north side of this diorite outcrop has been wonderfully rich all along the south side of the Lake Angeline basin, and it is not expecting too much to think that there must be valuable lenses in the ground between the east and west ends of the old lake. Indeed, it would be surprising if none existed. There will probably be careful search as soon as new lenses are needed. The Lake Angeline company has many years' work ahead of them and when the time comes that other bodies will be needed they will probably locate them, as they certainly have favorable territory upon which to explore. There is an immence dyke crossing the formation a short distance east of their D shaft, which would cut off the chances for ore at that point, but to the east of this crossing there should be ore met with. The local management will look after this in due time. It is progressive, and overlooks nothing that tends to the welfare of the company.

The hard ore deposit in the old mine is still being worked and the ore raised is reduced in the big crusher which was added to the mine's equipment this year. The crushing plant has operated continuously since it was installed, and gives perfect satisfaction. The crusher was built by the Lake Shore Iron works, Marquette.

The Lake Angeline employs a large force of men, the present number being about 700. The company has every convenience in the way of comfortable change houses, and none are more careful in the provision of excellent ladder ways, ample ventilation and comfortable dwellings.

James Laughlin, Jr., Pittsburg, is president; W. G. Pollock, Cleveland, Ohio, secretary and treasurer; Alfred Kidder, Marquette, agent; Thomas Walters, Ishpeming, superintendent; George R, Persons, cashier; E. F. Bradt, mining engineer; C. T. Kruse, clerk; Richard Smith, master mechanic.

THE WINTHROP MINE.

The Winthrop-Iron company, whose operations are centred about the old mine located upon Section 21, Town 47, Range 27, is doing no actual mining work at this writing, February, 1898, having closed down their pits as soon as hard freezing weather set in last fall. The company is confining its entire attention to the development of its silicious ore deposits, of which it possesses several large ones. Its principal pit adjoins the Section 21 mine of the Lake Superior Iron company, and lies between the Mitchell shaft and Winthrop old No. 1 shaft. At this time they are stripping a piece of ground extending eastward from the big open pit towards the Mitchell shaft, this being a continuation in that direction of the ore of the open pit. To the west the stripping has grown heavy, and they will not proceed further in that direction until the ore to the east has been secured. In earlier days the Winthrop worked underground at this point, but its ore lenses gradually went upon lands of the Lake Superior Iron company.

South of the old workings, and upon the south side of a large diorite outcropping extending for some distance east and west, they did some work underground at what is known as their No. 2 shaft, but this has been abandoned for the time. Ore was found, and they hope for a continuation of it to the west.

Still further south, at No. 3 shaft, they are working a deposit of silicious ore in an open cut. About half the product for 1897 came from this pit. The ore comes very readily, is blasted down in huge masses, broken, loaded into tram cars, and delivered into the skip. The ore outcrops here, and the deposit where it is covered with drift is exposed in a few feet from surface. There is no place in Michigan where ore of this class can be more readily obtained. This ore gives about 45% iron, and is of Bessemer grade. Forty men were employed when the pit was worked.

The Winthrop possesses a valuable property and there is excellent chance for finding ore of better quality than that now mined. It owns the fee of its lands, and will probably do some exploring next season if the market conditions warrant. There is a wide ore formation here, and the location is a favorable one for the finding of new lenses.

M. A. Hanna, Cleveland, president; F. Braastad, Ishpeming, vice-president and general manager; C. T. Fairbairn, Superintendent; J. O. Flack, mining captain; William Brooks, clerk.

THE EAST NEW YORK MINE,

located upon Section 2 in the City of Ishpeming, is idle. There is ore in the property, but during the hard times of the past few years none were found who were sufficiently courageous to attempt its mining. The mine is filled with water and dismantled. A. M. Bigelow, of New York, is owner of the fee. The Ames mine, located just east and upon the same section, has been abandoned, the ore apparently giving out. The old New York mine, to the west of the East New York is abandoned.

The next active mine going westward from Ishpeming is

THE CHAMPION,

which is located upon the south half of Section 31, Town 48, Range 39. It is pleasing to know that the Champion mine has made some improvement in its developed, mineral-bearing territory. There is much depending

upon the success or failure of the property. The villages of Beacon and Champion are wholly supported by the earnings of the labor employed in and about the mine. The location is one of the neatest and pleasantest in this mining region. It has many comfortable homes, excellent schools, and it has long been the residence place of many progressive, loyal citizens.

In its earlier history the Champion mine possessed magnicent lenses of specular and magnetic ores that furnished a large product annually, but as depth was gained upon the vein the big deposits grew smaller, and finally cut out altogether. There were also two parallel veins of ore and these gave place to one at the lower levels before the total pinching out came. The change was a gradual one, as the opening in such mines requires time to complete, and it was not until a thousand feet had been sunk upon the vein that the ore ceased to be found at the fourth shaft put down from the eastern end of the deposit.

In No. 5 shaft the ore was found at greater depth than in those to to the east, and to care for it heavier machinery was put in, the mine possessing one of the finest plants to be found in the iron districts, but the reduced size of the ore lenses has not given this enough to do, and the property has been rather top-heavy. The discouraging condition of the mine and the market caused a suspension of operations in 1893, the property remaining idle until the spring of 1895 when a start was made, since which time there has been no cessation of mining. Mr. Walter Fitch, the agent, believed he could bring a little profit out of the mine, and he has, by dint of the closest application and careful attention to all details, managed to get a balance upon the right side of the books, even in these times of low prices, and has also added to the former items of expense that of crushing the ore. He spends considerable time underground and has inaugurated many improvements that tend to reduction of former costs. In accomplishing a favorable result financially, Mr. Fitch gives much credit to his men, there having been a great gain in the amount achieved per man. This is due to the fact that the miners are more skilled than they were formerly, constant association with the work having taught them how to best secure the ore, and they produce considerable more each per day than in previous years and without any decrease in their wages. The contract system here observed is one that encourages the miner to do his best. All work is by the foot. Holes are drilled under the direction of the foremen and are paid for by the foot. There is no cutting in case a gang of men make more than the usual wage. In this way the best men are anxious to make all the headway possible, knowing they will receive the same pay per foot the following month.

No. 7 shaft, the most westerly, has for some years past been the one in which the management has been most interested. Its location is about 2,400 feet from the old eastern workings of the mine, and connection is had with the shafts to the east. The ores of the Champion pitch to the west, and there appears to be several big "chutes" of ore separated by rock having an inclination in this direction. With the exhaustion of the ground further east, the hope of the company was to the west, and No. 7 shaft has been given considerable attention with the idea that it would reveal paying deposits. At the time of my last writing of the mine No. 7 shaft had been sunk to the 12th level, 700 feet from surface. It is now to the 18th level, five levels having been added during the year, a distance of 300 feet. Besides this sinking the shaft has been increased in size so as to give room for two instead of one skip, it has been re-timbered generally from top to the 12th level and newly timbered to the 15th in ground sunk through during the year. The performance at this point is little short of remarkable. To the 12th level the shaft follows the vein, but at this point it assumes the vertical. The dip of the vein is very sharp, but it was thought best to get out of the ore with the shaft, the latter having run into ore lenses at this depth, as this will give the shaft solid ground and permit the taking of all the ore in the vein. In the widening of the shaft it was necessary to shift the ladder road into the main workings between two or three levels, but this is no great inconvenience, as the men are lowered and raised in a double-decked cage that takes twenty-two at a trip. At the point in the shaft where it changes to the vertical there are eight-foot sheives that can be easily reached to repair, a platform having been built around them. At all of the levels the shaft has been substantially fenced in so as to prevent one's walking into it. Every care has been taken for the safety of the men.

At the 9th level of No. 7 they are carrying a drift west and are now 400 feet from the shaft. They are putting this drift through upon the under side of the quartzite hanging, which is decomposed for a few feet upon its contract with the jasper, which renders the work easier than if they drifted in the jasper. They are observing this plan wherever they now are putting in exploring drifts. On the east of the shaft at the 9th and loth levels they are working out a block of ore carrying a slope 120 feet high. At the 12th level west they have mined 100 feet and at the 1i6th are west of the shaft 150 feet. Upon the 13th, 14th and 15th levels east they have mined west from No. 6 to a point not far distant from No. 7 shaft, and upon the 17th level they are working about 250 feet west of the shaft. No. 6 is about 400 feet east of No. 7. At No. 7 there is excellent ground tributary to the lower levels of the shaft, some of which has been proved up in No. 6. In a few places the vein is forty feet wide, and in many it runs between twenty and thirty feet. There is the same contracting and expanding of the lode here as is seen to the east, but the lenses average bigger, and, what is of importance, they are more free from rock than is the ground in No. 5 shaft. The product of a few years since used to be mainly second class, or more than half was second class, whereas now about 80% of the product is first class. This change means a great deal to the company, as they do not mine a ton of second class at a profit. In the vein in front of the shaft upon the 16th level they have started a winze which is going to the

18th, 120 feet. The vein here looks well, being of good width and of fine quality ore.

At No. 7 they have constructed a substantial shaft house, sheathed with galvanized iron, and have begun work upon a trestle to convey the ore from the shaft to the crushers. From what has thus far been revealed underground at No. 7 the chances for large, clean deposits of ore seem to be favorable. The territory is a new one, and ore bodies are eccentric, but the openings up to this time give promise of yielding a substantial product for some time to come. It is yet too early to speak conclusively upon this point, but that there is a change for the better a trip through the underground workings readily shows.

At No. 5 shaft, 875 feet east of No. 7, they have reached the 24th level, a distance from surface of 1,360 feet. No. 5 proved a very unsatisfactory portion of the mine. There were few good lenses tributary to it. The vein was narrow, and the ore badly mixed with rock. On the 2Oth level west they are working a 9-foot lens 450 feet from the shaft; upon the 21st level they have a vein the same size which they have mined west of the shaft to a distance of 300 feet. Upon the 22nd level east they have mined the same deposit a distance of 260 feet from the shaft. No work is being done upon ground tributary to the east side of No. 5.

No. 5 being the deepest shaft, Mr. Fitch has decided to put a drift to the west from the bottom level, the 24th, for the purpose of exploring the territory in that direction. He will soon start a gang of miners upon this drift. They will follow the underside of the hanging quartzite, which is comparatively easy to cut. This drift will be run west for a distance of 1,800 feet. It will need some time to complete, as the average gain per month will be something like sixty feet. The drift should be of great value to the company in developing the ground under Nos. 6 and 7 shafts.

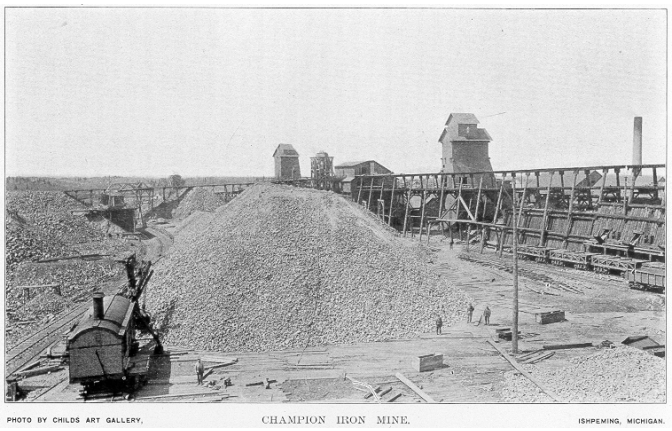
At No. 5 the crushing plant is located. It consists of three Blake pattern crushers weighing fifty-five tons each, and having 24”x24” openings. Manilla rope transmission is used to connect them with a Corliss engine, ropes running over ten-foot reels. The concrete foundation put under this plant, and mentioned in my last report of the mine, has given excellent satifaction. It is solid, has not yielded a particle, and the machinery works smoothly and almost noiselessly upon it. The crushed product is being stocked at this time of year, the piles being about forty-seven feet high. There is little moisture in the ore and it makes the finest kind of steam shoveling into cars during the shipping season. There is a tendency upon the part of the ore to slip away upon the pile, this requiring care upon the part of those who are handling the cars upon the top. New timbers have been placed beneath the ore floor of the foundation, the former ones proving too light to hold the load.

At No. 4 shaft, 375 feet east of No. 5, they are securing ore in an open pit.

At No. 3, 200 feet east of No. 4, they are taking the pillars left in the former operations. They commenced at the 14th level and are working upwards, being now engaged upon the 11th and 12th levels east of the shaft. Two power drills are being used, and all of the ore in pillars and floors is being taken. The ore comes readily, at reasonable cost, and there is enough to last for many seasons to come. It assists considerably in the making of a product and in bringing down the cost of the ore of the whole mine to a point where a little margin of profit can be realized. The ore is milled to the 14th level, where it is handled through a substantially timbered drift to the shaft and from thence sent to the surface. The most of the ore to be secured in this way lies upon the eastern side of the shaft, although there are several pillars upon the west between the 10th and 14th levels.

The product of the Champion for the year recently closed was 137,599 tons, a considerable increase over the shipment of the previous year, which was 113,375 tons. It is the largest shipment the mine has made since 1890. The total shipment to date is 3,231,314 tons. The total number of men employed is 300.

The Champion will probably add, during the present year, a Worthington, triple-expansion pump. This can readily care for the water by working ten hours each day.



CHAMPION IRON MINE.

An interesting feature of the Champion's shipment for the year 1897 were several cars of magnetic ore masses. These had been mined with great care. Dynamite could not be used in winning them because of the liability to cause fracture of the ore. These masses were sent to New York where they were cut up into slabs of a thickness of an inch and a half and having a surface of about 12"x12". The cutting into this shape was no easy task as the ore is very hard. Steel filings and sand were used under a toothless saw, and the finished slabs are smooth and perfect. These slabs are used as anodes in the securing of chlorine. Formerly plates of platinum were employed but these lasted but a short time. It was discovered that slabs of magnetic oxide were practically indestructible and were better conductors of electricity than the platinum. The patentee believes he has a great fortune in his discovery, and is convinced that it will not be long ere he will demand all

the ore suitable for this purpose the Champion can produce. The ore must be free from fractures, practically homogeneous, and outside of the Champion there is no other mine in the country that can provide the desired material. A very little has been found in Russia, but it is an inferior article as compared to the Champion's ore. The chlorine is used in the bleaching of wood pulp that now forms the base for most of the paper used in America. The desired ore does not occur generally throughout the Champion mine lenses. There are only small areas compared to the ore-bearing ground that provide it. The test is made by sending a current through a piece of ground, the ringing of a bell proclaiming it to be conductive of an electrical current to the desired degree. Should the material prove what the inventor claims it swill be a neat thing for that gentleman as well as for the Champion Iron company, as the ore would be worth a good, round figure. There are certain spots in some of the stopes where masses of suitable size and structure are found, and by taking extra precautions the pieces suitable for the magnetic slabs are obtained. This would make a little change in the method of mining at these places, probably. The Champion carries high stopes, forty-five feet, taking first a drift at top and underhand stoping the balance using powder freely, the ore being massive and hard. It may be that channeling will will be resorted to in the taking of the magnetic blocks, quarrying rather than mining them.

The Champion should produce the present year 160,000 tons of ore. Mr. Fitch estimates that this can be done from the ground already developed. The Champion makes now but two grades of ore whereas in former years there were many. The first class grade gives 65% iron and .045% phosphorous. The second class gives 56% iron and the phosphorous is the same in both grades. All the ore mined is of Bessemer quality. Crushed, it is a most desirable material, and is popular with furnacemen. It should not be difficult to sell all the ore the mine can raise and at the highest market price.

The Champion begins 1898 with some advantages not possessed a year ago. It has made gains, but these have not been without much hard work and by the liberal expenditure of money. There has been much done in the way of "dead" work, and it has not yet been finished. We can readily see that every dollar has been made to count for the most, and that everything in and about the mine has been intelligently handled. The conditions have not permitted of any waste. It has been only by the most careful operation that the Champion has been enabled to live, and that it has made a little profit in the face of the much that has had to be done in the opening of new territory at great depths, and the sorting and crushing of the ore and then selling it at very low price, is certainly an excellent performance. The mine was opened in 1868, since which time it has been the support of the thriving little village surrounding it. The present would indicate that it will be active for many years to come, and truly no mining company in the iron region deserves more success.

Walter Fitch is agent and superintendent; G. S. Barber, surveyor and chemist; A. Fitch, cashier. The general office is in Boston, Mass. Henry H. Fay, president; W. E. Stone, treasurer; W. B. Bosson, secretary.

THE REPUBLIC MINE.

The Republic mine, located in Section 7, Town 28, Range 46, has been a producer since 1873. In this time it has marketed 4,502,728 tons of ore, and has been noted for the rare purity of its product. For many years it made the price in the market, and the spring of each year was an anxious time for other producers who waited to see what Republic would do. In justice to the company it can truly be said that they always maintained the very highest prices they could, a decided contrast to some of the big concerns of the present time who aim to sell at the lowest possible point so as to drive the less fortunate in large deposits and surpluses out of the business.

The Republic no longer possesses the big lenses found in its open pits near surface, and from which a product was cheaply secured. With increased depth in the older workings the lenses pinched to such proportions as to give no further value to the miner, and one after another they have become exhausted and abandoned until now none of the pits at the south end of the property are being wrought. At the Morgan they are taking out a shaft pillar, and the shaft will be abandoned, as whatever ore remains in the shape of pillars and floors can be taken from the old Ely pit.

Something was expected from the West Republic property at this end of the old mine, but diamond drill work has not revealed anything of value. Narrow seams of ore were found, but nothing of marketable size encountered, and no work is now being done in the way of exploration. There are many people outside of the company who believe this to be a valuable property and some of them imagine the Republic company has a desire to conceal anything of value it may have found upon the property, but this is only idle talk as the company would gladly develop anything in the way of promising lenses the West Republic might hold. They have no hopes of increasing their stores of ore from this portion of the property. They hold the West Republic under lease. The first work of importance going from the old pits northward along the strike of the formation is at the old No. 6 shaft, where they are taking the shaft pillars, working from the bottom upward. They went behind the old shaft and sunk a new one in solid ground. The old one had caved so that it was unsafe. The work of mining at this point from the old pillars has been going on for a couple of years, and the product obtained has not been shipped, but is stocked near the shaft. It will require several seasons to secure the ore about the old No. 6 at the present rate of mining. The work is necessarily slow, as care has to be taken to prevent accident.

At No. 1 shaft, to the northwest of No. 6, they have added no levels since my last report and are working the same stopes. There is some change in the appearance of the lenses from time to time. Some months they look well and others find them changed for the poorer. The ore obtained is of excellent quality. The shaft is to the 115 3-foot level, is single compartment, and curves from 45° west to 47° to the north before it reaches bottom.

The No. 8 shaft, to the north of No. 1, is at the same depth as reported in my last description of the property, to the 115 3-foot level. No. 8 is a single compartment shaft, and the ore body for which it is the outlet, lies about 800 feet to the north, so that the work of production has been considerably retarded owing to these conditions. There was such a long distance to drive to connect the shaft with the ore body that but four levels were started, the 644, 758, 911 and 1153-foot. In winning the ore they first put in a substantially timbered drift through the deposit upon the trend of the latter. They go on top of this, breaking the ore which is permitted to accumulate under the feet of the miners, mills being carried upward through which to send the ore to the floor of the level. The ore, a fine specular, breaks in massive pieces, the walls are firm, needing no timbering, but after rising to a height of over too feet it was found difficult to use the mills. The ore which is very dense, would go thundering through, the velocity increasing with the added height of mills, and the cribbing of the latter would be broken and knocked out of place. Then, too, the ore would choke the mills, binding together so firmly that dynamite was often resorted to in order to loosen it. This has greatly interfered with the task of mining in this new deposit.

Two years since a shaft was started 1,200 feet north of No. 8 for the purpose of opening the ore body lying in that direction, and which was being worked from No. 8. The tram to reach No. 8 was a long-one, being over 1,100 feet from the northern workings. Power was used, but it was tedious, and then the shaft was a single-compartment one, and not what was desired.

The new shaft is now nearly completed. It is three-compartment, 6'x18' within timbers, and is in solid ground, the hardest kind of jasper for the greater portion of the distance. In the lower portion of the shaft they have encountered the ore body, and they have about 30 feet of ore to cut through to complete the shaft to the 911-foot level. The shaft was sunk 568 feet from surface, and from the 758-foot level it was raised to connect. From the 911-foot level there was 130 feet of raising. The work of surveying was well done, and the lines of the shaft are satisfactory. As soon as this shaft is equipped it will be placed in commission. It has been greatly needed, and once in operation it will be a great aid to mining work. Sub-levels will be put in between those now opened, and mining conducted to better advantage than now, as the present high mills will be done away with. They are opening the 115 3-foot level in this portion of the mine, and will have the shaft to this depth as soon as possible. There is a fine lens of ore here, one of the most regular that the company has had in many years, and the quality is of the best, specular, giving 67% iron and .018 to .033% in phosphorous. To the north there is an excellent chance for a continuation of the deposit, and the new shaft should be a busy one for many years to come. The lenses of magnetite that used to occur so frequently in the southern end of the mine, have thus far been missing in this north lens.

No property in the Lake Superior mining region can excel the Republic in the quality of product. The different grades shipped the past year, and amount of same were as follows:

GRADE.	IRON.	PHOS.	TONS.
Specular No. 1,	67	.018	48,512
Special,	68	.012	28,525
Kingston,	64.82	.030	35,956
No. 3,	50	.030	11,349
Total			124,342

The No. 3 grade is from the waste piles from the pits at the southeast end of the mine. It was upon these piles that an effort at concentration by crushing and washing was unsuccessfully made some years since. There is a large amount of ore in these piles that is readily secured.

While the product of the Republic is of the "hard" variety, it has not been crushed as are other hard ores of this district. The specular ore is readily broken, and if it is thought desirable to put in a crushing plant there is an excellent site for it at the new shaft the mouth of which is 40 feet above the railway track leading to the present stockpiles.

The mine is a comparatively dry one. They will lower their Cornish "lift" to the bottom level shortly.

The Republic is fortunate in the possession of a water power upon the Michigamme river which develops sufficient energy to operate the greater portion of the mine plant. Air is compressed at the hydraulic works, and the saving to the company over fuel is considerable.

The mine has been the sole support of the village which bears its name. It has ever been a thrifty location, and one which has been noted for its business qualities. Just now the company is employing about 250 men, who work upon the contract system. It has a fleet of boats for carrying its ores upon the lakes. David Morgan is agent; Peter W. Pascoe, mining captain; W. D. Rees, Cleveland, Ohio, is president and treasurer; W. B. Castle, secretary.

THE SWANZY MINE.

This mine is located upon Section 18, Town 45, Range 25. The property has been worked in a quiet way, and rather spasmodically, for many years, producing 217,089 tons. It is upon the lands of the Escanaba River Land & Iron company, who own 703 acres, and who operated the mine for several seasons prior to the summer of 1885 when work was suspended from a lack of funds. The water has since been kept out, and Mr. T. M. Wells, of Negaunee, the receiver, for the company, has finally

made a sale of the mine to Todd, Stambaugh & Co., of Cleveland, Ohio, who have placed John Thomas, of Ishpeming, in charge as mining captain, and the work of mining will be resumed at once.

A new shaft, a fine three-compartment, vertical, was sunk by the former operators to a depth of 255 feet. It is in hematite jasper, solid and safe. The shaft is to the fifth level, and the ore tributory to it was reached first from drifts put in from the old incline shaft, and later by the new shaft. A heavy water course was encountered in the main drift not far east of the new shaft that drowned the mine for a time, but it was readily caught up, and the mine now makes but little water, it all being easily handled by a No. 10 pump, a four-inch discharge pipe running about one-third full.

The ore at the fifth level possesses a length of about 225 feet, and its average width is about eighty feet. Upon the level above, the fourth, the ore has been opened for 300 feet upon its trend, being further east than the lowest opening. That the fifth level will find the ore as far east as shown upon the fourth is almost certain, as in the breast of the drift when work ceased the deposit was still big and strong, showing no sign of cutting off. Much of the ore to be seen is of a blue color, not unlike some of the best grades of the Menominee range, or those of the Marquette, and where it has been given a chance it is dry, the water having run freely from it. It is sufficiently porous in its character so that the moisture will readily leave it if an avenue is provided for that purpose. The shaft will be deepened and the ore blocked out for several levels so as to permit of proper drainage. In the level now open the ore is dry and stands well, and would mine readily and safely.

There are several raises connecting the fourth and fifth levels, but during the idle period these have become choked up so that I could not get through them at a recent visit. The distance between the fourth and fifth level is forty feet, vertically, and the ore is continuous throughout. The deposit is very regular, and it gives excellent results by assay.

Some of the raises in the mine were put up on the hanging side of the vein with the idea of working upon the caving or wrecking plan, but the water had not been cared for as it should, the ore being too wet, and the plan was not a success.

The possession of the fee is an item of greatest importance, and then the company has a large territory, much of it located directly upon the range, that should be worthy of consideration. Near them is the Brotherton mine than has been idle for some time. I am told that in the bottom of the shaft they made the mistake of drifting into the footwall instead of towards the ore formation. How true this is I do not know, but it is vouched for by several prominent mining men of my acquaintance.

The company has an adequate plant of machinery that is able to take care of the ore for some time. There is a pair of four-foot-hoisting drums, driven by a 10x16" engine, a Rand air compressor, an ample supply of pumps, and sufficient boiler capacity. The company has about twenty houses, the most of them being in fair condition, and the location is an ideal one, being well up, pleasant and connected with the Chicago & Northwestern railway by a spur track six miles in length.

IDLE AND ABANDONED MINES.

There are a large number of idle mines upon the Marquette range, as in all other districts where mining has been carried on for some time. West of Ishpeming is the Saginaw, Albion, Goodrich, Fitch, St. Lawrence, American and Dexter. The latter property was abandoned in 1867, the company not possessing the means to operate it. The shaft was to the 8th level, 560 feet from surface, and there was a large deposit of low-grade ore showing in the bottom. The property yielded considerable manganese it running from 7 to 15% in the ore.

In the vicinity of Humboldt village, the Humboldt, Foxdale and Bessie mines are idle with no signs of revival.

North of Champion, in Sections 29 and 30, Town 48, Range 29, are the Marine, Northampton, Phœnix, North Phœnix, Pascoe and Hortense mines. These, in their time of activity, produced limonite ores giving 52 to 56% iron and high in phosphorus. The shipments of the idle properties will be found further on in the report where outputs of all mines are printed. There were large deposits at some of these mines, and if the market could care for it an immense tonnage could be raised annually.

At Michigamme village is the Michigamme mine, the property of the Cleveland-Cliffs company, which has been idle for several years. Its ores are of the hard variety. West of Michigamme are limonite deposits of large size at the "Farm," Webster, Beaufort and Titan properties, long since closed down.

Northwest of Republic is the Kloman, Metropolitan, Riverside, Standard, Erie and Magnetic mines, all idle for many years, and holding hard ores. Ores of better grade have taken the place of these old properties. Eventually they will be given attention, but not until the cream of the range has been skimmed—when the rare ores have become exhausted.

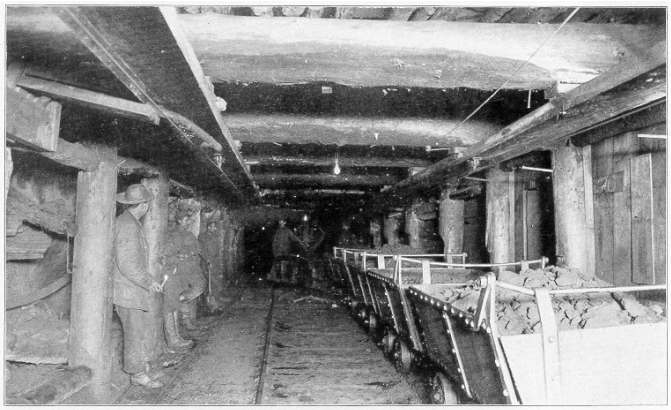
EXPLORATIONS.

Little was done in an exploratory way in the district during 1897. Upon lands owned by the Cleveland-Cliffs company, the S E ¼ of the S W ¼ of the S W ¼ of the S E ¼ of Section 24, Town 47, Range 27, J. E. Carey and others of Negaunee have done a little work. A shaft was sunk upon silicious ore formation, and now a drift is being put into the side hill to intercept the shaft. The ore found is similar to that of the Tilden mine, which is a short distance east.

The S. M. Stephenson Mining company, Menominee, Mich., parties being interested, cleaned out one of the old pits on Section 12, Town 47, Range 31, in the fall of '97, but soon discontinued operations. Lean ore was

found, but nothing of any value was encountered. The property was explored some years ago by B. M. Colwell, of Appleton, Wis.

The Marquette Range Mining company, E. F. Bradt, Ishpeming, president and treasurer; W. J. Allen, Negaunee, vice-president; did a little work at the old Ogden property, upon lands owned by the Iron Cliffs company on the west half of southwest quarter of Section 13, Town 47, Range 27. They shipped 942 tons from an old waste dump, that gave 41% iron and .021% phosphorus. There is a large deposit of silicious ore here, and it was to mine this that the company was organized. There is a chance, too, for better ore being found. No mining work has yet been done.



ELECTRIC HAULAGE, LAKE ANGELINE MINE.

THE MENOMINEE RANGE.

This iron ore-bearing district is parallel to that of Marquette, and is located fifty miles south of the latter. It extends a distance of fifty miles from its eastern limits in Michigan to the boundary line between our State and Wisconsin, has a width of from three to fifteen miles, and is badly split up with granite in the eastern portion, this separating the Menominee and Felch Mountain ferruginous formations. Geologically there is a great variance as compared with the Marquette district. The order of the rock formation is: Granite, siliceous limestone, clay slate with iron ore, quartzite and Potsdam sandstone. The folding of the limestone has played an important part in forming troughs or basins in which the ore has been deposited. The tilting of this rock has been very sharp at different places, standing nearly vertical as it nears surface, and the depressions made by this folding are often of great depth, permitting extensive ore deposits.

The Menominee range produces but little ore of Bessemer grade. The Loretto, Vulcan, Pewabic, Aragon, Millie, Traders, and Mansfield, comprising the list of mines sending out low phosphorus ores, and the annual contribution of some of these is small. The most active points upon the range are to be found at Norway, Quinnesec, Iron Mountain and Crystal Falls, and the area given attention is a small fraction of the range, which also is true of other fields.

The range is located favorably with reference to the transportation of its ores to market, the principal portion of the output being mined within 50 miles of the port of Escanaba, to which place all the ores of this range which go to Lake Michigan and Lake Erie ports are shipped. There is a considerable tonnage sent by all-rail to Chicago and other points during the winter months, this being possible by reason of a considerably shorter distance as compared with other Michigan ranges. There is one line of railroad, the Chicago & Northwestern, that handles the principal portion of the ore mined, although the Chicago, Milwaukee & St. Paul road took ores from the Chapin and Traders mine, at Iron Mountain, during the season of 1897.

With but few exceptions the mines of this range pay royalty upon the ore produced, the rate running from 50 to 10 cents per ton according to the grade of the ore mined and the liberality of the fee owners. The tax, however, is a considerable one, and the amount annually paid to owners of the property is about $250,000.00. When this is deducted from the selling price of ores of non-Bessemer class it is a very severe tax upon the operators. There is considerable water to handle at the different properties, timber generally has to be employed, or, if not, expensive systems of filling are observed, and these expenses with a royalty added to them necessitates the most rigid economy and thorough methods in winning the ore. Much enterprise is shown at the principal mines, the minutest details being given attention, and nowhere, considering the obstacles encountered, is better work being done.

For the year 1897 the range sent out 1,799,856 tons of ore, this being a gain over the previous year of 390,261 tons. The total for all years is 21,788,278 tons, and, with the two Wisconsin properties, the Florence and Commonwealth, just over the Michigan border, the range has shipped 24,781,111 tons. The 1897 shipment including the Wisconsin properties upon the range, was 1,935,669 tons.

The Menominee, like the Marquette, has immense areas of silicious ores running about 40% iron and often of Bessemer quality. These have been prominently wrought at Iron Mountain during the past three years. The district has a large territory as yet not thoroughly tested for ore, and which will be given attention in years to come. In the concluding meetings of the Bessemer Ore association recently held in Cleveland, Ohio, the "Rex" grade of the Chapin mine was included in the ores to come within the association's allotment, which will add considerably to the importance of this company in the market.

During the past year twenty mines were worked, and when all are full-handed about 3,500 men are given place. The most easterly property now being given attention upon the range is

THE LORETTO MINE.

The Loretto is located upon Section 7, Town 39, Range 28, about one and one-half miles from Loretto, a station upon the Chicago & Northwestern railway. Its shafts are sunk close to where Pine Creek forms a junction with the Sturgeon river, and there is every reason to believe that the ore extends under the river.

The original opening here was in a bowl-shaped deposit that came up to within a few feet of surface, and to secure it a vertical shaft was sunk to a depth of 180 feet and two levels opened, one at eighty feet from surface, the second at 180 feet. The second level found the bottom of the deposit, the foot coming in upon all sides. It was simply a circular hole, with rounded bottom, filled with ore. This has given the principal part of the product of 205,712 tons, and they are still raising ore from this pit, it coming from floors and pillars left in the original opening and rooming. The ore was taken upon square timbers, which method is still adhered to in a new deposit that has been found and partly opened up. There will be another season's work in the old mine, and it may require a longer time to take the ore still remaining. They did some diamond drilling from the bottom of the pit, finding quartzite. The ore body appears to be an isolated one.

The lens of ore that now gives promise for future products is 200 feet to the south of the old mine, and was found by crosscutting through the intervening slates from the second level of the old workings. They have not done a great deal of work upon this new find since its discovery, the property being idle from August 26, 1896, until February 22, 1897, still enough has been done to show that it is of considerable importance. A shaft has been sunk 160 feet in the ore body, and below this is a winze seventy-five feet in ore. A diamond drill boring made from the second level perpendicularly, found 160 feet ore, and the drill was still in ore when it was stopped. The width of the ore is about thirty feet, and they have put in their drifts upon its strike for 350 feet, finding jasper in the breast at the west end, and clean ore still showing in the east. In the latter direction they have not yet reached a point under the river, and will take no chances in making openings there. Upon the third level, which will be seventy-five feet lower than the second, and 255 feet from surface, they may put a small drift in the ore under the stream. There would be no danger in this, and it would test the continuance of the ore to the east. Should the ore make to the other side of the stream a shaft would be sunk upon that side. One was begun a year since and was carried downward sixty feet. This could be readily deepened, it being in the slates, which are easily cut.

The dip of this new ore body is 85°, and the enclosing walls are slate and jasper. In mining the ore they take rooms three sets wide and leave pillars having a width of four sets. The ore is blue, mines readily, and is of excellent quality, similar to that of the old deposit. Their "Loretto" gives 62% iron, .020% phosphorus; the "San Jose" 65.80% iron, .015% phosphorus. The dip of the ore lens is to the south and the pitch is east.

It may be that they will use filling, taking sand and loose rock which is convenient to the mine, but they have not fully decided as to this. The mine makes but little water and the drift under Pine Creek is dry. Not to exceed 300 gallons per minute are pumped.

They are now making changes in the railway tracks and pockets which will give better facilities than formerly had for the handling of ore. There is a neat little stockpile now at the mine, and everything in and about the property is being well looked after by the local management. A force of 150 men is now being given place.

Harry Truscott is superintendent; Robert Murray, mining engineer; E. J. Anderson, clerk. The main office is in Chicago. D. F. Bremmer, president; W. H. O'Brien, secretary.

THE APPLETON MINE

just east of the Loretto, has been idle since 1894. It is full of water. There were three levels opened, and the ore lenses were small in the lowest. The strike of the ore agrees with that of the new find in the Loretto, and it is likely that something in the way of exploration will be done upon the property the coming summer. It produced 12,102 tons during the time it was active. It is owned by the same parties who hold a control in the Loretto.

The next active property in going east from the Loretto is that of

THE PENN IRON COMPANY.

The Penn has been one of the prominent iron ore mining concerns of the Menominee range since the latter began business many years ago. Its properties are located at Vulcan, a little town just east of the village of Norway, and are the Vulcans, Cyclops, Norrie and Norway. Of these the "West Vulcan" and Curry had been the only ones operated for several years, but the Curry closed down in the summer of 1897, leaving the West Vulcan as the only one at present being given attention.

As I have described in former reports there are two ore formations here, the "north" and the "south." In earlier times the south formation was wrought but nothing has here been done upon it for the past four seasons, the lenses having given out, or pinched to such small proportions that there was no profit in following them.

The West Vulcan is to the 12th level and has been working upward from that point, the depth from surface being 1,010 feet. It is a wet mine, making about 900 gallons of water per minute, and there has been a constant dread of a greater flow than this. The limestone country is known to be full of water, and its tapping might be a serious thing for the mine. There has been great caution taken in the opening of ground

towards the limestone, and two fine pumps have been stationed at the 12th level, C shaft, to care for the present and future. These are both Worthingtons. Besides there is a Cornish "lift" that is capable of handling the present flow of water in case it is called upon to do so. One of the Worthingtons was put in the past year. It is a triple expansion, 19, 30 and 50-inch, with 11-inch plunger and 24-inch stroke. Its capacity is 1,200 gallons per minute in a lift of 1,200 feet under a pressure of 80 pounds. In the vertical feed pipe leading through the shaft 4⅛% of steam went into the pump, an excellent showing considering the distance, 1,000 feet. The condensation from the boilers to the mouth of the shaft has not been ascertained. Wood has been largely used as fuel, but Mr. Kelly, the general manager, is now making careful tests with coal and a new shed for coal has lately been completed. Guages recording pressure and temperature of water are used, the fuel is weighed, and every pains is being observed to make all tests accurate and valuable. Mr. Kelly is thorough in all he undertakes and his figures mean something.

Everything upon surface at the mine is in the neatest possible shape. The machinery is adequate to take care of the hoisting and pumping, the shops are well equipped with tools, etc., the system of railway tracks is perfect, and no other mine in the district is better located for the ready handling of cars,

Underground, however, the conditions are not as flattering as could be desired. The ore deposits are generally small and too often badly mixed with rock, requiring great care in the mining. Five grades of ore are made, and it is plainly noticeable that the poorest quality forms the greater portion of the product. They are working from the 12th level upward, the present active levels being from the 11th to 7th, inclusive. While the 12th level is the lowest in the mine it is not to the bottom of the ore stratum. Indeed, there is more ore showing upon the 12th than at any point above, it having a width of 100 feet in places, and a length of several hundred feet, pinching up to ten feet at many points, being irregular in size, but an improvement over the levels above where the conditions are far from satisfactory, due to the irregularity of the strata and the mixture of jasper and lime. The company is not yet ready, however, to sink and open levels below the 12th. The plan of mining in vogue for many years is to take the ore from the 12th level upward, and it is thought best to carry this out until the ore above this point has been secured, before going deeper. There is a wholesome fear of the water, and it is thought best to take the ore now in sight before running any chances of meeting with a greater flow of the enemy in going downward.

In winning the ore they employ square timbering, backstoping, and taking rooms from two to three sets wide. The mined-out portions are filled with rock, this being principally graphitic slates from the foot wall of the formation. Of late they are using the material of an old waste dump upon surface which is milled down through the old mine workings and taken from the mouth of chutes upon the several levels to the places needed, by mule power. This filling comes readily and cheapily. Occasionally pieces of heavy timber come down from the old levels with the caving surface, but these are quickly barred out and are used for blocking in the mine. The pockets into which these chutes lead are substantially built so there is no danger of their giving way, and are so arranged that tram cars are readily filled from them. A mule takes from two to four cars at a load. It is the practice to employ water in assisting the spread of this filling material in the rooms. When the waste is not sufficiently wet to be carried readily into all portions of the room it is helped by a stream of water from a hose attached to a main that is carried through the different levels for this purpose. Once deposited in the room and sufficiently moistened, the filling soon solidifies so that it is firm and stands finely. In taking pillars they work back from the foot to the hanging so that any fall of ground from the hanging will not threaten the safety of the miner. The lagging employed is generally ripped in the company's sawmill. The larger pieces are all treated in this way, it being found economical, and it makes neat looking work in the mine. The timbers employed for the sets are little if any heavier than those used where the settling plan is observed. The mission of the timber is ended as soon as the rooms are rock filled, so that the timber need be no heavier than that used in mines where the surface is caved. In the one case the surface is brought down and in the other the bottom is brought up. The filling plan as here practiced certainly works satisfactorily.

Upon the 8th level, north side, they encountered a body of ore 100 feet wide, and considerable was expected from it. In proving up its length it pinched out at seventy feet. This is but a repetition of ore occurrences in the mine. Where a fine showing is seen one month in the next the rock may come in, changing it completely. This necessitates an immense amount of dead work, and is very discouraging to the management. Mr. Kelly certainly deserves great credit for the admirable manner in which he has made the best of the perplexing conditions here met with. It has been no easy matter to follow the intricacies of Nature in the West Vulcan, and the wonder is that he has succeeded in living with the active competition from mines possessing such great advantages over his. All features from the greatest to the smallest have been studied and taken advantage of. Jasper, the principal rock of the ore measure, is very stubborn, hard to cut and break, and it is difficult to carefully select it from the ore. With every precaution against mixture underground, it is also necessary to have pickers at the stockpiles upon surface.

The company owns the fee of the eastern end of its mine, and it has given this territory considerable attention on this account. Could it find merchantable ore bodies upon which no royalty would have to be paid it would be a great advantage. The ore thus far found, however, has been of inferior quality, their poorest, in fact. It gives about 50% iron and .050 phosphorus. It is rich in lime, however, and for this element the

purchasers of this grade, called "Pluto," allowed ten cents per ton over the contract price for 1897. This ore is coming principally from the 9th and 10th levels, and forms the greater part of the product thus far mined since the close of navigation last fall. They are still following this ore east in the hope that it may improve in quality.

The best ore secured is from the 7th, 8th and 9th levels in the northern portion of the mine. Above the 7th there is little ore thus far known, so when that point is reached, everything having been mined from below, there will be need of sinking the shaft or of locating new ore bodies. There is ore in the 12th already exposed that can be attacked, and then there is a fair chance to find other deposits, the formation being a larger one with plenty of chances for ore in the south as well as north formation.

The mules used for tramming the ore and rock in the mine have given perfect satisfaction, doing the work easily and at low cost. They require but little feed, and keep fat and strong. One lot is taken to surface every Saturday, but the other cannot be gotten to the shaft and have been in the mine since they were started here. They show no sign of failure due to the long confinement, looking equally as well as those that see daylight once a week, but it will soon be possible to send them to surface when they will be given a ride up every Saturday. A box for the holding of the mules is placed upon the cage, and the knowing animals walk into this with alacrity, seeming to enjoy the ride to sunshine.

The men are lowered and raised in the cages, but once each month they are required to walk to surface through an old shaft in which an excellent ladder way is maintained, to be used in case of accident. The monthly trip in this way is to familiarize the men with the location and condition of the road. Throughout the mine excellent ladder-ways are had, and every precaution taken for the safety of the men.

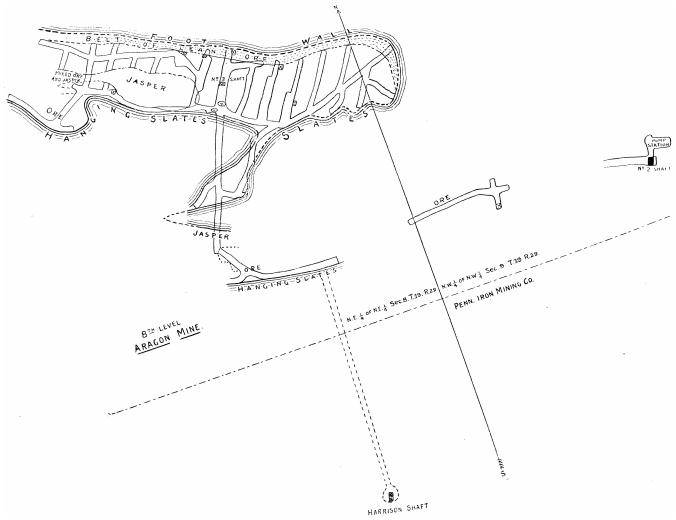
In the tramming of ore from shaft to stockpile the West Vulcan has one of the simplest and most efficient devices in this mining region. A small engine has been fitted up to operate a wire cable to which the tram cars are attached. The cars are handled rapidly, and are side dumpers, the load being released at any desired point by the tripping of a lever which is set in the shaft house by the man who handles the car from the cage. The cage is lifted above the level of the trestle tram track, the car run off, going into a cylindrical cradle which revolves, dumping the ore into the tram car below. The arrangement is a neat one, and despite the high speed maintained on the trestle there is yet to be reported the first mishap to the car. The trestle is a high one, nearly sixty feet. They use a steam shovel to load the ore from stockpile to cars, one having recently been purchased. The high bents forming the trestle foundation are taken down to give room for the shovel in the shipping season, but the cost is not heavy. Mr. Kelly has kept close track of it, and we hope to hear some interesting figures from him upon this subject at the next meeting of the Lake Superior Mining institute.

The owners of the mines of the Penn Iron company use all the ore they produce in their own furnaces, which is a help. The company also has its own stores at the mine. These were a necessary adjunct in the earlier history of the work upon this range and they have since been maintained. The present working force at the mine numbers about 350 men.

THE CURRY MINE,

next west of the Vulcan, has been idle since my last report, and has nothing new to offer. It has ore, the best deposits being upon the south formation, and there is considerable territory yet undeveloped. The mine is 800 feet deep, to the 8th level. Thomas Oliver, who was mining captain, has accepted a similar position with the Newport mine, Gogebic range.

The mines of the Penn Iron company are not exhausted of their mineral treasure by any means, but just now they are looking decidedly "ragged". They are admirably cared for, and are worked in the most advantageous manner. William Kelly is general manager, F. C. Copeland, assistant; William Bond, mining captain.



The product of the mines of the company for the year 1897 was 237,886 tons, and the total for all years reaches the respectable sum of 5,224,401 tons.

Going westward from the properties of the Penn Iron company, the next active property is

THE ARAGON MINE.

It was a very fortunate transaction for the people of Norway, Menominee range, when the Commonwealth Iron company secured possession of the Aragon mine, the principal one of that village. The property had been severely handicapped from a lack of sufficient and adequate machinery, it being the desire of the owner to sell rather than to operate the mine. The local management, while blamed by many for the unsatisfactory manner in which business was done, was helpless to make such improvement as thorough and economical practice demanded, for the reason that the

owner would not advance the means to make changes necessary to achieve success.

The strike inaugurated at the mine the 15th of December, 1896, may not have been without its favorable side, as it resulted in a change of ownership that might have been longer delayed but for this incident. The Commonwealth Iron company, whose principal mining operations had been centered at the Commonwealth and Badger mines, Commonwealth, Wis., purchased the Aragon after the latter had been idle six months, and took possession the first of July, 1897, since which time much has been done to improve the condition of things both above and below surface, and there is still a great deal to do before the present management has completed the plans laid out for the future working of the property.

When the Commonwealth Iron company took hold they found considerable ore opened up in the lowest levels. This, of course, was the inducement that resulted in the purchase. The mine had been opened by two shafts to the 8th level, a distance from surface of 750 feet. The shafts were 700 feet apart, No. 2 being at the east end, and No. 3 in the west. The principal mining for the year previous had been done upon the 7½ level. When the levels were first opened they did not have the 6½, this being put in after the 7th was reached, the distance between the 6th and 7th being 150 feet. Between the 7th and 8th levels the distance it 100 feet. Above the 6½ level there was little ore left, while below there was considerable. The plan of winning the ore was mining it upon square sets, the usual form of timbering, and sand filling the worked-out rooms and pillars. Where the vein was small, as in many places in the upper levels, they took the ore without leaving pillars, using timbers to correspond to the size of the deposit.

They found a very wet mine, there being about 1,500 gallons of water per minute, half of which amount came from the ledge. The mine by reason of the great water flow and the filling of the rooms with sand was an expensive one to work. Mr. O. C. Davidson, the superintendent, realized that a change to reduce this great pumping and filling charge was necessary in order to give a profit to those whom he was representing. He also knew that a considerable addition should be made to the previous annual product of the property to insure success, and no time was lost in commencing changes so badly needed. With the much that has been done the mining of ore has not been stopped. Indeed, since taking hold the new management has accomplished more in this direction than ever before achieved at this property in the same length of time. From the middle of July up to the close of navigation last fall there were produced 95,000 tons of ore.

It is the intention of Mr. Davidson to win the ore of the Aragon upon the settling plan in vogue at many mines in this region. To carry out this system it will be necessary to have a substantial shaft which will not be affected by settling or drawing ground. The No. 3 shaft, the last sunk by the Aragon company, is much disturbed by the work being done around it. Its location, as a glance at the plate of the 8th level will show, is not of the best, and it has been constantly in need of repair. There is a heavy drift at this location, this consisting largely of peat, soft in nature, and upon which ore cannot be stocked. Because of this a long trestle was necessary so that the ore could be deposited upon firm ground, this requiring a long tram and extra cost.

To the south of the No. 3 shaft about 700 feet is a shaft sunk by the Penn Iron company in 1890. This shaft known as the "Harrison", was put down 200 feet. At that depth a drift was run north 275 feet, which is the extent of the opening at this point. The property was owned by the Briar Hill Mining company, and has been secured by the Commonwealth company who will continue the shaft to a depth of 750 feet, corresponding with the lowest level in the Aragon mine, and will be made the main hoisting shaft. There are two parallel ore formations here, the Aragon being in the north and the Harrison shaft being in the south. Separating these formations is about 400 feet of silicious slates. It is upon the south formation the Curry mine is opened. The shaft was started in the hanging slates of the south formation, but being vertical it will soon enter the ore formation below its present bottom of 200 feet from surface. The drift put in to the north was in lean ore, and the chances for having strong ground to the depth desired are excellent. There is a possibility of encountering a merchantable deposit of ore in this south formation, but should this occur the company will not feel badly about it. With the shaft down they can then let the surface of the Aragon cave instead of trying to hold it up by filling with sand as at present. This would effect a great saving in the cost of mining.

The Harrison shaft is a small one, 6'x13' inside, and Mr. Davidson hesitates about enlarging it, because when it was put down care was taken to dam all the surface water back from the ledge upward. This was securely done by special timbering, wedges, clay and concrete, the work being skillfully performed at some expense. The flow of water was reduced from 200 to 90 gallons per minute, and it is desired to gain the benefit of this in the shaft. The latter may be widened at a point below the ledge as they carry down the new portion, so that in case they decide to enlarge it at surface it can readily be done. It would probably be easy to again dam the water about the upper portion of the shaft, and the increased size might be of great advantage, particularly if additional ore were encountered in the south formation. It is probable that a long skip will be used here. The No. 3 shaft is small, two cages being handled through it, each carrying a ton car. This is too light a load for economical handling, as twice that could be lifted with nearly the same power as that now employed in the engine house.

Some sort of power tram will undoubtedly be used in handling the ore through the crosscut connecting the Harrison shaft with the Aragon ore deposit. At this shaft they have erected a boiler house 45'x50', frame,

sheathed with galvanized corrugated iron. In this they have placed two Babcock & Wilcox boilers, having a combined capacity of 528 horse-power. There is room in the building for another boiler when one is needed. These boilers are now in place and ready for business. An iron stack seven feet in diameter and 150 feet high is nearly completed. The water for the boilers is brought from a lake to the southwest. A wooden main five inches in diameter leads for a distance of 1,900 feet to an open launder connected with the lake. The water is brought to an iron tank near the boiler house, the flow being about fifty barrels per hour. At the Harrison shaft there is plenty of room for the necessary stockpile foundations, buildings, etc., the company having eighty acres in the lease on Briar Hill property. There has been a new dry erected, its dimensions being 113'x24', two stories, frame, sheathed with galvanized corrugated iron. This is provided with steam and water pipes, and upon each floor are lockers for the use of the men.

To better care for the large flow of water a new Worthington pump has been ordered and is upon the ground. It is triple expansion, 15 and 23"x38", with 9½ inch plunger and 24-inch stroke. The water column is lo-inch, the steam pipe feed 6-inch. It has a capacity guaranteed of 750 gallons per minute in a lift of 1,100 feet, and can do better than this if crowded.

This pump will be located at the 8th level of No. 2 shaft, and a place for its reception is now being cut out in solid jasper.

For the Harrison shaft a new hoisting plant has been ordered from Webster, Camp & Lane of Akron, Ohio. This will be a duplicate of the plant put in during 1896 at No. 3 shaft, a split drum, g-foot face by 6-foot diameter. The hoist is the first of the kind introduced in this mining region. Heretofore a plant of first-motion hoisting engines having a capacity for handling independent cages or skips from a depth of 1,200 to 1,500 feet has meant the use of independent drums and engines for such depths as named. The Aragon plant handles the same amount of ore as the larger usually employed with smaller drum and engines, and still has the same degree of economy as Corliss engines are used with automatic cut off, controlled by governor. The drum is constructed as follows: For a depth of 1,200 feet the main part is of 6-foot diameter and of sufficient face to accommodate the required amount of rope. It is securely keyed to the main crank shaft and is fitted on the left hand side with a brake ring eight feet in diameter which is made sufficiently heavy to answer as fly wheel, giving proper momentum to insure early cut off to the valve gear. The right hand end of the drum in the Aragon's plant is eighteen inches, giving sufficient adjustment for several levels, is loose on shaft, but capable of being connected therewith at any instant by a powerful clutch of the band-friction type. This loose section of drum also has an 8-foot heavy brake wheel with fly wheel rim in same. The brakes may be operated simultaneously by one lever when hoisting in balance, or the brake on the fixed part of the drum may be set, holding the engine at any point, while the brake on the loose section is used for lowering, for adjusting to a desired level. In adjusting two ropes are securely fastened, one to each end of the drum, being of sufficient length to reach a desired depth. The cages are then attached to the other ends of the ropes, and the cage, attached to the fixed part of drum, is then raised to the landing station at surface. The drum is then locked at that position by means of the brake on the left hand brake ring. The cage attached to the loose section of drum being at some one of the levels can be readily adjusted to a higher or lower level without winding onto the main part of drum. When both cages are at the desired position the clutch is engaged, after which the engines are operated in balance and the entire drum controlled by the powerful brakes at either end. The advantage of the arrangement is readily seen, as substantially one drum is used for winding both ropes, one unwinding from the bottom as the other winds up on the top. The groove is so arranged at the junction of the two sections that there is no trouble in the rope running from the narrow section to the wider one. The new plant will have steam reversing and clutching device, which will also be added to the old one.

A large compressor from the Commonwealth mine is upon the ground and will soon be placed in position. It may be that the company will purchase a new compressor large enough to supply air for all the drills in the mine, this to take the place of the three which will soon be in use.

Until all the new machinery is working they will continue to fill the mine with sand as heretofore. The latter comes from a hill to the north of the mine, but the supply is not inexhaustible. It is hauled to the mine by horse power, and comes readily enough, but it requires considerable work to distribute it throughout the mine where needed. An incline shaft takes it to the 7th level, this having been completed in 1896.

A glance at the map of the 8th level will show that there has been a great squeezing of the formation at this point. The limestone has been buckled into a large fold, and in this the ore occurs. It is supposed to be such a fold as occurs at the Pewabic and Loretto mines. In the upper levels the ore was found upon the north side of the fold with silicious slates forming the hanging and jasper the foot. The jasper overlaid talc slates and next in order was the limestone. Between the 4th and 5th levels ore was found upon the north side of the fold, and now at the lowest workings, the 8th level, there is a fine deposit of ore upon both the north and south sides of the fold, it making around the point of the slates which intrude to the west from this portion of the mine. Upon the north side they have opened a fine stretch of ground over 500 feet that has a width of a hundred feet in places. There are a few bunches of jasper to be seen, one of which is of large size, but as a whole the deposit is much freer of rock than in any of the levels above. Upon the south side of the fold they are opening ground to the west of No. 2 shaft, being in ore several hundred feet. They are also working east from the western end

of the deposit to meet the eastern drift, and it now looks as if the ore is continuous for the entire distance between the two present active points. Should this prove true there will be a stretch of ore of something like 600 feet. They have not tried for the width of the deposit here in the eastern end as yet, having decided to connect the drifts, or to follow the ore until it gives out before putting in crosscuts. The present management has done considerable opening of new territory since they took hold, and are proving up ground that will be productive for some time to come. The foot wall of the deposit waves or rolls considerably and is flatter than the hanging, the latter being nearly vertical in places. The ore throughout the 8th level is more regular as well as cleaner than at levels above. Much of it is very blue in color, and often is bright and sparkling like the hard speculars. It is sometimes finely crystallized. Where particularly hard there are many seams and joints, and nearly all is porous as if previously filled with water. Where the water has been drained from it the ground stands remarkably well, and in most places the mining is easy. Analyses shows it to be improved in iron over many levels above, which is encouraging. It will be an easy matter to take the ore upon the caving plan. With sub-levels put in every twenty-five feet, as here laid out, nothing further will have to be done. There will probably be no need of intermediate levels, as the ore gives every appearance of running readily once it is undercut. Numerous mills have been put in through which to send the ore to the floor of the level, and when everything is ready to attack the deposit energetically a large product can readily be obtained. Thus far there has been no mining done upon the 8th level, all the work done consisting of opening the deposit by drifts, and blocking it out for the future. There is also a decrease in the amount of phosphorus held by the ore on this level as compared to those above, and taking it altogether the bottom of the mine presents a very satisfactory appearance.

The engraving of the 8th level shows a long drift running west. This is in 910 feet west of No. 3 shaft, and followed a narrow seam of ore for the greater portion of the distance. A crosscut to the north near the end of the drift found mixed ore, and there is a chance for the finding of marketable deposits upon that side of the drift, it being the foot wall side in which the ore has often made in such formations. This drift is under the town, Nelson street being over the end of it.

The tramming of ore and sand underground is performed by hand, and this work as well as all other in the mine is done upon the "company account" plan. Mr. Davidson is satisfied with the accomplishment per man here. There certainly is no loafing, and all seem to take an interest in their tasks and to get as much ore to surface as possible. Nowhere have I seen more activity displayed in the tramming and mining than here. Between the management and employes there is evidently the best of feeling, and the men seem to be anxious to assist in getting the property in shape for better things as fast as possible. There are now about five hundred men upon the pay roll, and the gain to Norway is one the people of that place should appreciate.

The shipment for the past year was 144,760 tons, exceeded but twice in any previous year since the mine was opened, which, considering a six months' shut-down, was an excellent record. The total shipment to date is 1,003,106 tons. The stockpiles have already grown considerably since the close of navigation, and they are shipping by all-rail to Chicago twenty cars per day. In stocking from the long trestle between the shafts a rope haulage plant is used that works nicely.

The Aragon has made a great gain in good looks since my last visit. It is being energetically operated, and bids fair to take place with the prominent Michigan producers. It pays royalty upon its ore, but it is upon the sliding scale plan and entirely satisfactory to the company. Four grades of ore are made: "Castile," the fancy bessemer, is limited to a few thousand tons per year; "Aragon" is their standard bessemer, giving 63% iron and .045% phosphorus; "Grenada" gives 63% iron and .063% phosphorus; "Lerida" takes the place of Grenada No. 2, and has 64% iron and no limit as to phosphorus, it being non-bessemer. The company pays royalty upon these ores according to the price they bring at the mine, which is certainly the fair way to levy royalties.

O. C. Davidson, Commonwealth, is superintendent; H. F. Ellard, Norway, assistant superintendent; Gustaf Hellberg, mining engineer and chemist; G. A. Alvar, mining captain; Arvid Bjork, clerk; R. Knight, master mechanic. Of the company E. W. Oglebay is president; John Whitelaw, treasurer; C. W. Merrill, secretary, Wade building, Cleveland, Ohio.

THE CUNDY MINE.

Quinnesec, in the early days of the Menominee range, was the liveliest town of the district. It did a thriving business, and was noted for its hospitality and the enterprise of its founder, John L. Buell. The stoppage of work at the Quinnesec mine also stopped the growth of the village of that name, and for many years it lay dormant. The discovery of the Cundy mine, in the townsite forty has changed things for the better, and again Quinnesec is busy and looks forward to great things in the future.

The Cundy mine deposit of ore was located with the diamond drill several years ago, and was reached by a shaft sunk in 1886 by J. R. Wood of Appleton and others. Afterward the property was sold to prominent members in the Illinois Steel company, and named after Captain Cundy, who was placed in charge. The product from openings in 1896 was 3,892 tons. In the upper levels the ore made small and was of inferior quality. It was not until the 300-foot level was reached that it assumed regular proportions. At this point however, it is large and strong, and gives all evidences of developing into a big mine. The quality of the ore if not of the best, it being low in iron, about 54%, but an improvement is

reported below the 300-foot station in the amount of iron held.

The first shaft sunk is known as the "Gray." It is to the 300-foot level, is two compartment, and in the hanging, which is here sound and stable. A short distance to the west of the bottom of the shaft they have sunk a winze sixty feet in ore, and are now drifting back under the shaft from the bottom of this winze. The openings at the 300-foot level show the lens to be about sixty feet wide, and as yet they have not found the true foot wall of the deposit. The dip of the ore is to the south, the walls standing upright at an angle of about 70°.

To the west of the "Gray" shaft a second shaft was sunk the past year, being down to a level corresponding with the bottom of "Gray." The western shaft is named the "Foote," and its distance from the eastern shaft is 550 feet, and it is back of the ore body eighty feet. The ore in front of this shaft is fully eighty feet wide, and the ore body between the shafts is continuous. They have worked west from "Foote" shaft about thirty feet, the headings being in ore.

During 1897 there was mined, in the course of opening, 41,642 tons, the total to date being 45,834 tons, and Captain Cundy figures he can send out 150,000 tons for 1898. They carry their levels sixty feet thick and will take the ore upon the underhand stoping plan, much after the method employed at the Champion. The walls are very substantial and they believe they can get along without the use of timber. In the mining so far done large rooms have been taken without the use of timber, and the ground stands firmly. It is the idea to leave pillars upon the sides of the deposit, doing this by narrowing the size of stopes, contracting and expanding the work as the nature of the ground requires. But little water is made, a small pump easily caring for it.

The 360-foot level will soon be ready. They are raising from the winzes to connect with both shafts, and with this addition the mine will be in shape to make a great gain in its output. Much has been done in the short time the company has been in charge.

A new air compressor 18x30" will be added to the equipment. It will have a capacity for operating twenty-two drills, and the foundation is now ready for its reception. Changes are being made in the hoisting plant which will add much to its efficiency. New gears are being made by the Marinette Iron works, which will give greater speed. The plant is an old one, three six-foot drums, second hand.

A force of 100 men is now being employed, which will soon be added to in case the ore can be disposed of, which is assured, the company being associated closely with large consumers.

Going westward from Quinnesec, four miles, Iron Mountain is met with. This is the most important mining town on the Menominee range, and its biggest property is

THE CHAPIN MINE.

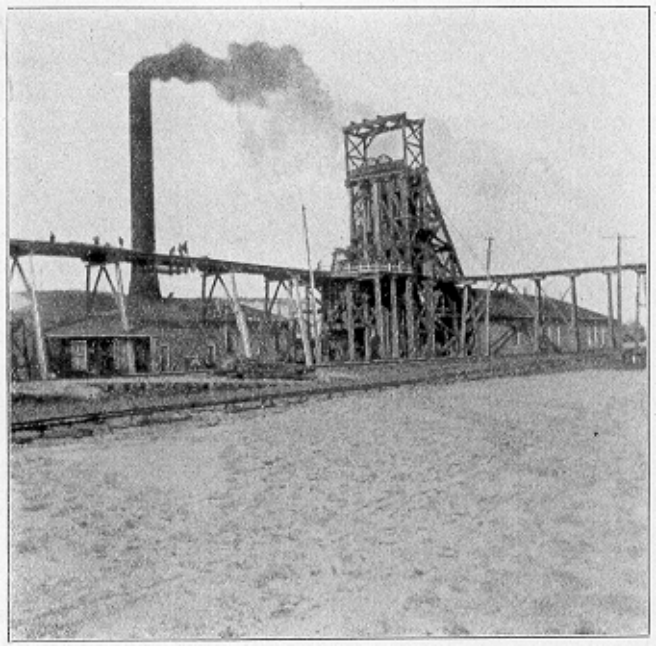
The Chapin is the largest mine in the Menominee district, and is the principal support of the city of Iron Mountain, in whose corporate limits it is located. Of the 24,781,111 gross tons of iron ore sent from all the mines of the Menominee range, the Chapin has contrib-buted 6,775,990 tons of the grand total. It has been in operation since 1881, in which year it shipped 34,556 tons, and its greatest achievement in any one season was 742,843 tons, which were sent out in 1890. For the year 1897 there were shipped 642,347 tons, this amount being exceeded only twice in its history.

Of the many systems in the way of winning the ore and the troubles of mining and financial kind that marked the earlier history of the property my readers are generally familiar. The company is now in competent, reliable hands and so ably are all its affairs handled that both those who have money invested in its shares as well as the population which surround it are all deriving substantial benefit from its activity.

The Chapin iron-bearing formation is a strong one, being composed of silicious slates banded with jasper. The ore occurs in lenticular form, and thus far there have been four of these bodies which have been the principal ones in the mine. These are locally known as the "old and new north," and "old and new south" lenses. Between the north and south bodies of ore is about fifty feet of chlorite schist, this forming the foot wall of the north deposit and hanging wall of the ore of the south "vein". The ore lenses have a dip of 70° to the north and pitch west at about 45°. With continued operation the ore has therefore been followed westward, and a length of ground of about 2,500 feet has thes far been opened, with the eastern portion pretty well exhausted of its mineral. At B shaft, near the extreme eastern end of the property thus far mined upon, they have recently resumed sinking, the shaft having been fifty feet below the 8th level. Three years ago they found ore in drifting upon the loth level old north lens, east end, and it was followed upward for some distance. The vein was small, but the quality of the ore was good, and they are going after it. There is a chance, too, that there may be another lens coming in from the east, and the work is partly to explore the ground with this hope in view. A drift of 280 feet will be necessary to get this ore to shaft.

At the main south lens the present work consists of taking the pillars above the 10th level. These are generally eighteen feet thick, although there is one at C shaft that is fifty-six feet. The change in the system of mining the ore, which has been going on for some years, necessitates the attacking of the deposit upon one level at a time, the caving plan having been adopted. The mine was originally opened up on a different system and to bring about the change, after many levels had been opened, has required much time and great care. At present they are taking all the ore upon the plan which the present management adopted when it took hold of the property. This main south lens has been a magnificent one, being of large size, and has been

opened to the 12th level. Upon the 11th they have simply put in their drifts, no mining having been done, and the work upon the 12th consists of a winze from which crosscuts have been run. The openings in the lowest levels show the deposit to have lost none of its dimensions, and the quality of the ore is somewhat better than it was at points nearer surface. It is non-bessemer, giving from 62% to 63% iron and .065 to .070 phosphorus. The openings on the 11th and 12th levels are now filled with water.



HAMILTON SHAFT, CHAPIN MINE.

The shaft from which this ore has been taken is D, located in the foot, but the upper portion is in ground that slips away and is in danger of pulling in the shaft as far down as to the point where it penetrates the jasper. To prevent such disaster they have left an immense pillar of ore in front of it, this containing more than a million tons, and far too much to be used as a retaining agent, so it has been decided to abandon this avenue in the near future. At this shaft is located an immense steeple compound pumping engine, and arrangements have been concluded for the dispensing of this as well as the shaft. Reidler pumping engines will take the water from the mine, and are already in place. One I described in my last report and the other has been placed in the "timber shaft," a short distance to the east of D.

The ore from the south lens that has been going through D shaft will soon be sent through the Hamilton shaft, 1,174 feet to the northwest. With the closing of D shaft, and the taking of the ore in front of it, there will be need of changing the railway tracks as well as the highway, as the subsidence of the surface will necessitate it. The south lens will furnish a considerable product annually for many years to come. It has a large amount of ore already shown by openings, and the big pillar in front of D will yield enough to last for several seasons from the top of the lens to the loth level. The 12th level is 975 feet from surface, and the bottom of the trough has not yet been reached.

The new ore lens, of which I made brief mention in my last report on the mine, has been developed considerably since that time. They have opened four levels, the 7th, 8th, 9th and 10th, have a body of ore something like 750 feet in length with a width equalling the biggest deposits found at any part of the mine. The hanging has not been encountered everywhere, yet enough is already known to prove the latest discovery to be a valuable one. Upon the foot side of the deposit is a brownish ore of earthy appearance that is shipped with their "Rex" grade, their second class. It follows the foot persistently, and is also found further west upon the Ludington property. In the new north lens many pieces of jasper occur in the ore, these following the trend of the latter, and running in thickness from a few inches to ten or twelve feet. In opening the levels there were many of these rock intrusions encountered. They changed the course of the drifts to get around some of them and others they have drifted through. They vary in length as well as in thickness, and there is little trouble to keep them from mixing with the ore in the mining, the jasper being readily selected. Wherever possible they waste the rock in the levels. The levels here are 100 feet apart. In securing the ore they put in three sub-levels between the main ones, and afterward they may cut these up with intermediate levels, this depending upon the way the ore comes to them in the task of mining. The ore of the new north lens has been blocked out from the 7th to the loth levels, and all that has thus far been sent to surface has come from these preparatory openings. In the levels thus far opened the ore is of excellent quality, and it gives every appearance of being easily mined. When the drifts are put in the ground may be hard and stubborn, but soon after the cut has been made it loosens up wonderfully. There seems to be a lateral pressure that forces the ore from the sides of the drift, it coming off in sheets and slabs of all sizes, breaking up finely in many places, and rendering the task of mining comparatively easy. The ground comes in to fill any opening, no matter how small. A single drift, away from any other opening, soon shows weight upon the timbers. This is favorable to the plan they have adopted for the winning of the ore, and now that there has been so large a territory prepared, the work of securing a product will be readily and cheaply performed. I do not hesitate in saying that the Chapin is in shape to mine its ore as rapidly and cheaply as an underground producer in the Lake Superior region. No property presents more prominent deposits of ore and no concern has taken a livelier advantage of the gifts of nature. Numerous winzes have been put in so that there is a ready means of getting from one portion of the mine to another, and for the milling of the ore to the 10th level, to which it is sent, and from which point it is conveyed to the Hamilton shaft. The latter is in the limestone to the north, and to this station the bulk of the ore will be sent.

They have recently installed a chain haulage plant hore which takes the cars to the shaft and into the level. An

old engine has been fitted up, located at D shaft, opposite the Hamilton, and the management believes it will be an improvement over the rope haulage plant now used in the mine. The chain is carried over pulleys in the usual way at a speed of about 100 feet per minute. The cars are provided with a rigid hook riveted to the end and near the bottom of the car, the hook reaching below the line of the car's botton. To hitch the car onto the chain the latter is simply lifted by hand and dropped upon the hook. The wire ropes wear rapidly, the clutching device tearing the strands, and it is thought the life of the chain will be considerably greater. At the time of my visit the cars were being satisfactorily handled by this plant, and it will probably take the place of the rope. The cars hold something over two and a half tons of ore, and are carried to a tipple at the shaft, where they are dumped by their momentum into the skip pocket, a neat device which is opened for the load to enter the skip by a lever operated by one man who opens and closes the way by simply turning a wheel. The skip is loaded considerably faster than it can be clumped at surface. The skip used in the shaft is mounted upon a cage frame, attached to the latter by a substantial shaft. In coming to the pocket the skip is deflected from the perpendicular by wheels coming in contact with grooves formed of angle iron, turns upon the shaft, releases its load, and the lowering of the cage brings it back to the perpendicular again and upon the cage platform. It is one of the neatest arrangements to be seen in this mining country, and it is not patented. The skip holds five tons of ore and dumps into a five-ton car, which is automatically opened at the sides to discharge its load wherever desired by tripping a lever at any given point along the line. The bottom of the cars rises in the center like an inverted trough. There are wings upon the sides of the car that open, and in returning the car to the pocket these wings are automatically closed. The car can discharge its load into the ore pockets from which the railway cars are loaded or can be sent out upon the stockpile trestle at will. This shaft can easily take care of all the ore that can be sent to it from the mine. The speed of the chain haulage engine can be increased if desired. The pull is not rendered difficult by sharp turns. For 831 feet the line is a tangent, and the curves are on a radius of 100 feet, these being near the ends of the line.

The Chapin handles a large volume of water, about 1,700 gallons per minute. Of this amount 1,200 gallons are lifted at D shaft, and 500 at Hamilton. The Reidler pump in the timber shaft is located at the 8th level, the suction being twenty-eight feet below the level. The steam end is from a Corliss engine which was used at one of the old shafts, and the water end was built by Frazer & Chalmers. The water column is 14¼ inches, the same size as that in Hamilton shaft. With these two pumps the water can be easily cared for even should there be a considerable increase over the present volume.

A new trestle has been built at Hamilton shaft, double tracked and a new pocket and haulage house. All the old buildings at this point and at the Ludington have been torn down. There has been a vast amount of work done at the Hamilton shaft since the property was acquired by the Chapin company. The station is a substantial one, the shaft being sunk in solid limestone. Thus far the shaft has been used only for the taking of Chapin ore to surface, and it will be some time before the Hamilton lens will be reached, it being encountered at the 14th level. The shaft is filled with water below the loth, and in will be some time before the bottom will be reached in the course of mining, as the company will probably bring all their workings to this point by slicing from the top downward, one level at a time, the Hamilton lens awaiting such time as other lenses are being exhausted to this point. The main south and north Chapin lenses are still strong at their lowest workings, and the bottom of the trough may be a considerable distance below the deepest point to which they have been tested.

That the new north lens continues westward upon the Ludington property is pretty well determined by work being done from the Ludington mine eaat. The ore is of the same kind, has the same characteristics of enclosing formation, and the ground separated the workings upon the two properties has a length of about 250 feet. This indicates that the north lens is a healthy one, and will be prominent in the mine for some time to come.

The purchase of the Ludington and Hamilton properties was a wise move on the part of the Chapin company. At the Hamilton they have a substantial shaft, and ore will be found at greater depth. The Ludington has been given considerable attention since its unwatering. At the old B shaft, 4th level, 280 feet from surface, they drove a drift east in the foot wall across the Chapin line, and crosscutted upon the north and south lines of the properties, encountering an old room where the Ludington had encroached upon Chapin ground. Considerable ore was secured here. Between the 4th and 5th levels there was much jasper mixed with the ore. Upon the 5th, 383 feet from surface, they extended the work east of the Ludington line 330 feet, finding the ore of satisfactory width. At the 6th level they are 155 feet upon the Chapin fee, following the strike of the ore. At the old C shaft they are taking a big pillar, raising in it and putting in "subs," settling the top, following the plan that is in vogue throughout the mines. No ore was found upon the 8th level. The ore from the 7th will be sent to the 9th as soon as a raise can be put through for the purpose. The ore upon the 9th is small. The Ludington company went north below this level and found what is probably the Hamilton lens. Connection is to be made with the Chapin at the 8th level. According to the old maps there is a lens of ore at the 14th level having a width of about eighty feet where considerable work can be done upon pillars when that depth has been attained. This is probably an extention of the Hamilton lens. The ore of the Ludington is mined easily, jumpers being used for drilling. In quality it is satisfactory. They make two grades, the "Star," giving 63% iron and .070% phosphorus, and the "Chapin," giving 63% iron and

.060% phosphorus. The Ludington has already given enough ore to go a long way towards its purchase price, and will be a producer for many years to come. About fifty feet south of the main deposit is a smaller one about eight feet wide, giving ore of excellent quality, but it has been too narrow to warrant working. A new air pipe line 12-inch, was put in at B shaft, Ludington, the past year, replacing an old one which had crossed the caving ground, necessitating a new route and extension of main to supply power.

All the power to operate the hoists, drills, haulage, plants, shops, in fact all the power used with the exception of that to operate the pumps, is furnished from the company's hydraulic works, located upon the Menominee river, three miles distant. This is a great saving to the company as compared with other mines in this region. The Ludington purchase included an interest in the water power and pipe line which gave to the Chapin full ownership of the entire falls and power plant.

The company is figuring upon lighting their main underground stations with electricity, an improvement which will greatly facilitate the handling of ore upon the levels, particularly at the shaft stations.

There are two lines of railroad leading to the mines, the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul. Ore is shipped over both, the tracks being arranged so that one can get to the stockpiles without inconveniencing the other. The Chapin sends considerable ore to market by all-rail in the winter season. Its location is favorable to this, being more fortunate than mines further away from Chicago, and giving it considerable profitable business in the winter season.

The company has done an enormous amount of opening the past year, the total length of drifting, crosscutting and raising amounting to 16,380 feet. There have been many changes made, and the season was a very busy one for the local management. The latter can be complimented upon the excellent manner in which everything has been accomplished. The number of employes is about 700, nearly all of whom work upon the contract plan.

Jas. MacNaughton is general manager, L. B. Sutton, mining engineer; Martin Goldsworthy, mining captain; M. Lonergan, cashier. The main offices are in Cleveland, Ohio. M. A. Hanna, president; L. C. Hanna, vice president and treasurer; A. M. Robbins, secretary.

THE PEWABIC.

The Pewabic Mining company, operating in the city of Iron Mountain, is one of the solid concerns of the Menominee range and one that has shown commendable enterprise in the development of its lands, and in the invention and adoption of the best methods and equipments. Its president, Dr. N. P. Hulst, who now fills the important position of general manager of the interests of the Oliver Mining company, was one of the first to engage in the exploiting and development of the iron-bearing lands of the Menominee district, while the superintendent, E. F. Brown, has well proved his fitness for the position.

Since its opening the Pewabic has shipped 1,495,695 tons of ore, and of this amount 279,095 tons were contributed in 1897. In the earlier history of the property the bulk of the product was of high grade called "Pewabic," and the shipments for an entire season have given iron averaging 66% and phosphorus averaging .007. This has probably not been equalled by any other mine in America. But the former large areas of Pewabic grade ore have greatly diminished in size, ores higher in phosphorus have been found as the mine deepened, and the present finds the greater portion of the product of the highly-silicious class.

This is not coming from the lower levels of the mine, however. Some time since an immense flow of water was encountered which prevented the opening of additional levels. A triple expansion Worthington pump was installed and readily cares for the water now made, but the company desires to take the ores already developed before going deeper.

At the 3d level and 300 feet west of No. 2 shaft they are mining ore of the silicious class it giving 42% iron and .010% phosphorus. This ore is in the centre of the mine in the opening upon the trend of the deposits from east to west. There is a block of ore here 350 feet long, 150 feet wide and from 73 to 125 feet thick. It is estimated to contain 350,000 tons. This has been undercut, and it has dropped down nicely, breaking and crushing by its own weight, so that the miners go through it at the bottom and afterward go in over the same ground several times the ore coming clown to them readily. It makes easy mining and the results obtained are satisfactory.

Upon the 4th level and immediately under the silicious portion of the 3d, the ore continues downward. It is smaller in proportions here than upon the 3d, there being about 250,000 tons in the block which has been cut as upon the 3d level. Should the market demand it, 250,000 tons of this silicious ore can be mined this season.

From the 3d level upward to the underlying sandstone, they are taking out a few pillars left in the original openings. From these they expect to take 30,000 tons of non-bessemer, and a quantity of ore of Pewabic grade during the year 1898. This work is in the east end of the mine.

From the extreme east end of the 3d level they are putting in a drift to the east. This has encountered sandstone and 20 feet of ore of Pewabic grade, and they have a theory that there may be a fold here similar to that found at the Loretto, Aragon and other mines on this range. Should this prove true it would be possible for a profitable lens of ore at this point. It is the object to prove this portion of the mine as speedily as possible,

and to learn all about the territory tributary to the upper levels before going deeper.

Upon the Walpole property now in the possession of the Pewabic company, and lying immediately north, they are still continuing the explorations commenced several years since.

There was a shaft sunk upon this property in 1897. It is down 353 feet. At 150 feet from surface a drift was started east and is in 395 feet. It has 400 feet to go to reach the Pewabic line. There has been 275 feet of crosscutting north of the shaft and crosscuts will be driven north and south from the east drift at intervals of 250 feet. The company is hoping for lenses of high grade ore. The drift is in lean ore giving 42% iron and low in phosphorus. They will mine 30,000 tons of this in the course of openings this season. The new shaft is 1,100 feet south and 600 feet east of the old Walpole shaft. The Walpole enjoys a most favorable location and will be explored thoroughly.

The Pewabic company is now devoting considerable attention to a body of ore and sandstone upon the northeast quarter of the southeast quarter of Section 32, Town 40, Range 30, it being the intention to crush the ore and rock, removing the latter from the ore by washing. Explorations up to the present time have revealed a deposit of ore and sandstone having a length of about 2,600 feet and a width of 1,600 feet. Overlying the ore-bearing sandstone is drift to the thickness of 40 to 175 feet. The ore is about 30 feet thick. This mixed ore body lies upon a hillside, and they have opened it by driving an adit into the hill. The ore-bearing stratum is underlain with limestone. This adit will be carried to the extreme north side of the deposit, about 1,600 feet as judged at present, and will be the main drift. From this they will put in lateral drifts to the extreme east and west ends of the ore-bearing sandstone and will begin mining from the ends of the deposit, working back towards the north and south main drift in the centre of the mine. They will let the surface come in after the ore has been removed. The main adit is now in 300 feet. The ore will be taken from the mine by a rope haulage plant operated from the mill building.

It is figured that three tons of the ferruginous sheet will yield one ton of ore giving 64% iron and .010% phosphorus. To treat the material from the mine they have constructed and equipped a concentrating mill having a length of 149 feet and a width of 30 feet. Besides there is a wing from the main building for compressor, engine, dynamo and boilers. As the ore comes from the mine it will be dumped into a chute leading to a set of grizzleys the openings of which will be two inches. The material goes to picking tables where boys sort out the chunks of clean ore and clean sand. From this point the material is carried to grizzleys having smaller openings, and to the crusher and roller set at three-fourths inch. The crusher has opening 14"x24", is of the Blake pattern, and built by the Lake Shore Iron Works, Marquette. The rolls are 14"x24", are of steel and made by Frazer & Chalmers, Chicago. From the rolls the material goes to the shaking tables passing through three sizes of screens, one-half, one-fourth and one-sixteenth inch mesh, this making four sizes of ore. From the screens the ore goes to storage bins and from these is elevated ten feet by link conveyors, belts and buckets. From the storage bins the crushed and screened material is taken by screw conveyors to the washing jigs, and screw conveyors take the ore from the jigs to the pockets at the railway track. The site is an admirable one for the automatic handling of the ore, there being plenty of fall to give room for the dropping of the material from one level to another. The force required to look after the plant will be one man to regulate the flow of water, and one to look after the machinery.

It is thought that 20% of the product will result from the hand picking, although the company has taken no account of this in figuring upon the enterprise. In making their calculations they credit all the material mined as going through the mill from top to bottom. The plant will be illuminated with electricity, a 150-light dynamo having been installed. Two tubular boilers 100-horse power each, will provide power. The engine is 9 5-horse power, and built by the Norberg Manufacturing company, Milwaukee. The water supply will be obtained from the Pewabic mine, one and one-half mile distant, and will be piped in a steel main. There is plenty of fall to insure a satisfactory flow and the amount obtainable will be ample for the needs of the company. Prof. Louis M. Heidenberg, of the Michigan College of Mines, will have charge. By the opening of navigation there will be a railway spur completed to the property, and everything will be in shape for business. The operations here will be watched with much interest by mining men throughout this district. A force of about seventy-five men will be employed.

Several attempts at the concentration of the ores mixed with rock have been made in the Lake Superior region, all of them, so far as I know, proving failures. Upon the Menominee range, on the Felch Mountain branch, the Groveland Iron company erected a mill and equipped it with machinery, the whole plant costing in the neighborhood of fifty thousand dollars. Its total product was about twelve hundred tons. Those who were selected to look after the work of mining and concentrating were novices in the business, and it was not surprising that they met with failure. The material treated was not refractory and should have been cheaply and profitably handled. The disappointment of the trial was so keen that nothing has since been done at this location, but the success of the plant at Iron Mountain might show the Groveland people why they failed.

The Negaunee Reduction works, Marquette range, was organized by foreign capital to treat the jasper-banded ores of the Jackson mine formation. The material was of the hardest possible character. No rolls could be secured to withstand the strain to which they were subjected in order to reduce the rock. The specific gravity of the jasper was nearly as dense as that of the

ore, so that much of the latter was washed away in trying to get rid of the former. Something approaching a half million of dollars was expended in the plant and trial, the pile of broken machinery far exceeding in size the stockpile representing the finished product. The mill still stands as a monument to the stupidity, or rascality, of those who had the scheme in charge.

The Republic Reduction company was an organization formed to treat the immense waste piles at the Republic mine, Marquette county. A large building was erected, crushers put in and considerable money expended in a system of concentrators, but these were all abandoned and the product obtained was by hand-sorting, which was discontinued after a trial of a few months. The piles of waste have reverted to the Republic Iron company and they have been shipping it as lean ore, for which there was no market at the time the concentration was being tried.

At the Michigamme mine, Marquette county, the first trial of electric separators was made in this district. These were of the Venstrom type, the same as being used at several places in Norway, where the inventor lives. A considerable product was obtained in the time the trial was under way, but it is questionable if a profit was realized. The separators worked satisfactorily, but there was something in the plan that made the finished product cost too much.

At Humboldt, Marquette county, Edison, "the wizard of Elmo park," put up a small plant and treated a few tons of material. There were many changes made in the time the experimenting was under way, and before a satisfactory conclusion had been reached fire destroyed the plant and the latter was never rebuilt. Mr. Edison has transferred his operations to New York state where he has an immense electrical concentrating works in motion. He claims that he will be able to place the finished product in cars for thirty cents per ton, the ore being absolutely free from phosphorus and running high in iron. Several millions of dollars have already been invested in the plant. Steam shovels take the lean ore from the deposit, after which it is crushed and the ore removed by powerful magnets. The ore is briquetted and in that shape is supplied to furnacemen.

In the Lake Superior country are immense belts of lean ores that could be concentrated electrically if those of New York state can be. Upon the Menominee are millions of tons and the same is true of the Marquette range. The Pewabic lean ore is an attractive one from the fact that the sandstone with which the ore is associated is easily crushed and can be readily washed from the ore. No other district has this sort of material to treat, but have bases of more refractory kind.

The Pewabic is now employing a force of about 300 men, all of whom are working upon the company account plan. They observe bi-monthly pay days, being the only mining company in the region that does. All others pay monthly.

Dr. N. P. Hulst, Milwaukee, president; E. F. Brown, Iron Mountain, superintendent; Jas. Holland, mining captain.

THE MILLIE MINE.

The Millie mine lies just east of the Chapin and its ore lenses, which are generally small, are located in the Chapin mine foot wall. It is operated by the Dessau Mining company of New York, N. Y., Simon Dessau, manager, and has produced 172,076 tons, of which amount 10,374 tons were mined in 1897. The property was idle for a portion of the year, but is now employing eighteen men all told, and is preparing to open up the eighth level. There is a vertical shaft to the 4th level and upon the 4th, and 150 feet west of this shaft, an incline has been carried down following the foot, this necessitating a transfer of ore at the 4th. In adding levels they sink a winze on the top of the deposit, near the hanging, and rise up on the footwall for the shaft.

As they have gone downward in the Millie the pitch of the ore has carried them into Chapin territory, until at the eighth level the ore deposit is nearly entirely upon Chapin lands. They have a vein sixteen feet thick between foot and hanging walls, and the length of the lens upon the level is about 120 feet. The ore of the mine is of excellent quality. The royalty charge has been reduced from 60 to 35 cents per ton.

The company did some diamond drilling for ore near Quinnesec, the location tested being the southwest quarter of Section 34, Town 40, Range 30. Small seams of ore of fine quality were struck, but nothing of marketable size was found, and the work was discontinued in January, '98.

The Millie has large outcroppings of silicious ore in which its high-grade ores are held, but they do not care to give them attention, as there is little or no money in their mining. Charles McGregor is superintendent.

THE ANTOINE ORE COMPANY.

This company is one of the most prominent in the mining of ores high in silica. It has large deposits of this class of mineral upon Sections 17 and 20, Town 40, Range 30, a mile and a half distant from the city of Iron Mountain. Oglebay, Norton & Co., are in charge at the present time, O. C. Davidson, of the Aragon mine, being manager, and F. L. Coventry in local charge.

There are three pits, the "Traders," Clifford" and "Cornell." Of these the Clifford has been the most extensively wrought, it possessing the best ore. It is located upon the northeast quarter of the northwest quarter of Section 20, and the ore gives 43% iron and .025% phosphorus. This ore body has been stripped for a width of 120’x300' and to a depth of from 40 to 70 feet. The ore is mined in the summer season, none being stocked during the winter months, and is blasted from the sides and bottom of the pit, milled to a level below the bottom of the latter, and from there trammed to a shaft at the west end of the pit. The shaft is 75 feet

deep, has double skip road, and a product of 1,200 tons daily was secured when the pit was actively operated. There are five mills entering the east and west drift through which the ore is sent to the shaft. About 500 feet west of the Clifford pit shaft is a shaft known as the "Flesheim." It is sunk in lower ground than the Clifford, and is deeper than the latter. From a point near its bottom a drift has been run east to connect with the pit shaft, and there is about 200 feet to be driven to make the connection. It is proposed to make this the pumping station when the water level had been reached.

The ore mined here is flaggy, easily secured, and is readily crushed, the Gates crusher located at the shaft being able to treat 3,000 tons in twenty-four hours. There will have to be some stripping done here to give chance for mining the coming season, and there is a large area yet to be uncovered, the ore extending east and west as well as north far beyond the territory thus far cleared of the overlying drift.

The Traders pit is 50 feet north of the Clifford. No ore was mined there during the year 1897. The pit is well equipped for the ready securing of a product, but its stores have not been drawn upon as the quality of the product is not equal to that of the Clifford, it being a little lower in iron. They have an abundance of silicious ore here, it being run out over a trestle from the side hill to a Lake Shore Iron Works crusher. The pit is fifty feet deep in the lowest point reached. The Chicago & Northwestern and Chicago, Milwaukee & St Paul railroads have tracks to these pits and shipments are made over both lines. The product of the Clifford pit for 1897 was 102,396, and there has been shipped from both pits 217,840 tons.

The company also has under lease the old Cornell property on Section 20 immediately southeast of the Clifford. It possesses also the Keel Ridge, and has taken a little lean ore therefrom. In quality it is inferior to the ore of the Traders and Clifford.

It is probable that ore will be mined from the Clifford, Traders and Keel Ridge pits the coming season. The management of these properties is looking for an active business and can place the different properties in shape for a large output with but little preparatory work, which would consist principally of stripping.

THE PROTECTION.

For the past few seasons a little work has been done upon the southeast quarter of Section 22, Town 40, Range 30, by Welcome Hyde of Appleton and others. During the year they retimbered the old shaft which is 175 feet deep, and since then have been driving a drift east and west from the bottom, with the formation. They have silicious ore giving about 40% iron and .030% phosphorus, and are in hopes of finding something of better grade. The Schlesinger railway of the Northwestern company is within three-quarters of a mile from the exploration, and a spur may run to the mine. There are several thousand tons now in stock. John T. Spencer has local charge.

SECTION SIX.

Upon Section 6, Town 40, Range 29, just west of the village of Norway, Benjamin High, of Norway, has been conducting explorations for several years. There is a strong outcropping of lean ore extending east and west for some distance, and it has been the object to find ore of better grade in this formation. Since my last report they have started a pit 150 feet further west, and are working in lean ore. The effort put forth is deserving of better success than thus far met with. Two men are employed.

MINES OF IRON COUNTY.

Iron county possesses large deposits of hematite iron ore. For thirty miles north and west of Iron Mountain these ore bodies are found, and the county has iron-bearing formation for a width of twelve miles. The ore is not of bessemer grade, however, and at many places is not as high in ore as furnacemen demand, this greatly affecting the output of the district. Many mines have been discovered and wrought which are now idle, and there is a great territory as yet practically unexplored. The time is not far distant when the higher-phosphorus ores will be in demand in the manufacture of basic steel, and when this period has been reached Iron county will take on new life. The county has a wonderful growth of hardwood, and no better site could be had for the erection of charcoal blast furnaces. Considerable is being done in the way of agriculture, the soil being rich and adapted to the growing of such roots and cereals as thrive in this climate.

NEAR CRYSTAL FALLS.

The present active properties, four in number, now operated in Iron county are located near the village of Crystal Falls, the county seat. The first met with is

THE CRYSTAL FALLS MINE,

occupying the east half of the northeast quarter of Section 21, Town 43, Range 32. For many years this was looked upon as of little value, and various attempts to dispose of it were unsuccessful. In 1886 Corrigan, McKinney & Co., of Cleveland, Ohio, were induced to take possession, and began systematic exploration. The result is that the property is now one of the best in the county, and has rare promise of being an active producer for many years to come. Up to 1896 the total output was only 18,352 tons; in 1896 there were shipped 44,526 tons, and in 1897 it sent out 95,210 tons, and was not operated to its full capacity. There was a shaft put down upon the hanging wall side of the deposit, to the third level, and the present winter a second shaft has been put down upon the foot-wall side. It has been timbered to a depth of 170 feet, and they have "holed" from the bottom 70 feet into this, making depth of shaft

240 feet. This shaft is 40 feet back of the ore body, following the angle of the dip of the formation which is south about 65°. The shaft has been raised for its entire length. The work originally done here was in open pits or cuts, and the present company has done some work of like character in the old pits, but the principal ore body was not revealed until the present management took hold. An ore body about 500 feet in length and running from 40 to 60 feet wide has been shown up. The ore gives from 58% to 59% iron and from .500% to .700% in phosphorus. The deposit is perfectly free from rock.

In winning the ore of the level worked last year they drove a main drift along the foot, put up raises every fifty feet, and sliced from the top downward, using the raises for chutes. Occasional pillars were left where the ground demanded.

They are thinking of changing the plan upon the third level which will soon be ready for mining. They talk of undercutting the ore, putting in drifts upon the foot and hanging sides of the deposit, and taking off horizontal slices, letting the broken ore accumulate under the feet of the miners, milling the same down whenever needed. The walls are very substantial, standing firmly, as plainly evidenced by many large rooms now to be seen and which were mined out a year or more ago without the use of timber. The ore is brown in color, mills well, and contains 2½% of lime, assisting in its fluxing in the furnace. With the opening of the third level the company will be in shape to make a neat output the coming season. No property in the district can show better results in the accomplishment per man. The new shaft is double skip tracked, and a new shaft house and pocket are now nearly completed. Improvements will be made in the railway tracks in early spring. There is an ample equipment of machinery, one hoist being obtained from the Williams property, Mesaba range, and another from the Sunday Lake mine, Gogebic range. There is a compressor of sufficient size to provide air for the drills and nothing is lacking to do work with. The location is well elevated above the surrounding country, and the mine makes but little water. A force of fifty men is now employed, which number will be materially increased the coming shipping season. S. C. Bennett is superintendent; Edwin Jacka, mining captain; John Roach, clerk. Like all the properties of Iron county, the Crystal Falls pays royalty to the owners of the fee. Immediately adjoining the Crystal Falls mine is an exploration called

THE HILL TOP,

which has been conducted by C. T. Roberts. It is in line with the trend of the Crystal Falls deposit, but the foot wall of the latter property, which is a black slate, makes a decided fold before the Hill Top line is reached. It will probably resume its regular trend again, as the underground workings of the Crystal Falls now suggest this. There is nothing being done at present at the exploration. There is a shaft down a short distance. The ore did not give results equalling the Crystal Falls, but may improve as did that of the latter as they get deeper. Four miles east of Crystal Falls is

THE MANSFIELD MINE.

The changing of the course of the Michigamme river so as to permit the mine being worked, was fully described in my last report. The encouragement to do this expensive task was due to the fact that the Mansfield was a producer of bessemer ore, the only property in this section possessing mineral of that quality. They worked in the old lenses which outcropped in the bottom of the river, but these were narrow, and were mostly of non-bessemer grade. The vein pinched up to a few feet in places, and the outlook was discouraging. They went into the old mine after the water had been removed last summer, and sunk another "lift" of sixty-five feet. To the south they have carried the drift upon the trend of the ore for a distance of 125 feet, and to the north for 100 feet, the ore to the south being of the better quality, and mostly of bessemer grade. The drift is following the foot, and the width of the ore is from seventeen to twenty-two feet. Upon the third level there are 25,000 or 30,000 tons to secure, and there is also ore to be had from the open cuts.

Upon the sixth level they have extended the old workings north and south, being north 150 feet and south 175 feet, in new territory, and showing ore that is principally non-bessemer. There has been a considerable gain in the amount of ore developed since my last visit to the property.

The ground stands well, and they intend to cave the surface, going to the extreme north and south ends of the deposit and working back towards the shaft. A force of sixty men is now employed. The property produced 37,182 tons in 1897 and has sent out for all years 244,138 tons.

A mile south of the Mansfield, or Lot 6, George Maas of Negaunee, did diamond drilling in 1897, locating a body of bessemer ore thirty feet thick, the analyses of drill borings showing 62% iron and .051% phosphorus. The ore was generally soft and blue, but there were bunches of hard steel-like ore giving 63.10% iron. There is a heavy drift here. Some years since a shaft was sunk half way to the ledge under direction of J. Parke Charming. Mr. Maas has prepared to continue drilling upon Lot 5, immediately south of the former exploration, and expects to get started next spring. The territory is a promising one. The Armenia and Hollister mines, located midway between the Mansfield and Crystal Falls, have long been idle.

THE GREAT WESTERN.

This mine is immediately southeast of the Crystal Falls. It is looked upon as one of the most promising in this portion of the Menominee range. It has been idle since February, 1893, and is full of water. There were two shafts sunk to a depth of 700 feet, and four levels of ore are cut out and are ready to attack whenever the

company desides to resume. V. K. Moore, of Detroit, is receiver, and were it not for legal troubles it is said the property could be operated now. I believe there is a bonded debt of $150,000 upon the mine. The ore runs above 60% in iron, and the property produced 373,100 tons during its activity.

THE LINCOLN MINE,

which was also known as the Fairbanks, adjoins the Great Western, and was closed down when the latter pulled its pumps, the Lincoln being unable to handle the water of both properties. Escanaba parties are interested, F. Brotherton, of that place, having been superintendent. The affairs of the company are in the courts, an injunction having been served upon the fee owners, principal among whom is Angus Smith, of Milwaukee, Wis., preventing the leasing of the property to others who have applied for it. The Lincoln has shipped 36,589 tons and has a shaft 150 feet deep.

The Paint River, Lament (Monitor), and Youngstown, all located upon adjoining properties, are idle and there is no talk of a resumption. I heard that inquiries are being made concerning the Claire, located upon the east half of the southeast quarter of Section 19, Town 43, Range 32, and that there is a chance for its re-opening. There has been mined from open cuts 66,964 tons, the ore giving about 56% to 58% iron and .975% phosphorus. The fee is owned by the Pfister Land company, of Milwaukee, Wis. No work has been done here since 1893. The May, located just southeast of Crystal Falls, upon Section 28, the Junietta upon the adjoining Section 29, have deposits of ore of low grade.

Southwest of Crystal Falls two miles, upon Section 31, town 43, Range 32, is

THE COLUMBIA MINE.

This property has also been known as the Shelden, Shafer and Union. It is one of the most important of the Crystal Falls district mines, and has sent to market 470,039 tons. It is operated by the Huron Iron company, with general offices at Chicago. John Crera is president, M. S. Saunders, secretary. Frank Scadden, Crystal Falls, has charge as superintendent. The Columbia ore deposit is egg-shaped. In the upper levels the ore was in smaller pockets or lenses which were badly mixed with rock, and a belt of jasper formed two stratums of ore. At the fifth level there was a better condition of things, and at the sixth the showing was a magnificent one, the ore having a width of 230 feet, and was free from rock mixture. At the time of my last visit they had fairly begun the work of developing the sixth level, which is 520 feet from surface. In June of 1897 there was a caving of the upper portion of the hanging wall in which the shaft was sunk, the shaft was lost, and the season's business in ore production stopped. There were 24,624 tons of ore sent out that had been placed in stock previous to the accident. Since this unfortunate disaster the company has been engaged in the sinking of a new shaft, the location of which is at the southwest end of the ore deposit. The trend of the latter is northeast and southwest, and they think they are 150 feet beyond the southwest extension of the ore, and in solid ground. The shaft 8'x20' is four-compartment, three ways for the handling of ore and one for pumps and foot-way. It is now 200 feet deep, and will be carried to the bottom level of the mine. Its location is 400 feet south and 300 feet west of the caved shaft. They will raise the shaft from the 4th, 5th and 6th levels, and have already begun the extension of the drifts to the necessary point from the old workings. In cleaning out the caved shaft they found an old room at the second level which had been worked out at some time in the earlier history of the property. This was just east of the shaft, and it is credited with being the cause of the cave. The back of the old shaft is intact, the front having slid away. Between the second and third levels the timbering was found in place. In clearing away the debris the old room was found, and they threw over fifty cords of wood and old blocking into the opening before the place was made secure. The water has been lowered to the back of the 5th level, and will soon all be out.

In mining the ore they carry their levels eighty feet thick, and begin the opening with a big drift stope which is carried twenty-five feet high. In this they put in a raise for fifty feet, raises having no regular distance apart, and work from the end of the deposit to the shaft, letting the surface follow down. The dip of the deposit is 73°, and and the walls are of the very best. The ore comes down freely, and care must be taken to remove it as fast as it releases from the back. If permitted to rest for a few days the surface sand comes down, mixing with the ore. The mine is a wet one, and the water causes the trouble. About 500 gallons per minute are pumped. The ore contains about 60% iron, is non-Bessemer, and has 2½% lime, and from 3 to 5% silica. It is salable, and the mining cost is low. There is considerable water to handle, but little timber is required. A force of sixty-five men is now employed which will be largely increased as soon as the new shaft is completed. They expect to be able to send out considerable ore the coming shipping season. The new shaft will be of great advantage in future operations.

THE DUNN MINE

is the nearest active neighbor of the Columbia, being located upon Section 1, Town 42, Range 33. It was idle for the greater portion of 1897, this being due to troubles between the fee owners and operators, the latter being the Dunn Iron company, of which F. Schlessinger is president. F. E. Woodbury, of Ironwood, Mich., is general manager. The difficulties were finally adjusted, and the property resumed late in the year.

The Dunn was formerly a large mine. Its ore was readily obtained, there being little water to pump and no timber required to hold the hanging wall in place. Large openings were made, and even at the low price received for the ore, which is of low grade, the operators

managed to earn a small profit. As the mine grew deeper the ore lenses grew smaller. The pitch of the ore carried the latter away from the No. 2 shaft to the northwest, necessitating the sinking of an incline shaft from the 9th level and 320 feet from No. 2. This causes a transferring of the ore, adding something to the cost of hoisting.

They are now opening the 11th level in the northwest end of the mine, where there is a body of ore the dimensions of which are not yet proved up. Where first encountered it was narrow, about eight feet wide, but as they work to the north and west it is gradually increasing in size, being twenty feet and the walls still spreading. They are putting in a raise connecting this portion of the mine with the 10th level, seventy feet above. In reaching the deposit upon the 11th along rock drift was necessitated. There is also a timbered drift leading from the shaft to the rock drift, and the expense of connecting the level has been a heavy one. There has been some improvement in the quality of the ore mined of late, it giving 60 to 61% iron. It is high in phosphorus. A force of seventy-five men is engaged. S. C. Bennett is superintendent, F. W. Cole, clerk. The mine shipped 31,062 tons during 1897, and has a total for all years of 1,000,207 tons.

The Alpha, Dephic and Mastodon are properties in this section, all of which are idle, and the Mastodon has been abandoned its ore being exhausted, North and west of Crystal Falls ten miles is

THE HEMLOCK MINE,

located at the village of Amasa, and upon Section 4, Town 44, Range 33. The property is named from the river which runs across a portion of it. The mine produced 96,051 tons in 1897, and has sent out for all years 305,181 tons. Mr. C. E. Lawrence has done excellent work at the mine in its superintendence. Everything has been well handled and cared for, and the costs have been surprisingly low when the character of the deposit is taken into consideration.

The ore deposit has a trend northwest and southeast, with a dip to the south of 60° and a pitch to the west. The vein is narrow and they have opened it up for a distance of something like 500 feet. The thickness of the ore will average about sixteen feet, contracting to a few feet in places and widening to thirty feet in others. The ore is in a grey schist, that stands well.

They have one working shaft in the foot, and back of the ore deposit about thirty feet. It is to the 4th level, and they are now sinking for the 5th. Levels are sixty feet apart. In winning the ore they drive crosscuts from the shaft to the deposit, put in substantial timber, drift upon the trend of the ore, undercut the latter, letting the broken ore accumulate under the feet of the miner, and afterward tap the broken ore from the drift whenever desired. The ore is hard, and it runs well. The ore extends under the river, and they have followed it here, putting in solid cribbing so as to prevent damage to the back of the drifts. There is no sign of water, the territory immediately under the stream being the dryest in the mine. The ore under and north of the river is harder than that found to the south. The third and fourth levels have been carried beneath the stream. There is fifty feet of ore remaining in the back of the 3d level, and above the ore is twenty-five feet of sand which, with ample protection, in the way of solid timbering, insures against the encroachment of the water from the river. At the north end of the mine the ore is swinging to the east.

They are sinking winzes from each end of the deposit to the 5th level. A force of 105 men is employed, Charles Hughes is mining captain. The general office is in Cleveland, and the property is operated by Pickands, Mather & Co.

The Michigan mine located upon Section 9, immediately south of the Hemlock, is still idle, although there is considerable talk of resumption.

Fifteen miles west of the village of Crystal Falls are found the

MINES OF IRON RIVER.

This section, is productive of ore similar to that in the vicinity of Crystal Falls, is all of non-bessemer grade, and at the present writing, March, '98, there is not a property in operation. There is an abundance of ore of such grade as here found, but the market calls for only a limited amount of it, and the price has been so low for that which is demanded that it has left nothing for the miner.

THE DOBER MINE,

located upon Section 1, Town 24, Range 25, has done nothing since my last report. At this writing March 15, '98 they are preparing for resumption and are securing additional machinery from the Mastodon mine. They have a small-sized shaft to a depth of seventy-four feet, it being in the ore body, and from the bottom a drift was run 165 feet to the southeast. There is a large deposit of ore here, and it can be easily mined whenever the market calls for it. It gives from 49% to 60% iron. They have crossed the deposit for 100 feet, and have yet to find the enclosing walls. It certainly is one of the best prospects in this portion of the range. Captain E. S. Roberts is in charge.

THE HIAWATHA MINE.

There was a little work done in 1897 at this property which is located one mile south of Iron River, this being done by the Ballou Mining company, a re-organization having been effected from the old Hiawatha Mining company. M. H. Ballou, of Carney, president; F. H. Morrison, Iron River, secretary; Wm. H. Selden, Stambaugh, Mich., treasurer. They have a shaft 150 feet, and are just fairly into the ore deposit. The ore obtained here is of excellent quality for this range, giving from 60% to 62% iron. The property is well equipped

with machinery, but has lacked railway facilities, having to haul the ore by teams to the Northwestern railway nearly a mile distant. I am informed that there will be a spur track built to the mine this spring. No ore was shipped during the year. The total product of the company is 2,884 tons.

THE SHERIDAN MINE

is located in the village of Iron River, upon Section 26. The mine has one shaft 325 feet deep, and has three levels, the bottom one showing well in ore, although there is considerable rock mixture. The mine has done nothing since my last report, and is full of water. It has produced 77,132 tons. A. Gulgren is superintendent; John Power, Escanaba, is president; M. K. Bissell, of the same place, is secretary.

Besides these properties there are the Miller, Iron River, Isabella, Nanaimo, and other prospects, the contributions of which will be found in the shipping tables following the descriptions of the iron ore mines of the several ranges.

FELCH MOUNTAIN RANGE.

This iron-ore bearing district is twelve miles north of the Menominee range proper. It was given considerable attention in the eighties, but the ore deposits were thin, and soon gave out. The surface showings at some of the properties were wonderful, but the shafts soon passed through the ore which proved flat and thin. In January, '98, J. T. Jones, of Iron Mountain, secured possession of the old Groveland mine upon the southwest quarter of the southwest quarter of Section 31, Town 42, Range 29 and talks of reviving the old shaft. There was some concentrating work done here an account of which appears in my description of the Pewabic iron mine. The ore is low in phosphorus. 1,049 tons were produced. There may be large deposits of ore upon this range but for years nothing has been done in the way of searching for them.

THE COMMONWEALTH.

The Commonwealth mine is upon Wisconsin territory, but is such a near neighbor that I give a brief account of it in my reports. At the present they are doing nothing but taking pillars in the property, having worked out the deposit with this exception. There is enough to keep the property busy for a couple of seasons. It has been a great mine. Its walls were so firm that rooms 200 feet in height were mined out without the use of timber. It paid the company well. The latter is a fine one, and Michigan gladly welcomes them to its list of operators, they being the present owners of the Aragon mine, Norway. The total output is 1,827,807 tons, and the shipment for 1897, was 98,219 tons. O. C. Davidson, Commonwealth, is in charge.

The Florence mine, adjoining the Commonwealth, has been idle for some years. It had an immense stockpile at the time it closed, and from this it shipped 37,593 tons during 1897. Its total product is 1,165,026 tons.

THE GOGEBIC RANGE.

The Gogebic ore range, being in Gogebic county, is one of the important ones of the State, and is the youngest in the order of discovery and development. Its ores are of remarkable purity, are readily mined, and have commanded the best price the market gives. All of the mining companies pay royalty to owners of the land upon which the mines are located.

The range has developed profitable mines for a length of territory of about twelve miles, and has a width of from one to three miles, it being the most regular of any of the Michigan iron ore fields in its strike and enclosing formations. The latter are very persistent. To the south is the older granite. Overlying them is the Keweenaw trap. The iron-bearing series are as follows: The lowest, silicious limestone, which is very thin and often is not seen; second, a variegated quartz slate, the upper portion being hard, massive quartzite; third, ferruginous cherts, schists, ore bodies, etc; fourth, graywackes, schists, cherty carbonates, etc. Generally, the ore has been found resting upon dykes of diabase or diorite, decomposed, particularly at the point of contact with the ore. They have a general pitch east of south, and a dip to the south at nearly right angles to that of the footwall quartzite. At places there is a conspicuous bending of the dykes as at the Pabst mine, Ironwood, and the Tilden mine, at Bessemer. While there are numerous dykes cutting through the formation, there is one locally referred to as the "main" dyke. This has a thickness of from 40 to 150 feet, and, resting upon it, are some of the largest ore deposits of the district. These dykes are impervious to water, and in the deposition of the iron ore in the form of solution they acted as concentrating tables. There are places where the dyke has been faulted, notably at the Newport mine, Ironwood, and here ore has been found below the dyke for a distance of at least 120 feet. At several other places ore has been found under this big intrusive, but to what extent it will occur has not yet been demonstrated, as thus far the efforts of the miners have been at points above it.

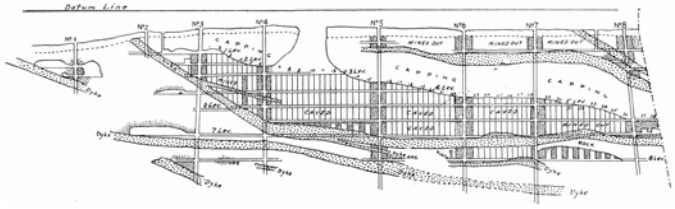
Since the work of mining began here, the Gogebic has sent out 22, 708,664 tons of ore, included in which amount are the products of the mines located in Wisconsin at the west end of the range. The contribution of the Wisconsin properties amounts to 3,414,503 tons. For the year 1897 the Gogebic sent to market 1,799,884 tons, of which 365,662 came from Wisconsin, leaving to Michigan's credit 1,434,222 tons, which was 448,418 tons in excess of the shipment for 1896, a marked gain.

The year saw many changes in the ownerships of the principal properties of the range, the Oliver Iron Mining company having secured possession of the Norrie, East Norrie and Pabst, at Ironwood, and of the Tilden, at Bessemer. In 1897 these properties marketed

1,101,668 tons of the total of 1,434,222 sent from the Michigan portion of the range. The Oliver Iron Mining company is controlled by the Carnegies, the renowned makers of steel and iron, and as they are great users of iron ore, the change insures a steady operation of the mines. For the two years previous there had been a discriminating against the Norrie mines by this big buyer, and the population surrounding the mine felt the blow keenly, it necessitating a stoppage of operations during a portion of the season. Just now there is much satisfaction expressed by reason of the change, as it is looked upon as great help to the labor of the town in which the mines are located. Fourteen mines were worked upon the Gogebic during the year, and when all are busy a force of about 3,500 men is engaged. In writing of the mines of the Gogebic I will take them up from the western boundary line, the Montreal river, and proceed in their regular order to the eastern end of the range, beginning with

THE ASHLAND MINE.

The Ashland still continues to do business, but the company operating it, the Penokee and Gogebic development, can see the end. There may be new lenses to be discovered, but of the present developed area but little remains in the way of marketable ore bodies. It has been an interesting mine geologically because of the great number of dykes encountered. It seems as if this was the starting point of several of these intrusives. In the map of the mine herewith presented the number and pitch of the dykes is shown. The lower levels of the mine are full of water, the operations since the resumption in 1894 having been confined to the upper levels, and have chiefly consisted in the taking of the ore pillars that had been left for the support of the shafts.



THE ASHLAND MINE.

There has been a new shaft put down in the footwall 226 feet to the trough of the dyke at No. 3. A glance at the map will show that the ore here makes only to the third level in this end of the mine. There is about 25,000 tons in the pillar which will be taken through the new shaft. The latter was placed in commission early in February, '98. The ore in the pillar is of excellent grade, giving 63% iron and .030% phosphorus.

They are also taking the ore pillar in the upper portion of No. 8 shaft, the most easterly. The ore here runs only to the second level, and is of non-bessemer grade. It gives 63.50% in iron and .088% in phosphorus. It is being shipped to the Ashland, Wis., blast furnace. This shaft is connected with the 7th level, and the ore can be taken through the latter avenue whenever No. 8 is unfit for further use.

At No. 5 shaft they are taking the shaft pillar, the ore being sent to surface through No. 6 shaft. The bottom of the ore is found eighteen feet below the 6th level. This work has recently been started, and they are now working two shifts in the mine, one having been observed for some time previous. A force of 130 men is employed. They take the ore of the pillars on the caving plan, working from the top downward, slicing, in the usual way. The mine produced 111,658 tons in 1897, and has credit for a total for all years of 2,101,658. Capt. T. H. Davey has local charge. The main office of the company has recently been removed here from Bessemer. George H. Durkee, is cashier; W. J. Olcott, Duluth, Minn., is general manager. Next east of the Ashland is

THE NORRIE MINES.

To the discovery and operation of the Norrie mines the greater portion of the prominence earned by the Gogebic range is due. It is the largest producer of the range, and has credit for having sent out a greater tonnage in a single season than any other iron property in the Lake Superior region. Its total product is 6,880,282 gross tons of which 604,282 tons were sent out during 1897. The ores of this property are principally of Bessemer grade, and for some years they have been taken as the basis upon which ores have been sold.

The purchase of this property by the Oliver Iron Mining company during the fall of 1897 was one of the important events in the history of the mine. It is still operated under its old title "The Metropolitan Iron & Land Co.," although there has been a complete change in its management and officering.

Upon the Norrie forty are shafts Nos. 1, 2, 3, 4, 5, 6 and 7, and upon the East Norrie forty adjoining immediately upon the east are shafts Nos. 1, 2 and 3. These have opened up the vein across the two forties, from the Ashland mine upon the west to the Aurora upon the east. The shafts are all in the ore formation, and those in the west end of the Norrie forty are idle. They follow the ore in its inclination north of about 55°. The ground has caved around the old shafts, several of which are now unfit for use. There is considerable ore still remaining in pillars in this portion of the mine, although some of the big pillars formerly left to retain the shafts have been considerably "thinned". Attention will be given this end of the mine as soon as the necessary preparations for so doing can be completed. It is the intention, when work of taking the pillars once begins, to push it with all possible speed until all the ore now remaining is secured. It will not do to give it any time to crush and come in once they start upon it, as much ore might be lost, and to avoid this they will inaugurate a very active system of mining.

For several years nothing has been done in the Norrie and East Norrie in the way of adding new levels, the ore

mined having been taken from the levels blocked out above the main dyke. All the millions of tons which were removed naturally make a big hole in the blocks of developed ground, and the need of new levels was urgent when Mr. Cole began mining here for the new company. As it was the intention of the latter to largely increase the amount of ore annually raised here for several seasons past, the first thing to be given attention was the prominent shafts, the No. 7 of the Norrie and the East Nome's Nos. 1, 2 and 3. At the No. 7 shaft they are sinking from the 8th to the 9th level. At the 8th level dyke rock had been met with and proved to have a thickness of 50 feet. Ore was encountered beneath this dyke. The former company had carried the shaft to and into the dyke. Nos. 1 and 2 East Norrie are to the loth level, and No. 3, East Norrie, has been sunk from the 10th to the 11th level, the work having recently been completed. All the shafts at this end of the mine will be continued downward, and new levels opened.

The ore deposit is a very wide one, running from 80 to 200 feet, with an average of 80 feet. The plan of winning the ore has been to take it by driving footwall drifts, crosscutting to the hanging and taking blocks of ore three sets wide from the hanging to the foot, beating out the ground from hanging to foot so that in case of falls from the roof they would come clown upon the foot. Pillars three sets wide were left, and the surface was allowed to follow clown after the pillars were secured. Mr. Cole will change this system to the caving plan he has so successfully observed at other properties over which he has had charge. Lighter timber will be used, and he believes he can make the change without a great deal of trouble. There will be no difficulty in getting the surface to follow down as it is already coming under the plan of mining which has been in vogue. The caving plan should work favorably here. There is a great territory to be given attention, and the trouble heretofore has been that after the deposit was opened to its full length the market did not call for such an amount of ore as could be mined, and which should have been taken in order to keep all of the many shafts working. The stoppage had the tendency to close the old shafts and drifts, the ground settling during the times of idleness. As the recent purchasers of the Norries are to use the ore here mined in their own furnaces, and want all the properties will yield, there will be opportunity to keep all levels going, and to make an excellent product. This means much to the people of Iron wood, in which city the mines are located.

An important work now in progress is the sinking of No. 9, or "Curry" shaft. This was started several years ago, put down 400 feet and stopped. It is now 560 feet to the 9th level. Its location is 500 feet north of No. 1 East Norrie shaft, and it is the intention to take the ore from this portion of the property through the new avenue. It will be in position to secure the ore in front of Nos. 1 and 2 East Norrie and that at No. 7 Norrie. It is a big shaft 8'x22' inside of timbers. It will be put down to the 11th level as speedily as possible. They are now working upon a new engine house for this station, preparing the foundation at the time of my visit in March, '98. In two of the compartments cages will be operated in balance. These will be used principally for handling men and timber, although some ore may be raised with them. The other two compartments will be used for two skips which will have a capacity each for five tons of ore. The drums will be 8-foot diameter by 9-foot face operated by Corliss engines 24"x48 ". The plant will be of first-motion kind, will have a capacity for hoisting from a depth of 2,000 feet, and is being manufactured by the M. C. Bullock Co., Chicago. There will be a direct pull from the top of shaft house to the drums. At this station they have converted the old engine house into a machine shop, the latter having been well supplied with tools of the best manufacture. This will be a very important shaft, and, while it is located in the hanging, it will probably not be disturbed for many years by the settling or "drawing" of the surface to the south where the ground is affected by mining.

In line with this No. 9 shaft is one of the same size started some years ago about 800 feet north of No. 2 Norrie, at the west end of the property. This can also be continued downward whenever it is needed to take the ore from that end of the mine. It is to a depth of 400 feet. It was not far from the site of this shaft that the deepest diamond drill boring made on the Gogebic range was put down, it having been made by the Metropolitan Iron & Land company. This is important in showing the occurrence of ore beneath several large dykes, and at a depth of 1,500 feet from surface. The engraving showing the strata cut by the drill is interesting to the people of this range. It suggests great additions to the ore now showing above the main dyke, and greatly modifies the theory advanced some years ago that few ore bodies of merchantable size would be found below this main rock intrusion.

The Norries are comparatively dry mines, which can also be said of the properties in the vicinity of Ironwood and Bessemer. The Aragon or Vulcan mines of the Menominee range each pumps more water than all the mines of the Ironwood district. The ore of the Norrie is easily mined, and is but little mixed with rock. Thus far hand tramming has been observed underground and upon the stockpiles. The mines are lighted by electricity, and the management talks of putting in a lighting plant of its own in the stead of taking it from the concern manufacturing light for the city. Wood has been used for fuel here, but there will probably be a change in the near future to coal.

All the work done upon the Gogebic range is upon the basis of ten hours for a day, and generally the men work upon the contract plan. The Norrie has made some reductions in the club fund, the men being given the advantage of an accumulated surplus. Mr. T. F. Cole, the superintendent of the mines of the Oliver Iron company upon the Gogebic range, is an energetic, wide-awake mining man who has had much experience, and who will operate the several properties of the company vigorously. With additional levels the Norries will be able

to send out a large amount of ore annually. Just now there is about 325,000 tons in stock at the Ironwood properties, and the piles are rapidly being increased. There are 825 men employed. T. F. Cole is local manager; F. L. Barrows, cashier; J, Kellerschon, mining engineer; J. H. Goudie, engineer and chemist; Irwin Sutherland and John Luxmore, mining captains. Dr. N. P. Hulst, of Milwaukee, Wis., is general manager of the mines of the Oliver Iron Mining company.

THE AURORA MINE

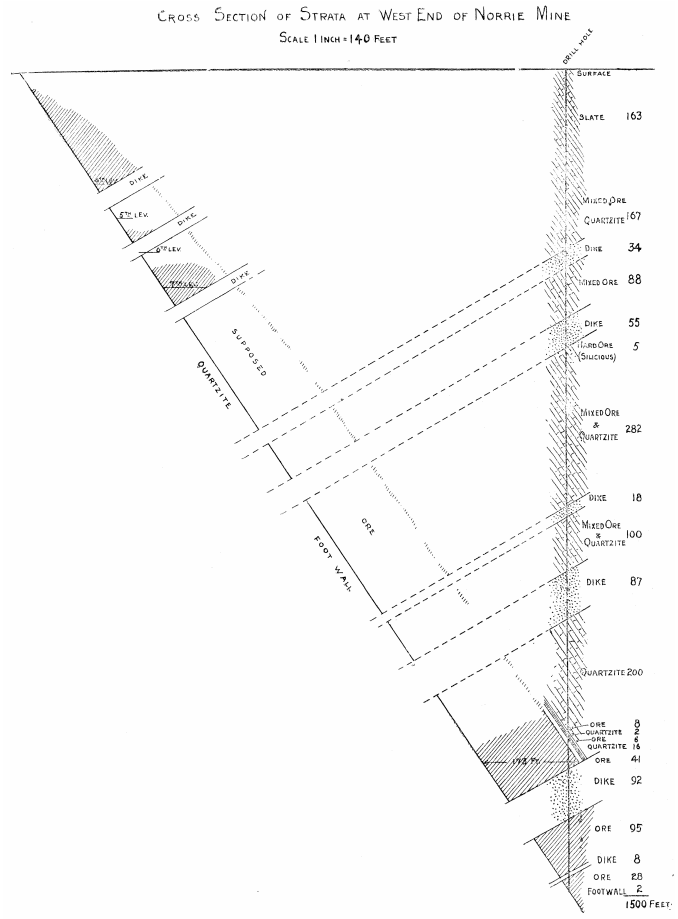
lies next east of the East Norrie. It was one of the first mines opened upon the Gogebic and has proved to be one of the best. Its product is of excellent quality, and its total to date is 2,270,112 tons. For 1897 it shipped 166,122 tons, 25,000 tons less than for the year previous, but it labored under several misfortunes in the way of caving ground that retarded its mining operations considerably. The Aurora is under the same management as the Ashland mine. It has developed its property across the forty, its workings being up to its east and west lines, and for the past few years it has been giving considerable attention to the taking of old pillars. No. 1 shaft, at the west end of the property, is to the 12th level. It is in the ore formation, inclined, and has a vertical depth from surface of 720 feet. The 12th level was opened in 1897, and met with a heavy flow of water that delayed mining operations for some time.

No. 2 shaft, next east of No. 1, is idle. They keep it open because the water flows through it upon its way to No. 3 shaft, where the pumping station is located.

No. 3 has added a level since my last report, being now to the 11th. At 300 feet east of the shaft upon this level the dyke is encountered in its downward pitch to the east. They have cut through the dyke and find the ore overlying it, as usual.

No. 5 is the most easterly shaft, and the only one in the footwall. Since it was sunk they have opened up two new levels in this end of the property, the 6th and 7th. The shaft is an incline, three compartment, and will take care of all the ore at that end of the property. The pitch of the dyke to the east is fast carrying the ore away from the Aurora territory, each added level finding it further from the shaft. They observe the same plan of mining as described in my former reports, taking the ore upon square sets in the usual manner of rooming. The ore comes easily, and excellent results are obtained. In quality the ore has improved over the previous year. They make one grade, "Aurora," or "Vaughn," the name depending upon the portion of the property from which the ore is taken, two parties being interested in the fee. It gives 62.40% in iron and .028% in phosphorus.

A new work of considerable importance is the sinking of a shaft to the north of No. 1, something like 850 feet. This shaft was begun some years ago, work being stopped upon it in 1893. It is 580 feet deep, is vertical, three-compartment, and is 18’3"x7’6" inside of timbers. Over this shaft has just been erected a steel shaft house, the manufacture of the Variety Iron Works, of Cleveland, Ohio. It is a substantial structure, of neat appearance, and has the merit of being fireproof. In case it is ever necessary to remove it to another location, it can be readily taken apart and put up again. This shaft is being sunk for the purpose of taking the ore in front of the western shafts to the south. Crosscuts of about 750 feet will be put in for this purpose. There is also a chance of striking other lenses of ore in the territory intervening between it and the old shafts. There are two strata of ore in the upper and eastern portion of the mine, locally termed the north and south formations. A tongue of rock intrudes through the ore, thinning as it goes west. At this new shaft they have erected an engine house, frame, with pressed steel sheathing, imitating brick, and have put in a hoisting plant of the Webster, Camp & Lane manufacture. Drums are 6-foot diameter by 9-foot face. Engines are 20”x42". The plant is an exact duplicate of that recently put in at the Aragon mine, Menominee range, of which a description will be found in the account of that property. Two cages will be operated in balance. With this shaft in commission the ore of the western portion of the mine can be readily secured, and the big shaft pillars can also be taken. The affairs at the mine have been well looked after. There has been much hard work to do, but it has been ably performed. A force of 250 men are employed. N. B. Roscorla is superintendent; R. D. Blackburn, clerk.



THE PABST MINE

is next east of the Aurora. It is now the property of the Oliver Iron Mining company, having been included in the purchase of Gogebic range mines by that concern last year. It is one of the best mines on the range, and has been well handled. Its total product is 1,427,462 tons, and its shipment for the past year was 207,064 tons. The ore is of excellent quality, similar to that of the Norrie, giving 63% iron and .040% phosphorus. The Pabst, like most of the mines in this section, has opened upon its vein for the entire length of its lands, and the mining thus far done has been above the main dyke. There has been a considerable bending of the dyke here, however, it forming a big basin. From the Aurora upon the west the dyke pitches east upon the Pabst lands and from the Newport upon the east the pitch is to the west, this giving to the Pabst a big bowl-shaped depression filled with ore. The latter makes to great width in places, and the average is excellent.

Originally the Pabst worked upon the two formations, but the first wrought, the north, proved very thin, and was soon exhausted. It was at this time when the Norrie people purchased it. Three shafts were sunk upon the north formation, the ore averaging about two levels in thickness. Upon the south formation, which for years has been the principal producer, there are three working shafts. Of these "C" is located at the west end of the property. It is vertical and in the hanging formation. This shaft is now to the 7th level, a level having been added here since my last report. No. 4, 700 feet east of C, is to the 8th level, 625 feet from surface. It is a substantial shaft being in the footwall of the south formation. No. 2 shaft, 400 feet east of No. 5, is an incline and is to the 560-foot level.

In winning the ore they have observed the same system as followed in the Norrie, taking the ore upon square timbers, working from the foot to hanging, taking blocks of ore three sets wide, and leaving a like amount for pillars; afterward taking pillars and caving surface. At the Pabst there is still an immense amount of ore lying upon the big dyke. The great width of the deposit offers ample opportunity for the securing of a big product at the lowest cost.

With the Pabst and Norries the company has a stretch of ore-bearing lands of one and a quarter miles, all of which, upon the south formation, has been developed. It may be said that the ore deposit is continuous for this distance. Besides this there is the chance for finding other deposits below those now worked, and indicated by the deep drill boring before referred to. The Pabst is certainly a promising mine, and will be sending out substantial stockpiles for many years to come. John Tregambo is mining captain; D. R. Bundy, clerk.

To the north of the Aurora is the North-Aurora property upon which work has been done from time to time. A shaft was started some years ago but was not carried sufficiently far to be of value. Just now it is idle. It is generally looked upon as a promising property, but it will require money to thoroughly explore it, as it will be necessary to sink to a considerable depth in order to catch the ore upon its northern extension from the Aurora.

THE NEWPORT MINE.

The Newport lies just east of the Pabst. There was a change in the ownership last August, Ferdinand Schlesinger having purchased a control. The property is still operated under the title of "The Newport Iron Company." It has had many different owners and names, and has been a prominent producer among the mines of the range. It has shipped 1,256,310 tons, and sent out for the past year 150,979 tons, 8,000 tons in excess of the tonnage shipped the previous year. The Newport is securing the principal portion of its product from pillars which were left in the course of mining during the operation of the property. Indeed, pillars have provided the bulk of the shipments for the past three seasons.

The only point at which any development work is going on is at their "K" shaft, the most eastern. This was formerly known as "The Bonnie." This portion of the mine is interesting by reason of a faulting of the big dyke, the prominent break having permitted the depositing of ore beneath it. At K shaft they are now to the 9th level, 600 feet vertically from surface. The dyke is encountered between the 6th and 7th levels, and the ore underneath appears to be in the form of a chimney. The distance between the 7th and 9th, is 120 feet. They have just resumed the sinking of the shaft, and will follow the ore down. The occurrence of the ore here is interesting, and is unquestionably due to the faulting of the intrusive, permitting the depositing of ore beneath it. They will follow the ore downward and open out upon it as fast as possible, being desirous of learning something of its extent. The ground here is generally firm and they may sub-level it. In some of the openings timber has been used, while in others it has not been needed. But little has been mined as yet. They have a raise connecting the 7th and 9th levels. No actual mining has yet been done, the work thus far performed being of preparatory kind. In quality the ore is manganiferous, running from 1% to 20% and even higher than the latter in places.

Like the Pabst, the Newport has two ore formations. A, B and C shafts are located upon the south, and Nos. 1 and 4 upon the north formation. Nothing is now being done upon the latter. At C shaft they are taking out a three-cornered piece of ore near the west line of the property where the Pabst is encountered. They are also sinking this shaft with a view to exploring the territory beneath the dyke. At the other shafts upon this formation nothing is being done excepting taking out the pillars to the north, no levels having been added since my last report. The ore has been mined to the dyke, and the hope of the company is to find other bodies beneath it.

A new air compressor, fifteen-drill capacity, manufactured by the Nordberg company, Milwaukee, is being installed. A force of 375 men is employed and there is now about 100,000 tons in stock. The miners work upon the company account plan it being necessitated by the nature of the work being performed. The taking of pillars requires care, and it is thought best not to remove them under contract, as it might lead to trouble. The present operators have one-half section in the lease purchased from the old concern. There is a mile of territory to the east that was held by the former company. It has received considerable attention, but nothing valuable has been found upon it, although it is generally looked upon as favorable territory. The Newport ships four grades of ore, all Bessemer. The "Newport" gives from 6% to 7% manganese. J. R. Thompson is superintendent; Thomas Oliver, mining captain; V. B. Sherrod, engineer and chemist; M. E. Russell, cashier.

To the east of the Newport there are no active properties met with until the village of Bessemer, three miles distant, is reached. The intervening territory will some day be producing ore, however. It has been explored, but not thoroughly. Generally, the shafts were not deep enough, and the work was not as systematic as it should have been. It needs money to properly exploit the range in this particular section. Going east from the Newport are the Davis, Royal, Ruby, Lowell, Federal, Jack Pot and Valley properties, all idle. The last to receive attention of these was the Jack Pot, Marquette county mining men having pumped out the water and done a little work in the lowest level, the 5th, 380 feet upon the incline of the formation. Nothing has been done since the beginning of last year, 1897. The ore is of excellent grade, but the "pockets" are small.

THE COLBY MINE,

is next east of the Jack Pot, being located upon Section 15, Town 47, Range 46. The lease of this property was surrendered some years ago by the Penokee & Gogebic Development company, and was afterwards secured by Corrigan, McKinney & Co., who placed Captain Peter Ramquist in charge of underground affairs. Since then attention has been given to the mining of No. 5 shaft pillar. No. 5 is in the footwall, and the pillar has been taken by slicing from the top downward, settling the surface. In 1896, 48,000 tons were secured, and in 1897 there were mined 22,921 tons. There is still considerable ore left in the shape of pillars which can be secured, and will give employment to the miners for several years. About 180 men are now engaged, and a neat stockpile is showing at the shaft. The Colby has produced all told 1,459,988 tons, and was once one of the most promising mines upon the range. The extension of the Colby ore body to the west is found at

THE TILDEN MINE,

This is one of the largest mines upon the Gogebic range, the ore having been developed for three-fourths of a mile in length. The deposit has an average width of about 80 feet. This property has passed from the possession of the former company to the Oliver Iron Mining company, or from the Rockefeller to the Carnegie interests. As I understand the transaction the property was not sold, but was leased to the Oliver people for a term of fifty years, at a certain royalty per ton, from which the Tilden people realize their profit, it being a gain over the royalty formerly paid by the Tilden to the fee owners. At the west end of the property there are Nos. 6 and 7 shafts, No. 6 being to the 525-foot level, No. 7 to the 590-foot. Nothing has been done here for several seasons, clue to the character of the ore mined. It contains just enough manganese to make it undesirable, although it will probably find a market in the near future as the present owners can use it to advantage with other ores now controlled by them. No. 7 is now being prepared for mining. No. 8 shaft, 600 feet east of No. 7 and is in the foot. It is the only foot-wall shaft upon the property, as well as the only one inclined. All others are in the hanging, are vertical, have three compartments, are 7’6”x18’3” inside of timbers, and expect to reach the foot-wall at a depth of about 1,100 feet. At No. 8 they are now taking the pillar from about the shaft, and will soon be ready to abandon this station. No. 9, next in order going east, and 700 feet from No. 8, is one of the busiest places at the mine. They have added a level here since my last report, being now to the 12th, and have a large stockpile to show for the work since the closing of navigation.

At No. 10 shaft, in the low ground 1,300 feet east of No. 9, they have crosscutted from the shaft to the ore measure, but have not found the ore. They have also drifted with the formation, and at last reports were meeting with softer ground. It is thought that there may be a bending of the dyke here as at the Pabst mine, Ironwood, but this has not yet been proven. With such a persistent vein as shows to the west it will be strange if the ore does not continue to this portion of the property. Upon the east boundary of the company's lands the Palms mine has developed a, body of ore that continues westward upon Tilden territory, although the location is much higher than at the Tilden's No. 10 shaft. The local management is considerably interested in the exploratory work now being conducted at No. 10, as the result means much to the future operations of the company. The Union shaft, sunk upon the boundary line at the east end of the property, and 1,300 feet from No. 10, is owned in part by the Tilden, it possessing one of the three compartments of the shaft.

They are observing the same method of winning the ore as described in former reports, it being what is styled "drawing." The hanging is remarkably firm, showing no inclination to follow clown when the ore has been removed. The ore is funnelled down, coming readily. It is soft, and much of it is bored with augers in preparing for the blasting. In case a room ceases to run they permit it to stand for a few days when it invariably starts by its own weight. It is more a question of tramming than of mining, and to assist in the taking of the ore to

the shafts they are now figuring upon putting mules in the mine. Capt. Jas. Piper has taken excellent care of the Tilden. He has not been given an opportunity to show how cheaply he can secure a product for the reason that in the past the property has been subject to many stoppages, this preventing the best results upon the cost sheets. With the recent change of management, however, a steady operation is hoped for and even better results per man than heretofore can be shown. There is little water in the mine, 178 gallons per hour in the entire length of the big openings. The timber is inexpensive, all kinds, hard and soft, being used.

The mine is well equipped with machinery and pumps. A portion of the old saw mill building has been, torn down, and a part of the machinery has been removed. The most of the timber is framed by hand. A force of about 275 men are now being employed, which number will be considerably added to in the near future.

During the year 1897 the property was worked but feebly. There were 276,891 tons shipped. The mine has a credit for all years of 1,551,250 tons. The ore is all of Bessemer grade giving from 62% to 65% iron and .034% to .045% phosphorus. Jas. Piper is mining captain; Chas. Grabowsky, clerk.

THE PALMS MINE

joins the Tilden upon the east. It is operated by The Dunn Iron company, of which Ferdinand Schlesinger is at the head, and is locally managed by F. E. Woodbury, of Ironwood. They have confined their operations during the past year to the territory reached by their No. 5 shaft, which is also known as the "union" shaft between this mine and the Tilden. Mr. Woodbury has done excellent work at the Palms. When he took hold it was not a very promising showing. The former operators had surrendered the lease because of the pinching out of the deposit, and there were many obstacles to contend with. New machinery had to be provided and much done to prepare for active business. Since then the mine opened out satisfactorily up to the present time. In 1896 the product was 46,965 tons, in 1897 it reached 113,412 tons, and there are now, March 15, '98, about 80,000 tons in stock. At the time of my visit in the spring of '97 they were opening up the 13th level, which was the best the mine ever had. The ore deposit was large, free from rock, and everything predicted a bright future. The 14th level is now in course of development, but the conditions are not pleasing. They have encountered rock in the bottom of the mine. It is not looked upon by the management as the main dyke that runs east and west through this portion of the range, it being too thin for that. It is about 33 feet thick, and thus far no ore has been found under it. The drifts upon the strike of the vein have been in this dyke material. By raising up in it a short distance they find the bottom of the ore deposit worked upon the 13th level. They have done some diamond drilling, but as yet have discovered nothing of value. Ore deposits are subject to many fluctuations, however, and the present condition may vastly improve as they carry explorations to greater length, but just now the outlook is decidedly unfavorable.

In mining the ore they have observed the caving plan, which has worked well. A force of 300 men are being engaged. Wm. Rowe is mining captain; L. W. Powell,, clerk. The Palms has shipped 545,955 tons. To the east the company has

THE ANVIL MINE

but are doing nothing upon it. There is a chance to find ore here, but it will need a liberal outlay of money to thoroughly explore the property. East of the Anvil is the Eureka, Gogebic, East Dangler, United and Mikado, all idle. The Mikado received some attention during the past two years. It was unwatered, and a little work done at the lowest level, 573 from surface. Work was suspended in August; of '97, the property being in the hands of the Bessemer Ore Co., of which M. P. O'Brien and George Curry, of Ironwood, were interested. To the east of the Mikado are a number of abandoned mines all of small size. No activity is seen until the village of Wakefield is reached. Here is found

THE BROTHERTON MINE

located upon Section 9, Town 47, Range 45. It is the only property now worked at the east end of the Gogebic range. It was idle from June, '96 to July, '97, when mining was again resumed. The property has been subject to many periods of idleness during the past few years. In December, '97 there was afire that burnt the timbers completely from the east shaft, causing the shaft to come together, and requiring much labor and expense to re-open. There are three shafts to a depth of 600 feet, two levels having been added since my last report. The ore of the Brotherton is of excellent quality, but the lenses are small, and the mine is a very wet one. The stopping of the Sunday Lake, which adjoins, has added much to the former pumping charges. A force of eighty men is employed. Richard Bawden, Bessemer, who was mining captain since 1887, died March 21st, '98. Jos. Sellwood, Duluth, is president.

THE SUNDAY LAKE MINE

has been surrendered to the fee owners by Corrigan, McKinney & Co., for the reason that a reduction in royalty could not be secured. The machinery has been removed and the lower levels are filled with water. The mine was an expensive one to operate. It was very wet, and the ore bodies grew smaller in size as they went downward. At the 12th level, the lowest, the ore was 510 feet from the shaft and 160 feet from the Brotherton mine line. The royalty was 30 cents per ton. The ore is of excellent quality, yielding 64% iron and .024% phosphorus. It had been secured upon the caving plan. The Brotherton company is in better position to mine the ore of this property than anyone else. It would not be an easy matter to find capital to re-open the property,

equipping it with machinery, and doing what would be necessary for resumption of mining.

ON THE WISCONSIN SIDE.

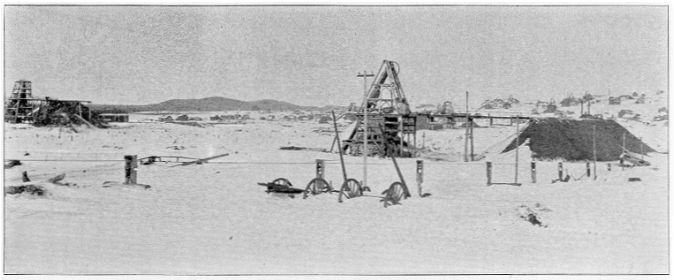
Upon the Wisconsin side of the Montreal River, there are several mines that have contributed considerably to the annual product of the Gogebic range. But few of these are now being operated. The Germania has been idle for several years. Two years since a portion of the water was removed from the levels and a start made to explore it, but it was soon after closed. There may be ore here but it lies at great depth from surface. At the Superior and Carey, a little work has been done, this being shown by the shipping tables to follow. There is a neat little stockpile of ore now at the Carey, but the mine is idle. The Atlantic is doing a little, and shipped 50,327 tons the past year.

THE MONTREAL MINE

is the most important now boasted of in Wisconsin. It shipped 191,106 tons during 1897, and is developing into a magnificent property. It is located upon Section 33, Town 48, Range 2, east. While the ore deposit has been opened by several shafts, they have concentrated their work so that now all the ore is hoisted through No. 3, a substantial one, inclining to the north with the foot-wall. This shaft is to the 13th level and is sinking to the 14th. There is also a vertical cage shaft in which the timber and men are handled. Upon the lowest level now being opened they have a body of ore about 600 feet long, and averaging 90 feet wide. It is of excellent quality. Two grades are made, the No. 1 yielding 65.50% iron and .050% phosphorus. In addition to this deposit there is a parallel one of leaner grade to the north, which is now receiving attention.

In winning the ore the caving plan is observed. They put in sub-levels and slice in the usual manner, letting the surface follow down. The ore is dry and stands firmly, but it crushes well when cut by the sub-level drifts. It is not as quick to move as some of the ores of the Menominee and Marquette ranges, but it mines very easily, augers often being used to make holes for the powder. Crosscuts are run from the main drift every 48 feet, and the blocks of ground can be attacked from all sides if desired. The mine is nicely laid out and handled. Mules are used to do the tramming, three of them easily taking the ore from stopes to the shaft. The mine makes but little water, a Prescott pump handling it. They have the same dykes, forming the ore troughs as seen upon the Michigan portion of the range.

The company is also doing something in the way of exploring the Trimble property, adjoining upon the east, and have found a body of ore which is now being opened up. The Montreal is a property the State of Wisconsin has reason to be proud of. The mine is well equipped with machinery. A force of 300 men is employed. George Hurley, Wis., is manager; Captain Hocking looks after affairs underground; Dunbar Scott is mine engineer.



C SHAFT, PABST MINE. NO. 4 PABST. NO. 5 SHAFT, AURORA. NEWPORT SHAFTS *in distance.*

To the west of the Montreal are many idle properties before the next active one, the Iron Belt, is reached. The Iron Belt is not looking as well as in past years. Its ore deposits have been pretty well worked out, and exploration has been in progress for new ones, but the outlook at the present time is not encouraging.

Further west the Shores Iron company is doing considerable work in the way of trying to find a mine. They are using a diamond drill, and hope to develop a paying deposit of ore. The ore found here is of exceptionally high grade.

EXPLORATIONS.

There is little being done at the present time upon the Gogebic range in the way of exploring. There is nothing being attempted by parties outside of the old companies, and I having nothing new to report. There is a vast field, as I have before stated, in which ore ought to be found, but it requires money to carry on the work properly. Soon there will be a shortage of ores of the fine grade mined upon this range and then there will be energetic looking for more, which will doubtless lead to the finding of profitable ore bodies.

CLASSES OF IRON ORE.

These can be divided into four: Red hematite, being all anhydrous hematites, known by various names, such as red hematite, specular, micaceous, fossil, slate iron ore, martite, blue hematite, etc. Second—Brown hematite, embracing the varieties of hydrated sesquioxide of iron, and recognized as limonite, turgite, pipe and bog ores, etc. Third—Magnetite, ores in which therein occurs as magnetic oxide, and including some martite which is mined with the magnetite. Fourth—Carbonate, ores containing a considerable amount of carbonic acid, such as spathic ore, siderite, clay-iron stone, etc. Of these classes the Michigan and Lake Superior product is about 95% red hematite.

SHIPMENT OF IRON ORE.

The following tables will show the gross tons of ore produced by the different mines of the several Michigan districts as well as by the mines of Minnesota and Wisconsin:

Shipments of iron ore from Marquette Range for season of 1897 and and for all years.

Name of Mine.	1897	Total.	Name of Mine.	1897	Total.
Albion	.....	4,592	Michigamme	.....	880,362
American (Sterling)	.....	112,933	Milwaukee	.....	375,451
Ames	.....	6,298	National	.....	150,216
Bay State	.....	16,537	Negaunee	181,181	1,004,853
Bessie	.....	847	Negaunee Con. Works	.....	12,708
Beaufort	.....	90,217	New York	.....	1,113,102
Blue	2,517	92,637	N. Y. Hematite	.....	37,587
Boston	.....	62,544	North Republic	.....	289
Braastad (Winthrop / Mitchell)	107,006	2,081,356	Northwest	.....	1,687
			Norwood	.....	5,753
Cambria	110,648	959,186	Nonpareil (St. Lawrence)	.....	23,395
Champion	137,599	3,220,314	Ogden	986	986
Cheshire (Swanzy)	.....	217,089	Palmer	.....	4,474
Chicago	.....	9,012	Pascoe	.....	59,806
Cleveland	456,778	6,344,219	Pendill	.....	45,993
Columbia (Kloman)	.....	94,813	Phoenix (Dalliba)	.....	59,114
Curry	.....	16,671	Pioneer	.....	15,409
Detroit	.....	140,841	Pits. & Lake Angeline	490,724	4,185,535
Dexter	1,237	118,622	Platt	.....	73,844
Day	.....	2,709	Quartz	.....	491
East Champion	.....	76,002	†Queen	239,976	2,619,252
East New York	.....	166,243	Republic	124,342	4,502,728
Edison	.....	893	Republic Red. Co	.....	47,274
Erie	.....	8,136	Richmond	4,786	5,874
Etna	.....	1,091	Richards	.....	1,374
Fitch	.....	31,817	Riverside	.....	16,169
Gibson	.....	16,257	Rolling Mill	3,975	238,600
Goodrich	.....	49,754	Saginaw	942	451,424
Grand Rapids (Davis)	.....	110,596	Sam Mitchell	.....	17,780
Hartford	.....	14,480	Samson (Argyle)	.....	267,805
Hortense (No. Champion)	.....	30,574	Schadt	.....	1,261
Humboldt	.....	723,961	Sec. 12	.....	21,887
*Iron Cliffs	261,630	3,867,936	Spur	.....	164,244
Imperial	.....	64,206	Starwest (Wheat)	942	181,946
Iron Mountain	.....	393	Taylor	.....	32,970
Jackson	79,101	3,540,786	Titan	.....	90,371
Lake Superior	376,761	7,571,150	Volunteer	1,617	1,075,104
Lillie	112,781	704,338	Webster	.....	14,108
Lucy (McComber)	10,181	574,461	West Republic	.....	133,077
Manganese	.....	6,359	Wetmore	.....	50,870
Marquette (Winthrop)	.....	152,907	Wheeling	.....	10,555
Mesabi (Consolidated)	6,886	22,929			
Totals				2,711,505	49,258,759

*Includes shipments from Barnum, Salisbury, Foster and Tilden.
†Includes shipments from Buffalo, South Buffalo and Prince of Wales.

Shipments of ore from Menominee Range for the season of 1897 and total shipments for all years:

Name of Mine.	1897	Total.	Name of Mine.	1897	Total.
Antoine	102,306	217,840	Keel Ridge	.....	88,291
Appleton	.....	12,101	Lee Peck	.....	2,844
Aragon	144,760	1,003,105	Lincoln	.....	36,589
Armenia	.....	78,969	Loretto	54,104	205,712
Beta	.....	4,211	Ludington	.....	1,001,518
Briar Hill	.....	14,981	Manganate	.....	6,844
Calumet	.....	38,713	Mansfield	37,182	244,138
Chapin	643,347	6,775,990	Mastodon	.....	425,648
Claire	.....	66,964	Metropolitan	.....	107,027
Columbia	24,623	470,039	Michigan Explo. Co	216	1,869
Cornell	.....	6,630	Millie (Hewitt)	10,374	172,076
Crystal Falls	93,218	158,088	Monitor (Lamont)	.....	128,909
Cundy	41,942	41,942	Nanaimo	.....	127,166
Delphic	.....	33,718	Northwestern	.....	17,206
Dunn	31,062	1,000,207	Paint River	.....	222,371
Fairbanks	.....	8,500	*Penn Iron Mining Co	237,886	5,224,401
Great Western	.....	373,109	Perry	.....	3,138
Groveland	.....	1,049	Pewabic	279,885	1,495,092
Half and Half	.....	7,524	Quinnesec	.....	284,084
Harriton	.....	96,072	Shafer	.....	6,315
Hemlock	93,032	305,181	Selden	.....	2,092
Hersel	.....	955	Sheridan	146	77,132
Hiawatha	.....	2,884	South Mastodon	.....	8,203
Hollister	.....	4,098	Stephenson	.....	39,350
Hope	.....	17,819	Sturgeon River	.....	18,408
Indiana	.....	17,871	Walpole	.....	19,085
Iron River	.....	904,587	Youngstown	661	151,425
Total				1,799,856	21,788,278

*Penn mines include Curry, Cyclops, Vulcan and Norway.

Shipments of iron ore from mines of Wisconsin located on Menominee Range for 1897 and grand total for all years:

Name of Mine.	1897	Total.
Commonwealth	98,219	1,827,807
Florence	37,594	1,165,026
Totals	135,813	2,992,833

Table showing iron ore sent from the Gogebic Range for 1897 and total shipments to date:

Name of Mine.	1897	Total.	Name of Mine.	1897	Total.
Alpha	.....	2,010	Iron Chief No. 2	.....	551
Anvil	.....	305,974	Ironton	.....	58,368
Ashland	111,825	2,101,658	Jack Pot	1,265	6,860
Aurora	166,122	2,270,113	Mikado	11,297	20,269
Blue Jacket	.....	1,799	Newport	150,979	1,256,310
Brotherton	46,186	588,756	Norrie	604,282	6,880,125
Colby	22,921	1,459,988	Odannah	.....	77,124
Comet	.....	89,191	Pabst	220,495	1,440,893
Davis	.....	48,714	Palms	297,064	647,957
Eureka	.....	128,717	Ruby (Puritan)	.....	86,525
Father Hennepin	.....	184,928	Sparta	.....	4,862
Federal	.....	27,928	Sunday Lake	45,815	370,182
First National	.....	1,997	Tilden	276,891	1,551,250
Imperial	.....	8,515	Valley	.....	1,878
Iron Chief	.....	14,199			
Total				1,882,640	19,294,161

Iron ore shipments from mines of Wisconsin on the Gogebic Range for 1897 and total for all years:

Name of Mine.	1897	Total.	Name of Mine.	1897	Total.
Atlantic	50,327	187,268	Pence	120	41,381
Bessemer	.....	20,889	Section 33	.....	258,590
Cary	2,268	538,990	Superior	35,086	156,707
Germania	.....	330,633	Shores	17,588	30,011
Iron Belt	95,727	740,561	Trimble	.....	25,931
Kakagon	.....	71,994	Tyler's Forks	.....	10,683
Montreal	191,106	735 160	Windsor	.....	145,735
Nimikon	.....	28,635			
Total				374,634	3,414,503

Shipments from the Mesabi Range, Minnesota, for 1897 and all years.

Name of Mine.	1897	Total.	Name of Mins.	1897	Total.
Adams	175,80[illegible]	469,503	Lake Superior	259,910	385,692
Aetna (Lowmore)	.....	19,368	Mahoning	519,892	805,921
Auburn	175,263	791,921	Minnewas	.....	15,998
Biwabik	427,466	1,158,648	Mtn. Iron (& Rathburn)	765,000	1,975,708
Canton	.....	633,550	Norman	101,070	310,984
Cincinnati	32,720	133,993	Ohio	47,309	146,177
Cloquet (Vega)	12,215	161,823	Oliver	609,612	2,547,250
Commodore	60,797	155,210	Penobscot	11,933	11,933
Duluth	.....	37,626	Roberts	18,614	
Fayal	642,939	1,028,185	Sparta	66,720	
Franklin	30,351	817,886	Sellers	.....	200,470
Genoa	349,514	326,650	Williams (N. Cin'ti	.....	14,295
Hale	13,728	142,521			
Total				4,280,863	12,355,446

Shipments for the Vermilion Range, Minnesota, for 1897, and for all years:

Name of Mine	1897	Total.
Chandler	438,336	4,231,343
Minnesota	592,196	5,761,267
Pioneer	207,103	417,116
Zenith	40,817	88,961
Totals	1,278,482	10,498,687

RECAPITULATION.

RANGE.	TONS.
Marquette	2,711,505
Menominee (including Wisconsin)	1,935,669
Gogebic " "	2,257,274
Mesaba, Minnesota	4,280,863
Vermilion "	1,278,482
Total from Lake Superior Ranges	12,463,783

In the handling of this enormous amount of iron ore, the railroads of Michigan are finely equipped, possessing magnificent docks, fine locomotives, and other rolling stock. There has been a great change in the size of cars and trains as compared with a few years since. The little "hopper'" cars holding from five to seven tons have been replaced with those holding 30 to 35 tons, and it is not infrequent that 1,600 tons are taken in a single train. I hear of an order for a number of cars the boxes of which are to be of pressed steel, and to have a capacity of 45 tons each. This has been placed by the Lake Superior & Ishpeming Railway, a company pulling ore between Ishpeming and Marquette. This company's dock at

Marquette has a capacity for 30,000 tons. The road handled 1,036,594 tons in 1897, all of which was secured from Ishpeming and Negaunee mines.

The Chicago & Northwestern railway takes ore from the Marquette, Menominee and Gogebic ranges. It has four clocks at Escanaba with a combined capacity of about 150,000 tons. One of these, No. 4, was destroyed by fire during the year, but is being rebuilt, replaced by a modern structure. The Northwestern also has a dock at Ashland, Wis., capacity 35,800 tons, to which it carries Gogebic range ores. The road handled for the season of '97, a total of 3,711,080 tons upon both divisions.

The Wisconsin Central railway, pulling ore to Ashland, Wis., from the Gogebic range, took 984,910 tons to its dock. It dock capacity is 40,000 tons. The road will add to its locomotive equipment before the opening of navigation, '98.

The Duluth, South Shore & Atlantic railroad takes ore from the Marquette range to its docks at Marquette. It handled 903,736 tons during the year 1897. Its dock capacity is 70,000 tons.

The Minneapolis, Sault Ste. Marie & Atlantic railroad has a 16,000 ton dock at Gladstone, Mich. The Chicago, Milwaukee & St. Paul delivers ore to this company from Marquette and Menominee range mines, the tons carried for 1897 being 302,191.

These ore carriers are equipped to handle a much greater tonnage than produced by the mines, and add improvements as fast as they are needed. They are enterprising and a great help in the marketing of the mineral product of the State.

LENGTH OF RAIL HAUL.

The distance from the principal raining centres to lake ports is as follows:

From Republic to Marquette	36	miles.
From Ishpeming to Marquette	15	"
From Ishpeming to Escanaba	65	"
From Iron Mountain to Escanaba	52	"
From Crystal Falls to Escanaba	80	"
From Ironwood to Escanaba	184	"
From Bessemer to Ashland	46	"
From Ironwood to Ashland	40	"

From the Minnesota iron ore fields the distance from mines to Lake ports runs from 80 to 120 miles. Michigan is fortunate in the location of its mines with reference to lake ports from which the ore is loaded for shipment to the great distributing centres, Chicago, Cleveland, Buffalo, Ashtabula, Erie, Toledo, Lorain, Tonawanda, Conneaut and Fairport.

SAILING DISTANCES.

The following are the dietances from the principal iron ore shipping ports to Cleveland, Ohio:

Marquette to Cleveland	583	miles.
Escanaba to Cleveland	523	"
Ashland to Cleveland	774	"
Duluth to Cleveland	823	"
Escanaba to Chicago	192	"

COST OF BAIL HAULAGE OF ORE FOR YEAR 1897.

From mines of Marquette range to Escanaba, per gross ton	45	cents
From mines of Marquette range to Marquette	32	"
From mines of Marquette range to Gladstone	45	"
From mines of Menominee range to Escanaba	45	"
From mines of Gogebic to Escanaba	90	"
From mines of Gogebic to Ashland	45	"
From mines of Minnesota to Duluth and Superior	80	"

Since 1894 there has been a reduction in the cost of haulage per ton of eighteen cents per ton, and for the coming season, 1898, there will be still further reduction, the Chicago & Northwestern having announced a five-cent cut in its 1897 rate. This will affect all other Michigan carriers, and the saving to the miners will be fully $350,000 by this small lessening per ton. In the aggregate it means considerable.

ORE ON DOCKS.

The following figures show the amount of ore in stock at Lake Erie ports at the close of navigation for the past seven years:

1891	3,508,489	tons
1892	4,149,451	"
1893	4,070,710	"
1894	4,834,247	"
1895	4,415,712	"
1896	4,954,984	"
1897	5,923,755	"

IMPORTS OF IRON ORE.

Imports of iron ore to the United States for the past six years have been as follows:

1892	806,585	tons
1893	526,951	"
1894	167,307	"
1895	524,152	"
1896	776,283	"
1897	489,970	"

AVERAGE FREIGHT RATES ON IRON ORE PER GROSS TON, FROM PORTS NAMED TO OHIO PORTS.

YEAR.	ESCANABA.		MARQUETTE.		ASHLAND AND OTHER PORTS AT THE HEAD OF LAKE SUPERIOR.	
	Wild or Daily Rate.	Contract Rate.	Wild or Daily Rate.	Contract Rate.	Wild or Daily Rate.	Contract Rate.
1878	$0 81	$0 90	$1 22	$1 30	....	....
1879	1 25	90	1 83	1 40	....	....
1880	1 70	1 85	2 26	2 75	....	....
1881	1 36	1 75	2 05	2 45	....	....
1882	1 04	1 40	1 26	1 75	....	....
1883	1 22	1 00	1 40	1 20	....	....
1884	87	1 10	1 08	1 35	....	....
1885	78	90	98	1 05	$1 25	$1 15
1886	1 28	1 05	1 51	1 20	1 78	1 20
1887	1 59	1 40	1 87	1 63	2 23	2 00
1888	1 05	90	1 30	1 15	1 43	1 25
1889	1 01	1 00	1 19	1 10	1 34	1 25
1890	89	1 10	1 07	1 25	1 17	1 35
1891	84	65	1 02	90	1 11	1 00
1892	74	1 00	98	1 15	1 15	1 25
1893	56	85	81	1 00	77	1 00
1894	46	60	60	80	78	80
1895	73	55	92	75	1 13	80
1896	56	70	66	95	77	1 05
1897	45	45	55	65	57	70

Charge to vessel in 1897 for trimming and unloading 16½ cents a ton.

Average ore rates for the entire period of twenty years: Escanaba, contract $1.00, wild 96 cents; Marquette, contract $1.29, wild $1.22. Average for past ten years: Escanaba, contract 78 cents, wild 72½ cents; Marquette, contract 97

cents, wild 90 cents; Ashland and other ports at the head of Lake Superior, contract $1.04½, wild $1.02.

UNITED STATES PRODUCTION OF IRON ORE.

Showing the importance of Michigan as a producer of iron ore, the following figures giving the product of the United States will be of interest:

In 1891 all states produced	14,691,178	gross tons
In 1892 " " "	16,296,666	" "
In 1893 " " "	11,587,629	" "
In 1894 " " "	11,879,679	" "
In 1895 " " "	15,967,614	" "
In 1896 " " "	16,005,449	" "
In 1897 " " "	16,100,000	" "

Michigan's product for 1897 was 6,476,413 gross tons, and the Lake Superior region furnished 12,463,783 tons. Outside of this region the state of Alabama ranks well, taking third place in the list of states. The product in 1897 was 3,241,846 gross tons.

The world's production of iron ore annually amounts to between 52,000,000 and 60,000,000.

PRICE OF IRON ORE.

The price at which standard Bessemer iron ore has been sold, delivered at lower lake ports, since 1895 has been as follows:

YEAR.	YEAR.	YEAR.	PRICE.
1856	$ 8.00	1890	$6.75
1866	9.50	1891	6.00
1868	9.75	1892	5.50
1873	12.00	1893	4.00 to 4.50
1876	6.75	1894	2.50 to 2.75
1881	9.00	1895	2.75 to 3.50
1886	5.50	1896	3.15 to 4.50
1887	7.25	1896	2.40 to 3.18
1888	5.50	1898	2.35 to 3.64
1889	5.50		

Since 1890 non-bessemer have ranged all the way from $5.75 to $2.00 per ton, there having been a great falling off in price.

For 1898, while the base ore is fifteen cents higher than in 1897, the price is being regulated according to the analyses of ore cargoes for the past season. The following examples will show the variations:

Name of Mine or ore.	1897 Price.	1898 Price.
Chapin	$2.40	$2.56
Palms	2.57	2.60
Brotherton	2.62	2.74
Norrie	2.64	2.84
Aurora	2.80	2.95
Chandler	2.92½	3.13
Minnesota	3.11	3.36
Republic Specular	3.17	3.35
Republic Special	3.40	3.65
Republic Kingston	2.99	3.17
Montreal	2.77	2.98
Lake Superior O. M. Hem	2.68	2.74
Bessemer	2.73	2.85
Cleveland Bessemer	3.16	3.29
Salisbury Bessemer	2.50	2.56
Angeline hard	3.46	3.64
Angeline Hematite	2.82	2.84

These prices are for the ore delivered at lower lake ports. All ores are sold by sales agents located principally in Cleveland. Ten cents per ton is the price for this service.

COPPER.

Never since the discovery of the metal in the Upper Peninsula of the State of Michigan, has there been more interest in the mining of copper than now. While the business has been a very steady and satisfactory one for many years, and while, during the hard times experienced generally throughout the country the copper district of Michigan has been a stranger to financial depression, there is now apparent a marked gain in the interest attaching to the district. Evidence of this is found upon every hand. Properties that have lain idle since the sixties are being unwatered, the old shafts deepened, new levels run, and the signs of renewed activity are plentifully seen from "old Keweenaw" county to the north, down through Calumet, Hancock and Houghton, in Houghton county, through to Ontonagon and the old workings in the western portion of that county. New organizations for the development of virgin territory have also been formed, new finds of copper have been made, and everywhere upon the range there is something being done to attract the attention of capitalists as well as to add to the world's supply of this most useful metal. As in all like scenes, there are the stock jobbing concerns, but they are happily few, and easily kept in sight. Generally, the businesss is honestly conducted, and with a view to adding to the principal used in the work of exploiting and development.

All this bustle is due to the demand for the metal, which has raised the price. At this writing, April, '98, the miners are receiving 12¼ cents per pound, a great gain as compared to that quoted for several years past. An increase of one cent per pound in the price of the copper produced by Michigan mines amounts to about $1,450,000 per annum. The average for 1897 was 11¼ cents for Lake copper, which was one-thirty-seventh of a cent more than obtained during the previous year.

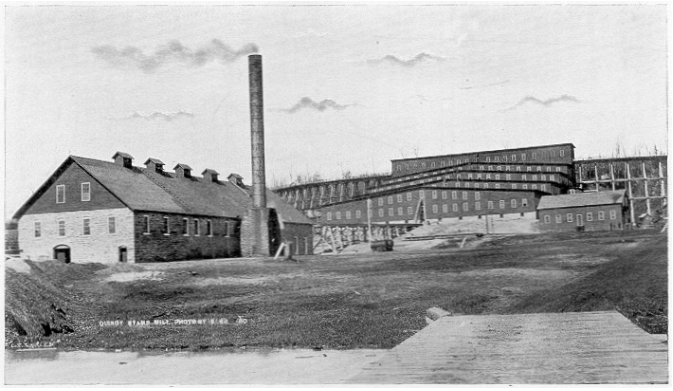
And there is reason for believing that the present satisfactory price will be increased. The home consumption of the metal has been weak for the past five years due to the depression prevailing in all branches of business. Construction work requiring copper has been quiet, but a better demand is now apparent, and it will evidently be permanent. Numerous plans in which copper will play an important part are in course of perfection while many more are already begun. The addition of electric railways, now so general, is of greatest importance. War, with all its attendant horrors, consumes an immense amount of copper, and at this particular time nearly every powerful nation, as well as several weaker ones, are strengthening their fortifications, adding ships, and making rifle shells. With peace fully secured, there will still be an active preparation to prevent future international disturbances, and each country will pay far more attention to this work than ever before. It has been generally neglected, and to the detriment of several. Lake copper is popular with shell makers, because of its rare purity and ductility,

permitting of easy working, and production of the maximum amount of the finished article. There are those who are predicting fifteen-cent copper before the close of '98. It is not impossible, but it might prove unhealthy, it that it would certainly mean resumption of mining in many countries where the present price allows no margin of profit.

During the year 1897 the mines of Michigan produced 144,930,670 pounds of refined copper, a gain over the previous year of 6,533,910 pounds. The production for the United states was:

Montana	231,902,796	pounds
Michigan	144,930,670	"
Arizona	80,592,049	"
Other Sources	26,656,000	"
Total	484,081,515	pounds

Of this amount there was exported 128,806 long tons, or more than 59½% of the production, and despite the increase the visible supply is steadily decreasing.



QUINCY STAMPS.

The dividends paid by the principal mines of Michigan are attractive, and as the stock of the organizations is listed upon the Boston stock exchange there is a great amount of dealing in them. The increase in the value of shares for the year 1897 was a wonderful one, nearly every producing mine being listed at a higher figure than ever before in its history. The total valuation atone time reached $95,000,000. I find great interest taken by investors and speculators in the shares of these mines. Throughout the Upper Peninsula nearly every town of any magnitude receives several quotations from Boston daily, and there is much trading in them by Michigan people. Brokers are found in many towns who make a specialty of "coppers," and there are many people in the State who live well upon the dividends received from their investments in these mines. The total amount paid shareholders is a magnificent one, and is shown by the following:

Name of Mine.	Total Dividends Paid.
Atlantic	$ 780,000
Calumet & Hecla	52,850,000
Central	1,970,000
Cliff	2,518,630
Copper Falls	100,000
Franklin	1,280,000
Kearsarge	160,000
Minesota	1,820,000
National	359,255
Osceola	2,263,500
Pewabic	460,000
Phoenix	20,000
Quincy	9,770,000
Ridge	100,000
Tamarack	5,190,000
Total	$ 79,641,375

Of this magnificent total fifteen mines have contributed, and one, the Calumet & Hecla, has furnished over 65% of the whole. Of the mines declaring dividends for 1897 the following made up the list:

Atlantic	$ 40,000.00
Calumet & Hecla	4,000,000.00
Kearsarge	40,000.00
Osceola	141,000.00
Quincy	800,000.00
Tamarack	360,000.00
Total	$5,381,000.00

To these dividend-payers it is expected that the Wolverine mine will be added before the close of 1898. It has been earning money for the past three years, and a considerable gain over former products of copper will enable it to pay a fair interest upon the present price of the stock. The Calumet & Hecla paid $1,000,000 April 1, '98, and the Quincy has already paid $300,000 in the same year.

One of the important changes in the copper district during the past year was the consolidation of the Osceola, Kearsarge and Tamarack Junior mines, of advantage to these companies, and a substantial foundation for a most prosperous concern.

The copper region of Michigan is at the fore in all that pertains to the business of mining. Here is found the biggest and best in the line of machinery. No other country boasts such deep shafts, none show equal enterprise. It has also the best copper in the world. To view its wonders, mining men from all portions of the globe make visits, and all are astounded with its magnitude. The district supports happily a large and thrifty population. The mines are well handled, and labor finds comfortable place. There are hospitals for the care of the miners, club insurance in the case of accident or death, and the dwellings of the workingmen are commodious, airy and pleasant. Sanitary conditions are exceptionally good. In the mines particular attention is paid to the prevention of accident, the ventilation is excellent, and easy and safe method of ingress and egress is provided.

Everywhere in Houghton county is seen evidences of the thrift of the people. New residence and store buildings are being erected in all the towns, the population is steadily being added to and signs of unusual prosperity are distinct and plentiful.

While the geology of the region has been often described, I will briefly give principal characteristics for

the information of any who may not already be acquainted with it:

There was originally a deposit of sandstone over which has subsequently flown lava in which are interbedded conglomerates. Sandstone was finally deposited on the top of this, after which there was a tilting of the formations forming a great basin, the upturned edges of the south rim of which is found a few miles back from the shores of Lake Superior, and following in the general direction of the shore line of Keweenaw Point and peninsula. The north rim of the basin is found on the Canadian shore, and is prominently exposed on Isle Royle, fifty miles northwest of Houghton. The dip of the copper-bearing rocks of the south shore is to the northwest, the angle of inclination varying from 15° at the extreme northeastern end of the point to 60° at the western portion of the range. On Isle Royale the dip is to the southeast at an inclination of about 12°.

The disturbances to which these rocks were subjected caused longitudinal and cross-fracturing and faulting, and the action of thermal and cold waters caused changes in the rock structure whereby place was made for the deposition of copper, the latter having been carried in solution and stored wherever there were opportunities for its concentration. The copper was carried from the rocks adjacent to these beds and fissures and stored in cavities made by the decomposition of the lavas, conglomerates, etc.

The conglomerates such as now contain the copper at the Calumet & Hecla, Tamarack, Tamarack Junior and Centennial mines, are known as old sea beaches, made by innumerable pebbles of all sizes, and all worn smooth by the action of water. Cementing this mass is quartz, calcite, epidote, chlorite, datolite, and other minerals that have been secured from a decomposition of the lavas and carried hither by the flowing waters.

The amygdaloids in which the Atlantic, Quincy, Franklin, Osceola, Wolverine, and other mines are working, are old lava flows in a belt of which—the upper, foamy, portion—the copper has found place.

In the fissures extending across the formation are the Central and Arnold.

There are many veins, or belts, of amygdaloid and conglomerate traversing the range, over forty being met with in the sinking of the deep shafts at Calumet, but few of them hold copper. Only one conglomerate belt is being given attention, and not to exceed five amygdaloid belts are furnishing copper at this time.

While mining has been carried to a great depth, 4,900 feet at the Calumet & Hecla's deepest shaft, there is as yet no atmospheric trouble. Just how much farther downward it will be possible to follow the lode cannot be told. The increase in temperature is slight. Of this more will be told in the mine descriptions to follow.

The copper region of Michigan is sadly in need of a railroad to open up the territory lying between Houghton and Ontonagon. There have been rumors without number concerning the time of the starting of such a desired improvement, but the time has not yet arrived, and I hear nothing indicating such an addition at any time in the near future. It would seem that the developments being made southward of Houghton would lend ample encouragement to the railroad companies now near this district to extend their lines through it. The territory is certainly a promising one and each day adds something to the many excellent reasons for opening up the range. That these will ultimately command the attention of capital and the securing of the road is certain.

In writing of the copper mines of the State I will begin with those lying south of the village of Houghton and Portage Lake. First of these in going south are the properties of

THE ISLE ROYALE CONSOLIDATED MINING CO.

The merging of the Grand Portage, Isle Royale and Huron mining companies into the Isle Royale Consolidated Mining company was effected in February, 1897. With the perfecting of the organization the work of preparing the old mines for resumption was at once begun, but it was August before the company was ready to touch the old shafts, there having to be so such performed in the way of getting the surface in shape. The old locations had been shorn of everything in the way of machinery, buildings, etc., during the long term of idleness, this being particularly true of the Grand Portage and Isle Royale properties, which had long been idle, and where the work of preparing for mining has thus far been concentrated by the new concern.

At the Grand Portage, which is the most northerly of the old mines, they have devoted their attention to the old No. 2 shaft, which is now designated as "No. 1." There was much trouble in getting this stared. The foot-wall was not easy of location. A large pile of waste rock had been piled about the mouth of the old shaft which had to be removed, and some time was consumed in getting a proper start. The walls were finally located, and, while late in the fall of '97 when the work was fairly begun, the shaft has been enlarged and timbered to the bottom of the mine at this point, the fourth level. The shaft is a three-compartment, the two skipways for handling rock being each 6’4” inside of timbers, and the man, ladder and timber way being 10’4”. It has been no easy task to construct the new shaft due to the fact that there was considerable ground taken from about the old shaft by tributors. It has needed a great deal of blocking, and often the timbers had to be swung in ropes to points where they could secure a footing; but bottom has finally been reached and the work of sinking will go on vigorously, and with far less trouble than has been met with in the enlarging and carrying down of the old avenue through the levels. The dip of the lode at this end of the property is about 56°, it flattening a little as they go south.

In the work of cutting down the shaft they have encountered several bunches of copper, and a few masses of fair size are seen at this station, they having been raised to surface. The heavy copper has been found in the foot-wall, where epidote is plentifully seen, and carries copper in satisfactory quantity. At No. 1 shaft a substantial shaft house, 36'x36', has been constructed. There is a temporary landing for the dumping of rock and waste from the ground being sunk through. Rock houses, with proper equipment will follow as soon as practicable. There is a five-foot hoisting drum of Bullock pattern, and air is provided by the compressor located at No. 2 shaft upon the Isle Royale property. The waste rock is being used to level up the surface about the shaft and mine buildings, while the stamp rock is being stocked.

The old Grand Portage, during the time of its former activity, was operated in the crudest kind of way. The rock was raised by windlass, the bucket being kept in position by skids run upon the foot-wall, and the copper secured was hauled by team to the lake. According to all reports the lode was well charged with copper, and there was besides considerable silver. There were two lodes worked, the Isle Royale and Portage, the latter being credited as being the richer. There were six shallow shafts upon these lodes, and favorable results, even in the primitive methods employed in winning the product, were obtained.

At No. 2 shaft, which is the old Isle Royale No. 8, and located 2,280 feet south of No. 1, there has been much work done since last fall. This shaft has been enlarged down to the 4th level. It is the same size as No. 1, and a shaft house, the counterpart of that at No. 1 has been constructed over it. While there was considerable difficulty attending the enlarging at No. 1 due to ground having been robbed from about the old shaft, the troubles at No. 2 on this account have been even greater. There has been need of constant blocking of the shaft, and an immense amount of extra timber has been required to make the avenue substantial. The tributors, to use the words of the mining captain, Edward Warmington, "took shaft and all in places." The piratical robbing of the shaft could have been induced only by one fact, and that was the presence of excellent copper ground. It suggests that the lode about the shaft must have been rich in copper, and there are signs now apparent that the location was a healthy one, as copper is often seen. The bottom of this shaft is at the 9th level, so there are five levels more to be passed through before solid ground will be encountered, and the latter is eagerly looked forward to by the management, as the present work is tedious and expensive. The water is pumped out to the 6th level. The levels here as well as at No. 1 are irregular distances apart. The shaft at No. 2 was started at an angle of 51°, but it was found to be sharper than this, and they are now carrying it down at 54°. Old drawings found indicated the dip to be 51°, but Capt. W. E. Parnall's recollection of the lode was that it dipped at 54°, and it proved to be correct. The Isle Royale was the first property operated by modern miners upon the Michigan mainland, work having begun here in 1852. In 1853 eight Cornish stamps were dropping, and ten years later forty were in motion. Since 1870 but little had been done. Ten shafts were sunk, and the product of copper was 9,204,071 pounds. The lode is an amygdaloid, and the strike is east of north.

No. 2 is the point at which the mine buildings are principally located. Here have been erected machine, blacksmith and carpenter shops, compressor house, warehouse, two boarding houses and two small offices. Engine houses, and at each shaft have been built, and also one small dry house at each shaft. At No. 2 shaft there is a Merritt hoist, four-foot drum and a National compressor capable of supplying air to ten rock drills. All the building has been done since August, '97, and the headway made since the new management has taken hold is certainly commendable.

At the Huron mine nothing has been done in the way of preparation for the mining of the lode, it being the intention to get the Portage and Isle Royale shafts producing first. There have been about twenty of the old dwellings repaired so they are fit for occupancy by the employes of the company. The property is south of the Isle Royale, the next adjoining.

The Isle Royale Consolidated expended $55,143 in 1897 in preparatory work, leaving $947,540 on hand, of the $1,002,683 received from a ten-dollar per share subscription and $2,683 collected in interest. There are 100,000 shares having a par value each of $25. Shares are to be issued in July next. The company owns 1,640 acres of land, and possesses a great length of lode, over 9,000 feet upon the strike of the mine. There is yet to be constructed a railroad and mill. The company has a mill site at the mouth of the Pilgrim River, although it may not decide to locate its mill at that point. They are opening up the property in a thorough manner, and conducting their business in a sensible, legitimate way. It is the intention to carry the shafts downward to a depth of 1,500 or 2,000 feet, open up levels and learn just what is possessed in the way of profitable copper-bearing ground. The management is an active one and well skilled in the business of copper mining. The local officers are, superintendent, W. E. Parnall, Calumet; Edward Warmington, mining captain; Jas. E. Richards, surface captain; H. D. Haddock, clerk. The main offices are at Boston, A. S. Bigelow, president; W. J. Ladd, secretary and treasurer. The company is employing seventy men.

THE ATLANTIC MINE

has for many years been the only active copper producer upon the south side of Portage Lake. It is one of the best known in the copper district of the upper peninsula, if not in the entire country, having achieved a national reputation by reason of the excellence of its performance in the mining and milling way. Its rock holds about three-fourths of one per cent of copper, and with this small amount it has produced sufficient metal to

pay $780,000 in dividends to the shareholders of the company besides providing an equipment of buildings, machinery, etc., that is substantial and of the best.

Nature has given to the Atlantic a few advantages that have been made the most of. The amygdaloid holding the copper is probably a little softer than that of the Quincy and other mines, and the copper is very evenly disseminated through it, so that all of the vein matter is mined and sent to the mill. There is no selection of the rock as in other mines of this district, and no time is lost in sorting the fat from the lean. Whether it stamps more readily than the rock from other amygdaloid mines of the copper district I cannot say, but an excellent product per head is secured in the company's mill. The heads have the old-style wooden frame, have 18-inch cylinders, four have solid foundations and contract for placing solid foundations under the others have been let. They are averaging 200 tons per day per head, striking ninety-five blows per minute with a steam pressure of 105 pounds. In the mortar mesh they use an oval slot, 11-61's inch opening. Heads have common double slide valve with auxiliary valve for regulating the upstroke. They are now treating between 1,200 and 1,300 tons of rock daily, employing four and sometimes five heads, with one in reserve. With the solid heads they average 316 tons, and have treated as high as 350 tons per day with them. The mill secures its water from the Salmon Trout river, it coming into the top of the building by gravity, this doing away with the expense of pumping. It is an ideal site and important in economical operation. Mr. F. G. Coggin, Jr., is superintendent, and gives competent attention to all departments of the interesting plant.

At the mine there is considerable new work being done. The past year a forty-acre tract lying immediately north on the strike of their lode, was purchased from Fred Smith, of Detroit. The land occupies the northeast quarter of the southeast quarter of Section 4, Town 54, Range 34. The lode traverses this forty from near its southwest corner to the northeast corner, giving the greatest possible length in a straight line, and if the vein proves productive for its entire length in this distance it will insure constant operation for a dozen years at least, and will add much to the present rock output of the mine. They have begun the sinking of a shaft upon the lode, and are down 180 feet. The shaft is three-compartment, 10'x20', and its location is 1,377 feet north of No. 1 shaft, the nearest upon the south. In the distance sunk the lode has shown copper all the way and in quantity equalling the average of the rock taken from the shafts to the south and from which the product has been derived. The lode is a little narrower here than to the south, being twelve feet, but it is characteristic of the vein that it .widens and contracts, as is true of all amygdaloids in this region. In appearance the copper-bearing rock is identical with that of the shafts to the south, being of dark-brown color, with occasional seams of spar, the latter always being accompanied by fine showings of copper. The shaft is known as "A".

Should the rock in this shaft continue to hold copper as it now does it will be a great help to the company, increasing their output, so Mr. F. McM. Stanton, the enterprising agent, informs me, by fully 25%.

In the upper levels of No. 1 shaft, 1,400 feet to the south of this, they ran into barren ground in the northern end of the workings, and the levels were not continued further in that direction. It is the intention to further prove this territory by putting in drifts from the new shaft to cut the ground between the levels to the south. The finding of such fine rock in the new shaft lends the hope that it should continue some distance to the south, and they will lose no time in proving what the intervening territory holds as soon as the new avenue is ready for rock hoisting and has reached the necessary depth for carrying on such exploration. Should this shaft find such ground to the level of the present lowest point in the old mine as it is started in, it will be a great gain to the company, and one the latter has well earned by reason of its persistency and enterprise. No. 1 is now to the 19th level having been extended from the 17th during 1897. The levels below the 12th and north of No. 1 and the 18th level south of No. 4 were extended an average of 228 feet, the total drifting done in the year being 5,927½ feet.

No. 4 shaft was sunk from the 23d to the 24th level.

In the old mine the richest ground found for some years past has been on either side of No. 3, which occupies a position in the center of the mine. This shaft has been improved by enlarging and adding another skipway, making two, and the old No. 3 has been equipped with a car for the handling of men and timber, so that the main hoisting shaft is not occupied with this work, giving all its time to the raising of rock. Between the 27th and 28th levels at No. 3 rich rock has been encountered, being full of coarse shot copper, and better than anything that has been seen at this property. It equals the best found anywhere in the copper country. The finding of this at the lowest point at which they are opening, and centrally located with reference to the trend of the lode is very encouraging. It would need but a small streak of this to help the percentage of Atlantic rock, the average of which is the lowest mined in the United States. No. 3 is nearly to the 28th level having been extended from fifty-five feet below the 26th.

The Atlantic company has been doing something in the way of looking for copper-bearing lodes on Section 16, south of its active property, being attracted by the showing that was made upon the Baltic property, upon the northwest quarter of the northwest quarter of Section 21. They took measurements from the supposed line of the lode on the Baltic and started a shaft near the southeast corner of the section. This shaft is a big one, 20’x20', it being the aim to take a large block of ground as the lode would be more likely to be met with in this way. A lode was encountered that in some respects bears a resemblance to the Baltic. The hanging trap was identical, and characteristic green spots and blotches were found. There were also signs that are at

variance with anything found at the Baltic. The shaft was sunk fifty-five feet and crosscuts were driven east and west from the bottom. The west crosscut was stopped in December, and attention has been given to the one reaching east. This was in 215 feet March 26, '98, had left Atlantic lands, being upon those of the Baltic, with the lode not yet found. In the belt of amygdaloid passed through some months ago the copper was not held in paying quantity. Near the centre of Section 16 an exploring shaft was sunk to a depth of twenty feet, and mineralized trap was found. Work was abandoned when cold weather set in, and may be resumed this spring. Should the Atlantic succeed in finding the Baltic lode, and as rich in copper as Baltic mine north pits, it would be an addition of much value to the company. The Atlantic has arranged to treat the rock of the Baltic in their mill, and is surveying for an extension of about three miles of their railroad.

A purchase of four sections, these being 2, 3, 4 and 5, in Town 53, Range 35, was made in January, '98. This property formerly belonged to the Globe Copper Mining company, and was bid in by the Atlantic at public sale for $12,800. The lands are in position to hold the Baltic lode, should the latter continue that far south. The price paid for the forty-acre tract in Section 4, where the new shaft is being sunk, was $7,000 cash and a parcel of land near their old mill on Portage Lake.

For the year 1897 the receipts exceeded the expenditures by $57,077.43, which, added to the surplus at the end of 1896, left a balance in the treasury of $196,362.81. From this a dividend of $1.00 per share was paid in February, 1898. A summary of results for the year 1897 shows the following:

Rock stamped	394,296 tons
Product of mineral	6,766,960 lbs.
Product of refined copper	5,109,663 "
Yield of refined copper per fathom of ground broken	209 "
Yield of rock treated 12.96 lbs. per ton, or	0.648%
Gross value of product per ton of rock treated	$1.46
Cost per ton of mining, selecting and breaking and all surface expenses, including taxes	.7343
Cost per ton of transportation to mill, 9 miles	.0454
Cost per ton of stamping and separating	.2394
Cost per ton of working expenses at mine	1.0191
Cost per ton of freight, smelting and marketing product including New York office expenses	.1703
Cost per ton of running expenses	1.1894
Total expenditure, including construction, per ton of rock treated	1.2969

The yield of copper was less per ton than for 1896 when it was 18.19 lbs. per ton of rock treated, and the larger earning is accounted for in the greater amount of rock produced. The average receipts per pound of copper sold during the year were 11.23 cents, the cost of production per pound was 9.19 cents, leaving a profit per pound of 1.22 cents.

They are observing the same method of winning the rock as described in my former reports, backstoping, letting the rock accumulate upon a heavily timbered drift, the miners working on top of the broken material, and afterward drawing the broken rock down through openings made in the drift. A force of 500 men are employed at mine and mill.

F. McM. Stanton is agent; A. D. Edwards, clerk; Wm. S. Tretheway, mining captain. The main offices are in New York. President, Jos. E. Gay; secretary and treasurer, John Stanton.

THE BALTIC MINING COMPANY.

This company, was organized in November, 1897. It owns 800 acres of land in Sections 20 and 21, immediately south of Section 16 of the Atlantic Mining company. No exploration has been watched with greater interest than this, and none has shown more for the amount of opening that has been made. It has much that is at variance with the lodes of the copper region. The dip is 72°, much more abrupt than other lodes, and its strike is 8½° more to the east of north than others in this vicinity. Dip and direction are liable to fluctuation, however, and it would be surprising if both do not change as work progresses so as to conform to other amygdaloids in this section, showing the variation of lode where opened to be local.

NO. 2 SHAFT AND ROCK HOUSE, BALTIC MINE.

The original discovery was made herein 1883 by Capt. John Ryan, who found the lode by testpitting, and who afterward sank a shaft upon it to a depth of ninety feet, and did something in the way of diamond drilling. The upper portion of the shaft was rich in heavy copper, but this disappeared as they went downward, and the drill was resorted to in order to find a continuance of the lode. It is now very easy to see that the unusual dip of the belt deceived Mr. Ryan, who, thinking he was following its inclination, carried his shaft down at an angle of about 50°, which soon took him into the hanging wall trap. The old shaft has been straightened, and continued downward to a depth of 115 feet, following the footwall, the original opening into the hanging being plainly seen. It was from the latter that the diamond drilling was done, and a hole put across the true lode from the bottom of the old shaft was unlucky enough to have cut barren ground, a few feet on either side

showing well in copper, this having been proved by work recently done.

The lode at this point is trappy in appearance, the rock being gray in color, and much mixed with the enclosing rock, giving the idea to the original explorers that it was more of a mineralized trap than a true amygdaloid. There was also an absence of stamp rock and, while considerable coarse copper was showing in the upper portion of the old pit, it was not generally looked upon as of much value, and was considered by people generally as a pocket in the trap. The belt seems to be much disorganized at this point, trap and amygdaloid occurring indiscriminately. The belt is a wide one, showing 51 feet from foot to hanging at No. 2 shaft, the original discovery point, and holds considerable copper, the most of it being barrel work, although s in the drifts now being run near the footwall north and south there is more stamp rock showing than nearer the shaft. The drifting has been done from the go-foot level. To the north they are in 80 feet, the breast of the drift showing copper, while to the south they are in 75 feet. This south drift has not shown so plentifully of copper as the one north because they are too close to the foot, the ground being -much mixed with the footwall trap. It is the intention to carry this drift to a point 174 feet south of No. 2 shaft, and then raise to surface upon the footwall for a permanent shaft.

At No. 2 they have erected a shaft house, engine and boiler house, and have a hoist of sufficient power to take care of their immediate needs. In the shaft house, at the second landing they have placed a steam hammer for the cleaning of rock from the copper masses which works satisfactorily. It has a foundation of stull timbers reaching from the floor of the first landing. There were several tons of small masses at the mouth of the old shaft when the present company took hold, which have been cleaned and piled in the shaft house. The stamp rock is being placed in stock.

Nine hundred feet north of No. 2 shaft No. 3 shaft has been started. At this point there was about 20 feet of drift covering the lode. This has been penetrated and timbered to the ledge. The shaft is three compartment, 24’x10' inside timbers, and the lode has been uncovered for a width of about twenty feet without the hanging being exposed. The shaft is upon the foot. Portions of the lode are well charged with fine copper, and it has a better appearance than at No. 2. An engine house has been constructed here and there is a second-hand hoist ready for work as soon as sinking is fairly begun.

Nine hundred feet north of No. 3 shaft is No. 4 pit. This is the most promising portion of the lode yet exposed. It is of better color, more uniform, and is well charged with copper, the greater portion being stamp. At the time of my visit, March 26, '98, the pit had reached a depth of twenty-five feet, was over twenty feet wide, with the footwall showing, and signs of hanging being apparent. Timbering for the shaft had not yet been started. The rock broken is being pulled to surface by windlass worked with men. There was a neat little stockpile of rock rich in copper that is being saved for the mill. The lode at this point comes close to surface there being but a foot or two of stripping to be done to expose it.

The Baltic lode has been pretty well proven up for a length of eighteen hundred feet, and if the Atlantic Mining company finds the extension of it in their exploration a quarter mile further north it will be an excellent addition for both the Baltic and Atlantic. The Atlantic company is now across its line and into Baltic territory with a crosscut from an exploiting shaft started upon Atlantic side of the line.

There has been much work done here since Capt. W. A. Dunn, who secured an option and revived the old property, took hold last fall. The thick growth of hardwood and undergrowth has been cleared away for a considerable distance upon the strike of the lode, and wide enough to prevent danger from fire. Besides the shaft house and engine houses constructed there have been dwelling houses and an office and warehouse put up, and a great change has taken place in the surface appearance at the location. The company is certainly going ahead with the idea that they have a mine here.

To the east of the Baltic amygdaloid 140 feet is a belt of conglomerate. Such a belt is found to the east of the old Huron mine, and there are those who argue that the Baltic lode is an extension of the Huron. Others aver that it is a counterpart of the Mabbs lode to the east of the Isle Royale and near Portage Lake. This was a very narrow amygdaloid belt, three feet were exposed many years ago when an attempt at mining it was made. The strike of the Baltic is 58½° east of north, whereas the Atlantic is 50° east of north. A change in dip and strike conforming to other lodes in this section would not be surprising.

The St. Mary's Canal & Mineral Land company, of which R. Goodell, of Houghton, is local agent, was owner of the fee of the Baltic lands, and possess a fine territory upon the strike of the lode aside from that disposed of to the Baltic. The Baltic company was organized with 100,000 shares, having a par value of $25 each, and has called an assessment of $1.00 per share to conduct explorations. Its local management is the same having charge of the Atlantic mine, which insures the very best attention. The Atlantic mine railroad will be extended here the coming summer, and the rock will be treated in the Atlantic mill. There are fifty men now employed at the property, which number will be materially added to if developments continue to show the present healthy condition of lode. There is a long stretch of ground to the south upon the company's lands that has yet to be explored.

F. McM. Stanton is superintendent; A. D. Edwards, clerk; Thos. Rowland, mining captain. The main offices are in New York. John Stanton, president; John R. Stanton, secretary and treasurer. Cameron Currie, of Detroit, Mich., was prominent in the organization and is a director.

The revelation at the Baltic suggests much for the territory to the north and south of this point. There is a

large unexplored tract that will now command attention, and the present year promises to be an active one in the search for other mines. I heard considerable talk of

THE WINONA,

which is located twenty-six miles southwest of Houghton, the company owning lands in sections 21, 22, 23, 28, 29 and 32, Town 52, Range 36. There are 1,400 acres embraced in the tract. Some work was done here in the sixties, and three copper-bearing lodes exposed, and amygdaloid, conglomerate and epidote, of which the amygdaloid gave the best results in copper. It is looked upon as a promising property, and an effort is now being made to interest capital in its reopening. Were the territory supplied with a railroad there would be activity shown all along the line from Houghton to Ontonagon. J. A. Hubbell and Johnson Vivian, of Houghton, are largely interested in the Winona.

Just west of the village of Houghton is the South Side, where it is thought by many that the Quincy mine lode will be found, it being in line with its strike. Capt. W. A. Dunn is now trying to arrange for a revival of mining operations at this point. Adjoining is the old Dacotah. There are numberless old prospects in this vicinity, and twelve-cent copper, with the present demand for the metal, is sufficient incentive to give many of them attention.

The Everett is a property located in the same township as the Winona. Some work was done upon it many years ago, and considerable copper shown in a belt of amygdaloid.

Southward from the Winona mine there is the extension of the copper-bearing range into

ONTONAGON COUNTY.

Ontonagon county has not yet resumed the work of developing the copper-bearing lodes that were once so prominent and which are now matters of history. There have been many attempts made to gain the attention and help of monied men, but thus far these have proven fruitless, and the mines which were once so full of mass and barrel work, and which earned excellent dividends show no activity aside from that lent by a few tributors who delve in the old workings at points above the water level. There have been various plans presented to the gentlemen who have been foremost in the bringing to the light of day the copper of other and newer districts, but thus far they have been productive of no good other than to get the old mines more talked about, and to create a desire in the minds of people to learn more of them. There have been plans perfected that consolidated sufficient territory to insure satisfactory stretch upon the strike and dip of the lodes, the price at which all were offered was reasonable, but still the start has been delayed.

The people of Ontonagon have not yet given up hope of seeing the smoke rising from the mine stacks, and hearing the dropping of stamps. They have implicit faith in the productiveness of the lodes which have been wrought, and feel certain that sooner or later actitivity will be secured to them and a corresponding gain to the business volume of the county.

And there are many reasons to support the residents of Ontonagon county in their faith in the district that was once so prominent in the mineral world. The achievements of the past are looked upon as of importance in figuring upon the future, and certainly the district was once the most attractive in the copper-bearing way that America possessed. It was here that the first important finds of copper were made, where the much-talked-of prehistoric miner secured his copper that was afterward distributed among his people over a broad expanse of country that had Mexico as its southern boundary. Pennsylvania its eastern and Arizona its western, as between these points native copper ornaments, tools, etc., were abundantly found. The largest mass of native copper ever known came from Ontonagon county, its weight being about 500 tons, and here the first active mining for the metal was done in Michigan.

Further north and east copper mines have been operated for years and have paid handsome returns to their shareholders. Forty miles away are the rich mines of Houghton county. These are in the same rock formations, the same copper-bearing trap. At numerous points intervening between the properties of Ontonagon county and the Atlantic mine, (the first active copper producer going northeast after leaving the old mines of Ontonagon), copper has been found. The trouble in the development has been the lack of a railway to bring in supplies and to take copper out. The Baltic prospect, so much talked about of late, laid untouched for thirteen years even after a shaft sunk eighty feet upon the lode had revealed copper in wonderful quantity. There are unexplained problems to be found in all mineral-bearing regions, and this is one of them. There were years when times were hard, when capital was difficult to find to engage in any undertaking no matter how promising it might appear, and capital is necessary to re-open and properly work the old mines in the county of Ontonagon.

When these mines were wrought they were equipped with machinery of primitive kind. They were expensive to handle due to the lack of apparatus now deemed necessary to the very best properties. Give to any of the successful mines of today the means employed during the time of Ontonagon's activity and few could make a dollar. The old mines were stopped when few of them had reached a depth of 1,000 feet, and yet it is true that many of the best properties of the now active copper field of this state found copper, but sparingly until a greater distance downward upon the lode had been attained. A thousand feet is but a trifling depth in these days of great machinery and great achievements in a mining and mechanical way. It would be surprisingly strange if the mines of Ontonagon ceased to be productive at so slight a depth as that to which they have

been followed. I know of no instance in which the lode was lost, or where the lowest level in the mine did not show copper in some quantity.

Now that the business of the country has revived, when the future of copper as a popular metal seems to be assured, and when the amount annually needed is so steadily increasing, it will be strange if some attention by those who possess sufficient means and a knowledge of the business is not devoted to the old mines which have so long been idle. When the excitement attendant upon the finding of rich fields afar off has worn away, and when all sides of the story have been told, capital will seek investment closer at hand where it can watch operations and where it can proceed without the many disadvantages of climate, disease and lawlessness. Ontonagon county certainly offers a legitimate field for the systematic exploration of copper lodes. It has already shown enough to warrant liberal treatment by those who desire to possess mines of copper, and it surely will not be long ere the old mines will again be doing their share in the supplying of a product. Ontonagon possesses a railroad, has but a short distance to reach the lake, and certainly has advantages of transportation which are valuable, and which the territory still further north and east of them, and midway between Ontonagon and Houghton does not yet boast.

THE NATIONAL MINE

located at Rockland, was the last to cease operations, the last to suspend work in its mill and to pump water from the levels. The time of its closure was in August, 1893. Since then it had been doing something in the way of tributing. Mr. B. F. Chynoweth, who is in charge, and who is familiar with its formations and peculiarities, still continues to send a certain amount of copper to the smelters annually. He has unlimited faith in the mine, backed up by a record of $320,000 paid in dividends. The lode is a contact having a gray, compact trap for the hanging and a conglomerate for the foot, and is locally styled the "Conglomerate" vein, although in reality the conglomerate holds copper only where it has been cracked or fissured in the upper portion of the belt. The copper produced was fully 30% mass and barrel work. Considerable work, was also done upon an amygdaloid belt 140 feet north of the conglomerate, but at the lowest level worked but little copper was found During the past year a few tributers worked in the old levels and took out 39,256 pounds of rough copper. Considerable copper is showing, and there is sufficient encouragement for the starting of mill and mine upon a scale that would treat more rock than under the former period of operation. Adjoining the National is

THE MINESOTA MINE

that paid its shareholders $1,820,000, and required from them only $380,000 in the shape of assessments. During the past two years some attention has been given this property by the Jeffs estate, Rockland. In the fall of 1896 a new collar was put in the old No. 10 shaft and the shaft was cleared down to the 30-fathom level enabling them to get through a portion of the old workings. There is some ground standing above the water level, which is the 50-fathom station in this portion of the mine, and the lode looks well in copper. In the winter of 1896 a few tributers worked in the adit and 40-fathom levels and in May last 28,040 pounds of copper were shipped as the result of their labors. No tributing has been done since that time. As is generally known there are two ranges here productive of copper, the North Bluff, or Minesota, and the South Bluff, or Evergreen, these being about a half mile apart, and are parallel ranges. Upon the north are located the National, Minesota, Toltec, Penn, Hazard and others, and upon the South Range are the Knowlton, Ogima, Ridge, Evergreen, Adventure, Belt, Merrimac and others. The Minesota has been devoting some attention to the South Bluff. Several old crosscuts were opened up reaching into the different lodes, and some drifting was done upon those known as the Knowlton, Mass, Evergreen, Ogima, and South Minesota stamp lodes, all of which showed copper, the South Minesota being particularly promising, there being considerable stamp copper and barrel work in sight. From the appearance of the rock, and from tests made at various places upon the lode, Mr. Jeffs believes the latter will yield copper at the rate of 3½%, and he makes this as a conservative estimate. There are several old shafts upon this vein having a depth from 40 to 150 feet, and four crosscuts expose the lode, these being put in at a considerable distance apart, covering a stretch on the strike of the vein of one and one-half miles, all upon the south side of the bluff. This lode is a heavy one, being 30 feet thick, and having a dip of 42°. The company has 1¾ miles on the strike of the lode upon their possessions, it being located upon sections 14,15 and 21, 50-39. The drifting from the shafts upon this lode is less than 400 feet, with very little stoping. Eight men are being worked here and considerable barrel copper is being shown. Mr. Jeffs believes the showing warrants the putting in of an extensive plant, and there is hope that the old Minesota, which was once so rich in copper, will again show that it is deserving of fair treatment on the part of the miner. The mine is owned by the Jeffs estate, Rockland, W. B. Jeffs, administrator.

THE RIDGE MINE.

produced, in 1897, 31,490 pounds of copper taken out by a few tributers. The property, as has been reported in a former article, was lost to the Ridge Copper Mining company through their neglect to pay one year's taxes. The company has appealed from the decision of the Ontonagon court, going to the supreme court, and from there will go to a still higher source in case of not securing the property. The outcome of this case is being watched with no little interest. In the meantime nothing is being done at the mine. Previous to its possession upon tax title the company had commenced the unwatering of the shafts and were to have expended

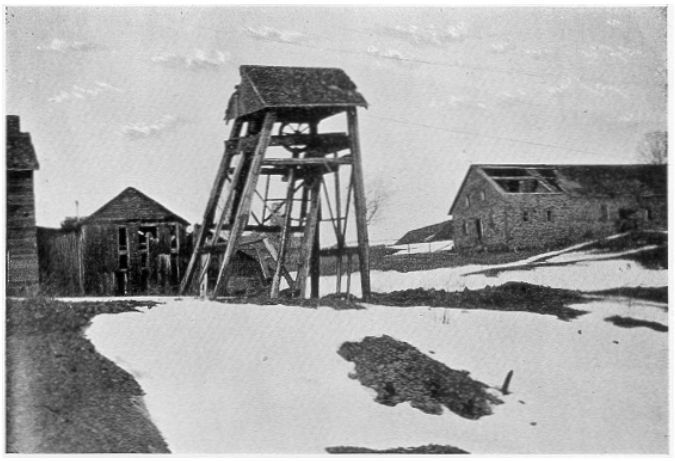
$40,000 in the opening up of new ground. Thos. Trevarrow has local charge.

THE MASS MINE.

The Maas mine, is one of the noted ones of the Ontonagon county district. Its shafts have penetrated to a depth of only 700 or 800 feet. Its location is the southwest quarter of Section 6, 50-38. During the year 1897 tributers took out 33,760 pounds of rough copper from the adit and lo-fathom levels. Tributers have been very successful at the Mass and the lode, besides the barrel and mass, shows considerable stamp rock. B. F. Chynoweth, Rockland, is local representative.

THE ADVENTURE

is located upon the east half of Section 35 and west half of Section 36, 51-38. Tributers shipped 15,316 pounds of copper the past year. There is now one pair of tributers working in the adit level of the lode known as the "Butler." They have taken out about ten tons of copper within the past two months and have now in sight and partially stripped a mass that may weigh twenty-five tons, about eighteen feet of the mass being now exposed. Besides this the lode is full of copper on all sides, Harry Tregidion, Greenland, has charge.



NO. 3 SHAFT AND ENGINE HOUSE, MINESOTA MINE.

THE BELT MINE,

located on the southwest quarter of Section 29, 51-37, shipped 6,603 pounds of copper from tribute work during 1897. Shafts are about 400 feet deep. Of this property much has been said concerning its magnificent equipment and subsequent failure of the company that attempted its development. The money was first expended upon a plant and they gave a little time trying to find a mine. The property was never given the right sort of test. Algo Treverrow, Greenland, is in charge.

THE HILTON MINE,

located on the east half of Section 36, 51-38 shipped from tribute work in 1897, 2,583 pounds of copper.

Thus the mines of the Ontonagon district shipped for 1897 the total of 157,048 pounds of copper, showing that a little work is yet being done, and that the lodes are still productive.

THE PORCUPINE MOUNTAIN DISTRICT

of Ontonagon county has been an interesting one to the prospector for many years. These "mountains," so-called, rise near the shores of Lake Superior in Ranges 42, 43 and 44, extending inland for seven or eight miles. A deep gorge separates the mountains into two ranges, the Carp river flowing between them, it being the outlet of Carp Lake which crosses Section 22, town 43, Range 50. Some of these hills rise to 1,200 feet above the level of Lake Superior. It was just east of this range where the finds of silver were made in the 70's that attracted so much attention.

THE CARP LAKE MINING CO.

was one of the first to give attention to the copper-bearing rocks of the Porcupine Mountain district. It was organized by Cleveland, Ohio, parties in 1858, and the territory included in the name of the company consisted of 1,087 acres. Mining work was begun in 1859 and carried on until 1862 when there was a suspension. A stamp mill was erected, several shafts sunk to a slight depth, and two adits driven. The copper produced amounted to fifteen tons 1,135 pounds. The work done was upon Section 15, Town 51, Range 43, and was upon the north side of the north range, about one-half mile from Lake Superior and four miles from Union Bay.

Under the direction of John C. Jones, manager, a resumption of work took place upon the 25th of September, 1897. A shaft was started upon the south side of the bluff, and fifty feet from the top, just opposite Carp Lake. This shaft was sunk to a depth of twenty-five feet in the altered sandstone which carries copper, and upon which formation the company originally worked. It followed the dip of the formation, which is 26° to the north. Copper was found from surface to the bottom of the opening, and was heavier and more plentiful in the bottom of the shaft than at any point above. The copper-bearing sandstone was about three feet thick.

Overlying the sandstone is a belt of amygdaloid and at the bottom of the shaft this held copper for a thickness of two feet, pieces weighing several pounds each being found. Trap overlies these formations. Winter weather put an end to the sinking of this exploring shaft, but it will be resumed the coming spring.

Attention has been devoted to the old mine workings upon the south side of the bluff. Here there was a shaft sunk to a depth of forty feet, and a little drifting upon the lode was done from the bottom. An adit was run into the hillside for a distance of 1,000 feet. The timbers of the adit have decayed and the adit has been choked up to the point where it reaches solid ledge. They have been

cleaning out this old avenue and re-timbering it, the object being to examine the lode at this depth.

It is the intention of the company to drive an adit from the north side of the bluff which will cut all the formations, and should paying copper lodes be encountered it will give 1,200 feet of stoping ground above the adit. The old shafts are upon the same belt of sandstone as the new shaft has been sunk in, the location of the new work being half a mile to the west. The old mine was tested upon surface for a distance of half a mile, showing a continuous lode. Sufficient has not been done to devermine the actual value of the property. M. G. Waterson and N. P. McLean, of Cleveland, Ohio, are largely interested in the mine.

The copper generally found in this district has been to fine to successfully save in the mill. This was the trouble with the Nonesuch mine, located at the southeast end of this mountainous range, upon Section 12, Town 50, Range 43. Much money was expended at this property and considerable copper secured. There are many who still contend this mine, with modern appliances, would make money. Four shafts were sunk, the deepest being 350 feet. The thickness of the lode was about seven feet, the copper-bearing rock being a clayey sandstone. Four hundred thousand dollars was put into the property, and 180 tons 1,072 pounds of copper was the return. It was a bitter disappointment to those who invested in the mine. The mistake made was in putting so much money into a surface equipment before it was known that there was copper to pay for it.

The Muscowaubic Mining company owns lands adjoining the Carp Lake mine; was organized in 1859, and possessed 1,000 acres in Town 51, Range 43.

The Porcupine Mountain Mining company owns lands, 480 acres, contiguous to the Carp Lake and Muscowaubic properties. It was organized in 1860. A few shallow shafts were sunk, and some clearing of the surface done, but little in the way of developing the copper-bearing lodes was accomplished.

The Halliwell Copper company did some work in 1896 upon Sections 27 and 28, Town 51, Range 42, sinking two shafts to cut the veins upon their dip. Copper was found, but the work of following it has been stopped, although those interested claimed the percentage of copper was sufficient to make a profit.

Ten thousand acres of land in Carp Lake township belonging to the Massachusetts Copper Land & Mining company was recently sold to Jos. E. Gay, of Boston, this closing up the affairs of the old company.

There were many attempts at copper mining in this locality in the early history of the range. The Lone Rock, Cuyahoga and other properties were given brief attention, but were not producers of metal.

West of the Ontonagon river, where now all is silent in the mining way upon the range, there was once great activity. One of the most important locations was the Norwich, located upon Section 1, Town 49, Range 50. It was worked in the fifties. Considerable was done here in the way of opening. The lode outcropped upon the hillside and an adit was driven at the base of the hill from which the most of the work was done. In 1863 the company consolidated with the Windsor, which adjoins the Norwich, worked a couple of years and stopped, having expended $230,000. During the time it was operated the Norwich produced 496 tons 1,360 pounds of copper, and the Windsor 34 tons.

Adjoining the Norwich is the property of the Ohio Trap Rock Mining company, one of the first formed here, it being organized in 1849. After doing considerable work in the way of opening the lode by an adit and two shafts, and expending $150,000, the property was abandoned in 1857. But little copper was obtained, 20 tons, 1,125 pounds being the amount secured. The company held 3,316 acres of land, but disposed of 1,614 acres to the Collins Mining company.

In this same section are a number of old properties which were worked in the 60's. The developments consisted generally of the driving of adits into the sides of the bluffs, and the sinking of one or two shafts having depths of from forty to sixty feet. Among these the most prominent were the Hudson, Pittsburg, Clifton, Sharon, Cascade, Clinton, Derby and Eureka.

In the vicinity of Lake Gogebic there has been some work done upon the copper range. The Forest Sheppard company, organized in 1864, owns 2,366 acres near the lake and did some testpitting and crosscutting many years ago. Nothing of value was found. The Waukulla Mining company, owning 480 acres in Sections 19 and 20, Town 49, Range 42, have done some work in the way of crosscutting the formation from the side of the bluff near the lake, this being in the trap rock. One finds many pits in this district, and considerable was done in years gone by in the way of surface exploration. Some copper was found, but not in merchantable quantity.

NORTH OF PORTAGE LAKE.

For fifty miles the copper-bearing range makes north and east of the village of Houghton, it forming a curve-shaped belt having an average width of six miles. The eastern end of the range, forming Keweenaw Point, has an east and west trend for about twenty miles. The most active mines of the copper country are located at Hancock and Calumet, these places possessing the most important producers since the decadence of the mines of Ontonagon county. Renewed activity is shown throughout this portion of the copper range from Hancock upon the south to Eagle Harbor upon the north. Many old properties are being revived, and the busy ones are adding considerably to their producing capacity. The first property demanding attention at Hancock is

THE QUINCY MINE.

This is one of the most important producers of copper in Michigan. Its growth has been steady, and it has yet to reach its maximum achievement in the way of annual shipments. It is a conservatively handled mine. There is nothing of the pyrotechnic in connection with its management, and no steadier stock is to be found upon the market than that of the Quincy. At the mine Capt. S. B. Harris and his able assistants have given competent direction to all matters pertaining to their departments. There has been no waste, no extravagance, and both upon surface and underground there is evidence of competency upon the part of those whose duty it is to keep this giant enterprise in motion.

The improvement of the Quincy has been marked since the present local agent took hold, fourteen years ago. Previous to that time it was operated in a very quiet way, and its annual product was little in excess of the old Huron upon the opposite side of Portage Lake. Now it takes third place in the list of lake producers in the amount of copper annually mined, and it occupies second place among the list of dividend payers, its accomplishment in this important direc-being $9,970,000. It has produced 216,313,139 pounds of copper, which, with the silver, obtained in the mine, has been sold for $32,221, 311.18. Its receipts, up to January 1st, '98 were $10,681,171.29 in excess of its expenditures.

For the year 1897 the Quincy produced 20,630,625 pounds of mineral which gave 16,924,618 pounds of refined copper, this being 61,151 pounds in excess of the product for 1896. The season's output was sold for $1,872,213.69, and $18,024.95 was realized from the sale of silver, making the total marketed value of the product of the mine $1,890,238.64. The mining profit for the year was $720,767.32, and there was received from interest, etc., enough more to bring the total to $731,278.83.

The Quincy has a magnificent territory, it possessing about 2,900 acres upon the dip of its mine, and has about two and a quarter miles upon its strike. For nearly a mile upon the southwestern portion of its possessions it can follow the lode upon its downward course for more than two miles before it passes its boundary line. It has been enterprising in securing new lands upon the dip and strike of this lode, its latest acquisition being the Mesnard and Pontiac properties, which were added during 1897 at a cost of $38,560.60. The Mesnard comprises the northeast quarter of Section 24, and the Pontiac the southeast quarter of Section 13, Town 55, Range 34, immediately east and north of their Pewabic property. The lode crosses the southeastern portion of these sections, giving the company the advantage of great depth upon the dip of the vein. Included in the purchase are also valuable water frontages upon Torch Lake. The company also owns a considerable territory in addition to its available mining lands.

In the many years the Quincy has been operated it has attained great depth in its shafts, the deepest, No. 2, being now nearly to the 52d level, over 4,300 feet from surface. It has opened the lode upon the strike of the mine for a length of about 6,000 feet, and has three shafts, No. 4 being the most southern, No. 2 located 600 feet north of No. 4, and No. 6 the most northern, being 2,500 feet from No. 4.

During the year 1897 No. 2 shaft was extended from 30 feet below the 49th level to 30 feet below the 51st level, The drifting done from this shaft was at the 51st, 50th, 49th, 48th, 47th, 25th, 17th and 9th levels, north, and at the 50th, 49th and 16th levels south, and the stoping was at different points from the 9th and 50th levels north, and the 17th and 50th levels south. No. 4 shaft was sunk from 30 feet below the 49th level to the 5oth level. The drifting done here was at the 49th level north and south and at the 48th, 47th and 45th levels south on the main lode; and at the 42d and 41st levels south of the hanging branch of main vein. The principal stoping was at and between the 18th and 49th levels north, and the 36th and 49th levels south. No. 6 shaft was extended from the 47th level to 30 feet below the 49th level. The drifting done from this shaft was at the 49th, 48th and 47th levels, north and south, and at the 46th, 45th, 44th, 43d and 42d levels north. The stoping done was at and between the 34th and 48th levels north, and 43d and 48th levels south. The total drifting done was 11,957 feet, shaft sinking, 641 feet, winzes 924 feet. The amount of ground broken was 35,123 cubic fathoms, or 632,867 tons.

There has been another shaft started, which will be known as No. 7. Its location upon surface is 876 feet south of No. 4. Work upon it was begun in December, 1897. It will be two-compartment, 18½ feet north and south by 7 or 8 feet. The Quincy management adheres to its two-compartment style. They have a neat arrangement for the changing from skips to man cars, which I have described in former reports, and they prefer to retain this plan. The ropes and engines are constantly in use, the engineers are thoroughly familiar with the work, and they believe the danger of accident is reduced to the minimum under the system here in vogue. No accidents in the lowering and raising of men have yet occurred. This shaft will be curved so as to agree with the flattening of the lode. The latter starts at surface with a dip of about 54° to north and west and at a depth of 4,300 feet it is about 44°. To follow the footwall the new shaft will have the, form of a catenary. Timbers used will be 12”x12" and everything will be of the most substantial, necessary for the speed at which the heavy skips will be pulled through the shaft. This new shaft touches the southern workings of the mine, and fifteen levels already extend to the line of intersection in its downward course. From the 39th to 47th, inclusive, the drifts are into the line of the shaft, while the 22d, 24th, 27th, 30th and 33d are also in. The shaft is being attacked from the different levels, and this greatly facilitates the work of putting it through. From one level they sink, carrying ground the full size of shaft, while

from the level below they put in a raise on one side of the line of the shaft to meet the party who are sinking. When the two meet the ground left in the side of the shaft by the party who were raising is readily trimmed down by the use of the power drill. By observing this plan a great many men can be placed at work, and remarkable headway made. They have not been crowding the shaft, and still have completed about 1,000 feet since it was commenced. At several levels there is but little trimming to be done to make place for the new avenue, former mining having already opened a way for it. As it goes downward from surface it steadily draws away from No. 4, which inclines northward, so at the 5oth level it will be about 1300 feet from No. 4. Completed, it will be of great advantage in the more ready handling of rock, as now a very long tram is necessitated from the stopes of the southern levels to No. 4, the distance at the 47th being about 1,500 feet. All tramming in the mine is done by hand. It is probable that a portion of the shaft will be sunk from surface, but the greater part of it will be put through from underground, as explained. Much of the rock broken in the shaft is wasted in the openings in the adjacent levels, saving the cost of sending it to surface, which would be considerable.

There is also talk of another shaft to be sunk upon the Mesnard property, the location being just north of the Franklin. This may be commenced the present year.

Underground, the Quincy is looking healthy. The lower levels show considerable improvement, and grayish amygdaloid rather lean in copper that was seen in several stretches at the time of my last report has given place to that of a browner, more kindly nature, and richer in copper, this being in territory adjacent to No. 6 shaft. From No. 6 they have drifted out under the Franklin mine boundary, the lode here being rather below the average of the mine in copper.

They have two veins, so-called, in the Quincy, the "main," and the "east branch," the latter being parallel with the former and is simply a footwall deposit, with a run of rock separating it from the main vein. They use the diamond drill freely in locating these footwall copper-bearing chutes, and in exploring the property. During 1897 there were bored 982 feet of holes, and the record for all years shows borings amounting to 55,425 feet. There is need of but little timber, and the mine is a dry one. In places the hanging shells off freely, and great care has to be exercised in keeping it from coining down upon the miners. Capt. Thos. Whittle gives careful attention to all details underground and is assisted by under captains Cornelius O'Neil, Geo. Jacobs, Rickard Hocking, Chas Kendall and John Edwards, whose time is fully occupied in traveling through the mine. In many places in the lower levels they are constructing walls of waste rock, bringing them up from the foot to the roof. These are substantial, offer protection to the hanging and they also serve as retainers of waste rock which is thrown behind them, saving the cost of hoisting to surface. They are also better than timber in that they will not burn. The plan is more expensive than timbering, probably, but it has advantages over timber that are important.

Like all amygdaloids, the lode of the Quincy is irregular in its holdings of copper. There are many lean stretches and many that are very rich. The poor runs are left in the mine. The openings are kept well ahead, there being a large territory to draw from, and the encountering of lean lode affects the monthly yield but little. Indeed, there has been no diminution noted, but on the other hand a steady gain is shown from year to year. With the new shaft in commission, and with one to take the rock from the northern portion of the property, Quincy will make a considerable gain to its present annual output of copper. While the heavy masses are less frequently met with than in the upper portions of the mine, smaller mass and barrel work occur abundantly. Of the 20,630,625 pounds of mineral produced last year, 5,200,000 pounds were of this class of copper, it being secured from the rock houses, being cleaned of its rock by steam hammers. This copper goes direct to the smelters without having to be treated in the stamp mill, this effecting a saving of transporting and milling. In the case of some of the large masses weighing several hundred tons, which used to be found in the upper levels, it required considerable time and money to cut them into sizes so they could be handled through the levels and shafts. The cutting was done by hammers and chisels and was exceedingly slow.

There were no additions of machinery at the mine during the year, no changes in the system of winning the rock. The equipment of machinery is of the best. At the stamp mill there are six heads, all with solid foundations, and all having twenty-inch cylinders, two having recently been changed from eighteen-inch. Mr. George Bedell, the superintendent keeps everything running smoothly, and there is no better mill in the district.

The company has talked of erecting a smelting works for the reduction of its mineral. It produces sufficient copper to warrant such an addition; it has an excellent location, and may conclude to engage in the enterprise. Thus far all its copper has been smelted at the Lake Superior Smelting works, Hancock, which are located conveniently to the mine.

The company is now employing over 1,100 men and will probably make some addition to its present force as soon as its new shaft is completed. This number includes men at mill also. There are about 400 miners the most of whom work upon the contract plan, securing so much per foot or fathom for drifting and breaking. The average pay of miners for the past year was $52.50 per month.

The total rock mined was 632,867 tons; rock hoisted, 568,822 tons; stamp rock treated, 542,622 tons; yield of mineral per fathom of ground broken, 587 pounds; yield of refined copper per fathom of ground broken, 481 pounds; the mineral gave 79.486% ingot copper; balance of assets, January 1, ‘97, $1,211.171.00.

The officers at the mine are: Agent, S. B. Harris; mining engineer, J. L. Harris; mining captain, Thos. Whittle; chief clerk E. D. Johnson. The main offices are in New York. President, Thomas F. Mason; secretary and treasurer, Wm. R. Todd.

Immediately adjoining the Quincy, and surrounded by property of the latter upon all but the east side, is

THE FRANKLIN MINE.

The Franklin mine has long been a prominent one in the Lake Superior district. It has been constantly operated since 1857. Its total product of refined copper amounts to 93,452,453 pounds, of which 2,908,384 pounds were secured in 1897. It has paid in dividents $1,280,000, and the total assessments have been only $220,000. The old mine still continues to produce copper and earn money although it has reached its limits as to depth, and its last year (long ago reached according to various local authorities) has yet to be recorded. The copper obtained is principally from the upper levels, where former lean stretches left behind are being taken.

The Franklin Mining company, realizing the fact that they must secure additional territory if they desired to long continue in the copper producing business, purchased the property of the Peninsula Mining company in 1894. The lands are located in Sections 7, 8 and 9, 55-34, hold 1,359 acres, and are three miles northwest of the old mine. Considerable work had been done upon the new possession of the Franklin before the present company took hold of it, something like a million and a half dollars having been spent in the endeavor to locate a profitable lode. In 1870 the Albany & Boston company was organized which did its first work upon an amygdaloid belt. One level was opened for a length of 800 feet, a portion of the lode being very rich, but it did not continue to be profitable at greater depth, and work was suspended. In 1864 they opened upon the Boston & Albany conglomerate, which is a continuation of the Allouez conglomerate. This yielded copper at the rate of 4% at the start, but it lessened in the metal as they sank upon the vein, and again the experiment was stopped in 1869. In 1883 there was a re-organization under the name of Peninsula Mining company, and a resumption of mining took place to be discontinued the following year. In 1888 the company raised more money and made another trial of the lode, working spasmodically until the fall of 1892, when they gave up. The property was afterwards purchased by the Franklin company, and the location has since been known as

THE FRANKLIN JUNIOR.

In the time the property had been operated it had produced something like 3,000 tons of copper, the greater portion of which had come from the conglomerate. They had reached a depth in two of the shafts of about a thousand feet, and the rock averaged ¾ of 1%. Some diamond drilling had been done, but little was known as to the value of the property. It had proven a failure, and for this reason the Franklin company was enabled to purchase it at a reasonable figure.

Mr. Graham Pope, who has made such an excellent record in his management of the company's interests since taking hold of their mine, had an idea that the Franklin lode should extend to the Junior, and he reasoned that it should hold copper in quantity which would pay for its extraction. He was given permission to conduct the exploration of the property as he thought best, and since he began the task has pushed the work in an energetic, systematic way that has redounded to his credit and wisdom. It was generally known that all the principal copper-bearing lodes of the district crossed the lands of the Franklin company. The most westerly of these lodes is the Pewabic, upon which the Quincy and Franklin company mine. In order going east is the Allouez conglomerate, distant from the Pewabic 475 feet; the Calumet conglomerate, 1,420 feet east of the Allouez; the Osceola amygdaloid 605 feet from the Calumet, and the Kearsarge conglomerate 646 feet east of the Osceola. While Mr. Pope expected more from the Pewabic lode than any other, he did not neglect to give all the others a testing. Naturally, he inclined a little towards the Pewabic as it was upon this belt of ground he had for years been operating with such success at the old mine. A shaft was sunk 156 feet upon the Osceola amygdaloid. They drifted from it 90 feet and sunk a winze 50 feet. Considerable heavy copper was found, but there was not enough stamp rock to please, and they stopped operations awaiting a time when they can devote attention to it again. They found more promising ground elsewhere and were anxious to secure copper to assist in paying the way of opening a new mine. The Osceola amygdaloid is an attractive point, however, and no doubt will receive the attention due it at some time in the future. They drove a crosscut of 2,600 feet to tap other veins. It found the Calumet conglomerate, which was unproductive. They drifted 90 feet upon it and put in several crosscuts. In the summer of 1896 they sunk a shaft 77 feet and put in a crosscut 223 feet to the Kearsarge lode. A shaft following the lode was put down 90 feet, finding but little copper. At the same time they were sinking upon the Pewabic lode, and it is upon the latter where the entire attention of the company is now being concentrated.

No. 1 shaft, the most northerly, is now to the 9th level, 900 feet from surface measuring upon the incline of 48° to the northwest. It is 7'x12' inside timbers, and has single skipway. It was started to explore the property, and will probably be enlarged to give place for another skip road. The three upper levels show but little copper and have not been extended far beyond the shaft. At the 4th better ground was encountered, and they have opened up 250 feet upon the north side of the shaft and 375 feet upon the south side. The lode had an average thickness of about six feet at this depth in the shaft.

At the 5th level they have drifted 600 feet north of the shaft and 900 feet south. The lode upon this level

shows some improvement over the 4th, it being uniform in size and holding of copper, excepting at the north end of the drift where they were working upon a very handsome stope. It is one of the most promising places in the mine, and considerable rock is now being stoped here. They are confident of striking it upon the 4th level and have resumed the work of drifting upon the latter, it having been stopped some weeks ago to give attention to points lower down the shaft. From the strength of the lode at this rich stope upon the 5th level it is expected to extend downward to the 6th.

Upon the 6th they have drifted 550 feet north and 200 feet south of the shaft, the lode being uniform, and copper-bearing throughout.

At the 7th level they have drifted 200 feet north and 250 feet south, at the 8th, 100 feet north, and have just begun adrift south. At the 9th they are fifteen feet upon each side of the shaft, and will soon be ready to commence another lift. The lower levels all show well in copper, the bottom of the shaft having the metal in pleasing quantity. The lower portion of the mine shows a considerable improvement over the upper levels, and lends color to the statement that the Pewabic lode has never been rich near surface. This is said of the old Franklin mine and of the Quincy. Maps of these companies show large areas of barren ground, and much of the rock now being treated in the Franklin mill comes from the upper levels of the old mine where the miners considered the lode too poor for working in the earlier history of the property. The heaviest copper shows in the lower levels, the largest mass yet being taken from the Junior coming from the 6th level. It weights 240 pounds. The lode is almost identical in appearance with that of the old mine, but the rock is somewhat softer. The color is similar, the amygdules the same, and there is the same crystallization of copper and calcite, the same minerals, and occasional pieces of native silver are seen. There is no question about this being the Pewabic lode, Mr. Pope having taken accurate measurements and driven crosscuts that settles the point conclusively. There is much heavy copper in the lower levels, and stamp rock is seen generally in the drifts. It may be yet too early to say that the company has developed a paying property at the Junior, but they certainly have made an excellent start. The lode is narrow, but they hope it will increase as they sink upon it. In the sinking of the shafts at the Junior the water has bothered greatly, it coming through the walls at frequent intervals. At many places, in sinking the shafts, "forks" had to be cut in the footwall to catch the water, from which points the water was lifted to surface by pumps. This has been a great source of annoyance and delay in the deepening of the shafts. It is thought that when the surface water has been drained from the surrounding country the mine will show much less.

There is now in stock at No. 1 shaft between 8,000 and 10,000 tons of stamp rock that has come from the shafts and drifts. They are sending to the mill about 175 tons of rock daily that is hoisted from the mine in the work of opening. None of the rock has yet been sent from the stockpile to the mill. In the few places from which rock is being stoped they use heavy stull timbers, lag these upon the stope side of the drift and permit the broken rock to accumulate against the timber, to be taken as it may be wanted. It is the intention to secure a considerable tonnage of rock in this way to be drawn upon as soon as the milling facilities are equal to caring for it.

No. 2 shaft is 1,050 feet south of No. 1. It follows the lode, is three-compartment, two skipways and a man and pipe way, is 22’x7', is finely timbered and is to a depth of 240 feet. The lodes in No. 2 is better than at No. 1 at similar depth. There is a temporary shaft house over the shaft. No. 3 shaft is located 1,100 feet south of No. 1 and is in the lode, showing copper. Nothing is being done at this point. The shaft was sunk simply to locate the lode. Copper is showing in the bottom.

In the 7th level at No. 1, when they were cutting a sump in the footwall to take up the water, they encountered rich lode 14 feet back of the lode proper, it being separated from the main vein by trap. They ran a crosscut back of the shaft and found this copper-bearing ground to be 10 feet thick. They will crosscut at the 9th level at right angles to the formation in the hope of finding a continuation of the new lode struck upon the 7th. It suggests to the management that it will pay to put in an occasional crosscut in the foot. Large bodies of rich ground have been similarly found in the Franklin and Quincy as well as in the Osceola.

Just what percentage of copper the rock of the Franklin will yield can only be told by putting it through the mill. The property possesses an immense amount of lode. Upon its length it has 7,280 feet of Pewabic lode. At No. 1 shaft, upon the dip of 48° they can follow the vein 3,000 feet. Ahead of No. 2 shaft the lode can be followed downward upon the lands of the company 6,000 feet, and ahead of No. 3 7,500 feet can be sunk before they cross the property line to the north and west.

There is also a chance to profitably mine the Allouez conglomerate. Mr. Pope will give this some attention in the future. This and the Osceola amygdaloid are favorable points for future prospecting.

Besides the immense amount of shaft sinking and drifting at the Pewabic and other lodes upon the property there has been much accomplished in the way of surface equipment. At No. 1 there is a shaft and rock house 35’x45' and 65 feet high. It is frame, sheathed with corrugated iron as are all new buildings upon the location. Upon the upper floor there is a Hodge rock breaker weighing twenty-four tons with 18"x24" opening. The crushed rock from this goes to two smaller breakers, 9”x15" openings, located upon the floor below. The rock from the large breaker does not run direct to the smaller ones, but goes to a large, flat table in front of the smaller crushers and is fed from that point to the smaller breakers by hand, one man attending to both. The object of this is to keep small masses of copper from

finding their way into the smaller crushers. There was a pile of small mass in the rock house at the time of my visit. There is a trestle now being constructed from the upper portion of the rock house over which poor rock will be sent. Mr. Pope is planning a conveyor that will swing from a cable for the handling of waste rock, delivering it at a point several hundred feet from the shaft. The shaft and rock house is a substantial structure, there being but little vibration under the action of the crushers and skip.

The boiler house is located midway between the two main shafts, and well back on the foot. The different buildings have been so located that in case of fire no more than one would be in danger. Mr. Pope has had more than his share of fires at the old mine and this has made him particularly cautious in the building of the new plant. There are four large boilers in place, three of which are used and one held in reserve. The steam is sent through the main into the top of the building, when the main is brought down to the floor, this insuring dry steam. The steam is conveyed through a tunnel to the engine houses, the exhaust being returned in another main in the same tunnel and carried to the different mine buildings for heating purposes, and also heats the water that feeds the boilers. The cold water is brought into a cylinder in which are fifty steam heated pipes, and it goes thence to the boilers very hot. The boiler house has room for two additional boilers. There is a large fire pump here, and everywhere precaution for the extinguishing of fire is taken.

At No. 1 engine house there is a 10 foot drum, rebuilt under direction of Mr. Pope and master mechanic Henry Keys. It is of the old friction gear pattern, but it works to perfection, starting its load smoothly and easily, as I can attest, having ridden through the shaft upon the skip bail. There is an extra hand brake which can be applied in case of accident to the machinery, and one man is to take care of the whole plant. There is a first-class Corliss engine 48”x50”. In this building there is an Ingersoll-Sargeant compressor with a capacity for operating eighteen rock drills and a Norwalk compressor having a 12-drill capacity, both being in excellent condition. There is a well-equipped machine shop and blacksmith shop and a carpenter shop that is a neat one. In the upper story of the latter is storage room for the supplies of this department. The blacksmith shop and machine shop are stone buildings which were constructed some years ago.

Located upon one of the old dump piles of the conglomerate lode is a water tank containing 24,000 gallons that gives a pressure to protect all buildings with the exception of the upper portion of the big rock house are No. 1. The railroad track arrangment is simple and perfect. Cars can be switched back by gravity from the main track to the siding leading to the rock house, and upon the opposite side they can be run upon the coal trestle. A new coal dock has been constructed. The tracks were finished and the first rock sent to the mill the last week in October.

All the old dwelling houses of the company have been practically rebuilt, and are now in excellent shape. Captain Nicholas Clymo, gives excellent attention to his duties, and besides his work here also looks after the Tecumseh.

Now that the future of the Junior appears to be assured, the Franklin company has pressing need for a new stamp mill. At the Junior there are two heads of stamps of the Ball type, but they are worthless in their present location, as there is lack of sufficient water to supply such a mill as it is hoped the Junior can keep busy. The old mill building will be torn down the coming spring. Upon the south shore of Portage Lake, and in front of the old mine, the company's mill is still in operation and is the only one now upon the lake, all others having been ordered closed by the United States government because the stamp sand was interfering with navigation. Fortunately, there is a little bay here that is outside of the pathway of vessels and this has been receiving Franklin sand for many years. The rock comes from the mine 580 feet above the mill, by gravity, the arrangement being a neat one, the cars working in balance, the loaded one pulling the empty one up. The mill has been in constant operation for thirty-seven years. It has three heads, under which 14-ton anvil blocks have been placed during the past few years, so that the foundations are as good as they can be made with general conditions here. The mill treats about 450 tons of rock in twenty-four hours. The stamp sand is now being handled by a Prescott sand pump having an 8-inch suction and 10-inch discharge. It is centrifugal, the blades throwing the water to the center of pump. Blades are cast steel and linings are of chilled iron. Blades and bushing last about five months. The cost of handling the sand by the pump is fully 25% cheaper than by the sand wheel plan formerly used. The stream is also given a force that assists in delivering it into the lake where wanted. The company has done well in the keeping of the mill in such good shape, but they are handicapped by the lack of modern conveniences. During the year a new boiler, 140-horse power, was added, and a new iron stack takes the place of the two old ones. What is needed is a new mill where the sand can be gotten rid of without the cost of the present one, and where the plant can be of the best from top to bottom. A great saving could be effected over the present cost of treating the rock, enough to pay a fair interest upon the cost of the improved mill. The present mill will be inadequate to care for the rock from the mines of the company. A new mill is a necessity, and should be had at the earliest possible moment. Numerous mill sites have been offered to the company, and Mr. Pope has visited and inspected them all, but none have yet been accepted. One may have been decided upon but it has not been made public as yet.

The old mine continues to send out rock that gives a fair profit even with the mill disadvantages. Its longevity has been the subject for no little discussion and comment. Graham Pope, Houghton, is general manager; Arno

Jaehnig, clerk; Thos. H. Perkins, Boston, is president; D. L. Demmon, secretary and treasurer.

The annual meeting of the company is to be held in Boston upon the 20th of April, '98. It is expected at this time that steps may be taken for the construction of a new mill. There is talk that the company will sell the old mine to the Quincy company to whom it would be valuable by reason of its shafts which extend to Quincy territory. The Franklin is now employing 419 men in its mines and mill. Of this number 252 are engaged at the old mine and 167 at the Franklin Junior.

A little more than a mile east of the Pewabic lode upon which the Quincy and Franklin mines are operated is the northeastern extension of the Isle Royale lode upon which the Isle Royale Consolidated is working. At least it is generally credited with being the same. It has the same characteristics, epidote upon the foot wall in which the heavy copper is found, and the amygdaloid is of the same color and makeup. Upon the strike of this for a length of two miles, N. F. Leopold of Chicago has secured for Lewissohn Bros., and other capitalists of Boston, possession of the lands containing the lode and has commenced the work of exploring and developing them. The first given attention was

THE ARCADIAN

which is located upon the northwest quarter of section 20, Town 55, Range 33, a mile south of the Franklin Junior mine. This property was first opened in 1864, the original shaft having been sunk by Capt. E. S. Roberts, now of the Dober mine, Iron River, Mich. It showed considerable cepper in the upper portion, the lode being exceedingly rich, so Mr. Roberts informs me. There are many fine pieces of copper now to be seen in the old rock piles as the tributers who worked the property after it was deserted by those who sunk its shafts took nothing that did not give 3%, or better.

The present operators did their first work here September 30th, 1897. The old shaft, at which the shaft house was erected and was the principal station of the old company, was unwatered, and since then they have been sinking and drifting. There had been two levels opened, the bottom of the mine being 136 feet from surface. From the second level the present operators have enlarged the shaft from the single skip way to 27 feet wide, to give room for four compartments; they have carried the shaft down 95 feet to the 3d level and are now sinking for the 4th. From the 2d to the 3d level they have not been in the lode, the latter having been thrown back into the foot by a crossing which cuts through the mine at this point, carrying the lode back of the original line of the shaft which had an inclination of 51° conforming to the dip of the lode near surface. The shaft has been changed to an angle of 69° in the hope that it will catch the lode with greater depth, but thus far has not penetrated it. Under the 2d level a crosscut was put into the foot from the shaft which found the lode in about 20 feet, but further tests of the intervening ground have not been made lower down. The crossing is trap with a foot or more of fluccan upon its upper surface, and has caused no little annoyance to the miners.

From the 1st level they have drifted north 150 feet. To the south at this station is an old drift extending for a distance of 600 feet. At the 2d level 405 feet of drifting has been done north of the shaft, and nothing has been done to the south. The old level is in upon that side for about 500 feet. At the 3d they have drifted north 75 feet and 125 feet south. In the work of opening some fine copper ground has been shown in the upper levels, but the faulting of the lode has prevented the development in the lowest. At this shaft there is the old shaft house still remaining, which is being used. They have a 6½-foot hoisting drum, compressor, with the necessary engines and boilers. There is a scarcity of water, an old boiler being used as a reservoir. During the winter water was drawn upon a sled to supply the mine. There is an old shaft the mouth of which is filled up, a short distance south of the one being sunk, but is not being given attention. Several of the old dwellings have been repaired and placed in condition for occupancy, and this work is still going on,

THE CONCORD.

This property is immediately southwest of the Arcadian, comprising the southeast quarter of Section 19. It was given attention in the sixties, has the same lode as the Arcadian, and upon it two shafts were sunk to a depth of 480 feet. The unwatering of the mine was commenced in the latter part of March, 1898, and since then they have started upon the task of cutting away the mouth of the second shaft which is to be the principal one and will be enlarged to four-compartments, similar in size to the one at the Arcadian. During the time this property was first opened there was but little work done underground, and the lode where exposed was not so rich as at the Arcadian. It is the intention to sink the shaft as rapidly as possible, and to learn the value of the lode at greater depth than before attained.

THE EDWARDS

lies immediately north of the Arcadian, embracing the south half of Section 17. There are two old shafts 210 feet apart. Their depths are unknown, but they are shallow. They unwatered them to the 1st level since which the present management has done nothing. The original opening was made here beginning in 1864. The property was bought in April, '98, for $5,000, and there is $9,000 back taxes due upon it. The lode gave excellent results in heavy copper. There will be a widening and sinking of one of the shafts, it being the intention to have three or four big shafts upon the line of the lode embraced in the several properties. There is plenty of territory, and the prospect for success is considered favorable by those who are conducting the task of developing the vein in this section.

At the present time, April, '98, there are eighty men employed. J. M. Wilcox is mining superintendent; J. M. Hoar, clerk; Fred Hall, master mechanic.

MINES OF CALUMET.

At this portion of the copper district the greatest activity is shown, and it has been the possessor of the largest mines for many years. There is a population estimated at between 25,000 and 30,000 people in the villages surrounding the mines, and this is being steadily added to. Foremost in the list of producers is

THE CALUMET & HECLA MINING CO.

History records no greater triumph in the line of mining than that achieved at the Calumet & Hecla. Many of my readers well remember the time when the shares of this company numbered 40,000 and were selling at from $3 to $6 each. Since then the number has increased to 100,000 and during the month of January, 1898, sold at $535.00 each, representing a value for the property of $53,500,000. It has paid in dividends the gigantic sum of $52,850,000; paid $4,000,000 in 1897, and $1,000,000 on April 1, '98. There are many residents of the state who are interested in its shares and who profit by their holdings. One owner of 800 shares is a modest drayman of Calumet who works early and late at his chosen vocation seemingly undisturbed by the fact that his dividends amount to $32,000 annnally and that his stock has a market value of $420,000. The mine has produced about 1,179,000,000 pounds of refined copper. In its fiscal year ending May 1, '97, it made 86,809,266 pounds of refined copper and for the calendar year of 1897 its product of ingot copper was 83,248,054 pounds. It smelted during the year 88,378,986 pounds. The product for the past six years ending with May 1, is as follows:

Year	Pounds.
1892	56,495,211
1893	60,427,913
1894	73,944,889
1895	79,485,509
1896	85,552,756
1897	86,809,266

All of this copper has come from the famous Calumet conglomerate, the company, up to within the past year, having confined its energies solely to the development of this great lode. Upon the latter there are twelve inclined shafts following the dip of the vein at an angle of between 38° and 37° to the northwest, and one vertical shaft. Of the inclined ones No. 5 is at the north end of the line. It is two-compartment, and reaches the 52d level. No sinking was done here for the past two years.

No. 4 the deepest of the inclined shafts, is to the 57th level, two levels having been added since my last report.

No. 2, next to the line going south, is a two-compartment shaft, and is to the 49th level, three levels having been added since the spring of 1897.

Next are the shafts of the Hecla branch. In going from north to south the mine is known under different local names these being the "Calumet," "Hecla" and "South Hecla." No. 2 Hecla is a single skip shaft and reaches the 42d level, the same depth as reported last year.

No. 3 Hecla is a single-compartment and to the 39th level. No extensions have been made here for the past two years.

No 4 Hecla is only to the 9th level. It was not extended during the past year.

No. 6 Hecla, next in order, is to the 46th level, two levels having been opened during the year. It is a single skip shaft.

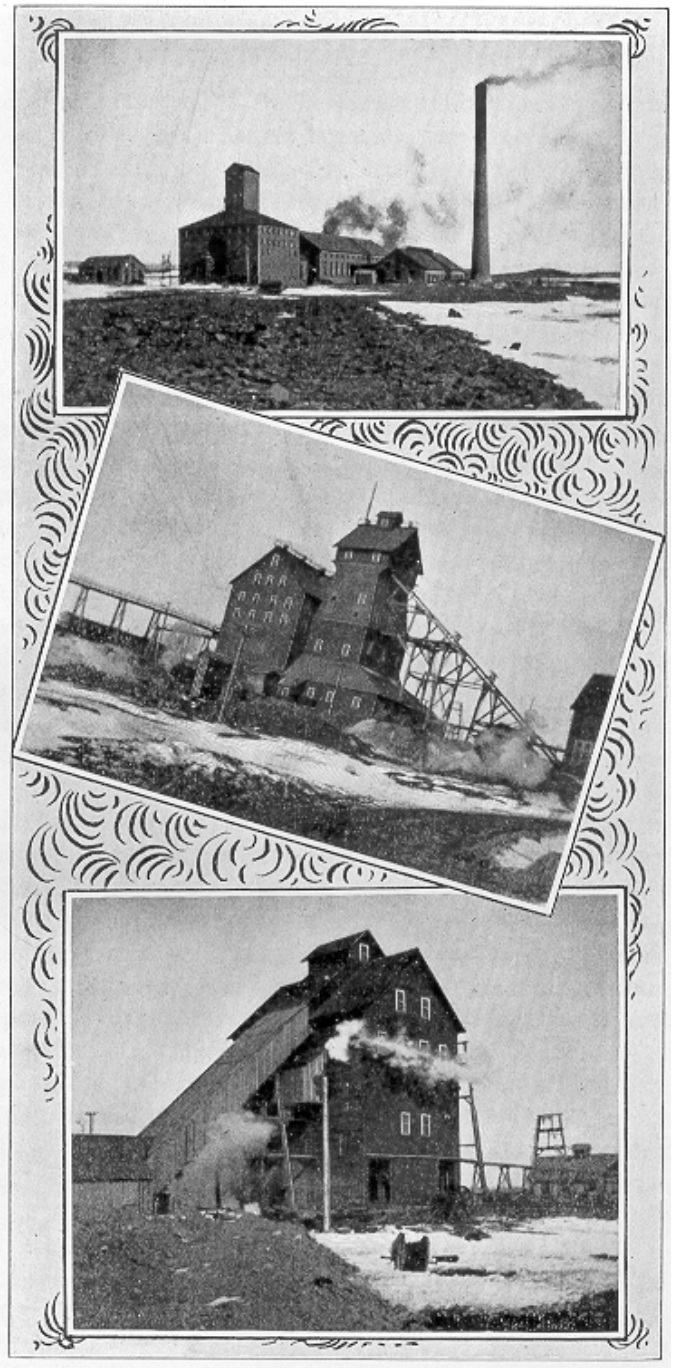
No. 7 Hecla, a single skip-road shaft, is to the 45th level, having been sunk one level since my last report.

Nos. 9 and 10, really one shaft, are to the 42d level, having been extended one level since my last report of the mine.

No. 12, South Hecla, is to the 43d level, three levels having been added since my report of last year. The shaft has one skip-road.

These three branches are under different mining captains, Thos. Hoatson, Jr. being at the Calumet; Thos. Wells at the Hecla, and Wm. Stephens at the South Hecla; all being under Jas. W. Milligan, chief mining captain.

The mining of the conglomerate at these shafts has been going on uninterruptedly for many years, and numerous levels have been opened ahead of those where the principal stoping is done and product of rock secured. Excellent ground is being generally met with in all the lower portion of the mine, the barren stretches in the upper portion of the lode and about centrally located upon the strike of the mine having changed to productive ground at greater depth, this being particularly true of the southern end of the mine. The conglomerate is wonderfully rich, the average being excellent. If one figures the cost at 7 cents per pound, and the selling price at 12, it will be seen that the earning capacity of the company is something like $4,300,000 per year, and the present time will find them doing better than this. There has been no change in the method of winning the rock, it being as I have described in former reports. There is still an immense amount of timber being used for the support of the hanging, which needs constant attention. Of the square timber employed there is used about thirteen millions feet annually, the sizes being 12"x12", 14"x14", and 6"x12". Of the heavy stull timbers used in the upper portion of the levels, about twelve millions feet are annually consumed. The shaft house at No. 9 was destroyed by fire and has been replaced with one of steel.



RED JACKET SHAFT, CALUMET AND HECLA.
NO. 2 SHAFT, TAMARACK.
NO. 4 SHAFT, WOLVERINE.

The vertical shaft that taps the Calumet conglomerate upon the property of the Calumet & Hecla, has been talked of by nearly every newspaper and magazine in the country. It is the deepest shaft in the world, 4,900 feet from surface, is 12½'x25' inside timbers, and is six-compartment. Covering it is a fine steel shaft house, and the equipment of machiney, described in former reports, is the finest to be found anywhere. The mine buildings are of brownstone, solid and substantial. Over ten miles of Georgia pine stringers to guide the cages were needed in the shaft. The shaft pierces the Calumet conglomerate at a depth of 3,287 feet from the collar of shaft.

They are now engaged in the task of connecting the shaft with the lode and No. 4 shaft. The 60th level crosscut is now nearly holed, while the 57th is already in. The plan is to connect every third level and afterward connect the intermediate ones. As the lode is reached in the crosscuts they will open out for a short distance north and south.

At the lowest level in the mine, the 81st, they started a crosscut for the lode to the west, put it in about 200 feet and discontinued it. A crosscut of similar length was also started from the 78th level. The distance to the line is something like 2,250 feet. The shaft is 100 feet below the 81st level, it being used as a sump under the level.

There is a little rock coming from the shaft in crosscuts, but it is not the purpose to have this an active producer for some time to come. The connections are being made for ventilation and to afford an outlet for escape for the miners in case of accident in the incline shafts. It may be that connections will be made at all of the levels before the shaft will be used to its fullest capacity. With its many compartments, and with connections with the lode at the many levels it could bring a great amount of rock to surface. The load figured upon is ten tons and the speed will be about sixty feet per second.

The work of developing the Osceola amygdaloid, to which I referred in my last report, is still being pushed at three shafts. No. 13 is 270 feet north of the Osceola boundary line. It is to the 3d level, 350 feet from surface. It has been full of heavy copper and stamp rock, one of the best shafts in its showing of copper ever sunk upon the Osceola lode. No drifting has been done at the levels, the latter having simply been opened 75 feet each side of the shaft so they can be readily extended.

No. 14, is 2,800 feet north of No. 13, and is to the same depth as 13. It is not as rich in copper, being in poor ground for the most of the distance sunk. No. 15, 2,350 feet north of No. 14, is also in poor ground, and is to the 3d level. From the 9th and 14th levels of the South Hecla, crosscuts have been run to the amygdaloid and drifting is going on.

Enough has not yet been done to determine the value of the lode, but considerable copper has been shown in several places, the richest being at No. 13 shaft.

These shafts in the amygdaloid may serve a useful purpose in the mining of the Calumet conglomerate lode at some time in the future. At each of the shafts in the conglomerate there is a pillar of rock left to protect the shaft that has a length of 150 feet. It is plain to be seen that there will be a great deal of rock left in these pillars when the western boundary of the company's line has been reached. Crosscuts could be run from these amygdaloid shafts to the conglomerate and the shaft pillars upon the latter lode taken readily. The distance between the lodes is about 750 feet. The shafts in this ground would be free from caving hanging. If the

Osceola amygdaloid proves productive where it crosses Calumet & Hecla territory its shafts will surely serve a double purpose. Temporary hoisting plants have been placed at the shafts sinking upon the amygdaloid, and shaft houses of temporary kind have also been erected. Capt. Jas. Hoatson looks after affairs underground at this portion of the mine.

No new machinery has been added during the year aside from the hoists at the Osceola lode shafts. The company is now well equipped at all portions of its immense property for doing work rapidly and economically. It has expended enormous sums to this end, and has looked well into the future in so doing. They are prepared for great depths and for increased output. The machinery is the best money and brains can produce. Its local care is in the hands of Jas. Ramsey, master mechanic.

While the Calumet & Hecla yearly removes an immense amount of the great copper belt, the latter has a length upon their lands of two miles, and upon the dip for the southern mile they can follow as far as men can work. Just what the heat will be at a depth of 10,000 feet is not known. At 4,900 feet in the Red Jacket shaft the mercury shows 87.6° Farenheit.

The company stamp mills are located at Lake Linden, upon Torch Lake. There are two immense frame buildings sheathed with iron. Each building contains eleven Leavitt heads, the combined capacity being more than sufficient to care for the rock sent from the mine. The superintendent of this department is F. G. Coggin. The company owns its own railroad connecting mine and mill, has an excellent equipment of rolling stock, and handles its material cheaply.

It has smelters at Lake Linden and also at Buffalo, N. Y. At its Lake Linden plant it has furnaces of the standard type and a fine lot of buildings. James B. Cooper is superintendent of this department. It has recently started up several furnaces here that have been idle for some years. This is to meet sales that have been made for delivery as soon as lake navigation opens. For the year 1897 there were produced here 31,867,192 pounds of refined copper, and at the Buffalo works 56,511,794 pounds were produced.

At Torch Lake a 100,000-ton iron coal dock was completed last July, which is a great convenience to the company.

No mining company in the world treats its employes better than Calumet & Hecla. It has just completed a large library building which will be provided with a fine collection of books, many new ones having been added to the old list, which is free to the employes. There are baths in the building and many comforts the workingmen enjoy. There has been, for the past two years, free medical service to all the workingmen of the company. There is a fine hospital, an excellent staff of physicians, and the sick and injured receive the best of care. There have been no club dues collected for the past two years. There are now employed in the mines, mills and railroad of the company about 3,800 men. The miners work upon the contract plan, being paid so much per lineal foot for sinking and drifting and so much per cubic fathom for breaking. The trammers have what they call contracts, but in reality it is a monthly wage, they receiving so much per month. The miners make excellent wages, the average being above other mines in the state.

The rock houses show no changes. There has been an extension made to the skips permitting them to carry the former load without danger of the rock falling from their mouths. It is not now necessary to fill them to the top in order to take the required load.

One could write a book of the workings of the Calumet & Hecla. Its many miles of underground openings; its interesting geology, and its machinery would take a hundred pages to properly describe. It is the exception to all other mines, and thus far, with its neighbor the Tamarack, it has held all of the conglomerate that has paid a profit to the miners of this copper-bearing belt. It is wonderful, but true. Time may bring additions, but thus far they have failed to appear although hundreds of thousands of dollars have been expended in trying to secure them.

At the last annual meeting of the company its officers reported a surplus of cash on hand of $5,889,211.59, to which there has been a substantial increase since then. Its treasury is in healthy condition as is its mine. Its past has been one of great successes, and its future will be in no wise dimmed for very many years to come.

The local officers are: S. B. Whiting, general manager; S. D. Warriner, superintendent; John Duncan, assistant superintendent; Preston C. F. West, mining engineer; J. H. Lathrop, chief clerk; J. N. Cox, cashier. The general offices are in Boston. Alexander Agassiz, president; Geo. A. Flagg, treasurer.

THE TAMARACK MINE.

The Tamarack Mining company secures its copper from the same lode as the Calumet & Hecla, but it has much more to do in the way of preparing for mining than its big neighbor. The latter, in all but one of its openings, has started upon the lode where it outcropped upon surface, and followed downward upon it with its shafts. The Tamarack had to begin operations where Calumet & Hecla is to leave off. Its property is immediately west and north of the Calumet & Hecla's and it was forced to sink deep vertical shafts in order to penetrate the copper-bearing conglomerate in its downward dip of 38°. No. 3 shaft reached the lode at a vertical depth of 4,185 feet, No. 4 found it at 4.393 feet. The first shaft sunk, No. 1, was further north than Nos. 3 and 4, and struck the conglomerate sought at a depth from surface of 2,270 feet. This object was accomplished June 20, 1885, after three and a half years of sinking. It was a wonderful task, a work requiring much faith as well as money and skill. Since the original tapping of the lode by the Tamarack company three additional shafts have

been sunk and a fourth is sinking. Since the conglomerate was reached upon the date above stated the Tamarack has paid to its shareholders $5,190,000, $360,000 being distributed in 1897. During the past few years the rock has not been up to its former average in the percentage of copper held, but now there is a marked improvement in this respect that will be valuable to the company.

There has been a change in former method of mining by which selection of rock is not as easy as formerly, but it will prove better in the long run. The plan is now to extend the drifts from shafts to the boundary of the company's lands at Nos. 1, 2 and 3 shafts and then the beat out the ground from the extreme ends of drifts back towards the shaft, letting the hanging follow down after the lode has been removed. This is being done to save the former high cost of timbering as well as to prevent accidents to miners. It is working finely, and will result advantageously to the company. Captain Parnall has the right idea for the mining of the lode, and has been gradually changing the work so as to permit of the rock being taken without the use of so much expensive support to the hanging as was formerly necessary. The hanging is generally treacherous and needs constant attention under the old method of protecting it. Much lighter timber is being used, and the plan is a success.

In the taking of the ground, however, the miners are not distributed over the former large areas, but are working upon several levels in the same run of ground, beating their way back towards the shaft from the boundaries of the property. In case a poor run of ground is met with it shows in several levels, generally, and until it is passed through it the rock shows poor results in the mill. Of course a rich chute of ground would give handsome results, and the average will be all right, although they have been unfortunate in the past two years to be in unsatisfactory territory. A change for the better is apparent in the lower levels at all of the shafts, however, and better things are looked for.

There has been no sinking at No. 1 shaft for several years it having reached the Calumet & Hecla line in its descent. The Calumet owns territory upon all sides of the forty excepting the west. It is 2,240 feet deep.

No. 2 shaft 600 feet north of No. 1, is to the 25th level. It was sunk 149 feet since my last report. The lower seven levels have been opened up north and south of the shaft, but there has been but little stoping done. There is an excellent territory ahead of this shaft, and the lode can be followed more than 10,000 feet upon Tamarack territory.

An important work has been commenced here in the sinking of an incline shaft located between Nos. 1 and 2. East of the Calumet conglomerate about 100 feet is a belt of amygdaloid having a thickness of 100 feet. It follows down under the conglomerate regularly, having the same dip, and Captain Parnall has decided to sink a three-compartment shaft in it. Crosscuts have been driven to it from the 17th, 18th, 20th and 21st levels of the conglomerate belt. This amygdaloid is barren of copper, where-ever tested. The ground is firm, and the shaft will be a substantial one. It will be carried down under the conglomerate and connected at the different levels with the latter. The vertical shafts as they go down are farther away from the lode at each additional level necessitating very long crosscuts, about 1,500 feet at the present bottom of the mine in this territory. The dip of the lode is about 37°, and takes the latter from the vertical shaft rapidly. Levels are about 80 feet apart, vertically, and about 133 feet on the incline. The cost of driving the long crosscuts is a heavy one, the tramming distance is too great, and then it takes time to connect the shaft with the lode. By following down in the amygdaloid belt referred to, the crosscuts will be short, all of the same length, and all of the mineralized lode can be taken. In the opening of new levels at No. 2 the past year 2,317 feet of drifting was done.

No. 3 shaft, 4,200 feet north of No. 2, is steadily improving. It is now 4,526 feet deep and fourteen levels have been opened. This shaft is sunk upon the most eastern tier of forties of the twenty-nine the company owns. Next east is the Calumet & Hecla and the latter company has two forties immediately south, so that the shaft is in the corner made by these lines. To the south at the nth level it is about 1,300 feet to the Calumet line, but as the shaft deepens following the lode to the west, there will be a stretch of ground two miles long. The method of opening at No 3 agrees with that being followed at the lower levels of No. 2. They carry their main drift and a cut ting-out stope to the boundary of the property and then stope out the ground from the extreme ends of drifts to the shaft, letting the hanging come down after the rock holding copper has been taken. The lode in this portion of the mine is very wide, running from 20 to 25 feet. It is seldom all copper-bearing, and that which is not is left behind. It may be richest upon the hanging wall in one place and upon the footwall in another, or it may be barren upon each side and rich in the centre. There is no regularity as to the coppery and barren places. No. 3 is improving steadily and now furnishes a large portion of the daily output of rock from the mine. The equipment of hoisting machinery here has not been satisfactory in its operation. It has required many changes, and is not now what should be had for the work there is to perform. The amount of drifting done at No. 3 the past year was 3,816 feet. At this station a fine new compressor house of red sandstone has been built and will contain an air compressor capable of supplying 80 No. 3 drilling machines.

No. 4 shaft, 700 feet north of No. 3 is 4,450 feet deep. But little drifting has been done here the past year, it amounting to 337.5 feet. They are drifting to connect with the 12th level with No. 3, and sunk a winze from the bottom of the shaft that found four feet of coppery ground, the first met with here, and is taken as a favorable sign.

No. 5 shaft is the one that is sinking for the lode and was started the latter part of the year 1895. It is located

3,300 feet south of No. 4, is five-compartment, 27'5"x7'2". There will be four cage-ways and a ladder and pipe-way. The depth of this shaft, April 15, '98 is 2,300 feet. It was sunk 1,029 feet during 1897, which is excellent work when the size of the ground taken is considered. It is expected to strike the lode at a depth of 4,600 feet. There has been a fine building erected for the reception of the new machinery. There will be a hoisting plant installed here that will be new to the Lake Superior country. There will be four engines, one at each corner of the great frame. There will be set in an inclined position, cylinders being 32"x56" stroke. The drum will be tapered at ends running from 16 feet on a cone to the straight face of drum which is 25 feet diameter. Both ends of drum are tapered. The framework of this engine will weigh over 500 tons, exclusive of the drum. It is claimed for this four-cylinder type engine that it will start the load readily and smoothly, and give the highest efficiency. If it fails it will be at the risk of the manufacturers, the Nordberg company, Milwaukee, Wis. The drum will hold 6,000 feet of 1½-inch rope. The plant will be installed the coming summer, and will attract much attention from mining men.

No. 5 should be one of the greatest producers on the Tamarack line. In front of it, to the east, the Calumet & Hecla company has sunk its famous Red Jacket shaft which found the lode exceedingly rich. The conglomerate in this territory has been of the richest found upon the Calumet property, and has been continuous from surface in their No. 4 shaft. All signs are favorable for a very rich lode where No. 5 will pierce it. If this results they will have a shaft and a hoisting plant that will be able to care for the rock. It will add wonderfully to the productiveness of the mine. It is receiving the most careful attention from Captain Parnall, who, with many properties to direct, has a great responsibility resting upon him. It requires skill and capacity as well as a rugged constitution to shape and direct the work of these great mines. Tamarack has an excellent future. It has 1,160 acres of land through which this great copper-bearing conglomerate passes, and has as yet but fairly commenced the task of mining.

At the present writing Tamarack is producing about 2,000 tons of rock daily, or 50,000 tons per month from the North Tamarack. For the year 1897 it hoisted from all sources 726,665 tons, of which 611,539 tons were stamped. This gave 29,580,380 pounds of mineral, yielding 20,222,559 pounds of ingot copper. The gain for the past three years has been a considerable one, and is shown by the following figures:

Year	Pounds refined copper.
1895	14,900,316
1896	16,045,039
1897	20,222,559

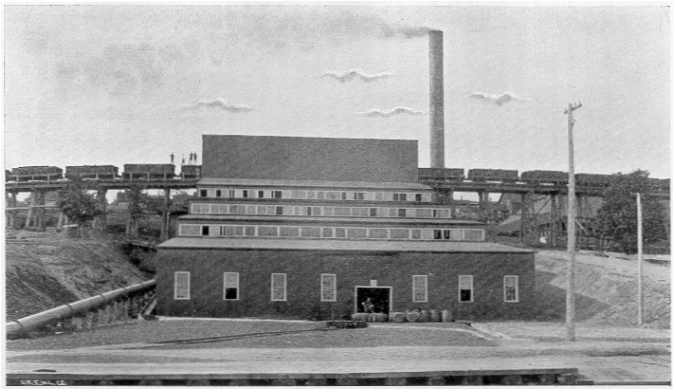
The total number of pounds of refined copper produced by the mine to the end of 1897 is 157,264, 520.

The new stamp mill of the company referred to in my last report, has worked smoothly. The company now has seven heads, all with solid foundations and 20-inch cylinders. The daily performance per head for the year, actual running time, was 332 95-100 tons per day. Chas H. Krause is superintendent, filling the place of John Grundy, who died during the year.

During the year fifty-three new dwellings were added to the number of houses for employes, either built by the company or by their men upon leased ground, the company having the option to purchase. A similar addition is advised by Captain Parnall the present year. The force employed at the mine and mill numbers about 1,600 men.

Total number feet of sinking and drifting	13,444.7
Tons of rock stamped	611,539.
Cost of stamping per ton, cents	26.413
Total cost per ton of rock mined	$1.74
Total cost per ton of rock stamped	$2.07
Pounds of mineral obtained for the year	29,580,380
Pounds of ingot copper obtained	20,222,559
Cost of construction at Nos. 3 and 4 shafts	$23,198.02
Sinking and construction at No. 5	$111,061.11
New stamp mill	45,351.28
Sundry construction	25,312.32
Receipts from the sale of copper and interest receipts were	$2,267,340.75
Total costs were	1,835,809.86
Net income for year	431,530.89
Dividends paid during the year	360,000.00
Surplus for year	71,530.89
Balance of assets Dec. 31, '97	854,835.56

At the mine W. E. Parnall is superintendent; John T. Reeder, chief clerk; R. M. Edwards, mining engineer; Thos. Maslin, head mining captain; Jas. H. Gribble, mining captain at No. 5. The main offices are in Boston; A. S. Bigelow president; W. J. Ladd, secretary and treasurer.



NEW STAMP MILL, TAMARACK MINING CO.

THE OSCEOLA CONSOLIDATED MINING CO.

This is one of the most active of the Lake Superior copper producers, and one with an excetlent future. It embraces the Osceola, Kearsarge and Tamarack Junior mines, a consolidation of the three properties having been effected October 26, 1897. The stock of the consolidation is 100,000 shares of which there were paid 25,000 shares for the Kearsarge, and 16,000 shares for the Tamarack Junior. The Osceola is represented by 50,000 shares and there are 9,000 shares in the treasury which are not included in the balance of assets, which were $475,822.32 at the close of business Dec. 31, '97.

The consolidated company has a magnificent territory which was considerably added to during the past year. Previous to the consolidation the Kearsarge mine had purchased the Iroquois property lying immediately north of Kearsarge, a tract of land containing 560 acres, nearly all of which contains the Kearsarge lode and sixteen forties being crossed by the Osceola amygdaloid and Calumet conglomerate. Just south of the Wolverine mine an 160-acre tract was recently purchased by Osceola from the Canal company. It comprises the southwest quarter of Section 7, Town 46, Range 32, the Kearsarge lode cutting through the southeast corner giving excellent length upon the dip of the lode. The Consolidated has 2,000 acres available for mining purposes, profitable lodes passing through them, these being the Kearsarge and Osceola amygdaloids and the Calumet conglomerate. The several tracts of land have their greatest length upon the dip of the lode where mining can be prosecuted to a depth that would be interfered with atmospherically. No property in Michigan has more favorable conditions geographically with reference to the position of the copper-bearing belts.

With the improvements being made at the properties of the company it has been found that there is a lack of facitities for stamping the rock, which is to be remedied the present year by the building of a new stamp mill upon the shores of Torch Lake. There will be three heads to start with and more will be added as they may be needed. With this needed addition to the equipment, the company will be able to make a considerable increase in its annual output.

For the year 1897 the combined production of the mines of the Consolidated company amounted to 11,201,103 pounds of refined copper. This was 1,664,728 pounds in excess of the yield of the properties for the previous year, a substantial gain. The mines are now yielding about 600 tons of mineral per month, a decided increase over the performance of 1867, and this will be steadily added to as the properties are developed and equipped.

The amount of mineral smelted for the past year was 13,857,370 pounds; the amount of rock stamped, 443,086 tons. The net profit for the year was $262,401.08, from which was paid Osceola dividends amounting to $141,000; Kearsarge dividends, $40,000.00; and $62,611.25 for real estate, leaving a balance as surplus for the year of of $18,789.83.

THE OSCEOLA MINE.

There has been much work done at the Osceola mine since my last report. The new No. 6 shaft at this time, April, '98, is to the 33d level, and is about ready to send rock to the mill. The shaft is a fine one, three-compartment, and is located 1,750 feet north of the southern boundary of the property. It is 1,050 feet south of No. 5 shaft. It has been in excellent lode from surface, and indications are favorable that this will be as rich in copper as any portion of the Osceola amygdaloid yet worked. The machinery for the shaft is in place and is being moved slowly so as to get it smoothed up for active business. The hoist is a fine one, consisting of a pair of Nordberg engines of the horizontal type, 32”x72" and a drum tapering from 12'6" at the ends to 18'6" upon the straight portion. A fine new shaft and rock house is completed at this point. The mine buildings are of stone, and were described in my last report. They are now supplied with the necessary machinery, boilers, etc., and No. 6 will be an active station from this time.

No. 5 shaft is to the 36th level and was sunk 83 feet in 1897.

No. 4 shaft is to the 36th level, having been extended 194 feet in the past year.

The amount of extension of levels throughout the mine running from the 9th to 36th, amounted to 6,497 during the year. A crosscut that has been closely watched by the speculating public is one being driven west from the 3ist level south of No. 5 shaft. The objective point is the Calumet & Hecla conglomerate, the horizontal distance between the lodes at this point being 700 feet. The crosscut should be finished by the first of the coming June and is now in about 250 feet. The Calumet & Hecla company has found this conglomerate lode rich upon their lands immediately north of Osceola, and this lends the hope that it may be found to hold copper In paying quantity upon Osceola territory. In the upper levels near the north end of their property the Osceola did some work upon the conglomerate many years ago, but did not find it satisfactorily productive, and it was abandoned. At No. 5 there may be better lode and the crosscut is being put in hoping to find it. It would be remarkable if the conglomerate held nothing north and south of the boundaries of the lands of the Calumet & Hecla company. Thus far this has been true, but an exception is being sought at the Centennial upon the north and at the Osceola upon the south.

The Osceola is sure of its amygdaloid, however, and can follow this at its Osceola mine for over a mile upon its dip. They have a fine territory here, fourteen forties being crossed by the vein. Should the conglomerate prove profitable it would be a wonderful addition, as it follows down ahead of the amygdaloid, being about 700 feet to the west.

The shareholders will soon be receiving substantial interest for the money spent at the property the past two years. In 1896 there was expended at No. 6 shaft $63,000 and in 1897 $74,455.68 were spent in sinking the shaft and building engine, boiler and rock house. P. Richards gives closest attention to affairs underground. Wm. Veale is clerk. The mine force consists of 649 men,

THE KEARSARGE MINE.

This branch of the Osceola Consolidated Mining company has been worked in a very quiet way for several years. There was a lack of stamps to care for all the rock of the mines of the company and Kearsarge

was permitted to remain in the background. During this time it has not been idle, however, but has devoted considerable attention to underground development so that today it has a large territory blocked out and ready for stoping. During the past year the extensions of levels amounted to 2,573 feet. There is one shaft, No. 2, which is to the 21st level. The company is working upon the same lode as Wolverine mine and is immediately north of the latter. The workings of both properties are connected at several levels, which adds to the ventilation and safety of both, the Kearsarge in particular. It has been decided to sink another shaft to the north of the present one and upon the Iroquois territory lately acquired. This will be of much benefit to the company. Kearsarge has an eccentric lode in its holding of copper, but in this respect it differs little from other mines. Where copper is found it is generally very plentiful in the rock. A new compressor has been added to the mine equipment and with another shaft Kearsarge will be able to nearly double its present product. John Hosking is mining captain, Wm. M. Harris, clerk. There are 230 men employed.

THE TAMARACK JUNIOR.

This branch of the Osceola Consolidated Mining company finds its copper in the Calumet conglomerate. It possesses three forties these being in line running north and south with the lode dipping to the northwest. The Calumet & Hecla surrounds them upon all but the east side. Their territory is limited, but they have found some very rich ground this being in the southwestern portion of their property. There are two vertical shafts which tap the lode to a depth of 2,400 feet. No. 1 is about 1,200 feet from the southwestern corner of the property. It is to the loth level. To the north of the shaft a winze has been put down to the 11th and from this they have drifted to the north under the line of No. 2 shaft, about 1,000 feet north. No. 2 is sinking to connect. The copper chute seems to be flattening out as it goes to the north which lends the hope that No. 2 will find productive ground at greatet depth. No. 1 has found excellent lode in all its lower levels, and has recently found encoaragement behind the shaft above the 1st level. Rich rock has been struck, and they are looking for something good from this portion of the mine.

There have been no additions of machinery or buildings here the past year. They are well equipped for conducting the work, and the mine shows some improvement over a year ago, particularly to the north. There is considerable rich territory developed and the property will be an active producer for many years to come. The property has paid no dividends, and was expensive to open due to the deep shafts necessary to reach the lode. William Daniell is mining captain, Wm. M. Harris, clerk. The force of men given place numbers 90.

The stamp mill of the Osceola Consolidated received a thorough overhauling the past year. New sills have been laid, uprights re-footed and placed upon stone foundations, and they are bringing a tunnel from the lake to the pumps, cutting a channel 8'x8' feet in the sandstone. The cost of stamping for the year, including these improvements, was 25 574-1000 cents per ton.

The total number of men employed in the mines and mill of the company is 969. W. E. Parnall, Calumet, is superintendent. The main offices are in Boston, Mass. A. S. Bigelow is president, W. J. Ladd, secretary and treasurer,

THE TECUMSEH COPPER CO.

The Tecumseh is just south of the Osceola. It is an exploration and has been sinking upon the Osceola amygdaloid and Calumet conglomerate lodes, being down about 650 feet in its shafts. It has done considerable drifting but thus far has found nothing of value. It has the lodes, but there is little or no copper. Occasional small bunches of coppery ground are met with but nothing of marketable value has yet been found. The company possesses a narrow strip of territory upon the strike of the lode, about 1,400 feet at the widest, but no doubt could procure additional land if it is so fortunate as to find something of importance. Assessments of $80,000 have been called to conduct the explorations, and the latter having been under way for the past three years, a small force of men being worked.

Graham Pope, of Houghton, is general manager; John C. Watson, of Boston, is president; D. L. Dernmon, secretary and treasurer.

THE CENTENNIAL MINE.

Few properties have been more talked about during the past twelve months than the Centennial. Its history is not one of success, there having been expended nearly a million and a half dollars in trying to discover a place upon the Calumet conglomerate, which crosses its lands, where copper was plentiful enough in the rock to pay for the mining, milling and other costs. The company owns all of Section 12, Town 56, Range 33, and is immediately north of the Calumet & Hecla. Its location with reference to the Calumet is excellent, and its mile square of territory is traversed by all the prominent copper-bearing lodes of the district, these being well to the southeastern side of the section, giving them abundant room upon the dip of the belts.

In the work done before the present management took hold there was but one deep shaft sunk, No. 3. This was upon the conglomerate and reached a depth of about 3,100 feet. Its location was 4,500 feet north of Calumet's No. 5 shaft. The latter found copper at the 30th level. Midway between Calumet No. 4, and Centennial No. 3, but further west, the vertical shafts of Tamarack Junior found the conglomerate rich in copper. No. 3 Centennial should have been continued downward a few hundred feet. It might have caught the northern extension of the copper chute at Calumet's No. 5 shaft. North of Centennial No. 3 is No. 6 shaft, which has been

the one given attention by the present company. There are five other shallow shafts, none of which showed anything encouraging in the way of copper. The work of unwatering this shaft was commenced in the middle of January, '97. The shaft has since been carried down to the 7th level, and there has been 516 feet of opening up to April 1, '98. Bunches of copper have been exposed, but nothing has yet been found of sufficient size to provide rock to keep a mill in motion. Nos. 4 and 5 shafts show copper and will be opened up. Drifting from 5 to 4 will be continued.

The greatest attention has been given to the shafts upon the Osceola amygdaloid, to the east. No. 1 has been straightened from surface to the 4th level. It was badly out of line, and it was necessary to place it in better condition to pull the skip through it at the desired speed. They have opened up north and south of the shaft at the 3d level.

No 2 shaft has been sunk 130 feet to the 6th level, and is getting ready to begin sinking for the 7th. Drifts have been extended north and south of the shaft at the 4th, 5th and 6th levels. The total number of feet of opening at these shafts by the present company is 2,135. The lode is generally of good width, running from 6 to 12 feet, and copper has been frequently met with. A few small masses have been found, and there is encouragement to continue with the work of exploring.

The company intends sinking a shaft upon the Kearsarge amygdaloid the present year, and will begin the work in a few weeks. This lode is 2,000 feet east of the Osceola amygdaloid, and outcrops east of their east line. To reach it a vertical shaft for a depth of about 700 feet will be necessary. When the lode is encountered in this the shaft will be turned to follow the dip of the vein, 42° north. Drawings for the shaft are already completed. Captain Chynoweth has great faith in the Kearsarge amygdaloid. He believes it will be found rich in copper. Just east is the Wolverine and Kearsarge mine both showing a fine lode, and it would be strange if the latter should prove unproductive at this point. According to the developments at other mines the copper-bearing lodes are apt to be more continuous upon their dip than upon their strike.

The local management is an energetic one, and is going to do considerable work with the money raised for the development of the property. There are eleven drilling machines now at work, and 515 feet of opening was made during the month of March. The old stamp mill has been repaired, a trestle constructed connecting it with No. 1 shaft house, and a trestle has been built connecting Nos. 1 and 2 shaft houses. There is a new dry, and two six-room dwellings, and a new rock house at No. 1, all of which has been done in the past year.

The starting of the mill was premature, and they are now running it but one shift. Stamping was commenced the 1st of the December since which time they have produced 225 tons of mineral. Forty tons were produced in March.

When the present management took hold there was a balance of assets amounting to $72,012. In the much that was necessary to be done in the way of preparation this was largely used. As assessment of $3.00 per share was called, payable March 5, '98. This has been all paid in, giving $240,000 upon the 80,000 shares, and is being expended intelligently. Captain Chynoweth will certainly give the shareholders something in the way of exploration for their money, and will fill that particular section of country full of holes in trying to locate a profitable lode. No new machinery has been added since my last report, there being no need of it. A force of 210 men is now being employed.

James Chynoweth is superintendent; John Pentecost, mining captain; Chas. Chynoweth, clerk. The general office is in Boston. Harry F. Fay is president; Fred'k Beck, secretary and treasurer.

THE WOLVERINE MINE.

South of Kearsarge and east of Centennial is the Wolverine mine. It is a popular property with Lake people. Its management is a careful, conservative one, its affairs are well handled, and the growth of the property under those who now direct it has been steady and satisfactory. From $3.00 per share the value of the stock has risen to $23.00, and this within a few years, the increase being upon the production of the mine and not upon exaggerated ideas of the future.

The addition of No. 4 shaft at the southern end of the property has permitted a marked gain in the output of the mine, providing sufficient rock for a second head of stamps, which was secured from the Allouez company, whose old mill, four miles distant, is being used. This mill was started up in the middle of last December. Previous to that time the monthly product averaged about 104 tons of mineral. The fiscal year of the Wolverine Copper Mining company ends with the 30th of June. The product of mineral for their last fiscal year was 2,557,445 pounds. Since that time the monthly product has been as follows:

Month	Pounds.
July, 1897	214,000
August	212,700
September	214,800
October	212,900
November	212,000
December	303,345
January, 1898	427,700
February	419,050
March	426,900

These 2,643,395 pounds of mineral will give about 2,286,500 pounds of refined copper, and there will be added to this by the end of next June about 1,106,000 pounds, making a total for the fiscal year of about 3,392,500 pounds. This should give a profit to the company of about $116,000 providing copper keeps at its present price. There was a cash surplus at the beginning of the fiscal year amounting to $157,060.61, so that at the end of the present fiscal year there should be a surplus, less construction account, of about $273,000.00. For the new work done at No. 6 shaft, old Allouez mill and new railroad $4,545.50 were paid during

the last fiscal year, so that the account for the present one will amount to something like $40,000, leaving a surplus of about $233,000 at the end of next June. Should the present price of copper be maintained throughout the coming year, Wolverine's net earnings would be something like $187,000, over three dollars per share.

For the fiscal year ending June 30, '97, the cost of making a pound of copper was 8.27 cents exclusive of construction work. Since its No. 4 shaft and second head of stamps has been added, the cost should be considerably lessened. The number of men employed by the company is 315, whereas a year ago it was 175, an increase of 40. They are now operating 21 machines, an increase of only five over last year, and the product of copper is more than double what it was a year ago, so there must have been a substantial decrease in the cost of making a pound of refined copper when the construction work is deducted.

The Wolverine has confined its work wholly to the Kearsarge amygdaloid, and has opened upon the latter entirely across its property in the upper levels of the mine. It has an excellent lode, varying much in its content of copper, but giving a satisfactory average. Much of the product is small mass that is cleaned by steam hammer at the rock house and does not go to the stamps. The mineral gives about 86.500% ingot, the dressing being admirably done. There are four shafts, three of which are the principal ones. Of these No. 4, the latest, is near the southern boundary of the property. It is to the 8th level and is sinking for the 9th. Connections have been made with No. 3 shaft, 1,385 feet north, at the 1st, 2d, 4th, 5th, 6th, 7th and 8th levels. To the south the drifts have been extended from the 2d to and including the 7th. Work is now going on at the 8th, 7th, 6th and 3d levels north, and at the 6th, 5th and 4th south of No. 4.

At No. 3 they have reached the 13th level, and are stoping at the loth, 8th and 5th levels south, and at the 12th level north of the shaft.

No. 2 is to the 14th level. They are doing a little work to the north of shaft upon the 13th level.

The richest ground being met with is the territory between Nos. 3 and 4 shafts. The rock from No. 4 goes to the Allouez mill and that from No. 3 to either Allouez or the old mill, so that they divide the rich ground between the two mills. If the lode happens to be poor where they are working at No. 4, they "sweeten" the output with rock that could be sent to No. 3. In this way they secure about an equal amount of copper from each mill.

No. 4 is now in excellent shape for doing economical work. The mine buildings are completed and contain the mine machinery, which is all in operation. The buildings are of stone. The boiler house is 42'x38', the compressor house 46'x30'. The rock and shaft house is 50'x40' feet, and the body of building is 48 feet high. It is a remarkably solid structure, and is little affected by the vibration of the crushers. The compressor is a Rand, one of latest type, and guaranteed to provide air for 25 drills. They can run 30 with it. The hoist is a Bullock, 12-foot drum, Corliss engines, 24"x48". The boilers are Stirling, two in number, each 200 horse-power. Ten and a half pounds of water were evaporated with one pound of coal is a careful test recently made.

There are four miles of railway track leading from No. 4 to the old Allouez mill. The old mill building has been put in excellent shape, and was sadly in need of repair. An entire new floor was laid, the uprights refooted, a new trestle constructed, likewise a new dam, and much was done to bring the old plant to a condition of usefulness. Indeed, it was nearly as costly as a new one.

A contemplated improvement is a new hoist for No. 3 shaft. The old one is not sufficiently powerful to take the rock from greater depths than now attained in the shaft, and it is too slow. It is probable that a change will be made here the present year.

The rock for the past year yielded considerably better than it did for several years previous, it gives 20.66 pounds of refined copper per ton of rock hoisted, and 27.2 pounds for every ton of rock stamped. Of the total amount of rock hoisted, 108,320 tons, 24.05% was discarded as poor.

The product of the mine for the past six years is as follows:

Year.	Pounds.
1891-2	500,074
1892-3	218,855
1893-4	1,611,857
1894-5	1,744,079
1895-6	2,011,638
1896-7	2,237,698

The mining profit for the last fiscal year was $67,156.54. The cost of sinking was $13.81 per foot; of drifting $6.19; of stoping, per fathom, $8.28; cost per ton of rock hoisted, $1.45; cost per ton of rock stamped, $1.91, cost per pound of refined copper including New York office expenses, 8.27 cents; yield of rock treated, 1.36%.

The amount of sinking for the year was 595.9 feet; of drifting, 4,488.9 feet; the amount of stoping, 5,780 fathoms.

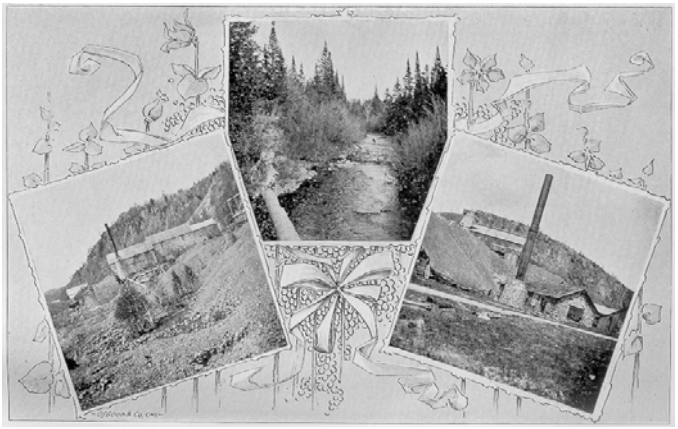
The principal offices of the company are in New York city, John Stanton, president; J. R. Stanton, secretary and treasurer. At the mine, Fred Smith is agent; John Nicholas, mining captain; C. L. Noetzel, clerk.

THE ALLOUEZ MINING CO.

owns several thousand acres of land, and its mine is directly north of Kearsarge, upon Section 31. It has not been worked since 1892. The belt given attention was the Allouez conglomerate, a very hard lode, and unprofitable. The directors do not believe it would pay to re-open the mine, but hope some of their lands may hold paying copper lodes. At the beginning of 1898 there was a surplus in the treasury of $3,694.73. There are 80,000 shares. William C. Stuart, New York, is

president; John Stanton, treasurer. Fred Smith, at the mine, is superintendent.

In the way of exploration but little has been done in this portion of Houghton county the past year. There was some testpitting on the Fulton property, a half mile northeast of Kearsarge, but nothing of importance discovered. A resumption of work here will probably take place the coming summer.



SCENES IN KEWEENAW COUNTY.

IN KEWEENAW COUNTY.

North and west from the mines of Calumet are the mines of Keweenaw county. In years agone this was one of the liveliest portions of the copper district. Today the decaying mine buildings and residence dwellings alone mark the sites of former activity. This portion of the copper-bearing district is one of the most picturesque to be found in our state. It is rich in scenery and regret is felt that the busy mines of other days are not now in motion, giving employment to the hardy miner and providing comfortable homes for his children. The most attractive in history of this line of old properties are the Cliff and Phoenix, long idle, and with no talk heard of their resumption. The first active mine met with and until recently the only one in operation in the county for many years is

THE CENTRAL.

located upon Section 23, Town 58, Range 31. The property has paid in dividends $1,970,000, but none of this has been earned in the past ten years. At the 30th level the formation has been faulted, and below this point nothing has yet been found, the copper-bearing fissure not having been located. The work which has been done the past three years has been south of No. 2 shaft from the 10th to the 22d levels. In this direction the company has two miles of practically unexplored territory. At the loth level the drift is south of the shaft 165 feet; at the 16th, 553 feet; at the 16th, 426 feet; the 19th, 652 feet; the 20th, 804 feet; the 21st, 1,249 feet. The 21st is further south than any drift at this shaft, and at the present time three feet of the vein in the end of the drift shows profitable stamp rock. A fire in the 20th level occurred in November, and closed the mine for about three weeks. It not only stopped production but necessitated considerable work in re-opening the drift. Stoping has been done upward from the 21st, 20th and 19th levels, and from winze below 21st level. The amount of ground broken was 1,324 cubic fathoms of which fully a third was from drifts and was barren.

The product of copper secured during the year was 614,891 pounds, which was sold for $69,112.44. Interest amounting to $389.43 was received. The working expenses, freight and other charges amounted to $88,573.57, leaving a deficit for the year's business amounting to $19,461.13. The balance of assets January 1, '97 was $50,259.02, so that the company had cash surplus on hand January 1, '98, $30,797.89. A force of about 100 men is employed.

While the year's business was conducted at a loss, the showing underground has improved and it hoped a better record can be made during the present year. The company is anxious to find profitable lode, and has shown much enterprise in keeping the property active when there has been little encouragement for so doing. An incentive to operation is found in the fact that there is a community supported by the mine and who have lived here a lifetime; who have comfortable homes and who would greatly regret having to leave them.

The main office is in New York. John Stanton is secretary and treasurer; F. McM. Stanton, of Atlantic Mine, Mich., is agent. At the mine John F. Robert is clerk; John Trevarrow is mining captain.

THE ARNOLD MINE.

The Arnold is located upon Section 15, Town 58, Range 31, being about a mile northwest of the Central. It was first opened in 1864. Since my last report it was consolidated with the Copper Falls Mining company owning over 2,000 acres of land a mile east of Arnold. The number of shares is 60,000 and there has been raised an assessment of $120,000, this being $3 per share upon the original number of shares, 40,000. Preparations are now under way for a thorough equipping of the property. A railroad three miles in length will be constructed between the old Copper Falls mine and Arnold. The rock from the Arnold will be sent to the Copper Falls mill where there are two modern heads of stamps and two of the old-fashioned Ball type. Solid heads will be placed under the stamps. A 25-drill Rand compressor similar to the one recently installed at Wolverine has been ordered. There will be a rock house built, a duplicate of Wolverine's. A 12-foot hoist, new boilders, and complete equipment has already been provided for. The dwellings at the old Copper Falls will be fitted up for the employes.

At the mine No. 1 shaft is now nearly to the 8th level, 800 feet from surface. It follows downward with the lode at an angle of 27°. The copper here is found in the lode locally known as the "ash bed," an amygdaloid in which the lava is of gray color and coarsely cellular, somewhat

resembling a bed of volcanic ash. The vein is not a fissure although they have copper-bearing fissures crossing it upon each side of No. 1, shaft.

At the 7th level they have just begun the work of drifting upon the lode, and the ground thus far cut shows well in copper. At the 6th level, 114 feet above the 7th, they have drifted east and west of shaft about 200 feet.

At the 5th level they drifted west 303 feet when they encountered the west fissure vein. They have gone beyond this paint in the drift over 100 feet. East upon the 5th level they found their east fissure vein at 200 feet from the shaft and have driven in beyond this 100 feet. At the 4th level they are in about 100 feet each side of shaft, and at the 3d, 2d and 1st have short drifts. Captain Clark estimates that they have 300,000 tons of productive stoping ground opened up between the fissure veins above referred to.

On the west fissure vein they have opened up about 240 feet, the extension south from the ash bed lode showing copper in the breast of drift. To the north of the ash bed they followed the fissure north 90 feet, finding but little copper. The fissure veins in this locality generally carry considerable mass copper, and they hope to find something of value in the Arnold. The ash bed shows some excellent ground, it being erratic in its mineralization as are all other amygdaloids. No. 2 shaft is a shallow one as yet, the principal attention having been given to No. 1.

It is also the intention to resume work at the old Copper Falls mine in the near future. It has been idle for several years. It has produced about 1,200 tons of refined copper, and has two principal veins, the ash bed, of the Arnold, and the Owl Creek, the latter being a fissure, that was very rich in copper in places. It is said that the Owl Creek vein has shown copper for limited areas as plentifully as any mine in the district. The mine was worked from an adit driven along a fissure into the side hill. The ash bed lode was worked to a depth of 1,500 feet, had 17 levels, and upon the strike of the mine was opened about 1,500 feet. The ashbed was generally poor as to its holding of copper, but it it thought there may be a chance for a profit in these days of modern machinery and a better understanding of mining the lode economically.

There is a faulting of the formation here throwing the lode about 65 feet north, this making considerable trouble in the extending of the levels west from the adit. The Arnold has plenty of territory and it is the intention of the present company to give it a thorough testing.

A force of about 60 men is being employed under the superintendency of Wesley Clark. Boston capital is conducting the work, David Nevins and John Brooks being prominent. Stock has risen in value from $3 to $11.50 per share.

THE ASHBED.

This property occupies a positions between the Arnold and Copper Falls. It was formerly known as the Petherick. It was opened in the early history of copper mining in Keweenaw county, and is said to have shown a lode rich in copper in places. Boston parties are interested in its reviving. It will have its rock treated in the Arnold mill and will also secure its supply of air from the Arnold compressor. Should it make a favorable showing of copper the property will probably consolidate with the Arnold.

THE HUMBOLDT.

This is one of the old prospects of Keweenaw county at which nothing has been done for many years. It owns Sections 16 and 21 just west of the Arnold. There is an old shaft 150 feet deep, to sink which and conduct other explorations, $100,000 were spent. An assessment to raise $20,000 has been called for the purpose of unwatering the shaft and resuming exploring work.

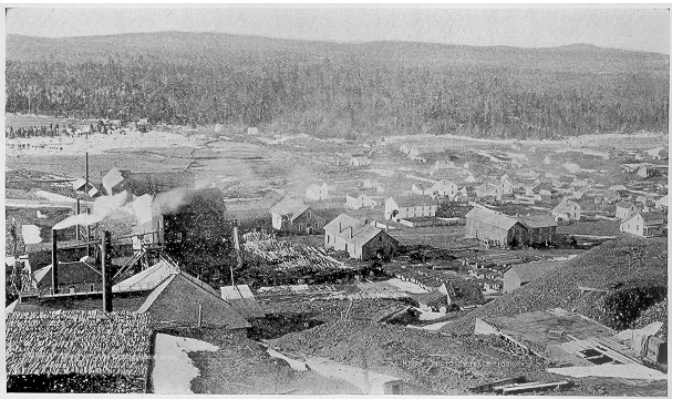
IN MARQUETTE COUNTY.

Marquette parties have been doing something in the exploring of Section 5, Town 46. Range 26, Marquette county, and have found a little native copper associated with quartz in the granite. A test shaft is being sunk, and is down 15 feet. The property is owned by the Michigan Land & Iron company, and the parties interested in the explorations are Captain Daniells, Samuel York and John Tebo.

Three miles south of Marquette city, in the Mesnard quartzite and kona dolomite, gash veins containing copper ore, oxide, are found. Considerable prospecting has been done in this vicinity but all the shafts thus far put down have been shallow and have not been a satisfactory test of the copper-bearing formation. A trial of twenty tons was made for J. M. Longyear, of Marquette, it giving less than 1% copper. The lot was treated by the Aurora smelting works of Aurora, Ills. Specimens can be found giving much better results than this. Chicago parties made a start last winter, did a little work and quit the field neglecting to pay for the labor performed. With the interest now being taken in copper, the Marquette field will undoubtedly receive attention the coming summer, and something im-important may be revealed.

ISLE ROYALE LODES.

Upon Isle Royale, where considerable exploring has been conducted from time to time, nothing was done during 1897. The English company organized to prospect the island, having been idle for the past four years. The last work done was by Jacob Houghton, of Detroit, who has great faith in the future of the place.



CENTRAL MINE, KEWEENAW COUNTY.

MINING CAPTAINS AND SUPERINTENDENTS.

In the list of prominent employes of mines and mills in the preceding descriptions I omitted those of James Trebilcock, mining captain of the Lake Superior Old Mine hematites and Section 16 mine, Ishpeming; Thomas Dennis, head mining captain of the Franklin copper mine, Hancock, and E. S. Warne, superintendent of Franklin mine stamp mill, Hancock.

SHARES AND SURPLUS.

The following shows the number of shares in the active companies and the balance of assets at their last regular meeting:

Name of Mine.	No. Shares.	Balance of Assets.
Atlantic	40,000	$ 196,362.81
Arnold	60,000	130,000.00
Baltic	100,000	100,000.00
Calumet & Hecla	100,000	5,889,211.59
Centennial	80,000	245,000.00
Central	20,000	30,707.89
Franklin	40,000	34,847.92
Isle Royale Consolidated	100,000	475,822.32
Osceola Consolidated	100,000	1,211,171.00
Quincy	60,000	854,835.56
Tamarack	60,000	157,290.66
Wolverine	100,000	947,540.00

PRICE OF COPPER.

The price, per pound, of Lake copper for the following years will be of interest:

Years.	Cents.
1860	22½
1865	36½
1870	20⅝
1875	22½
1880	20½
1885	11⅛
1890	15⅝
1891	12 3-5
1892	11½
1893	10⅝
1894	9 9-16
1895	10⅝
1896	10.88
1897	11¼

COPPER SMELTING.

The smelting of copper was first begun in America in the year 1850 when John R. Grout, of Detroit, with several gentlemen of Waterbury, Conn., organized the Waterbury & Detroit Copper company, built works at Detroit, and made a bid for the business of Lake Superior miners. Mr. Grout was the superintendent of the works and continued with the company constantly until his death, which occurred many years since.

In 1860 smelters were built at Portage Lake, upon the north side of that body of water and in the village of Hancock. In the year 1867 the Portage Lake company formed a union with the Detroit concern under the title of "The Detroit & Lake Superior Copper company," under which name it was run until 1891. In 1867 the Portage Lake plant was in part rebuilt, and many changes made for the better. The old furnaces were of the Welch pattern and were of the reverberatory air style, and the cupolas were of the American blast furnace type. In the former the best quality of copper could not be made and in the latter all the fine copper could not be extracted from the slag. In the reverberatory furnaces the changes permitted the converting of the coal into gases and of igniting the latter by passing through them currents of highly heated atmospheric air. A powerful and steady heat is attained and perfect regulation as to its degree, and melting of mineral and refining is best done, as well as greater durability of the furnace. The old cupola furnaces were changed to the elliptical form and the belt tuyere and usual blast furnace bosh arranged to receive a water lining extending to the top of the melting zone of the charge, preventing melting of bosh and permitting unlimited heat and entire liquidity of the slag. Nowhere are better smelters to be found than now are seen at Hancock and Dollar Bay, the company having erected a plant at the latter place to care for the mineral of the copper-producing companies whose rapidly growing product demanded it. Another change in the name of the organization was made in 1891, it now being "The Lake Superior Smelting company." Prominent men of Waterbury, Conn., are still interested in the works, James S. Elton of that place being president. Gustav Stellwag, of Boston, is treasurer. Mr. J. R. Cooper, of Houghton, has long been superintendent, succeeding Mr. Grout, and Z. W. Wright, of the same place, is cashier.

There are ten smelters at the Hancock plant, six of which are in operation. The capacity is much in excess of the present needs of the mines, but the company is looking forward to a considerable addition from the new properties upon the Houghton side of the lake as well as from Franklin, Wolverine, Tamarack and others upon the north side of the lake. The Calumet & Hecla company has built its own smelters. But for this division of the lake business the local company would need the most of the furnaces now idle.

The reverberatory furnaces use bituminous coal for fuel, this being fed into the back of the furnace, the reduction resulting from the ignited gases being forced over the top of the charge of mineral, the latter melting from the top downward. Copper is an excellent conductor of heat, and with the melting of the top of the load the mass underneath is quickly liquified. These furnaces hold

from twelve to thirteen tons of copper and the daily output of each is twice such amount. The mineral is rolled in barrels to the furnaces and fed into the latter by men using long-handled shovels. The masses of copper are placed in the furnaces by removing a door on the furnace top, the masses being raised by hand winch and derrick. Pieces weighing as high as nine tons are thus placed in the furnace. When the copper is drawn off it is run into moulds forming ingots, bars or cakes, according to the wants of the consumers, the ingots being barreled, 1,250 pounds being put into each barrel. Just now they are casting bars that have five ingots joined together, this being to save the cost of the barrels, and at the request of the consumers. The smelting company has a cooper shop of its own and probably makes a small profit from its product. The bars cast under the new plan are called bar ingots, and have the usual cut through the ingots, which has ever been observed in the casting, and which are probably intended to make the task of cutting up the ingots more easily performed. Small users of the metal are accommodated by this form of ingot. Large consumers who roll the metal into sheets are satisfied with the common pig or cake form.

Besides the ordinary forms of ingots, bars, cakes, etc., the company is now casting the copper into anodes to suit the wishes of certain electrolytic concerns that are separating the silver from the copper. As is generally known, certain grades of Lake Superior copper carry native silver. Considerable of it is obtained in the mine and mill, it being secured by pickers in the stamps, but there is a quantity so finely disseminated throughout the copper that it cannot be separated by hand, and electricity has been called into use. The Quincy is at present the only mine that is supplying silver-bearing copper for electrolytic purposes, and that has mineral smelted at the Hancock works. The anodes are plates about ten inches wide by four feet long and a quarter of an inch thick. Different electrolytic concerns observe different forms of anode. These anodes are suspended in solution, and have shapes to suit the ideas of those who use them in this manner, the forms of the ends of the castings varying in slight degree so as to suit the style of fastening them in the bath. Some of the copper from the Quincy mine has shown as high as sixty ounces in silver per ton, but of late it has been growing less. The ingots, pigs, etc., are cast in iron moulds, and the copper of each mining company is plainly marked so as it can be readily recognized.

After drawing off the melted copper from the reverberatory furnaces there is a certain amount of copper that escapes in the slag. The slag is treated in the cupola blast furnaces, being fluxed with lime, and large blocks are cast in iron receptacles lined with cement. These blocks are broken into pieces of suitable sizes and are returned to the reverberatory furnaces for final treatment, this course resulting in the closest possible saving of all the copper the mineral contains. In some of the most refractory mineral, this coming generally from the conglomerate mines, a little lime is added in the reverberatory furnaces, this assisting in the work of reduction and refining.

The furnaces of the company located ot Dollar Bay are six reverberatory and one cupola having a nominal capacity of 90 or 95 tons in twenty-four hours. These were built in 1888 and were placed in operation the following year. Mr. R. G. Collins looks after the Dollar Bay plant under general superintendency of Mr. Cooper. There was a slight change in the business plans this year by which the two plants keep separate accounts, and Mr. Collins has recently been selected to look after this branch. The location is about three miles east of the Hancock smelters, on the north side of Portage Lake.

The furnace buildings are of stone, substantial and fireproof. The docks are roomy and the largest vessels can draw alongside to take on cargoes of copper. A force of men numbering about 176 is employed, and the concern is an important one for the community in which it is located. Last year the amount of refined copper turned out from the furnaces was 52,844,004 pounds.

The Calumet & Hecla Mining company has its own furnaces located at Lake Linden, where in refines a portion of its mineral product. It has also smelters and electrolytic works at Buffalo, N. Y.

At their Torch Lake smelting works the buildings of the Calumet & Hecla occupy about thirty acres. There is a short railway line connecting the works and the stamp mills over which the mineral from the mills is handled and stored in the mineral houses. They have four stone furnace buildings 80’x130' each, with four furnaces, boshes, cranes and all the ordinary equipment; one blister furnace building of stone 50’x70' with two furnaces; one cupola building containing two furnaces, with necessary engines, blowers and boilers. There are machine and blacksmith shops and an electric lighting plant. The two mineral buildings have a combined capacity for 11,000 tons. There are two wharves 1,000 feet long with apparatus for the handling of coal and limestone. Water is secured from an artesian well. There is a stone cooper shop 33’x81', a barn, store, office and laboratory; a warehouse and storehouse 60’x130', a bituminous coal house with a capacity for 15,000 tons; a cooperage storehouse 60'x120’; a charcoal house of a capacity of 37,000 bushels, and store houses for oil, paint, brick, clay, hose, iron, etc. The Hancock & Calumet railroad runs through the works. The company has twenty-two dwelling houses for its employes. There is a force of about 180 men engaged.

James B. Cooper is superintendent; Chas. Smith, clerk.

PRODUCT OF SMELTERS.

The following is the amount of refined copper produced by the smelting works of the State for the year 1897:

Lake Superior Smelting Co., at Hancock	29,644,224 lbs.
Lake Superior Smelting Co., at Dollar Bay	32,130,488 "
Calumet & Hecla Co., at Torch Lake	31,867,192 "
Total for Michigan smelters	93,641,804 "
Smelted in Buffalo by Calumet & Hecla	56,511,794 "
Total Michigan copper smelted at all points	150,153,598 "

PERCENTAGE OF INGOT IN MINERAL.

The percentage of refined copper in the mineral of the different mines is about as follows:

Name of Mine.	Percentage.
Atlantic	75.009
Calumet & Hecla	70.000
Centennial	75.380
Central	69.900
Franklin	81.107
Osceola	84.083
Quincy	79.489
Tamarack	67.421
Wolverine	86.414
Ontonagon Co. Tributes	75.514

COPPER MANUFACTURES.

The rolling and wire drawing mill at Dollar Bay annually makes about 1,250,000 lbs. of sheets and 3,000,000 lbs. of wire. But little of the copper produced in Michigan is manufactured in the State.

PIG IRON.

All of the pig iron manufactured in Michigan is charcoal iron. There are no coke furnaces. The competition of the coke irons is so keen that but little profit remains to the Michigan smelters. The margin has steadily been growing less, and the present finds but little inducement for new stacks or improvements upon the old ones.

A few concerns secure by-products that are of assistance. The Pioneer furnace, of Gladstone, the property of the Cleveland-Cliffs Iron company, secured 102,914 gallons of wood alcohol and 932,478 pounds of acetate in its last fiscal year ending November 30th. The Weston Furnace company, at Manistique, is building a chemical plant. It has already completed twenty-four sixty-cord kilns. There has been no changes of importance at any of the other furnaces in the State.

The Superior Charcoal Iron company has lost several furnaces from its former list, the Pioneer, Antrim and Elk Rapids stacks now being the only ones controlled by the company. J. C. Holt, of Grand Rapids, is secretary and treasurer. The company was formed for the purpose of selling the product of the charcoal iron makers of Michigan, with an idea of securing better price.

The furnaces operated for the year 1897, their time of operation, number of men engaged and product is shown in the following table:

Name and Location.	Mos. in Blast.	Tons Product.	Men Employed.
Antrim Iron Co., Mancelona	3¾	10,218	125
Elks Rapids Iron Co., Elk Rapids	11½	25,238	118
Excelsior Furnace Co., Ishpeming	4¾	10,024	40
Gaylord Iron Co., Detroit	11	9,731	30
Peninsula Iron Co., Detroit	12	11,129	27
Spring Lake Iron Co., Fruitfort	3½	7,275	150
Pioneer Furnace, Gladstone	12	36,700	163
Union Iron Co., Detroit	4½	5,203	35
Weston Furnace Co., Manistique	3¾	10,595	75
Totals	63¾	126,113	763

The total tons pig iron made was 20,756 less than for the previous year.

CALUMET AND HECLA SMELTING WORKS, LAKE LINDEN.

IN THE UNITED STATES.

The total production of pig iron in 1897 was 9,652,680 gross tons, against 8,623,127 tons in 1896, 9,446,308 tons in 1895, 6,657,388 tons in 1894, 7,124,502 tons in 1893, 9,157,000 tons in 1892, 8,279,-870 tons in 1891, and 9,202,703 tons in 1890. The production in 1897 was 1,029,553 tons more than in 1896, an increase of almost 12 per cent.

The production of Bessemer pig iron in 1897 was 5,795,584 tons, against 4,654,955 tons in 1896, and 5,623,695 tons in 1896. The increase in 1897 over 1896 was 1,140,629 tons.

The production of basic pig iron in 1897 was 556,391 tons, against 335,403 tons in 1896.

SALT.

Michigan still retains its position as first in the Union in the production of salt. The business is in the hands of an association that guarantees quality. All salt manufactured is inspected. There are eight districts, made up as follows: No. 1, Saginaw county; No. 2, Bay county; No. 3, St. Clair county; No. 4, Iosco county; No. 5, Midland county; No. 6, Manistee county; No. 7, Mason county; No. 8, Wayne county.

The inspection has been the means of keeping the grade up to the required standard, making Michigan's

product very popular and salable. The makers pay for the service.

The number of firms that engaged in the business during the year 1897 was 61; the number of salt blocks was 69; the number of solar salt covers was 1,500. I am indebted to state salt inspector, Hon. J. B. Caswell, of Bay City, for information concerning the business for the past year:

DISTRICT NO. 1.

Name of Manufacturer	No. Barrels Made.
Bliss & Van Auken No. 1	33,476
" " " 2	15,590
Wright Lumber Co	9,621
Brand & Hardin	9,450
A. Simpson	6,232
Linton Manufacturing Co	9,525
Brewer Lumber Co	21,433
A. T. Bliss	6,330
Central Lumber Co	15,258
Saginaw Lumber Co	44,095
E. Germain	13,076
W. B. Mershon & Co	17,256
Melbourne Salt Co	16,096
A. T. Brown	4,615
Green Ring & Co	12,973
D. Hardin & Co	2,387
C. K. Eddy & Co	41,858
C. L. Grant & Co	1,359
Ralph Loveland	2,678
Mitchell & McClure	1,029
	284,337

DISTRICT NO. 2.

Theo. Hine	5,814
Kern Manufacturing Co	20,646
Pitts & Co	51,028
Eddy Bros. & Co	49,969
McEwan Bros. & Co	23,683
C. C. Barker	16,868
Edmund Hall	37,815
Smalley & Woodworth	28,672
Bay City Manufacturing Co	10,013
T. E. Bradley & Co	32,197
South End Lumber Co	35,026
J. Boyce	12,260
Wm. Peters	5,137
W. B. Rouse	10,000
Fitch Salt Co	1,766
	340,894

DISTRICT NO. 3.

Michigan Salt Works	13,458
Davidson & Wansey	103,690
Thompson Bros	86,812
Diamond Crystal Salt Co.	53,978
Marine City Stave Co	27,892
Walton Salt Co	11,234
	297,064

DISTRICT NO. 4.

Pack Woods & Co	10,517
Iosco Brine Co	922
Tawas Bay Mumber Co	24,806
C. W. Luce & Co	5,986
	42,231

DISTRICT NO. 5.

Wm. Patrick	18,954
Midland Salt & Lumber Co	25,102
	34,056

DISTRICT NO. 6.

Michigan Trust Co	56,673
R. G. Peters S. & L. Co	365,637
Filer & Sons	111,697
Canfield Salt & Lumber Co	59,757
Eureka Lumber Co	44.846
Union S. & L. Co	104,277
Reitz Salt & L. Co	65,280
Louis Sands	198,958
Buckley & Douglass	521,877
State Lumber Co	155,584
Canfield & Wheeler	67,654
	1,827.427

DISTRICT NO. 7.

Pere Marquette Lumber Co	54,127
Butters & Peters	124,538
" " No. 2	9,415
Thos. Percey No. 1	81,827
" " " 2	200,922
" " " 3	51,495
	522,324

DISTRICT NO. 8.

Detroit Salt Co	160,378
Carter Salt Co	22,780
Tecumseh Salt Co	88,203
Brownlee & Co	3,070
	274,431

RECAPITULATION.

Manistee Co	1,827,427
Mason Co	522,324
Bay Co	340,894
St. Clair Co	297,064
Saginaw Co	284,337
Wayne	274,431
Iosco	42,231
Midland	34,056
	3,622,764
No. barrels in bins Dec. 1, '97	821,048
Total	4,443,812
Salt in bins Dec. 1, '96	738,952
Amount Manufactured	3,704,860
Excess of '96	368,618

INCREASE OVER '96.

Midland Co	9,698
Manistee Co	410,718
Wayne	163,923
	584,229

DECREASE UNDER '96.

Saginaw Co	144,156
Bay Co	24,140
Huron	2,665
St. Clair	13.853
Iosco	87,484
Mason	25,519
	297,817
Increase	286,522

SALT MANUFACTURED IN MICHIGAN, AND PRICE OF SAME.

Salt manufactured in Michigan prior to the enactment of the State Inspection Law in 1869.

Years.	Number of Barrels.	Price.	Years.	Number of Barrels.	Price.
1860	4,000		1865	477,200	
1861	125,000		1866	407,997	$1.80
1862	242,000		1867	474,721	1.77
1863	466,356		1868	555,690	1.85
1864	529,073				
Total				3,283,037	

Salt manufactured in the State of Michigan since the enactment of the State Inspection Law in 1869.

Years.	Number of Barrels.	Price.	Years.	Number of Barrels.	Price.
1869	761,288	$1.58	1883	2,894,672	$0.81
1870	621,352	1.32	1884	3,161,806	75⅝
1871	728,175	1.46	1885	3,297,403	70
1872	724,481	1.46	1886	3,677,257	66
1873	823,346	1.37	1887	3,944,309	57 4-10
1874	1,026,979	1.19	1888	3,866,228	58¼
1875	1,081,856	1.10	1889	3,846,979	54 3-10
1876	1,482,729	1.05	1890	3,838,637	55 1-10
1877	1,660,997	85	1891	3,927,671	54 2-5
1878	1,855,884	85	1892	2,812,054	52¼
1879	2,058,040	1.02	1893	3,514,485	44 7-10
1880	2,676,588	75	1894	3,138,941	51
1881	2,750,299	83⅓	1895	3,529,362	48 9-10
1882	3,037,317	70	1896	3,336,242	56¾
			1897	3,622,764	58¾
Prior to 1869				74,474,141	
				3,283,037	
Total				77,757,178	

NEW BLOCKS.

The Michigan Solar works of St. Clair Co., which were burned two years ago have been rebuilt.

C. W. Luce & Co., East Tawas, have erected a new plant 90,000 barrels yearly capacity.

The Tawas Lumber Co. are making additions to double their present capacity.

The Reitz plant, Manistee, owned by Louis Sands is preparing to double its capacity.

Butters & Peters, of Ludclington, are erecting a small grainer block 25,000 barrel capacity.

Pere Marquette Lumber Co. has gone out of business, but others may step in to take their place.

Brownlee & Co., Wayne, are erecting a grainer 50,000-barrel capacity.

COAL.

Michigan displayed much interest in the development of its coal sheets the past year, and there was an increase in production over 1896 of 101,897 tons. There has been considerable new work done in the vicinity of Jackson and Bay City. Large tracts of land have been optioned, and indications point to a great deal of exploring the coming summer. The big coal strike of last year in the mines of Ohio, Pennsylvania and Illinois stimulated Michigan production considerably, and the start made promises to be followed by considerable activity in the future. The coal seams are generally thin, and often the ground in which they occur is very wet, but it is also true that the methods employed in the working of the mines have been of primitive kind. There has also been a lack of skilled miners to open the properties properly, the labor for a considerable part having been secured from the surrounding farms, and was employed but a portion of the year. The coal is excellent for steaming purposes. From time to time newspaper accounts of the finding of cokeing coal have appeared, but I fail to find these statements verified in the mines. The price secured the past year ran from $1.20 to $1.90 per ton at mine.

THE BAY MINING CO.

This company's mine is located near Bay City. It was worked in a quiet way prior to the past year it lacking railway facilities. A spur track connecting with the Michigan Central and Grand Trunk roads was extended to the mine in 1897, and they are now employing 105 men and raising about 5,000 tons of coal, lump and slack, per month. The area of the sheet mined is about eight acres in extent, in which pillars have been plentifully left to protect the hanging. The mine was worked eight months during the year and the average number of men employed was sixty-four. The shafts are 140 feet deep, and the coal seam three and one-half feet thick.

THE BLACK DIAMOND COAL CO.

This company is operating near Jackson. It mined 18,592 tons in the year, employing thirty-five men.

THE CORUNNA COAL CO.

operated at Corunna, and is one of the oldest coal companies in the State. Its product for 1897 was 21,277 tons. It gives place to seventy-five men.

THE MONITOR COAL CO.

The Monitor occupies a position near the Bay company, at Bay City, and enjoys the accommodation of the spur track built last August to the Bay. Since then the property has been working energetically, and about 300 tons per day are now being mined. An independent air shaft was sunk in the year. They employ fifty men, and produced 32,362 tons in 1897.

THE NEW HOPE COAL MINING CO.

The mine of this company is near Jackson. It is a new property, its first coal having been put upon the market last December. The quality equals the best produced in the State. There is one shaft to the coal seam, piercing the latter at a depth of eighty feet. The coal seams here

averages 3 feet 10 inches thick. A force of twenty men is given place.

NEW SPRING ARBOR COAL CO.

This is a Jackson property, recently opened. It has two shafts fifty-four feet deep, and employs twenty-five men. They were active for eight and one-half months during 1897, and produced 9,503 tons.

TRUMBULL COAL CO.

This company, located at Jackson, was busy the entire year, producing 25,246 tons. It has one shaft to a depth of 100 feet, and has a coal seam three to four feet thick. It has operated two years and its total product to date is 61,134 tons. Its mining force consists of fifty men.

THE SEBEWAING COAL CO.

The mine of this company is located at Sebewaing. It was operated continuously throughout the year, producing 18,283 tons, and employing sixty-five men. The average price for its product at the mine was $1.23.

THE WHITE ROSE MINING CO.

This is a new concern, its first coal being placed upon the market in August, '97. Since then it has produced 3,961 tons. It has one shaft 100 feet deep, and the coal seam averages three and one-half feet thick. The number of men employed is fifty.

SOMERS MINE.

This is a property recently opened near St. Charles. One shaft is to the coal, and is producing, while a second is soon to be started.

COMPANIES AND PRODUCT FOR 1897.

	Tons.
Bay Mining Co.	23,467
Black Diamond Coal Co.	18,592
Corunna Coal Co.	21,277
Monitor Coal Co.	32,362
New Hope Coal Mining Co.	159
New Spring Arbor Coal Co.	9,503
Trumbull Coal Co.	25,246
Sebewaing Coal Co.	18,283
White Rose Manufacturing Co.	3,961
Total	122,850

GOLD.

Throughout the upper peninsula of Michigan gold has been found in many places in the Huronian rocks, and numerous attempts at developing a paying lode have been made. The field given the greatest attention has been that lying a few miles to the north and west of the city of Ishpeming, and it was in this that the Ropes mine was wrought for fifteen years, it being the first opened. While gold, according to many excellent authorities, is "where you find it," still there are certain rocks in which it seems to be most plentifully placed, and the Michigan formation is identical with that of promenent western districts which have given bountifully of the precious metal. It is the same as that upon the north shore of Lake Superior where the Rainy Lake and Michipicoten discoveries have been made. The oldest rocks have been most favorable to the existence of gold, and these predominate in the upper peninsula. While many promising veins bearing gold have been discovered, there has not been the interest taken in the search for the metal which usually accompanies these discoveries. One reason for this is probably found in the fact that the lands of this region are principally held by large corporations, the explorer having to secure options for leases and to conform to certain requirements opon the part of the possessors of the fee. While the royalty and terms are generally fair, still the contrast to the western mining laws is so marked that it meets with objection from many who make a business of looking for minerals. In the western country one has simply to stake out his claim, perform a certain amount of work annually and he secures from his "find" all it may yield. It is the discussion of the difference in the plans of the fields that has worked against the local one. So far as I have been able to learn the holders of local lands are willing to give the finders of gold fair leases.

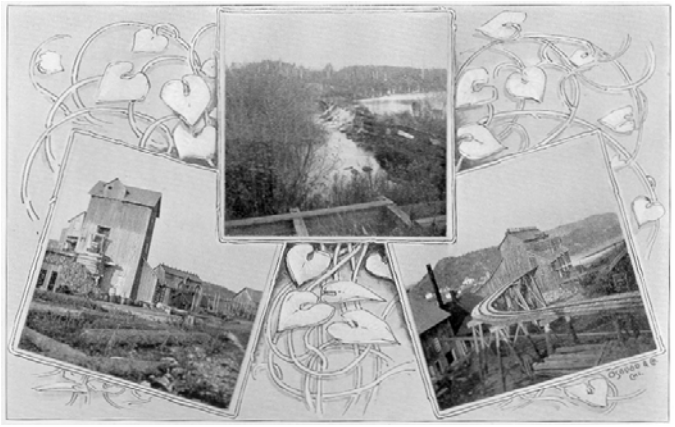
Up to within a few years since the search for this region was for mines of iron ore. There was an excellent market for such properties, and more was known of this mineral than of gold. The formations were better understood, and then the population was one versed well in iron and but little in the precious metal. Some wonderful specimens have been taken from several prospects in this field, but they failed to arouse anything like the enthusiasm that similar discoveries in other fields would have awakened. This was either due to lack of faith or of a correct understanding of the real value of the rock.

The district most explored was in the southwestern corner of Town 47 and the southeastern corner of Town 48, Range 28, two and a half miles north and from two to four miles west of the city of Ishpeming.

THE ROPES MINE.

The Ropes gold mine was the first one worked in the state of Michigan, and is the only one attaining the development deserving the name of "mine". It is located in Section 31, Town 48, Range 27, and was operated for fifteen years, closing down in July of '97. Its shafts are in the serpentine, or peridotite rocks, and the principal one has reached a depth of 850 feet. There have been bodies of low-grade ore, and at the bottom of the mine, when work was discontinued last summer, the lode was richer than it had been for years previous, and was also of greater and more regular dimensions. The mine has produced $647,902.37 in gold and silver, about 80% of the product being gold. The lenses in the bottom of the mine were richer than for many levels above, and they

had also discovered a new chute of ore extending upward from the 5th level and at a point considerably further west than any before reached in the mine. Assays from this lead gave from $9 to $ 12 per ton. The company had been much harassed by a lack of funds with which to properly equip the mine and to open its levels. There was no stoping ground opened up beyond the daily needs of the mill, it being a hand-to-mouth system, made so by reason of the lack of money to properly develop the mine. There was no chance to select the rock, and the good and poor was mined and milled indiscriminately. The shaft was not carried down to the bottom of the mine, but was stopped at the 15th level, and from that point an incline was carried down upon the ore, necessitating a transfer of the rock in the hoisting. What was much needed was the sinking of the shaft and the opening of new levels from which the rock could be taken according to its worth. There are many copper mines that could not find it profitable to take all the vein matter, but selection is necessary, leaving the barren stretches in the mine. It costs money to secure the poor material, to hoist and mill it, and it gives nothing to the treasury. The wonder is, when all things are summed up, that the Ropes succeeded in keeping afloat so long. It developed the lode upon the strike of the latter for a length of between 400 and 500 feet, a very small extent of the property, and the depth reached proves conclusively the continuity of the vein. The ore-bearing formation is a wide, strong one, and the finding of the rich ground in the west end of the mine just before the property closed down suggests that there may be many more such stretches in the territory tributary to the upper levels that might be found if systematic search were carried on.



ROPES GOLD MINE MILL AND DAM.

The mine is favorably located. Supplies are cheap, a railway runs within a short distance of the property, there is water in plenty to be had, it being pumped by a turbine wheel from the Carp river, there being head enough to operate a pump with the turbine, this forcing the water into the mill, an inexpensive plan. The mine is dry, having little or no water to raise and no timber is needed to support the hanging wall.

There is need of about $20,000 with which to equip the surface and to sink the shaft and open new levels. It is hoped this amount will be obtained. B. W. Wright, Ishpeming, is receiver for the company, W. H. Rood, general manager. Captain Thomas Robbins is still at the mine and is filling the position of caretaker. The success of the Ropes would be a great incentive to further work in the gold field, and the mine is certainly deserving of it. At the time the property was closed down by its creditors it was taking out more than enough gold to pay all expenses, and this in the crude way referred to. The company owns the fee of its lands, and has many natural advantages of importance in the conducting of a mining enterprise. There is a neat location in which all the men necessary to operate the property can be comfortably housed. The Ropes has been unfortunate, but it has a mine and one that would pay a neat profit if rightly handled.

THE MICHIGAN.

The Michigan, during the short term of its activity, attracted much attention, due to the wonderful richness of its rock. It held gold as the richest copper rock holds copper. Thirty dollars' worth in a piece of rock as large as a man's fist was not uncommon. Thousands of dollars' worth were carried away by the miners, and nearly three thousand dollars' worth were captured from a departing pair who had put it into a trunk preparatory to going to Europe. The Michigan is located in Section 35, Town 48, Range 28. Several shallow shafts were sunk, the gold-bearing rock grew less, and the work of following it was finally abandoned. I know of no other place where the search would have been so speedily given up. It really seems almost criminal not to have given the property a fairer test. In the short time it was operated it yielded $17,699.36 in gold, the rock being free milling. The greater part of this was secured by the crushing of the rich specimens obtained. Adjoining properties were the Gold Lake and Superior, the latter being upon lands owned by the Lake Superior Iron company. The fee of the Michigan is owned by Peter Gingrass, Ishpeming. The Michigan is idle and has been for several years.

THE GRAYLING

is just north of the Michigan, upon Section 26. It had a shaft fifty feet, and showed very rich rock in places. It is idle. Just east of the Grayling, on Section 26, is

THE PENINSULA.

An option upon this property has just been obtained by C. T. Fairbairn and A. K. Sedgwick, of Ishpeming, who will do something in its development as soon as the weather will permit. There is a heavy lode here, and gold has been found in many samples taken. Detroit, Mich., parties did some exploring here at the time the Michigan was active, but have given it up.

The property now commanding the attention of Ishpeming people is

THE B. & M.

located upon the southwest quarter of the northwest quarter of Section 21, Town 47, Range 27, near Ten Kilns. This property was prospected by the late Edward Robbins in the summer of '96, was afterward secured by other Ishpeming parties and a shaft has been sunk fifty feet, it being put down in the kitchi slates overlying the quartz vein. The latter shows a thickness of eighteen inches, and carries free gold plentifully. Numerous samples are frequently brought into town and all of them show gold. While there is considerable coarse gold readily seen without the aid of a magnifying glass, much of it is very fine, and shows up many colors by panning. They have sunk the shaft fifty feet and are opening out upon the trend of the vein. The slate makes easy ground to sink in. The angle of the dip is about 65°. The quartz is of a banded character and carries considerable iron. It is glassy in appearance and would pulverize readily under the stamps. William Murdock, H. H. Mildon, Mr. Billings, A. B. Miner and R. P. Bronson, of Ishpeming, are interested and have formed a company to work this property. It will be known as the B. & M., all those interested having names that begin with either of these letters. They are now deciding just what the vein holds and how persistent it is. The following assays have been made within the past few weeks, and they certainly show handsomely in gold. The highest one contained several pieces of free gold which could be readily seen with the naked eye, but the other assays were from rock purposely chosen because it showed no gold:

No. 1	$ 22.75
No. 2	144.62
No. 3	14.46
No. 4	8.20
No. 5	20.66
No. 6	12.39
No. 7	8.26
No. 8	4.13
No. 9	14.40
No. 10	10.30

To the north of the Billings several miles is

THE DEAD RIVER GOLD DISTRICT

where a little work was done in 1892. A shaft was sunk sixty feet and $2,063 in gold obtained, the rock being treated in the mill of the Ropes Gold & Silver company. This is an interesting region. The rocks are principally granetic, and there are many small veins showing free gold. The district between the river and Lake Superior is a favorable one, and should be given attention from the explorers.

The yield of the different properties in the Ishpeming field while in operation was as follows:

Ropes Gold and Silver Co.	$647,902.37
Michigan Gold Co.	17,699.36
Fire Center Gold Mining Co.	2,063.00
Various Prospects	820.00
	$668,484.73

In the Ishpeming field the explorers should give careful attention to the points of contact between the peridotite, or serpentines, and the associate formations. It is here where gold-bearing quartz is most likely to be found, as the veins will occur at the contact planes, the openings being at those points where there was the least resistance, and where the gold would be carried by thermal waters or eruptive action. The peridotites are rocks which should be given careful scrutiny. They are generally rich in minerals, and outcrop here so as to be readily followed.

There has been some looking for gold in Baraga county and in the Huron mountains, but no particular location has been announced. There are several parties who claim to have found rich gold-bearing quartz and are trying to secure the lands upon which it was discovered. This is one of the delays necessary where the land is not open to the explorer as in the west. It often happens, too, that the explorer wants too much of the adjoining property and will not make the whereabouts of his "find" known until he has optioned a large tract of land upon the trend of the vein. I have seen some very rich rock claimed to be from the Huron Mountain country the past summer. Assays have given anywhere from $50 to $12,000 per ton.

In Dickinson county, in the valley of Pine Creek, in the granite, Iron Mountain parties have been doing a little work for the past three years. Pits were put down upon a gash vein, and samples of rock showing well in gold having been secured. There is nothing being done at this writing, the prospecting being confined to the summer months.

A much discussed point is, where did Dr. Douglass Houghton, Michigan's first geologist, find his eagle's quill full of gold. It was somewhere between L'Anse and Marquette, and many claim to know the exact location. Each new location is advertised as the one the lamented geologist discovered, but the exact place was not recorded either by the doctor or his helpers. That gold exists in Michigan hills is well established, and some day a lucky individual will come across a vein that will well repay him for the trouble incurred in its finding. As yet but little has been done in the line of systematic exploration.

SILVER.

The silver now obtained is in the copper mines, where it is associated with the copper. The Quincy secures about $18,000 worth per year. An account of the method of securing it will be found in my description of the Lake Superior Smelting works. The Franklin, and other mines working upon amygdaloid lodes secure a little silver annually by hand-picking at the mills.

Silver associated with lead occurs in several places in the Upper Peninsula but no mines are being worked, the percentage of silver being too small.

There was also considerable silver obtained from the Ropes mine, Marquette county, while it was in operation. In was associated with the gold ores.

SANDSTONE.

Michigan sandstone did not find a ready market the past year. The demand was lighter than for several years previous, and the amount of stone quarried was small, the total being 120,338 cubic feet, a falling off from the previous year of 122,173 cubic feet. There were but three concerns that shipped sandstone these being

The Kerber- Jacobs Redstone Co.	30,000	cubic feet.
L'Anse Brownstone Co.	10,338	"
Portage Entry Quarries Co.	80,000	"
Total	120,338	"

Of the amount quarried by the Portage Entry Quarries Co., 5,000 feet were obtained from the quarry in Marquette city, the balance from their quarry upon the shores of Portage Entry.

The Kerber Jacobs Redstone company is preparing to re-open its old quarry at Marquette. It has begun the work of stripping the overlying drift from the sheet, and is pumping the water from the old openings with an idea of going deeper. This stone is of the brown and raindrop varieties so popular with builders.

There are several idle quarries on the shores of Portage Entry that are meritorious and will become active in case a demand for the stone arises. At several of the quarries, this including the active ones, there was considerable stone carried over from 1896.

Of other building stones Michigan possesses an abundance, they being well distributed throughout the State. There has been little building and consequently but little quarrying during the past few years.

GRINDSTONES.

In Huron county there are several producers of grindstones and scythe stones. The value of the product for 1897 amounted to something over $100,000.

The Cleveland Stone company quarries at Grindstone City shipped 4,054 tons of loose grindstones, 5,917 gross of scythe stones and 246 cars of rough stone.

The Huron Grindstone company, Port Austin, Huron Co., shipped 2,000 tons grindstones; 2,500 gross of scythe stones and 1,000 cords of wall stone. These are the most prominent operators in Michigan in these products. The grindstones and scythe stones are of fine quality, and meet with a ready sale.

GYPSUM.

Of late years the gypsum products of Michigan have shown a considerable falling off. At one time the State commanded nearly the entire business of the country, but competition has sprung up in other places, reducing the former volume. For the year 1897 the following concerns did business, and sent out gypsum, mostly as calcined plaster, as follows:

Alabastine Company	13,100	tons.
Grand Rapids Gypsum Works	14,000	"
Grand Rapids Plaster Co.	14,000	"
Durr Plaster Co.	3,200	"
Michigan Plaster Co.	4,200	"
Total	48,500	"

The Godfrey Bros. & Co's mills were not operated during the year. The gypsum business of the State is in the hands of the Michigan & Ohio Plaster company, Grand Rapids, Mich., the Michigan Plaster Co., and the Durr Plaster Co., at Grandville, Mich.

MARBLE.

Michigan's sole marble quarry, located at Foster City, is idle. It has done nothing for the past year and a half. The Harmon Lumber company, the owners, have failed in business, and the property is idle awaiting a settlement of their affairs.

The marble range in Marquette county, a few miles to the northwest of the City of Ishpeming, is receiving no attention, a fact that is a strange one when the rare beauty of the stone is considered. Here are the true *verde antiques*, rich in coloring, fully equalling the product of the best foreign quarries. W. H. Rood, of Ishpeming, is interested in the ownership of the lands.

SLATE.

There has been no mining of this mineral for the past ten years in Michigan. Prior to that time there was a little work done in Baraga county, at Arvon. The sheet was badly shattered and the product was not salable on account of this defect.

In the fall of 1897 a find of slate was made north of Covington upon the line of the Duluth, South Shore & Atlantic railway. Section 14, Town 48, Range 34. It is said to be of superior quality, and Mr. Hebard, of Pequaming, Mich., is to explore the property the coming summer.

GRAPHITE.

One mine has been worked in this State. It is located in Baraga county, in Section 16, Town 49, Range 33. It is the property of the Detroit Graphite Manufacturing company, R. A. Parker, of Detroit, being president; A. A. Boutelle, treasurer and manager. They have mined in all about 1,000 tons, but nothing has been done for several years past. They talk of re-opening the mine the coming summer. The mineral is used principally in the manufacture of paint. R. R. Williams, of L'Anse, had local charge when the property was active.

Limestone is abundant, is being burnt at many places, Bellevue being noted for its fine product of this mineral. The value for 1897 is estimated at $115,000. Granite is plentiful in the northern portion of the State, and marl is also found, although generally lacking in phosphorus, a necessary element for fertilizing purposes. It is being

used in the manufacture of cement in a few places. Quartzite is also plentiful in the Upper Peninsula. Kaolin is found in Ontonagon county, Wm. Jeffs, of Rockland, having charge of a deposit from which a few tons are annually shipped. Asbestos is found in Marquette county, but no deposits are being wrought.

MINERAL WATERS.

Michigan sold mineral waters in 1897 to the value of about $100,000. Fourteen springs were active. Besides the water sold there was a large sum realized from those who attended the baths at Mt. Clemens and other places. The following springs were busy:

Americanus Wells, Lansing, Ingham County.
Clarke Red Cross Well, Big Rapids, Mecosta County.
Crystal Spring, Crystal Falls, Iron County.
Magnetic Mineral Spring, Spring Lake, Ottawa County.
Medea Spring, Mt. Clemens, Macomb County.
Midland Mineral Springs, Midland City, Midland County.
Mount Clemens Sprudel Water, Mt. Clemens, Macomb County.
No-che-mo Mineral Spring, Reed City, Osceola County.
Pagoda Springs, Mt. Clemens, Macomb County.
Plymouth Rock Well, Plymouth, Wayne County.
Salutaris Spring, St. Clair Springs, St. Clair County.
Ypsilanti Mineral Spring, Ypsilanti, Washtenaw County.
Zauber Wasser Springs, Hudson, Lenawee County.

CLAY.

Clay is abundant and is found in nearly every county in the State. The value of the brick and tile made during the year was estimated at about $100,000, and the pottery at about $21,000. Michigan stood eleventh in the rank of states for clay production.

MINE FATALITIES.

Mining is a precarious vocation despite every attention paid to the prevention of accident. In the iron and copper mines of Michigan for the year ending Nov. 30 last, sixty-two men lost their lives. The average of fatal accidents per 1,000 men employed was 3.70. The Finnish workers suffered most, twenty-six of that nationality being killed. The falling of ore and rock, and the rolling of pieces of rock down the stopes, was accountable for the death of twenty-six men. Nine were killed by being blasted in premature and delayed explosions. Six were caught by skips or cages, a portion of these in the attempt to get upon ascending or descending skips.

The number of fatalities in the different counties was as follows:

County.	No. Fatalities	No. in 1,000
Dickinson	10	4.62
Gogebic	8	4.75
Houghton	26	2.99
Iron	1	2.07
Marquette	17	4.09
Total	62	3.70

Each of the above counties has an inspector whose duty it is to examine the mines at least twice a month. The inspectors for the different counties are as follows:

Dickinson, Wm. Trestrail, Iron Mountain.
Gogebic, John H. Taylor, Ironwood.
Houghton, Josiah Hall, Calumet.
Iron, A. Gulgren, Iron River.
Marquette, Jos. Tregonning, Ishpeming.

These inpectors are chosen by the boards of supervisors of the different counties and have no stated term of office.

MICHIGAN COLLEGE OF MINES.

The Michigan College of Mines, located at Houghton, is one of the most successful schools of the kind in the world. Established for the brief period of eleven years, it is today at the head of all like institutions of the kind in the United States both in point of attendance and in the education given. There are but few of the foreign schools boasting a greater membership, and some of these were organized more than fifty years ago, have millions of dollars invested in buildings, grounds and apparatus, and the whole of Europe to secure students from. The following figures show the increase of attendance from the start: 1886-7, 235 1887-8, 29; 1888-9, 40; 1889-90, 35; 1890-1, 65; 1801-2, 78; 1892-3, 101; 1893.4, 82; 1894-5, 94; 1896-6, 94; 1896-7, 140. Of the present number attending fifty-seven are from the Upper Peninsula, seventeen from the Lower Peninsula, while sixty-six come from outside the State.

The location of the college is an attractive one to the student desirous of making rapid progress. There is the advantage of association with the most skilled mining men in the world; the viewing of the practical side of mining problems. Here are found the deepest mines the world possesses; the greatest machinery. Mines of copper and iron ore are abundant. The most successful properties of this kind to be found anywhere are located within easy reach of the school. There is besides the dressing of these minerals, the reduction, and all that pertains to the production and manufacture to give practical illustration of the subject taken up. The location is an ideal one, and the college will continue to grow in popularity and usefulness. It is admirably conducted. Dr. M. E. Wadsworth, the president, has issued excellent papers showing the course of study and all that pertains to the institution, and will be glad to mail them to those who may be interested.