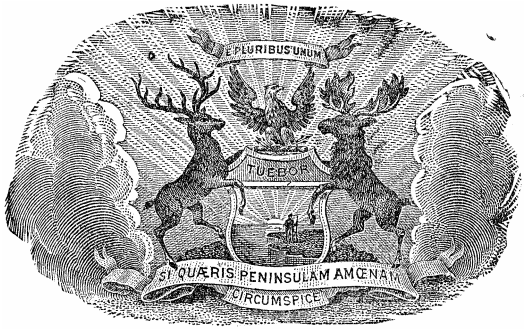
STATE OF MICHIGAN,

MINES AND MINERAL STATISTICS

BY

GEORGE A. NEWETT

COMMISSIONER OF MINERAL STATISTICS.



BY AUTHORITY.

LANSING:
THORP & GODFREY STATE PRINTERS AND BINDERS,
1896.

LETTER OF TRANSM1TTAL.

STATE OF MICHIGAN,
OFFICE OF THE COMMISSIONER OF MINERAL STATISTICS,
Ishpeming, Michigan, March 10, 1896.

HON. JOHN T. RICH, *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.

The greatness of Michigan as a mineral producing State is realized by but few people. Even those who are directly associated with the mining of its treasures seldom stop to think of the much that has been, and is being accomplished, or of the great value its minerals are to the people of these wonderful peninsulas.

Michigan bears the proud distinction of being first in the United States in the production of iron ore, first in salt and second in copper, these being foremost amongst the earth's natural treasures in the successful building up of a nation. Of salt, Michigan has credit for yielding about 26 per cent of the entire product of the United States, and the mineral is one that is widely distributed. Of iron ore she yields over 30 per cent, and some thirty states and territories contribute to the grand total. In copper she was first from 1847 until 1884, and today furnishes over one-third of all that the United States produces.

A better idea of the vastness of its mining industries may be had when it is stated that the value of Michigan's mineral products amounts to over thirty-one millions of dollars annually, this being the price at which they are marketed.

The remarkable growth of the upper peninsula of Michigan within the last quarter of a century has been wholly due to the minerals contained within this territory, and of the population now credited to this portion of the State, fully one hundred and twenty-five thousand depend upon the operation of the mines for a livelihood. Houghton county, with its forty-four thousand souls, and Keweenaw county, with three thousand, have their mines of copper to support their thriving villages. There is nothing in the line of agriculture, and only the copper smelting and wire drawing in the way of manufacturing; there is nothing else to occupy the attention of the people.

Marquette county, with a population of thirty-eight thousand, Dickinson county, with fifteen thousand, Gogebic county, with fourteen thousand Iron county, with five thousand, are entirely engaged in the mining of iron ore. Delta county, with over fifteen thousand, is largely occupied in taking care of the ore shipping from the port of Escanaba, where as high as four millions of tons have been received in a single season of six months' duration. Other counties are engaged in the supplying of fuel and timber for the mines, mills and furnaces, and the number given as dependent upon the activity of the mines is a conservative one.

Nor does the labor-giving service stop here. Hundreds of Michigan's sons are given place on the boats that take these ores and metals to market; hundreds of staunch sailing craft plow through waters adjacent to our shores, and yearly the number is growing greater, and the benefits accruing to the public are extending and becoming more important. The building of boats and cars for the transportation of this fast mass of mineral affords place for the artisan in wood and iron; the steady increase in the mining population furnishes improved markets for the Michigan farmer, and the influence for commercial good of this giant, successful, enterprise is far-reaching and important to Michigan as a whole.

In the lower peninsula the production of salt is the chief one from a mineral point of view and affords employment to a large number of men. Generally the salt blocks are operated in connection with saw and other mills, so it is not an easy matter securing figures showing the full importance of the industry with relation to the labor engaged, but it requires a vast amount of work to care

for the three and one-half millions barrels produced each year.

There is an abundance of lime, land and other plasters; of stone suitable for building purposes, whetstones and grindstones, and several thousand men find place in the work of operating these quarries. Of coal there is a vast area not as yet properly exploited, and which offers promise of profitable mines.

Michigan is still young in its mineral development. It has vast stores to be unearthed, and the increase, remarkable as it has been during the past twenty years, should show no diminution in the percentage of gain for many years yet to come. She has the natural resource in mother earth, and unexcelled facilities for rapid and cheap transportation of her treasures to market. In the latter feature she is remarkably fortunate. Her copper is produced within a few miles of Portage lake and Lake Superior; her iron ores are found at from twelve to fifty miles from the shores of Lakes Michigan and Superior; her salt is within easy reach of Lakes Huron, St. Clair and Erie. The great tonnage from these mines and wells is easily moved, and cheaply, to the importance distributing centers of the country. Her great coast line is of much value in the transportation of the products of mine, mill and soil.

Coupled with the bountiful gifts that nature has bestowed, Michigan also possesses men of energy and skill who have taken advantage of these vast mineral deposits. Nowhere else are such deep shafts to be found; in no other state or country is there such mining machinery; at no other place has such courage been displayed as in the development of these mines. With all of this to her credit, Michigan will continue to hold the exalted position in the mining world she now maintains, and which has been so nobly earned. It is hoped that the near future will witness a still greater addition to the mineral importance of the state in the way of home-smelting of its iron ores, the great bulk of which are now reduced in Ohio and Pennsylvania. Interest in the matter is being aroused, important trials are to be made, and in a few years the smoke from our own furnaces and rolling mills should note increased gains to our people.

Indicative of the attention being attracted by the mines and minerals of this State are the numerous inquiries for Information received by the commissioner, these coming not only from the State and union, but from abroad. I already have requests for more than one-half of the number of copies of this report that the State requires shell be printed, and the edition of 1,000 will fall far short of the demand that will be made upon it. To make these reports of fullest advantage to the state I respectfully suggest that a sufficient number of them should be printed to supply all those who make calls for them.

In the pages that follow, and descriptive of the mines and minerals of Michigan. I am under many obligations for favors extended by those who are connected with the properties given attention. I have everywhere been courteously received, have been granted every possible facility for the obtaining of information, and here wish to extend my thanks to those who have so ably assisted me in the collection of material for this volume.

It will be observed that I have noted whatever changes of importance that have occurred in the mines since the first of January, 1896, and up to the time of publishing this report, the object being to have the reader as thoroughly informed as possible, and thus add to the value of the descriptions. Mines are subject to many changes, and the more recent the information concerning them the better for those interested.

COMMISSIONER.

IRON.

IRON ORE.

Michigan, which has been at the head of all states in the union for many years in the production of iron ore, bids fair to retain that distinction for many years to come. Its mines are many and generally in excellent condition physically. Their location, with reference to a marketing of their output, is favorable, and then they are well known to the makers of iron and steel, who have long used their ores, and who have a perfect knowledge of their action in the furnace. Michigan mines all classes of ores of high grade. There are the soft hematites, the hard, the speculars and magnetites, and from these the best combinations can be secured. In addition to ores of this class there are others that cannot stand transportation charges, these being limonites and lean hematites, of which there are vast deposits that will some day prove valuable when there is a smelting of the leaner grades in furnaces located in close proximity to the mines.

Michigan has produced 78, 911, 712 gross tons of ore since the time mining was first begun within its limits, the credits for the different ranges being found in the articles descriptive of them that are to follow.

Showing its importance in the iron industry of the country, the shipment of 6,063,267 tons, made in 1895, will be sufficient. This is about 40 per cent of the output of the entire United States, and has a value, delivered in the market, of about $18,000,000. This exceeds the output of Michigan mines for 1894 by 1,654,193 tons.

I have endeavored to secure the figures showing the amount of capital invested in the iron ore mining industry of the State, but find the task no easy one. The iron mining companies are generally close corporations whose stocks are not listed, and it would not be fair to quote the prices that have ruled during the past three years, even if the desired information were at hand. However, I hope to present this in my next report. The total will run high into the millions of dollars. The sum necessary to the mining and marketing of all these vast

outputs is an enormous one, the magnitude of which is known to but few people.

Bearing upon this feature, the figures compiled by the Lake Carriers' Association and Mr. Geo. H. Ely have important bearing. These were prepared for the purpose of presenting to the United States congress in the interest of desired legislation, and are mostly from official sources. They combine the figures from all the Lake Superior fields, however, embracing mines and interests of Minnesota and Wisconsin, but as Michigan contributes the great bulk of the business, the figures will be of interest:

Capital in the mines of the four iron ore ranges, as shown by U. S. census and estimates since last census was taken	$96,325,122
Capital in docks and their equipment at Lake Superior and Lake Michigan ports, built and used exclusively for shipping ore (official)	14,185,665
Capital employed exclusively in railroad transportation of ores from mines to shipping ports on Lakes Superior and Michigan (official)	32,364,594
Floating capital on the lakes employed exclusively in ore transportation from upper lake to lower lake ports, estimated	46,680,907
Capital in docks and in their equipments for receiving and forwarding ore exclusively, at Lake Erie ports between Toledo and Buffalo, inclusive of both (official)	15,492,880
Capital employed exclusively in rail transportation of ore, inland to mills and furnaces from Lake Erie ports (official)	28,193,617
Total, January 1, 1896	$233,242,085

The figures showing the capital employed in the mines were compiled by the late Mr. Geo. H. Ely, of Cleveland, Ohio, and were made up with great care. Combined, they represent an enormous total, and give a fair idea of the magnitude of operations in this wonderful industry.

I find the condition of the iron mining business vastly improved over what it was even a year ago. Prices have advanced about 20 per cent and a corresponding gain has accrued to the labor employed in the mines.

Combinations to regulate outputs and to secure living prices were made in January, 1896, and these bode good for the coming season. Many of the idle mines are resuming, this giving place to additional labor, and everywhere the business is taking on its old-time appearance of activity.

The hard times have not been wholly devoid of education, however. Necessity has shown where there can be a cheapening of cost of production, new methods are being employed, modern machinery introduced, and a progressive spirit is everywhere apparent. Many of the richer corporations possess their own lake ore carriers, fine modern steel steamers, whose great capacity and speed aid considerably in a marketing of the ores. There is also a railroad being built in the Marquette district that is controlled by the mining companies, and nothing is spared to meet the active competition of foreign and other domestic sources of supply.

While accidents in the mines still occur, they are not as numerous as in the past, this being due to many causes, one of which is safer explosives. Then, too, there is more skilled labor employed. In the earlier days, when wages were higher, many were attracted to the mines who were not familiar with the vocation, and on this account ignorantly brought accidents upon themselves. Each county has a mine inspector whose duty it is to examine the different properties once a month. Reports of these officers will be found elsewhere.

I find nearly all the mines provided with several outlets through which men can escape in case of accident. The ventilation is improved. There are everywhere comfortable change houses, where hot and cold water is found. Many of these houses are provided with baths. Mine hospitals are generally conducted in connection with the mines and are cared for by skilled physicians and surgeons. Nearly all the mines have "clubs" to which the men contribute from 25 cents to 50 cents each per month, the mining companies adding a like amount. The funds are used to take care of the men in times of sickness or disabling injury.

The work in the mines is universally done on the contract system, at so much per ton for breaking or stoping, or so much per fathom. Drilling is paid for by the foot, as is drifting and shaft sinking. The miner prefers to work in this way, and is not satisfied unless he is contracting. The trammers who wheel the ore from the stopes to the shafts are generally paid so much per car or ton. In a few mines they work by the day, here termed "company account."

While the iron ore mines of Michigan are of enormous extent, a feature of great value is the excellent quality of the product, it surpassing that of other ores in the union excepting in the states of Wisconsin and Minnesota that have similar deposits in the territory embraced within the iron formation of the Lake Superior region. The percentage of iron will average 63, whereas the southern fields will fall about 20 per cent below this. The large quantity of bessemer ores, those suited for the manufacture of bessemer steel, adds wonderfully to the importance of the district, as it is from here that the United States must secure its supply. The great change that has occurred in the past few years whereby steel has supplanted iron by reason of its greater toughness and the fact that it can be manufactured at less cost, makes the Michigan fields still more important metallurgically.

During the depressed period these high grade ores were sold as low as $2.60 per ton, this being for deliveries at Lake Erie ports. The non-bessemers were quoted at $2.00 per ton. The price in 1895 was considerably in excess of this during the latter part of the season, the highest grades commanding $4.00 per ton, the non-bessemers $2.40.

During 1895 there also arose a demand for ores high in silicon, these being wanted for mixture with Minnesota ores from the Mesaba range that were wanting in this element. Highly silicious ores could not be supplied from Minnesota owing to the cost of transportation, the distance being 600 miles greater for a round trip from the mines to Cleveland, Ohio, than from the Marquette and Menominee ranges of Michigan, and to the latter fields the furnacemen have applied. Several mines have started up to supply this want, and considerable is being done. Of this, reference will be made in the mine descriptions.

With improved waterways from Sault Ste. Marie eastward through the chain of great lakes, Michigan will become still more important in a mining way, as her ores will then be transported more rapidly and at a considerably less cost than now. This great water route is being deepened and made more easy of navigation, a work of incalculable value to the iron ore mining industry.

THE MARQUETTE DISTRICT.

Briefly, it possesses a length of forty miles and has a width of from three to ten miles. Its eastern terminus is near the city of Marquette, and its western a few miles south of the village of L'Anse. The formation trends nearly east and west. The iron ores occur in the Huronian rocks of this area of which there are some 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 forced their way. In these folds of the formation the ore is found generally in lenticular-shaped masses or "pockets," as they are locally termed. The formations are very much distorted and twisted in many places so that following of ore veins is not easy of accomplishment, in this respect being much more difficult than upon any of the other ore ranges of the Lake Superior region. The eruptive rocks have played an important part in assisting in the concentration of the ores as well as protecting the latter at the time of the terrific glacial grinding to which this country was subjected. Of this there is frequent illustration in the descriptions of the mines that follow.

While the first discovery of ore was made in the Marquette district as early as the year 1845, it was not until 1856 that shipments of ore were credited to it, there being no means of transportation until the latter-mentioned year. Naturally, the work of development was tedious and expensive. Little was known of the business of mining. The methods were faulty, the machinery primitive, and the first million of tons was not produced in a single season until 1877. This achievement was not referred to without some feeling of apprehension on the part of the mining companies, however. I will remember the sober predictions that such an enormous quantity of ore must surely flood the market to the exclusion of other stocks for some time to come. At this period in its history Lake Superior boasted no other ore range than this. Since then the gain has been steady, and the close of 1895 finds a credit of 43,937,510 gross tons for this range.

From a personal inspection of every working mine in the district, I can assure the people of the State of Michigan that the Marquette district is still one of the most important in the country. Its stores of ore are abundant, new discoveries of promising nature have been made, and at no former time has there been a greater tonnage developed in its mines and not yet brought up to the light of day. It possesses both hard and soft ores, bessemers and non-bessemers (all that the makers of iron and steel need to give them satisfactory mixtures, and it has the means at hand to produce them rapidly. The distance to lake port is fifteen miles from the most active scene of mining operations, Marquette being the nearest lake shipping point, while Escanaba is sixty miles away, but with a lake rate for the handling of ore that brings the freighting charge, rail and lake combined, to about the same figure for deliveries at Lake Erie ports. I find excellent equipments of machinery everywhere, and at all places there is progressive, wide-awake business management.

The total number of tons sent out in 1895 was 2,095,166, this being a gain over the previous year of 36,483 tons. This would have been considerably increased but for a strike of miners and mine laborers lasting for ten weeks in the midst of the shipping season.

In writing of the mines of this district I shall not attempt to take them up in the order of their discovery, but will associate them with the different towns nearest which they are located. This will more readily familiarize the reader with their whereabouts, and assist in an easier reading of the map showing the boundaries of the different properties.

The most easterly mines of the range now in operation are those in and surrounding the city Negaunee, a bright town with a population of over six thousand.

THE BUFFALO MINING COMPANY.

Under the above title are now operated the Queen, Prince of Wales, Buffalo and South Buffalo mines. They are all located on section 5, town 47, range 26. The ore deposits occupy troughs made by the folding of the slates. On the south forties there is a fold that holds what is termed the "Regent" lens, this being on the Queen tract. The Queen mine old lense occupies another fold in the same forties farther north, and in the next fold is the Prince of Wales and the Buffalo vein. The ore made up to the overlaying sand and was first secured at the Buffalo old mines in open cuts, but they have mined out these, and all the ore is now taken from underground. The lenses pitch to the west and at that end of the present workings a very strong capping is met with. This has given some trouble on account of its firmness, the plan of working adopted here being to cave the overlying burden, letting it follow after the ore. They mine out one level at a time, commencing at the top of the ore deposit and slicing it off, protecting the ground with light drift sets, and letting the surface rock, sand, etc., come down in the mined-out territory. The accumulation of timbers, called "gob," soon forms a strong network, and, protects the miner from danger of a too-sudden rush of ground. The object is to take one level at a time, cutting it up into as many blocks as can conveniently be handled, and winning the ore as rapidly as possible. The heavy capping offered a serious obstacle to the method employed, and square sets of the old-fashioned sort were used so as to open up a large room under this capping. On the 24th of last December

the surface broke away, and now the management can operate the caving system satisfactorily.

The ore is a non bessemer, a soft hematite, that gives about 62 per cent metallic iron. In the “Regent” lense, which was opened upon about two years ago, there was ore of bessemer grade near surface, but at greater depth it has changed to a non-bessemer, Mr. Cole, who has charge, arguing that the phosphorus of the higher horizon has leached out, being carried to the lower portions of the lens. Work of mining has been confined to this regent deposit since the resumption of operations in 1894, and a find showing is now presented. They have mined out the ore to the fourth level, 250 feet from the surface, and are now preparing the fifth level for attack as soon as the fourth has been finished. They have a two-skip underlay shaft here that inclines at an angle of 45 degrees, following the dip of the foot wall.

The Queen has reached a vertical depth of 450 feet, and has a level of ore standing that can be wrought at any time when there is a demand for it.

The Prince of Wales is 450 feet deep, and awaits the pleasure of the management. It has large stopes of ore that can be readily obtained. There is a rope haulage plant that handles the product from stopes to shaft at a rapid rate of speed. The shaft is a fine one, having two cage-ways. Skips and cages are worked in balance at all the shafts of the Buffalo company, and single engines are employed, changes in their original fitting having been made to permit them handling two skips without centering.

The old Buffalo mine has ore showing, and could send out a considerable tonnage, but nothing is being done at this point.

The ore deposits of the South Buffalo are exhausted, and the shaft is used for the sending of timber into the mines.

The shafts are all in solid ground at the different properties; substantial rock drifts have been put in connecting the several mines, so that all the ore can be obtained, the miner protected and the ventilation of the underground workings made perfect. The mines make considerable water, they taking the large volume coming from the Blue property that adjoins immediately on the west, and which is idle. The company possesses fine machine, carpenter and smith shops, is well equipped for taking care of its mining affairs, and has expended a large amount of money in preparing for the future. When working full force of men about 600 are employed, but this number has not been given place since the depression of 1893.

The mines of the company have produced 2,053,705 gross tons of ore, of which 220,300 tons were sent out in 1894, and 160,817 tons in 1895. The fee is owned by the Breitung estate, W. P. Healy and others. The principal owners of the lease are Corrigan & McKinney, Cleveland, Ohio. The general manager is T. F. Cole, Negaunee. Richard Roberts is mining captain, Walter Croze mining engineer, Thos. Carmichael cashier.

The above mines were closed on the 2d of January, in this year, and the working force of 225 men discharged. The company informs me that an excessive royalty rate forced them to this course. It is 40 cents for each ton mined. This rate was not paid in 1893 and 1894, however, concessions having been made by the fee owners. At the present time, March 10, 1896, the mines are still idle, occasioning great distress amongst the labor of Negaunee, the Buffaloes, when active, being the principal labor-employing concern in the town.

THE NEGAUNEE MINE.

This property lies north of the Buffalo group of mines, being located on the northwest quarter of section 5, and for some years has been an important producer of high-grade bessemer ore. The latter is of a schistose nature, is so firmly in place that it all has to be drilled and blasted, and in the upper levels very large stopes were mined without the use of timber. The vein is a flat one, having a dip to the northwest of 34 degrees on its upper side, and of 31½ degrees on its lower. They have opened up on the trend of the deposit for about 700 feet. The thickness of the ore between hanging and foot walls is about 35 feet, and the width is from 280 to 350 feet. The walls are a lean ore formation, and very substantial. Crossings of paint rock, having a thickness of from 6 to 20 feet, are met with occasionally, they cutting the ore body from east to west.

The mine has but one shaft, this being in the hanging in the upper levels, and has been continued to the 486-foot level, which is the third in the lower portion. It is vertical, having skip-way and ladder-way. The three levels reached by this shaft have been worked out. From the third level a shaft was put down on the foot wall, but the inclination of 35, degrees being more upright than the dip of the vein, the shaft is now into the foot wall, crosscuts being necessary to connect with the ore of the different levels. Of the latter there are six, upon the upper four of which the principal mining is now being done. On the fifth level they have run their main drift along the foot, and upon the sixth level they have just begun this task.

On the fourth level, at the time of my visit, they had opened five rooms in ore. These rooms are three sets wide, sets of timber being seven feet from center to center, legs being eight feet. They leave pillars to support the hanging, these being three sets wide, or as thick as the mined-out portion. They mine from foot to hanging, first driving their main drifts and following with wing drifts, taking care not to have the latter as far advanced as the former so that the ground will not be too much weakened. Hand drilling, with hammer, or jumpers, is practiced, no machines being employed. The rock, is disposed of by dumping it upon sixteen-foot lagging that is laid in the bottom of drifts, the drifts being also lagged on the sides to prevent the waste from

mixing with the ore. They use hemlock for legs and pine for caps. The water is carried over the sills in the drifts, and upon the sills a four-inch tie is placed, this carrying the tram car rails which insures dry footing for trammers. In getting the timber into the mine they take advantage of the noon hour to lower it as far as the vertical shaft extends, this permitting the cage to run steadily on ore during regular working hours. On each side of the incline shaft raises have been put in from the top to bottom of the mine, and through these avenues the timber is handled from the bottom of the vertical shaft. These raises also afford ventilation, and would serve as a means of escape from the lower levels in case of accident in that portion of the mine.

Protecting the incline shaft, a body of ore 112 feet thick has been left, and two lines of hose are always in readiness in case of fire. The vertical shaft is a very wet one, the water running over the timbers everywhere, so that there is no danger from fire. This precaution is observed because it is the only avenue leading from the mine. From the top of the incline shaft a stairway takes the place of the usual ladder road, and, due to the flatness of the vein, it is a great improvement over the ladders.

In the lower levels they are meeting with high phosphorus areas that were not encountered nearer surface. The greatest care is observed in the sampling of the ore in the stopes. Each set of timbers bears an iron tag showing the quality of the ore. If of bessemer grade, the iron shows one hole punched in it. If non-bessemer, three holes are found in the tag. There is also a tag showing that the chemist has not yet determined the class of ore. In this way they keep close watch of the different kinds, and a stockpile is secured that can be guaranteed to the consumer.

The mine has fine slopes, and could produce a far greater tonnage than has been averaged for the past few years. For 1895 the gross tonnage mined was 90,731, for 1894 it was 132,493, and the grand total to date is 648,338. A royalty of 15 cents per ton is paid the fee owners.

The mine needs a better hoisting plant, and one is now being arranged for. Employment is given to 140 men. Captain Samuel Mitchell is agent, Alfred Newcombe mining captain.

THE GRAND RAPIDS MINE.

This mine is located in the southern part of the city of Negaunee, occupying ground considerably elevated above the town. Its ores are found in the western extension of the formation of the old Milwaukee mine, now idle on account of exhaustion of the lenses which gave the product in the past. The diorite rises on both sides of the trend of the formation, which is east and west, and in the jaspers and soapstones the ore lenses are found. They have two shafts in the foot-wall, these being down to the 450-foot level, and have a length of 450 feet, measured on the incline, of about 65 degrees. The most westerly of the shafts was put down 100 feet in the winter of 1895-6, but no mining has since been done. They have a deposit of ore possessing a thickness of 20 feet and it has been opened on its trend for 300 feet, the ore being a non-bessemer. Two 5-foot hoisting drums are in workable condition and are ample to take care of the ore mined. In December of 1895 the lease was purchased by Edward Breitung and others, who intend to operate the old Milwaukee in connection with it. The Breitung estate owns a controlling interest in the fee, Jas. H. Rough, Fred Nightingale and other Negaunee gentlemen were holders of the lease, and had done the work of sinking referred to. The late purchasers have not as yet commenced the task of developing the property.

The total production is 110,599 tons, of which 6,767 were shipped in 1895 from stockpile mined several years ago.

Since the above was written the recent purchasers have relinquished possession of the mine and seek to have the former operators release them from the conditions of the sale, which the latter refuse to do, and the matter will be decided in the courts. The shafts are now filled with water.

THE BARASSA.

This property lies directly east of the Negaunee mine tract, and adjoins the latter. Ore of excellent quality was cut by diamond drill borings, and they attempted to reach it with a shaft through quicksand. After many months and many thousands of dollars expended in the effort, it was finally abandoned without the sought-for ledge being encountered. The owners now talk of trying a shaft in the solid rock that outcrops a short distance north of the old shaft, but the work has not been commenced as yet. Mr. Barassa, of Negaunee, is the principal owner of the fee, and the tract is looked upon as a most favorable one. A shaft will probably be sunk early the coming spring.

THE JACKSON MINE.

This property is attractive in the history of the iron ore region of Michigan and the entire Lake Superior region because of the fact that it was here the first discovery of ore was made, here the first mining was done, and from its ores the first iron was manufactured. The discovery of the ore was made in the winter of 1845-6, the glistening mineral being first seen where the upturned roots of a tree exposed it to view. Since that time the mine has been an active producer, and the fact that it is still one gives some idea of the persistence of the ore deposits of this range.

The older workings of the mine extended well towards the main street of the business portion of Negaunee city, but this territory has been abandoned and operations are now being conducted on the western end of the company's property, half a mile farther west, where one

shift is worked and where the monthly product amounts to about 4,000 tons.

They have two working shafts at this end of the mine, the "Sand shaft" and "North shaft," the latter being so named because it is the most northern at this portion of the mine. It is vertical, is 210 feet deep, and operations are confined to the robbing of pillars that were left in former years to support the hanging wall. At the Sand shaft, which is down 300 feet, they are following the ore vein on its western extension, and some fine stopes are seen. The ore occupies a trough or fold and is quite flat, about 35 degrees. On the hanging wall side there is soapstone for four feet and over this is banded ore and jasper. The foot is a lean ore formation. The soapstone, where free from water, stands well, and needs no timber to hold it in place.

The Jackson is productive of both hard and soft ores, these occurring indiscriminately in the vein. They may be working in a stope of soft hematite and find ore of the hardest nature at any moment. The metallic contents of each are about the same, yielding 58 per cent iron, and is just on the bessemer line. There is a constant rolling or waving of the foot wall, and generally the hanging conforms to it, but I saw places where it did not, and here the largest stopes of ore are found. Some very high stopes are worked, the miners letting the broken ore remain under their feet while they work upward, this being preferable to high staging or ladders.

The ore is making under the swamp to the west, and evidence of this is seen in the increased dripping of the water in the back of the level. There is plenty of room in the west end of the mine for large deposits of ore, and it would not be surprising if they are met with. There is considerable ore yet left in the shape of pillars, and at the present modest manner of operation it will require many years to secure this.

The company is fortunate in possessing the fee of its property, and it has also advantages in the way of transportation facilities, possessing its own boats that are of modern construction, built of steel, and are fast steamers.

The Jackson has produced a grand total of 3,380,691 gross tons, and in the past has paid handsome dividends to its shareholders. About 80 men are employed, they working on the contract system, being paid so much per skip for breaking and tramming the ore to the shaft.

Capt. Samuel Mitchell, one of the progressive mining men of the district, has charge, and is president of the company. James Harvey is mining captain, Thomas Pellow is secretary, Chas. Jennings cashier, C. B. Mason mining engineer and chemist.

THE BLUE MINE.

This mine is idle and has been since October, 1894. There is plenty of ore in the mine, but the fee owners exact a royalty of 40 cents per ton, and the selling price of the ore will permit of no such extravagant figure for the privilege of extracting the mineral.

The location is the next west of the Buffalo group of mines, adjoining the Queen, and its ore deposit is a continuation of that found in the Queen. They have a shaft in the foot wall to a depth of 540 feet, the lowest level, the third, being run at a depth of 526 feet. No mining has been done upon this level, and the crosscut from the shaft had not reached the ore when operations were suspended. The workings of the Queen have proved considerable of value for the Blue, however, and it is fair to predict a satisfactory ore deposit on the third level when the latter has been opened out.

In appearance and quality the ore is like that of the mines of the Buffalo company, yielding 62½ per cent metallic iron and from the .100 to .112 in phosphorus. They are well equipped with machinery, and are ready to resume business whenever they succeed in obtaining a more favorable rate of royalty.

Samuel Mitchell is president, Thomas Fellow, secretary and treasurer, Negaunee, Mich.

The mine has produced a total tonnage of 83,280, of which 44,140 was shipped from stockpile in 1895.

THE CAMBRIA MINE.

The location of this is about a mile north and west from the business portion of the city of Negaunee. It lies close to the south shore of Teal lake, a magnificent body of water from which the city secures its supply, and is worked under lease from the Teal Lake Iron Co. Work was begun here in 1876 on lenses of ore that outcropped on surface, and from which a considerable product was secured in open pits. They finally went underground, and a caving in of the surface caused them to abandon the workings. The present management has an idea that there may be ore in the bottom of the old pits, and an exploring shaft is being sunk. At a depth of 100 feet it struck the old timbers of the mine. They will go through these and endeavor to learn something of the territory beneath. The ore in the old pits was of excellent quality, better than any since found on the company's lands and surpassing that of most mines in this district.

Two lenses of ore are found to the north of the old pits, these having about 300 feet of ground between them, and to each a shaft has been sunk. No. 2 shaft is the most easterly and is down to the eighth level, 570 feet, and 60 feet more has been sunk for the addition of another level. At this shaft they are taking ore pillars on the seventh and eighth levels.

No. 3 shaft is located 400 feet northwest of No. 2, and pillars are being taken on the 5th, 6th and 7th levels. The shafts are connected by a drift at the 6th level, and similar connection will be made at the eighth level.

The ore is of a hard nature, having to be drilled and blasted, and occurs in a ferruginous schist. Its pitch is to

the west, and it may dip to the north or south, it occupying folds in the formation, the footwall of one lens making the hanging of another. The ore generally makes into the hanging wall and into this holes are frequently bored so that none may be overlooked.

The footwalls rolls and waves irregularly, and it is often perplexing to those who have to follow it. The vein may narrow to a few feet and then swell out to 30 or 40. It has been as thick as 100 in the upper levels at the west end of the mine.

In winning the ore they use the ordinary square sets, taking rooms two sets wide and leaving three sets of ground to support the hanging. The pillars are secured by caving them. The best ore is found in the east end of the mine, where it is of bessemer quality, giving about 64 per cent in iron. But little water is pumped. In a drift being run to the north to explore the ground in that direction, they were meeting with considerable water at the time of my visit in January, and the miners were somewhat nervous, thinking the lake might be the source of the increased flow, but they are too far away from that body of water to meet with trouble from that quarter. It may be the water that has lain in some ore pocket, this being of usual occurrence in hematite mines, and, instead of a menace may prove the forerunner of something valuable.

The mine is well equipped with machinery, having four 6-foot hoisting drums, and gives promise of being an important producer for many years to come. It has yielded a grand total of 751,260 tons, of which 39,467 tons were shipped in 1895.

A. W. Maitland is general manager, John Deacon mining captain, Fred Nightingale cashier. The president is W. M. Barnum, New York city; the secretary and treasurer, S. P. Ensign, Lime Rock, Conn. The title of the organization is The Cambria Mining Co.

THE LILLIE MINE

adjoins the Cambria immediately upon the west, and is operated by the Cambria Mining Company. The ore occurs in the same fold in which the original workings of the Cambria mine were made, but it is of different character, being very soft, and is also non-bessemer. They have two shafts, one to the 300-foot level, which is used only for ventilation, and one to the 6th level. The latter is vertical to a depth of 350 feet, and then follows the inclination of the foot, 51 degrees, for 400 feet, measuring on the incline. They talk of sinking another shaft several hundred feet southeast from the present main one, but the work has not been commenced as yet.

The ore is won by slicing from the top, letting the overlying drift and rock follow down. This is osberved throughout all parts of the mine with the exception of a portion of the east end where the capping is very strong, and here the ordinary square sets are employed.

They are now preparing to attack the ore on the fifth level, the lowest opened up. The shaft is down to the sixth, but nothing has been done in the way of starting the level. They mine out one level at a time. The showing of ore on the fifth is a fine one, the ore lense having a thickness of fully 100 feet and is several hundred feet long. Indeed, the Lillie never looked as healthy as the present finds it. Owing to its soft character, the ore mines readily, and the caving system can be worked to advantage. The best ore is met with in the west end of the property, whereas at the Cambria the opposite is in the condition. Like the Cambria, it is a royalty paying mine.

There has been considerable surface improvement here during the past few months. They have put in an 8-foot hoist and two new boilers with new buildings for their reception.

Capt. Deacon looks after underground affairs at the Lillie and Cambria. Ben LaLonde is mining engineer and chemist. About 300 men are employed at both mines.

The Lillie is one of the few properties at which 8-hour shifts are worked.

The mine has yielded a total of 429,946 tons of ore, shipping 54,445 for the year just ended.

THE HARTFORD MINE

is located next east of the Cambria, and is now idle. It has two shafts, the deeper of which is 450 feet on its incline. Mr. Ben Neeley, of Negaunee, the president and manager, informs me that they have 60 feet of ore of good quality. To the east of the shaft the ore outcrops and they have done some testpitting on it. About 200 tons were shipped from a lean ore dump this year, 1895. They lease the property from the owners, the Teal Lake Iron Co. The shafts are full of water, and the time of resumption is uncertain. S. R. Bell, Milwaukee, is secretary.

There are other idle properties in and about Negaunee, some of which are well located. The Lucy, on the south side of town, was formerly operated by the Cambria Mining Company, but was surrendered to the fee owners, who would not lower an unreasonable rate of royalty. It was a producer of a manganiferous ore, the lenses being small and expensive to work.

The old Rolling Mill property has been idle for several years, but the location is a favorable one and there is talk of exploring it.

On section 8, to the south of the Buffalo mines, there is a fine chance for ore deposits.

At the present time there is nothing being done in the way of exploring at these abandoned places, whereas, a few years since, the surface was dotted with drills and windlasses; but with an improved condition of the market for ore they will resume with their old-time activity.

MINES OF PALMER.

The village of Palmer is the commercial centre for the mines of the Cascade range. It is five miles south of the city for Negaunee, and the vicinity has been the scene of great activity in former years, but during more recent ones it has felt the depression like other towns depending on their iron mines for business. While much has been done in the past in the way of exploration, but few mines have been developed. Just now there is a demand for iron ores high in silica and low in phosphorus, and the Cascade range possesses those of this nature, and they are being developed. Prominent among these are the mines of

THE CONSOLIDATED MINING CO.

These were formerly known as the Mesaba's Friend mine and the Richards' mine. The first was located on the south half of southeast quarter of section 28, town 47, range 26, the latter on the northwest quarter of northwest quarter of section 33, and were leased for a term of twenty years, the royalty being ten cents per ton for ore yielding under 58 per cent in iron and 15 cents for ores that gave a higher percentage than 58. The company also owns the fee of the southeast quarter of section 26, same town and range as properties above described. The leases are secured from A. H. Wick, of the Home Iron Mining Co., Cleveland, Ohio.

From the first described of the above there were mined and shipped 5,503 tons of high silicon ore during 1895, the product coming from an open cut, from which it was cheaply secured. On the old Richards property no ore was shipped, but a considerable body of it was exposed by stripping off the surface, which is but a few feet thick. A large output can be made from these properties, and, while the price is low for ores of this class, they have no pumping or timbering to do, and with proper management ought to make a profit. The ore assays 48.30 per cent in iron .026 per cent in phosphorus, 28.80 per cent in silica.

On section 33 they have a shaft down 40 feet, and are drifting north in lean ore.

J. H. Quinn is president and treasurer, T. J. Dundon, secretary, Ishpeming, Mich.

THE PLATT MINE.

The mine has been working for the past five years, and is located on the northwest quarter of the southeast quarter of section 29, 47, 26. They have a shaft down 200 feet, have followed the deposits for a length of 400 feet, the latter being much broken and twisted. They have opened five levels. At a distance east of the shaft of 280 feet they have sunk a winze 80 feet, have a crosscut from the bottom of this 75 feet, and have followed the formation on its trend for 120 feet, but the showing of ore was not satisfactory. The jasper comes in too frequently for comfort, and the mine has been a perplexing one to handle. The ore found is of excellent quality, and they secure it by mining from the bottom up, using drift sets. There has been some talk of closing the mine, but this has not been done up to the 2d of March, 1896. They have an excellent plant of machinery, 6-foot drum, 10-drill compressor, and two 80-horse power boilers. The fee is owned by H. Wick, of Cleveland, O. The mine superintendent is John A. Redfren; cashier, O. B. Warren. The president of the company is John F. Eddy; secretary, Newell A. Eddy; treasurer, Chas. A. Eddy, of Bay City, Mich.

THE STARWEST MINE

is better known as the Wheat, under which title it was operated for many years. Its location is the southeast quarter of the southeast quarter of section 29, 47, 26, the fee being owned by the Home Iron Mining & Manufacturing Co., Cleveland, O. The mine was closed in 1891 and resumed again in September, 1894, being taken hold of by Samuel Hoar and others, of Negaunee and Palmer. The work was confined to outcroppings of lean ore, and 5,550 tons were mined in that year. During 1895, 51,207 tons were mined and shipped, this being of the lean ore class. Late in the fall of '95 the task of unwatering the old workings was commenced, and has been completed. The lowest level is 225 feet from surface, and there is a promising lens of ore here, having a pitch to the west, and in this direction they hope to develop something of importance. The quality is much better than that of the surface deposits upon which work was conducted the past summer. There are two ore formations here with diorite separating them, and two shafts reach the deposits. These have lately been repaired and placed in condition for active operations underground. Additions and improvements have been made to the plant of machinery, and a reorganization of the old company has taken place, Mr. Hoar's interest having been purchased by prominent people of Marquette county. The officers are: S. R. Kaufman, president and treasurer; T. F. Cole, vice president and general manager; L. G. Kaufman, secretary; Harry Whitburn, mining captain.

THE VOLUNTEER MINE.

This is the most important mine on the Cascade range, and is located in the village of Palmer. It was for many years known as the Palmer mine, and has sent to market 1,009,955 tons of ore. It was closed down in the spring of 1894, due to the feeble market and the prejudice against hard ores, of which it is a producer. In 1894 it shipped 26,946 tons and in 1895 sent out 32,672 tons, and has something like 40,000 tons now on hand at the mine.

The Volunteer is rich in large bodies of ore, but the quality is not up to the standard of hard ores now demanded by makers of iron and steel, and the price offered is not sufficient to pay for working the property, so the latter is full of water. The principal work done for two years before the closure was at the east end of the mine in A, B and C shafts. The former is the most

eastern and is down to the 6th level. B is 300 feet farther west and is to the 10th level. There has been but little work done below the 5th, and the showing of ore was a magnificent one. They were driving a drift from the 9th level to connect with C shaft, 700 feet west.

The ore at B shaft gives about 55 per cent in metallic iron and is wavering on the bessemer limit as to its phosphorus content. C shaft ore gives 62 per cent iron.

There is a fine equipment of machinery, and everything is in shape for active mining whenever the order for resumption comes. The company possess the fee of 1,800 acres in the immediate vicinity.

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

EXPLORATIONS.

J. Q. Adams and others are exploring on the northeast of section 33, 47, 26 and the northwest of the northwest of 34, and are looking for ores high in silica.

THE MARQUETTE & NEGAUNEE EXPLORING CO.

are looking for ore on the east half of the southwest of 19, 47, 26. They have a shaft down 82 feet from the bottom of which there is a drift north of 10 feet in rock and one of 25 feet to the south in mixed ore and jasper. Four men are employed, and the option is from the Iron Cliffs Company.

The Pittsburgh & Lake Superior Iron Company, of which Mr. Jos. Kirkpatrick, of Palmer, is one of the principal owners, did considerable diamond drilling for iron ore to the east of the Volunteer mine some years ago, and found much of promising kind, hard ore of excellent quality, but they have not yet started a shaft to develop the vein, they awaiting the advent of better times.

MINES OF ISHPEMING CITY.

Ishpeming is the mining center of the Marquette district. It is a lively town of over 12,000 inhabitants who are wholly supported by the mines. It is two miles west of Negaunee, and fifteen from the lake port of Marquette. Its mining corporations are powerful ones, possessing the fee of their vast estates; they have ample capital to carry on their affairs, and have been remarkably successful.

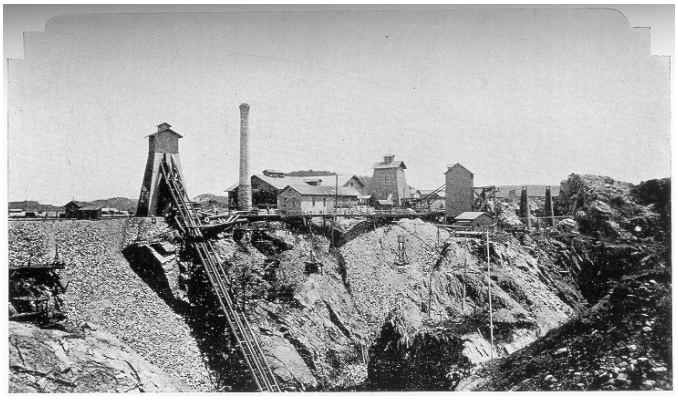
THE LAKE SUPERIOR IRON CO.

was the second to engage in iron mining in Isheming, and the third in chronological order in the Lake Superior district, its first shipment of ore having been made in 1858. It has also credit for having produced more ore than any other iron mine in the district, its shipments up to the present reaching the magnificent total of 6,734,472 gross tons, of which 342,097 tons were marketed in 1895. It has been in constant operations in all seasons day and night. It has paid its labor promptly, has been progressive and energetic, and has done much in calling the attention of capital to this mineral field.

Due to so long a period as has marked the operations of the company, there are many changes from the conditions that marked their earlier history. In the early days the hard ores were the ones sought, but little being known of the softer, and these were mined from immense open pits that still mar the surface in many places. The hard ores outcropped on the north side of a high range of diorite hills that trend east and west through the city and on this side of the hills the work of the company was confined for many years. Extending eastward there is a change from the hard to the soft ores, and a break in the hills makes the valley or basin in which Lake Angeline formerly lay. The waters of this lake, 800,000,000 gallons, have been pumped out, and underneath the old lake bottom the Lake Superior, Cleveland, and Pittsburgh & Lake Angeline Companies are now all conducting mining operations.

The ores of the Ishpeming mines occur in troughs made by the folding of the diorite, the latter being in line with the trend of the immense synclinal, east and west. On the north fold there is the hard ore mines of the Cleveland-Cliffs Company; in the next going south is the hard ores of the Barnum and Lake Superior, and the soft ores of the Lake Superior; next south the soft ores of the Lake Angeline deposits, and succeeding this is the fold in which the old Lake Angeline and the section 16 mines of the Lake Superior Company are held. In these folds are the usual quartzites, jaspilites, soapstones, paint rock, and other associates of the ores common to this field.

The Lake Superior operates the Lake Shaft, Old Mine Hard Ore, Section 16 Mine, and Section 21 Mine.



A VIEW AT LAKE SUPERIOR HARD ORE MINE.

THE OLD MINE HARD ORE

is located at the west end of the high range of diorite to which I have referred. Its lowest level is 920 feet from surface, this being at the most westerly shaft, No. 7. There is ore still showing in the bottom. On the 860-foot level they are driving east to connect with a drift being

put in from No. 6 shaft, several hundred feet farther east. No. 6 is the most easterly shaft on the hard ore deposits, and is down 840 feet. On the 860-foot level 350 feet west of No. 8, they have a find stope of ore, and at the 680 and 760-foot levels at No. 7 they are developing new lenses that give promise of being valuable. These ores are of the slate variety, running high in iron and containing no moisture.

They secure the ore here by mining from the bottom upward, filling with waste rock that is readily milled down. There is a great tonnage of ore still remaining in pillars that will give a substantial portion for many years to come, as pillars are plentiful throughout this portion of the mine.

An interesting study at No. 7 shat is the position of the diorite. To the bottom of the old open pit it formed the footwall, conforming to the inclination shown in the surface outcropping, but below the bottom of the pit it dips south, forming the hanging wall, and at a depth of 920 feets till observes the latter position, gaining about 15 feet in every level of 40 feet that has been sunk. Eventually, it will probably assume the position shown by the inclination near surface, but as long as it holds its present course it gives opportunity for ore lenses to make. The great eruptive evidently came up vertically and then tilted over the north.

THE LAKE SHAFT.

This shaft was sunk to find the eastern extension of the bodies of hematite that were encountered farther west, and which have been worked out in what used to be known as the “Old Mine Hematite.” It is vertical and is down to the 750-foot level, but up to the present the 513-foot is the lowest level upon which mining has been done, six levels having been opened up to and including this. The ore in the upper levels contains about 5 per cent manganese, an unusual element to such extent in the ores of the Ishpeming basin. There is considerable non-bessemer in this mine, and the vein has been irregular, and contains many bunches of rock. In the east end of the mine they are following the ore upward, it turning towards the surface. The object is to get on top of the deposit and mine it downward, letting the surface follow. In the levels where ore has been mined it has been taken on square sets, beating out rooms two sets in width across the vein. There are four raises connecting the different levels. The water is taken up at Cage shaft, at the eastern end of the old mine hematite, and 700 feet west of the Lake shaft. Eastward they have mined to the west line of the Cleveland company's property.

What promises to be one of the most important mines of the Lake Superior Iron Company is now being given attention. The location is 800 feet south of the Lake shaft. Here they explored with the diamond drill in the summer and fall of 1895, and five holes encountered soft blue hematite of excellent quality, it having a thickness of from 50 to 100 feet. Assays give from 65 to 68 per cent iron and show well under the bessemer limit as to phosphorus. To reach this ore they are driving a drift from the 300-foot level of their Lake shaft, the object being to get under the bottom of the deposit and then rise into it, opening out on the top of it, and letting the surface come down. The surface here is composed of 15 feet of mud and 53 feet of sand, gravel and hardpan. On the 5th of March, 1896, this drift was in 550 feet. In size it is 9 feet high by 8 wide. The ore from the new deposit will be taken through this to the Lake shaft, power of some kind being used to do the tramming.

By way of illustrating the skill of the modern miner, I will add that 166 feet were cut in this drift in the first month, the rock being stubborn hematite jasper. Three shifts of eight hours each were worked

SECTION 16 MINE.

This property of the Lake Superior Iron Company adjoins that of the hard ore workings at the west end of the Lake Angeline mine, and it has been a producer of hard ore for several years past. It was prospected from a small shaft put down near the Lake Angeline mine, and since then two others have been sunk to the northwest. Of these what is known as the “New Shaft” is the principal working one. It is down to the 630-foot level, but the two lower levels are not opened out as yet.

At the old shaft they are stoping up on the vein on the 190 and 230-foot levels, the ore broken being sent down to the 270 foot level from which it is trammed to the New shaft and sent to surface.

Nothing is being done on the 310, 350 and 390-foot levels. They are mining on the 530 foot and are carrying down a slope that makes quite flat to the west, the angle of inclination being something like 40 degrees. They have followed this down to a point corresponding to the 530-foot level of the shaft, and will continue downward to the 580 foot territory, when it will be connected with the shaft by a dirft now being driven. The ore from the slope is hoisted by a small engine located underground to the 430-foot level.

To the west the vein is quite flat and is also very irregular, it folding and twisting in a way that bothers the miners not a little. A dyke possessing a thickness of about 130 feet cuts through the ore formation from east to west and ore is found on both sides of it.

A soft hematite is found on the 530-foot level to the north and east of the shaft, and they are now developing this.

There is but little timber used in this mine. At certain places the hanging is weak and it has to be employed, but generally the ground is solid and remains in place after the ore has been secured.

There are fine stopes in the mane, lenses that run from 20 to 40 feet thick, and the outlook I consider promising. There is a large territory to the north and west, and it is generally thought that the ore formation will make

around the western end of the diorite hill, joining that of the hard ores of the north side of this elevation.

Two miles south of the city of Ishpeming is the Lake Superior Iron Company's.

SECTION 21 MINE,

which adjoins the workings of the old Winthrop and Mitchell mines on the north and west. This is a comparatively new mine, and they have not produced much from it as yet, the work thus far performed being confined to the sinking of shafts, opening of levels, and preparing the property for active production.

There are three shafts to the ore body. The west shaft is vertical from 300 feet when it is inclined to conform to the dip of the footwall. It is to the 450-foot level, and, as its name indicates, is near the western end of the property. From the 400 foot level they explored the territory to the north and east, this resulting in the finding of a large deposit of ore about 20 feet from the shaft. This has not yet been drifted to, the find having been made with the diamond drill, but the work of testing the size of the discovery will soon be commenced.

The east shaft is 1,100 feet east of the one at the west end of the mine, and is down to the 580-foot level, and was sinking for another lift of 100 feet at the time of my visit. In the upper levels of this shaft the ore is very irregular; there are many bunches of rock encountered, and there is considerable low-grade ore that is not being touched. The ore of the entire mine is generally non-bessemer.

From the East shaft to the Mitchell shaft is 750 feet. The Mitchell was formerly sunk to take care of the Mitchell mine ore, just south of the Lake Superior, and as the ore was worked out to the Lake Superior line, the latter company purchased the shaft for their use. This shaft is to the 580-foot level. As they work east the vein swings gradually to the north, and one cannot but believe that it will eventually make alongside a diorite outcropping some distance northeast. If this proves to be true, it will insure a long stretch of ore. In the east end of the mine on the lower levels the vein is regular and has a thickness of 40 feet. The quality is also improved over the ore of the upper levels.

In winning the product they use timbers, but not the ordinary framed sets, "sprags" being used instead of the fitted pieces. They put in raises and mine for 50 feet each side of them, working from the farthest side of the block of ground back to the raises. When the rooming is finished on a level they go back to the end of the vein, beating out the pillars from the end of the mine first, and letting the hanging follow them, in this way keeping the back safe where they are taking the ore.

The new shafts are fitted with skips that work well in their vertical positions. Shafts are three-compartment.

This promises to be an important addition to the mines of the company. Indeed, it is that already. They are finely equipped with modern hoisting, compressing and pumping machinery. Capt. John Trebilcock is in charge of the underground and has general supervision over the surface as well. Jas. Trebilcock is mining captain at the Hematite and Section 21 mines of the company, while John McEncroe performs similar duty at the old hard ore mines.

C. H. Hall is agent, W. H. Johnston, superintendent; Jas. McKutcheon, assistant; Jas. Clancy, master mechanic; J. C. W. Chipman, cashier; J. D. Sliney, assistant; C. E. Hendrick, mining engineer. The organization is one of the most complete. The different properties are finely equipped, and the company has its own shops where they do repairing and make much of the apparatus used in and about the mine. A force of 1,000 men are given place.

The company owns six boats that are employed in conveying their ore to market. Their combined capacity from Marquette is 15,000 tons.

G. W. R. Matteson is president, Boston, Mass., and W. D. Rees is treasurer and acting director, Cleveland, Ohio.

THE PITTSBURGH & LAKE ANGELINE IRON CO.

is one that enjoys a national reputation, this being brought about by the fine quality of its ores and the magnificent dividends it has paid. For many years it was feebly worked, its earlier history not being marked by any of the activity that has appeared during the past ten seasons. Their large deposits of ore were unknown in the early days when operations were confined to an open pit on the north side of the big diorite hill that rises abruptly a few hundred feet south of the old Lake Angelina bottom. The first discoveries of importance were to the west of this open pit, and here, up to within the past three years, operations have been solely confined in what they now call the "old mine." One day when Capt. Thos. Walters, the superintendent, had a little time on his hands he went to the eastern end of the old lake bottom and drove a stake to mark the spot where he wanted to have some exploring done. The results following the carrying out of the plan have been of a most gratifying nature, and they now have at this point what they call their "East End Mine."

The ore occurs in a fold of the diorite, the latter trending north of east about 30 degrees and having a pitch to the west. Lying upon the ore is a hanging wall or capping of jasper. This also extends downward into the ore for some distance in a wedge-shaped mass, so that on the upper portions of the deposit they have two veins, locally called the "north vein" and "south vein." Lower down this capping does not appear, the two veins coming together, making one large bed.

To this ore body they have a working shaft on the north foot wall. For a distance of 75 feet it is vertical and from that depth it inclines south at an angle of 68 degrees. It is about 40 feet below the second level, levels being 75

feet thick, vertically. This shaft is 10x12 feet having two skipways and a ladder and pump way.

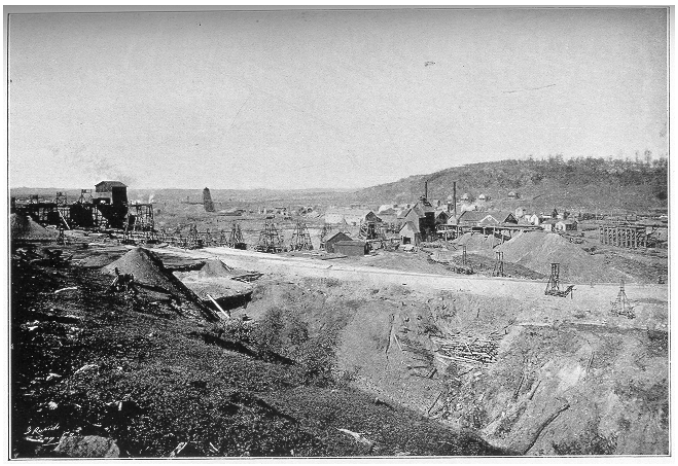
On the south foot wall of the deposit they have a timber shaft inclining north at an angle of 68 degrees. It is 6x9 feet inside of timbering, and is down to the second level.

The ore here is secured by what is known as the "caving," or "North-of-England" system. They slice from the top of the deposit downward. They begin by going to the top of the deposit and taking off a horizontal slice of ore 9 feet wide by 8 feet high. They use light drift-set timbers to take care of the hanging, and in the bottom of the drift they place long poles lengthwise with the drift and across them lay lagging. With the slice of ore removed they let the surface capping settle down. They then go beneath this and take off another slice of ore. Over them they now find the poles that lay in the bottom of the first drift, and they place their light drift sets under these, which insures the rock from above against coming upon them, and it is easier than the driving of the ordinary back-lath. After several of these slices have been taken off there is a large mass of timber the accumulation of repetitions of the work of timbering, and this binds together, forming a strong network that makes an excellent protection to the miner. This mass, generally described as "gob," follows down by reason of the immense weight of the surface rock, sand and gravel above, and this is what the miners want as, if it did not come readily, it might hang up until a large opening would be had between the capping and timbers, and the sudden coming down of the rock mass might cause great damage to life and property. Whenever there is a disposition on the part of the hanging to lag behind they accelerate its movement by large blasts of dynamite.

In the manner above described the Lake Angeline Company has worked out its first level, and were laying its tracks and getting ready to attack the second level when I was in the mine early in 1896.

The ore is run down through rises that are put in at every 100 feet. These have an inclination of about 60 degrees, and have two ore ways and one ladder way. They are cribbed up solidly with timber, and afford means of ready escape from the mine in case of accident, and are also important as ventilators. The reason for the double ore ways is so that a more ready separation of the different grades of ore may be had. There are bessemer and non-bessemer stopes, the product from which as to be carefully watched. In the upper level about 88 per cent of the ore was bessemer, and they figure out that 80 per cent of the product of the second level will be that of desirable class. The first class is guaranteed at 64 per cent iron and .045 per cent phosphorus.

Dykes of varying size are found in this ore deposit, but they are generally small. They usually cross the formation, but one is seen conforming to the trend of the latter. They have opened up the lens for a distance of 1,400 feet, and find a thickness of ore varying from 50 to 250 feet. It is a very encouraging showing. Explorations with the diamond drill made in the bottom of the basin prove up a large amount of ore in the bottom of the fold.



SHOWING PORTION OF LAKE ANGELINE MINE, LOOKING NORTHWEST.

Carrying the ore from stopes to shaft is an electric motor capable of handling 10 cars of two tons each. Power is provided by an 85 horsepower dynamo, the voltage being 500. The motor travels at a rapid rate of speed, and can handle twice the amount of ore that is produced at this mine. The books of the company show that the cost does not reach one-third of what it used to be when hand-tramming was done. This figures in all costs of repairs, fuel, etc. The cost is under six cents per ton, this not figuring in the filling of oars or skip-tending, which is not a proper tramming charge. The electric motor is a most convenient power for this kind of work. Further figures on the cost of operating it will be found in my description of the Cleveland Lake mine, of the Cleveland Iron Mining Company, these being the only properties in the Lake Superior mining districts where electricity is employed for such purpose.

At the East End mine they have recently completed a new brick smoke stack that is 5 feet in diameter inside, with 24-inch walls at bottom, drawn into 8 inches at top of stack. The height, including 15-foot base, is 100 feet. A railway track has also been changed, a fill of 35,000 yards across the south side of the old lake bottom being necessary to accomplish it. The task is now completed.

At the old mine they are principally employed in the taking out of pillars in D and C shafts. At D this work is confined to the fist and third levels, the lower ones having been mined out.

At A shaft nothing is being done. There is a block of ore 200 feet wide that stands to retain the shaft.

C shaft is a fine 6-compartment one, and is down to the eighth level, the last two of which are not being worked. Attention will soon be given to the seventh. Pillars are being taken out at the third, fourth, fifth and sixth levels.

A lens of hard ore 100 feet north of the soft ones is being developed from the 6th level upward, connections being had with several of the upper levels. It looks as if it were going to make to surface, and they are carrying up a big

raise with the idea of making a shaft of it in case the ore makes upward as it now gives evidence of doing. This ore inclines southwest at an angle of about 45 degrees.

At the west end of the old mine ore of wonderful purity has been secured, it giving 66.7 per cent in metallic iron and .009 per cent in phosphorus. There is yet many years' work in the old mine.

The Lake Angeline mine observes the eight-hour day, working three shifts, and was the first to adopt it.

The mine has a progressive, wideawake management, and is of great value to the city in which it is located. Employment is given to 750 men.

Wm. Tregambo is mining captain; Geo. R. Persons, cashier; C. T. Kruse, assistant; R. T. Smith, master mechanic; Capt. Thos. Walters is superintendent; E. F. Bradt, mining engineer and chemist, Ishpeming; Alfred Kidder, agent, Marquette; Jas. Laughlin, Jr., Pittsburgh, is president; Wm. G. Pollock, Cleveland, O., is secretary and treasurer.

The mine has produced, up to and including 1895, 3,352,561 tons.

THE CLEVELAND-CLIFFS CO.'S MINES.

The different properties of the Cleveland Iron Mining Company and the Iron Cliffs Company are now operated under the title of Cleveland-Cliffs Company. This is a powerful corporation possessing about 50,000 acres of land in the mineral territory of this district. They are an enterprising concern, employing a large number of people, and have done much to assist in the development and success of the district. Their prominent mines are the Cleveland Hard Ore, Cleveland Lake Shaft, Cleveland Angeline, Cleveland Hematite, Salisbury, Foster and Cliffs Shafts.

THE CLEVELAND LAKE MINE.

Under the old Lake Angeline bottom, and near the huge diorite bluff that rises from the north side of the lake basin, is located the Cleveland Lake mine. Its ore was discovered with the diamond drill a dozen years ago. Since then the lake has been pumped out, and the teasurers underneath have been revealed. While they are in sight, but a small pecentage of the amount shown has been brought to surface. It has taken many years to open up the mine, and the company has not engaged in rooming ore to any great extent because of the fact that lying above the ore is from 15 to 40 feet of mud, this having the consistency of cream. The ore does not lie next this mud, there being sand and gravel between in places, and at certain points there is a capping of rock separating the two, but the intervening material is not sufficiently substantial to warrant them in thinking it would remain to protect the levels from the mud in case the ore were mined in the usual manner. The mud has delayed them greatly, and they have been forced to move slowly that the mine might be properly insured against accident.

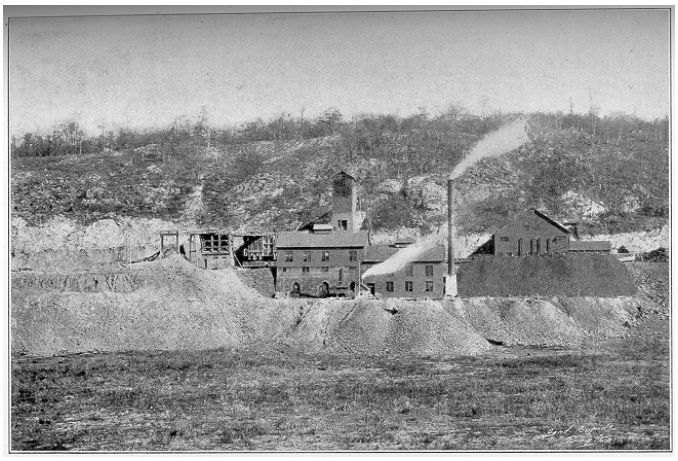
The ore is a soft hematite occupying a fold in the diorite, the trend being nearly east and west. It is generally non-bessemer, although they have several stopes of bessemer grade.

To reach this ore they have a shaft in the diorite foot on the north side of the lake basin, this following the inclination of the foot formation. It is 5x18 feet inside timbers, having four compartments. The first level was started at a depth of 150 feet, vertically, measurement being taken from the original level of the lake. This leaves considerable ore above them to insure against trouble from surface caving.

On this first level they have opened up 76 rooms, and the ore has been developed on the length of the deposit 2,760 feet. They have drifted to their west line to the Lake Superior Company's Lake Shaft property, before described, and here they find a width of ore of 150 feet.

Lying upon this body of ore is a mass of jasper, wedge-shaped, with the thin edge downward. This makes, in the upper level, a north and south vein, or fold. This jasper is 370 feet wide on its upper surface.

To the east the formation makes a curve, horse-shoe in form, and the ore outcrops at this end, so that they have been mining from open cut, stripping the surface drift and wasting it in the roomed-out portion of the underground levels. This pit has a length of 400 feet, and an average width of 60 feet, and from it 80,000 tons of ore were taken in 1895. The ore is milled to the first level of the mine where it is conveyed to the main shaft by electric motor. At this end of the property there is no mud to bother.



CLEVELAND MINE, LAKE SHAFT, LOOKING NORTH.

In the northwest end of the mine they have a sub-level that is 56 feet above the first main level, and here they are experimenting with the mud. They are caving the surface, and are bringing down a portion of ground 110 feet in diameter. To date it has settled 10 feet. The ore at this point is 115 feet thick. Thus far the plan is working satisfactorily, and they have hopes that they will be able to hold the mud above their gob. A peculiarity of the mud is that the water it contains will not leach from it. I saw several places where the mud was fairly down on

the timbers and it was showing no disposition to come through the lagging. If the surface can be brought down evenly there should be no difficulty in operating the caving system. It will not do to run the mud to some low point, however, as it would prove troublesome, and this they are trying to avoid. Where they have started the caving of the surface the mud is not as thick as farther south and east, but it will prove the action of the enemy, and should it result that they cannot keep it out of the mine it will be less dangerous than if they had attacked it where thicker. Late in February, 96, another cave occurred and the mud is acting satisfactorily.

The second level is 100 feet below the first, and here 72 rooms have been opened u. The ore shortens at the east end of the mine on this level, due to the dipping west of the east end of the basin in which it is contained.

On the third level, they have done but little. They have opened up fourteen rooms in ore, a length of 588 feet, but they are giving attention to ground above.

In mining the ore they take rooms of 21 feet across the vein and leave 21 feet of ground for support to the level. On the second level considerable ore has been mined on square sets, the rooms so beaten out having been filled with waste from the open pit.

There is an immense body of ore here that has simply been developed. The mine is capable of an enormous output and should secure it cheaply. With the mud problem satisfactorily settled the Cleveland Lake shaft can make a record second to no other mine in the district or State.

THE CLEVELAND ANGELINE

mine is located on the south side of the old lake basin, and is a continuation of the deposit of the East end mine of the Pittsburgh & Lake Angeline Company, the ore partaking of all the excellence of that of its renowned neighbor. This occurs in a fold of the diorite to the south of the one containing the Cleveland Lake Shaft ores and to reach it they have put in a drift 635 feet long from the second level of the Lake Shaft mine, this being all in diorite.

The shipments of ore from this mine for the season of 1895 yielded 67.25 per cent metallic iron and .025 per cent phosphorus. It is a soft, blue hematite, similar in appearance to the ore of the Lake Angeline Company.

They have proved this body of ore for a length of 385 feet, and through the central portions of the lens the thickness is 100 feet, it thinning as they go towards either end of the lense. Its pitch to the west, and I look for satisfactory developments in the direction. They have a sub level 32 feet above the second level, where they are following the ore upward on the foot. This is at the east end of the mine where the ore is making upward, and is also extending eastward. It gives indications of going up tot eh surface sand.

The plan is to get on top of the ore, to work the latter out on square sets, and cave the surface.

They have made preparations for the sinking of a new shaft at this Angeline deposit. It will be located at the second level and near where the main drift from the north side mine intersects the ore body, will have an inclination to the southwest of 45 degrees, and will be in the foot, 50 feet back of the ore.

A new find of ore 37 feet northwest of the lens being worked here was made late in February, 1895. They find it 25 feet thick at the east end, and fast growing larger as they go west. It is of excellent quality and its discovery may change the location of the shaft above referred to.

The electric motor has proved a valuable addition at these properties. Due to the long distances they have to tram the ore, some other power than the old-fashioned hand pushing was necessary. From the east end of their Angeline deposit to the main shaft the distance is 2,160 feet; from the northwest end of the main mine, on the first level to shaft is 820 feet, and from the open pit and around it to the main shafts 1,425 feet. Two motors are used, one of thirty and one of sixty horse-power. The electric generator is 4-pole, 100 kilowatt, 220-volt, making 600 revolutions per minute, and driven by a 16x24-inch Corliss engine with separate wrist plates and excentrics for admission and exhaust valves. Ten 3½-ton cars can be handled in a train. Cars are bottom-dumpers, and are automatically locked by passing over a roller placed between the rails of the track after the load has been discharged.

As there has been considerable interest shown in power tramming apparatus of late, I have secured the following figures from the books of the company, showing the cost per ton of ore of operating the motors:

Engine house expense, motormen and brakesmen	$.0201
Men running underground pockets and chutes	.0175
Small amount hand-tramming and tending skips	.0128
Total cost per ton	$.0504

This test was based on a monthly product of 41,604 tons. The motor capacity is 60,000 tons per month, for the two.

The mine is a dry one, but little pumping having to be done to free it of water. To take the storm water that would otherwise run into the old lake basin, there is 3,000 feet of 16 inch cast iron pipe and 1,000 feet of 17-inch wooden pipe. From the dam that is constructed at the head of the basin there is a fall of 47 feet to the outlet of the pipe.

To secure stockpile and other room at the north side of the basin where the main shaft is located, it required the removal of a portion of the side of the diorite hill, this being an expensive task. Here there is a shaft house 115 feet high, permitting lofty ore piles. The cars are run out and returned by power. The ore pocket has three delivery chutes which permits of filling railroad cars

without shifting the latter from one place to another as is often necessary when but one chute is used.

The plant of machinery is a fine one. The engines are 22 and 32x48-inch cross-compound, Corliss, condensing, with 12-foot first-motion drum, equipped with hydraulic brake. Air compressors are Rand, 16x32-inch duplex.

There is a fine mill for the framing of mine timber, the neatest in the mining region of Lake Superior.

THE CLEVELAND HARD ORE MINES

are located in the eastern part of Ishpeming city. These are idle with the exception of the "Sawmill" pit, where 1,000 tons per month are secured from the roof and pillars. This ore is of fine quality, giving 68 per cent iron and .030 per cent phosphorus. It is a specular, slate, and it is regretted that there is not more of it.

The Moro and No. 3 mines are full of water, nothing having been done here since the depression that closed so many of the hard ore producers. The Moro is 708 feet deep, the No. 3 mine 635 feet deep.

THE CLEVELAND HEMATITE,

located in the northern part of town, was abandoned in July, 1895, the ore deposit having grown so small that it could not be longer worked at a profit. The mine was 1,000 feet deep. The ore in the bottom was 50 feet long by 15 feet thick. This mine is located on the Teal lake range, and it is the western neighbor of the Lillie mine, before described. Previous to deserting it a systematic exploration of the territory in the underground workings was made with the diamond drill. The machinery has been removed and nothing further will be done in the way of mining at this location.

THE SALISBURY MINE

is south of the Pittsburgh and Lake Angeline mine, and separated from it by a diorite ridge that rises to a height of 240 feet above the level of the ground about the collar of the shaft. Work was first started here in 1872, and an open pit provided the product for several seasons, after which the mine was worked as an underground one. The ore lenses were found in close proximity to the southern side of this diorite hill, but they gradually made southward and against another ridge of diorite that lies in that direction, forming the southern side of the fold in which the ores are here contained. To reach this territory to the south a new shaft was sunk, and the old ones that came up through the old open pit were abandoned. This shaft, a vertical, is in the ore measure, and is now to the 16th level, a distance from surface of 759 feet. It has three compartments, a cage-way, skipway and ladder and pump-way.

On the north side of this shaft the ore has been mined to the 14th level, at which point it cuts out, nothing being found below it in the way of ore lenses on this side of the shaft. They are now taking the pillars that stand from the 9th level to the bottom. Four pillars are being robbed on the 9th. They work from the top of the ore downward, letting the surface follow them to fill up the mined-out ground. They thus have the pillars from the 9th to the 14th levels to remove. Three years ago, when the bottom of the lenses was found, the management was greatly discouraged at the condition of things underground, and began a systematic course of exploring. This resulted in the finding of another body of ore on the south side of the shaft, being separated from the north lens by 100 feet of jasper. This ore extends from the 11th level to the 16th, and how deep it will continue beyond the present lowest point to which it has been developed is not know, but they are proving this by the use of the diamond drill. A number of holes have been drilled in the bottom of the mine, and while the ground has caved, preventing satisfactory progress, much ore has been proved, and diorite has not been met with.

In the upper levels of this south deposit the ore occurred in lenticular-shaped pockets of varying size. The ore measure here is very wide and in the paint rock and jasper, of which it largely consists, the ore was found in the shape described. It was not until the present lowest level, the 16th, was reached that the ore has been found without this seaming of rock. On the fifteenth level there was a much better condition with reference to rock bunches than at any point above, and it is on this level that the principal mining is now being done. The deposit is about 400 feet long by 175 feet wide.

The 16th level has not been opened up to the full extent of the ore body as yet. They have crossed it with drifts showing the width of the level above, and have it developed on its trend for about 275 feet, all the work having been done in clean ore of finest grade. It is a soft, red hematite, differing in color from that of the north side lenses which yielded an ochreish-looking ore. It can be shipped at 64 per cent iron and .035 per cent phosphorus. Bunches of hard, blue ore are often met with that will give 69 per cent iron. In these some magnetite is found. These bunches will often weigh several tons each.

In taking the ore they room out from two to three sets wide, and leave about as much ore in pillars as they take from the rooms. On this side of the shaft they have mined out all the ore to the 14th level.

The ore dips to the south on the under side and pitches west. On the hanging is from 20 to 30 feet of paint rock, badly decomposed, being greasy and slippery. Much of the ore in this lens partakes of the appearance of the paint rock, and it is not until one puts a pick into it that he detects the difference. It looks much like an altered paint rock. Overlying this paint rock is diorite, which here makes the hanging. It will be interesting to know how far it will hold this position which is not the correct one as compared to these eruptives generally, and the drill work that is being done here will be eagerly watched by many people, and by none with greater attention than

the company. The changing of the position of the diorite to a northern pitch might cut out the ore unless the jasper that now dips south also changes its direction.

The ore in the new deposit is all west of the shaft, and is heading for another outcrop of diorite in that direction, and around which it will probably make. The showing here is a magnificent one, a fine thing for the company and for the people of the town in which the mine is located.

SALISBURY MINE, LOOKING SOUTHWEST.

There has been some trouble occasioned by a settling of the ground in the vicinity of the shaft. All the great mass above the lowest level is moving, settling downward. It seems to be breaking away from the slippery, unstable, paint rock, and for a height of over 700 feet the movement is apparent. The roomed-out portions of the mine surrounding the shaft have been filled with rock, and the shaft itself has been reinforced with extra wall plates so that there is no danger of losing it. About the first of January, 96, the mine was idle several days while the timbers were taking the great weight of the mass. I was all through the mine on the 17th of January, 1896, and found that the mine had “quieted” down considerably. There was still a “crying” of timbers, and the many broken caps and splintered legs testified to the great strain to which they had been subjected, but the miners were retimbering and cleaning up the levels and everything was in shape for active business again. A peculiarity of this ground is that where the timbers are bent and crushed, they can be taken out, the drift trimmed, and the ground appears to stand firmly and without showing weight on the timbers. This is true of many mines. The squeezing seems to have tightened and compressed the mass of ground so that it shows no disposition to give away.

At present the mine has but one opening, and they are now putting in a diamond drill hole for the 11th level of the old workings on the north side of the shaft, this being to unwater an old incline shaft that extends from the open pit to the 9th level. This is to provide another outlet in case of accident, and is a wise precaution. With the water drained out, they will rise from the 11th, connecting with the old shaft, which will then be put in shape so men can get through it readily.

The mine has but little water, this being cared for by a Cornish lift. The mine dry was consumed recently and another has been contracted for. There is an excellent equipment of machinery.

The mine produced 168,812 tons in 1895.

THE CLIFFS SHAFTS.

This mine lies to the north of the Lake Superior hard ore, old mine, and is in a fold of the diorite to the north of the Superior, hard ore fold. The property has been idle since the summer of 1894, having at that time a large stock of ore that the company could not dispose of at a living price. Considerable has since been shipped, but there is now in stock at the mine 156,000 tons. During the year 1895 there were crushed and shipped 29,184 tons from this property. A crushing plant was added in 1894 due to demands made by furnacemen. Much trouble was had the first year from breakages of crusher parts, but no delays from this account were experienced during 1895. Changes were made in the crushers whereby heavier castings were used. The weight of the first machine was 55,000, while the one as rebuilt weighs 82,000 pounds. Crusher openings are 18x24 inches. A Lake Shore Iron Works crusher is the one operated for the past season.

There is a wonderfully strong ore formation at the Cliffs shafts. They have mined upon its length for 2,410 feet, and on its width for 600 feet. This has not been in clean ore for such distances, but immense lenses have been found throughout this territory, which is all ore bearing. On the north they have worked out under Lake Bancroft, and here the ore lies very flat. Farther south it rolls over, the inclination of the fold being about 45 degrees. The pitch is generally west, but there are places in which an east and west pitch is observed. Eastward the mine workings extend to within 80 feet of North Main street.

Reaching this ore are two magnificent vertical shafts that are to the lowest level, 511 feet. The first level, called “C,” is 313 feet from surface, and the sixth is the lowest. No timbering is used, the walls being so firm that none is needed.

There are fine stopes of ore in the mine. Indeed, the property is just fairly developed for mining, and a product of 250,000 tons annually could be secured for many years to come. There has been some talk of resumption, but no time has been set for this much-to-be-desired event. There is everything at hand to operate the mine when it does resume. The machinery is first-class, there are fine stone engine and boiler houses and shops, and nothing is lacking.

THE FOSTER MINE

has been dismantled, and new machinery will have to be installed if they decide to do anything more at this point. The location is sections 22 and 23, 47, 27. It produces a non-bessemer ore suitable for malleable iron. It could furnish 50,000 tons annually. There is one shaft.

At present the mines of the Cleveland-Cliffs Company are employing 550 men, and four times this number could be given place if all their mines were being worked to anything like their full capacity.

The company owns a fine fleet of lake ore carriers, modern steel steamers that are valuable, and earn fair interest on their cost.

W. G. Mather is president, Cleveland, Ohio; F. P. Mills, who had been agent for many years and thoroughly competent, resigned in January, 1896, and his place has not yet been filled; A. J. Yungbluth is auditor; J. D. Jopling, mining engineer; J. M. Vickers, master mechanic. Thos. Buzzo is mining captain at the Cleveland Lake mine, A. E. Buzo of the Salisbury mine; Thos. Martin, clerk; Walter Sterling, clerk Salisbury mine; Thos. Bargh, clerk Cleveland Lake mines.

ABANDONED MINES.

The New York, East New York and Ames mines have all been abandoned and the machinery removed. These properties are all located in the corporate limits of Ishpeming, and the East New York will probably be revived the coming summer. A few miles distant the Fitch, Saginaw and Detroit have all ceased operations permanently, exhaustion of the ore deposits being the reason for the stoppage.

THE WINTHROP MINE

is two miles south of Ishpeming city. The underground levels of the old mine have given all they possessed in the way of ore, and operations are now confined to the taking of a low grade material found in the upper portions of the ore measure. They are securing this by open-pit mining, and have a large stoping face, about 100 feet high from the bottom of the level up to the surface sand. To secure the ore by this plan they have considerable stripping to do, a work they perform in the winter months by steam shovel. They are working west, and on the north side of a diorite hill. The ore is easily won, immense burdens being thrown out at a single blast. They charge long holes with dynamite, and thousand of tons are dislodged at a single explosion. The stripping is wasted in the open pit where the ore has been taken out. The ore is hoisted in skips to the ore pockets and stockpiles. There is a large amount of ore of this class at the Winthrop. It gives about 46 per cent iron and is of bessemer grade.

On the south side of the diorite hill they have opened what they call their No. 2 mine. They have here a soft hematite, two strata of ore being found, one lying about 300 feet south of the other, the intervening ground being jasper and paint rock. No. 2 shaft is to the 480-foot level. From this the north vein was first located, and has been mined out, it being cut out with rock in the bottom level. There is yet considerable ore in pillars and under the 445-foot level they have ore that they will take in a sub-level 35 feet below. This is put in to take the ore in ground that has caved.

CLIFFS SHAFTS, LOOKING NORTH.

The south vein was located in the summer of 1895. They have followed it for a length of 140 feet, and it gives promise of developing into a valuable addition to the mineral stores of the property. It has a dip to the north and pitches west. The foot is somewhat irregular, and has made a turn to the south some distance but is now swinging around again observing the course held for 180 feet west from the drift that leads to the shaft. In the east end the ore makes upward, and may go to near surface. They began diamond drilling to determine this point in December, '95, but stopped owing to the great destruction of diamonds in the broken ground. Diamonds at $25 per caret are too expensive to put into rock so hard and so badly broken up as it proved to be here.

This ore is of better quality than that found in the north vein, it giving about 64 per cent in iron, and is very close to the bessemer limit as to phosphorus. The north foot is diorite, the south foot jasper.

The company is fortunate in possessing the fee of its mines, and does not hesitate to improve the property. There have been several residence dwellings erected for employés within the past year, and the outlook is certainly more flattering for successful mining operations than has been present for some time past.

F. Braastad, Ishpeming, is vice president and general manager; Jas. Reed, mining captain; J. O. Flack, surface captain; Wm. Brooks, cashier; N. Billy, master mechanic; M. A. Hanna is president; A. C. Saunders, secretary and treasurer, Cleveland, Ohio.

EXPLORATIONS.

Mr. Edward Robbins is exploring on Cleveland-Cliffs Company lands on the north half of the southwest quarter of section 12, 47, 27, and has three pits in ore, some of it being of fair quality. He has excellent prospects for something valuable, and is working energetically to develop it as rapidly as possible.

John O. Flack is working on Cleveland-Cliffs company lands on the southeast of the southeast of 15, 47, 27, and has three pits in ore. Work was begun in October, 1895. Sufficient has not yet been done to determine the extent of the deposit.

E. F. Bradt and W. J. Allen have an option from the above company to explore the west half of the southwest quarter of section 13, 47, 27. Here there is a lean ore formation that is high in silica. The location is better known as the Iron Mountain mine, an old workings on the shores of a lake bearing the same name. They expect to put in a railway track the coming spring, and to make shipments of ore this year. They figure on shipping 100,000 tons in 1896.

THE DEXTER MINE

is six miles west of Ishpeming on section 3, 47, 28. It is a small mine, and constant sinking of the shaft is necessary to give them stoping ground from which the annual product of from 7,000 to 21,000 tons is secured. Their main shaft is down 500 feet, and 30 feet below their 7th level, the deepest. Besides this shaft they have another on what was formerly known as the Day property, but this has been consolidated with the Dexter, and both are now known under the title of the "Dexter Consolidated Mining Co."

The ore contains from 7 to 15 per cent of manganese, and it is on this account that it finds a place in the market at a figure that will give the company anything like a fair return for the expense they are at in mining it. The ore trends east and west, and a peculiarity of the foot wall is that up to the seventh level it has been quartzite, whereas the proper place for this rock is upon the hanging side of the vein. On the seventh east of the shaft, there are indications that the foot is straightening up, and it will probably prove to be the hanging in lower levels. If this occurs they expect something bigger in the way of ore lenses. On the present hanging they have soapstone, and this rock usually separates the lenses in the ore measure. A new lens of ore has been followed for 100 feet on the seventh level east of the shaft. It is regular, and ore is still on the hanging side of the vein. They have not drifted into it to find its thickness. They did nor have this ore on the level above.

On the 6th level the quartzite makes a decided turn to the north and west at about 300 feet east of the shaft, and it is now showing signs of a similar swinging about in the east end of the seventh. In the 6th level they encountered a fine lens of ore in following the quartzite to the north. They are not yet under this point in the lower level. From the 6th this ore made up to the 4th level.

In the east end of the 5th level they have found soft hematite in the back of the drift, and they are now raising in this with the idea of cross-cutting to determine its size.

All things considered, the Dexter is looking better than for many years past. The property is carefully looked after by Jacob Harper, mining captain; Geo. R. Persons, of Ishpeming, is cashier; E. A. Gott, Detroit, Mich., is president and secretary. About 50 men are employed.

THE REPUBLIC MINE

is located at Republic, Mich., and gives support to the bright little town of 3,000 souls. It has been one of the prominent mining properties in this iron ore producing district, and has enjoyed a world-wide reputation by reason of the purity of its product, it being of the finest found anywhere.

Three years ago I went through the underground workings of the mine and found them looking poorly. Indeed, so reduced were the lenses compared to what they were in the earlier history of the place, that the company talked seriously of quitting and moving their machinery to another district. The price of shares fell from $50 to $5, a shrinkage on the capital stock of $4,000,000, and the people of the town were much discouraged. On the 7th of January, '96, I made my latest visit to the underground portions of the mine, and was much gratified at the great change for the better that was apparent. It assures many years work and secures the homes of the people of that place, and enhances the value of the shares of those who are pecuniarily interested in the mine.

Originally, the workings of the mine were three-fourths of a mile from the present scene of activity, and in an immense bowl-shaped basin to the lowest point of which the ore dipped and in which direction the shafts were inclined. The foot is a high range of jasper that rises above the surrounding level to a height of 150 feet, and it is in a belt of this that the ore occurs, being lenticular-shaped masses of varying size. Near the surface they were of immense proportions, but as the bottom of the basin was neared they kept pinching up and growing smaller, until all of the old pits at the west end of the curve were abandoned. On the northern swing of the curve there is a change in the direction of the trend of the formation, it making nearly north and south, and it is on this north and south line that new and important discoveries have been made. Near the point at which the formation turns northward at the north side of the basin, is located No. 8 shaft a one-compartment, vertical, down to the 1153-foot level. This and No, 1 shaft, a short distance to the southeast, have been the principal ones for several years past.

When the mine was looking so poorly they concluded to do some exploring to the north, and accordingly put in a drift 800 feet in that direction. At this distance they were rewarded by finding a lens of bright, specular ore. This they have opened for a length of 400 feet, it possessing a thickness of about 25 feet. Drifts connecting it with No. 8 shaft have been put in at the 644, 753 and 911-foot levels, and one is going from the 1153-foot level, being in 450 feet at the time of my recent visit. Levels are carried so thick because of the long rock drift necessary to reach the ore.

On the hanging side of this magnificent ore body is soapstone for 15 or 20 feet. The walls are vertical. They secure the ore by overhand stoping, first taking a drift stope 15 feet high, which they timber heavily. In this

drift they place their tracks. The soapstone on the hanging turns out as soon as the ore is removed and they level it off in the bottom of the stope, and use it for filling, raising upon it to reach the ore in the back. Formerly all rock was sent to surface, but under the new system it is all used in the mine, and the cost of hoisting it is obviated. Mills are carried up frequently so that the ore is run down through them without much effort. Many of these mills are divided for ladder way, affording places through which the men can escape from the levels in case of accident.

They are sinking a fine new three-compartment shaft on the line of the strike of this ore, and 1,200 feet north of No. 8 shaft. It is in the jasper foot, and will have two skip ways and a cage way, its inside measurement being 6x18 feet. It has reached a depth of 100 feet. The collar of this shaft is 42 feet above the railway tracks, so that ample facilities for ore crushers will be had in case the company decides upon their use. With this shaft down 200 feet they will put in a crosscut from it, as they have hopes of striking ore that was found with a diamond drill in the summer of 1895.

As I have said, the ore is a bright specular and presents a handsome sight under the light of the miners' lamps. It gives 67 per cent in metallic iron and .033 in phosphorus. There is nothing finer in the district excepting a lense at No. 1 shaft already referred to, where they have a stope 180 feet high that gives an ore yielding 68 per cent iron and .020 phosphorus. On the hanging wall side of this No. 8 ore body they find small lenses of ore, specular. In the older workings of the mine these used to be magnetite, but no ore of magnetic nature has been yet found in the vicinity of the north lens.

No. 1 shaft is down in the 1,153-foot level. It is an incline with an angle of 45 degrees, starting to the west, and gradually turns 47 degrees to the north, the No. 1 shaft lens occupying a position at that end of the mine conforming to the new No. 8 lens.

Farther south on the curve from No. 1, No. 6 shaft, which caved in several years ago, is being sunk, but they are going back of the old shaft 20 feet, so as to get solid ground. They will sink this to the 9th level, 487 feet, and are now down 363 feet. This work is done to mine the pillars about the old No. 6.

In times of high water in the Michigamme river there is enough air generated at the company's hydraulic works to supply power for all the machinery at the mine, but in stages of low water they have only enough to operate one-half their plant, and air compressors of the mine are run by steam to provide this. Power for the new shaft will be transmitted from No. 5 engine house where there are four 12-foot drums. Nos. 1 and 8 shafts are operated from this station.

A Cornish "lift" at No. 8 shaft takes care of all the water the mines make, it running about nine hours in the twenty-four. This plunger is down to the 911-foot level, and will be extended to the bottom of the mine this year.

The Republic has shipped, all told, 4,251,026 gross tons of ore, and its product for '95 was the greatest since 1891. I am pleased to find it so much improved.

A valuable possession of the company is a fleet of lake ore carriers.

David Morgan is agent; Peter W. Pascoe, mining captain; W. D. Rees, of Cleveland, is president and treasurer; W. B. Castle, of the same place, is secretary.

THE CHAMPION MINE.

This property is located thirty miles west of Marquette, on lines of the Duluth, South Shore & Atlantic, Chicago & Northwester and Chicago, Milwaukee & St. Paul railroads. There is a town of 2,000 inhabitants named after the mine. The ores here found are hard slate, specular and magnetic hematites, that are of fine quality, the entire product being of bessemer grade, although several classes are made that contain different percentages of iron. The first shipments were made in 1868 and there has been sent out since that time about 3,000,000 tons.

The property was closed during '93 and '94, and resumed in the spring of '95, when work was confined to the eastern end of the mine and consisted in robbing the old pillars. In September of '95 the task of unwatering the underground workings at the west end of the mine was begun, which has now been completed, and they are again doing regular mining and development work.

The Champion has been opened on the trend of its ore formation for a distance of 2,500 feet and has, going from east to west, shafts C, 1, 2, B, 3, 4, 5, 6 and 7. Of these Nos. 1 and 6 are in the footwall, the others in the ore measure, they have been located long before the present management took hold. They have two "runs" or lenses of ore, the pitch being to the west at an inclination of 60 degrees. The hanging is a compact quartzite, the foot a jaspilite underlain with diorite. The walls are very substantial, timbering being seldom needed, and the closeness of the walls prevents the water finding a way into the mine, so that but little pumping has to be done. With the resumption of operations, recently, the mine was unwatered by the use of bailers holding 1,200 gallons, these lifting 300 gallons per minute.

The walls of the mine are very regular, so that it is not difficult to follow the ore, but there are numerous dykes of soap rock crossing the formation, these being of varying thickness, in one place 300 feet on the trend of the vein, in another 200 feet, and having an oblique position in the vein. They have learned the characteristics of these so thoroughly that they know just where to go through them to meet the point of ore on the opposite side. The worst trouble caused is the mixing with the ore where the latter comes in contact with the dykes.

The specular and magnetic ores often so blend one with the other that it is impossible to see where the one ends or the other begins. There is often an indiscriminate

mixing of the two, and it is an interesting study geologically.

Owing to the pitch to the westward of the lenses, the shafts at the east end of the mine have long since been abandoned, work now being in the central and western end of the mine. Where there is anything being done east of No. 4 shaft it is in the way of robbing the pillars that were originally left to support the hangings and in taking the floors. They were “thinning" pillars in this portion of the mine when I visited it last, four power drills being used. A strong timber drift has been constructed at the 14th level to which the ore from several levels above is being milled, it coming readily and cheaply. They are not crowding this work, but are adding a certain percentage to the product from the stopes, which reduces the cost of the latter considerably. It is expected that the pillars and floors in the old mine will give a product in the way they are now securing it, for three years to come.

The “new mine," so called, comprises shafts Nos. 5, 6 and 7, covering a distance in length of 1,800 feet. The lenses in this portion of the vein are considerably smaller than in the old mine, and the soapstone dykes are very much larger. These crossings have been penetrated at the different levels and stopes opened out. Not only are the ore bodies smaller in this portion of the mine, but they are of inferior quality as compared to those found in the old mine, and yield in working very much less first-class ore, athough the phosphorus has remained favorable, the product being bessemer. In No. 7 shaft this element has been found more favorable than in any other part of the mine, and as this is the present most westerly working, in which direction the Champion’s future expectations lie, this is regarded as a very hopeful feature.

In No. 5 shaft stoping is being carried on at the 16th, 17th, 18th, 19th and 20th levels, and the skip road is being extended to the 21st and 22d. At the latter a crosscut north has been carried toward the ore 39 feet and expects to reach the ore in the next 15 feet. All of these levels are working in a lens of ore a horizontal section of which is expected to give a length of 125 feet and an average width of about 15 feet. East and west of this occur lenses of smaller dimensions which are not reached on these levels and are separated by rock crossings intermixed with jasper 125 feet on the east and probably about 50 feet on the west. At the 20th level in the shaft the last of the south deposit was seen. The two deposits had previous to this time been met with in this portion of the mine. In the western workings but one deposit has yet been encountered.

In No. 6 shaft work is being pushed at the 9th, 11th, 12th, 13th, 14th, 15th and 16th levels, and the skip road is soon to be dropped to the 17th, which will permit of the continuation of the drift to reach the ore that is estimated to have pitched off to the west 125 feet. It is also hoped that some ore pitching off from No. 5 shaft will be encountered at this level, and they will diamond drill north and east in exploring for it. The best ore in this shaft is that first struck in the No. 7, the eastern extremty of which is to be found at the 9th, 11th and 12th levels in No. 6, at a distance from No. 7 of 150, 170 and 190 feet, respectively, thus showing a reversal of the ordinary direction of pitch to the west, and indicating the presence of a lens of large proportions, the lines of its eastern extremity pitching to the east preparatory to its taking on its usual pitch of 60 degrees west. This ore at the 9th has a length of 130 feet, and maximum width of 18 feet; at 11th will have a length of about 220 feet and width of 26 feet; at 12th it promises to have a length of about 300 feet, with a maximum width that cannot now be determined. The 11th level will reach the western limit of this ore in the spring. The 12th has got about 200 feet of stoping yet ahead providing no crossings are encountered. This development is of the greatest importance to the mine.

No. 7 is not being operated at present because the ore can be trammed more cheaply to No. 6 while working in this ore body. As soon as the 11th stope ends as expected, a short distance west of No. 7, it is the intention to drift west in search of new ore. Above this level no ore has been found of any importance but it is hoped and expected that some may be developed in the western ground. On surface where exploring has been done the soapstone was found lying immediately under the quartzite and they hope to find this condition changed with the added depth now reached.

The misfortune of the mine is that it has no longer any stopes that yield an unmixed product, the whole now requiring a large expense at every handling to separate the rock. But 10 per cent of the output at this time is first-class ore, the balance being second and third class.

In the last few years of working the whole of the territory covered by shafts 6 and 7 has been opened, the cost of the large amount of work of preparatory nature thus entailed amounting at times to half the underground expense. This now enables the company to look for its main product at this point. It was a wise foresight that developed these new lenses to take the place of the old mine by the time of the exhaustion of the ore bodies of the latter. The transition period, coupled with the low price of ore, and difficulty found in selling ores of this character, has made the property profitless for several years, but they now hope, with closest attention to economy, to make some return to the shareholders.

They carry levels 60 feet thick, leave floors of 15 feet, carrying stopes 45 feet. They go to the top of the stope putting in a drift, and from this they underhand stope n the usual way. The contracts to miners is so much per foot of ground drilled. The company has foreman who superintend the placing of holes. The contracts also call for the blasting of the holes. It is simply a question of drilling with the miner, and he hastens to get as many feet as possible. Power drills are used. The tram cars are large ones, holding four tons each. They are mounted upon short trucks and the body of the car is turned on a pivot to face the stope, the hopper being made low on one side to permit of easier loading and

inspection. The ore is all inspected and the rock taken out underground.

The Champion, like other hard ore producers, has been forced to add crushers to its plant to reduce the ore to the size demanded by furnacemen. It is installing a new plant at the present time, which consists of three 55-ton crushers placed side by side. These are of the Blake pattern, with openings 24x24 inches. These will be run by manilla rope transmission by a pair of Corliss engines, ropes running over 10-foot pulleys. The ore from the different shafts will be run to the crushers by gravity, and thence to the stockpiles or cars, it being the object of Mr. Walter Fitch, the competent agent, to minimize the cost of treatment. The company has no royalty to pay, which is a point in their favor.

There is a magnificent equipment of machinery, four 14-foot drums, 7-foot face, a compressing plant with 30x48-inch air and 28x48-inch steam cylinders. The company possesses complete shops for repair and also builds considerable new work. Mr. Wm. Williams is master mechanic, and has charge of this department.

The Champion possesses one of the finest mining locations in the Michigan fields. It is kept neat and clean, possesses many comfortable homes, has excellent schools, all of which are kept up by the company.

The officers are: H. Fay, president; W. E. Stone, treasurer; W. B. Bosson, secretary, Boston Mass; Walter Fitch, superintendent and mining captain; G. S. Barber, surveyor and chemist; A. Fitch, cashier, Beacon, Mich.

SUSPENDED MINES.

Near Champion are several producers of low grade soft ores that are idle.

At Humboldt, a few miles east, are the Humboldt and Foxdale mines, hard ore producers, that could not earn a profit under conditions met with the past few years. The Bessie, also near the latter place, is idle. It lacks a railway.

At Michigamme, still further west of Champion a few miles, is the Michigamme mine, a hard ore, that is idle, and in the near vicinity are several properties that contain large amounts of limonite ore that is too poor to stand transportation charges to Lake Erie ports. These ores generally smelt freely, and are excellent for foundry purposes, but until they can be converted into iron at home there is little likelihood of their being worked.

There are several prospects a few miles from Republic that have been given considerable attention in the past, but the quality is not right for their resumption. They are hard ores, and generally much mixed with quartz.

THE SWANZY.

This mine is the property of the Escanaba River Land & Iron Company. Its location is apart from the range on which the principal mines of the Marquette district are found, being in town 45, range 25. The owners have the fee of about 700 acres containing this and other promising prospects in the immediate vicinity. It is reached by a branch track of the Chicago & Northwestern Railway from Swanzy junction, 18 miles south of Negaunee.

Considerable work was done during the past three years, but operations were suspended in the summer of 1895 due to a lack of sufficient funds on the part of the company to properly open it up. There is a find body of soft ore here and considerable of this proves by analysis to be of bessemer grade. They have one shaft reaching his ore, and have partly opened up the lens on one level. What has been done is of an encouraging character, and there ought to be money in its conducting. The fee in itself is valuable, and is a feature worth considering by prospective purchasers. The mine has not been opened up sufficiently to give the ore a chance to leach out properly, and for this reason assays have shown considerable moisture. The mine is now in the hands of a receiver, T. M. Wells, Negaunee, Mich.

The Brotherton, the second mine on this Swanzy range, is idle.

ABANDONED MINES.

There are many abandoned mines, some of which have been prominent in the past, but they need no writing up in this report. They have gone out of the business, and to repeat their history would but uselessly take up the time of the reader and commissioner.

SHIPMENTS OF ORE.

Table showing shipments of iron ore from the Marquette range for season of 1895, and total tonnage shipped for all years.

Name of mine.	For 1895.	Total all years.	Name of mine.	For 1895.	Total all years.
American (Sterl'g)		112,933	Mesabi's Friend	5,503	5,503
Ames		6,298	Michigammee	3,214	880,262
Bay State		16,637	Milwaukee		375,431
Bessie		847	National		150,216
Beauford		90,217	Negaunee	90,731	648,279
Blue	44,140	90,120	" Con. Wks.		12,708
Boston		61,955	New York (York)		1,113,102
Braastad { Mitchell / Winthrop }	118,854	1,824,913	N. Y. Hematite		37,587
Cambria	39,467	753 452	North Republic		200
Champion	100,398	2,969,340	Northwest		1,687
Cheshire (Swanzy)	6,593	217,089	Norwood		5,763
Chicago		9,012	Nonpareil (St. Law.)		23,395
Cleveland	270,778	5,610,570	Palmer	3,433	3,433
Columbia (Klom'n)		94,813	Pascoe		59,806
Curry		16,671	Pendill		45,900
Detroit		140,841	Phenix (Dalliba)		59,114
Dexter	13,752	98,455	Pioneer		15,409
Dey		2,709	Pitts. & L. Angeline	313,556	3,352,569
East Champion		76,002	Platt	13,695	62,548
East New York		166,243	Quartz		691
Edison		893	†Queen Iron M'g. Co.	160,817	2,053,706
Erie		8,136	Republic	174,027	4,251,038
Etna		1,091	Repub. Reduc. Co.		47,274
Fitch		31,817	Richards		1,374
Gibson		16,357	Riverside		16,160
Goodrich		49,754	Rolling Mill		234,625
Grand Rapids (Davis)	6,764	110,596	Saginaw		451,424
Hartford	200	12,957	Sam Mitchell		17,790
Hortense (N. Champion)		30,574	Samson (Argyle)		267,805
Humboldt		721,664	Schadt	1,261	1,261
*Iron Cliffs	205,370	3,360,718	Section 12		21,897
Imperial		61,206	Spurr		164,344
Iron Mountain		393	Star West (Wheat)	51,207	171,346
Jackson	42,202	3,380,975	Taylor		32,970
Lake Superior	342,097	6,734,814	Titan		90,371
Lillie	54,445	484,231	Volunteer	32,672	1,019,953
Lucy (McComber)		491,280	Webster		14,108
Manganese		6,359	West Republic		133,077
Marquette		152,907	Whetmore		50,870
			Wheeling		10,635
Total				2,695,166	43,937,510

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

THE MENOMINEE DISTRICT.

This iron ore range is south of the Marquette district about 50 miles, and occupies a position parallel with the latter. The order of the rock formations is: granite, siliceous limestone, clay slate with iron ore, quartzite and Potsdam sandstone. The ore-bearing strata form basins, the edegs of which rise to surface at a very sharp angle, there having been the same folding, caused by pressure, that is apparent in the Marquette district. The limestone occupies a position immediately under the ore-bearing rocks. The ore lenses are held in the silicious slates which are banded with jasper, and upon them are the gray slates, the latter having quartzose bands.

The Menominee was the second ore district in the Lake Superior region that was given attention by the miner, it being opened up early in the seventies, since which time it has sent to the market 18,578,827 gross tons of ore. The range is an extensive one, and none other has been given more attention in the way of exploration. Unfortunately, the western end of the district has ores that will not answer for the manufacture of bessemer steel, so that there has been a great falling off in the production at mines that a few years ago were giving place to a large number of men and contributing an immense tonnage to the grand total. When the time comes that these ores will be converted into pig iron on Michigan soil a revival may be looked for where now there is nothing in the way of activity to report.

For the year 1895 the Menominee district shipped 1,694,804 tons, this being for the mines located in Michigan, which was a gain over 1894 of 734,354 tons, this being due to improvements in the ore market, and reorganization and financial strengthening of the principal shipper, the Chapin. The depression proved a hard blow to the district as a whole. The properties were generally operated under lease from the owners, royalties had to be paid, and there was often not sufficient capital invested to tide the companies over the time when business wreckages were general throughout the country.

The district is extremely fortunate in possessing a lake port from which boats can be loaded to their fullest capacity, there being plenty of water from Escanaba both toe Lake Erie ports and Chicago to take any cargo the boats can hold. This is an item of no small importance, and assists the mines considerably in securing liberal freight rates. The increase of iron and steel-making in the west also gives the range an advantage over those located farther from the principal western manufacturing center, Chicago, and as the growth is fast inclining westward, the Menominee district should continue to gain in industrial importance, and meet the keenest competition of other ranges.

MINES OF NORWAY.

It is in about this village that the operating mines at the eastern end of the Menominee district are located. Norway is a bright town of 2,500 people, where there are excellent schools, electric lights, and improved sanitary conditions. It was here that the first mining operations of importance were inaugurated on this range, and where the latter received the attention that has since led to such important disclosures at other places.

THE PENN IRON MINING CO.

is the largest operator at this place, it having charge of the West Vulcan, East and Southeast Vulcan, Curry, Briar Hill, Cyclops and Norway mines, of which the West Vulcan, Curry and Norway are the present active ones.

The East and Southeast Vulcans were little more than explorations, this being particularly true of the latter. There were irregular chimneys of ore and no reliance could be placed in their continuance from one level to another. On the 8th level at No. 1, East Vulcan, there was a chimney of ore possessing a thickness of 40 feet for 400 feet, 10 feet for 700 feet, and much hope was entertained for the development of something important, but on the ninth level the ore was found to possess a length of but 400 feet, this being a great disappointment. Work was suspended at the East Vulcan on April 21, 1893.

The closure of the Southeast Vulcan occurred on Sept. 22, 1893, due to several causes: The panic was one of these, and the fact that an expenditure of $20,000 would be necessitated in the introduction of an improved pumping plant, was another. The iron in the ore is also low, but the grade is a bessemer.

The West Vulcan has been given considerable attention since the suspension of operations at its sister mines, and I find much of valuable kind has been developed at this point. There are two ore formations here, jasper being prominent in both, and separating them is the indurated slate common to this section. It is a question more or less discussed as to whether or not these two formations will meet, making one large ore body, as greater depth is attained. Reason for taking the affirmative side is found in the difference of dip of the so called “north” and “south” formations, the former observing a considerable flatter dip than the latter. On the bottom level of the mine the distance separating the two is 200 feet, while at the second level the intervening material measures 400 feet. When the point of meeting is reached it will be interesting to know whether a big trough will be found, or whether the formations will continue downward indefinitely. The former theory would conform to ore occurrences at other places throughout the iron region of Michigan.

The first work done at the West Vulcan was in open cuts on the north formation, after which the ore of the south formation was found. The extension downward of the ore lenses led to a change from open cutting to underground mining. Attention is now being wholly devoted to the north formation, as it is here that the ore is more regular in size and quality. The principal working shaft is C, located in the slates between the two

formations. It is down to the 12th level, 1,010 feet from the surface. It is vertical and well equipped. No. 2 is in the footwall of the south formation, being 300 feet in front of the north ore body. It is being protected by pillars as well as possible, but it is not expected it will stand indefinitely. It will be used for the upper levels as long as it lasts, and will be a prominent one in the near future. It is now down to the 11th level, and connections with the ore body are made at the 8th, 10th and 11th. The task of connecting the 7th and 9th levels was under way at the time of my visit. Between the 10th and 11th levels the shaft is not full size, being used only for a rock mill at present.

In front of No. 2 there are three strata of ore with from 12 to 20 feet of rock intervening. Jasper occurs throughout the ore in this portion of the mine in irregular lenticular masses, dividing the ore into strata. No. 2 shaft is not yet equipped, but they are preparing for this. A shaft house and ore pocket have been built, buildings have been removed from the surface to make room for railway tracks and stockpile grounds, and all will be ready when the upper levels of the mine are properly connected and opened out, which will be in the spring of 1896. The shaft is an incline, following the dip of the formation.

On the 12th level, north formation, the ore makes for a thickness of 105 feet, this being the greatest ever found in the mine, but it does not hold this for any great length, the deposit running from this to 10 feet. The formation is very irregular, being folded, contorted and twisted strangely, particularly at the east end. In this portion of the mine the limestone has interfered with the quality of the ore. To the west the deposits are cleaner and more regular. To ascertain if there was danger of striking the Huronian limestone if the shaft was sunk, a diamond drill boring was made at the 12th level at C shaft, cutting the formation at right angles. This did not meet with the enemy, cutting jasper and lean ore and finally ending in soapstone.

They mine from the bottom upward, filling the mined-out portions as the ore is removed. Up to March, 1895, they put raises from the rooms into the slate, giving incline enough so that the rock would come down by gravity, but since then they have been securing material for filling from the hanging of the south formation, a soft graphitic slate in which drifts have been driven at the 8th and 10th levels. All the other levels will be similarly connected. To convey this rock to the places where it is needed in the mine, mules are being employed. They are also talking of using similar power in tramming the ore from the stopes to shaft. The filling comes cheaply, and no better method of protecting the mine could be had.

Throughout the western end of the mine there are two strata of ore, one overlapping the other. On the 7th level the ore is somewhat higher in iron than on the 11th and 12th, but it is also somewhat higher in phosphorus. Two grades of ore are shipped, these differing in their iron contents. For 1895 the West Vulcan did not mine any non-bessemer, it being left in the mine wherever encountered, the price at which it could be marketed not warranting its extraction.

There is a fine Worthington pump located at the 12th levels a compound condensing with 25-inch high-pressure cylinders, 43 3-10 inch low-pressure; four 12-inch poles, 36-inch stroke. Capacity is 1,000 gallons per minute in 1,000-foot lift under 60 pounds steam pressure.

The recent construction of a railway track at No. 2 shaft has done away with the long trestle at C shaft, effecting a considerable saving in the cost of handling the ore at this point.

An old dump pile, near No. 2 shaft, was disposed of during 1895, it being wanted for the silica it contained. It yielded about 45 per cent iron and was low in phosphorus.

Capt. Wm. Bond has charge of underground work at this mine, and the number of men employed is 240.

THE CURRY MINE

adjoins the West Vulcan immediately upon the west, and has the two ore formations described in connection with this property. The mine is not looking well throughout the lower levels, the ore lenses having given out, and new ones to take their places have not yet been located, although Capt. Thos. Oliver has worked energetically to find them. They are down to the 8th level, 800 feet from surface, and have one two-cage, vertical shaft, and between the 7th and 8th their ore was cut out by jasper. A peculiarity of the mine is that they find nothing of value on the north formation, whereas at the west Vulcan, but a short distance away, they are working entirely on this north vein, and have an excellent showing of ore. On the 8th level at the Curry they started a drift to reach the north formation which was in 780 feet, having reached the desired territory, but it was barren of ore. They have drifted from the north end of this crosscut 156 feet west, on the junction of the hanging slates and vein, and are in 45 feet in the same direction on the foot side of the vein, but as yet have not yet found ore, and they are much discouraged.

On the 5th, 6th and 7th levels there are fine stopes of non-bessemer, that were left in the course of mining for several years past, and in the fall of ’95 orders were received to take these, as a market has been found for them. This will give the mine activity for three years unless other orders to the contrary are issued. The vein has a thickness of about 20 feet, and at Nos. 10 and 11 rooms on the 7th level, the ore ha a thickness of 40 feet.

Rock for filling is taken from a drift on the 5th level. The ore is a blue hematite, and four grades are mined, all of which give about 60 per cent in iron, but varying considerably as to phosphorus. Their “Cyclops” holds .020 in this element, their “Vulcan” .050; “Diana,” .080 and “Harper,” 1 per cent.

The properties of the Penn company are well managed, and everywhere is seen evidence of able supervision. Wm. Kelly is general manager; Frank Copeland, assistant.

The fact that the company possesses its own furnaces is an important one in the interest of the mines and those who depend upon the latter for a livelihood.

The company's mines have produced a total of 3,968,630 tons.

THE NORWAY MINE,

that remained idle for many years, is showing signs of life again. About twenty men are working above the adit level where there is no water to interfere, resumption having taken place in the fall of '95, the work being in the nature of "scramming." There is a hope that something new may be found which will develop into a marketable deposit of ore. At one time the Norway was prominent amongst the largest soft ore producers in the Lake Superior region. Capt. Wm. Williams has charge of the work in the mine.

THE BRIAR HILL,

just west of the Curry, has been idle for years. The water in the shaft is slowly lowering due to the deepening of adjacent properties and the gradual draining of the water from the rocks of the lower horizons, and when the shaft is dry the company intends doing something in the way of exploring at this point.

THE ARAGON

mine, is located in the village of Norway, is south of the old Norway mine, and is one of the principal pillars of support of the village. In years gone by it was known as the "Swamp" mine, and the title is one that still clings to it locally. This comes from its being located in what was originally a cedar swamp, and a very wet one at that. The work of sinking shafts has been a stupendous one, due to the water in the ground, quicksand being plentiful. It needed some such excellent manager as Mr. Per Larsson to take charge of the place, and when he was finally secured the work progressed, and has since gone on uninterruptedly, but it has not been without some obstacles. With the reaching of the rock ledge and the exploring of the territory surrounding the shaft, the company did not find the promising condition of things that it had hoped for. The ore lenses were too small, and it was not until the fifth level had been reached that anything like a settled and satisfactory state of things was revealed. There appears to be a great disturbance in the limestone near this mine, by which the formations are badly twisted, and create a puzzling turning that it not at all satisfactory to the miner. The forces that caused this folding have here formed an irregularly curved basin, and in this the ore is showing well at the lowest levels in the mine, it having a width of over 150 feet. The seventh is the lowest point reached, 586 feet, and it is at this depth that they have their best stopes. The outlook for further improvement as other levels are added should be favorable in the light of what has been shown thus far in the mine. The company certainly deserve all the good fortune possible for the persevering way in which they have conducted operations here.

On the 7th level at the time of our visit through the underground workings, their most westerly extension was in ore for a distance of 110 feet, the deposit having a thickness of 20 feet, which, with the exception of 4 feet on the footwall, was of excellent quality.

On the 6th and 6½ levels, in the southwest portion of the mine where the ore occupies a fold of the formation, it has a width of 150 feet. The here forms two hangings, so that the strata as divided would have a thickness of 75 feet.

On the 6th level, and in a space of two feet in sinking, ore of high phosphorus grade was encountered, but at the 6½ level it has improved considerably, and they look for still greater gains in purity as they go deeper in this portion of the mine. The principal mining is being done on the 6½ level, and the main working shaft is No. 2, a vertical, and in the hanging. No. 1 shaft takes nothing below the 6th level, and the ground here is very hard to sink in.

A new shaft to be known as No. 3, has been started. Work upon it is going forward from surface, and from three different levels underground. A new equipment of machinery has been ordered from the Webster, Camp & Lane manufactory Akron Ohio.

They mine the ore on square sets carrying these two sets high and fill the first set and a portion of the second with sand, when they repeat the operation. They take 8 feet of ore leaving 16 feet. The sand is obtained from a hill 1,300 feet from the mine, it being handled by a power tram. The sand runs through chutes from the bottom of the pit into cars and is distributed wherever needed. This filling costs about seven cents per ton of ore hoisted. The hanging wall is a slate, talcose in places, and is hard to keep drifts open in. The ground rises in the bottom of drifts due to the pressure laterally, the drifts requiring frequent retimbering.

They are figuring on installing a power tram on the 8th level having a loop at the west end of the mine where the ore makes biggest. The lower levels of the mine are 75 feet thick.

While the mine has been a very wet one, the constant pumping has considerably reduced the former volume. The water comes principally from surface, and three pumps take care of it at the upper levels. The lowering of water in adjoining lakes shows what the company has had to contend with in this way, but they are fast draining the surrounding country, and their heavy water charge should be fast growing less.

There are four grades of ore shipped:

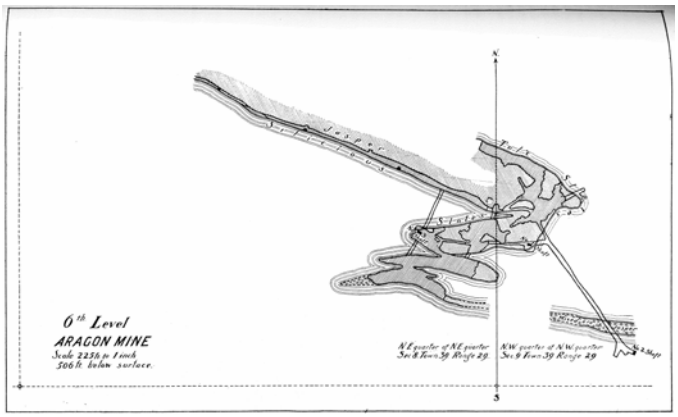
Grenada No. 1 gives	64.30	per cent	in	iron,	.140	per cent	in phosphorus.
Grenada No. 2 "	63.40	"	"		.080	"	"
Aragon "	65.00	"	"		.030	"	"
Castile "	65.55	"	"		.009	"	"

Of these only about 10 per cent is of the higher bessemer grades. The company is sending ore to furnaces by all-rail, they doing considerable in this way throughout the winter months. They also send a considerable tonnage to Alabama where the ore is used for fix. The mine is a royalty-payer, the fee being owned by Messrs. J. A. Hubbell, T. L. Chadbourne, of Houghton, and others.

Angus Smith, Milwaukee, is president; Per Larsson, Norway, vice-president and superintendent; Gustaf Hellberg, mining engineer and chemist; Daniel Stewart, cashier.

The Aragon has produced 762,537 tons of ore since it was first opened, the largest annual shipment being made in 1895, and consisted of 183,296 tons.

The engravings showing the principal levels will illustrate the irregularities of the ore deposits. For their drawing I am indebted to Mr. Hellberg, the mine engineer.



THE LORETTO.

This property has received considerable attention by reason of its having been claimed that its enclosing formations dipped under the limestone, and also from the fact that its ores were of a very pure quality. Were the first claim borne out by the developments at the mine it would have been important in the opening up of a new territory for exploration, with probable success attending it, but the Loretto has not as yet demonstrated that it occupies the position credited to it in its early history, and the ore deposit has not held out to a depth that the management had hoped for.

The mine is located on Sec. 7, 39, 28, near the Sturgeon river. It has two levels, the first being 80 feet thick, the second 100 feet. The ore in the first level comes up to the overlying sand. The shaft is in the hanging, jasper slates. The ore occupies a basin or trough made by a folding of the formations, and the dip is very flat, particularly in the lower level. The deposit is cut up with quartzite and soapstone.

did some churn drilling in the bottom of the mine the past summer, putting down a hole 100 feet, but found nothing excepting quartzite.

Mr. Rothwell, the engineer at that time, but who has since accepted a position with Mr. E. Breitung, Marquette, desired to put in deeper holes in the bottom of the basin, but this has not yet been done.

Before an accurate knowledge of the extent and shape of the ore deposit was had, the engine and boiler house was located directly over the latter, thus tying up about 100,000 tons of ore to retain the building. To secure this these buildings were removed the past fall, and the pillar will now be taken out.

The ore is mined on square sets, they taking rooms of 8 feet and leaving pillars of 16 feet. Rooms are filled with rock milled down from surface. There is a timber shaft reaching to the bottom level.

Two grades of ore are shipped, "Loretto," giving 62 per cent iron and .020 phosphorus, and "San Jose," yielding 65.80 in iron and .015 in phosphorus. The mine produces about one-half each of these. The property is well equipped with machinery.

There has been some drilling done on the property at some distance from the mine, but nothing more favorable than lean ore was found. Since my visit there I hear that another lens of ore to the south of the main one has been found, but little is known of its extent as yet. It is hoped that it will prove of larger proportions as an ore of the quality here found is valuable in the market.

The officers of the Loretto Iron Company are: D. F. Bremner, president; W. A. Amberg, treasurer; W. H. O'Brien, secretary, all of Chicago, Ill. Harry Truscott is superintendent, S. McRoberts cashier, Loretto, Mich.

The mine has produced 117,274 tons.

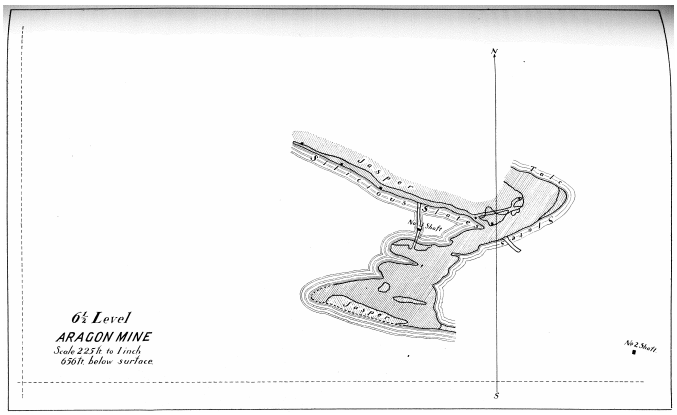
THE APPLETON,

located just across the river from the Loretto, is practically in the hands of the same people who control the latter. Work was discontinued in 1894 due in part to the burning of the boiler house from which steam to operate the pumps and other machinery was supplied. The main lens of ore had given out, also, but they had encountered another which they had not opportunity to fully develop before the fire above referred to occurred. There are three levels in the mine, which are reached by one shaft. There is a competent equipment of hoisting machinery, and the property is looked upon as a promising one. The company is figuring upon resuming work here at some time in the near future.

AT QUINNESEC,

four miles west and north of Norway, on the line of the Chicago & Northwestern railway, Mr. John R. Wood, of Appleton, Wis., is exploring, and has struck ore in a shaft at a depth of 215 feet. The property is owned in part by the Canal Company and partly by John L. Buell, of

Quinnesec. The ore was located with a diamond drill several years ago by John T. Jones, of Iron Mountain, Mich., when three holes were bored, the records showing from 20 to 60 feet of vein. They are now sinking in the deposit, which has not gotten blow the line at which the rock mixture from the capping leaves it. The prospect is considered a promising one. The old Quinnesec mine, which was long since abandoned, was, while active, a producer of ore of excellent quality. This is within a short distance of Mr. Wood's exploration.



MINES OF IRON MOUNTAIN.

Iron Mountain, in Dickinson county, is the most populous city in the Menominee district, containing 8,000 inhabitants. It is the important mining center of the range. It possesses modern improvements, a wide-awake population, and natural advantages that assist it in meeting the keenest competition from other fields. Principal amongst its labor-employing institutions is

THE CHAPIN MINE

that occupies a place next to the Norrie, of the Gogebic range, amongst the largest producers in the Lake Superior region. Since its opening in 1880 the Chapin has sent to market 5,710,962 tons of ore. For the season of 1895 the output was 618,589, surpassing all previous records of the property, with the exception of 1890, when 742,843 tons were sent out.

While there is such an enormous product to its credit, the mine has not been a profitable one to those who operated it up to within two years ago. The owner of the fee, Mr. Chapin, of Niles, Mich., had no reason for complaint, however, as a royalty of something like fifty cents per ton paid him for the ore extracted, was a satisfactory return for the money he had invested in the purchase of the lands containing the mine. A reduction from the former price of royalty has been obtained however, but the mine is a very nice property still for the owner. There were many plans of working tried, experiments seeming to interfere greatly with dividends, and the panic that stilled so many enterprises so affected this that it virtually went into bankruptcy. The control was secured by M. A. Hanna and other prominent iron men of Cleveland, Ohio, Mr. Jas MacNaughton was placed in charge as superintendent, business was actively resumed on May 10, 1894, and since that time success has attended the efforts of the company. The local affairs are admirably managed, and a practical, careful operation is resulted.

The Chapin has been working on two lenses of ore, the "main vein," so called, and the "north vein." The former is also referred to as the "south vein." This main lens has been wrought upon its trend for a distance of about 2,000 feet, and its thickness has been from 125 feet to 50 feet. It will average about 70 feet. The north lens has a length of 700 feet, a thickness of from 55 to 60 feet, and separating the two is from 30 to 40 feet of slate. That this slate will eventually cut out, permitting the two lenses to come together, is evident from the thinning out of this intervening material in the bottom levels of the mine.

The dip of the ore is north at about 70 degrees. It has a pitch west of 45 degrees on the top of the vein and is somewhat flatter on the under side. The immediate inclosing material is slate, and this of the most slippery, treacherous nature. When the ore has been removed, the hanging starts downward immediately, and the foot also shows movement. On the latter side a clay seam of thickness not exceeding an inch, extends for a considerable distance, it being not far from the point of contact between the slate and the banded ore formation underlying it. The foot appears to be sliding upon this, and while the movement is very slow, it means considerable.

In the earlier history of the mine the attempt was made to support this rotten hanging, and large sums of money were used in trying to solve a plan that would make this possible. Stone was used as filling, and various plans were followed to be finally given up. The present management did the sensible thing by letting the surface come down, and the rapidly growing depression that marks the course of the vein proves that it is going. In the latter part of January, 1896, I visited the mine, and all but four rooms were being operated on the caving plan. It has taken some time to bring this about for the reason that so many levels were opened up at the time the system was inaugurated. As is generally understood, the best way to cave the ground is to take one level at a time, but here were many, and it has required great care to change from the old system to the new without doing damage.

They cut the deposit into blocks by crosscutting from one wall to the other, and keep drifts open along the walls. The levels are 100 feet thick, and sub-levels are run through these. Generally one "sub" will take care of all the ore above it, as the latter runs very freely. They put in the ordinary drift through the ore using small drift timbers, and permit the ore to fill up the drift. They then go through this same ground again, and in this manner have gone through on the same floor as many as seven times. This serves to show how readily the ore comes to them. At times they attack all sides of a block of ore at once, although they usually do the slicing from the foot back to the hanging. As the latter has a very friable rock

they aim to work towards it so that it will not come away, mixing with the ore, and imparing its quality. Mills are put in at every 40 or 50 feet, this depending upon conditions, and a ladderway is protected on one side of the mill, the whole being well cribbed, affording ready outlet for the miner in case of accident.

The principal working shafts are B, C and D. B is at the east end of the mine and is down to the 8th level. It is a two compartment, and has two cages. C shaft is 750 feet west of B, is in the hanging wall, and to the 11th level, 875 feet. All levels in the mine below the 5th are spaced at 100 feet each. This shaft has two cages. D shaft is in the footwall, 600 feet east of the west line of the company's property, and 100 feet back from the ore body. It will soon be down to the 11th level, work of sinking and raising going on between the 10th and 11th. This shaft has four compartments, two for hoisting ore and handling men, one for pump and one that is unused. There is a timber shaft in the soild jasper midway between B and C that is to the 8th level. It has four compartments, two of which are equipped.

The deepest point reached in the mine is about 470 feet west of C shaft, where there is a winze 50 feet below the 11th level. A crosscut was in 60 feet from this, and for that distance was in ore of excellent quality which was still showing in the breast of the crosscut at the time of our visit.

A third lens of ore was shown by the diamond drill the past summer. The boring was made from the extreme west end of the 9th level, was horizontal, and at 116 feet cut 36 feet of clean ore. There is about 530 feet of ground between this point and the Ludington property, which adjoins, and has been obtained by the Chapin company.

A peculiarity of the Chapin ore is that the poorer quality comes from about the center of the lenses. On the upper portion of the vein the product gave about 61.25 per cent iron, this being shipped as their "Chapin" grade, while at lower depth there was a belt of ore that yielded but 58 per cent, this being shipped as their "Rex" grade. They have passed through the latter and in the lower levels there is little else than "Chapin" grade showing. These are the only grades of ore mined. In phosphorus the product runs very steadily at .070 per cent. The shipment of 1895 was practically all "Chapin" grade, the best sent out for many years.

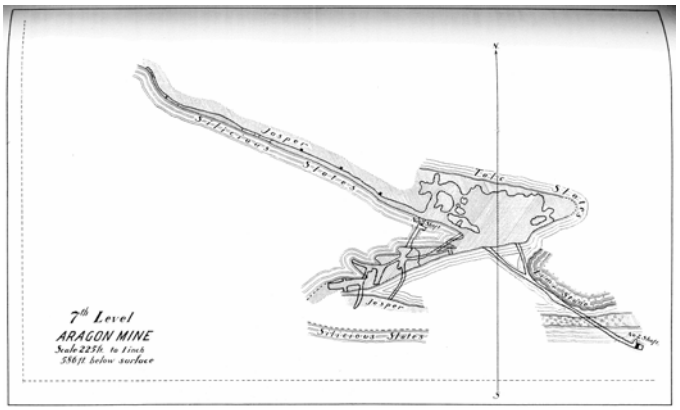
To assist in the work of shaft sinking, there is what is known as "C 1" shaft, located between C and D, and started at the 6th level. They keep this ahead of all other shafts, raising to the latter instead of sinking them. This permits of ore hoisting at the shafts being deepened.

At B and C shafts there is a pair of Corliss engines, 30 x 60 inch, with conical drums having an average diameter of 12½ feet, with a capacity for 1,500 feet of 1⅜-inch wire rope.

D shaft has a magnificent plant consisting of a pair of 24x48-inch Corliss engines operating two flat rope reels holding 1,500 feet of ½x4-inch steel rope.

The pumping plant located at D shaft has been described by many writers. Briefly, it is a steeple-compound, 50-inch initial cylinder; 100-inch low-pressure cylinder; 120-inch stroke; pump plunger 28x120-inch. Its capacity is 3,000 gallons per minute in a lift of 1,500 feet. It shows an excellent duty, but it is to be removed due to causes we will describe later on. There is a pair of plungers to the 6th level at A shaft for taking care of the water in case they are needed. The mine is not a very wet one considering the amount of territory it has to drain. There is a dam in the east end of the property, from where the bulk of the water comes, in which the latter can be retained for nine hours without having to pump from the mine. This gives an opportunity to make repairs on pumping machinery in case such time is needed.

The ore on the 7th, 8th and 9th levels is trammed from the stopes to shafts by power, an engine being located on the surface that does the work. On the 10th level a small engine located underground provides power for the purpose.



In the way of power the company is very fortunate, possessing a water falls on the Michigamme river, three miles distant, at which point a hydraulic station has been built. The four large compressors supply all the motive force the mine needs with the exception of that for the big pumping engine at D shaft. All their hoists, electric lighting plant, 105 power drills, machinery in the extensive shops, tramming, etc., are driven by the air compressed at this station. A pressure of 60 pounds per square inch is exerted at the mine. During the past summer extensive repairs were made at the hydraulic station. The race was retimbered, the compressor house repaired, the whole plant being given careful attention. The advantage to the company in the possession of this feature is an important one.

The company has a new timber mill, the old having been removed from its location due to settling ground. The timber cost is not as heavy as it used to be under the old plan of securing ore. Due to the enormous pressure from the walls, there is a constant repair of drifts needed, which is expensive, as heavy pieces of timber are

required, but the timberman in not as numerous as formerly.

All mining work is done on the contract plan, the little hand tramming, and main drift timbering being paid for at so much per day.

An addition that promises to be of great value to the Chapin Mining Company is the Hamilton and Ludington properties, which have been secured and are located immediately west of the Chapin. The Ludington occupies the south half of the southeast quarter and the northeast quarter of the southwest quarter of Sec. 25. The Hamilton embraces the north half of the southwest quarter of Sec. 30.

These mines have been idle since 1892, when they became financially embarrassed, and when a vast volume of water was met with, filling the mines in a few hours. Since that time the water was bailed out, however, to prove whether it could be controlled or not. All the arrangements for the transfer of these mines to the Chapin company have been perfected, and now, the 29th of January, '96, the new proprietors expect to begin the task of unwatering the mines in April, 1896. They are arranging for this, large bailers being gotten ready, this method of removing the water having been decided upon.

The ore of the Ludington and Hamilton mines are separate lenses from those found in the Chapin, they lying north of the like of the latter. They occupy the same trough or ore formation, being farther west and north. The Ludington had several shafts which have gone together during the time of idleness. There is considerable ore of good quality standing throughout the mine in the shape of pillars, but just how it will appear after the levels have been relieved of the water remains to be seen.

The Hamilton has one shaft in the limestone that can be used. The mine is 1,460 feet deep, and there are five levels opened in ore. The latter property has a fine equipment of machinery, a direct-acting flat rope hoist with a capacity of lifting 10-ton skips from a depth of 2,500 feet.

The Chapin is in better position to operate these properties than any other concern would be. They can simply continue their underground workings to the west and northwest and reach the ore that may lie in that direction. They can mine it to better advantage and care for the water more easily and cheaply than another concern could by reason of their being opened up so near the line of these properties, and having the equipment at hand to take care of them.

Then, too, the water in the old mines was a constant menace to the Chapin, as an unlucky seam might let it in upon them at any moment, and they hesitated to get anywhere near their west line.

The plan is to establish a new pumping station at the west end of the Chapin, placing a steam pump of modern make underground. Another pumping station will be made at the No. 2 timber shaft, farther east, and then the mammoth pumping plant at D shaft will be removed. Owing to the fact that over a million and a quarter tons of their Chapin grade ore are tied up in supporting this D shaft, Mr. MacNaughton has excellent reason for arguing for the removal of the pump. Then, too, the ground here shows the effects of the "drawing" of the foot, and there is danger that the pumping station will be pulled into the mine if it is not removed. Eventually, the settling surface could not help seriously affecting it.

The Chapin, with these mines, makes one of the finest properties in the country. Indeed, it is a big one without them. Worked to its fullest capacity, it will be an important factor in the market, as well as a supporter of the city in which it is located. The mine is a big one, and great improvement not only in the quality of the ore, but in the amount in sight, it is noticeable as compared to the conditions apparent a few years ago. I have been in the underground workings of the mine three times within the past year, and find it steadily improving.

About 1,000 men are employed. A comfortable hospital is attached to the mine.

The Menominee Transit Company, possessing six modern steel steamers, is closely associated with the mining company. The officers are: M. A. Hanna, president; L. C. Hanna, vice president and treasurer; A. M. Robbins, secretary, all of Cleveland, Ohio; Jas. MacNaughton, superintendent, Iron Mountain; L. B. Sutton, mining engineer; Martin Goldsworthy, mining captain; M. Lonergan, cashier.

THE PEWABIC MINE.

This was one of the few properties on the Menominee range that worked uninterruptedly through the late depression. It has been a producer of ore of excellent quality, in this respect being surpassed by no mine in the world that I have information about. Its bessemer grade has yielded 68 per cent in metallic iron and .008 per cent in phosphours. The latter element is not from a limited number of samples or cargoes, but has been the result of the year's output for several seasons. This is accomplished because, first, the ore of such purity is present, and, secondly, because great care is taken in the sampling and mining. The ore is not all of that fine quality, some of it running very high in phosphorus, and there is nothing by which the eye can detect the change from the bessemer and non-bessemer portions of the deposit. It has to be very carefully sampled, and constant determinations in the laboratory are necessary. This pains is well rewarded in the better price the ore secures in the market, it being very desirable for admixture with ores of poorer class.

The property is operated under the title of "The Pewabic Company," and its lands are in the southwest quarter of the northwest quarter and the southeast quarter of the northwest quarter of Sec. 32, 40, 30. Half of the fee is possessed by the company itself, and a royalty of 15

cents per ton of the best grade of ore mined, is paid. On ores of lower grade a lesser price has been fixed. Owning half of the fee makes the royalty in fact but 7½ cents per ton, which is not a great burden.

The first work done here was in May, 1887, and in 1892 the mine shipped 115,273 tons of ore. Its total output to that date has been 939,037, the greatest product for a single season, 304,010, having been achieved in 1894.

The trend of the ore is a little south of east. The dip is variable: In the west end of the mine it is 80 degrees to the south; 1,200 feet east of No. 1 shaft it changes to the north, and for 300 feet is about 70 degrees. Beyond this point for 500 feet it has a dip of 45 degrees to the north. The pitch is to the west. The hanging is grey slates, the foot red slates.

There are two shafts, No. 1, located 550 feet east of west line of Sec. 32, and No. 2, located 1,200 feet east of No. 1. No. 1 is a vertical, 14 ft. 6 in. x 5 ft. 6 in., and has three compartments. No. 2 is 21 ft. x 6 ft. and has four compartments. One of these is subdivided for two timber cages, so that there are five compartments now being used, two timber, two ore cages, and one pump-way. At each of these shafts there are there are two 10-foot drums with direct-acting engines, 24 in. x 48 in.

These shafts are down to the 5th level. As will be seen by the accompanying engraving, kindly loaned by the Lake Superior Mining Institute, the west end of the mine has a great deal of jasper, and that lying upon the ore deposit is a strong capping of sandstone, the greatest width of ore being in the upper portions of the deposit. Jasper is frequently met with throughout the mine, and has been a very troublesome enemy at all times. The principal mining done has been east of No. 2 above the third level, and west of No. 2 above the third and between the third and fourth levels. While the jasper has given some disappointments underground, the management consoles themselves with the thought that this hard material prevented the erosion of the ore in the glacial age.

They win the ore by taking it upon square sets, originally, in the usual manner observed in this method of mining, and subsequently by caving the pillars. The latter is done by first taking a 14-foot slice from the top of the first pillar on the 1st level. This done, they go to the bottom and take two cuts of 7 feet each. If this should not start the ore running they take another seven-foot cut from the bottom. They leave seven feet of ore to protect their drift in the last cut, and afterward the timbers are blasted in and the ore gotten when the second-level pillar is brought down. They secure the ore safely, and get all of it. They take rooms of 30 feet, leaving pillars of 20 feet. All the ore is milled to the third level, and from there hand-trammed to shaft, cars holding one ton each.

At the time of my last visit to the mine they were opening on a body of ore at the 5th level midway between the shafts. This ore begins at a distance east of No. 1 shaft of 500 feet. They looked for it at 300, but the ore has evidently shortened by a change in the pitch from the level above, and they are hoping that the pitch on the under side of the lens will change to conform to it.

On the third level they are preparing to take a block of high silicon ore 300 feet square. They have opened out 5 rooms each 80 feet square. There is a thin strata of this material and they are going to cave it, Mr. Brown, the competent superintendent, believing this will aid in the crushing of the ore so that it will not have to be reduced by machinery. This ore is very low in phosphorus, giving .007 per cent and is very steady at that. This will make a desirable mixture for those who are looking for the ores of the high-silicon class.

During the past two years the mine has made a large amount of water, too much for the pumping capacity of the property, and they resorted to a building of a dam at the 4th level near No. 2 shaft. The gauge on this showed a pressure of 100 pounds to the square inch, and it was figured that 7-10ths of the water was held back by this dam. The company desired to explore the lower levels, but nothing could be done against the flood, and a new pump was ordered which was installed about the middle of January, '96. This is the only triple-expansion pumping engine in the iron mines of the Lake Superior country. It is a Worthington, cylinders 15 in., 23 in., and 38 in. x 12 in. plunger, 24 in. stroke. It is supplied with surface condenser. The capacity is 1,500 gallons per minute for 700-foot lift, with 125 pounds steam pressure. It can readily be bushed down so that it will lift 1,000 gallons 1,000 feet per minute. Two 200-horse power boilers supply the steam. A building to accomodate the latter, with room for two more like them, has been constructed of stone. Its dimensions are 45x50 feet, inside measurement. A capacity test was made of the pump, it coming up to the required standard. A duty test will be made in the near future.

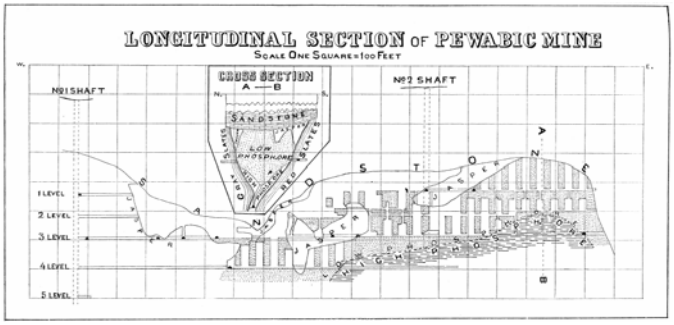
The superintendent is of the opinion that the water from the sandstone has had much to do with carrying the phosphorus from the upper portions of the vein to lower zones, as the under portion is much higher in this acid than the upper. The map printed will show this plainly.

The Pewabic Company has recently secured possession of the Walpole property, located one-fourth mile west and one-fourth mile north, and they are now exploring this. They have an idea that there may be another folding of the limestone in which ore of high grade will be found. They have nearly established the fact that the ore of the Pewabic is in such a fold. They refer to the Aragon and Loretto as occupying similar folds, and think their theory is well worth spending a little money on. Just east of the Chapin they are crosscutting east from the bottom of an old shaft that is down 318 feet. This drift is now in 700 feet, and they are cutting lean ore that gives 44 per cent in iron and .015 in phosphorus, for which there is a market, and which will assist in paying for the work. They have constructed a shaft house at this place. They are also driving a drift from the 5th level of the Pewabic westward. A peculiar changing of the red slates to black slates was met with here, about 25 feet of

the black being found in the drift with no apparent cause for its presence.

About 400 men are employed, the most of whom work on company account. This is considered the best plan because great care has to be taken in the mining of pillars, and as there is considerable jasper met with they want pains taken in keeping it out of the ore. There is a hospital for the men that is finely equipped.

George Van Dyke is president; Nelson P. Hulst, manager, Milwaukee; E. F. Brown, superintendent, Iron Mountain; Jas. Holland, mining captain.



THE MILLIE MINE

is located directly south of the east end of the Chapin, its ore being in small lenses in the foot wall formation of the Chapin. The mine resumed operations in July, '95, after a two years' idleness. It is operated by Simeon Dessau, of New York, who pays a royalty of 60 cents per ton for the privilege of mining, which is certainly an exorbitant tax. The ore is of excellent quality, yielding 64 per cent iron and .025 per cent phosphorus. There is a vertical shaft down 240 feet, after which there is another shaft following the ore on its dip, this necessitating a transfer underground. There is not a railroad track to the mine, the ore being trammed for some distance to the railway, which adds still more to the cost of production. The present bottom of the mine is 360 feet from surface, and they were opening on a new lense of ore on the 6th level, a force of 40 men being employed. They have three 4-foot Lane drums. A new office was constructed the past summer, the old one having been destroyed by fire. Ten thousand nine hundred and twenty-four tons were shipped in 1895, and the total output since 1881 is 139,887 tons. C. W. Kennedy of New York, is president; Chas. McGregor, of Iron Mountain, is superintendent.

THE ANTOINE ORE CO.

This is a company recently organized for the purpose of developing the lean ores of this section that are low in phosphorus and high in silica. John T. Jones, of Iron Mountain, is president; Reuben Williamson, of Sharon, Pa., is secretary and treasurer.

The first work done was at what is known as "The Traders," on the southwest quarter of the southwest quarter of Sec. 17, 40-30. Here they have stripped off the surface drift that averages 10 feet thick, and have mined from an open pit about 20,000 tons that gave 40 per cent iron, .030 per cent phosphorus, 38 per cent silica. There is a large body of ore of this class at this pit. An old shaft is down into it, and from the bottom there is a crosscut 130 feet in ore. The ore is of a flaggy nature, and mines readily and cheaply. They crush it, having a 30 in. x 30 in. Lake Shore Iron Works reducer, that does the work satisfactorily. From the pit to the railroad track where the crusher and ore pockets are located, there is a steep incline, giving plenty of room to handle the ore automatically. Two dinkey engines hoist the ore from the pit and convey it over the trestle to the crusher. This trestle is four-tracked, the two outside ones being for waste rock that may be hoisted. The ore is not a difficult one to crush. The deposit is free from water, they being 200 feet above the water line. Two miles of spur track were constructed by the Chicago, Milwaukee & St. Paul Railway Company to reach this property. The company did its first mining in June, '95.

There is a second pit opened up on this lean ore formation not far distant from their Traders, which is known as the "Clifford." The ore is a little higher in iron than that of the Traders pit, giving 45 per cent, and contains .025 per cent phosphorus.

The Antoine Ore Company is shipping ore to the Illinois Steel Company, and will send out a considerable amount during the winter of '96, having an order for all it can supply. A contract for stripping off the surface drift has recently been let.

The same company is also shipping a lean ore from the old Keel Ridge property. This gives 41 per cent iron and from .036 to .040 per cent phosphorus. From this they sent out during 1895, 19,441 tons. From the two pits at the Traders 27,931 tons were produced.

The same company is exploring on Sec. 33, diamond drilling, and report having struck ore in January, 1896.

A portion of the town site of Iron Mountain has been leased to Mr. J. T. Jones, of this place, A. C. Cook, of Norway, Mich., and others who are figuring upon doing something in the way of lean ore mining. A start has not yet been made, however.

THE CUFF.

This property adjoins the old Indiana mine, and is located about tow and one-half miles north of Quinnesec. The fee is owned by Welcome Hyde, of Appleton, who has decided to work it for a deposit of lean ore that will give over 40 per cent iron and is low in phosphorus. The Chicago & Northwestern Railway Co. will build a spur track to the location, a distance of about three-fourths of a mile. Josiah M. Davey is in charge of the work. An eight-drill air compressor, hoist, and other needed machinery, has been secured.

EXPLORATIONS.

The panic interfered with explorations being carried on at many points throughout this portion of the Menominee range. Aside from those already mentioned there is

something being done at Sec. 6, 39, 29, where search has been prosecuted steadily for some time past, and where those who are conducting it deserve success by reason of the efforts put forth. They have found ore at different times, and believe they will be able to develop a mine that will figure in the coming shipping season.

THE WISCONSIN END

of the Menominee range is very quiet, the Badger, of the Commonwealth Iron Company, being the only active property. This has been a remarkable deposit. The ore is of non-bessemer grade, but as it stands very firmly, needing no timber, and as the deposits have been large, they have been able to secure a profit even in the dullest seasons. Then, too, Mr. O. C. Davidson, the superintendent, is one of the keenest gentlemen in the mining business. There are stopes in the Badger that are 250 feet high without a stick of timber, and in the course of mining they leave nearly a half of the ore for pillars. They will soon begin robbing these. I believe the plan is to fill the old rooms with rock from the hanging that can be easily secured, to raise in the pillars, and to slice from the top. The shafts have reached a depth of 450 feet, and the ore forms in large basins. The mine has produced 1,636,081 tons since it began business in 1880. Diamond drilling to explore the property is now under way.

AT SAUNDERS.

The Pewabic Company is conducting explorations at Saunders, Wis., on Sec. 30, 41, 16, just across the line from Michigan, and separated from Michigan by the waters of the Brule river. It is so near our State that anything of value found might be duplicated on the Michigan side of the river, and for this reason would be interesting to Michigan readers of this volume. They have one shaft down 218 feet. There is a very heavy drift here, 230 feet, and they are at this time, February 3, ’96, preparing to put a diamond drill in the present bottom of the shaft, a standpipe being driven to the ledge. The bottom of the shaft is quicksand. A second shaft is down 80 feet. They have the limestone outcropping a short distance away, and the slates also show, they being similar in appearance to those found in the Pewabic mine. The Pewabic Company owns the fee and are desirous of proving if the lands have any mineral value.

MINES OF CRYSTAL FALLS.

Crystal Falls, in Iron county, is beautifully located, being one of the most picturesque spots in the iron districts of the Lake Superior country. Is has a population of about 2,000, and was for some years an attractive place to those who sought active business surroundings. There were many mines that provided employment for a large number of men, wages were high, there was a demand for the ore, and the people were contented and happy. The condition today is in marked contrast with that noticed a few years since, however. But a few of the mines are now being wrought, and many of the people are devoting their attention to agriculture. What Iron county needs is the addition of blast furnaces that will reduce the ores that do not now demand attention from consumers. The principal trouble with the product of these mines in that there is too much phosphorus, this undesirable element generally appearing in too great a quantity to permit of a profitable mixing with ores of low phosphorus classes. Until there is a change that again gives to iron the popularity that I believe will yet come to it, the mines of Iron county will be badly handicapped m the struggle for place in the market. The growth of the basic process of making steel is favorable to ores of the class here found.

THE DUNN MINE

occupies the west half of the northeast quarter of Sec. 1, 42-33. It made its first shipment in 1887, and has sent out in all 921,964 tons. It has been one of the most important mines of this section, and I regret that its underground showing is not as promising as the future has found it. However, iron mines are subject to many changes underground, and while today may meet with discouragement, tomorrow may entirely alter the situation. The south lens of ore, to reach which No. 1 shaft was sunk, gave out a depth of 300 feet, and all efforts to find an extension of it have proved fruitless. They drifted south 350 feet, east 60 feet, southwest, 60 feet, and raised from the 375-foot level to the one above, but were not repaid by encountering a continuance of the ore had to the 300 foot level.

Operations have since been confined to the northwest end of the mine, where No. 2 shaft is located, and in which direction the ore is pitching. The ore making so much flatter than the inclination of the shaft in this end of the mine, a shaft was started from the bottom level, the 9th, and 350 feet from No. 2. This shaft was down 60 feet at the time of my visit, and was following the dip of the formation. From this another level has been opened up for which the product for 1896 is expected. Bunches of rock have recently been encountered in this level, and appear to be of serious character. They have opened up on the trend of this ore for a distance of 150 feet, its average thickness being 40 feet. The ore is transferred from the new; shaft to No. 2, the hoisting from the new incline being done from surface by a skillful placing of pulleys.

They have an excellent plant of machinery, the finest on this end of the range. A force of 85 men is employed.

One thing that has aided the Dunn in mining its ore so cheaply that it could compete with other properties is the firmness of its hanging walls, no timber being needed. A No. 7 pump would take care of the water if the latter were collected at one place in the mine.

The ore in the portion of the mine now being worked gives an average of 58 per cent iron and from the .300 to .500 phosphorus.

Samuel C. Bennett is mining superintendent. The property is operated by the Dunn Iron Mining Co., of which T. F. Cole, Negaunee, is general manager.

THE COLUMBIA.MINE

is the nearest active one to the Dunn, it being located on Sec. 32. This property has been known as the Shafter, Sheldon and Union. Its first shipment was made in 1882, and its total output is 358,214, and its greatest annual product was made in 1895.

They have two ore formations here, the north and south, and there is a shaft to each of these. The No. 1 shaft is on the north formation, and is down 250 feet. It was being sunk at the time I visited the mine in June, '95, but in November of the same year they discontinued it. The north formation has a dip north of about 60 degrees, which is about fifteen degrees flatter than the dip of the south formation, which inclines to the south. The coming together of these formations may result in a more regular run of ore than has thus far been encountered on the upper levels, the formation being badly contorted and mixed with jasper.

On the south vein they have reached the 4th level, 400 feet from surface, and are now adding another level of 60 feet thick. In winning the ore they drive a drift along the foot, crosscut to the hanging, rise in the ore and backstope, leaving pillars to support the levels. No pillars have yet been taken. The main working shaft on the south vein is a vertical, 4-compartment.

The mine is a wet one, and a bailer is used to keep the water out. Its capacity is 600 gallons, and they were figuring upon one twice this size. Mr. Frank Scadden, the general manager, reports a saving of fully one-third by the use of the bailer as compared to the ordinary steam pump.

The property is in need of a heavier hoisting plant. A new dry to replace one that was destroyed by fire in the summer of '95 has been built. They are now employing 125 men.

The property is operated under the title of the Huron Iron Company, of which John Crera, of Chicago, is president; Frank Scadden, vie president and general manager, Crystal Falls; M. S. Saunders, secretary, Chicago.

The mine was closed in 1893, resuming in July, '94. It is being well looked after. The ore contains 60 per cent iron and from .125 to .500 per cent phosphorus.

THE MASTODON MINE

has been abandoned, the final work having been done in the summer of '95. Originally the mine was worked as an open cut, but below this deep surface pit they have three levels of 50 feet each. On the third level the ore was cut out by graphite that stands vertically in the mine. They have done considerable diamond drilling but have found nothing of any value. In point of quality the ore was similar to that of the Columbia. The property was worked on lease from the Canal company. Ed. Breitung, Marquette, is president; Jos. Austrian, Chicago, secretary and treasurer; E. S. Roberts, mining superintendent.

The company has recently taken an option on the Dober property, Iron River, of which reference will be made later on in this volume.

THE CRYSTAL FALLS MINE.

This property is located within a short distance of the village of Crystal Falls. It was recently secured by the Corrigan McKinney Co., of Cleveland, Ohio. Mr. T. F. Cole is manager. It was worked for a portion of 1985, being closed in the fall of that year. It produces a low-grade ore, this being mined from an open pit. What the intentions of the company are with reference to further operation of the mine has not been announced.

IDLE MINES.

The Dunn and Columbia are the only mines of the many the Crystal Falls district possesses that are now working. Of the idle ones the Great Western produces the best ore, but the mine is an expensive one to operate by reason of the great amount of water that has to be handled to keep it dry. When it closed in 1893 its neighbor, the Lincoln, was also forced into idleness as it would have to pump the water of the Great Western if it continued, and it did not possess the necessary plant to do this even if the company were so disposed, and it has remained idle since that time.

The Lamont, of which Frank Scadden has charge will have to sink another lift if they decide to resume.

The Paint River lens of ore gave out at the 300-foot level, a dyke with a southwest dip coming in and cutting it off. The property is finely equipped with machinery. Frank Scadden is in charge.

There are several other properties, among which are the Clair, Mansfield, Hope, Hollister, Lee Peck, Wagner, May and Delphic. The number of explorations is many, but all await the advent of such times as will permit of resumption.

MINES OF IRON RIVER.

Iron River is another of the towns of the Menominee range that has suffered the loss of many active concerns of mining kind, the same trouble being apparent here that is met with at its nearest neighbor, Crystal Falls. At Iron River is witnessed the most westerly workings of the mines of the Menominee range. The town has been supported by its agricultural and lumbering interests since the general closing of iron properties in 1893.

At the time of my last visit in the fall of 1895, Iron River had but one active mine, this being

THE SHERIDAN,

which is located on the southeast quarter of southeast quarter Sec. 26. It was originally worked as an open pit, the ore making to the surface, and from this pit a considerable product was easily and cheaply secured. In August, 1893, the mine was closed down, and remained idle until July, 1895, at which time a sale of ore was affected, and orders for resumption issued. For the season of 1895, a shipment of over 16,000 tons was made, which amount could have been increased but for a too high freight rate. There are about 3,000 tons remaining in stockpile at the mine and between 6,000 and 7,000 are broken in the levels underground.

There is one shaft 225 feet deep, vertical, and fro this two levels have been opened which are about mined out. Another level of 100 feet is now being added. The ore body trends north and south and has a thickness of about 30 feet. It has been followed 200 feet, and cutting across it is a large "horse" of lean ore about 100 feet thick. The foot is slate, the hanging hematite jasper. No timber has to be used, and the mine is a dry one, these features assisting in securing the ore at low cost, which has been necessary in order to secure a profit. The ore is of hard character, and power drills are sadly needed to hasten the work of sinking and opening. The mine needs a new hoisting plant.

There are two ore formations here, the Sheridan being on the south. The mine has shipped, all told, 73,567 tons. Thirty men are employed.

John Power is president; M. K. Bissell, secretary, of Escanaba, Mich. A. Gulgren is superintendent, Iron River.

THE HIAWATHA MINE

is a mile south of the Sheridan. It is a newly-developed property, and sent to market 1,200 tons in 1895, but was operated in a very quiet way. Work was suspended in October and the shaft permitted to fill with water. The shaft is 100 feet deep, and is in the ore formation. At 50 feet from surface they had a stope of ore 60 feet long by 20 feet thick, which they worked out. The ore obtained for the past season was secured from surface, being a continuation of this deposit, they working down to the back of the 50-foot level slope.

From the bottom of the shaft they drifted north and south, and have ore showing in the south, which they think is the top of a lens. The ore is very soft, mining easily with pick, and gives 62 per cent iron and .126 phosphorus.

There is not a railway track to the mine, and the ore shipped was hauled one-half mile on wagons. The property is in need of better hoisting and pumping machinery, and they were figuring upon adding this at the time of my visit.

W. H. Selden is president, F. A. Morrison, secretary and treasurer, Iron River. The property is operated under the title of "The Hiawatha Iron Co."

The Nanaimo, north of the Sheridan, is idle, with no prospect of immediate resumption.

On the north formation is the Miller, Iron River, Isabella and Dober exploration. Of these the Iron River is the most important. It is held under lease by the Florence Iron River Co., and has been idle since 1891. There appears to be some difficulty between the fee owners and the company. The later took some of the machinery out of the buildings in the summer of '95 and threatened to throw up the lease, when some concession was made them by which the work of dismantling was stopped. The machinery removed lay upon the dock at the time of our visit. Mr. Geo. D. Crippen, at Iron River, has charge of the property in the company's interest. The mine has produced 904,587 tons of ore, and has a large deposit of such quality as this portion of the range generally yields.

The Dober exploration consists of four pits that have been sunk on the northwest quarter of Sec. 1, 42-35. Two of these were to the ledge, and in two the latter had been found with the churn drill. The owner, Alos Dober, of Iron River, did the work, and informed me that assays of the ore gave 63.82 per cent in iron. He had given an option for lease to the Columbia Iron Company, and the latter were placing machinery on the ground in January, '96, with which to develop the property. Mr. Dober claims an ore formation having a width of 75 feet.

THE HEMLOCK MINE

is operated by the Hemlock River Mining Co., and its location is the southwest quarter of Sec. 4, 44, 33. It takes its name from the river that runs near by. It was opened in the winter of 1889-90. The ore will average 61 to 62 per cent iron, and .100 to .300 per cent in phosphorus.

The ore is nearly continuous, having an average thickness of 15 feet, but varying in the different lenses that are separated by a small strata of rock. The trend of the vein is northwest and southeast, with a pitch to the west of 60 degrees.

There are two shafts sunk in the footwall and following the dip of the formation. They are distant from each other 360 feet. A shaft is down 150 feet, to the 2d level, and B has a depth of 290 feet, and reaches the 4th level.

The property was idle during the depression, resuming in the fall of 1895. They are now mining ore that was opened up before the orders to close down were received. Three modes of winning the ore are observed according to the size of the lens and hardness of ore. Where the latter is very firm there are large open stopes where pillars are left to support the hanging, and where no timber is used. Where the ore is soft they have used drift sets and caved the surface. On one lens they have taken the ore on square timbers.

A total of 113,262 tons has been produced. The mine is well equipped with machinery. They are now employing 100 men.

Chas. E. Lawrence is superintendent; Chas. Hughes, mining captain. The officers of the company are located in Cleveland, O., and are: Col. Jas Pickands, president; J. H. Hoyt, secretary; H, G. Dalton, treasurer.

THE MICHIGAN,

on Sec. 9, is the nearest neighbor of the Hemlock, but has been inactive the past year. There are two shafts, the deeper being 150 feet, and promising ore bodies are met with, the latter producing non-bessemer grades. T. Gibson is superintendent. The shipment made the past season was carted in wagons to the Northwestern track, there being no railroad to the mine. The shipment was made under the name of the Michigan Exploring Company.

FELCH MOUNTAIN RANGE.

This belt of the Menominee ore district lies about 15 miles north of the main one on which mining is now prosecuted. Nothing aside from two small explorations is being done. At Randville, on the western end of the range in Sec. 34, 42-30, the Pewabic Iron Company are sinking a shaft and will do diamond drilling when the ledge is reached. There is a strong magnetic attraction here for a distance of three miles on the trend of the formation, although this may result from magnetic schists. North of the shaft is greenstone, and south of it is diorite. Three-fourths of a mile south of the shaft is the Laurentian granite.

Shipment of iron ore from Menominee Range for season of 1895, and total shipments for all years.

Name of mine.	1895.	Totals.	Name of mine.	1895.	Totals.
Antoine	31,768	31,768	Lee Peck (D)		2,844
Appleton	2,107	12,102	Lincoln		36,589
Aragon	181,359	762,537	Loretto	53,160	117,274
Armenia	2,045	78,969	Ludington		1,001,518
Beta		4,211	Manganate		6,844
Brier Hill		14,981	Mansfield		206,956
Calumet		38,713	Mastodon	23,781	425,648
Chapin	618,371	5,710,962	Metropolitan		107,027
Claire		66,964	Michigan Explo. Co.	1,071	1,653
Columbia	65,192	358,214	Millie (Hewitt)	10,924	139,887
Cornell		6,630	Monitor (Lamont)		128,909
Crystal Falls	13,037	18,352	Nanaimo		127,566
Delphic		33,718	Northwestern		17,206
Dunn	90,886	921,064	Paint River		222,371
Fairbank		8,500	*Penn Iron M'ng Co.	292,808	4,806,598
Great Western		373,100	Perry		3,138
Groveland		1,049	Pewabic	262,764	939,077
Half and Half		7,524	Quinnesec	761	284,084
Hamilton		96,072	Shafer	6,315	6,315
Hemlock	1,046	113,362	Selden		2,092
Hersel		955	Sheridan	16,754	73,567
Hiawatha	1,201	2,884	South Mastodon		8,203
Hollister		4,098	Stephenson		39,350
Hope		17,818	Sturgeon River		18,404
Indiana		17,871	Walpole		19,089
Iron River		904,587	Youngstown	13	150,764
Keel Ridge	19,441	88,291			
Totals				1,694,804	18,578,827

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

Shipments of iron ore from mines of Wisconsin located on Menominee Range for 1895 and grand total for all years.

	For 1895.	For all years.
Commonwealth	208,579	1,636,081
Florence	22,820	1,092,296
Totals	231,399	2,728,377

The ore deposits of the Felch Mountain range where wrought were generally very thin. At the Calumet mine, which produced the best quality of ore found on the range, considerable excitement was created by reason of the large area of ore shown in the stripping, but it was very thin, having been ground away in the time of the glacial scouring, or else never having had any great thickness. There is now nothing being done on the range, and there is no prospect for activity here unless the Pewabic people may happen upon something valuable in the portion of the range in which they are exploring, and where no attention in a practical way has yet been given aside from the work they are doing.

THE GOGEBIC DISTRICT.

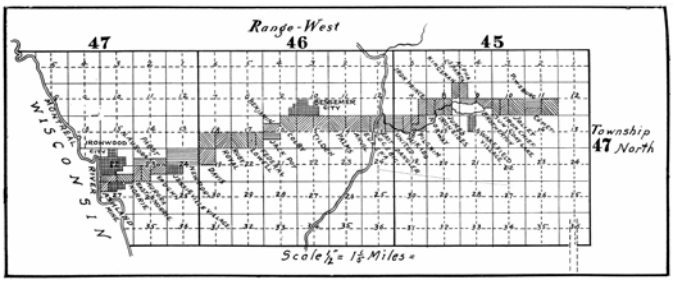
The Gogebic iron ore district is the youngest of the three boasted by the State of Michigan, and is also one of the most important. As a producer of high grade ores it is at the head of all others, not only of Michigan but of all other states in the Union. With reference to the quantity of its ores of this class, it is certainly adequate to supply any reasonable demand upon them that will be made for many years to come. I find the mines of the district generally looking well. They are being skillfully managed, and the same spirit of progress and improvement is noted here as is apparent upon its sister ranges. While there were many failures at the time when the whole country suffered so much in a financial way, I find that recovery is general. Many of the idle mines have resumed, more are preparing for activity, and the different towns throughout the field are much more prosperous than for any time within the past three years.

The Gogebic, during the brief time it has been producing, has sent to market 16,395,375 gross tons. The output for 1895, including a few mines on the Wisconsin end of the range, was 2,560,775 tons, leading all other Michigan ranges, and exceeding its product for 1894 by 750,475 tons. The Michigan portion of the range sent out 2,132,397 tons.

The formations here are of the most regular found in the iron ore districts of the State. They are very persistent and strong. They rest on the older granite to the south, are overlaid by trap of the Keweenaw series, and have a width at the widest point of about three miles. They are tilted north at an angle of 60 to 70 degrees. The iron-bearing series is divided into four members: The lowest is a silicious limestone, thin, and not generally encountered. Second, is variegated quartz slate, the upper portion of which is hard, massive quartzite. The third is ferruginous cherts, schists, ore bodies, etc. The fourth is of graywackes, schists, cherty iron cabronates, etc.

An important feature of the geology of the district are the dykes met with in all the important mines. These are a diorite, or diabase, similar to those found in the copper-bearing rocks of this peninsula, and I find many different opinions concerning their make-up and the part they play

in the concentration of the ore. These dykes pitch east of south, generally, although there are places where they show a decided westerly pitch. Their dip is to the south at about right angles to that of the footwall quartzite, and it is in the trough thus formed that the largest ore bodies have been found. Up to the present time but little work has been done below these dykes where the latter have made strong and persistent, as is below these dykes where the latter have made strong and persistent, as is the case at many of the largest mines in the district, but that there is ore below this main dyke seems to have been shown by diamond drill explorations made by the Metropolitan Land and Iron Company, at their Norrie mines. According to the record of a deep boring made upon their property six dykes of varying thickness were encountered in a vertical hole of 1,500 feet deep, the thickest of these being found at a distance of 1,291 feet from surface, it being 92 feet as cut by the drill. Under this was found 95 feet of ore, then a small dyke 8 feet thick, and under this 28 feet of ore. We publish an engraving showing the record of this hole, which is certainly interesting.



SHOWING LOCATION OF MINES ON THE GOGEBIC RANGE.

At the Ashland many dykes were met with, and there appeared to have been a shattering and splintering of the principal main one. Between Nos. 1 and 2 shafts of the East Norrie is a dyke standing nearly vertically in the mine. The maps of these will also be found in the report where the mines are individually treated. There is a rolling of the main dykes causing a change in their pitch. At the Newport the pitch is clearly to the west, while at the Norries it is in the opposite direction. The same thing is found at the Palms mine, Bessemer, the dyke pitching west, whereas at the Tilden, a short distance west, the pitch is to the east. In both the instances cited the pitch conforms to the shape of the surface of the properties.

The outlet for the ores of this range is at the shipping ports of Ashland and Escanaba.

The ores of the Gogebic are all soft hematites, red, and are generally blue in color. They are easily mined, and a large product per man is secured.

MINES OF IRONWOOD CITY.

It is in and about the city of Ironwood that the greatest activity in a mining way is noticed on the Gogebic range. Ironwood possesses 10,000 inhabitants, has modern improvements in the way of sewerage, water works, electric lighting, fine schools and churches, an electric railway, and an enterprising class of people.

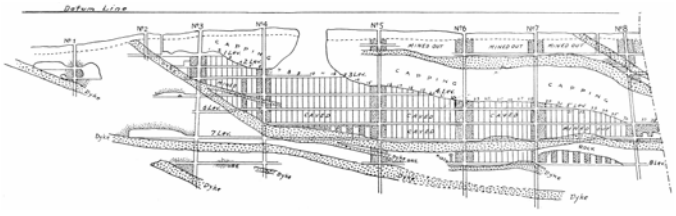
Its location is at the extreme western end of the Michigan portion of the range, being on the east bank of the Montreal river that is the boundary line on the opposite side of which is the state of Wisconsin. Beginning at the western end first comes

THE ASHLAND MINE,

one of the properties of the Penokee & Gogebic Development Co., and one that has figured conspicuously in the mining history of this range. In this mine the dykes were very numerous, and they have cut out the ore in the lower levels so that the robbing of the pillars has been all that could be done. There has been considerable exploring conducted, the diamond drill having been resorted to, but nothing of importance has been located under the present lowest level, the 9th, and in the latter the lenses of ore were very small. The mine was closed when the panic came, and resumed in November, 1894. The lower levels are full of water, operations being confined to the upper ones, where some old pillars are being taken, and where a new lens of ore is being opened up in the territory east of No. 7 shaft. There was a drift in 480 feet at the time of my visit, which was within 20 feet of the Norrie mine like. There were nine rooms opened in ore, but close to the capping, and a cave of the latter delayed them considerably. The drift has turned considerably, swinging, with the ore, around towards the foot.

They have what they call two runs of ore here, the north vein and south vein. On the latter are located shafts Nos. 5 and 8, and on the former shafts Nos. 6 and 7. The ore of the north vein is of the better grade, giving 63.50 per cent iron and .031 per cent phosphorus. The new deposit being developed by the Ashland gives promise of leading to something in the new territory now being opened up. The ore is of excellent quality, and the management would like more of it. At No. 8 shaft they were caving the pillar on the third level.

For the year 1895 the mine shipped 126,096 tons, and the total output of the mine to date is 1,898,884 tons, this giving some idea of the importance of the property in its history. The largest yearly output was in 1890m when 435,949 tons were shipped. At the time of our visit 170 men were employed. T. H. Davey is mining captain.



SHOWING THE DYKES MET WITH IN THE ASHLAND MINE.

THE NORRIE MINES.

The Norrie mines have earned a national reputation by reason of the immensity of their product and the fine quality of their ores. They have credit for shipping more ore in a single season than any mine in the United States. Indeed, I believe the world has no single property that has sent out such an enormous tonnage in a twelve-month. While the mines are wrought under option from two different parties, they extending across an eighty and a forty acres owned by different people, they are one deposit. There is no break in the ore vein, and they are entitled to be described as a single mine in view of the fact that the ore is continuous and is being mined by one concern and as a single property.

The Norrie has sent to market from the time of its opening until the present, 5,946,773 tons of ore, the greatest annual output having been made in 1890, when it reached the enormous total of 906,728 tons.

The mine gives employment to about 1,300 people, and is the principal support of the city in which it is located. It has played an important part in setting the price for ores of bessemer grade, which it has been enabled to do by reason of its immense tonnage and its excellent quality of product.

That the Norrie is still able to keep up its old-time record as a big shipper is shown by the output of the year 1895, when 738,480 tons were sent out. In the month of October of the past season 94,000 tons were mined, which was at the rate of over a million tons yearly. There is no denying that these immense outputs make serious inroads on the vein. Few people have a proper idea of what these millions mean. It requires a great many cubic feet of ground to supply them, but the Norrie possesses a wonderful deposit, and it is in shape to keep up the great record of the past for many seasons to come. The mine has been favored with some wonderfully large portions of the vein, as thick as 275 feet in places, although the average thickness for the distance opened up will average about 70 feet.

During the past three years nothing aside from the addition of a level at the East Norrie has been done in the way of development work. No dead work of any description has been performed, no new territory opened up, they simply drawing from the reserves that were so abundant. This also serves to illustrate the possibilities of the mine.

Beginning at the west end of the property there is shaft No. 1, following which, going eastward, are Nos. 2, 3, 4, 5, 6, 7 and 8. These are located on the Norrie forty. Proceeding eastward on the line of these shafts is found the East Norrie's Nos. 1, 2 and 3. These are all located in the ore measure, inclining to conform with the dip of the formation which is here about 55 degrees north. These shafts have developed the vein across the two forties with the exception of about 400 feet on the east side of the East Norrie, but that the ore is continuous for the remaining distance is clearly shown in the west end workings of the Aurora mine, adjoining immediately on that side, and which is worked up to the East Norrie line.

The present biggest bodies of ore, and the points where the principal mining is being done, is at Nos. 6, 7 and 8 shafts, Norrie, and the three shafts of the East Norrie. A new level is being added at the East Norrie at the present time and will be ready to furnish considerable ore in 1896. At this portion of the mine they are below the dyke, the 9th and 10th levels being under it, but the deposits are not as large as they were above. What greater depth will reveal is a question of considerable importance to the management. At No. 6 shaft they are bottomed on the dyke, but will probably do some sinking at this point in the near future. This dyke, measured on the incline of the shaft, has a thickness of 64 feet.

To the west of No. 6 it will be noticed that three dykes occur. Under the lowest of these nothing has been done. The old shafts at this end of the property are in bad shape, and but little is being done about them. It is the intention to sink a shaft some distance to the north, and to secure the ore from this new avenue. There is a large amount of ore now tied up around these old shafts, and it is expected that the new shaft will be going downward again soon. One was started some years ago about 800 feet north of No. 2. It is a four-compartment, vertical, is 9x22 feet, and is down about 400 feet. With this completed, it will be of great advantage to the company. This shaft is located about 450 feet east of a diamond rill hole put down on the west line of the companys' lands and on a line between the Norrie and North Norrie forties. We present an engraving showing the record of this hole, which gives much information of valuable kind to the company as well as to others in this district. If there is ore beneath the main upper dyke of the Norrie, why should it not also occur at the Ashland, on the west, and also at the Germania, on the Wisconsin side of the river. If there is any such immense body of ore as is indicated by this drill boring at a depth of nearly 1,500 feet, then it argues favorably for the existence of similar bodies, and at even less depth on the Ashland, lying immediately west, as well as at the Germania just across the Montreal river on the Wisconsin side, and now idle because it has been cut out by the dykes. Like many other people, I would much like to see the B shaft of the Norrie down to the 1,500-foot level. Its finding of such ore deposits as the drill boring indicates would add untold wealth and prosperity to the Gogebic range, and be of great assistance to the State of Michigan as a whole.

Taking the portion of the Norrie vein now being most energetically wrought, which is from No. 6 shaft northeastward, there is a length of vein of about 2,500 feet, besides which there is the territory to the west that cannot be readily mined by reason of the old shafts that are in bad shape or collapsed together. On its northeastern extension the vein makes upon the north forty of the East Norrie eighty, so that the No. 3 shaft is located on the latter. The Curry shaft, also a 4-compartment of a size similar to the new B shaft, is

located about 500 feet north of No. 8 shaft, it being in line with B, and like the latter in the hanging. It is down 350 feet, and has been connected with the upper levels of No. 8 shaft. No. 6 shaft is in solid ground, being protected by fully half a million tons of ore. This shows the desirability of securing other shafts located at such distance from the vein that these immense pillars can be secured.

From the 4th level of their No. 2 shaft they have drifted to the Ashland deposit to which I have referred in the description of the latter. They were in 50 feet to the north and 113 feet west, and here they were sinking a winze and were also putting in a raise to test the size of the ore body. They had just begun the development of the deposit at the time of my last visit. A crosscut will also be put in from the 6th level of No. 2 to catch the ore from that point, if it should extend to such depth which there is good reason to believe will be the case.

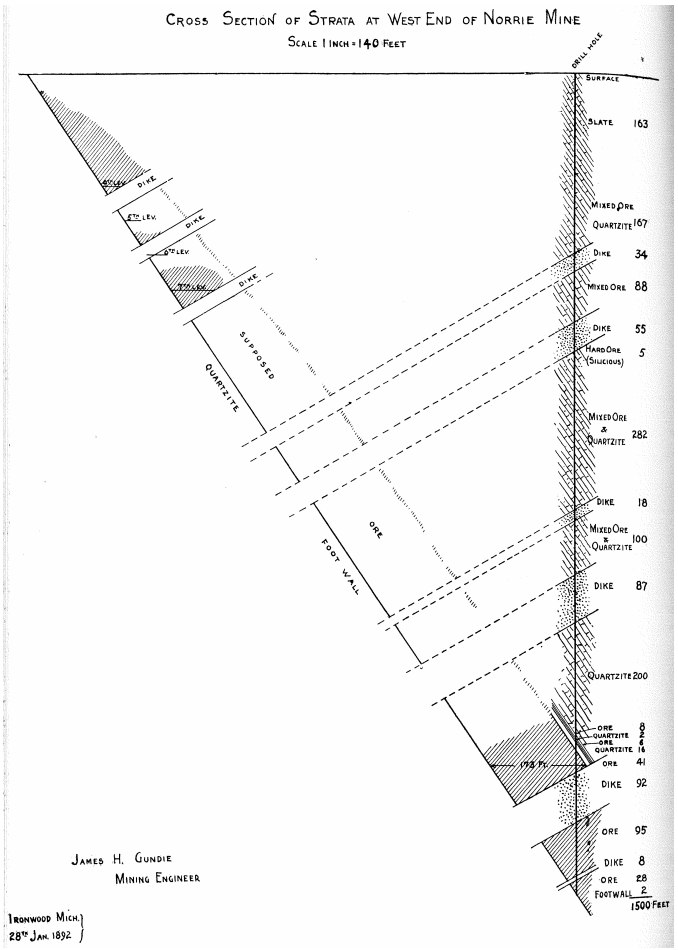
The Curry shaft will be the one at which the pumping for the entire mine will be done when it is down to the required depth. The boilers for supplying the necessary steam are in place, but the panic interfered with the work of equipping and sinking. The mine is not a very wet one. The water from the Ashland side is dammed back so that it does not have to be lifted.

In winning the ore they run drifts along the footwall and from these crosscut to the hanging, taking a three-set raise to the hanging, then beat back towards the foot, three sets in width, and leaving three sets of ground for pillars. Pillars are secured by the same method. Beating back from the hanging to foot gives them soild ground to protect the miner, and they have few accidents. The usual form of square sets is employed, but they use all kinds of timber, hemlock, balsam, spruce, and even maple being seen. It stands but a short time, and it is practically a question of but a few weeks when the surface crushes it down. One sees on surface an immense depression marking the course of the vein. This shows where the caving is taking place, and indicates that an immense burden has gone down. The settling is very gradual, there being no sudden movement that might interfere with successful mining. The ore is all taken, as an ore of such class should be. They guarantee the latter at 63.20 per cent iron and .040 per cent phosphorus. It is of soft nature, and works admirably in furnace, for which excellent qualities it is eagerly sought.

Due to the constant settling of the ground, the drifts needs close attention, they having to be frequently retimbered to keep them open. They would soon be closed by the pressure upon them if this care was not taken. There is no sudden movement, however, and with ordinary precaution no delays are experienced.

The water is easily handled by a large Worthington pump located at No. 6 shaft.

During the summer of 1895 a new hoisting plant was installed at the East Norrie, it having two drums of 10-feet diameter. This is not one of the finest plants the company possesses. The Norrie is not noted as much for expensive machinery as it is for big outputs and satisfactory dividends. There has been no money wasted in equipment. Everything has been watched carefully, and a surprisingly large amount of work done with equipments that many would have considered too small. It only goes to prove what can be done when one understands how. With the new shafts down there will be need of heavier hoists, and they will be forthcoming at the proper time.



The mine is lighted with electricity, incandescent lamps being used. Power is supplied by a general electric company that makes a business of illuminating the different mines at this place, as well as performing a similar service for the streets, residences and business places of the city.

Mr. S. S. Curry is president of the company and general manager of its mines. Owing to the death of Mr. J. D. Day, who was for many years superintendent, the latter office is, for the time being, vacant. Wm. Trebilcock is general mining superintendent; Jas. H. Goudy is mining engineer; F. L. Barrows is cashier; John Luxmore is underground captain at the Norrie; Erwin Sutherland fills a similar position at the East Norrie; the secretary of the company is H. S, Hasleton, Milwaukee, Wis.

adjoins the Norrie immediately upon the east, and is worked upon the same vein as that of the East Norrie, to the eastern line of which property it has reached in its underground development.

The Aurora is one of the properties of the Penokee & Gogebic Development Company, and has been the best paying of the group operated by this concern. For the year 1895 it sent out 245,883 tons, which is within less than one thousand tons of the greatest shipment ever made in a single season. The total product to date is 1,916,823 tons, and work was begun in 1885. The Aurora has mined a very fine grade of ore, and one that has been popular in the market. It has been of bessemer grade, and a favorite in the furnace. The produce of the past year has come principally from pillars, however, and unless something new is discovered the mine cannot long keep up the excellent record of the past. This work has been tedious and attended with no little difficulty, owing to the fact that the mine was opened up so deep before the task of taking the pillars was commenced.

Had the mine been wrought one level at a time, and the pillars removed as they had gone down, there would have been no trouble, but the Aurora is not the only property where similar methods were employed. Indeed, it was the prevailing system throughout the hematite mines of the Lake Superior region up to within a few years ago.

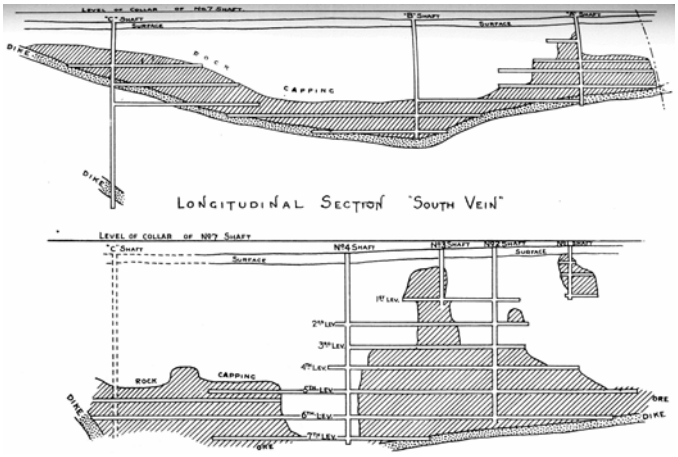
In the east end of the mine they were so unfortunate as to lose their No. 6 shaft, due to the lack of protection to the overlying burden, which came down, and which was hastened by the mining of their neighbors, the Pabst, to whose line they had worked on the east. They began the sinking of another shaft midway between No. 6 and No. 3. This shaft is now completed to a depth of 215 feet, and they are crosscutting to the old workings. They had opened up nine rooms in ore here before the cave came shutting them off from the shaft. The accident occurred on the 29th of April, 1895.

Three shafts are being operated, Nos. 1, 2 and 3, and work has been carried down to the dyke. There has been a great deal of heavy timbering done to make the mine safe. In places they have gone through caved ground to secure ore, and here they have had to do considerable bulk-heading in order to make a safe way. This has been very expensive work. At No. 3 they were adding another lift. At places in the hanging they were finding bunches of ore that had been left behind under the impression that the true hanging had been encountered, and from these sources a considerable tonnage was being secured.

The 11th level is the lowest, and is 600 feet from surface. At No. 1 shaft, which was five feet out of line at the bottom, they have done some repairing and put this avenue in better shape for hoisting. At places they have to handle the ore twice underground, and mills were being put in to avoid this.

Two 10-foot drums do the hoisting at Nos. 1 and 3 shafts, and two 5-foot drums perform similar service for Nos. 2 and 5 shafts. The latter plant was installed last spring. No. 1 shaft is now used as a timber shaft, it being provided with timber cage. A 50-drill Ingersoll compressor furnishes power for this class of work. The mine is lighted by electricity, and 345 men are employed who work wholly on the contract system. The company has excellent shops, and everything is well kept up.

The ore shipped is guaranteed at 63.50 per cent iron. There is considerable met with that does not reach this figure and it is left standing in the mine. In places there has been a mixture of sand, this being met with most frequently near the East Norrie line. The Norrie ore where exposed at this point is very clean and the vein is of large size. Capt. N. B. Roscorla, who has charge of the Aurora, is doing well considering the much he has had to contend with. The mine is not yet exhausted of its treasure, and what it possesses beneath the dyke remains to be disclosed. There is no reason why it will not meet with the same deep-seated deposits as the Norrie, and if the drill hole of the latter company is correctly tread the Aurora will be benefitted equally with its big neighbor.



DYKE OCCURRENCE AT THE PABST MINE.

THE PABST MINE,

is operated by the Metropolitan Land & Iron Company, and is next to the Aurora on the east. Ever since the present management secured possession of it there has been a marked change for the better in its ore deposits. There are two veins here, being made so by a rock capping that extends downward from surface into the ore body. Originally the north vein was attacked. This was before the present owners had possession. The ore had a considerable length, but the rock capping forced it down close to the dyke so that but two levels were had. It was the unfavorable conditions here that induced the former owners to sell the mine. The Metropolitan people under the leadership of Mr. Curry, put a drift to the south, thinking they would find something better in that direction, and in this they were not disappointed, having developed an excellent property, and one that bids fair to be such for many years to come.

The year 1895 witnessed the largest output yet made by the Pabst in a single season, it being 219,960 tons. The grand total for all years is 1,151,415 tons. Mining has been conducted her since 1885. In point of quality the ore is fully up to the excellent standard of the Norrie. A force of 200 men are employed, and the property is important in the commercial affairs of the city in which it is located.

There are three principal shafts now in operation. C is located at the west end of the mine, is a vertical, in the hanging, and is down 560 feet. At the 490-foot level they have a large Prescott pump that gives perfect satisfaction in its operation.

No. 4 shaft is in the foot of the south formation and is down to the 8th level, 625 feet. This shaft has lately been re-timbered throughout, and is now in fine shape. It is located about 700 feet east of C. They were taking pillars at the 7th level.

No. 2 shaft is 450 feet east of No. 4, is an incline and down 555 feet. They were rooming ore at this portion of the mine. The deposit has been opened up for 450 feet east of this shaft, which is the most easterly one on the property.

Between C and 4 shafts the capping makes downward to a point near the 5th level, but east of 4 it rises, and the ore goes to a point near surface, giving a fine deposit. They are down upon the dyke at No. 2, and it is found that it is pitching west in this end of the mine, while in the western portions of the property it pitches east. This change makes a deep basin here and in the lower portion of this they are meeting with a very large body of ore that is being developed at the present time. The Pabst never looked as well as it does now, and large outputs can be made if the market demands them.

They have recently placed a new hoisting plant to take care of the ore that comes from Nos. 4 and 2 shafts. It consists of a 24x48 in. engine connected by 14-foot gear wheel to a pair of 10-foot hoisting drums. The machinery is the well known Webster, Camp & Lane, of Akron, Ohio. A new engine house has been constructed to receive the plant. It is 32x52 feet. Solid masonry supports the engines and hoist. This will prove a valuable addition to the mine.

In securing the ore they follow the same plan in vogue at the Norrie, working three sets wide from the hanging to the foot, and leaving pillars of the same thickness. On the foot in many places the ore is very firm, and large stopes can be worked without timbers. Large masses are dislodged by a single blast, and while the ore drills hard, it breaks admirably. It is from the foot that many fine specimens of needle ore are obtained.

John Tregambo is mining captain, and knows his business well. D. R. Bundy is superintendent.

THE NORTH AURORA,

its name implies, is just north of the Aurora mine. There is a shaft being sunk, a few men being employed, the object being to comply with the terms of the option so that they can retain possession of the property.

THE NEWPORT MINE.

This is one of the important iron-producers of Ironwood. It occupies a place next east of the Pabst, being located on a lofty elevation that can be equalled in this respect only by one other property on the Gogebic ore range, this being at the Montreal mine, on the Wisconsin end of the range. It has been operated under many different titles, and many changes of ownership have taken place. It was one of the few mines of this range that operated during the most of the hard times, being idle but three months in 1894. The owners are prominent cotton manufacturers of the east. S. W. M Connell is superintendent; Wm. Stephens, mining captain; J. R. Thompson, mining engineer.

The company possesses a valuable tract of land on the mineralized portion of the range, and in their operations adjoining the Pabst they have, like the latter, worked upon two strata of ore, the “north vein” and “south vein.” In then north vein they have but one shaft, No. 4, while on the south is A, B, C, D, G and K, the latter being at the extreme east of the property.

No. 4 shaft is down 360 feet. This is the only point at where anything is being done on the north formation, the work now consisting of taking a little ore that is remaining west and south of the shaft on the third level. The ore in the upper levels at this shaft is pockety, and they are finding it in back of what was originally looked upon as the hanging. They have risen about five sets high at one place on these small lenticular-shaped deposits.

Of the line of shafts on the south vein, D and G are idle.

A shaft is 540 feet deep, and mining is going on at the upper levels, the ordinary square sets being used, on the rooming system.

C shaft is to the 439-foot level, and was idle at the time of my visit, the local management awaiting advice from headquarters before proceeding further.

B shaft was down 520 feet, and ore was being mined from the upper levels.

They have the same dyke here that appears in the Pabst mine on the west of them. At least it is generally believed to be the same, although there are those who combat the idea. I find many different opinions on the subject of dykes among the miners of this range. The Newport dyke is pitching west, this agreeing with the pitch of the Pabst dyke in the east end of the latter property. The dyke on the Newport side shows certain peculiarities, however. There appears to be a faulting of the formation which causes a vertical dyke at C shaft to be thrown 300 feet east of the shaft, whereas at one

point it is within 12 feet of it. A break has also occurred in the foot, the latter being thrown 40 feet to the north at one point, while at two others the foot has been thrown to the north 25 or 30 feet. More will be learned of this as the mine is opened up. Mr. Thompson the engineer, is a keen geologist, and is making a study of the mine formations. When he has had time to complete his survey, he will have something interesting on the subject of dykes. He had but just taken hold of his position at the time of my visit.

The Newport has been operated conservatively, and many fine stopes of ore are seen in the mine that will contribute to a large output if the company sees fit to make it. A third of the ore is manganiferous, and at K shaft, at the old "Bonnie" end of the property, they have a drift 60 feet in ore of this class that will give 30 per cent manganese. With proper care there could probably be three grades of manganiferous ore made that would command a high figure in the market. K shaft is down 509 feet, and ore is being mined on the 3d, 5th and 6th levels. Considerable water is made in this shaft, while the other portions of the property underground are comparatively dry. A Prescott pump lifts it to the surface.

The company will do considerable exploring with the diamond drill, and a machine was put in place at the bottom of A shaft the latter part of January, 1896.

There are excellent facilities in the way of machinery for doing all the business of the mine. A new 6-foot drum was recently added. A force of 200 men are employed who work on contract. The mine sent out 157,821 tons in 1895, and its total product is 962,963 tons.

THE DAVIS MINE

is the next in order going eastward from the Newport. It had lain idle for some time, and resumed in the spring of 1895, it being worked by the Metropolitan Land & Iron Company. The deposit was a small one, but the ore was valuable by reason of the manganese it contained. The company mined 10,253 tons, when the deposit gave out, the dyke rock and hanging wall meeting, and the property was abandoned in October, 1895. The mine has produced in all 48,714 tons.

Going eastward from the Davis are found the Royal, Ruby, Lowell, Federal and Jack Pot, all of which are idle and full of water. All are small deposits of ore, and while the quality is all right there is little encouragement in re-opening them under the present condition of affairs. The first active properties met with after leaving Ironwood are the

MINES OF BESSEMER CITY.

Bessemer enjoys the distinction of being the county seat of Gogebic county. It is a neat town of about 3,000 inhabitants, possessing electric lighting, water works, fire department, fine schools and churches, and a magnificent site. The mine that first gave this place its prominence was

THE COLBY,

where Joseph Sellwood and others made excellent records in the way of rapid and cheap production of ore. It was a fine mine, and there were immense lenses of ore that have been well-nigh exhausted. For the last two years nothing was done, but the property was secured by Corrigan, McKinney & Co., of Cleveland, Ohio, with T. F. Cole, general manager, and they began the task of equiping No. 5 shaft in the early summer of '95. The property had been dismantled, and an entire new equipment was necessary. By November they began hoisting, but for some reason work was discontinued in December. There is a body of manganiferous ore at this portion of the property, and then there is a hope indulged in that something may be found in the way of new deposits that were not revealed in the former operation of the mine. It is thought that the mine will resume shortly. The Colby has produced 1,388,574 tons, the greatest annual shipment, 285,880, having been made in 1888. Early in March, 1896, they have orders to resume mining operations.

THE TILDEN MINE.

This mine is immediately east of the Colby, and is one of the most promising ones in Michigan. It occupies the whole of Sec. 15, the vein crossing this possession from west to east. They have not as yet developed it for this entire distance, but enough has been done to assure them that they have the ore the entire distance of one mile.

The Tilden suffered during the depression, and its matters were placed in the hands of a receiver, the mine being idle for some months, during which the time the people of Bessemer suffered considerably, as this is the principal labor-employing enterprise the city possesses. At the time of the close-down it was the only mine being wrought in the town, and its stoppage was a great commercial lost. In April of 1894 resumption took place, and operations have been actively carried on since that time. At this writing, early in February, '96, they are employing about 500 men, and the great prospect for a big season's business is encouraging.

This great deposit of ore was first located by the use of the diamond drill, more than a mile of holes being bored to fully test the formation before shaft-sinking was begun. There are now six shafts, these being Nos. 6, 7, 8, 9, 10 and Union.

No. 6, the most western, has reached a depth of 525 feet; No. 7, 590 feet; No. 8, 640 feet; No. 9, 539 feet; No. 10, 425 feet. With the exception of No. 8 all the shafts are vertical, are located in the hanging and have three compartments. Size of shafts is 7 ft. 6 in. x 18 ft. 3 in., and all are well equipped. They are expected to reach the footwall at a depth of about 1,100 feet.

No. 8 shaft is in the foot, following the inclination of the formation about 60 degrees to the north.

No. 10 shaft has not yet reached the ore, but they are sinking it and expect to have it in shape to produce ore the coming season. A level will be opened at 475 feet.

The Union shaft is one located at the east end of the vein, on the line between the Tilden and Palms properties. It owns one of the three compartments of the shaft, inaccurate surveying having given their neighbors two of the compartments. With the shafts already to the vein the latter has been proved on its trend for a distance of nearly 3,000 feet. The average thickness of the vein will show about 100 feet, which rough calculation is sufficient to show that its producing capacity depends upon men and machinery to be made as large as the management requires. In the west end of the mine the vein is narrow, but as they go east it improves in size and in quality as well.

The dyke upon which the ore is found is very strong and its course is regular, it being traced throughout the entire length of the mine where explorations and actual mining have been prosecuted. It is the idea of the general manager, Mr. W. J. Olcott, who has made a careful study of the conditions, that the dyke forms an immense basin here, and that on the eastern end of the property it will be found to rise as is the case in the basin between the Pabst and Newport properties. It is a fact, too, that the dyke in the Palms pitches east, although those who now possess the Palms have an idea that theirs is not a true dyke. The Palms was originally one of the Penokee & Gogebic Development Company's properties, at which time Mr. Olcott had opportunity to give its formation considerable study. The Tilden mine is also operated by this company.

At No. 9 shaft, which is the most easterly one from which ore is being raised, there is a larger deposit of ore than occurs at any point west of this. In quality the ore yields from 64 to 65 per cent iron and .035 per cent phosphorus, this giving their Newark grade, the best shipped. In this there is less than one per cent manganese. Other grades of ore are the "Rand" and "Tilden," the first mentioned giving 60 to 63 per cent iron and from 2 to 3½ per cent manganese, the latter giving 62 per cent iron and from 1 to 1½ per cent manganese. It is thought that the Tilden and Newark grades will be shipped as one next season, as it is difficult to separate them.

The distance between Nos. 5 and 6 shafts is 1,000 feet; between 6 and 7 shafts, 700 feet; between 7 and 8, 600 feet, between 8 and 9, 700 feet; between 9 and 10, 1,300 feet; and between 10 and Union, 1,300 feet. When this distance is all connected underground it will give an immense length of ore to attack.

A feature of much value is the fact that there is no rock mixture with the ore. Everywhere the latter is perfectly clean, free from rock. This is an advantage worth considerable, as there is no time lost is sorting, and the quality of the ore is more readily kept up.

In winning the product they employ the system that can properly be termed "drawing." They drift to the hanging taking two sets in height, and let the ore run to them, they enlarging the "funnel" as occasion requires. The hanging is very solid and shows no inclination to follow downward. It is also smooth and clean, and there is no rock from it to mix with the ore. The sharp dip of the vein lets the ore come downward readily. In case it shows a disposition to hang, they leave it and seek some other room until the ore loosens and fills up the opening, which it is always sure to do within a few days after being left. In this way they let the ore "mine itself," as Captain Piper says. Often a bench of ground is attacked from three sides, this being made possible by parallel drifts. There is just enough moisture in the ore to make it run freely and to keep the rooms filled. One gang of miners can generally keep three or four gangs of trammers busy, and in this mine it is a question of tramming more than of mining.

But little timber is used, this being mostly hardwood, and little pains is taken in its framing. It is secured from farmers who are clearing off their lands and who dispose of the timber at very low price. In the west end of the mine they use the ordinary square sets in taking the ore, but this has been discarded for the newer system that prevails now. In working from the hanging to the foot the miners keep solid ground over them at all times, and any fall that might occur would strike the foot without doing damage. It is a safe plan, and Capt Piper thinks he is getting his ore as clean as anyone.

The ore is very soft, an augur, made for the purpose, being used to prepare place for explosives, and all this enables the company to secure a large product per man, which is the test as to the cost of production, as there is only the ore to pay all the charges.

The first level is generally run at 447 feet from the surface. Between 6 and 7 shafts an uprise was in 185 feet at the time of our visit, and there was hope entertained that it would continue to a point near surface. No. 7 is being sunk for another level.

The property is well equipped with machinery. There is a 12-foot hoist to do the work at Nos. 6 and 7 shafts, and at 8 and 9 shafts there is a Webster, Camp & Lane drum, 6 feet diameter, that has been increased in length by the addition of another drum of similar size. This innovation was introduced by the master mechanic of the mine the past summer, and gives excellent results, hoisting the cages in 29 seconds. They have a 60-drill air compressor of the Ingersoll-Sargeant pattern. A new boiler plant has been put in at No. 10 shaft, where power was formerly supplied by air.

The mine makes about 140,000 gallons of water daily, half of which amount is caught at the upper levels and piped to the city of Bessemer, where it is used for drinking purposes, the charge made the townspeople for the service being a very reasonable one. The mine occupies a lofty elevation several hundred feet above the residence portion of the place, so that the water is

carried to the city mains by gravity after it is delivered from the pumps to the latter.

The mine is lighted by electricity, the incandescent system being used. The company possesses fine ships, builds its own cages, and makes considerable new work for the other mines of the company. They are trying a roller bearing for skips and tram cars, and hope to have one that they can offer to users of these articles that will be the best thing in the market.

The Tilden sent out 418,188 tons in 1895, of which amount it had 125,891 tons in stock at the close of the shipping season of the previous year, but the year 1895 was the banner one of its history, and it can make a still better record for 1896 if there is a call for the ore. The total tonnage produced to date from the mine is 1,024,054.

Chas. F. Rand is president and treasurer; Howard Morris, secretary and general solicitor; W. J. Olcott, Duluth, is general manager; Jas. Piper, mining captain; Geo. H. Durkee, cashier; N. O. Lawton, mining engineer.

Next east of the Tilden is

THE PALMS MINE.

This mine was operated for several years by the Penokee & Gogebic Development Company, who threw up their lease of it in 1894. In the spring of 1895 it was secured by M. P. O'Brien, George Curry, and other gentlemen of Ironwood, Mich., who organized the Palms Ore Company. They unwatered the property, placed it in shape for active operation, and had mined some ore, when they sold it to the Dunn Iron Mining Company, of which Ferdinand Schlesinger is president, and T. F. Cole general manager, under whose direction the mine is now being operated.

The principal working shaft here for the past season is what they call their No. 5. It is also the "Union" shaft of the Tilden, being sunk on the line between the two. This shaft is a vertical, and is to the 11th level, 473 feet. They have a body of ore here possessing a thickness of 50 feet, from which the product of the past season, 46,955 tons, has principally come.

No. 4 shaft is located east of No. 5. It is sunk inclining towards No. 5 so that at the 11th level, where it is connected with No. 5 it is but 160 feet distant from the latter, whereas on surface the distance is 400 feet. They have been caving pillars east of No. 4. They mine the ore on timbers, the capping being very heavy and strong.

Near the east line of the property is their No, 1 shaft, and they are preparing to sink this to catch the vein on the Anvil mine to the west, which is pitching eastward

They have added a larger hoist, one that has been used, but is a great improvement over the old one, which was too small to permit of properly caring for the ore at No. 5. Capt. Christopher has been succeeded here by Cap! John Buddle.

The total product of the Palms amounts to 319,131 tons, and the prospects for developing a larger body of ore than any heretofore possessed are excellent. A force of 50 men are employed.

THE ANVIL MINE

lies directly east and next to the Palms. It is operated by the Dunn Iron Mining Company, which concern took possession of it in the winter of 1894, after it had been idle some time. No. 4, the most easterly shaft, has been the principal working one the past year, operations having been confined to the robbing of pillars. They have taken the ore on square sets, the capping proving too strong to cave.

No. 2 shaft, located 300 feet from the east line of the Palms, is being sunk deeper, and is also being enlarged by the addition of another compartment, making three. At a point near the west line of the Anvil there is said to be a large body of ore that caved in some years ago, and which the company will look for through the No. 1 Palms shaft. This ore, according to the information that can be had, was 8 sets wide, and of excellent quality. It will take some time to get these shafts down to that the ore body can be proved up, but the management believes it will find a paying mine here. They also have a lease of

THE EUREKA MINE,

located immediately east of the Anvil, or, more correctly, have contracted for the use of the two shafts that are here, and through which they are taking the product from the east end of the Anvil property. They are doing nothing in the way of mining, nor was anything done in 1895. They shipped 26,105 tons from this mine during 1895, from an old stockpile, and the total production amounts to 124,175, so that the mine has not been very extensively wrought. The vein in the upper levels was narrow, and pockety, but they hope for something better after sufficient time has been had to do a little searching.

Traveling eastward from the Eureka, we pass the Gogebic, East Dangler and United properties, upon which more or less work has been done, but the shafts are now filled with water, and nothing is heard of a resumption of mining operations. The next active property after leaving the Eureka is

THE MIKADO MINE,

that has lately been secured by the Dunn Iron Mining Company. The shaft was being unwatered at the time of my visit, the property having been idle for some time. The shaft has a depth of 470 feet, and the last work done before the shut down proved a vein of ore 16 feet thick with three feet of quartz cutting through it. They were both pumping and bailing the water, and were making rapid headway. Capt. Richard Trezona, who is

assistant to Mr. Cole on the Gogebic range, was looking after the work of all these properties.

East of the Mikado the Pilgrim, Iron Prince, Norway, Ironsides, Jumbo and Kingsman, were all idle and filled with water. The first sign of activity after leaving the Mikado is at

THE SPARTA MINE.

I call this the "Sparta," for the reason that it was formerly operated under this title, but at present time it has no name. The owner and operator is J. H. Finlay, of Warsaw, Ill. The location is the west half of the northwest quarter of section 9. A new company will be organized soon. They have pumped out the old shaft, which work was finished in December, and are cleaning up the levels preparatory to doing mining. A shipment of 1,950 tons was made to the Ashland, Wis., blast furnace during the year 1895, which amount was secured from an old stockpile. The shaft will be sunk deeper, and by careful management they ought to be able to hoist from 20,000 to 25,000 tons next season. The ore deposits are quite similar to those of the Brotherton. P. H. Putman is agent. This property is located close by the village of Wakefield.

On the east half of the northwest quarter of the same section is

THE ALPHA MINE,

which is, more properly speaking, an exploration rather than a mine. Its shaft was unwatered at the same time the Sparta's was. It is the intention of the management to sink this shaft also. It possesses the same deposit of ore as that found at the Sparta. A. S. Johns is mining captain. The shipment for 1895 amounted to 2,010 tons

Next to the Alpha, and immediately east of the east end of Sunday Lake is

THE BROTHERTON MINE,

the most important property in the eastern end of the Gogebic range. It has produced 489,020 tons of ore, its heaviest shipment for a single year being in 1882, when a total of 130,833 tons was achieved.

They are working three shafts to a depth of 400 feet each, and are now sinking them for another 60 foot lift. Their system of mining is to use drift sets and let the ore cave, permitting the surface to follow down taking the place of the mined-out portions of the vein. The plan has worked well here. They are mining from 8,000 to 9,000 tons per month, and expect to produce 125,000 tons in 1896. The property is well equipped with machinery

Jos. Sellwood, Duluth, is president; Ed. Niedecken, Milwaukee, is secretary; Richard Bawden, Bessemer, is superintendent; Geo. Strong, Bessemer, is cashier.

THE SUNDAY LAKE MINE

is nest east of the Brotherton. It is operated by Corrigan & McKinney, Cleveland, Ohio, and has sent out 235,632 tons of ore since work was first commenced. The shipment for 1895 was 20,970, and in this year the property was worked in a very quiet manner. The exact location is the west half of northwest quarter and the west half of southwest quarter of Sec. 10, 47, 45, Gogebic county.

The ore formation at this point is very wide, an increased width being shown as compared with mines farther east. The quartzite found on the foot wall side of the ore deposits is missed in the mines east of the Black river, but there are outcroppings of fragmental quartzite on the property of the Sunday lake, but the rock is missed in its position as noticed in all of the mines to the east of Black river.

In this ore formation, which is made up of jasper and lean iron ores, small lenses of clean ore are found, these possessing a thickness of from 8 to 15 feet, and having a length of about 150 feet. They come out from the foot across the formation, and dip downwards toward the hanging, thinning out at about the length mentioned.

By reason of the small size of these lenses, and the fact that one overlaps another, occurring frequently in this jasper and lean ore, there is a great deal of rock drifting to be done in order to secure the product. There is constant searching for new lenses to replace the exhausted ones, and this necessitates a great deal of rock-drifting. Ten per cent of the amount of ore hoisted is the amount of rock raised to surface, and besides this they waste all they possibly can in the levels. The mine is also a very wet one, the pumping charge per ton of ore hoisted being 17 cents. The royalty is 40 cents per ton, and were it not for the exceptionally fine quality of the product they would not be able to secure a new dollar for an old one. The ore contains 63 per cent iron, .022 per cent phosphorus, and 8 per cent silica, a most desirable product.

The clean ore bearing stretch of ground here is short, possessing a length on its trend of about 800 feet. In this they have two shafts sunk in the ore formation, but on the foot wall side of the ground holding the clean ore lenses. No. 1 is a new shaft that replaces an old one sunk directly in the vein. It follows the incline of the formation, and is down 460 feet, to the 10th level, and another lift is now being added. No. 2 shaft is 375 feet east of No. 1, is sunk on the underlay, and is 510 feet deep, to the 11th level.

They observe the caving system, such as I have described in connection with other mine reports. The ore is very soft, and mines readily, his being one point in favor of cheap mining. The stoping record is an excellent one. The property has improved of late, and can send out 100,000 tons in 1896, which is the amount assigned by the bessemer ore association.

They are well equipped with machinery, have a duplex compound pump, 10-foot hoisting drums, and everything to do work with. A force of 184 men are now being employed. Jas. Trezona is mining captain. This is one of the Corrigan-McKinney properties of which T. F. Cole, Negaunee, has charge as general manager.

East of the Sunday lake is the Iron Chief, Joliet, Pittsburgh and Comet, all of which are full of water. The Comet which was a prominent property at one time, has been abandoned, the machinery removed, and the lease surrendered to the owners of the fee.

The foregoing comprises all that is being done on the Gogebic range in Michigan. There has been little or no exploring during the past year.

Table showing iron ore sent from the Gogebic range for 1895 and total shipments to date.

	1895.	Total.		1895.	Total.
Alpha	2,010	2,010	Iron Chief No. 2		551
Anvil	68,064	250 965	Ironton		53,966
Ashland	126,096	1,898,884	Jack Pot		5,895
Aurora	245,883	1,916,823	Mikado	4,757	4,757
Blue Jacket		1,799	Newport	157,730	963,963
Brotherton	40,567	489,020	Norrie	743,168	5,966,772
Colby		1,388,574	Odanah		77,124
Comet		89,191	Pabst	220,913	1,151,413
Davis	10,253	48,714	Palms	46,965	319,121
Eureka	26,105	124,175	Ruby (Puritan)		86,525
Father Hennepin		184,928	Sparta	1,950	4,950
Federal		27,928	Sunday lake	20,970	225,022
First National		1,997	Tilden	416,936	1,024,154
Imperial		8,515	Valley		1,573
Iron Chief		12,199			
Total				2,132,397	16,342,961

ON THE WISCONSIN SIDE.

The western end of the Gogebic iron ore range extends into Wisconsin. There are several mines, now working, and these are of some importance to Michigan form a commercial point of view, as well as affording some information geologically. The Montreal is one of the most promising. The ore dips towards the north, pitches east, and lies on a dyke. They have three shafts in the hanging, and a vertical and inclined shaft in the foot. One shaft furnished the product of the past season, the others being sunk to the ore. The product is of a remarkably fine grade. Geo. H. Abeel, is general manager, Hurley, Wis.

Adjoining the Montreal is the Pence mine, a small property, but renowned for the fine quality of its ores. Jas. MacNaughton, Iron Mountain, is manager, who also looks after the Atlantic, a promising property near by that shipped 74,630 tons in 1895.

The Windsor is one of the Corrigan McKinney mines, T. F. Cole, general manager. This was unwatered the past summer, and 11,438 tons of ore shipped. They are mining from No. 6 shaft to the 700 foot level. Stoping is being done on the 6th, 7th and 11th levels.

The Carey has been an active property, and sent out 52,348 tons for the year.

The Iron Belt mines, the most westerly on the range, are developing into important ones. There are several shafts, and development has been carried on to a point where a large output can now result. The local manager is Duncan McVichie, Iron Belt, Wis.

The properties on the east end of the Gogebic range suffered much during the great depression, nearly all of them having been closed. Their revival is of great assistance to the people living in that district.

The mines of the Wisconsin end of the range have shipped, since they were opened, 2,674,207 gross tons.

Iron ore shipments from mines of Wisconsin on the Gogebic range for 1895 and total of all years.

	1895.	Total.		1895.	Total.
Atlantic	74,630	76,220	Nimikon		28,635
Bessemer		20,889	Pence	825	27,261
Cary	52,348	497,901	Section 33		258,590
Germania		330,633	Superior		121,627
Iron Belt	148,227	572,373	Trimble		25,931
Kakagon		71,904	Tyler's Forks		10,683
Montreal	140,900	512,523	Windsor	11,438	119,037
Total				428,368	2,674,207

GENERAL INFORMATION.

Showing the importance of Michigan in the iron ore production of the United States, I herewith present figures showing the amount mined by all states, including Michigan, in the following years:

1891,	all states produced,	14,591,178	gross tons.
1892,	" "	16,296,666	"
1893,	" "	11,587,629	"
1894,	" "	11,879,679	"

Other states, aside from Minnesota and Wisconsin, have not reported their products for 1895, so that it is impossible to present them thus early in 1896. Of the gains made outside of Michigan, Minnesota has made by far the greatest, and will stand next to Michigan in the list. The total tonnage sent from the entire Lake Superior region in 1895 is 10,438,268.

CLASSES OF 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.

Brown hematite, embracing the varieties of hydrated sesquioxide of iron, and recognized as limonite, turgite, bog ores, pipe ores, etc.

Magnetite, ores in which the iron occurs as mangetic oxide, and including some martite which is mined with magnetite.

Carbonate, Ores containing a considerable amount of carbonic acid, such as spathic ore, siderite, clay-iron stone, etc.

Of these classes Michigan produces most largely of the red hematite, fully 95 per cent of the whole being included in ores of this description.

DUTY ON IMPORTED ORE.

The duty on imported iron ore, as revised in 1894, is 45 cents per ton, having been reduced from 70 cents per ton. Under the very low prices that prevailed for iron ores in this country in 1893-4 and 5, the amount of importation fell off largely as compared to former years, but there are signs of revival of importations at this writing, several of the Cuban mines that look to this country for market, having resumed operations.

The following table shows the amount of iron ore imported to the United States for each of the past six years, and the countries from which it has come:

	1890. Quantity.	1891. Quantity.	1892. Quantity.	1893. Quantity.	1894. Quantity.	1895.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	For 11 months ending November, 1895.
Spain	512,933	323,771	236,957	99,640	15,067	
Cuba	351,814	257,189	307,115	349,977	140,025	
French Africa and Oceanica	96,428	96,961	62,502	16,541		
Italy	134,399	154,073	95,313	16,371		
England	51,857	39,451	35,638	16,798	9,947	
Greece	48,807	24,412	44,602	10,244		
Newfoundland and Labrador	6,320					
British Columbia		558	2,749	469	960	
Portugal	16,526	9,940	6,490	10,552		
France	2,401	9				
Quebec, Ontario, Manitoba and Northwest Territory	22,211	2,126	8,606	372	443	
Turkey in Europe		3,850	3,346	1,029		
Turkey in Asia	3,078	158		4,700		
Nova Scotia, New Brunswick, etc.		35				
Other countries	53	301	3,267	258	888	
Total	1,246,830	912,864	806,585	526,951	167,307	421,466

The figures for 1895 cover but 11 months of that year and the source of the importation is omitted, I being unable to secure it at this time.

PRICE OF IRON ORES.

The following prices will show the variation in the market for the years quoted. This is for gross tons and price is for ore delivered at Lake Erie ports.

Year.	Price.	Year.	Price.
1856	$5 00	1888	$5 50
1866	9 50	1889	5 50
1868	9 75	1890	6 75
1873	12 00	1891	6 00
1878	6 75	1892	5 50
1881	9 00	1893	$4 00 to 4 50
1886	5 50	1894	2 50 to 2 75
1887	7 25	1895	2 75 to 3 50

The above are for ores of bessemer class. The price of non-bessemers for the past six years, for deliveries at Cleveland and other Lake Erie ports, has ruled as follows:

Year.	Price.	Year.	Price.
1890	$5 75	1893	$3 00 to $3 50
1891	4 75	1894	1 80 to 2 20
1892	4 25	1895	1 90 to 2 20

Prices for the low iron, high silicon ores, have been about $2 per ton, for ore delivered in Cleveland.

TRANSPORTATION OF IRON ORES.

With the wonderful growth of the iron ore mining industry in Michigan, there has been necessitated an immense expenditure in the way of providing facilities for conveying the ores from mine to market. The handling of the enormous tonnage sent out annually, and this within the season of navigation upon our lakes, has forced the building mangificent docks at the different ports from which the ore is sent, as well as the construction of railway lines with equipments of engines, cars, and the much that is needed for the rapid forwarding of the product of the mines of the several ranges. Improvements in cars and docks have been marked, the different transportation companies exhibiting commendable enterprise in designing and putting into commission any feature that would bring better results to the shippers and themselves.

A few years ago the ore cars were small ones, "hoppers," as they were termed, and, due to their brevity of length, there were many accidents. These have almost entirely disappeared, and instead of 7 tons the cars now employed carry from 20 to 30. They are also fitted with air brakes with plenty of room for brakesmen to work around them, and give much better satisfaction than the old.

At the ore docks the dumping of cars and subsequent loading of vessels is much more rapidly performed than in former years, excellent dispatch being given vessels at all the docks. Taking the lead of all ports is that of

ESCANABA,

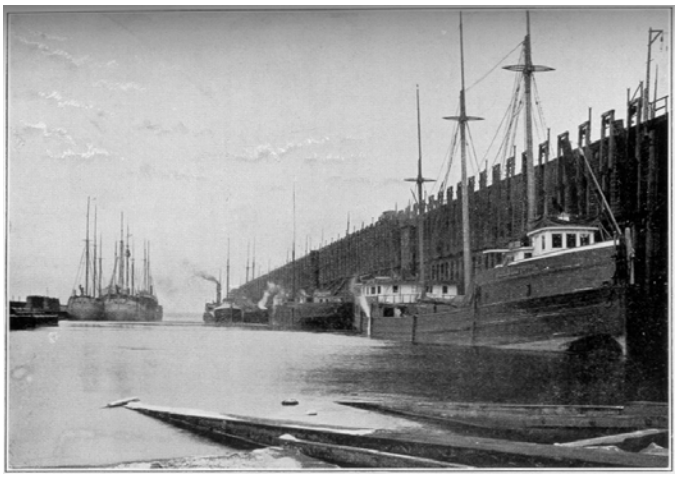
where the Chicago & Northwestern Railway owns and operates the docks, which are five in number. The capacity of these is as follows:

Dock No. 1, 24,104 gross tons; No. 2, 20,928 tons; No. 3, 30,284 tons; No. 4, 32,750 tons; No. 5, 43,152 tons, giving a total capacity of 151,218 tons. No. 3 dock is being rebuilt and will be ready by the opening of navigation in the spring of 1896. I give figures showing its capacity when completed. To this port the entire product of the Menominee range is sent, excepting the small percentage that may go out by all-rail; a considerable amount of ore is secured from the Marquette range, and some from the Gogebic. The quantity contributed from each of these ranges for the past season was as follows: From Menominee, 1,867,281 tons; from Marquette, 850,665; from Gogebic, 144,934; total, 2,095,166 tons.

The distances from the principal center of the different iron ore ranges to Escanaba is: From Ishpeming, on the Marquette range, 65 miles; from Ironwood, on the Gogebic, 184 miles; from Crystal Falls, Menominee range, 82 miles; from Iron Mountain, Menominee range, 52 miles. The Chicago & Northwestern Railroad Company has two lines running from Iron Mountain to Escanaba, it having purchased the second from the so called Schlesinger syndicate that built the road but lacked the means to operate it.

The Northwestern also owns the Milwaukee, Lake Shore & Western (now a portion of the C. & N. W. system), railroad docks at Ashland, Wis. There are two docks at this port receiving ore from the Northwestern line. No. 1

has a capacity of 35,800 gross tons; No. 2, of 25,700, a total of 61,500 tons.



ONE SIDE OF AN ORE DOCK AT ESCANABA.

To the Peninsula Division of the C. & N. W. (embracing lines operating in the Marquette and Menominee ranges), are assigned 3,200 cars with a capacity of 68,000 tons. Included in this number are 400 30-ton cars now being built and which will be ready next spring. During the shipping season of 1895 100 locomotives were used on this division. A large number of switch engines are required to handle cars at the mines, the latter loading rapidly from stockpiles by means of steam shovels. The terminal charges are heavy, as well as the extensive repairs required at docks, and the constant changing of tracks made necessary by the opening of new shafts and changes in the ore deposits.

To the Ashland Division of the Northwestern 1,100 cars are assigned, these having a capacity of 23,350 tons. One division of this system lends to another in case of increased business needing more cars or locomotives, and the system is one of the finest.

ASHLAND.

Besides the Northwestern Railway docks at Ashland there is one belonging to the Wisconsin Central Railroad. This is being much improved and added to in size for the growing business that is met with. With the opening of navigation next spring this company will have one of the finest docks on the lakes. Its length will be 1,908 feet; length of approach, 2,105 feet; height of dock, 54 ft. 6 in.; width of dock, 36 feet; number of pockets, 314; capacity of dock, 40,000 tons; making it one of the largest in the world. This company has an equipment of 1,800 cars.

The Wisconsin Central secures its ore business entirely from the Gogebic range, and, with the Northwestern line, gives excellent dispatch to the business of ore-handling. The distance from the principal mines of the Gogebic to Ashland is 45 miles.

The number of tons sent from Ashland docks in 1895 was 2,341,899.

MARQUETTE.

This is one of the prominent ore-shipping ports, and takes care of the larger portion of the business from the Marquette range, the distance from the center of the district to port being 15 miles. The Duluth, South Shore & Atlantic Railway, one of the best equipped in the region, has three docks at Marquette, these containing 700 pockets with a capacity of 100 tons per pocket.

They have 1,200 25-ton ore cars and 2,000 four-wheeled 7-ton cars. They use in the shipping season fifteen switch engines and twelve road engines. Owing to the nearness of the mines to lake port, this company gets a much better result per engine and oar than others where the distance is considerably greater.

Besides their main line the D., S. S. & A. R'y has something over fifty miles of side tracks used exclusively for the iron ore traffic. They have two lines of track running between Ishpeming and Marquette, and the value of the property used in ore transportation exclusively, this embracing the docks, is estimated at four millions of dollars.

The tonnage of iron ore sent from Marquette in 1895 was 1,075,374.

A second railway line is now under course of construction bewteen Ishpeming and Marquette by the Lake Superior & Ishpeming Railway Company, the latter being made up of capitalists who are prominent in the Cleveland-Cliffs and Pittsburgh & Lake Angeline Iron Companies. This line will be used for the handling of iron ore, and will be ready for business the coming summer. An ore dock, 1,200 feet long, is under way, which will have a capacity of 30,000 tons, 100 pockets holding 300 tons each. An equipment of rolling stock consisting of 11 locomotives and 400 30-ton ore cars has been ordered.

GLADSTONE.

The amount of iron shipped from this port in 1895 was 109,319 tons.

There is one ore dock here having a capacity of 16,000 long tons. It is the property of the Minneapolis, Sault Ste. Marie & Atlantic Railroad, and the ore is pulled from the Menominee and Marquette ranges by the Chicago, Milwaukee & St. Paul Railway, which has an equipment of cars for the purpose.

There is an ore dock at L^Anse and one at St. Ignace, both of which are owned by the Duluth, South Shore & Atlantic Railway, but neither are now used for handling ores the owners sending all by way of Marquette.

An ore dock has also been built at Huron Bay, on Lake Superior, to which the Huron Bay Railway, built between Champion and Huron Bay was to have hauled ore. The road has not been equipped, however, and no trains are being run.

In the accounts of the different copper mining companies I have printed the facts relating to the lines in that portion of the State for the carrying of rock from mines to stamp mills and the mineral from the mills to furnaces. Much of the ingot is sent east by boat during the summer months, while considerable finds its way by all-rail over the Duluth, South Shore & Atlantic.

The railroads of the iron ore district carry considerable ore direct to furnaces, the amount so sent for 1895 being 195,896 tons.

AVERAGE LAKE FREIGHTS ON IRON ORE.

The average ore lake freight rates for the period of 20 years from 1876 to 1895 inclusive were: Escanaba, contract, $1.05, wild, $1.30; Marquette, contract, $1.35, wild, $1.30; average for past ten years: Escanaba, contarct, 91 cents, wild 91½ cents; Marquette contract, $1.09, wild $1.12; Ashland and other ports at the head of Lake Superior, contract, $1.19, wild, $1.30.

The avearge daily or wild rates were: Escanaba, 73 cents; Marquette, 92 cents; Ashland and other Lake Superior ports, $1.13. The season contract rates averaged: Escanaba, 55 cents; Marquette, 75 cents, and Lake Superior ports, 80 cents.

SAILING DISTANCES.

The following are the distances from the principal iron ore shipping ports to Cleveland, Ohio.

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

PRICE OF RAIL FREIGHTS.

The tariff fixed for transporting the iron ores from mine to lake port for the season of 1895 was as follows:

From mines of Marquette range east of Republic and Michigamme to Escanaba, per gross ton	52 cts.
From mines of Marquette range at Michigamme and Republic, to Escanaba	67 cts.
From mines of Marquette range to Marquette	52 cts.
From mines of Marquette range to Gladstone	52 cts.
From mines of Menominee range east of Mastodon, to Escanaba	52 cts.
From mines of Menominee range west of Mastadon	57 cts.
From mines of Gogebic to Escanaba	97 cts.
From mines of Gogebic to Ashland	52 cts.
From mines of Minnesota to Duluth and Superior	80 cts.

The rate for 1895 was about 13 cents per ton less than that of the previous season, and is considered a reasonable charge. No rate has as yet been announced for 1896. The reduction in ore tariff was due to the depressed condition of the business. It will be seen that Michigan has an advantage of 20 cents per ton in rail freight over the mines of Minnesota, and from 5 to 25 cents per ton on lake freights, an item of great importance when figured on the immense tonnage sent out.

Iron ore shipments from Minnesota for 1895 and total of all years.

Mesabi range.	1895.	Total.	Vermilion range.	1895.	Total.
Adams	59,141	59,141	Chandler	432,760	[illegible]
Auburn	374,582	485,180	Minnesota	605,024	[illegible]
Biwabik	247,069	484,617	Pioneer	40,054	[illegible]
Canton	359,020	597,289	Zenith		[illegible]
Cincinnati	17,187	43,559			
Commodore		72,850	Total	1,077,838	8,123,140
Duluth		37,626			
Fayal	136,601	136,601			
Franklin	286,424	556,489			
Hale	30,100	58,787			
Lake Superior	58,123	58,123			
Lone Jack	389,338	389,338			
Lowmore		1,645			
Mahoning	117,884	117,884			
Mesabi Mountain	111,039	740,009			
Minnewas		15,998			
Mountain Iron	371,274	1,068,777			
Norman	93,392	132,391			
North Cincinnati	3,046	3,046			
Ohio	28,943	28,943			
Sellers	47,433	47,433			
Vega	47,700	53,328			
Total	2,778,266	5,192,504			

Ore shipments from all Lake Superior ranges by lake and all-rail for season of 1895.

Ranges and mines.	Escanaba.	Marquette.	Gladstone.	Ashland.	Two Harbors.	Duluth.	All-rail.	Total.
Marquette.								
Angeline	109,147	204,134					275	313,556
Bliss	36,890	7,250						44,140
Cambria	28,364	11,103						39,467
Champion		99,141	1,257					100,398
Cheshire	6,598							6,598
Cleveland	168,605	71,349					30,824	270,778
Davis	6,764							6,764
Dexter		13,752						13,752
Hartford							200	200
Iron Cliffe	90,291	80,141					34,938	205,370
Jackson	10,637	30,667					898	42,202
Lillie	33,868	20,577						54,445
Michigamme		3,214						3,214
Mesabi's Friend	5,503							5,503
Negaunee	23,163	67,568						90,731
Palmer	3,433							3,433
Platt	13,695							13,695
Queen	92,281	65,035					3,501	160,817
Republic		94,003	80,024					174,027
Schadt							1,261	1,261
Starwest	51,207							51,207
Superior	92,675	238,489					10,933	342,097
Volunteer	1,796	25,850					5,026	32,672
Winthrop	75,753	43,101						118,854
Total	850,665	1,075,374	81,281				87,846	2,095,166
Menominee.								
Antoine Ore Co.			28,038				3,730	31,768
Appleton	2,107							2,107
Aragon	168,606						12,753	181,359
Armenia	2,045							2,045
Chapin	618,371							618,371
Columbia	65,192							65,192
Commonwealth	205,039						3,540	208,579
Crystal Falls	5,214						7,823	13,037
Dunn	90,886							90,886
Florence	22,820							22,820
Hemlock	890						156	1,046
Hiawatha	1,201							1,201
Keel Ridge	19,441							19,441
Loretto	53,160							53,160
Mastodon	23,733						48	23,781
Michigan Ex. Co.							1,071	1,071
Millie	10,924							10,924
Penn Mines	292,808							292,808
Powabic	251,654						1,110	252,764
Quinnesec	761							761
Shafer	5,675						640	6,315
Sheridan	16,754							16,754
Youngstown							13	13
Total	1,867,281		28,038				30,884	1,926,203

Ore shipments from all Lake Superior ranges.—Concluded.

Ranges and mines.	Escanaba.	Marquette.	Gladstone.	Ashland.	Two Harbors.	Duluth.	All-rail.	Total.
Gogebic.								
Anvil	1,341			66,723				68,064
Ashland				123,757			2,339	126,096
Atlantic				71,053			3,572	74,625
Aurora				245,583				245,583
Brotherton				40,567				40,567
Cary	681			51,622			45	52,348
Chicago							1,950	1,950
Davis	647			9,557			49	10,253
Eureka				26,105				26,105
Iron Belt				143,924			4,303	148,227
Montreal				139,010			1,890	140,900
Mikado				4,787				4,787
Newport				157,322			408	157,730
Norries	91,385			595,186			56,597	743,168
Pabst	25,676			194,468			769	220,913
Palms	12,503			34,462				46,965
Pence				825				825
Pike							2,010	2,010
Sunday Lake	1,263			19,707				20,970
Tilden				416,936				416,936
Windsor	11,438							11,438
Total	144,934			2,341,899			73,932	2,560,765
Mesabi.								
Adams						59,141		59,141
Auburn					374,418		164	374,582
Biwabik						247,069		247,069
Canton					359,020			359,020
Cincinnati					17,157			17,157
Fayal					136,601			136,601
*Franklin						286,424		286,424
Hale					30,100			30,100
Lake Superior						58,123		58,123
Lone Jack and Oliver						500,377		500,377
Mahoning					117,884			117,884
†Mountain Iron						371,274		371,274
Norman					93,392			93,392
North Cincinnati							3,046	3,046
Ohio						28,943		28,943
Sellers						47,433		47,433
Vega					47,700			47,700
Total					1,176,302	1,598,784	3,210	2,778,296
Vermilion.								
Minnesota					432,736		24	432,760
Chandler					605,024			605,024
Pioneer					40,054			40,054
Total					1,077,814		24	1,077,838

* Bessemer and Victoria shipments included.
† Rathbun shipment included.

RECAPITULATION.

BY RANGES.

From Marquette	2,095,166
From Menominee	1,926,203
From Gogebic	2,560,765
From Mesabi	2,778,296
From Vermilion	1,077,838
Total	10,438,268

BY PORTS.

From Escanaba	2,862,880
From Marquette	1,075,374
From Gladstone	106,319
From Ashland	2,341,899
From Two Harbors	2,254,116
From Duluth	1,598,784
By all-rail	195,896
Total	10,438,268

COPPER.

The mining, milling and smelting of this metal forms one of the grandest industries of the State of Michigan, and in no other state of the union with the single exception of Montana (and this within the last few years), is any such magnitude achieved in the way of copper production. The region is not only of great commercial value to the State at large, but is prominent in being the source of supply for foreign countries lacking this metal.

By reason of its wonderful purity, toughness, strength and conductivity, Michigan's product is renowned the world over in these all-important features, none other equalling it, and on account of which it commands a better price than copper produced from other regions. It is pertinent to add that this difference in the market is not as great as its physical superiority entitles it to.

The wonderful advance made in the utilization of electricty is playing an important part in the consumption of copper, and the gain is most largely in favor of the Michigan metal which is pronounced superior for electrical purposes. Copper has but fairly started upon its victorious march, and the next ten years will witness a more rapid gain than has ever marked a similar period in the history of its mining on Lake Superior.

Great interest is taken in the copper mines of this State for the reason that the shares of the different companies are listed on the Boston stock exchange. There is much trafficing in them, and those of a speculative turn of mind find here an opportunity to test their skill as financiers and readers of the future. The success of one speculator may not always be marked by the failure of another, but some of the stocks are subject to great fluctuation, and herein lies the opportunity to make or lose. As permanent and satisfactory investments, the stocks of the largest companies are safe, and, while there are seasons of depression, the general average of success is as large as marks that of other lines of investment. There have been many failures of properties from which much was expected, but the industry as a whole has been remarkably profitable, the mines of the upper peninsula having to their credit in the way of dividends paid shareholders the enormous sum of $68,460,375, this having been contributed by fifteen different properties as follows:

Atlantic	$700,000
Calumet & Hecla	44,850,000
Central	1,970,000
Cliff	2,518,620
Copper Falls	100,000
Franklin	1,280,000
Kearsarge	120,000
Minesota	1,820,000
National	359,255
Osceola	2,022,500
Pewabic	460,000
Phœnix	20,000
Quincy	7,670,000
Ridge	100,000
Tamarack	4,470,000
Total	$68,460,375

The total product to date, about 859,000 gross tons, represents a market value in New York of about $290,000,000. The yearly gain in the production of the copper mines of Michigan is large and steady, it amounting to about 2,000 tons for each of the past fifteen years, and, while the price has shrunk from 20 to 10 cents per pound within this period, the cheapness has made the metal more attractive to consumers, and better methods for mining, milling, smelting, etc., have enabled the mines to continue and keep up fair rates of dividends. The region has affored employment to thousands of people, large communities have thrived while those of other sections of the country have been depressed by financial ills. There has been no suffering here, and none have known such a thing as hard times

so universal throughout the country. The copper range of the upper peninsula has made a wonderful record, and greater achievements are here yet to be recorded.

It was no less a statesman than Henry Clay who, in speaking of this peninsula, referred to it as “one beyond the range of the remotest settlement in the United States or beyond the moon.” This domain, thrust upon the people of the State of Michigan, and unwillingly received by them, has certainly proved a source of much gratification since the time of that historical event. When the Phœnix mine delivered a ton of material in Boston, Mass., that yielded $568.00 in silver and $200.00 in copper, some idea of the mineral value of the new possession was grasped, and Boston people were not slow in availing themselves of the opportunity to become financially prominent in the further development of this country.

While much has already been done in this copper field, there is yet much more to be accomplished. Only a small portion of the territory productive of the metal has been thoroughly and practically explored and developed. The length of the copper bearing formation in Michigan is fully 130 miles, and its width varies from 3 to 15 miles, becoming wider as it extends westward. Upon this large tract of land the present working mines are embraced within an area of 13 square miles, not one-eighth of the mineral-bearing territory. Of this present working portion the range there is Houghton and Hancock at the southern limit and Calumet at the northern.

The geological characteristics of the range have been often and elaborately presented, so that they are generally well understood, but I will give a brief outline of the formations for those who may not be familiar with them. 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 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 Royale, 50 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 degrees at the extreme northeastern end of the point to 60 degrees at the western portion of the range. On Isle Royale the dip is to the southeast at an inclination of about 12 degrees.

The disturbances to which these rooks 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. Why the copper is in native form instead of an ore (the general manner of occurrence), has never been satisfactorily answered, although the presence of iron oxide is thought to have an important bearing upon this peculiarity. Whatever the cause, it has been of wonderful advantage to the miners of this field, it permitting of greater purity of product, as well as a more ready and cheaper extraction from its associate rocks and other minerals. 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, and Tamarack Junior mines, are known as old sea beaches, made up of 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, but one mine is at present being wrought, the Central.

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 carry copper that warrants mining for this metal. Only one conglomerate belt is being given attention, and not to exceed four amygdaloid belts are furnishing copper at this time.

That section of the range lying between Houghton and Rockland possesses favorable indications for profitable mining, but through the territory midway between these points the lack of railway facilities has proved a serious bar to development. Many properties formerly pronounced valueless could undoubtedly be made to earn a profit with modern appliances and better understanding of the business, as exemplified at many of the mines on the range. With a demand for addition to the present product of copper, the search for other mines will be stimulated. Nature has evidently intended that mankind shall have to secure this wealth from her storehouses as it is required by the needs of the country, and it can only be obtained by the putting forth of energy and skill as well as money. Too plentifully given, the metal would not be as valuable as under its existing conditions, and patience, as well as capital are needed in the task of development.

Not only has this district been particularly favored in ready means for transporting the copper to market by water, but the presence of these magnificent lakes in such close proximity to the mines is invaluable in the separating of the mineral from the rock, something like 30 tons of water being used for each ton of rock stamped.

As to what depth these veins can be followed is a problem that can only be answered by actual operation.

The present lowest workings on the amygdaloids is about 2,500 feet from surface and on the conglomerates the lowest point at which mining is being prosecuted is at a depth of 4,900 feet. In these there is no sign of a lessening of the percentage of the copper contained in the veins as compared to territory nearer surface. The companies figure upon going to a depth of 10,000 feet, and the Calumet and Hecla are equipping their property with this end in view. It will be possible for the miner to work in the atmosphere that will be encountered at such depth, and there are reasons for arguing that the copper will extend downward to that point. There is a question, too, as to how long these veins will continue to their present dip. Ultimately they will flatten, forming the bottom of this immense trough, or basin, but when this will occur, or what the conditions will be when the bottom is reached, is evidently so far in the future that I will leave the solving of the problem to commissioners who will succeed me. I am convinced, as are the residents of the copper district, that the copper already proved up will last long beyond the time of the present generation, and further than this the present should not concern istelf. Those who follow will doubtless find an abundance for their needs, no matter how great the latter may be.

Native silver is often associated with the copper in the mines of this range, particularly in that of the amygdaloids. In the earlier history of the country thousands of dollars worth of this metal were annually secured, and even now the amount picked out by hand at the stamps amounts to several thousand dollars yearly. In certain grades of copper the silver is held by the latter in such fine particles that it cannot be secured in the usual way, and experiments are now being made to determine whether or not it can be profitably gained by electrical separation. In the No. 2 grade of copper at the Franklin mine, numerous assays show about 60 ounces of silver per ton of ingot. The separation of this would add considerably to the value of the output of this property.

Nowhere in the world can a more progressive spirit be found than is manifested in the operation of the copper mines of Michigan. Nothing that human ingenuity can devise, and that would add to the effectiveness of the operation is wanting. Nowhere is greater courage exhibited in the search for the metal, and at no other field in the world has there been such an expenditure of money to provide equipment with which to conduct the business of mining.

Throughout the entire district I find the properties well cared for, particular attention being given to protecting the lives of miners, and to make the underground work as easy of performance as possible. The ventilation is perfect, the means of getting into and out of the mines is the best possible to be had, skilled men are employed to do the timbering, and common-sense rules for the benefit of life and property are plainly exhibited. There are hospitals for the care of the employés where the best medical skill is present, there are comfortable homes and excellent sanitary conditions. Nearly all the mining is done on the contract system, so much per foot or fathom being paid.

The year 1895 showed considerable fluctuation in the price of copper. In the earlier months, 9¾ cents per pound was quoted, this falling to 9⅜ and 9½ cents in March and April. Large contracts being made about the end of April the price stiffened to 10½ cents at the end of May, gained another cent by the end of July, reaching its highest point for the year, 12 cents, by the end of August. The year closed with heavy sales by the Calumet and Hecla at 10 cents.

MINES OF HOUGHTON.

The village of Houghton is pleasantly situated on the south shore of Portage lake. It is the county seat of Houghton county, has a population of about 3,000 people, and possesses all the improvements to be found in a modern, progressive town. Houghton is not the scene of as great activity in the mining way as was apparent a few years ago, several of the then busy properties having been forced to suspend due to the shrinkage in the price of copper. In support of the statement of the residents of this district that the old mines could earn a profit at the present price if they were equipped with such machinery as could now be secured, and were operated by the improved methods now employed at other places, there is much in favor of their presentation. Enough has been done to lend encouragement to a better equipping of the old properties, and even now there is considerable being said with reference to resumption. The present and only active copper producer on the south shore of Portage lake is

THE ATLANTIC MINE,

the location of which is three miles south and west of Houghton on ground elevated several hundred feet above the lake's level. This mine has been one to which no little attention has been directed by reason of the excellent results achieved in its operation, it being credited with a net earning of about $900,000, this being won from a rock yielding an average of less than three-quarters of one per cent of copper. For the year 1894 the yield was 14.06 pounds of copper per ton of rock, and the gross value of product per ton of rock treated was $1.3376. At this low yield, and with a low price for the product, the mine earned $48,762.95 in 1894. When it is considered that this rock has to be all drilled and blasted, the ground timbered, water pumped, the rock raised from a depth of over two thousand feet, put through crushers, run into cars and transported by railway nine miles, then to be stamped and otherwise treated in the mill, and all this for less than $1.34 per ton, none will dispute the fact that there must be an active management, and one well skilled in the different branches of the mining and milling business. In 1895 the percentage of copper per ton of rock was 0.73, and cost of mining, milling, etc., less construction account, was $1.2034 per ton.

It is true that nature has given to the company some advantages not possessed by others in the same line of business, and it is also pertinent to remark that nature is not always taken advantage of in a way to assist mankind, by reason of the short sightedness of the latter.

The Atlantic is opened upon an Amygaloid belt of dark-brown color, the mineralized portion of which has an average thickness of 15 feet. The copper in this is very evenly distributed. There are few barren stretches, and few rich bunches. There can be no selecting of the rock, and all the mineralized lode is sent to surface, no attempt at selection being made. It is told us by miners who work here that the rock breaks freely, in this respect having an advantage over amygdaloids in general in this district, but it may be that the system they employ has something to do with the ease of winning the vein material.

The plan observed as follows: Leaving suitable pillar to support the shaft, they take a block of ground 100 feet long on the trend of the lode. All contracts here are for lengths of 100 feet. They first cut their drift, putting in heavy stull timbers to support the hanging and to give safe tramming way. They then go on top of these timbers and break the ground above, letting the broken dirt accumulate on the timbers as they carry on the backstopping. They continue upward until within a few feet of the floor of the level above. Levels are opened every 85 feet throughout the lower portions of the mine, this distance having been observed for the last six levels. As they rise upward the rock gains under them faster than they rise, owing to its being broken, so that near the top of the stope they may have no more than four feet of headroom to work in, but they have no trouble in going upward as far as they safely can, or to a point where no more can be taken on account of leaving support to the floor of the level over them.

The gang of men who take the second and succeeding contracts do not have the solid cut to make as is necessary at the shaft pillar, they beginning at the point where the first gang leaves off, and as a natural consequence they are not paid as high a price as is given the party employed at the initial contract of a level. Sometimes there is an “uprising” put in at the farthest end of the first contract, this depending upon the conditions met with. When a level on one side of the shaft has been thus cut out, they go to the extreme end of the level and draw the broken rock down, always working from the farthest end and towards the shaft. In this way they get all the rock. If there is a sign of weakness in the hanging over the ground being drawn down, they put in timbers to secure it. The old system was different in that they used to draw the rock from any portion of the territory containing the broken material, several places on a level being drawn down at the same time. This resulted in the broken ground making funnel-shaped openings in the broken rock, and where the hanging was unstable, and would come away, much rock was lost. One can readily see how this practice would cause trouble. If a piece of ground 100 feet long by 15 wide were milled down from a point midway on its length there would be considerable of it, and particularly near the bottom of the stope, that would not run freely after a certain territory immediately over the opening on the top of the drift had run down. If the hanging were poor, and would come away, it would bury a considerable portion of the milling rock already mined, and this is what it used to do, a great loss being thus occasioned. By milling from one end of the vein they avoid this, as they are enabled to protect the hanging, which, in the old way, they were not. Mr. F. McM. Stanton, the present agent, deserves much credit for this change, as well as many others inaugurated since his connection with the property. At the time of my last visit to the mine, on February 3, 1896, there were over 100,000 tons of rock broken in the different levels being worked and where this system is observed.

There are four shafts located on the lode, and the latter has been opened up for a distance of 4,800 feet, No. 4 being the most southern. It has reached the 22d level. No. 1, the most northern, is to the 16th level; No. 2 is to the 20th; No. 3 to the 25th, 2,100 feet from surface.

What is known as the “New No. 3," is now to the 24th level. It is located close to the old No. 3 shaft. The latter was a single-compartment and could not be widened, as sufficient ground had not been left about it to permit of this. The new shaft had to be built up in many places due to lack of sufficient rock support, but it is substantial, is two-compartment, and will be of great advantage in hastening the work of hoisting. It will be the principal working shaft of the mine, as it takes care of the product from the richest portion of the lode, and which is now being given greatest attention. The territory will include about 800 feet north of No. 3 shaft and 700 feet south of it, and they are mining from the 17th to the 25th levels, the work here being uniformly distributed throughout this territory.

At this new shaft a shaft house has been built, the trains dump their loads upon screens, and everything is at hand for rapid and economical handling of the material. No. 3 is ahead of all other shafts in depth, and others are deepened by rising from No. 3, this saving about one-half the cost of sinking. Where $25 is paid per foot of sinking $12 will pay for a foot of raising, which is an item of no small importance.

Formerly, all the rock from the mine was conveyed to No. 4 shaft rock house, but rock breakers are being established at other shafts. No. 2 shaft and rock house is ready, but has not been equipped as yet. This will effect a still greater saving, and enable the Atlantic to met the low prices of depressed periods.

The dip of the strata is about 55 degrees to the nothwest, and the trend of the lode is more westerly than any of the veins of this section, being interesting on such account. A feature of the mine is a heavy calc-spar vein that intersects the amygdaloid diagonally, and while not copper-bearing, they look for rich ground at the points of intersection with the copper-holding rock. Lying on this

amygdaloid is a belt of conglomerate 50 feet thick, but unproductive of copper. Between the Atlantic mine and the south shore of Portage lake are no less than fourteen belts of conglomerate, but generally barren of copper.

At the mine there is a new boiler house, 88x66 feet. This contains a battery of eight boilers, of 100 horse-power each. Wood is used for fuel, and tracks are so arranged that the loaded cars are run direct into the boiler house, a convenience that is appreciated by those who have to do the firing.

New machine and carpenter shops were also erected at the mine the past summer.

The location is a most pleasing one. There is a neat little village built up about the mine that is owned in greatest part by the Atlantic Mining Company. There is a well-conducted school, company stores, a church, and excellent sanitary conditions. The community is a thrifty, happy one, and it is pleasing to know that the mine, which supports all this, is looking as well as at any past time in its history. The new openings compare favorably with the old, and there is plenty of room on the company's property to follow the lode as long as it can be worked at a profit.

Due to the filling of the channel of Portage lake by the stamp sand at their mill, which was located on the shores of this body of water, the United States government forbade further obstruction of the channel, and a new mill site became a necessity. This has been secured near the mouth of the Salmon Trout river, on the shore of Lake Superior, and here a magnificent mill has been built. Its dimensions are 151x234 feet, is frame, with stone foundations, and contains six heads of stamps, 18-inch, of the Ball's type, fifty-four iron Collum jigs; one 14x22-inch Reynolds-Corliss engine, a Gardner fire pump, lathes, pipe, bolt and nut cutters, planer, etc., making in all a fine equipment. There is a boiler house, 101x71 feet, containing three 16x6 foot Evans fire box boilers with Gardner duplex feed pumps, and a fire pump of same make. The smoke is conducted in a steel flue 175 feet long and 7 feet in diameter, that has been lade to a stone base on the hill back of the mill, which is surmounted by a smoke stack 30 feet high and 6 feet in diameter.

From the old mill at Portage lake four heads of stamps have been made from the number formerly used there, and two new Allis heads have been purchased, all of which are now in position at the new mill, the last one having just been set up.

There is no pumping required to supply the water needed by the stamps. The water comes to the mill by gravity. A dam has been constructed across the Salmon Trout river, and the water form this is conveyed to the mill, a distance of 2,052 feet, being given a fall of 5 inches in each 100 feet. This dam cost the company over $20,000. It is constructed of timber, loose rock and earth. The main portion is crib work 53 feet thick at the bottom and 28 feet thick at the top, and 50 feet high. The length across the stream at the bottom is 51 feet, and a the top, 228 feet. The crib work is of hewed flat timber 14 inches thick and bound together at the joints with inch square drift bolts. Loose rock was used for filling the cribs. The supply launder is 18x36 feet, which discharges into a steel tank 8 feet in diameter and 10 feet high, from which the water is conveyed to the stamps as needed. This water supply is a point of greatest importance to the company. When one considers that thirty tons of water are used in the washing of a single ton of rock, and that this company treats about 1,000 tons of rock daily, the value of the new plant can readily be recognized. There is the money spent in constructing the dam, but it costs a great deal to install large pumping engines, as well as to operate them and keep them in repair after they are placed in commission. With the dam paid for, the expense of supplying water practically ceases.

The new mill location is fast taking on the appearance of a village. There are now thirty dwelling houses erected; there is a schoolhouse, which, with the mill building, lends an animated appearance to the place. At the rear of the mill they have railway tracks for the handling of heavy material and supplies, while in front of it are tracks for handling the product and lighter material. The arrangement is a most perfect one. Mr. F. G. Coggin is superintendent of the mill. During 1895 the company stamped 331,058 tons of rock,

The new mill is eight and one-half miles from the mine, and the company has connected the two by a standard-gauge railway. They have an ample equipment of locomotives and cars. There is one large consolidated engine, a Brooks, with four drivers, and weighing 90 tons, besides which there is a 45-ton Brooks, and two 20-ton locomotives. There are 32 flat cars and 127 rock cars, the latter having a capacity each of 5¼ tons.

The building of this line of railway has also cost a considerable amount of money, and due to this fact, and the cost of the new mill and its equipment, no dividends have been paid since the spring of 1892, but the company is now in shape to continue this popular practice of rewarding their shareholders for the money they have invested in the enterprise, and a resumption of dividends is looked for in 1896.

The new road has opened up a valuable timber tract from which wood for fuel and mine timbering is cut. A recent purchase of timber lands has recently been made from the Sheldon estate, 1,500 acres having been secured. The company has a new saw mill in which all its timber is prepared for use.

The product of refined copper for 1895 amounted to 4,832,497 pounds, an increase over the production of the previous year of 605,112 pounds. The total production of refined copper to date is 72,048,632 pounds. The gross profit for 1895 was $110,559 47. The net surplus, December 31, 1895, was $150,874.97. The number of men employed at mine and mill is 476.

The officers are: Joseph E. Gay, president; John Stanton, secretary and treasurer, both of New York; F. McM. Stanton, superintendent, Atlantic Mine, Mich.: A. D. Edwards, cashier; Theo. Dangler, mining engineer; Wm. S. Trethaway, mining captain.

Occupying territory between the Atlantic mine and the shore of Portage Lake, and about a mile south of Houghton village, is

THE HURON MINE,

now idle, but which has been the subject for considerable attention in the past. It has been through legal troubles, and was shut down in August, 1893, since which time nothing in the way of resumption has been done. The last fifteen months the mine was running it was operated on tribute by Mr. Graham Pope, the capable agent of the Franklin, Franklin Junior and Tecumseh properties. From that gentleman I learn that during this period he secured about 600 tons of copper from the mine, which is substantial proof that the metal exists in quantity to warrant a further trial with a better equipment of machinery than is now possessed. Mr. Pope, who is well qualified to judge of the value of the property, unhesitatingly says it can be made to pay even at ten-cent copper. The work performed by him at the mine was with antiquated machinery that was expensive to run and which was constantly occasioning delay by breakages. He opened considerable new ground, and the greater portion of the product was secured from territory never before worked. He has an excellent knowledge of the lode, having given it careful study for many years, and he is convinced that the mine can pay a fair interest on such a sum as would be needed to give it a modern plant of machinery. In this opinion the gentleman is supported by other prominent copper miners of this district.

It is claimed that the rock will yield one per cent ingot, which, if true, is sufficient guarantee for a revival of operations. The lode is an amygdaloid, locally known as the Isle Royale lode, and is not the same being wrought by the Atlantic, being nearly two miles east of the latter with a similar dip, and a trend a little more south of west than that of the Atlantic. There is an entire section of land with the vein running through the southeastern portion, giving plenty of room to follow the lode as far as atmospheric conditions would permit.

Between the Huron and Portage Lake are the Isle Royale and Grand Portage mines, both of which have long since ceased business. These might be profitably consolidated with the Huron. They were worked on the same vein as the latter, and, combined, would provide a large territory. I am told that the property can be secured at fair price, and at this time there is considerable being said about making a deal to include the lands of all three. A few years ago all the arrangements had been completed for purchase, but the death of the principal capitalist interested in the venture overthrew the plans of his associates, and the final failure of the proposed consolidation was announced. This was generally regretted, as the people of this section had looked upon the plan with favor and saw additional gains in the business that would naturally accure from the activity of these mines.

Since writing the above an option for purchase has been given N. F. Leopold, of Chicago, Ill., who is certain he can interest capital in them, and bring about their resumption.

The district lying between Houghton and Ontonagon is one of which little is known from a mineral point of view. There has been some prospecting work done, and the encouraging returns have been secured at several of the locations tested. The lack of a railway by which supplies could be more readily secured, or the product, if any resulted, shipped away, has been the most serious drawback in the further development of this portion of the mineral range. The tract is finely timbered, and a profitable district aside from the mining of the copper would result if a railway could be had. One hears more about

THE WINONA PROSPECT

than any other that has been explored in this section. This is owned by prominent gentlemen of Houghton, among whom are Hon. Jay A. Hubbell, and Capt Johnson Vivian, both of whom have abundant faith in the properly. The location is 26 miles from Houghton, in town 52, range 36, and embraces 1,400 acres in sections 21, 22, 25, 28, 29 and 32.

There are three lodes on the property carrying copper, an amygdaloid, conglomerate and epidote, the amygdaloid being the most promising. On the latter they have sunk two shafts to a depth of 40 feet, from which a satisfactory grade of copper rock was produced. There are options also held on adjoining lands, and a large tract is presented that offers rare inducement for prospecting. Sufficient has already been disclosed in the shafts above mentioned to warrant a liberal expenditure in the further development of the lode at this point. There are thirty-five miles of undeveloped territory on this same range, and sooner or later it will receive the attention due it. There is considerable talk of a railway extending to Houghton from Pori, a station on the line of the Chicago, Milwaukee & & St. Paul Railroad, about fifteen miles distant from the Winona property. The people of Houghton would much like to see this extension built, as it would undoubtedly bring increased business to them and add to the mineral wealth of the State.

MINES OF HANCOCK.

The village of Hancock is located on the north shore of Portage lake, and directly opposite the village of Houghton, the two being connected by a bridge. The town is an important one commercially, having for many years been known as amongst the most active in this

mining region. Within its corporate limits, and the territory it possesses in adjoining townships, is a population of about 9,000 souls, these being given employment in the mines and securing their supplies from this village. The latter is provided with all the conveniences that modern enterprise furnish, and the growth in population and wealth is steady. Of the mines that contribute to its welfare

THE FRANKLIN

has long been prominent. It occupies the southwest quarter of section 24, 55-34, and the surface elevation is several hundred feet above the level of the lake. Work was first begun here in 1857, in which year 6,699 pounds of copper were produced. The mine has been constantly operated since that time, for a few years on tribute, but this was under the direction of the company.

The amount of refined copper the mine has yielded is 87,797,993 pounds, and the dividends paid aggregate $1,240,000. The total assessments called amount to $160,000, so that the shareholders have received satisfactory compensation for the amounts invested.

The products for 1895 was 3,086,983, a falling off as compared to 1894 of 469,554 pounds. Contributing to this shortage was a stoppage of five weeks in the year due to the burning of the mine engine house and boiler house on the 24th of November, this requiring nine weeks to rebuild, five of which were in 1895, and during which period the mine and mill were idle. The time in which the new buildings were completed, the plant of machinery rebuilt, and important repairs made in and about the property reflects great credit upon the skill and energy of the agent, Mr. Graham Pope. The fire had not been fairly extinguished before the plans for a new structure had been arranged and the work of rebuilding under way. This is the third loss by fire the mine has experienced in its history.

When Mr. Pope took hold of the Franklin four years ago, the rumor was current that the mine would last no more than another year at most, but it has continued to send out a satisfactory tonnage since that time, and is good for several years yet to come. It is one of the properties that “die hard.” Of course the end can be seen. The company has reached the line of the Quincy mine in their shafts at a depth of 3,000 feet, and beyond this they cannot go. They are mining on the 32d, 34th, 35th and 36th levels in the lower portion of the mine, and in the 9th and 10th levels of the upper portion. Considerable of the rock stamped in the 1895 came from these upper levels. It has not been as rich in copper as levels of greater depth from surface, but they have made money from it, and that is the principal point now to be considered. The falling off in percentage of copper per ton is due to the fact that so much of the product came from these upper levels. The yield was the lowest ever recorded, being 1,215 per cent. It gave nearly 83 per cent ingot, however, which is excellent, in this feature keeping up with the high standard always achieved at this property.

The Franklin is working upon the same amygdaloid lode as that given attention in the Quincy mine, immediately south. The dip of the lode is 52 degrees to the northwest. They have developed the lode entirely across their property, and have two shafts now open to the bottom of the mine, these being inclined with the formation. The rock is run by gravity from the shafts to the stamp mill located at the foot of the steep hill, and on the shore of the lake, this affording a ready and cheap means of transportation. The mine machinery is old-fashioned, but it is not deemed advisable to introduce better for the reason that there is not sufficient in the mine to warrant it. It may cost more to operate than it would the modern plants, but, considering all this, they secure satisfactory results. The same skill applied under a better condition of things in the way of fine stopes of rock and modern surface equipment would accomplish much of pleasing character, and it is hoped that Mr. Pope will be provided with the natural advantages to warrant his making such a showing as he is able to.

In the rebuilding of the boiler and engine house, they have made separate structures instead of one, as formerly, so that in case of future fires they will not suffer the destruction of both engines and boilers.

At the stamp mill there is capacity for treating 500 tons of rock daily, and improvements have just been completed whereby they can use the lake as a place to deposit the stamp sand for at least five years to come. A new pump and sand wheel have been put in at the mill, and territory has been secured along the lake shore by which sufficient room will be had to deposit sand for the term named without encroaching upon the channel. Government officials are keeping close watch of the latter, and the Franklin is the only mine depositing sand in the lake, all others having removed their plants to Torch Lake or Lake Superior.

The Franklin Mining Company, knowing the end of the old mine will be reached before many years, have been looking about them for other properties to replace the old when the latter is exhausted of its available treasure, and has secured territory that have the virtue of being well located, and which they are now energetically exploring. The nearest to the old mine is known as

THE FRANKLIN JUNIOR,

the location being about two miles northeast of the Franklin mine. This tract, consisting of 1,359 acres located in sections 7, 8 and 9, 55-34, was purchased in November, 1894. It was originally known as the Albany & Boston, and later as the Peninsula. It stretches two and one-half miles across the mineral range, and has a surface length on the trend of the formation of about 7,000 feet.

This property is crossed by the prominent copper-bearing veins of this district. The Pewabic amygdaloid,

on which are located the Franklin and Quincy mines, is the most westerly on the property, and upon this a shaft is being sunk, and incline, following the dip of the lode, which has reached a depth of 320 feet at this writing, February 10, 1896. This shaft is showing encouraging bunches of copper in the bottom, indications being so favorable that the management has great hopes of finding a paying mine at this point. Each day during the past two weeks has added considerably to the excellent showing of copper in the lode.

The Allouez conglomerate is next in order crossing the property from west to east, it lying 500 feet east of the Pewabic. It was upon this vein that the old Peninsula Company did considerable work. The old shaft has been unwatered to the fifth level, and from the fourth level, a distance of 300 feet from surface, they are driving a drift eastward in search of the Calumet conglomerate that is now in 1,700 feet. The objective point has not yet been reached, and it may be that the Calumet vein will not be found. They are putting in this drift at the rate of 80 feet per month, carrying it 6x7 feet, the ground being trap rock. When the drift was started by the Peninsula Company much trouble was experienced due to impure air. An air pipe 1½ inches in diameter was used to supply the miners. Mr. Pope put in a 3-inch pipe line, running it a distance of 2,500 feet from the engine house to the end of the drift where the men were working. After blasting, the air compressor was employed to clear the smoke out of the drift. They disconnected the machine drills, and turned the full volume into this 3-inch air pipe. The result is that the drift is speedily freed from smoke and impure airs and the miners have no trouble in working steadily. The fact that the same party of men are now employed who began here over a year ago is proof that they are satisfied with the conditions.

If this drift fails to find the Calumet vein, or should the latter be unproductive of copper when found, they will push on to the Osceola amygdaloid, which is 2,700 feet east of the Pewabic vein, and from which something is expected. Indeed, there is probably more hope of finding this productive than the Calumet vein. Mr. Pope is taking the right course in exploring this property, and when he has finished his search his company will have a fair knowledge of the value of the possession. It costs money, but it is far ahead of the plan that sinks shallow test pits on surface, the cheapest and most practiced method in this section, as well as the most unsatisfactory. At the Pewabic shaft there is a new equipment of machinery, two boilers, a double cylinder hoisting engine and air compressor.

Another important possession of the Franklin Mining Company is one immediately south of the Osceola mine, at Calumet, and known as

THE TECUMSEH,

which comprises 520 acres in sections 32 and 34 in town 33, range 56. At this point they are sinking a vertical shaft to find the Osceola amygdaloid, and hope to achieve this object some time in February, 1896. The shaft is down 80 feet, and they are cross-cutting west to reach the desired lode. The most southerly shaft of the Osceola is said to be rich in copper near the Tecumseh boundary. The territory is certainly a most favorable one.

During the coming summer they will sink a shaft to reach the Calumet conglomerate on lands of the Tecumseh. While the Osceola did not find the vein sufficiently productive to warrant their continuing, there may be other zones richer in copper, and it is certainly well worth while to look for them. With such magnificent copper-producing ground as is possessed by the Calumet & Hecla mine a few thousand feet distant, there is the best of reasons to try to find more of it, especially when they own the same lode that is so rich to the north of them, and the Franklin people will make a faithful trial of the veins in the hope of finding that which will repay them for the time, trouble and expense. They have a boiler, hoist and compressor plant at this location.

D. L. Demmon is treasurer, Boston; Graham Pope is agent, Houghton; Thos. Dennis is chief mining captain; Arno Jaehnig, cashier.

THE QUINCY MINE

is just south of the Franklin, and its landed possessions surround the Franklin upon all sides excepting the east. It has been producing copper for the past forty years and has given substantial proof of its richness by distributing $7,670,000 in dividends, besides which it has credit for a surplus of $1,007,500.68. It has expended in the securing of this amount, $29,038,470.38, which enormous sum has played an important part in the support of the village in which it is located. The growth of the mine has been steady each year adding something in excess of the achievements of the previous one, and by reasons of which constant gain the property has earned the title of “The Old Reliable.” Time was when it used to vie with the Huron, just across Portage Lake, for the honor of the greater monthly product, and it not infrequently happened that the broom was displayed from the shaft houses of its neighbor, showing that it had fallen a few pounds short of the accomplishment of its rival. But time smiled upon the efforts of the Quincy, and while it has been a pronounced success for many years past, the Huron lies idle awaiting the enterprise of man to give it new life. When the Quincy reached a product of 300 tons of rock per day it was thought that the limit had been reached. It was about that time, twelve years ago, when Captain S. B. Harris was placed in charge, and since then the product has grown larger and more satisfactory. I look upon the Quincy as one of the best-equipped and best-managed mines of this region. True, nature has made it possible to achieve success, and the management has appreciated the natural advantages and has made the best of them.

NO. 2 SHAFT AND ROCK HOUSE, QUINCY MINE.

The Quincy is opened on a brownish, dark-colored amygdaloid belt, possessing a great width, probably nearly 200 feet, and in the mineralized portion of this the work of mining is prosecuted. There appears to be two belts of copper-bearing character in this formation, one being known as the “main vein,” the other as the “east branch,” the latter apparently occupying a position in the footwall. In the course of mining it is shown that there are many barren stretches of ground, and there is also considerable variation in the thickness of the copper-bearing material. In places it may be forty feet, and then may pinch to three or four. They simply take as much of the amygdaloid belt as is profitably charged with copper, leaving the poorer bunches as pillars to support the hanging wall, this practice affecting a saving in timber. However, the management would probably prefer to use the latter if the lode were rich enough to demand the extraction of the mineral. The copper-bearing portion of the lode will probably give an average thickness of twelve feet.

The mine is fortunate in the large amount of mass copper it produces, this running from the size of a man's fist to pieces weighing many tons. During a visit to the underground workings of the mine in the summer of 1895 I saw one mass of solid copper weighing over three hundred tons. This was just under the 33d level between Nos. 2 and 3 shafts, and was too large to be cheaply sent to surface, it requiring much labor in the cutting up so that it could be handled through the shaft. The amount of mass and barrel work amounts to about 34½ per cent of the entire copper product of the mine, and as this does not go to the stamp mill, but is sent direct from the rock houses to the smelting works, it is obtained at a much less cost than the mineral that has to be transported in the rock to the mill and is claimed by stamping and washing. This is one of the reasons why the mine "makes" copper so cheaply.

The strike of the Quincy lode is a very regular one, being north of east and south of west. The lode dips to the northwest at an angle of about 50 degrees, the lower workings at some places in the mine showing a little flatter angle, but as there is considerable waving of the footwall, the dip may not vary as much as it is generally given credit for. Sometimes the shafts are in the lode, at times on one side, and then again upon the other, due to the rolling of the formation. The shafts are located on the top of a hill that rises to a height of about 700 feet above the level of Lake Superior; and conforming to the contour of the north shore of Portage Lake. They are three in number, being sunk in the lode, following the inclination of the latter.

No. 4 shaft is the most southern and is 30 feet below the 47th level, one level having been added in 1895. It is east of the main vein and a cross-cut is now being driven to connect it with this portion of the mine.

No. 2 shaft is 600 feet north of No. 4, and is to the 48th level, having sunk 30 feet below the 46th in 1895.

No. 6 shaft is 1,900 feet north of No. 2, and is 30 feet below the 45th level, having been sunk from the 43d level in the year. At this shaft, during 1895, they drifted from the 43d, 44th and 45th levels both north and south, and at the 34th, 39th, 40th, 41st and 42d levels north. The 44th level drift was connected with the drift from No. 2 shaft. These openings showed much fine ground, but there is considerable disturbance of the vein. The principal stoping done at this portions of the mine was at different points between the 30th and 42d levels north, and at the 27th, 41st, 42d, 43d and 44th levels south of the shaft, and considerable low-grade ground was met with.

At No. 4 the drifting done was at the 46th level north and south, and at the 20th, 42d, 43d, 44th and 45th levels south. Considerable unproductive ground was met with, but on the whole more encouraging territory found, here and there, than has been seen in this portion of the mine for years. The stoping done at No. 4 was at the 19th, and between the 35th, 36th and 46th levels north of shaft.

At No. 2 the 48th level was opened north and south a few feet only, and they are cross-cutting to the main vein west of shaft. The drifting done was at the 11th, 43d, 44th, 45th, 46th, 47th and 48th levels north. The 46th level was connected with drift from No. 4 shaft. These openings showed a fair average vein more or less rich in the different grades of copper.

An adit being driven from the east for the purpose of exploring the territory in that section was holed during the year. It cut many belts of conglomerate and amygdaloid and one of them is being followed north but thus far nothing of value has been shown in the way of copper.

In locating the different bodies of copper-bearing ground the diamond drill is generously employed. During the past year 24 holes were bored, the total length of which was 2,933 feet. The number of holes thus far bored in the mine with the diamond drill is 558, and the total number of feet cut is 54,443.

It is the aim of the management to keep the mine opened up well ahead of where the actual stoping is taking place, and they are succeeding admirable in this, which assures a steady product. I saw several places in

the mine where there was considerable rock broken that could be sent to surface if there was a shortage from the regular sources of supply. This is simply to assure steady operation of the stamps, and to keep all the departments in motion. There is no attempt at stock manipulation. The company is in the business of producing copper, and gives its undivided attention to this legitimate industry. The public, knowing its policy, do not hesitate to invest in its shares, being assured of honest treatment, and a reasonable return for the money invested.

The walls of the vein are generally so firm that no timber is needed to sustain them, but occasionally, where the lode is of extraordinary width, it is employed. At every place where it is used in the levels or shaft there is the greatest precaution taken against litter that might result in fires. The loose bark is gathered and either sent to surface or buried beneath the waste rock in the mine. Another precaution against the spread of a fire if one occurred, is the placing of doors at the different levels so as to prevent a current of air. The mine is well ventilated, and is a clean, safe place for the miner.

Nearly all the drilling is performed by machines, No. 2 Rand. A little hand-drilling is done in places, but amounts to a trifle as compared to that done by the power drill. Drills used in the machines are single-bitt.

Three-ton tram cars are used, two men to a car. All the work underground is on the contract plan.

The shafts of the Quincy used to be a single-skip, but they have been enlarged to accommodate two skip roads. The skips at No. 2 shaft holds 6 tons each while 3-ton skips are used at No. 6 shaft. Guides to prevent the skips from leaving the rails are an important feature, and effectually prevent accident of this kind. The shafts are 8x18 feet, having two skip-ways and a ladder way.

The rapid handling of the men at this property is one of the attractive features. Formerly they were sent into and out of the mine on the old-fashioned man engine, this requiring considerable time to take care of the men. Now they are lowered and raised in a man car, and the entire force underground, but 400 souls, can be gotten in or out of the mine in 30 minutes. The man car bears a close resemblance to a section of a flight of stairs, the under side of which is provided with wheels that rest upon the rails of the shaft track. There are banisters on this section of stairs to prevent the men from being crowded over the sides. They take their seats on these steps, and enjoy their pipes as they are gently lowered into the earth a distance on the incline of about 4,000 feet. There is no jerking or jolting, no unpleasant sensation. Thirty men are carried at a load, and the different shafts are all equipped with this convenience. The change from the skips to man cars is made at each shaft in less than two minutes. Two 5-ton cranes are located in each shaft, one on either side of the skip-way, and with these the skips are lifted off and the man cars substituted in the time given. The closest inspection of the ropes is made daily. Ropes are of the finest steel, 1⅜ inches in diameter. This is a feature in which Captain Whittle takes great pride. It pleases the miners to be gotten out of the underground levels so quickly and smoothly, and the first accident has yet to be recorded.

The mine is a comparatively dry one. The water, which comes principally from near surface, is lifted to the 7th level, where it is delivered in an adit level. The lower levels of the mine are 100 feet thick, the upper ones are somewhat shorter, and are irregular as to the distance of spacing.

The Quincy mine is an attractive one to visit. The richest portions of the lode, where the native copper protrudes from the walls in scraggly masses upon which the miners may hang their coats, are always interesting places. The copper glistens under the light of the miners lamps, and the associate minerals often make specimens of rare beauty, many of the crystalline forms being highly prized, and are valuable to those who possess them. The masses of native metal (found nowhere else outside of this region), predict a bountiful charging of the lode with mineral, and their presence in the lower levels of the mine indicate that the depositions are still strong and healthy. Two gangs of miners are constantly employed in the cutting up of these masses.

The company has recently greatly improved its surface operations by the building of two immense shaft and rock houses at the Nos. 2 and 6 shafts, these having a height of 112 feet. The following figures show the amount of materials used in the construction of each, the buildings being duplicates:

Feet of pine	327,253
" clear pine	4,088
" hardwood	29,973
" siding	15,200
" flooring	5,731
Total feet	382,245
Number of shingles	91,750

The rock, as it comes from the mine, is dumped upon "grizzleys" in the top of the shaft house, the smaller pieces falling between the bars of the screen, the coarser going to a platform at the lower end of the screen, and from which they are rolled to barrows that carry them to the large breakers on the same floor. The rock going through the large crushers falls to the floor below where it is run through crushers reducing it still finer, and from there it goes to bins or pockets where it is ready for transportation to the stamps. Near the bottom of the shaft house there is a removable section of the skip track where, by taking out this piece, the skip will dump at this point instead of at the top of the shaft house. This is provided for the handling of the huge copper masses, which are loaded direct upon flat cars and sent to the smelting works.

In each rock house there is also a steam copper cleaner for removing the rock from the mass work. It is simply a steam drop hammer that breaks the rock from the copper. These have considerable to do owing to the large amount of copper of this class produced. It is the most effective device yet tried for this work, two men

being required to operate it, one to manipulate the hammer, the other to change the position of the copper under the drop.

The machinery in these rock houses is driven by an engine located on the first floor, belt transmission being employed for power needed on the upper floors,

A new shaft house has just been completed at No. 4 shaft. It is 30x89 feet and 72 feet high. At this shaft they have increased the size of the old engine house by an addition of 16 feet, and have installed a second engine. The old drum has been increased from 18 to 22 feet in diameter, and they are now in shape to do hoisting from a depth of several hundred feet beyond the present lowest levels.

At No. 2 shaft there is a magnificent new hoisting plant. It consists of a pair of 48x84-inch engines connected to a steel drum 26 feet in diameter with 12¼-foot face, having capacity for 7,500 feet of 1½-inch rope. The governor is regulated to prevent a speed of over 3,000 feet per minute, and the skip is prevented from going to o high in the shaft house by an automatic arrangement that shuts off steam, reverses the engine and applies the brake. The plant is a substantial, sensible one, and is contained in a stone building 58x94 feet.

A new brownstone supply house has been erected at No. 2 shaft and additions made to machine and blacksmith shops. The latter are models of neatness, as, indeed, are all portions of the surface. The company builds its own skips, power drills, and has a complete machine and smithing equipment. A new mine office, of brownstone, is to be constructed in 1896, a site having been procured, and some of the material for the building is already upon the ground. The company has the welfare of its employés in mind, and has built an addition of 26x46 feet to the schoolhouse, which will give room for 350 pupils.

The Quincy Mining Company has credit for one of the finest stamp mills on the lakes. It is of modern construction, and a very economical arrangement for the treating of rock is possessed. There are five Allis heads, and the mill is in charge of Geo. Bedell. There are six miles of railway connecting the mine and mill, the track being narrow gauge. There are three mogul engines and fifty 17-ton cars. The location of the mill is on Torch lake. There have been no improvements made at this portion of the company's works during the year, and none are needed.

During the year 1895 the Quincy paid $400,000 in dividends, and expects to pay an extra from the earnings of the year next May. In 1894, a similar amount was paid in dividends from the earnings of that year.

The mining profit for 1895 was $692,074.21, this exceeding the net profits of the previous year by $102,018.29.

The amount of refined copper produced during the year was 16,304,721 pounds, exceeding that of 1894 by 820,707 pounds.

The amount received from the sale of copper in 1895 was $1,657,701.05, an increase over the previous year of $187,174.12. The amount received from the sale of silver was $3,745.53, exceeding the returns of the year from this source by $663.67.

The average number of men employed during the year was 968, of which 336 were miners, who earned an average of $50 per month.

The number of tons of rock broken was 563,360; tons hoisted, 506,058; stamp rock treated, 495,402 tons.

The product of mineral from stamp mill was 14,670,530 pounds; from rock houses, 5,062,440 pounds. The amount of refined copper was 16,304,721 lbs.

In 1894 a track of 640 acres of mineral lands was purchased and authority was given to issue to stockholders script certificates for rights to 50,000 additional shares of the company stock of the par value of $25 each, payable in four installments. This script will be convertible into full-paid stock after April 16, 1897. The Quincy Mining Company now pays taxes on 4,094 acres of land, and has a valuable possession. The addition of the lands of the Old Pewabic mine was a magnificent one, and from this territory they are now mining a large amount of copper. The prospects for future large outputs are excellent, and nowhere are the interests of shareholders given abler attention.

Thomas F. Mason is president; Wm. R. Todd, secretary and treasurer, New York. S. B. Harris is agent; Thos. Whittle, mining captain; John L. Harris, mining engineer; E. D. Johnson, clerk.

MINES OF CALUMET.

Near the present most northern scene of activity on the mineral range are located the villages of Red Jacket and Laurium, these being in Calumet township and possessing a combined population of about 18,000 people. These are amongst the most flourishing communities to be found in the mining districts of the State of Michigan, and nowhere else throughout the mining fields of the world, is mining conducted on such a magnificent plan as is here witnessed. Here is the heaviest machinery, the deepest shafts, the richest lodes. These towns are steadily growing in number of people and fine business blocks and residences. They possess excellent schools, and churches, modern methods of lighting, drainage, fire-fighting, and in securing water supply. They have also credit for excellent highways, macadam being secured from the trap rock, than which nothing is better for this purpose. At the top of the column for the magnificence of its surface display, as well as for the extent of its underground operations, is

THE CALUMET AND HECLA MINE,

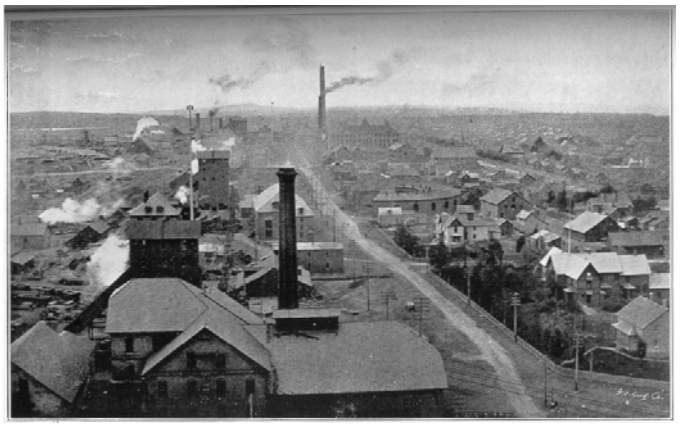
renowned the world over for the magnitude of its development and the achievements in the way of

dividends paid to those who have invested in the shares of its capital stock. There are various stories circulated as to how this wonderful mine was first discovered, amongst them being one that it was due to the inquisitive rooting of a hog, but later and apparently well-authenticated proof is in favor of Edwin J. Hulburt, who was identified with the early work in the history of this mineral-bearing region. However this may be, the fame of the mine has gone abroad through several continents, and it is recognized as one of the mineral wonders of the age.

The mine has paid in dividends the enormous sum of $44,850,000, and the total amount of assessments is, $1,200,000. The value of the stock at the highest point touched in 1895 was $33,000,000. During 1895 it paid four dividends of $5 each, amounting to $2,000,000, and has already paid one in 1896 of $500,000, this being presented to its shareholders on the 3d of March.

The Calumet and Hecla, like other giant concerns, has been freely criticised on account of the lavishness of its expenditures, but while its work now appears stupendous it must be remembered that the company is equipping its property with a view to following the lode to a depth of 10,000 feet, considerably more than one-half the distance already achieved. To handle its rock from such great depths must necessarily demand machinery of enormous proportions, and compared to that generally in use it certainly may look out of proportion, but considering what is expected of it the sizes are none too large. There is also another view to take of the expenditure. If the latter is more lavish than is necessary the people of the towns in which this property is located, and to which it is the chief source of maintenance of the people, certainly are not injured by the excessive amount of labor that is used in the construction of these enormous buildings and plants. To the wage-earners of this community the money expended in this equipping of the different shafts, mills and smelters is positively beneficial, so that as a Michigan industry this mine is one of the grandest within its limits. Nor has the shareholder any real cause for complaint. He is returned a fair interest on his investment, and he has the satisfaction of knowing that his principal is safe.

The Calumet and Hecla mine is worked on a belt of conglomerate, and it is a remarkable fact that of the many miles this belt is followed on its strike this company possesses the only profitable portion of it yet revealed. The Tamarack and Tamarack Junior mines are working on the extension of the dip of the lode, and upon its trend the profitable portion is cut off by the boundaries of the company's possessions. The copper-producing extent of the vein occupies a territory on the trend of latter of about 9,000 feet. To the north of the Calumet and Hecla the Centennial met with failure in its effort to earn a profit on the conglomerate, and upon the south the Osceola was similarly discouraged. There may be some point on the belt where mining may be rewarded by a profit, but this has not yet been located. It is one of the peculiar happenings sometimes met with in the mining fields. Of course all things have an ending, but that the workable portion of the conglomerate should lie within the limits of the lines of this company is indeed remarkable.



PORTION OF CALUMET VILLAGE, SHOWING LINE OF C. & H. SHAFTS.

The vein runs 33½ degrees east of north, and the inclination to the northwest is at an angle of 39 degrees. The average thickness of the vein is about 16 feet. The latter is made up of water-worn pebbles of all sizes between which are angular rock fragments, the whole being cemented together by silica and calc. The copper occupies the places between these pebbles, and has replaced material that has decomposed. In point of richness this mine possesses some of the finest ground to be found anywhere, it yielding copper at the rate of from 3 to 15 per cent. An average of something like 4½ per cent is obtained, which is remarkably good. When the Atlantic can earn dividends on copper rock yielding but three-fourths of one per cent, it can readily be seen that the Calumet and Hecla has a vein of great richness.

The amygdaloids are more cheaply worked, however, in that they have little or no timbering to do, whereas the Calumet and Hecla buries a forest of it in its underground levels each year, but the extra 3 per cent, or more, can readily overcome this extra cost of taking care of the hanging wall.

Upon this length of vein of 9,000 feet, the Calumet and Hecla has twelve shafts, all sunk in the vein, and one a vertical, that cuts the vein on its dip at a depth of about 3,300 feet.

Of the inclined shafts No. 5 of the Calumet branch, is the most northerly on the line. There are three branches, locally known as the Calumet, Hecla and South Hecla, with different mining captains, machinists, and other mine employés in charge of each, the whole being too large to be handled without such a division of the labor, etc. No. 5 is a two-compartment shaft and is down to the 52d level. It, like all the shafts working on this line, has independent shaft and rock house, and has also a man car for the lowering and hoisting of men.

No. 4, Calumet, is next in order. It is also provided with a man car, and is the deepest shaft in the lode, being to the 55th level.

No. 2 Calumet is next, is a two-compartment—two skip roads—and has reached the 46th level. It is also provided with a man car.

No. 2 Hecla is a single-compartment, is to the 42d level, and has a man car.

No. 3, Hecla branch, is to the 39th level, and is a single-compartment.

No. 4 Hecla is a shallow shaft, being to the 9th level, and is a single-compartment.

No. 6 Hecla comes next. It is a single-skip shaft, is down to the 41st level, and is equipped with man car.

No. 7, Hecla branch, is a single-skip shaft and is to the 40th level.

No. 8 is the first shaft on the north end of the South Hecla branch. It is provided with man car and is to the 34th level.

Nos. 9 and 10 are two-compartment, two shafts in one, and are to the 36th level.

No. 11, South Hecla, is to the 24th level, and is a single-skip shaft.

No. 12, South Hecla, the last one on the line going south, is a single-compartment, and is to the 35th level.

All of these shafts are susbtantial, and are well kept up. It will be observed that there are six man car stations where the men are raised and lowered. It is an interesting feature that the engines and ropes used for this purpose are employed for nothing else. They are wholly used for handling the men, which is something done at no other mine in the country that we know of. The best ropes procurable are employed. The engines are sufficiently powerful to handle the man cars easily, but not so large that an unusual obstruction in the shaft would not check them. In case of such trouble the engineer would readily know that something had gone wrong, whereas if the men were being hoisted by one of the powerful engines the car would be pulled through anything that might get in the way and the engineer would be none the wiser, or would not discover the danger until too late. The management argues, too, that in the case of a rope that is used for the hoisting of rock and men, there might be a strain on the cable when hoisting rock that would nearly approach the breaking point, and the engineer would know nothing about it. A skip might get off the track and be pulled against the timbers of the shaft, and while the rope might be strained, it would not show it unless critically examined, and at the same time be dangerous. The precaution taken by this company is certainly commendable. The man cars used are similar to those of the Quincy mine which I have described in my report of that property.

On each side of the shafts a block of ground 75 feet long is left for shaft support. They open the levels by driving a drift as far as they intend to tram the rock to a particular shaft, and then they beat out the ground from the farthest end of this territory back towards the shaft, the object being to have solid ground between the miners and the shaft. In the “cutting out” stope they go as high on the vein as the latter will stand without timbering. In places they can take ground that will give place for three sets of timber, and again they cannot cut out any more than enough to let one set be introduced. They raise in the center of a block of ground after the cutting out stopes have been run and beat the ground out towards both ends of the block. The timber used for two-thirds of the distance from the floor of each level to the one above is pine, 12x12 inches, framed in the company’s mill on surface. A battery of three of these are used as drift stulls, and are placed 5½ feet apart. To these the succeeding sets are framed, the interlocking being substantial, the sets being 5½ feet. The framed timber is easily handled and goes together rapidly. Two-thirds of the way up to the next level, the square framed sets are discontinued, and heavy round stull timbers are used. To prevent the framed timber from being knocked loose by the large masses of rock that are slid down the foot, they are protected by a row of round timber placed upright in front of and at the point on the vein where the square timbering is discontinued, openings being left at established distances through which the rock is milled to the floor of the level. Small engines driven by air are used to pull the round timbers to the upper portion of the level. Similar engines are also used to do the tramming where the distances from stopes to shaft are too great to be economically performed by hand. The tram cars used hold 2½ tons of rock. They are open at both ends, the coarser rock being built up at the ends, the finer thrown in the middle of the car. At each level a heavy piece of timber is drawn across the shaft for the skip to rest upon when it is being loaded. Tram track rails are 4 feet apart.

The greatest care is taken to prevent fires in the mine. Much damage was done several years ago by fires getting started in the levels, and the greatest caution to prevent a repetition of this is taken. It is due to the greatest caution to prevent a repetition of this is taken. It is due to the fires that no one is now admitted to the mine unless provided with a special permit to do so from the president of the company. The timbering of the main gangway is treated to a coating of chloride of zinc, after which it is whitewashed, this to prevent fire from the miners’ lamps in case the flame of the latter should come in contact with the timber.

There is excellent ventilation in all parts of the mine. The shafts at the southern end are downcasts, those at the opposite end of the line upcasts, and so rapid is the air current that doors have to be introduced in order that the men may not be troubled by too great a draught of air.

The conglomerate is all machine-drilled, and much of the ground is hard to cut on account of the great amount of copper it contains, the metal being extremely tough.

Here the miners sigh for poorer rock, where there is little copper and where they can drill faster, they being paid so much per foot for sinking and drifting and so much per cubic fathom for stoping. At many places throughout the conglomerate one sees sandstone, some of it bearing ripple marks, and generally in close proximity to it the ground is exceptionally rich in copper.

In vicinity of No. 6 shaft, at the 41st level, I saw sandstone showing in the drift, and here, also, is some of the finest copper ground the mine possesses. It certainly is a sight calculated to favorably impress a shareholder.

The conglomerate is not all rich in copper, there being many stretches of the vein that show but little, and is not worth taking. There is great variance in the percentage held from one level to another. They have opened up many levels from which mining is being done, the work of development being well ahead, but they are taking the upper levels as fast as and are letting the hanging come down, for come down it will, no matter what pains or means is taken to support it; and then there is no use in keeping it up after the copper-bearing rock has been extracted. The heaviest timbers are crushed, as the hanging is loose and treacherous, and shows great weight soon after a level has been finished. The men are constantly being cautioned to look after the backs of their stopes, and it requires persistent warning to secure the attention they should give it. Working on contract, they seem to think that time spent in barring down loose ground is so much lost, and then the habit of letting the barring work go just a little longer grows upon them. In my visits underground the captain several times called men from other work to take care of the ground above them, and severely criticised the miners for this neglect to look after their own safety.

The underground development of the Calumet and Hecla is immense. It shows sufficient territory for many years to come, even if nothing more were added in the way of new levels, and the bottom levels of the mine show as rich in copper ground as any point above. Indeed, it can truly be said that the bottom looks better, taking the entire length of the lode wrought, than ever before in the mine's history.

The single vertical shaft on this property is located several thousand feet in front of No. 4 shaft, Calumet branch, and is locally known as the “Whiting,” or “Red Jacket Shaft." It has reached a depth of 4,900 feet, the deepest of any shaft in the world. Its inside measurement is 15½x25 feet, containing six compartments. One of the principal objects in the sinking of this shaft was to give another outlet in case of fire. The work of sinking this wonderful shaft was begun in 1889, but there were many months in which nothing was done since that time. It is of interest to know that the shaft where it penetrated the Calumet conglomerate found very rich copper ground. They will put in a drift from the bottom of this shaft to their western boundary to test the richness of the vein in that direction.

Some work has been done in the way of exploring the Osceola amygdaloid which lies between 700 and 800 feet east of the Calumet conglomerate. Cross-cuts were put in from the 21st level of Calumet No. 4 shaft, the 31st level of No. 2 Calumet, the 9th level of No. 4 Hecla, and the 14th level of No. 11, South Hecla. At No. 9 shaft the Osceola lode was reached at a distance of about 730 feet from the Calumet conglomerate. They were drifting on the lode at the time of my visit in February, 1896, having just started north and south. This cross-cut was put in nearly 1,800 feet still further east of the Osceola amygdaloid, and many belts of conglomerate and amygaloid were cut. The most promising point yet shown on this Osceola amygdaloid is in the cross-cut from No. 11 shaft, where the amygdaloid is 773 feet east of the Calumet vein.

At each of the shafts of the Calumet vein there is a combined shaft house and rock house, of frame, sheathed with corrugated iron. On the upper floor the rock is dumped on grizzlies, the coarser pieces put through a 24x36-inch rock breaker, and sent to the next floor where is located a breaker 17x24 inch. A Westinghouse driving engine of sixty horse power operates the breakers. Each house contains a rock bin with a capacity for 1,500 tons. Cars are run directly under the bin, there being two tracks and cars can be loaded from each side of the bin. At No. 8 and the shafts south of it, are steam hammers for breaking large masses of rock.

In the way of hoisting, pumping and compressing machinery there is the finest here to be seen in the world. I will simply mention the most prominent.

At the Red Jacket shaft is a triple-expansion engine 20⅛ and 31¾ and 50-inch by 72-inch stroke.

At the Superior station, doing the hoisting for Nos. 5, 4 and 2 shafts, the engines are 40 and 70 inch by 72 inch.

At the Calumet Pond, pumping water for condensing purposes is a Worthington engine 14 and 24x36 inch, with 20-inch plungers.

At the shafts of the Hecla branch is the compound engine Fontenac, 27¾ and 48x72 inch.

Providing power for Nos. 6, 3 and 2, Hecla branch, are three engines, duplicates, named the Gratiot, Houghton and Seneca, cylinders, 18, 27¾ and 48x90 inch.

At shafts No. 7 and 8, South Hecla, are the engines of Hancock and Pewabic, 20⅛, 31¾ and 50x48 inch.

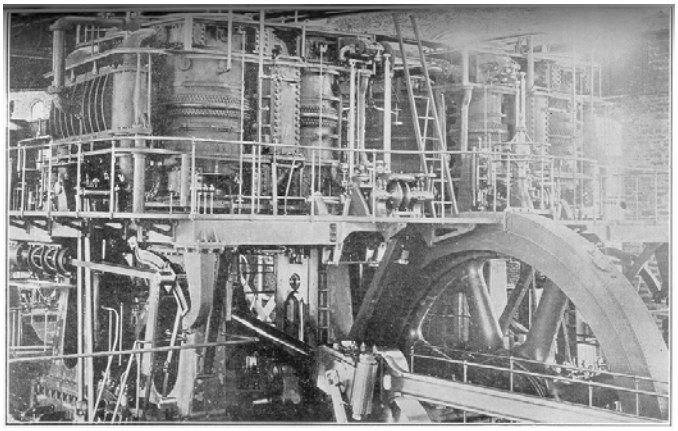
At shafts No. 9 and 11, South Hecla, are a pair of Corliss engines 18 and 32x48 inch.

All this machinery, together with boilers, is housed in substantial buildings of brownstone and other excellent building stone. The horse power of the mine now used amounts to about 14,000. Some of the boilers are of 700 horse power, and carry a pressure of from 165 to 185 lbs. to the square inch. Coal is used for fuel.

A new shaft house is being constructed at the Whiting shaft. The engine house at this station is 220x70 feet, and a load of 10 tons can be hoisted through the shaft at a speed of 60 feet per second. The tail house for the fleet gear is 412x32 feet. The boiler house will contain 10 boilers of 1,000 horse power each. The stack is of brick, 12½ feet inside diameter and 250 feet high.

There is an electric light plant that illuminates all the surface of the company's mine, including mine shops, engine and boiler houses, etc.

The machine shop gives employment to about 70 men, and is one of the best equipped in the region. In charge of the machinery is James Ramsey.



THE BIG HOISTING PLANT AT RED JACKET SHAFT, C. & H.

The water used at the mine and in the company's houses is obtained from Lake Superior, six miles distant, where there is a fine puping plant. There is a lofty elevation to raise the water over, a pressure of 300 lbs. per square inch on the pumps indicating this. A new water tower is now in course of construction on elevated ground north of the mine. This will have a capacity for 520,000 gallons.

The company owns a large number of houses which are rented to the employes at less than 3 per cent on their cost. The cost of rental to the men amounts to about 5 per cent of their wages, whereas those who rent houses outside of the company's location pay for them about 14 per cent of the wages earned. The company has an aid fund from which the men annually draw over $47,000. They have their own hospital where the best medical attendance is given the sick and injured.

Thos. Hoatson is the chief mining captain, and has been associated with the company 25 years. His assistant is Jas. W. Milligan, who has been here 23 years. Under them Thos. Hoatson, Jr., has charge of underground work at the Calumet branch, Thos. Wells, of the Hecla, and Wm. Stephens, of the South Hecla.

Connecting the mine with their stamp mills located on Torch Lake is a narrow gauge railroad nearly six miles long which, together with its equipment, practically belongs to the Calumet and Hecla Company. There are nine locomotives and over 400 cars. At Lake Linden, where the company's stamp mills are located, they possess a magnificent equipment. Two large buildings covering about three acres of ground, hold eleven Leavitt heads each, these having a capacity, per head, of about 250 tons in 24 hours. At the time of my visit 16 of these heads were in operation. Each head is supplied with independent engine, and to each head are also 28 Collum jigs. Three-deck slime tables are used. Here is said to be the largest cut gear wheel in the world, it being in connection with a sand wheel. It is 50 feet in diameter, and the sand wheel has a capacity of 30,000,000 gallons of water and 3,000 tons of sand in 24 hours. There is a second sand wheel 40 feet in diameter with a capacity of 18,000,000 gallons of water and 1,600 tons of sand. This sand is conducted by flumes into the lake where the water has a depth of 150 feet and where it can be deposited for a great many years without interfering with navigation on that body of water. Supplying the stamp mills with water is a triple-expansion engine with a capacity of 60,000,000 gallons every 24 hours. Several auxiliary engines can be placed in commission in case of accident to the big one. A compound engine, 22¾x38x60 inch stroke operates the washing machinery and sand wheels by means of wire rope transmission.

To prevent fires in the mills every possible precaution is taken. Under the roof of the mill a system of iron pipes is run that have perforations at every ten square feet, these being plugged with soft lead, so that the water is liberated when a certain temperature is reached, that particular portion of the mill being thoroughly drenched. Corrugated iron roofing and siding is being placed on the buildings as fast as the wooden roof and sides need repair. The rock at the mills comes in on the trains at the top floor is dumped into bins and runs to the various points at which it is needed. Formerly the road did not reach the mill, the rock being let into the latter by gravity from the top of a hill several hundred feet away. The past summer they built an addition of 160x70 feet to the boiler house. Taking the smoke from the boilers two brick stacks, steel lined, were erected in 1895. One is 14-foot diameter by 250 feet high, the other 12 feet by185 feet. Coal is used for fuel. In years past wood was exclusively burned, the cutting and hauling of which gave employment to a large number of men.

A new stone building in which an electric plant has recently been installed has been completed. There are three arc dynamos, Brush, each having a capacity of thirty 2,000-candle-power lights, and two Thompson-Houston dynamos, incandescent, of similar power. These are driven by a Lake Erie Engine Works triple-expansion engine 7¼, 12 and 19-inch. In this same building is an artesian well 15 inches in diameter by 1,500 feet deep, which has recently been finished, making two at the mills. This provides water for the boilers. An air pipe is sent down the well to a distance of 200 feet, a little artificial assistance being necessary to send the water to surface. A tank located on the hill just back of the mill holds one million gallons of water, and gives a pressure at the mill of 150 lbs. per square inch.

From these two wells about 500,000 gallons of water are drawn daily. F. G. Coggin is superintendent of the mill, and thoroughly understands his business.

The copper smelting works of the Calumet and Hecla Company are located at South Lake Linden, and occupy about 30 acres of ground. A short line of railway connects with the stamp mills. There are four stone furnace buildings, with four furnaces, one blister furnace, one cupola building, with cooper shop, carpenter shop, blacksmith shop, buildings for the storing of mineral, charcoal, supplies, etc., the whole making a complete equipment. An artesian well supplies the water for the boiler and household use. James B. Cooper is superintendent, and gives excellent attention to the work in his charge.

The company has smelters at Buffalo, N. Y., where they have recently erected an electrolytic plant that is now in successful operation.

The production of the Calumet and Hecla has been steadily increasing for many years past. The following figures show the output for the fiscal years ending on the 30th of April:

Pounds refined copper produced in 1892	56,495,211
" " " " " 1893	60,427,913
" " " " " 1894	73,944,889
" " " " " 1895	79,485,509

The total product for all years up to April 30, '95, is 1,006,838,795 lbs.

The cost of making a pound of copper by this company is not given in any of their statements, but it can be made lower than that of any other mine on the lakes, if this is not already being done. The rock is exceptionally high-grade, and they are now completely equipped for treating it as well as for getting it to surface. The immense construction cost should show great diminution from this time on. The last annual statement read at the annual meeting on the 21st of August, 1895, showed a balance of cash, copper, mineral and good paper of $4,362,719.17. The company possesses over 3,000 acres of mineral lands well located, and over 20,000 acres of excellent timber lands.

There are employed in mine and mills, 3,456 men.

Alexander Agassiz is president; Geo. A. Flagg, treasurer, Boston; S. B. Whiting is a general manager; John Duncan, assistant superintendent; Preston C. F. West, mining engineer; J. H. Lathorp, chief clerk.

To the west and north of the Calumet and Hecla's property, at Calumet, is

THE TAMARACK MINE,

second only to the Calumet and Hecla in the extent of its operations, and taking a second place to none other as regards the enterprise and skill displayed in the conducting of mining and milling affairs. The company owns 29 forties in sections 10, 11, 12 and 15, these all being favored with the Calumet conglomerate vein. It is upon the latter that operations have thus far been principally confined by the company, they working upon an extension of the dip of the lode from a point where it leaves the western boundary of the Calumet and Hecla's property

The sinking of the initial shafts to strike this Calumet conglomerate, the opposition given the project by mining men generally, and the ultimate success of the undertaking has been described so often that it will need no repetition here. It required no small amount of courage to spend such an amount of money in the task. There was the possibility of the lode being barren of copper when encountered, and most men would have dreaded the responsibility. But the lode was found rich in copper, the plans of the projectors won, and Tamarack has taken its place as one of the important mining enterprises of the State.

No. 1 shaft is located at the southeast corner of the company's property, and close to the south and west line of the Calumet and Hecla's lands, the latter surrounding this forty on three sides, as will be clearly shown by the map presented of the prominent mining lands of this range. Like all the shafts of the company, No. 1 is vertical. It is to the 18th level, 3,234 feet from the surface. This shaft is not sinking, nor will it be made deeper for the reason that it would encroach upon the territory of its neighbor. There is considerable copper yet seen in this end of the mine, but they can take it from No. 2 shaft. In February, 1896, the night shift was discontinued at this end of the mine, No. 1, as the stamping facilities could not take care of all the rock that could be sent out. No. 3 shaft was considerably increasing its output, and the management desires to prove the ground here as speedily as possible, being perfectly familiar with the conditions surrounding No. 1.

No. 2 shaft is about 600 feet north of No. 1, and is to the 22d level, having been sunk from the 19th in 1895. The crosscut connecting with the lode is now just about completed, February 18, 1896. The lode having an inclination to the northwest of about 38 degrees, and the shaft being vertical, each added level finds the crosscuts connecting shaft and lode growing longer, so that at the 22d the distance is about 1,300 feet. Nos. 1 and 2 are 3-compartment shafts, two cage-ways and a timber-way.

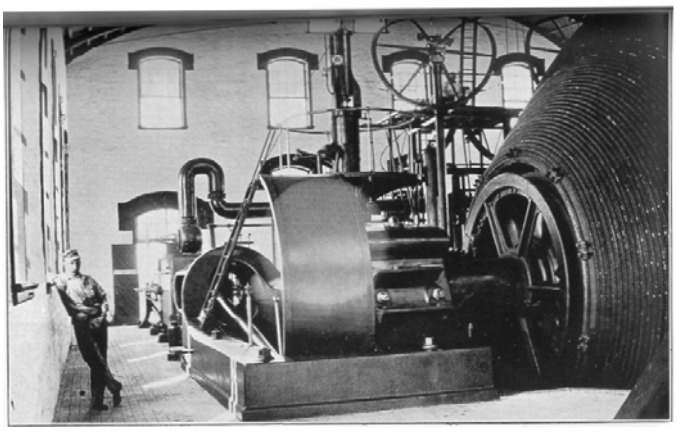
No. 3 is north of No. 2 something like 4,200 feet, being located on section 11, and struck the lode on August 5, 1894, at a depth from surface of 4,185 feet, and within a few feet of the estimated distance as figured by the company's local management. A great deal of interest centered in the striking of the vein at this point, it being so far removed from the other shafts of the company. The vein when first cut did not show encouragingly in copper, and on account of this disappointment to local shareholders, the stock sank considerably as compared to its former value. They are now stoping at the 5th, 6th, 7th, 8th, 9th, 10th and 11th levels in this shaft, and are meeting with much richer ground as they proceed from the line of the shaft. The vein is very wide, something like 22 feet, nearly twice as thick as the conglomerate generally is; it is not mineralized throughout its entire

width, and some of the vein matter is being left. At the present time about 325 tons of good-quality milling rock is being hoisted daily from this shaft, however, which shows that it is improving rapidly. In regard to the prospects for the future at this point they are considered flattering.

No. 4 shaft, located about 700 feet north of No. 3, reached the vein January 9, 1895, at a depth of 4,393 feet. The lode at this point has been a great disappointment, as thus far it has shown nothing encouraging in the way of copper ground. A drift is being put in to the north from the bottom of the shaft, but as yet it has not encountered that would pay for the mining. They will push this drift ahead a considerable distance in the hope that it may run out of the barren territory and into something that will pay. The conglomerate is not rich everywhere. I found many places in the Calumet and Hecla and Tamarack where the ground was too lean in copper to warrant its being broken. There is a great fluctuation as to the percentage held in the same "runs" or "chutes" of coppery ground. At one point it may give 5 per cent, and in a few feet it may fall to 2 per cent, or to ½ per cent. It might happen that a mining company would meet with poor ground for several months at a stretch which would greatly lessen the amount of mineral per ton or fathom, and then a change for the better might occur where the showing would be remarkably favorable. It is due to this fluctuation that the operators on the conglomerate belt do not wish to give public statements concerning the yield of their rock. They say some of the nervous shareholders would get to despondent in case of a period of low percentage, and correspondingly too exuberant were the percentage a high one. The general average is excellent, and the several years' product placed together are satisfactory.

No. 4 may meet with better territory to the north. That is yet to be shown. Many contend that the shaft is too far north, and that the copper-holding conglomerate will not extend so far in that direction, but no man knows because none have proved it. Where the vein at might show no copper in the rock, at a depth of 4,000 feet it might. Like the gold in the rocks of the world, the copper in the conglomerate is where you find it. This is not a valuable rule in locating the mineral, however, but is a fact well understood by those in the copper-mining business. No. 4 shaft has not been equipped, and will not be until it furnishes metallic reasons for it.

The need of another shaft on the long stretch of lode between No. 2 and No. 3 being apparent, the shareholders were asked to vote the directors permission to sink one, which was granted, a million dollars' worth of script having been issued to carry on the work for which 10,000 shares of the company stock will be issued after the first of April, 1896, this being additional to the 50,000 shares at which the company is capitalized. Three installments of $25 each have already been paid in, the fourth and last falling due on the first of April, 1896. This will be sufficient to sink and equip the shaft.



SHOWING PORTION OF CONE HOIST AT NO. 3 TAMARACK.

No. 5 shaft, the new one, has been located 3,300 feet south of No. 4. The work of clearing the ground, preparatory to beginning the sinking, was commenced on the 11th of August, 1895. There was a wet cedar swamp to be drained, necessitating a large amount of trenching and brush-cutting. Buildings had to be erected, and a great deal done in the way of getting ready, for the sinking of a shaft to the depth of 5,000 feet, to which this one will go, must be well started, and it needs much to carry on the task. They have erected a substantial shaft house, an engine and compressor house, have installed hoisting and compressing machinery, and at this date, February 17th, 1896, the shaft has reached a depth of 230 feet. Its dimensions are 27 ft, 5 in. x 7 ft 2 in, and will contain five compartments, four cage-ways and a ladder, and pipe way. This shaft, it is expected, will strike the lode at a depth of about 4,600 feet. The present sinking plant is from the Osceola mine, and compressor being from the old Cliff. The drums can be built out to ten feet in diameter, and will be able to take care of the rock until a depth something like 3,000 feet has been attained. The mouth of the shaft is protected by a neat arrangement, the invention of Capt. W. E. Parnal, who is one of the most progressive mining men of this district. He has spent 36 years in the business and has given much careful study to the practical and technical branches of it. The buckets, as they come up, open the cover of the shaft, and, descending, they close it, thus effectually preventing anyone walking into the opening. In the sinking of the deep shafts Nos. 3 and 4, not a man was injured, which is a remarkable record considering that about 9,000 feet of sinking was done. It is the desire to sink this shaft at the rate of 100 feet per month. They are now cutting a place to take up the surface water, and with this done, the miners will have dry ground to work in. Ten-hour shifts are worked in this shaft, and ten hours constitute a day's labor throughout all the mines of the copper district.

No. 5 shaft should strike rich territory if anything can be judged by what the Calumet and Hecla is developing in

their No. 4 shaft, Calumet branch, which is working on the lode directly in front of No. 5 Tamarack. The machinery to be permanently installed at No. 5 will be a credit to the company and district. It is no being planned by Capt. Parnal.

At No. 3 shaft there are horizontal duplex engines, 34x48 inches, connected to a conical drum 12 feet at smallest diameter, 36 feet at largest, having a possible wind of 7,000 feet of rope. At places in the shaft the cages contain a maximum speed of 4,000 feet per minute. The cages at the different shafts are worked in balance. There is a fine new shaft and rock house at No. 3 that is conveniently arranged. There are breakers 18x24 inches, and the second size are 15x20 inches. There are also steam hammers for reducing extra large pieces so as to prepare them for the crushers. By their use something is saved in blockholing the large pieces in the mine. Electric lights have been put in, and water mains extended to this portion of the mine.

No. 2 shaft has direct-acting, double engines, 42x48-inch cylinders. Drum has 16-foot face and is 36 feet 6 inches in diameter. Each shaft has two hoisting engines, one for rock and men, and an auxiliary for handling timber, tools and men.

During the past few months small engines operated by air have been located on the 19th level to tram the cars to and from the shaft. These are placed in the cross-cuts, and work on the endless rope system. Similar power trams will also be placed on the 20th and 21st levels. Five cars are handled at a time and a saving of fully 25 per cent is announced as compared to the hand-tramming. Cars hold 2½ tons of rock each. In the hand tramming three men are detailed to each car.

The mine is well ventilated, and no trouble is experienced on account of impure air. Nos. 3 and 4 shafts are connected by a drift at the 11th level, and the southern end of the mine is well ventilated by many openings.

The method employed in winning the rock is as follows: A 6x6 foot drift is first put in on the foot-wall. Following the drifters come a gang of miners who take a cut from the drift to the hanging wall, this being locally known as "the cutting out stope. A slice up the vein is called the "swing stope." Then come the second and third back stopes. Like the Calumet, the conglomerate here is very shaly, and timbermen closely follow the swing stope gang. Special gangs look after the timbering in this mine. Heavy stull pieces are first put up and wedged tightly at top and bottom, the ends of stulls being saved so as to conform to the inclination of the lode. From the stull to the hanging, where it rests in a notch cut for its reception, is a 10-inch backing piece, and this carries the lagging. A short leg is fastened by wrought iron cramps on the stope side of the stull, upon which rests the wall plate for carrying lagging. The stopes are timbered with double "batteries," two heavy timbers resting side by side in hitches cut in the rock. Supporting the wall plate is a heavy timber resting against the footwall and leaning against the battery timber. Three sets of batteries are 4 feet apart, the fourth being 7 feet, the latter space serving as a place to send the rock down that is mined in the stopes. Timbermen use small winches operated by air to handle the heavy timbers in the stopes. Some of the stulls are from 15 to 24 feet long and have a diameter of from 3 to 4 feet.

The copper-bearing rock of the vein is all mined out as they go for the reason that the life of the timber is little more than a year, and it will not do to leave ground untouched too long after it has been opened. During 1894-5 considerable ground was taken that had been left behind in former years. They clean out the levels as they go downward, letting the hanging come in as it will. The timbermen do much of the barring of loose rock in the hanging, and act a very important part in the underground work.

The territory adjacent to No. 2 shaft is remarkably rich in copper, and I have Captain Parnal's word for it that the bottom level of the mine looks better than any territory ever did above this point. The cost of making copper is not given by the reports of the company, nor by their officers for publicity, but when it is said that $1.90 pays all the expense of mining, milling a ton of rock, barreling, and transporting the mineral to the smelters, it will be seen that there is no waste. Everything is well done, and economically.

The Tamarack company did considerable work on the Osceola amygdaloid from the fourteenth level at the south end of their mine, having cut this belt with their vertical shafts, and they are now preparing to attack it from the 18th level between Nos. 1 and 2 shafts. They are driving upon it from the crosscuts on this level both north and south. They expect to secure considerable copper from the lode at this point, it looking fairly well.

The company has a fine stamp milling plant, smelting works, rolling and wire mill at Dollar Bay. It also has an elaborate saw mill, and possesses valuable timber lands. It gives employment in mine and mills to 1,426 men.

The product of refined copper for 1895 was 14,900,316 pounds, and the total product to date is 120,996,922 pounds.

The company paid dividends in 1895 amounting to $8 per share on its capital stock, of $400,000, making a grand total since the beginning of $4,470,000.

W. E. Parnal is agent; John T. Rider, clerk; R. M. Edwards, mining engineer; Thos. Maslin, chief mining captain; Jas. H. Gribble, captain at Nos. 3 and 4 shafts.

The principal officers of the company are: A. S. Bigelow, president; Thos. Nelson, secretary, Boston, Mass.

TEMPERATURE OF DEEP MINES.

As considerable has been said concerning the depth to which these conglomerates can be mined, a few words referring to the present atmospheric conditions will not

be out of place here: At a vertical depth of 4,580 feet in the deep shaft of the Calumet and Hecla the air temperature was 72 degrees Fahrenheit, and the increase from surface downward is 1 degree for every 223.7 feet. If this ratio is not increased it will be seen list a great distance can be attained so far as the temperature is concerned. The water at the lowest point reached is salty in places and also contains acids that blister the flesh but there is very little moisture so that the miners are but slightly inconvenienced on this account.

Running parallel with the Calumet conglomerate and from 700 to 800 feet east of it, is the Osceola amygdaloid belt, to which reference has been made in the descriptions of the Calumet and Hecla, and Tamarack mines. It is on this lode, and immediately south and west of the Calumet and Hecla where is found

THE OSCEOLA MINE.

The Osceola Consolidated Mining Company owns about 760 acres of mineral lands in sections 26 and 27, the lode running through the eastern portion of these lands and giving four forties wide on the dip of the vein. Work was begun here in 1874, and was first done upon the Calumet conglomerate, which also crosses the property, but the latter grew so poor as they worked south on the vein, that they finally abandoned it, and gave all the attention to the amygdaloid. From this they have made regular and satisfactory earnings, having paid to the shareholders the sum of $2,022,500. There are 50,000 shares, and on this $3.50 per share was paid in 1895. The total number of pounds of refined copper produced is 89,466,004, of which 6,270,373 were secured in 1895.

There are three principal shafts, Nos. 3, 4 and 5 and a new one No. 6 has been started.

No. 3, the most northern, is down to the 30th level and no hoisting has been done through it since September 7, 18955 due to the fire that destroyed the timbering from the 27th level to surface and which resulted in the death of 30 people. The fire caught in lagging at this portion of the mine. The day shift men were all underground at the time and were all ordered to surface. Those who obeyed the command to get out of the mine saved their lives but it was generally thought that there was not enough timber in the shaft to make a fire that would cause the miners any inconvenience, and so certain were many of them that there was no danger that they sat down and ate their lunches after being warned to escape. Thirty were overcome by the smoke and gases, and the fatality is the worst that ever occurred in the mines of this State. The shaft has been undergoing retimbering since then, and at this time. February 17, 1896, there are six levels yet to be retimbered before hoisting can be resumed.

No. 4 shaft is to the 32d level, two levels having been added in 1895.

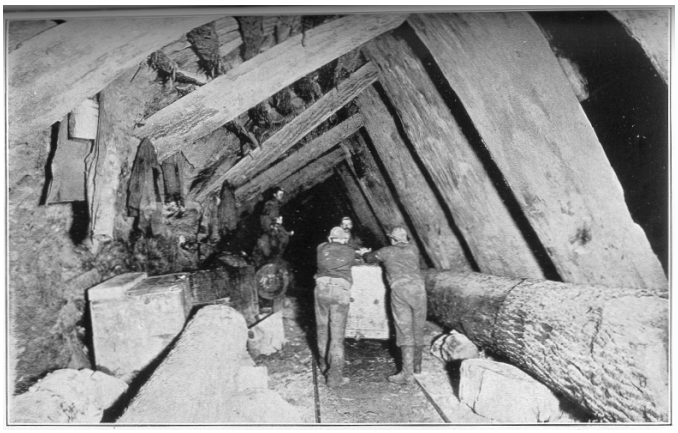
No. 5 is to the 32d level, a distance vertically of 2,000 feet. One level was added in 1895. This is a double-skip shaft, and it has been in the territory adjacent to this opening that the principal mining has been done during the year, about 750 feet on each side of the shaft being given attention. The rock has come from the 20th to the lowest level, and a little was secured from the 7th, 14th and 17th levels.

No. 6 was commenced in the spring of 1895, and has reached a depth on February 26, 1896, of 830 feet. It is the most southerly shaft on the line, and is expected to develop rich territory. It has two skip-ways, being 8x18 feet inside of timbers. All the shafts are in the lode, following the incline of the latter.

The Osceola, like all the amygdaloids of this section, is very irregular as to the occurrence of copper in the vein. There are many unproductive stretches and many that are very rich. Much has to be left in the mine, and the amount of work done to secure the product is great. They open a large territory annually, and at no other place is there better management of underground affairs. At the south end of the present workings there is a fine showing of rich copper ground, and the new shaft shows satisfactory lode, so that much is hoped for from this portion of the mine.

The total cost per ton of the rock hoisted is $1.63 and of the rock stamped $1.79. The cost of stamping a ton of rock is 29.40 cents. The ingot per ton of rock hoisted is 23.81 pounds. The mills of the company are located on Torch lake. There are six heads of stamps, and a perfect arrangement. The equipment of machinery at the mine is excellent, and no additions have been made for some time past. The number of men employed is 545.

The officers are the same as at the Tamarack, this mine, with the Tamarack Junior and Kearsarge belonging to the same group, the “Bigelow” group, locally styled. W. E. Parnal is agent of all. M. P. Richards is mining captain; Wm. Veale, clerk.



A MAIN DRIFT IN THE TAMARACK MINE.

THE TAMARACK JUNIOR MINE

owns three forties running north and south in section 11. The Centennial is upon the east, and the Calumet and Hecla surrounds it upon the other three sides. There are two shafts, No. 1 located on the most southerly forty and No. 2 on the forty next north.

No. 1 shaft is down to the 6th level, 2,788 feet. There is nothing being hoisted from this shaft at the present time, the rock mined from this territory being sent to No. 2. The richest ground is found under No. 1, and the 9th level is showing well. Stoping is also being done at the 2d and 6th levels. A new shaft house has been erected at No. 2, and connection with No. 1 has been made by a trestle 1,000 feet long.

There is considerable ground to be taken before the Calumet and Hecla boundary is reached, and the southwestern end of the mine presents a very gratifying appearance. They are well equipped for the handling the rock.

The Tamarack Junior has been little more than an exploration thus far, and its friends are expecting something substantial from it in 1896. It is one of the so-called Bigelow group with same officers as Tamarack and Osceola.

There were 2,547,861 pounds of refined copper produced here in 1895. In 1894 there were produced 2,372,302 lbs.

Jas. Chynoweth is mining captain, and Wm. M. Harris clerk. The number of men employed is 175.

Next in the line of active properties going north from the Calumet and Hecla is

THE WOLVERINE MINE.

Work was first commenced here in 1884, and after an attempt at finding a mine, in which the searchers were badly handicapped by lack of sufficient funds, the property was abandoned. In 1889 there was a reorganization of the company under the title of "The Wolverine Copper Mining Company," 60,000 shares were issued, and since then the work of developing the property has been vigorously prosecuted, and with gratifying results. Originally there were but two forty-acre tracts in the lands of the company, and the lode cut across the wrong corner of one of these. The purchase of three additional forty-acre tracts immediately adjoining the former possessions on the south and west, was consummated last year, and is a valuable addition. It was secured from the Selden estate, the purchase price being $60,000. The lode extends across all of these and gives a very important territory to the company. The vein is locally known as the "Kearsarge amygdaloid," and is 2,750 feet east of the Calumet conglomerate. The lode is of a dull, brownish color, and much of the rock carrying the richest copper is a porous epidote of light green color.

There are four shafts. No. 1 is the most northern and is to the 2d level. It is not being used, the ground being poor in that end of the mine.

No. 2,400 feet south of No. 1, is to the 13th level. No. 3, 700 feet south of No. 2, is to the 11th.

No. 4 shaft is one recently commenced, is a two-compartment, and is 1,400 feet south of No. 3. This is to develop the lands lately purchased, or to take care of a portion of the new territory. This shaft has reached a depth of 85 feet on the 15th of February, 1896. It has cut promising copper ground since the lode was entered, and gives excellent reasons for believing that it will find rich territory in this portion of the property. Like other amygdaloids this is bunchy in its holding of copper, but the general average is good. The mine has been steadily increasing its product of late, the returns for January, 1896, being 101 tons, the largest in the history of the mine for a similar period. They are short of stamping facilities possessing but one head, but with this they are treating about 300 tons daily, which is excellent work. They are now figuring on using the old Allouez mill for taking care of the rock that cannot be handled with the present head. There is a shortage of water here, too, as well as of stamps, the supply having to be used over several times in dry periods. The results obtained in the Wolverine mill reflect great credit upon the skill of those in charge. The mineral obtained is of very high quality, the best on the lakes giving, according to the smelting returns printed in another portion of this volume, 86.583 per cent, which is remarkably high.

They are stoping north of No. 2 on the 12th level near the boundary line, north of No. 3 on the 8th and 10th levels, and south of No. 3 on the 3d, 5th, 6th, 7th, 8th, 9th and 10th levels.

In my next annual report I hope to have considerable of interesting kind concerning this property, as sufficient will have been developed in the new shaft by then to give a fair idea of what ground there is worth, and the chances favor success.

The number of men employed is 165 and the product of refined copper for 1895 was 1,815,381 lbs. The yield for 1894 was 1,656,255 lbs. The cost of securing a pound of copper here is a trifle over 8 cents. The yield of copper per ton of rock treated is 21.08 lbs, or 1.05 per cent.

Mr. John Stanton, of New York, is president. Mr. Fred Smith, who has spent 20 years at the Allouez, and is one of the most competent in the business, is agent. John Nicholas is mining captain; C. L. Noetzel, clerk.

Immediately north of the Wolverine is

THE KEARSARGE MINE,

working on the same amygdaloid belt as the Wolverine. There is a block of 14 forties in the lands of the company, these running two in width east and west, being in sections 1, 6 and 5. The total product of refined

copper to the first of January, 1895, is 7,029,661 lbs., of which 1,946,162 lbs. were obtained in 1895. There has been paid in dividends the sum of $120,000, the last, of $1 per share, $50,000, being issued in December, 1895.

The Kearsarge is a very erratic lode in its coppery contents. One day it may be looking finely, and in a week all the drifts may change to utterly barren ground. All there is to do is to keep going. The occurrence of copper is so well understood that the management is not all discouraged to hear that the openings are showing but little in copper, knowing that a day or two may entirely change the condition. As Capt. Parnal describes it, the Kearsarge "is like a rope tied full of knots, the knots representing the portions containing the copper."

There is one shaft known as No. 2, a single-skip, that is down to the 17th level. They are stoping on the north of the shaft on the 8th, 9th, 10th and 11th levels, and on the south on the 11th, 12th, 14th and 15th, near the Wolverine mine boundary. At the 12th level they have connected with the Wolverine No. 2 shaft workings, this affording another outlet in case of accident, and improving the ventilation of the mine. On the 9th level, north of No. 2, the drift is in 1,300 feet and shows good lode. Should it continue to show well in copper another shaft to the north may be put down.

On the 16th level, 800 feet south of the shaft, they are taking rock, and on the 16th level north, 800 feet from shaft they are stoping. On the 17th they have run a drift south 750 feet, but have done no stoping here as yet. In the lower workings the mine is looking better than it was a year ago.

There were 84 feet of winzes and 4,202.9 feet levels added in 1895.

The yield of refined copper per cubic fathom of rock broken is 409 lbs., and the cost per pound of refined copper for 1895 was 9.22 cents. The balance of assets, December 31, 1895, was $163,567.73.

Chas. Van Brant is president; A. S. Bigelow, secretary and treasurer, Boston; John Hosking is mining captain; Wm. M. Harris, clerk.

The force of men employed numbers 125.

The foregoing enumerates all the active mines in Houghton county, the Kearsarge being the farthest north, the Atlantic the most southerly.

The Centennial, immediately north of the Calumet and Hecla, is one that may resume as soon as financial difficulties, at present being straightened out, are completed. It has a debt of $115,000, and its case will be disposed of in May, 1896. The conglomerate where tested was found to be unproductive, and the Osceola amygdaloid is the point that will receive attention when resumption occurs. Some work has been done on the latter lode, and enough shown to lend encouragement to further operations. The shareholders have secured a stay of proceedings and hope to be able to save the property and resume operations in the near future.

MINES OF KEWEENAW COUNTY.

There is but one mine now working and that very feebly. In years agone this was one of the most important portions of the copper range. The Central, Cliff and Phoenix were renowned in their time, and were of the most interesting geologically. It was in this county that the copper occurred in true fissure veins, this being the only portion of the copper reigon where it was so found. As the mines increased in depth the percentage of copper grew less and in places gave out altogether, or become so scarce that it was not profitable to mine it. These mines were generally producers of copper in the form of mass, or barrel work, and also yielded considerable silver, particularly in the upper levels. The single property now working is

THE CENTRAL MINE,

which is under the management of Mr. John Stanton, of New York, as president. The product of refined copper in 1895 was 379,020 lbs. In 1894 it was 584,871 lbs., and in 1893, 1,180,040 lbs., which shows the decline has been rapid. The total production is 50,778,110 lbs. The mine has paid in dividends $1,970,000.

During the past year the most of the work done was in an exploratory way in order to find the old vein from which, in the earlier history of the property, magnificent results in rich copper were achieved. The Central is worked upon a true fissure, crossing the formation at nearly right angles. The deepest shaft, No. 2, is just below the 32d level, and has a depth of 2,765 feet. The mine is operated only in the vicinity of this shaft at present. The vein has a slight dip to the east, so that the shaft, being perpendicular, is sunk on the vein at surface and in the lowest level they crosscut about 360 feet to catch the vein.

The extent of opening on the vein, which crosses the formation, as before mentioned, and exposes all the belts, runs from what is known as the Allouez conglomerate on the north (this being the first belt under the Greenstone range), to a point 1,536 feet south of the Kearsarge conglomerate. Where the Central vein strikes the Kearsarge conglomerate, it is faulted, and appears to be carried 250 to 300 feet to the west, intersecting the shaft at the 30th level. The vein where it strikes the conglomerate is split up and they find on top of the conglomerate a belt of brecciated material 3 to 12 feet thick, and carrying more or less copper. It is from this belt that nearly all the copper produced the past year was obtained. The mineral averaged only 58½ per cent. A force of about 40 men were employed, and 12,000 tons of rock were hoisted, of which 2,000 tons were stamped. The rock came from the five lower levels.

As yet it is not exactly known what took place in this faulting of the Central vein, and although there is nothing now of value in sight, it is still possible that the old vein will still come in again below the conglomerate and be as rich as ever. For the present they are concentrating their small force at two or three points in the mine in the hope

of being able to locate the continuation of the desired lode. The mine is making no money, and they are not going in debt, and they have still a fair surplus to work on.

The management feels that a change for the better will soon come. They have great faith in the old vein, and predict success in its relocating.

The Central is the sole support of the county, it being the only mine now in operation. The location is a pleasant and home-like one, and there is not another in the upper peninsula that contains as large a percentage of old settlers and ones that are quiet, diligent and love their homes so well. There are men now working in the mine who were born on the location and have always lived there. The company appreciates this condition of things, and, contrary to the saying that corporations are soulless, they have the happiness of these people at heart, and are making every possible effort to keep the mine in operation. The people of the entire copper range, being familiar with the conditions existing at this place, take great interest in the property, and also hope for its further success.

F. McM. Stanton, Atlantic mine, is superintendent; John Trevarrow is mining captain; John F. Robert is clerk.

MINES OF ONTONAGON COUNTY.

Ontonagon county was the place first given attention in the history of copper mining on the shores of Lake Superior. It was here that the first discoveries of the metal were made, the copper masses on the shores of the lake and the bright particles of copper in the water attracting the attention of the early voyageurs. As early as 1636, and thirty years before the renowned Jesuit Fathers, Allouz, Mesnard and Marquette, visit the region, the copper had been seen and the fact of its discovery made known. It was from this county that the prehistoric miner procured the metal from which to form his ornaments, knives and other weapons. He came from the land of Old Mexico, from the east as far as Pennsylvania, and from the west as far as Arizona. Throughout this vast expanse of country the evidences of his success at finding the copper is apparent. So long ago was it since he finished his work of production that the old pits have filled with decayed vegetation, and trees, hundreds of years of age, are growing over the spots from which the metallic supply used to come. Thousands upon thousands of cubic feet of rock were extracted, tons of stone hammers were left upon the former scene of action, and the amount of copper that was obtained in the masses loosened by glacial movement, and deposited upon surface, must have been enormous aside from the great quantities extracted from the rock of the veins in which it was contained. Masses of such weight that the early miners could not lift them from the bottom of the pits in which they had been found, were left behind and were helps in assisting in the discovery of the old veins. It is a highly interesting region and one that gives the student much room for speculation. On Isle Royale, fifty miles out in Lake Superior, and a portion of Michigan, the prehistoric miner did an immense amount of work, and as he probably used birch bark canoes to transport the copper and himself between the island and mainland, he must have been possessed of some of the pluck and skill that shows itself in miners of modern times.

There were some immense masses found in the mines of this county. There were several weighing from 200 to 300 tons, and one weighing over 500 tons. And yet today there is not an active mine in this county. The cessation of mining operations came before the advent of Balls heads, power drills, power trams, Collum jigs, improved slime tables, high explosives, economical machinery, and a hundred other things that, combined, have made it possible to make copper at from 6 to 9 cents per pound. All this applied to some of the idle properties of Ontonagon might bring about a vast change in the present condition of the mining field. Considerable effort is being made to bring this about. Mr. Alfred Meads, of Ontonagon, has done much in the past year to attract the attention of the outside world to the natural advantages of this section as a possible profitable mining field. He has charge of several of the most promising properties, and, with the advent of better times, will surely be successful in his attempt to revive the now dormant industry in this section.

What is needed is the consolidation of several of the old mines whereby there will be sufficient territory on the dip and strike of the veins to insure plenty of territory for the prosecuting of mining and stamping at a vigorous pace. It is the large amount of rock handled in these times of low prices that permits of a profit being won, and to secure this there must be the lands to take it from. Many of the old companies here possess but 40 or 80 acres on the lode, and in modern mining this is altogether too limited to warrant the introduction of such machinery, and such a large amount of capital as is needed in modern methods. The mines in many instances had reached the limit to which the old machinery could handle the rock, 1,400 feet, being about the maximum, and this is certainly but a short distance as copper mines go.

There has been some tributing done at several of the old mines, this being in the upper levels and above the water line in the several properties. Considerable copper has been gotten in this way where the lode was abandoned years ago as worthless, and is but additional proof that there is much to warrant the equipping and thorough exploration of the old workings. That barren stretches have occurred, and that these are showing in the present bottom of many of the old mines is true, but this can be seen at similar depths in many other mines that have passed through the unprofitable stretches and are now at a depth of 4,000 feet, on the incline of the lode, and paying dividends to the shareholders. The wonderful persistence of the copper in depth in the veins of the Michigan mines at points where mining has been constantly going on for many years is applicable to the

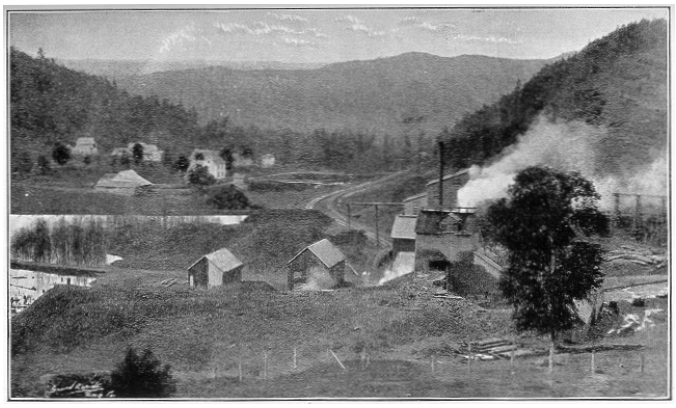
mines of this county. It is a good reason for arguing that the lode should be tested to much greater distance downward than has thus far been reached here. Then, too, the upper levels of these old mines were wonderfully rich. In the cases of the Ridge, National, Mass, Minesota, and others, nothing has been found to excel them in this respect, and why should the copper here not be found as deep and as rich as in the case of the Quincy, for instance. The latter mine shows many barren stretches, as does the Osceola, and all others. I saw a mass of 300 tons of pure copper below the 33d level in the Quincy. Why have not the same agencies placed it as deeply in the mines of Ontonagon county? Similar cases may await the hand of some enterprising capitalist who will search to such depths. The favorable feature is the great richness of these old mines in their upper levels.

THE NATIONAL MINE,

located at Rockland, Mich., was one of the last to close down, active mining ceasing in August, 1893, since which time a little has been done in the upper levels. The vein on which most of the mining was done is a contact, with gray, compact trap for the hanging, and a conglomerate on the foot. It is locally known as the conglomerate vein, but in reality the conglomerate carries copper only where it has been fissured, or split, on the upper portion of the belt, the copper from the contact flowing into and filling such cavities. The copper occurred in the lode in flag or slab-shaped masses of varying size, and after the manner in which shingles are laid on a roof. Over thirty per cent of the product was mass and barrel work. To the north of the conglomerate 140 feet is an amygdaloid belt on which considerable was done and that gave considerable copper which gave out at the lowest level worked. There is need of heavier machinery. Mr. B. F. Chynoweth is in charge, and has great faith in the mine, with which he is familiar.

The Minesota mine adjoining the National, has long been idle. Its shafts have gone together, and one cannot gain access to the old levels. It was a remarkable property in its time, paying its shareholders $1,820,000. The National divided $359,255 amongst its shareholders. These properties should be consolidated and operated as one.

There are two copper ranges here, the “North range,” or “Minesota,” and the “South Range,” or “Evergreen.” In the former were the National, Minesota, Toltec, Penn, Hazard and other, and in the latter the Knowlton, Ogima, Ridge, Evergreen, Adventure, Belt, Merrimac and others. About one-half mile separates these ranges. The Evergreen range has several veins locally known as the Knowlton, Mass, Champion, Ogemaw and Evergreen. Of these, so far as they have been developed, the Knowlton has given the most promise as a copper producer.



NATIONAL MINE, SHOWING NORTH AND SOUTH BLUFFS.

The Ridge, Merrimac, Adventure, Hilton and Toltec, adjoining properties, will be consolidated, and an effort made to revive mining. Combined they give a length on the strike of the lode of 2½ miles, and offer splendid opportunity for investment.

Of these the most important, in so far as recent activity is concerned, is

THE RIDGE MINE,

which has been doing considerable tribute work during the past few years. A few men are working here most of the time, and make a good living. The copper obtained is from the old levels that were abandoned from twenty to forty years ago. These are above the adit level, as no pumping of water is done. These tributers are not permitted to rob or injure the mine in any way, as those who own it are sanguine that ultimately it will be started up again, and mining carried on vigorously. The ridge has paid $100,000 to shareholders. The total product of copper to date is 5,509,811 pounds. Product for 1895 was 82,891 lbs. mineral that gave 64,363 lbs. ingot.

Alfred Meads, Ontonagon, has charge of the property.

A Cleveland company has been trying to do something with the old Belt mines located at Greenland, organized under the title of the Diana Mining Company, but nothing substantial seems to have come out of the venture. It looks to me more like a stock-jobbing scheme than one to develop the hidden treasures of mother earth in this locality.

The old Norwich mine, later known as the Essex, has also been recently examined with a view to doing exploring work. There are 600 acres in the fee. In these are the Norwich, Pressure and Indian Digging vein, and probably the Minesota and Evergreen veins. The location is 12 miles from Ontonagon, on the west branch of the Ontonagon river.

There is an abundance of water on the range for milling purposes, and water power to operate the mines and mills with electricity can be had. There is also plenty of wood for fuel. It is certainly a district that deserves the attention of copper miners and men who have money to invest in legitimate exploration. The Chicago, Milwaukee

& St. Paul railroad now runs through Rockland to Ontonagon, and gives better facilities for the shipping in of supplies and the sending out of the product than heretofore.

The soil here is remarkably fertile, fine crops of hay, roots and vegetables being grown, and with the addition of profitable mines this would be a veritible paradise for the laborer. The scenery is of the grandest and Michigan boasts no prettier section.

THE PORCUPINE MOUNTAINS,

twenty-four miles due west of Rockland, is a section in which some exploring for copper has been done in the past year. Most prominent has been the operations of

THE HALLIWELL COPPER CO.,

on sections 27 and 28, town 51, range 42. Several veins have been located, two of which are being developed, these being 300 feet apart on surface. One of these is a dark colored amygdaloid with a hanging of red sandstone. The other a lighter color epidote with the sandstone forming the foot. The dip of the veins is about 30 degrees. Both these veins show considerable copper. A shaft is being sunk on each, following the incline of the lode, but they talked, at the time of my visit, of putting down one between the veins and drifting from one to the other from this single avenue. In the latter part of February, 1896, they obtained machinery, and transported it to the property by sleighs from Ontonagon.

B. Schatzinger, of Cleveland, Ohio, is president; Chas. W. Voth, Cleveland, is secretary; A. A. Atwater in charge of explorations, Ontonagon, Mich.

The old Carp Lake mine, in this same district, is being given attention by Cleveland, Ohio, parties. H. R. Palmer, of Cleveland, has spent some time here during the past two years. They expect to put in a plant of machinery and develop the property, and hope to be able to accomplish this the coming summer. This district needs the attention of some of the old copper miners of Lake Superior who are thoroughly versed in the business, and who would be valuable aids to those who are working in this field.

The old Union mine, and the International also talk of resuming operations, and hope to make a start next summer. The territory is a new one that has not been given much practical attention as yet. The copper in many places is very fine, and in others is coarse enough to insure its being saved in the washing. Developments on this portion of the range will be watched with much interest.

The different properties in Ontonagon county that were worked on tribute in 1895, with the amount of mineral produced by each, are as follows:

Name of mine.	Pounds mineral copper produced.
Ridge	86,765
National	67,339
Mass	30,710
Knowlton	28,198
Minesota	12,800
Total	225,812

The miners who work on tribute are paid about one-half the price of ingot, taking the market value, at the time the copper is weighed up. In addition to this the owners of the mines generally pay the smelting charges. The copper mineral must yield at least 75 per cent ingot.

CALUMET AND HECLA STAMP MILLS, LAKE LINDEN.

IN GOGEBIC COUNTY,

at the western end of the range in Michigan, there has been some exploring done, but nothing of value shown. A little copper has been found, but it is generally so finely disseminated in the rock that it cannot be saved in the ordinary way, and then it would probably not give a profit even if all could be secured. I hear of discoveries now and then, but, traced to the source of operations, they amount to nothing. There may be points at which copper exists in paying quantity at this end of the range, but these have not yet been located.

PRODUCT.

The following shows the number pounds refined copper produced by Michigan mines in 1895:

Atlantic	4,832,497
Calumet and Hecla	77,337,922
Central	379,020
Franklin	3,086,933
Kearsarge	1,946,163
Minesota	10,585
Osceola	6,270,373
National	40,128
Quincy	16,304,721
Ridge	64,363
Tamarack	14,900,316
Tamarack Junior	2,547,861
Tributes, Sundry	37,583
Wolverine	1,815,391
Total	129,573,856

DIVIDENDS.

The dividends paid by the copper mining companies of Michigan for 1895 are as follows:

Calumet and Hecla, four dividends of $5 each, paid May 11, August 19, October 18 and December 18.

The Tamarack paid two of $4 each on June 25 and December 31.

The Quincy paid two regular dividends of $4 each on February 11 and August 15, and one extra of $4 on May 20.

The Osceola paid two dividends of $1 each on January 15 and July 25.

Kearsarge paid one dividend of $1 on December 30.

TOTAL AMOUNTS PAID.

Calumet and Hecla	$2,000,000
Kearsarge	50,000
Osceola	100,000
Quincy	600,000
Tamarack	400,000
Total	$3,150,000

The total amount paid in dividends by the copper mines of Michigan is $68,460,875, and the names of the different properties contributing this grand total will be found in my introductory remarks on the copper industry.

OTHER COPPER PRODUCING STATES.

Of the copper producing states in the union Montana stands a the head, the product for 1895 amounting to 185,000,000 pounds, the exact figures not being obtainable at this time. Michigan stands second, and Arizona has credit for 48,000,000 pounds. All other states, exclusive of those mentioned, are credited with 23,000,000, this giving, exclusive of Michigan, 256,000,000 pounds.

PRICE OF COPPER.

The average price of copper, per pound, for the years below enumerated will be interesting:

Years.	Cents.	Years.	Cents.
1860	22¾	1890	15¾
1865	36⅜	1891	12 8-5
1870	20⅜	1892	11¼
1875	22⅛	1893	10⅝
1880	20⅛	1894	9 9-16
1885	11⅜	1895	10¾

PIG IRON.

Michigan has led all other states in the manufacture of charcoal pig iron for many years past, and while the low price of this product has seriously interfered with profitable operation since 1893, the prospects for the future are somewhat brighter, and there will be attempts at meeting the competition from coke iron in the hope that modern plants may be able to earn a profit even at the greatly-reduced price. Of this I give particular notice in my description of the new furnace of the Cleveland-Cliffs Company, located at Gladstone. One trouble now experienced is that the old stacks are too small, as it is from the large amount handled that a lesser cost per ton is achieved.

Michigan possesses fifteen furnaces, the location of which is generally in the northern part of the State. During the year 1895 these produced pig iron, and were in blast as follows:

Name and Location.	No. months in blast.	Product.
Antrim Iron Co., Mancelona	8¼	21,627
Elk Rapids Iron Co., Elk Rapids	4⅔	10,097
Excelsior Furnace Co., Ishpeming	7	11,407
Gaylord Iron Co., Detroit	3	2,783
Peninsula Iron Co., Detroit	12	11,086
Spring Lake Iron Co., Fruitfort	12	25,015
Union Iron Co., Detroit	5¾	6,685
Total number gross tons		88,700

Of the above the Excelsior furnace, Ishpeming, was the only one that made any important additions or improvements in its plant. This has relined its stack, put in new blowing engines, new hot and cold blast, and electric lighting.

The Elk Rapids went out of blast in May, 1895, but is repairing and will blow in as soon as they can land ore.

The Western Furnace Company, located at Manistique, Schoolcraft county, intends blowing in the coming spring. They have built twenty miles of railroad to reach their hardwood lands, and will equip this with the necessary rolling stock to handle wood and coal readily.

In the line of new work, the Cleveland-Cliffs Company is the single exception.

THE NEW PIONEER FURNACE.

Gladstone is a pleasantly located town on Little Bay de Noquette. Its founders were first attracted by the magnificent harbor at this point, a fact that has been so well advertised that a railroad in the Minneapolis, St. Paul & Sault Ste. Marie, with fine docks, warehouses, etc., have followed. Besides there has settled here a population of about 2,000 souls; there is electric lighting, water works, fine schools, churches, paved streets, handsome residences, and pleasing scenery. Saw mills are located near by; there is a manufactory of dowel pins in the limits of the town, and two newspapers enlighten the people in what is going on about them.

The port did considerable during 1895, the records showing the following: Sent out iron ore 109,319 tons; grain 4,000,000 bushes; flour 1,200,000 barrels; lumber, 35,000,000 feet; cedar, 800,000 pieces. Received: Coal, 205,000 tons; merchandise, 40,000 tons, this indicating that the port is of considerable commercial importance.

The people of Gladstone are looking forward with no small degree of interest to the operations of the Cleveland-Cliffs Company, who are preparing to engage in the manufacture of pig iron and the by-products derived from the smoke made in the coaling of their wood. Should success attend the efforts of the company at this point it may mean much to the newest city on the lakes, and to those of the iron ore fields of this region. If one furnace can operate successfully others will undoubtedly follow, and if the furnaces come why not also the mills for the manufacture of steel rail, mill iron, etc.? The utilization of the iron ores nearer the points of production of the latter will be of benefit to those fields, and to the entire district. With the exhaustion of charcoal as fuel, the location is favorable for the receiving of coke, and it is claimed by those who have been giving the matter much consideration that coke can be imported and iron made for less money than at Chicago or Pittsburgh. The Cleveland-Cliffs people have so builded as to readily convert their stack into a coke-using one, and must have been convinced of the fair chance for success at this point before expending such a large amount of money as has been necessitated in the construction of the much that has been here completed. The company is officered by conservative, business-trained men, and they have given careful thought to all that this enterprise includes.

The successful employment of coke in the iron ore fields in the reduction of the ores, would be a grand thing for the entire State of Michigan, as it would add largely to her present enormous wealth in the iron way.

The furnace site of the Cleveland-Cliffs, is about a mile and a half from the business center of Gladstone. The furnace is located on a small island that stands out about 600 feet from the mainland, the two being connected by a railway, the intervening channel having been filled to make solid foundation for the road. On this island, and a strip of from 200 to 350 feet wide on the mainland, the company has 40 acres of land, this being ample for the present needs at least.

The island was a low one, but material from the dredging of the shores, to give desired depth for the largest boats, has been employed to raise it, so that now the yard level is four feet above water level, and the furnace level is above lake level. About 50,000 cubic yards of gravel were dredged from the front of the island which was used in grading for the building and railway track foundations. This gives ample security against the encroachment of the water, and places the works where the product can be most readily handled.

The furnace is of the most modern. It possesses all the features of merit that the most improved can give. Nothing has been spared that would add to its greater effectiveness. Mr. Austin Farrel, the manager of the company's plant at this place, is a gentleman well-skilled in furnace construction and operation, and his accomplishment at this location certainly proves the company were fortunate in the possession of his knowledge. The furnace is 12x60 feet. The hearth is 7 feet, stock line 8 feet, bell 5 feet. There are five tuyers and five rows of Gayley bronze bosh plates. The hearth is jacketed with 1-inch steel plate, the cooling being done by exterior spraying. The bell is operated by steam. The dust-catcher has down-comer that gradually increases in diameter as it drops.

There are two Cowper stoves (sometimes called Cowper-Roberts, due to the brick used, the celebrated Roberts), with room for a third stove if needed. These stoves are 16 by 70 feet. Bricks are 3 inches thick and so made as to form perfect bonding. Flue spaces are 9 inches square. Computed on the basis of 9-inch brick, each of these stoves contains 131,000 brick, which is 20,000 more than is used in the construction of the furnace stack. There are 40-inch slide valves connecting with chimney. The chimney is 130 feet high from level of foundation of furnace, and is 3 feet 4 inches diameter inside, and 3 feet 10 inches diameter, outside measurement.

Steam is provided by four Stirling boilers, two in each battery. These possess a heating surface of 5,750 square feet.

The blowing engines are two formerly used at the company’s old furnaces at Negaunee, Mich., are, of good type and ample to do all that is required of them. The engine house is a neat one, 41 feet 10 inches square, outside. The cold blast main is 30 inch diameter, the hot blast 44 inches lined to 25 inches, the bustle pipe 37 inches lined to 18 inches.

The casting house, stove and boiler room are all under one roof, and conveniently laid out. The casting house is 50x90 feet, and the extreme end is 115 feet from center of furnace. The roof is trussed with steel, corrugated iron being used for covering up top and sides. On each side of casting house are sliding doors through which the product will be handled to the dock immediately in front. On each side of the casting-room are sprayers made up of gas pipe, four jets to a section, which can be set at any angle, so that the whole or a portion of the pig bed may be moistened. This is a great improvement over the old method in which a hose is used. It does the work in much less time, and better. The portion of the main building in which the stoves and boilers are located is 67x78 feet.

The stock house is 100 feet square and has iron trussed roof, covered with corrugated iron as are also the sides. The hoist tower is framed with steel, and power is provided by Crane engine.

The pump house is 23x26 feet, containing two Worthington pumps. Two 8-inch suction pipes lead from the lake, and are placed 14 feet below the surface. The waste from the furnace is run back near the point at which the suction ends are located so that in winter weather the warm water will prevent freezing of the water about the suction, while at the same time it is not warm enough to interfere with satisfactory furnace practice in the summer months. The water is delivered into a wooden tank that is elevated 45 feet above the bosh plates of the furnace, this giving excellent pressure. By-passes are also observed whereby the water can be sent direct to furnace or chemical works. Much care has been taken in the piping so that delay may be avoided in case of accident to any one main or branch.

A machine shop, 36x68 feet, is well equipped, and is in charge of George Slining, master mechanic. In addition to the work done for the furnace and chemical plant, considerable repair and new work is done for the saw mills and other concerns in that vicinity that have heretofore been forced to send to Marinette or Milwaukee.

There is a car house, where charcoal cars are repaired. The company has 38 cars and one locomotive. A locomotive house is provided for the latter. It is heated by exhaust steam so that no caretaker is needed.

The dock is 150x600 feet. It is so gridironed by tracks, that the greatest distance the pig will have to be handled by hand is 30 feet. Turn-tables permit of changing to any portion of the dock required to be reached. On the furnace side is a depressed track 3 feet below the level of the dock permitting of easy loading of cars. There is 17 feet of water on the lake side of the dock, and no better facilities for vessel loading could be arranged. The dock is immediately in front of the casting house.

The capacity of the furnace is estimated at 125 tons daily, if forced. It is thought that 100 tons will be made regularly.

Located close to the furnace plant is a double line of charcoal kilns, forty in number, each kiln having a capacity for 62 cords of wood. A trestle built between this line carries the elevated railway track upon which cars of wood are run, and from which the kilns are loaded. Between the supports of this elevated track is a tram-way that conveys the charcoal to the furnace, power to be furnished by a horse. Tram track is on the ground, and on a level with the bottom of the kiln doors. The kilns are 31 feet in diameter at base, 27 feet, at skewback, outside, and the height to skewback is 14 feet. These kilns will supply about 65 per cent of the charcoal needed in the furnace, the balance being secured from parties who are coaling wood at various places in the neighborhood. The company possesses 8,500 acres of fine hardwood lands lying adjacent to the M. St. P. & S. R'y and located some thirty miles from Gladstone; besides this they own 12,000 acres of hardwood and softwood lands at other points. For the handling of this wood and coal they have a fine system of tracks. The designing engineers of this furnace plant were Frank C. Roberts & Co., Philadelphia, and the assistant who represented them was E. C. Brown.

The Cleveland-Cliffs Company is also doing something in the way of manufacturing wood alcohol. From each of the charcoal kilns a flue leads to a main that conducts the smoke to the chemical works, located several hundred feet distant. A draft for the purpose of conveying the smoke where needed is produced by fans, the revolutions of which create a vacuum, drawing the smoke through the mains. The gases are thus first drawn into wooden tanks that are filled with copper pipes kept cool by cold water, the gases coming in contact with which causes condensation. There are three batteries of these condensers with five tanks in each. In these primary tanks a large amount of tar is trapped by gravity, and is sent to the engine house where it is fed under the boilers, being artificially forced where needed. In this first stage there is also found about 25 per cent of the gases that are non-condensible, and these are also used as fuel under the boilers, this and the tar obtained furnishing enough to give all the power needed. A small quantity of wood is employed merely to give a flame and to insure ignition of the gases that might otherwise accumulate, causing explosion. From these primary tanks the condensation goes to two tanks at a lower level where considerable tar is secured and delivered to a tar well. From this station the acid is pumped to the second story of the alcohol house. All the pumps are of the Prescott pattern and all are copper lined. All the pipes through which the acid flows are copper, and many thousands of dollars' worth of the metal is seen. Here there is a system of vats and stils for separating the water, the flow being induced by gravity, at the smallest possible expense. There are worms and goose necks, stirrers, where lime is introduced, and tanks for storage that finally receive the pure product.

It is a fact not generally known that a single cord of wood contains 200 gallons of pyroligneous acid, and that between three and four gallons of 95 per cent pure alcohol is obtained from this. Computing the price at 90 cents per gallon, and figuring three gallons per cord, it will be seen that there is $2.70 worth of material per cord that would have been lost in smoke if not saved as above described. Figuring on 100 tons of pig iron per day, there would be in the wood necessary to provide charcoal for the making, 675 gallons of alcohol, over $600 worth. And a dozen men will be sufficient to operate the chemical plant, probably. This figuring would show that the alcohol making will prove a very important part of the business at this point. We are told by Thos. H. Noble, the wood superintendent, who looks after this branch of the business, that this is the finest plant of the kind in the United States.

Besides wood alcohol a fine quality of grey acetate of lime and acetic acid can be obtained, but the company will do nothing in this for the present. They have left space in the boiler room for additional power in case they decide to engage in it, however. The engine, fan

and pump house is 66 feet square. The alcohol house is 56x141 feet.

The fires were started in the kilns on March 10, 1896, and the blast furnace fires will be lighted about the 30th of this month.

The company has erected ten double tenement dwellings, a residence at the plant for the founder, P. Carroll, and neat residences in Gladstone for Manager Farrel, Clerk C. V. R. Townsend, and Master Mechanic Geo. Slining.

A great deal has been accomplished since the work of clearing the island was begun in May, 1895, and reflects credit upon those who have had the task in charge.

The company will give close attention to making grades of iron that are regular and satisfactory to the trade. They have engaged as chemist, J. S. Cary, who will give careful attention to this feature.

A saw mill will probably be built the coming summer. They have room for one and have dredged a way in the channel between the island and mainland through which the logs can be run and stored. A road leading from Gladstone to the furnace site has also been cut out and graded. When the finishing touches are pat upon plant and surroundings, this will be one of the most attractive spots along the lakes.

PRODUCT OF THE UNITED STATES.

The year 1895 was the banner one in pig iron manufacture in the United States. According to the figures compiled by James M. Swank, general manager of the American Iron and Steel Association, the total was 9,446,308 gross tons. The product for 1894 was 6,657,388 tons, and for 1893 it was 7,124,502 tons.

Of this grand total for 1895 the amount of bessemer pig made was 5,623,695 gross tons, an increase over the year 1894 of 1,815,128 gross tons. The gain in percentage of bessemer pig produced is wonderful, and is accounted for by the demand for steel for structural and other purposes in the stead of iron. It is this demand, too, that gives still greater importance to Michigan as a producer of ores suited to the manufacture of bessemer steel, as the State possesses vast deposits of ores of this class.

Imports of iron and steel, 1894 and 1895, tons 2,240 pounds,

	1894.	1895.		1894.	1895.
Pig iron	15,582	53,232	Hoop, band and scroll	805	15
Scrap	2,280	6,066	Ingots, blooms, etc.	9,494	25,363
Bar iron	9,228	20,049	Sheets, plates, etc.	28,795	14,525
Rails	300	1,447	Cotton ties	5	3,495
Hoops for barrels	50		Wire rods	22,608	26,894
Total				89,247	181,025

COPPER SMELTING.

The smelting of copper is observed at three places in the upper peninsula of Michigan, and the enterprise gives employment to several hundred men. During 1895 there has been no change in these plants, they having been fully equipped with the best appliances that were procurable.

THE LAKE SUPERIOR SMELTING COMPANY,

whose works are located at Hancock and Dollar Bay, roll copper and manufacture wire in addition to the smelting of the mineral. Jas. R. Cooper, a gentleman of long experience in the work, has charge of these enterprises. The following shows the smelting operations for the past year:

Name of mining company.	Mineral. Pounds.	Per cent.	Pounds refined copper.
Atlantic	6,237,877	77.470	4,832,497
Central	645,034	58.760	379,020
Franklin	3,721,458	82.950	3,086,933
Kearsarge	2,316,590	84.010	1,946,163
National	64,309	77.949	40,128
Osceola	7,463,173	84.017	6,270,373
Quincy	20,260,790	80.539	16,317,778
Ridge	82,950	77.592	64,363
Tamarack	21,607,721	68.958	14,900,316
Tamarack Junior	3,360,570	75.816	2,547,861
Wolverine	2,096,696	86.583	1,815,391
Tributes, sundry	48,123	80.469	38,724
Totals	67,905,291	77.092	52,239,547

CALUMET AND HECLA SMELTING WORKS.

These reduction works are located on Torch lake, near Lake Linden village, and have been referred to in my description of the Calumet and Hecla copper mine. The mineral smelted is all from the mine of this company, and there were produced, of refined copper, during the year, 1895, 77,337,922 pounds.

Lake Superior Smelting Company, pounds refined copper	52,239,547
Calumet and Hecla Smelting Works	77,337,922
Total amount ingot	129,577,469

SALT.

Michigan ranks first in the states in its production of salt. In 1895 there were made 3,529,342 barrels. For the year 1894 the United States produced 12,967,417, and the mineral is one very generally distributed throughout the Union.

The salt producing territory of Michigan is an immense one, and constant addition to former salt-giving area is being made. The table of districts will give a fair idea of lands already developed. In the earlier history of salt-making in this State, there was much trouble had by reason of the impurities contained by the mineral. These were principally iron, bromide of sodium and gypsum, and its proper place in the market was being seriously affected by these deleterious associations. To bring the standard up to a satisfactory point a law was enacted in 1869 for the inspection of the salt of the State, since which time there has been no trouble, and Michigan salt is as popular as the finest produced any where.

To further assist in keeping the business active and profitable, an association was formed in 1876 including all the prominent manufacturers which handled the product and maintained uniform prices. This has since been kept in force, and has been of great assistance to the industry.

Many of the salt works are operated in connection with saw mills, and the refuse from the manufacture of timber and shingles is used for fuel in evaporating the salt brine. Due to this practice the manufacturers have been able to make a small profit even at the very low price quoted for the salt, which, in 1895, was but 48 9-10 cents per barrel, this including the cost of the barrel. The rapid depletion of the forests of Lower Michigan has seriously interfered with salt making in many places, and at such points where the mills are no longer operated there is no money in the salt-producing business. It is only by strictest economy, and the utilization of waste for making steam that many of the salt men have been able to present a reason for continuing in the business.

The following information touching upon the industry I secure from the report of the State Inspector, Mr. Geo. W. Hill.

THE SALT DISTRICTS.

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

District No. 1, Saginaw county, has forty-two salt companies, with forty steam, three pan blocks and four thousand solar salt covers, having a manufacturing capacity of one million three hundred fifty thousand barrels of salt.

District No. 2, Bay county, has twenty-nine salt companies, with thirty-two steam blocks, one vacuum pan, and with a manufacturing capacity of one million three hundred thousand barrels of salt.

District No. 3, Huron county, has four salt companies, with one steam and three pan blocks and with a manufacturing capacity of three hundred thousand barrels of salt.

District No. 4, St. Clair county, has ten salt companies, with six steam and four pan blocks and with a manufacturing capacity of six hundred thousand barrels of salt.

District No. 5, Midland county, has two salt companies, with two steam blocks, having a manufacturing capacity of seventy-five thousand barrels of salt.

District No. 6, Iosco county, has six companies with six steam blocks, having a manufacturing capacity of three hundred thousand barrels of salt.

District No. 7, Manistee county, has ten salt companies with nine steam and two pan blocks having a manufacturing capacity of one million two hundred fifty thousand barrels of salt.

District No. 8, Mason county, has four salt companies, with two steam and two pan blocks, having a manufacturing capacity of five hundred thousand barrels of salt.

District No. 9, Wayne county, has one salt company with one salt block, having a manufacturing capacity of one hundred fifty thousand barrels of salt.

RECAPITULATION.

Total number of firms, one hundred ten.

Blocks, one hundred thirteen.

Solar salt cover, four thousand, with an estimated manufacturing capacity of five million four hundred twenty thousand barrels of salt.

The following table shows the inspection of salt in Michigan for 1894 and 1895, as shown in the report of Hon. George W. Hill, State Salt Inspector.

County and district.	1894.	1895.
District No. 1, Saginaw county	462,983	479,887
" " 2, Bay county	438,647	573,960
" " 3, Huron county	21,335	24,860
" " 4, St. Clair county	404,628	463,094
" " 5, Midland county	29,458	27,275
" " 6, Iosco county	87,100	97,528
" " 7, Manistee county	1,134,244	1,318,139
" " 8, Mason county	360,546	351,542
" " 9, Wayne county	----------	13,077
Totals	3,138,941	3,259,362

The year 1895 has added Wayne county, the 9th district, to the salt producing districts of Michigan, and in the near future it promises to be one of the largest salt producing counties in the State. The Detroit Salt Company is now successfully operating a large plant and manufacturing about five hundred barrels of salt per day.

There is now in contemplation, and if I am correctly informed, contracts have been let and the wells are now being sunk at Wyandotte for the largest plant in the world, and I predict with the closing of another year Wayne county will be in close competition with that of Manistee (which now makes the most of any county in the State). The salt deposit found at Wyandotte with the sinking of the first well, is unequaled in quantity to any yet found in Michigan. The first salt rock struck at a depth of between seven and eight hundred feet is of forty-eight feet thickness. If what I have been told by the men who bored the wells is true, I am of the opinion that this strata will produce salt brine better adapted to the new vacuum process than any brine I know of, from the fact of its freeness from gypsum and the presence of magnesium which counteracts the effects of gypsum adhering to the steam pipes, which retards rapid evaporation. At the depth of eleven hundred feet there is a deposit of fossil salt three hundred feet in thickness and as clear as French plate glas.

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	243,000		1867	474,721	1 77
1863	465,356		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	561,288	$1 58	1883	2,891,672	$0 81
1870	621,352	1 32	1884	3,161,806	75⅝
1871	728,175	1 46	1885	3,297,408	70
1872	724,481	1 46	1886	3,677,257	66
1873	823,846	1 37	1887	3,944,309	57 1-10
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	52½
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	83⅜	1895	3,529,342	48 9-10
1882	3,037,817	70			
Prior to 1869				67,515,115	
				3,283,037	
Total				70,798,152	

Operations in the Wayne county salt district are now being actively prosecuted. At this writing, the 4th of March, 1896, the first well of the Tecumseh Salt Company is completed. It shows a remarkable deposit of salt of finest quality. At a depth of 800 feet a strata of salt 40 feet thick was encountered, succeeding which was 32 feet of limestone, and 56 feet of salt. At 935 feet 20 feet of salt was found, then 10 feet of shale and 55 feet of salt. The drill then cut 118 feet of limestone, 16 feet of salt, 6 feet of rock and 15 feet of salt into lime again which was 141 feet, underlying which they cut 238 feet of salt. The well is 1,538 feet deep, has seven strata of salt with a thickness in all of 440 feet.

The company has started a second well, and four more will be commenced soon. The Solvay people have six wells, and will bore more. Capt. Ford has ten wells completed. The Tecumseh Salt Company have foundations laid for their main building wihch will be 600x200 feet.

SANDSTONE.

Michigan contains a vast amount of sandstone suitable for building purposes, the finest varieties being found in the upper peninsula, and near Keweenaw bay, on the shores of Lake Superior. Here is can be readily quarried and transported to Chicago, Cleveland, Buffalo, and other distributing centers on the great lakes.

The varieties most popular with builders are the brown, raindrop and red, these generally differing only in their markings. The brown is of the richest, and it has been principally secured from quarries at Marquette, Mich. The supply has steadily grown less, but limited quantities can now be furnished. Some of the finest buildings in Michigan, as well as other states, are constructed of this stone.

The year 1895 was not a profitable one for producers of sandstone. Architects have pronounced against it in their plans and specifications, not because it is not substantial or beautiful, but for the reason that architecture must have a change of style and material the same as millinery and tailoring. They claimed that too much sandstone was being used, and that the sameness must be broken into by the use of stone of other kind and color, and the sandstone must await the exhaustion of this new “fad,” which will have but a short time to run, as sandstone is far ahead of ordinary stone for buildng purposes. It is easier to quarry, works readily under the tool of the shaper, and is everlasting in the walls. It is much cheaper than most building stones, and is far handsomer than those generally employed.

While the four quarries of the upper peninsula produced a considerable quantity of stone, much of the latter lies unsold at the docks in the cities above mentioned. Some inquiry has recently sprung up, and quarrymen are looking for an improved business in the shipping season that is to come.

The work at the quarries is generally performed in the summer months, as the action of frost on the stone is apt to injure it while “green," and before it has time to "season." It becomes much harder after exposure to the atmosphere. This is true of all the finest grades. The inferior stone will disintegrate by exposure to the air.

THE KERBER-JACOBS REDSTONE COMPANY,

is one of the best known of the producers of sandstone in the State. Mr. J. H. Jacobs, the president and general manager, is one of the oldest quarrymen in this field, having been associated with the earliest work done in Marquette, the original point of development. The quarry is located at Redrock, Portage Entry, close to the water's edge. They have a strata of marketable stone about 15 feet thick, and the area of surface development is something like 2,000,000 square feet. The equipment consists of four boilers, four engines, four derricks, dock, incline and track with hoist, two channelers, four steam drills, with pumps, guys, etc., and complete facilities for transportation. An average of 60 men are employed during the year. In the winter months a force is kept busy stripping the drift that covers the stone. From May to October 100 men are engaged.

The product for 1895 was 137,529 cubic feet, an increase over the previous year 67,187, due principally to the fact that the quarry is a comparatively new one, and some time is needed to secure ample working faces.

J. H. Jacobs is president and general manager; E. H. Towar, treasurer, Marquette, Mich.; S. W. Goodale, secretary, Detroit, Mich.

THE PORTAGE ENTRY QUARRIES COMPANY,

is one of the oldest sandstone producing concerns on the lakes. As indicated by their title, their principal quarrying is done at Portage Entry, where they have a complete plant for securing the stone rapidly. They also operate the Marquette quarries. The amount produced from the latter in 1895 was 38,014 feet, and from Portage Entry 181,511 feet, in all 219,525 feet.

E. T. Malone, secretary, Security Building, Chicago, Ills.

THE EXCELSIOR REDSTONE COMPANY.

is quarrying stone on the shores of Portage lake, making their first shipment in 1894, the true sheet having been located after a year's systematic exploration. The thickness of the marketable strata averages about 8 feet, and the quality of the stone is of the finest. The overlying burden varies in thickness according to location, showing about 21 feet at the present point of operations. Work is prosecuted during ten months of the year, four in quarrying and shipping and six in stripping. An average of 60 men are employed.

The present equipment consists of 3 steam pumps, 1 steam channeling machine, 2 steam drills, 1 steam hoister, 1 boiler 170 horse power, 1 derrick, 20 tons capacity. Besides this there is a well-equipped blacksmith's shop, and three miles of railroad from the quarry to the lake shore, the company possessing this with a locomotive and 30 flat cars. They are well equipped to give prompt attention to the wants of those who need fine sandstone.

J. H. Seager is president; F. W. Rogers, secretary; J. B. Seager, local manager and superintendent, all of Hancock, Mich.; F. L. Smith, general manager, Detroit, Mich.

The product in 1894 was 18,000 cubic feet, in 1895, 45,000 feet.

THE L'ANSE BROWNSTONE COMPANY

is a new one in the brownstone producing business, having made its sample shipment, of about 2,000 feet, in 1894. Their quarry is at L'Anse, and five months were worked in 1895 and 23,000 cubic feet of stone quarried. The greater portion of this was of the brown variety. A force of 34 men was employed. The equipment consists of: 1 two-power 15-ton hoist geared for two derricks, 1 24-horse power engine, 2 Ingersoll-Sergeant steam drills, 1 bar channeler, 2 Wardwell channelers, 1 Worthington pump, 1 Lidgerwood double-drum hoist, 1 core drill, engine, boiler and fittings, 1 set Lidgerwood's friction drums worked by gravity for letting down cars from quarry to dock, a distance of 1,500 feet. The loaded car brings up the empty one. Another derrick is now being put up in the quarry. There is dredging being done at the dock to give 16 feet of water. The company is an enterprising one, and is making a lively bid for business.

Neil J. Dougherty is superintendent, L'Anse; W. A. Amberg, president; W. H. O'Brien, secretary, Chicago, Ills.

THE TRAVERSE BAY REDSTONE COMPANY.

This company is operating in Houghton county, T. 56, R. 31, and have shown sandstone of excellent quality covering 120 acres. They have constructed eight miles of three-foot railroad from the quarry to the bay, and have a dock 1,000 feet long at the latter place. The work of 1895 was devoted almost entirely to developing and equipping, 6,500 feet of stone being all that was quarried. There are two hoists with boilers, two derricks, and a full equipment of machinery for cutting stone. The company is now in shape to make a large output.

Chas. Hebard is president, Pequaming, Mich.

The price at which the stone is sold at the quarries averages about 40 cents per cubic foot,

The product for 1895 was as follows:

	Cubic feet.
Kerber-Jacobs Redstone Company	137,529
Portage-Entry Quarries Company	219,525
Excelsior Redstone Company	45,000
L'Anse Brownstone Company	23,000
Traverse Bay Redstone Company	6,500
Total cubic feet	431,554

Estimated value at the quarries, $172,621.60.

EXPLORATIONS.

Due to the quiet market, there was but little exploring done for sandstone in the past year. Of those who have searched with show of success is Allen Kirkpartick, of Hancock, Mich., who did considerable drilling near Newtonville, Houghton county, where sandstone of excellent quality was reveled under a shallow drift, of about 4 feet. This will be developed the coming summer.

Lower Michigan there are several fine quarries of sandstone in Jackson and Huron counties, but these have been worked in a very modest way during the past few years.

WAVERLY STONE.

This stone is of a bluish-gray color, uniform in its appearance and texture, and makes a handsome stone for building purposes. It is found at Holland, Ottawa county, and takes its name from similar stone that is quarried in large quantities at Waverly, Ohio. The Michigan stone is free from iron stains that present such an objectionable appearance in this stone from other places. It is readily cut with the ordinary tools, and can easily be shaped to meet the wishes of the worker. It hardens by exposure to the atmosphere, and its crushing strength, as determined by tests made at Madison University, Wisconsin, is 8,200 pounds to the cubic inch. While these quarries have been operated but a few years, there has been a lively market for the product which is finding its way into many of the new buildings erected in the principal cities of the State. At Holland, Allegan, Muskegon and South Haven one sees many buildings of this stone, while in Detroit, Grand Rapids and other places, it is extensively used for foundations and trimmings.

GRINDSTONE.

Huron county has been a producer of grindstones and whetstones for more than forty years. The location of the quarries is at Grindstone City, on the shores of Lake Huron, twenty-four miles northeast of Bad Axe, the county seat, and ninety miles above Port Huron. Lake Huron blue stone is known in every market in the United States, and is also recognized abroad. In grindstones and scythe stones the supply is not equal to the demands of the trade.

The Cleveland Stone Company has been the principal operator during the past year. They report to me the following statement showing the magnitude of their operations:

Produced 2,924 tons of grindstones, valued at	$23,000 00
" 14,357 bushed grindstones, valued at	5,742 80
" 6,555 gross scythe stones, valued at	13,110 00
" 1,100 cords of rubble stone, valued at	2,750 00
Total value of product	$44,602 80

The company's equipment consists of 6 derricks, 6 steam bolsters, 4 boilers, 4 engines, 2 steam drills, 2 steam pumps, 10 grindstone turning lathes, 2 sawmills containing 7 gangs of saws. The number of men employed is 230.

At Bay Port, twenty-four miles southwest from Grindstone City, are quarries producing stone suitable for grindstone manufacture, but these are worked but little. The quality is said to equal that of the grindstone material of Grindstone City.

NOVACULITE.

This stone, and of a very fine grain, suitable for hones, occurs in Marquette county, and near Marquette and Negaunee cities. Nothing is being done in the manufacture of hones, but something could be if the properties were developed.

SLATE.

There are large deposits of slate in Baraga county, and considerable attention was given to its quarrying several years since, but nothing is now being done. The quality is all right, but the sheets are too much fractured to afford a ready market. It may be that further work would find the formation less shattered, but those who possess the quarries are doing nothing in the line of development.

LIMESTONE.

Limestone is generously distributed throughout the entire State of Michigan. The manufacture of lime is carried on at several points, Bellevue being noted for its find product. The stone is also used for building purposes.

QUARTZITE.

There are vast deposits of this rock in the northern portion of the state, gannister being quarried for the lining of blast furnaces.

KAOLIN.

has been found in Ontonagon county, and a trial lot, consisting of a single carload, was shipped during the summer of 1895, by Joseph Voghtlin, the owner. The latter is endeavoring to interest capital in his property. There is any amount of the mineral, and if of the desired quality, the trade can be supplied from this point. It is said to be of the variety used in the manufacture of porcelain.

MICA.

Veins of mica have been found at several points in Marquette county, but it is too "cloudy" to be of value commercially/

PEAT.

At one time a blast furnace was operated with peat as fuel, this being at Ishpeming, where there are peat deposits of considerable extent. The using of this material for blast furnace purposes was not a success, however, and no peat is now being cut.

CLAY.

Clay is found in nearly every county in the State. Near Detroit a deposit suitable for the manufacture of pottery is being operated. The manufacture of brick and tiling is conducted at many places, and provides employment to a large number of men.

GRANITE.

This stone exists in immense areas throughout the northern portion of Michigan, and at no point is it being quarried. Near Marquette is a fine variety suited to building purposes, and upon which there is a talk now of doing some work. It is owned by the Iron Cliffs Company, of Cleveland, Ohio.

GRAPHITE.

Extensive beds of graphite have been found in Baraga county, but nothing is being done in the way of developing them. Assays show favorably, and trial lots will be mined and shipped.

ASBESTOS.

During the summer of 1894 asbestos was found in association with the serpentine rocks north of Ishpeming, in Marquette county, on sections 29 and 30, town 48, range 27. It possesses a fine fibre of from one inch to one inch and a half long, and compares favorably with the Canadian product, which supplies the greatest portion of the amount of this mineral consumed in the United States. A sample lot of twenty-five pounds was shipped to Chicago to the leading separating works, and they, immediately upon its receipt, asked how much could be produced of a similar quality. The owners of the mineral, the Deer Lake Company, replied that they could furnish a hundred tons if desired. The Chicago parties made no answer to this, and inquiry proved that they were interested in the Canadian properties now supplying the United States market.

The Michigan asbestos will undoubtedly soon be worked. The rock will yield about one per cent of the mineral, and the price per ton of the latter runs from $50 to $200, according to quality. Where the Canadian asbestos shows a breaking of the fiber in the center of all the pieces mined, the Michigan is without this damaging feature, the fibre being perfect. In length it fully equals that of the imported.

Asbestos is largely used in the manufacture of packing for steam engines, for indestructible garments, and other uses.

It occurs in the serpentine range where it can be readily mined, being above the water level, and a railroad is near at hand to transport it to market.

GYPSUM.

The principal gypsum producers of Michigan are now represented by the Michigan & Ohio Plaster Co., of which W. B. McCuasland is president, W. McBain vice president, A. C. Torrey, secretary and treasurer, all of Grand Rapids, Mich.

The business of the past year has been light as compared to previous ones. The mills were not operated continuously and several of them were idle altogether. About 175 men were given employment, but this number is greatly increased when business is active. The company's representatives inform me that their trade suffered due to the general business depression.

The following concerns were active in 1895:

Name.	Location of mills.
Alabastine Company	Grand Rapids, Mich.
Grand Rapids Gypsum Works	" "
Grand Rapids Plaster Co.	" "
F. Godfrey & Bro.	" "
Gypsum Plaster and Stucco Co.	" "
Loren Day	" "
Western Plaster Works	Alabaster, Mich., and South Chicago, Ills.

The product of the above named companies was as follows:

Calcined plaster, tons	52,700
Land plaster, tons	10,600
Gypsum rock, crude	12,000

The gypsum product of Michigan is noted for its purity, and the supply is equal to meet the severest call that can be made upon it.

TALC.

This mineral is found in the serpentine range of Marquette county, and preparations are under way for its mining. Adjoining the property on which is located the Ropes gold mine, a large vein has been found, and can be cheaply worked. The talc is of the fibre variety, the most valuable, it commanding from 9 to 15 per ton, pulverized. It is ground and put into barrels, in the supplying of the trade. It is largely use in the manufacture of paper, and in adulterations. The principal mines of the United States are located in New York state, St. Lawrence county being the most prominent.

The Michigan talc has a long, fine fibre, the color is white, and it occurs in such quantity that it can be readily extracted. The first important discoveries of this mineral in Michigan were made in 1894, when search was being made for serpentine and verde antique marbles in the region lying north of Ishpeming, and there has been no effort to do anything in the opening up of the mines until

the present time, when different parties are talking of going to this field. The quality thus far exposed in the exploration is ample to warrant a large output.

W. H. Rood, Ishpeming, is interested in the ownership of the lands, and in the development of the industry.

MARBLE.

Michigan has only one marble quarry that is being operated at this time, but developments are under way whereby there promises to be an important increase in the production of this mineral, that will add much to the wealth of the State. As is generally well known, a great deal of manual labor is necessary in the quarrying of this stone. It cannot be shaken by blasts of powder, as in quarrying certain kinds of rock, for the reason that the force of the explosions would shatter the marble, ruining the product, and on this account much hand work is necessary. The single quarry now showing activity is located in Dickinson county, on Sec. 26, 42, 28, and is operated by

THE NORTHERN MICHIGAN MARBLE COMPANY.

This concern has but fairly gotten started in the task of developing this portion of the marble range, the first work account being done in 1894. Since then they have quarried about 500 car loads which have been distributed generally throughout the principal cities of the United States, where satisfactory tests of its color, hardness, etc., were made. Among other customers the United States government figured prominently.

It is a very bright, sparkling, crystalline carbonate of lime, hard and tenacious, making it desirable for building or monumental purposes. Some of it is pure white, some variegated, shading from white to pink, green gray and purple, making beautiful slabs for wainscoting and interior work. It is somewhat granitic in nature, sufficiently so that the ordinary tests given foreign and New England marbles will not even tarnish the highest polish. It is susceptible of a polish almost equal to onyx. There is a pressing demand for the stone beyond anything they can supply, even the chips and small spals being disposed of. One concern in Chicago has used several car loads of small chips.

The price received is from $3 to $4 per ton for the rough rock that is produced in opening the quarry, and from $2.50 to $5 per cubic foot for sound, square-channeled rock. At present they are cutting some blocks 6x6x12 feet. An order for marble for a new school building at Marinette, Wisconsin, has just been received.

There is a spur track to the quarry from the Chicago & Northwestern Railroad. There is a steam hoist and derrick with a capacity of 30 tons; steam drills and channelers capable of cutting from 50 to 100 feet per day. In the spring it is intended to erect a saw and finishing mill, and get into shape to take a prominent place in the market. A crew of men will be worked all winter, and there will be considerable stone ready for the mills as soon as the latter are ready and equipped.

Regarding the amount of marble at this property, the supply appears to be practically inexhaustible. The lands are owned by Houghton county capitalists who lease it on the royalty plan.

The company is capitalized at 50,000 shares, all the stock being owned by six persons. Edwin Porter, Joliet, Ills., is president; F. G. Wilcox, of the same place, is secretary and treasurer; A. J. Foster, of Foster City, Mich., is director and superintendent.

Coming under this head can properly be placed

THE SERPENTINES.

They are amongst the most beautiful of the rock creations when they contain dolomite, the blending of the two forming what is known as verde antique. This is a rare form, and in Michigan is probably the only occurrence of the mineral in deposits of value outside of the little that is now found in the Old World, principally in Italy, where the veins are narrow, and where the supply is almost exhausted.

Serpentines are extensively found throughout the United States, but verde antique is not. The latter takes on a variety of shadings, green, grey, yellowish, brownish, dark approaching black, the variety being great. Chrome and other irons give handsome colorings, and nowhere in the world are handsomer specimens found than in Michigan. At the time when the recent financial panic occurred the Michigan deposits were about to be worked, a foreign syndicate having practically closed negotiations for handling the stone on a large scale, but the decided change in business conditions caused them to change their plans. However, the stone is still in place, and it surely will attract the attention of those who will not fail to recognize is rare beauty and value.

At the world's fair, where it had a section in the Michigan Mineral exhibit, it attracted much attention, and many who saw the specimens have since visited the locality from which the samples were taken and all expressed great surprise at the quantity as well as quality of the marble as it appeared in place.

The Michigan serpentine outcrops at Presque Isle, near Marquette, this being the most easterly point at which it is seen. It disappears from view going west, and again is seen fifteen miles east on Sec. 27, 48, 27, a few miles north of Ishpeming. Prominent ridges show for about four miles when it again sinks from view and reappears in small patches several miles farther west, near Lake Michigamme.

The portions of the ridge where the verde antique varieties are found are located on section 30, town 48, range 27, or at least this is the only place where they

have yet been prominently disclosed. The range runs through the southern portion of this section. In the southwest corner of the section is a knob of serpentine rising about 30 feet above the level of the adjacent country that is composed of the verde antique. This knob has a length of about 100 feet. In color it is a sea-green mottled with red. Farther east is another knob rising to a height of 100 feet, and is 700 feet long. This is also verde antique, being dark green in color, and mottled with particles of precious serpentine. Still farther east is another ridge of serpentine rising to a height of 80 feet. It is 1,500 feet long and 300 feet wide. There is a belt of 50 feet of verde antique, the balance being massive serpentine. On section 28, same town and range, there are two large bluffs of serpentine. On Sec. 36, 48, 28, Thos. Dwyer, Marquette, Mich., owns valuable serpentine that is attracting attention.

It is the verde antique variety that offers greatest inducement to quarrymen, because of its rarity and high price. In the London market it is quoted at $8 per cubic foot, whereas the massive serpentine commands about half that figure. The verde antique is full of veinings of dolomite, this, with the variety of shading of colors, making it very beautiful. To the uninitiated the veinings look like fractures; they probably were at some time, the dolomite having formed the cementing material, but these points are really stronger than where the rock does not show them. It is the net-work of veins that pronounces the rock verde antique, and it is this feature that proves its valuable character. It is used for interior decoration, and gives the richest possible finish.

On section 29 the heavy serpentine is stained with iron, and is solid and pretty. There is no end of either the verde antique or massive serpentine. Both can be secured in any quantity that the trade would demand. These marbles take on a beautiful polish, the finish being in every way equal to that which comes from Italy. It cannot be worked with a tool, as in the ordinary monumental marble. It would gouge out, being soft, although tough. This, with its handsome quality, is reason for its greater cost. It has to be finished by machinery, but as most marbles are now so treated as a matter of economy, this would be no drawback.

The massive serpentine was drilled into in the course of underground explorations at the Ropes gold mine, at a depth from surface of 500 feet, and showed the same characteristics as that taken from surface, so there is no question about the quantity of the rock.

The serpentines are eruptives, dikes that cut across diorites, diabases and felsites, arid are the youngest rocks of this particular section.

There is a railroad within a short distance from these outcrops of valuable serpentine, and, I hope, the near future will witness the development of the marble, which certainly demands it and is warranted by the merit the stone possesses. I see no reason why this should not become one of the prominent industries of Michigan.

W. H. Rood, Ispheming, Mich., is largely interested in the lands holding valuable portions of the serpentine range, as is Thos. Dwyer, Marquette, Mich.

GOLD.

As early as the time in which Dr. Douglass Houghton, Michigan's first State geologist, was engaged in the task of examining the upper peninsula rocks, it was known that gold existed in this portion of the State. Dr. Houghton, upon one of his brief trips from the camp at which he was temporarily located, secured enough gold to fill an eagle's quill. The gold, as remembered by those who saw it, was very coarse, and the doctor said he had obtained it from the bed of a little stream of water. The unfortunate drowning of Dr. Houghton occurred before he had disclosed the secret of the whereabouts of the discovery. It was his intention to have entered the lands upon which the gold was found when he had completed his season's work amongst the rocks of this region, but he was caught in a storm on Lake Superior shortly after he had discovered the gold, and his secret was buried with him. Those who accompanied him during his work in the upper peninsula are not clear as to the exact place in which the camp was located at the time, and many points have been chosen as the correct one. It is generally believed that the spot was not far from where the most active work has since been done in the way of developing the gold-bearing veins of this region.

In January, 1864, DuBois & Williams, analytical chemists, of Philadelphia, Pa., in assaying specimens of quartz for silver, from the Holyoke silver district, eight miles north of the present city of Ishpeming, were surprised to find gold, the quartz holding it at the rate of several hundred dollars per ton. They reported this, but little attention was given the story, and no searching resulted.

The first discovery that led to anything of practical kind, and the one from which has sprung all that has been done in the Michigan gold fields, was made by Mr. Julius Ropes, of Ishpeming. This gentleman, a chemist, had noticed the presence of the metal in numerous rock samples, he had taken, and he finally located a vein of quartz from which all subsequent excitement has resulted. This was in 1880, and the location was the south half of the northwest quarter of Sec. 29, 48-27, three miles northeast of Ishpeming City. It was in range of serpentine rocks, and near the edge of a wet swamp. A company was formed, the fee of the mineral having fist been purchased, and here

THE ROPES MINE,

the first gold mine in the State of Michigan, was opened, and where it still remains the only gold mine operated in this State. It was not started on the spot at which the original find was made, but high ground, about 850 feet farther west, was selected, and here a shaft was sunk, a small mill erected, and the first milling work was done in 1882. Since then the mill has been increased in size, and at one time 65 heads of Cornish stamps were dropping, but the number now operated is 40, these all being in what is known as the new mill. Those in the old are idle.

SHAFT HOUSE AND STAMP MILL AT ROPES GOLD MINE.

The Ropes has been unfortunate in that it has lacked sufficient funds to carry on its mining work as it should be done in order to secure the best results. In its earlier history there were many different managers who had charge of the business, and few of them were experienced in the work of milling. Like most gold mines, the Ropes has its peculiarities, and much time and money was expended in becoming familiar with them. About the time the best methods were learned, and the money had been spent, the people grew tired, the few assessments levied having discouraged them, and now, with an economical management, and one that fully understands the mine and the way to treat the ores in the mill, there is a refusal on the part of the shareholders to come to the mine's assistance, and for the past few years they have been working on the hand-to-mouth plan, and all this time, badly handicapped as they were, succeeded in getting a new dollar for an old one. They are mining and milling a ton of rock for about $1.85, which is certainly doing remarkably well considering the small amount treated per day, about 65 tons.

The Ropes rock is a hard one to stamp. It contains considerable talcose slate, this being sticky and soft, acting as a cushion under the heads. The rock has to be stamped fine, a 40-mesh screen being used, and the tonnage per head is small as compared to mines where a rock of different nature is met with. With all this understood, the present management has certainly made an excellent record, and deserves a better financial condition under which to labor.

The Ropes ore formation possesses a width of from 30 to 50 feet, and is made up of talcose slates in which the ore occurs in lenticular form and generally running transversely across the formation. Lenses are found in all imaginable positions, but the general course is as described. These lenses are made up of narrow bands of quartz and slate, and the minerals associated with the gold are galena, iron pyrites, gray and yellow copper ores. Occasionally one sees a speck of free gold, and at several places in the mine small vugs containing considerable free gold were found. At one such place about $400 worth of the native metal was taken. Generally, however, the ore bodies have been of low grade, the average yielding something like $2 or $3 per ton. Could the mine have been opened up differently, and a selecting of the rock made, this average could have been considerably improved.

There is one shaft to the 15th level, a vertical depth of 850 feet. To the 12th level the lode has a slight dip to the south, but from this point to the present lowest level it inclines slightly in the opposite direction, the walls being nearly vertical. The ore lenses have a pitch to the west. The bottom of the first main lens was found at the 5th level, that of the second at the 9th, and they are now working upon the fourth lens in the bottom levels, the work here being entirely upon the east side of the shaft whereas in the upper levels the stoping was done to the west. In the new lens recently encountered on the 16th level, the slate mixture is almost entirely missing, the vein being almost solid quartz, and giving an average of about $6 per ton, this showing a better and stronger vein than has been found at any other point in the mine. The shaft does not reach to the bottom of this level, but stops at the 15th. They have sunk an incline shaft at a distance of 150 feet east of the main shaft to secure the ore of this level, which they are carrying in the ore body, the hoisting being done from this sub-shaft by a small engine. They will carry this shaft down until the shape of the new lens is determined. They have an idea that its westward pitch will carry it under the line of the main shaft, in which case the latter will be continued downward and the lens be mined from this avenue. As the pitch of all the ore bodies thus far encountered has been westward, it is fair to argue that the position of this will prove no exception to the others.

The finding of ore of better quality, and in larger body than has been heretofore been met with is particularly encouraging on this lowest level. It speaks well for the persistence of the gold, and offers substantial reasons why the Ropes should be given a better show than has thus far been accorded it in the way of money to do business with.

A small territory has thus far been worked upon. A length of 550 feet on the trend of the lode embraces it all, and from this they have produced $605,056.95 worth of gold and silver. Of the grand total $548,973.40 has been gold, the balance silver. This is the gross yield,

and I give it to show that there is gold in the rock of this mine. This embraces the product from the commencement up to the first of January, 1896. The gold is generally free milling. What concentrates are saved are sent to Aurora, Ill., for treatment. Frue vanners are employed for the concentration. The bulk of the gold is held in the "quick" in the mortars and on the copper plates, the common form of amalgamation being observed.

Advantages the mine has is the solid walls that need no timbering and the freedom from water. In the 16th level not a drop of water comes from the level. The vein is stoped out on the overhand plan. The ground is drilled by machines. About 35 men are now employed.

Another point of vantage is the cheapness with which the water supply is secured. The source is the Carp river something more than a mile distant. Here a dam has been constructed, and, with a four-foot fall, a pump is operated by a turbine wheel that furnishes all the water the mill needs, and the supply is ample for any future demand that may be made under a prosperous condition of things.

There is an excellent equipment of machinery, assessments having been largely used in this direction.

At the point where gold was first found by Mr. Ropes on this property, the vien was narrow, but very rich, giving about $200 per ton, by assay. There is the territory lying between this and the shaft at the mine upon which practically nothing has been done in the way of exploration, and where there should be something valuable disclosed by practical testing If of the ground. The fact that the ore lenses in the mine pitch to the west, and that gold was found on surface so far east, is an encouraging sign.

Much depends upon the success or failure of the Ropes regarding developments at other points in this portion of the State. If success is achieved, then there would be much done in the endeavor to repeat it, for it is not likely that all the gold of Michigan has been placed in the Ropes mine vein. Nature never does things on any such selfish plan. There has been gold put into the rocks of these hills for the people to mine, and another industry with golden complexion will some day be added to the important ones of mineral kind already possessed by the people of this State. That the development of this field may be hastened, it is hoped that the Ropes mine may be assisted so as to earn a dividend, and it needs nothing more than a legitimate aid to do this. Failure here would have a very depressing effect upon the gold ranges, and it would be regretted if the Ropes, now that it looks so encouraging, is permitted to cease operations from lack of sufficient money to do business in the right way.

The product for 1895 was valued as follows: Gold, $34,838.69; silver, $1,373.16; total, $36,211.85. Julius Ropes is president; W. H. Rood, manager; George Weatherston, superintendent; C. R. Ely, secretary; all all of Ishpeming.

Two miles and a half west of the Ropes mine, on Sec. 35, town 48, range 28, is

THE MICHIGAN GOLD MINE.

This property has produced some of the finest specimens of free gold ever seen. Many of these yielded gold at the rate of $160,000 per ton. Indeed, so rich were they, that they offered too great a temptation to the miners who were employed there, and the trunk of one enterprising fellow who was all ready to take his departure for Europe was looked into and found to contain over two thousand dollars' worth of golden treasure, secured from this property when the eyes of the bosses were not upon him. How many thousands were stolen is not known, but there probably were many of them. This property was its busiest in 1890, and for a time there was a lively trading in its shares. It is now idle. At a depth of about 80 feet in two shafts that were sunk, the gold had diminished to such a degree as to dishearten those who were conducting the exploration, and work was abandoned. A little was done in 1895, but nothing of value accomplished. It consisted principally in making a test of some of the rock already mined.

The Michigan has several veins crossing its lands, and it was upon the largest of these that the work was done, although gold was found in the smaller ones. The veins are in diorite, differing in this respect from the Ropes. Their trend is nearly east and west, and they observe a nearly vertical position. There is little or no silver, and the gold where found is free milling, there being little mineral in the rock aside from the gold. The rock stamps freely, and under the ordinary Cornish head a large amount could be treated daily.

There was a Huntington centrifugal mill tried herewith indifferent success, and a considerable amount of gold was obtained by roasting the rich specimens, running them through a small crusher, and washing by hand, which work was superintended by Mr. Julius Ropes, of Ishpeming. During the months of January, February and March, 1890, the mine produced $12,675.35 worth of bullion, and this was the time when excitement regarding it ran highest. The total yield is valued at $17,699.36. With the greatly-diminished percentage of gold in the bottom of the exploring shafts interest also waned, and all work was finally abandoned, and those who invested in the shares of the company were out the money put in. The stoppage did not reflect that enterprise which has been shown in the mining of other kinds of minerals and metals in the upper peninsula. Had such a showing of gold been made in any of the western countries the population of the surrounding territory would have gone wild over it, but here, in staid old Michigan, there were many who would not walk across the street to see the specimens that held gold as freely as the conglomerate rock contains copper. This was due to the lack of information on the subject of gold mining. Had it been copper or iron ore that was shown, there would have been hundreds to examine it. This but shows the influence of education, and it is the lack of the

knowledge of gold mining on the part of the mining population of this region that has deferred the work of developing the gold-bearing district. There has been but little interest aroused. In the west, too, the prospector goes into the hills and if he finds a promising lode he stakes out his fifteen hundred feet on the vein, and prepares to get help to develop it. In Michigan the lands are held by large corporations, and while there would be no difficulty securing options, the average prospector does not like the conditions that ask for a certain royalty. He wants to own it when found, and this is not possible here without buying the claim after the vein has been located, and few have the money to buy with.

The shafts of the Michigan Gold Company were less than 100 feet in depth. What another one hundred feet would have shown can but be conjectured. The property was well equipped with machinery, there are several creditable buildings, and everything is in shape to resume work on short notice.

The fee of this property is owned by Peter Gingrass, of Ishpeming, Peter White, Marquette, Mich., has charge of mining operations.

THE GOLD LAKE.

This prospect is immediately west of the Michigan on lands belonging to the Lake Superior Iron Company. The latter company sunk a shaft, and secured many fine specimens, after which they leased it to the Gold Lake Company, by whom it was worked for a time in a very quiet manner. Specimens rich in gold, and comparing favorably with those from the Michigan, were secured. This vein is also in the diorite, and felsite shows in places cutting through the diorite. The vein “pinched” out at a depth of something like 60 feet, and its continuation was not sought beyond a few feet where lost sight of.

THE SUPERIOR GOLD MINING COMPANY

did some work on the northeast quarter of northwest quarter of Sec. 35, 48, 28. This was immediately east of the Michigan property, and the vein was in the diorite. Some fine specimens were secured, but the work was given up soon after it was begun. The vein is said to have been cut out by the diorite.

THE PENINSULA MINING COMPANY,

made up of Detroit, Mich., capitalists, did some work under the above title on the southwest quarter of the southwest quarter of Sec. 25, 48, 28. A shaft was sunk 70 feet. The quartz here is in granite and is in small stringers. Free gold was seen, and the company figured that they could treat all the granite impregnated with this quartz. Numerous assays were made and the company reported these to be satisfactory. They have not done anything in the way of equipping the property.

Other properties were worked more or less, the Grummett, Swains, Mocklers, Grayling and Giant being prominent at the time the excitement was at its height, but all work has stopped. These were all on the Michigan range.

THE DEAD RIVER DISTRICT.

One of the most promising territories for the existence of Gold is known under the above title. In the sixties there was great excitement in this field due to the discoveries of silver associated with lead ores. Hundreds of claims were started, and considerable silver secured from the Holyoke mine, but the lead did not prove rich enough in the more precious metal, and all work was finally abandoned.

This district begins in the Dead River valley starting about eight miles north of Ishpeming and extending northward to Lake Superior. The particular portion of this field as thus far exploited can be located by a line drawn centrally through it from east to west, which line would acre with the line of town 49. The eastern terminus can be placed at Lake Superior. Westward it extends several miles. The honor for first bringing this district to the attention of the people of the State was accorded Julius Ropes, who made his initial discovery here in June, 1890.

In town 27 there is a spur that leaves the main range, going at a sharp angle to the northwest. This is locally termed the north range, and the one from which it diverges, the south range. The south range appears to be the principal gold bearer so far as tests of the rock have been made. In width the range altogether is about three miles.

Here is found a great variety of the magnesian rocks, sedimentaries similar to those of the best gold-producing districts of the world, the chloritic, steatitic, and talcose, dolomites and granites. There is also a yellowish serpentine, and altogether this range, to use a miner’s expression, is “keenly.”

Two enormous beds have been found upon the southern slope of this range, and their equivalents are also to be seen on the opposite slope of ft the range. Through this strata intrusive rooks of igneous origin have out their way, breaking through, generally, on the seams of contact of the different original rooks, but in many places transversely. The blow-out of granite in many places is grand, and the traps have played an important part in opening a way for the depositing of quartz, which contains the gold. Small quartz seams are innumerable. In the granite the quartz often occurs in small squares as if it had been placed in a hole mortised for its reception. The seams of quartz run in size from an inch to several feet, and many of them are gold-bearing. The predominating minerals are copper ore, iron pyrites, galena, and sometimes zinc. No refractory ores are discovered. Tellurium has also been found in a trachitic greenstone, and it is reported from no other portion of this region.

The configuration of the surface of this field is attractive. The granites and traps sometimes rise to a great height, forming deep defiles, reminding one of the canyons of the west. The schists and softer rooks I have been gouged out, making the surface very rugged, full of galleys and corresponding hills. It certainly is an attractive region, and one that has not commanded the attention from gold hunters which it deserves.

Following the discovery of Mr. Ropes in this field, a company was organized that secured options on a large tract of land, and conducted explorations on Sec. 35, 49, 27 under the title of

THE FIRE CENTRE MINING COMPANY.

Two shafts were sunk upon different veins in the granite, and were carried downward about 100 feet. At this depth there was a diminuation of gold in the rock and the company ceased operations much to the disappointment of the many who were interested. As in the case of other explorations in this region, those who undertook development work were unfamiliar with gold mining. They were too easily discouraged.

In the summer of 1892 a trial lot of rock was treated in the Ropes gold mine mill. This consisted of 254 tons, and from it were produced $2,063 worth of gold, about $8.12 per ton, a most gratifying result. The gold was 69.7 fine, and the percentage of saving in the mill, including concentrates, was 76.7, showing the free-milling qualities of the rock. The latter stamped very freely, much more readily than that of the Ropes mine. The Fire Centre Company ordered a Crawford mill, which was set up and proved an utter failure. In the fall of 1892, the shafts having changed from pay quartz to barren, work was stopped, and the place has been abandoned. I consider this the most promising of the several gold fields in this region, and believed if it had skilled men to direct operations a success would be achieved. The tract is a large one, and little or nothing has been done.

I have been shown rich specimens that are said to have been taken from Baraga county, and from near Lake Michigamme. Nothing is now being done in that section.

Two miles north and east of the Ropes, Edward Robbins, of Ishpeming, found gold in the summer of 1895, and obtained many fine specimens showing the native metal.

This gold is associated with the iron ore-bearing formation.

The Ropes, in all this great field, is the single mine working. I hope to see men skilled in the work of prospecting searching amongst the hills of the upper peninsula the coming summer. With a revival in business affairs there should be considerable activity shown in this field. It certainly deserves a systematic searching, having already shown sufficient to warrant such attention.

GROSS VALUE BULLION MICHIGAN GOLD MINES.

Ropes Gold and Silver Company	$605,056 95
Michigan Gold Company	17,699 36
Fire Centre Gold Mining Company	2,063 00
Other prospects	820 00
Total	$625,639 31

SILVER.

It is to be regretted that no record has been kept of the silver produced in the State of Michigan. Associated with the native copper, native silver has been plentifully found at many of the mines, and in the earlier history of the mass mines of Ontonagon and Keweenaw counties, large quantities were annually saved. At the mines now producing copper considerable silver is obtained. The Quincy reports $3,081.86 from its sale for 1895. Its neighbor, the Franklin, also has a silver account, and the Wolverine, at Calumet, shows considerable of this white metal with its copper.

The No. 2 grade of Franklin copper shows, by assay, that it contains considerable silver so associated with the copper that it cannot be secured in the ordinary way, which is hand separation at the stamp mill, and experiments are now under way seeking to obtain it electrically. The Calumet and Hecla is successfully doing this at its smelting works at Buffalo, N. Y. The parties who are making the tests desire to buy the copper, and, if they can save the silver as they hope to, will pay an extra cent or two per pound for it. This would be an item of considerable magnitude for the Franklin people, and would probably be shared in to much larger extent by the Quincy Mining Company, producing copper of grade similar to that of the Franklin.

The returns from the Ropes gold mine shows that it has produced silver amounting in value to $56,083.55, and places are often found in the mine where the silver per ton of rock exceeds the value of the gold held in the same material.

In the sixties there was considerable excitement over the finding of galena several miles north of Ishpeming, an much money was spent—the most of it wretchedly—in exploring that field. A stamp mill was erected at the Holyoke mine, and considerable silver was obtained, but the affairs of the company were badly managed, and failure was inevitable even under favorable mineralogical conditions.

The only prospecting for silver is being done by Messrs. Gad Smith and A. E. Miller, of Marquette, Mich., who have a vein of galena on Sec. 30, town 46, range 24, in Marquette county. They are sinking a shaft on this and exhibit specimens that look rich, and show satisfactory results by assay. Enough has not been done to determine the probable extent or value of the find. There is about 30 feet of drift covering the ledge, and the shaft is 80 feet deep, showing a three-foot vein of galena. The vein has been more or less split up, but is

showing better in the bottom of the shaft than at any point above. A second shaft is in the vein, but they have been bothered by surface water and will construct a dam to avoid this trouble. A diamond drill boring made further east on the property showed the vein to possess a thickness of about six feet.

COAL.

Although several counties in the southern and central portions of Michigan are underlaid by detached basins of the Central coal field, there is but little being done in the way of coal mining. During the past two years considerable exploring has been done in the Saginaw valley, and encouraging results in the way of finding coal of excellent quality have been met with, but as yet these "finds" have not been developed. At other places where worked the coal seams are thin, and the cost of winning the product is too great to successfully compete with the mines of Ohio and Pennsylvania. The product is generally taken by local railroads and people living in the vicinity of the mines. The coal being mined is of a semi-bituminous character, is excellent for steaming and fuel purposes, and crude tests made of the recently-discovered beds in the Saginaw valley indicate it to be valuable for the manufacture of coke. Could Michigan provide the coal to smelt the iron ores within its borders it would be of great importance to the State.

The coal is disposed of to the railway companies for $1.40 per ton delivered on the track, at which there is little or no profit, the latter being secured from the sale of the fine coal, and the coal retailed at the mine, which commands $2 per ton.

The wages paid miners is from $1 to $1.50 per day. Many men employed in the coal mines are not miners, but farmers who live close by. The contract price for mining is $2 per yard for top coal and $2.50 for bottom.

The Corunna Coal Co., whose mine is located near Corunna, Shiawassee county, worked part time during 1895, producing 12,241 tons. About 60 men were employed. The mine can produce 150 tons per day.

The Sebewaing Coal Co., located near Sebewaing, Huron county, was the only one working continuously throughout the year, it sending out 38,523 tons, and giving employment to 75 men.

The Saginaw Bay Coal Company closed their mines early in 1895, and are not expecting to resume. The mines had been operated about four years, and produced about 10,000 tons annually.

The Bennet Sewer Pipe Company, of Jackson, has closed its mines, and the New Coal Mining Company, of the same place, has also abandoned its workings.

Michigan reached its maximum output in 1882, when 135,339 tons were produced, but in no year since that time has the output exceeded 81,500 tons.

The following is the total product of the State in tons of 2,000 pounds, for the past four years:

	1892.	1893.	1894.	1895.
Total product	77,990	45,979	43,780	50,764

MICHIGAN MINING SCHOOL.

One of the most important educational institutions of the State of Michigan is its mining school, located at Houghton. During the comparatively brief period since its establishment it has made for itself a name that gives credit to its teachings in all the principal countries of the world where mining is carried on or where the science of mining is given attention. It has representatives of many nations in its list of students, and gradually the world is recognizing the fact that at no other school of this class can such advanatges for rapid progress be secured as in the one located in Michigan.

With a progressive, ambitious and painstaking faculty, such as this school possesses, with the practical illustrations with which it is surrounded, and the liberality of men who are connected with the mines of this region in extending access to their different properties, the attendant of this mining school certainly is greatly favored, enjoying privileges that no other such school can give.

And what more appropriate school could be imagined for Michigan than one which trains for the better operation of these mines—that has for its objects the improvement of the mining industry—that makes it possible for the more skillful and less expensive securing of the vast treasures that nature has so lavishly bestowed, and which are so often of little account by reason of incompetent working on the part of those who labor in this great underground world. As a mining State Michigan stands high, but with all the much that has been achieved there is far more to be accomplished, and no other profession offers rarer advantages to the young man than that pertaining to the development of the mining regions. Not in Michigan alone is he expected to look for employment. As Michigan is growing, so other states and territories are expanding. Nor is the growth confined to the United States. Foreign countries are advancing, and the call for competent mining engineers, electricians and other professionals needed in mining work, is great. It far more than exceeds the supply.

In securing men to take charge of their mines the foreigners have not forgotten the Michigan Mining School. They have made applications for its graduates, because they know that the latter have some knowledge of mines outside of that found within the pages of their books. They know the Michigan students have coupled practice with their technical education, the one lending substantial support to the other, and it is better finish that the mining men want. To understand the science, and the best way to apply it, is the thing that counts when

mines are worked and stamp mills are run. It is this that saves money to the shareholders.

And as Michigan is so excellent a State for a school of this class, it necessarily follows that Houghton is an admirable location for the school. It is close to the greatest copper mines in the world, is within a few hours' ride of the greatest iron ore mines. It has the advantages of witnessing the mining and milling of copper, iron and gold, the smelting of iron and copper. It has a magnificent territory geologically, meeting with such rocks and formations as are generally in other countries producing ores and metals of the many kinds here found.

One has but to consult the pages of this volume to be satisfied that the filed is a varied one in its make-up of minerals, in the magnificence of its mining undertakings, and in the great helps that are afforded a student whose object is to acquire knowledge of the mines and mining. This is one reason why I have here mentioned this school of mines. It is to more clearly call the attention of those who may read these descriptions of the mines of this State to the fact that the school is admirably located and is an institution that should be well kept up. It should not be suffered to lose any of its present force or standing by inadequate appropriations on the part of the people of the State. To some of the latter the cost of graduation may appear high, but no other school of its kind in the world educates its students so cheaply, nor do they educate as well. And, too, it should not be forgotten that this is an institution but just founded. Some years must necessarily be consumed in the building up of the school, in attracting the people to it, in making its advantages known. None other will bring to Michigan more credit, not even excepting its renowned and grand university.

Tat the Houghton school the students have free access to the mines. They go into the deep shafts, the drifts, they operate the power drills, use the explosives, note the effect of their experiments, question the superintendents, the mining captains and the miners. They make maps of the mines, work with the mine chemists, examine the different systems of mine accounts, study fuel, machinery, and have the best possible illustrations in the operation of the most enterprising mining region under the sun. If one wants to see the greatest copper mine in the world, and the greatest mining machinery the world possesses, he has to go to the Calumet and Hecla. If one desires to see the biggest iron ore mines he goes to the Norrie, or Chapin, or Cleveland. He finds the deepest shaft in the world in this State. The biggest pumping engines used in mines and mills are here located.

The student also wants to study where he is surrounded by pleasant climatic and social conditions. At no other school can he meet with a more satisfactory place than the location of Michigan's. The air is bracing, pure, and in it the mind can work at its best. The people of the mining districts are whole-souled, are free with any information relating to their properties, and no better population morally can be found anywhere.

It would take more space than can be afforded in this work to properly describe the schools and its methods, but to those who may be interested catalogues can be procured by making application for them to the school.

At the head of the school is Dr. M. E. Wadsworth, learned but as few in the sciences pertaining to his position, and who combines with this knowledge the happy faculty of imparting it to the student. In Dr. Wadsworth the State has a brilliant man and one whose sole aim is to aid in the fame already achieved by this institution.

The board of control is made up of the following well-known gentlemen: Hon. J. M. Longyear, Marquette; Alfred Kidder, Marquette; J. R. Cooper, Hancock; P. C. F. West, Calumet; Hon. J. A. Hubbell, Houghton; Hon. Thos. B. Dunstan, Hancock.

REPORTS OF MINE INSPECTORS.

The inspection of mines, as provided for by State law, is observed in all the principal counties of the upper peninsula where mining is carried on. Iron county is the single exception, the board of supervisors having out off the salary, which defeats the object of the law. However, there is but little mining being prosecuted in that county at the present time, this being the reason for the failure to pay the inspector. The work of inspection is being followed out in other counties as the law directs. Every care is observed for the prevention of accidents. The latter are costly to the companies in that several days' idleness result after each fatality, the accident fund is lessened by $500, there is the chance of expensive litigation, and then there is the principal reason that a life has been ended. The mining vocation is a dangerous one, but the percentage of accident is gradually growing less. There are better explosives, better understanding of the proper care of ground, better methods of mining. In the past year a terrible accident at the Osceola mine, to which we refer in the mine description, has brought the percentage of that county to a high point. It was one of those unlooked-for occurrences that could not have been averted. It was an extraordinary calamity, and blamable to the carelessness of someone who set fire to the timbering of the shaft.

The following table, from the report of Josiah Hall, mine inspector, shows the number of fatal accidents in

HOUGHTON COUNTY,

for the year ending September 30, 1895.

Date.	Name of deceased.	Mine.	Circumstances.	Occupation.	Nationality.
1894.					
Dec. 11	Joseph H. Barlace	Quincy	Premature blast	Miner	English.
1895.					
Jan. 22	Jacob Heitala	Tamarack	Fall of rock	Trammer	Finlander.
" 28	James Phillips	Hecla	Burst steam valve	Mechanic	English.
Mar. 7	Jacob Breela	Tamarack	Fall of rock	Miner	Austrian.
Apr. 4	Peter Garyntygeiz	"	" "	"	Polander.
" 12	John H. Heikka	"	Fall from ladder	Laborer	Finlander.
" 22	David Isaacson	Quincy	Struck by skip	Lander	"
May 22	Alex. Mattison	Hecla	Fall of rock	Miner	"
" 24	John Kaivupalo	Tamarack	" "	"	"
June 1	Andrew Link	Quincy	Fall down shaft	Trammer	German.
" 8	William Holmes	N. Tamarack	" " "	Miner	English.
July 17	Wm. Karvanen	Atlantic	Fall of rock	Trammer	Finlander.
" 20	Paul Varbanish	Hecla	" "	"	Austrian.

Date.	Name of deceased.	Mine.	Circumstances.	Occupation.	Nationality.
Sept. 7	Capt. R. Trembath	Osceola	Suffocation	Miner	English.
" 7	Richard Bickle	"	"	"	"
" 7	Robert Johns	"	"	"	"
" 7	Richard Grenfell	"	"	"	"
" 7	William Bryant	"	"	"	"
" 7	John Undlip	"	"	"	"
" 7	Fred Peardon	"	"	"	"
" 7	Frank Lander, Jr.	"	"	Boy	"
" 7	James Williams	"	"	Miner	"
" 7	Thomas B. Curtis	"	"	"	"
" 7	Wm. H. Donald	"	"	"	"
" 7	Alex. Daniells	"	"	"	"
" 7	John Matson	"	"	Boy	"
" 7	Walter Dahl	"	"	"	Swede.
" 7	Peter Strandgaard	"	"	"	Norwegian.
" 7	Peter Malmstrom	"	"	Trammer	Finlander.
" 7	Isaac Harrio	"	"	"	"
" 7	Barney Hellner	"	"	Miner	Austrian.
" 7	Vincent Verbenz	"	"	"	"
" 7	Michael Schultz	"	"	"	"
" 7	Michael Voak	"	"	Trammer	"
" 7	Anton Zeswick	"	"	Laborer	Polander.
" 7	Andrew Rosinski	"	"	Miner	"
" 7	Michael Slotta	"	"	"	"
" 7	Joseph Slotta	"	"	"	"
" 7	Joseph Rasec	"	"	"	"
" 7	Stephen Ristivick	"	"	Trammer	"
" 7	Stephen Orlski	"	"	"	"
" 7	Michael Johnson	"	"	Miner	Finlander.
" 7	Jas. D. Harrington	"	"	"	Irish.
" 12	Michael Benich	Tamarack	Fall of rock	Timberman	Italian.
" 12	John Fayino	"	" "	"	"
" 13	Henry Rapson	Hecla	Fall from scaffold	"	English.

Total number fatalities, 46.

MARQUETTE COUNTY.

From the report of James Rough, mine inspector, it is seen that twelve fatal accidents occurred. One death resulted from blood poisoning, following treatment of a crushed foot.

The inspector reports having made 190 official visits, and that every instruction for the safety of the men has been speedily and properly carried out.

The list for the year is as follows:

List of fatal accidents in the mines of Marquette county, Michigan, from October 1, 1894, to October 1, 1895.

Date.	Name.	Occupation.	Nationality.	Mine.	Cause.
1894.					
Oct. 2	Peter Peterson	Trammer	Swede	Lake Superior	Crushed foot.
Nov. 17	William Langsford	Miner	English	Negaunee	Fall of ground.
" 20	James Prater	"	"	Lake Angeline	" "
Dec. 1	Lawrence Hickey	Shift-boss	Irish	Lake Superior	" "
1895.					
Feb. 13	Samuel Lease	Pit-man	English	Salisbury	Rock fell in shaft.
Mar. 15	William Chapman	Miner	"	Lake Angeline	Fall of ground.
" 20	Erick Makki	Trammer	Finlander	Champion	" "
June 2	Abraham Hakkola	Miner	"	Winthrop	" "
" 7	James Harrington	Surfaceman	Irish	Cliffs Shaft	Falling smoke stack.
" 10	Andrew Halstead	Miner	Swede	Queen	Fall of ground.
July 12	Henry Kullpakka	Trammer	Finlander	Republic	" "
Sept. 17	Charles Hulverson	"	Swede	Star West	" "

Total number fatal accidents, 12.

DICKINSON COUNTY.

The mine inspector for Dickinson county, William Trestrail, reports six fatal accidents for the year. In concluding his report this officer says he is pleased to note the lowered percentage of accident per 1,000 men employed that is steadily shown. In 1892 the percentage of fatal accidents for each 1,000 was 5⅓; for 1893 it was 3.615, and for 1894, 3.03.

The list of fatal accidents presented by him is as follows:

List of fatal accidents in the mines of Dickinson county from September 30, 1894, to September 30, 1895.

Date.	Name of person.	Occupation.	Nationality.	Mine.	Cause of accident.
1894.					
Oct. 7	Mike Petorila	Timberman	Hungarian	Pewabic	Fell down chute.
" 25	Frank Gorovaglia	Trammer	Italian	"	Cave of room.
1895.					
Jan. 20	John Anderson	Surface laborer.	Swede	Chapin	Fell down shaft.
May 14	Charles Palmgren	Gripman	Finlander	"	Fell down winze.
Aug. 8	Charles F. Fast	Miner	Swede	"	Fall of ore.
Sept. 11	Joseph E. French	Surface laborer.	French	Traders	Struck by piece of fly wheel.

Total number fatal accidents, 6.

GOGEBIC COUNTY.

Clarence M. Boss, mine inspector for Gogebic county, makes the following report concerning the list of fatal accidents in his county:

List of fatal accidents in mines of Gogebic county from September 1, 1894, to September 1, 1895.

Date.	Name.	Occupation.	Nationality.	Mine.	Cause of accident.
1894.					
Sept. 13	Joseph Sopko	Miner	Polander	Newport	Fall of ore.
Oct. 17	Charles Johnson	"	Swede	"	Fell through timbers.
" 24	Matt Kolto	"	Finlander	Tilden	Crushed by rolling mass of ore.
" 27	Ignatz Pavelline	"	Austrian	Pabst	Knocked from timbers by falling ore.
1895.					
Jan. 31	Edward Jacobson	Timberman	Finlander	East Norrie	Shock of electricity.
Feb. 27	Richard Lowrey	Miner	English	Norrie	Fall of ore.
Apr. 4	Louis Tickuli	"	Hungarian	Tilden	Fell off cage.
" 8	Jacob Lake	"	Finlander	"	Knocked from timbers by falling ore.
June 5	Thomas Inch	"	English	Norrie	Fall of ore.
July 31	Antone Ventinsiquo	"	Italian	Tilden	" "
" 31	Julius Panico	Laborer	"	"	" "

Total number fatal accidents, 11.