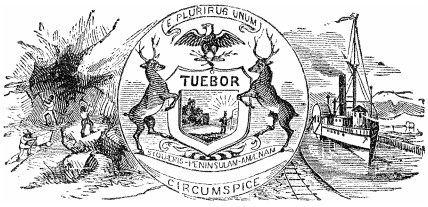
STATE OF MICHIGAN,

MINES AND MINERAL STATISTICS

BY

GEORGE A. NEWETT

COMMISSIONER OF MINERAL STATISTICS.



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ISHPEMING:
PRESSES OF IRON ORE PRINTING HOUSE,
1897.

LETTER OF TRANSMITTAL

STATE OF MICHIGAN,
OFFICE OF THE COMMISSIONER OF MINERAL STATISTICS,
Ishpeming, Michigan, May 1, 1897.

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

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

Respectfully, your obedient servant,

GEORGE A. NEWETT,
Commissioner of Mineral Statistics.

INTRODUCTORY.

The year 1896 has witnessed no diminution in the interest taken in the mining of the minerals of the State of Michigan. Activity has been manifested in all branches of the industry, and there has been a decided gain in some of the most important ones. The producers of iron ore and copper were generally well repaid for the capital and labor employed in these enterprises, the conditions generally being improved over those of the year previous. The value, marketed, of the minerals of the State for the year just closed amounts to about $34,500,000. The increased price for iron ore and copper adds largely to the sum total as compared to that of a year ago. In arriving at the value of the iron ore I have added the cost of freighing, the price being for the ores delivered at Lake Erie or Lake Michigan ports. It is fair to do this in view of the fact that the capital invested in the freighting is principally furnished by Michigan people. Many of the mines possess their own vessels, while others have both vessels and railroad. The labor finding employment in the different branches is principally resident in Michigan, and it is proper to give our State credit for the price of the ore delivered.

The growth in population of the Upper Peninsula has been steady and valuable, the class of people being desirable, representing the best of the different lands from which they hail. Those who come find place in our mines, and the latter are responsible for the thrifty condition nearly everywhere apparent. It is true that there are small villages now almost uninhabited where a few years ago all was bustle and business activity, but these are the exceptions. Mining is more or less precarious, and there have been failures, but in the districts where mining was first begun, and where the formations are regular and strong, the towns have thrived, have adopted all modern improvements commensurate with their size, and the inhabitants have been remarkably successful.

With reference to the future, Michigan has a reserve of those minerals staple in the markets of the world to last far beyond the wants of many generations to come. The State can truly be said to be in its infancy in the disclosing of its underground treasures, and I look for a great addition not only in the volume of product of iron, copper, salt and coal but in branches where now but little or nothing is being done. A territory so vast as is this requires long time to properly prospect and develop, and little attention has been given to minerals aside from those above mentioned. The Upper Peninsula offers a great field for the prospector versed in the science of mineralogy and geology, and I look for important gains to the State not only from Upper Michigan, but from Lower Michigan as well.

Thus far little has been done in the way of reducing the ores in close proximity to the places where they are mined. When the time shall have arrived that the reduction will take place near the shafts then will Michigan witness a great impetus to the mineral industry and a vast gain to the welfare of the commonwealth. Development of the different mineral-bearing districts has been wonderful. The few years that have elapsed since the outcroppings of iron ore and copper first attracted the attention of the early searcher have seen giant strides. Nowhere in the world can such mining machinery be found as is here. Nowhere else have such deep shafts been sunk; nowhere has money been expended so freely in the successful conducting of mining. It is the wonder of the world, and to view its magnificence, skilled men come from all portions of the habitable globe to learn how we have built and to dopy from the many striking examples here to be seen. It is a revelation to the foreigner who comes from the biggest mines of the world. At first glance it is somewhat

mystifying, and the beholder is imbued with a healthy respect for American enterprise and Michigan confidence.

Michigan possesses natural advantages for the ready distribution of her mineral products equalled by no other State in the union. Her immense mines of iron and copper are located within a few miles of Lakes Superior and Michigan, while her vast beds of pure salt are close besides Lakes St. Clair, Huron and Erie. This is a most important point in the meeting of the active competition that is everywhere apparent, and it is one that will always be possessed. With the deepening of the channels of our waterways, this permitting of greater loads being carried by the boats, it adds much to the advantage of the State. The waterways are of greatest value to Michigan, and I am pleased to note the interest being taken in their improvement. Where a vessel can take 500 tons more ore than before the deepening of the channel is accomplished, it shows what can be realized in a season by the immense fleet now plying on the lakes. It must effect a wonderful saving in the marketing of our ores, as well as in the securing of the coal that the vessels are loaded with in returning from Cleveland and other lower-lake points.

Those engaged in the development of the mineral interests of this State are an enterprising people, adopting all manner of modern conveniences and apparatus for the economical production and handling of the output of the mines and furnaces. They are at the fore in every progressive move, taking the initiative in all that pertains to advanced methods, and this speaks well for the future successful operation of the immense industry now so well begun.

Everywhere I go among the mines I find the managements alive to the importance of thorough equipments of machinery, the best classes of labor, the proper ventilation of their underground workings, and the protection of the miner and mine. Decided changes for the better have taken place within the past fifteen years, and old mines are being re-opened that were forced, in years gone by, to suspend because they could not be worked without resort to the unpopular assessment. The most striking examples of this are in the copper district, where there is now being much done in the way of revival of idle properties,

In the coal and salt fields of the Southern Peninsula greater interest is being manifested in development work than ever before, and several new properties have been added to the list of a year ago. Improved methods are aiding here in the more economical working of mines and blocks, suggesting substantial increase in product, and the employment of a greater amount of labor.

The year 1896 has been almost entirely free from labor troubles in Michigan mines, labor and capital showing a disposition to talk over differences and to settle them in a business-like way. The best of feeling has prevailed and greater comfort to both sides has been the result.

In my last report I referred to the fact that the number of volumes, 1,000, issued from this office annually did not begin to supply the demand. I have several hundred inquiries for the report preceding this that I am unable to fill, the edition being exhausted. The value to the State of this office is in having the facts concerning its mineral resources distributed amongst those who have an interest in them, and I regret that the State has not arranged for a greater number. Two thousand volumes would be none too many to give to all who apply for a copy, and I would be pleased to see a change made in the law providing for such increase.

While the statistical tables appearing in this volume are for the year 1896, I have brought up the mine descriptions to the time of publication, thus giving the most recent changes that have occurred in the different ranges.

In my visits to the many properties I have everywhere been received with courtesy, and given every possible opportunity to examine the workings of the mines, etc., being greatly assisted in my work by the kindness of the representatives of these producers, and I here wish to extend my thanks for such helpful favors.

GEORGE A. NEWETT, *Commissioner*.

IRON ORE.

Michigan still holds the proud distinction of being first in the list of States in the production of iron ore, a place she has held for many years, and one she can retain for many more to come. In common with the mines of Wisconsin and Minnesota, she produces an ore that must be employed in the manufacture of steel, and outside of which States, (bordering upon Lakes Superior and Michigan), but a small percentage of the required amount can be obtained. Ores the richest in iron, the purest in desirable physical features, and the greatest in demand are only obtainable (in the United States) in this favored region adjacent to the waters of these lakes just mentioned. As long as Michigan yields so bountifully of such pure ores the country will have to seek no further for its supply, and the present gives every indication of an abundance lasting far into the future. Coupled with the great purity of the product, the nearness to the lake ports, where immense docks are constructed for its ready handling, places the Michigan mines in position to meet the keenest competition from this country or from any foreign source where anything like as good wages are paid to labor as here.

Michigan has been magnificently treated by Nature in the depositing of its ores so that its transportation is ready, and at low cost, and its chemical make-up suited to the wants of the consumer. As consumption increases—and it will increase—still greater calls will be made upon the mines and, while other States are increasing their production, Michigan will keep pace with the most progressive, and favored. She has, in addition

to the desirable ores, the experience in mining, the money to conduct these great enterprises, and will carefully study every point calculated to please the consumer and to keep her labor employed. She has an immense capital invested in the business, and to keep this busy at a profit will be one of the chief aims of those who are principally interested. Nowhere can a more progressive lot of mining men be found than within the border of this grand State. While the past few years have brought about many changes requiring the careful thought and best ability of men to contend with, they have been philosophically met and, while former profits have been considerably reduced, improved methods have succeeded in keeping the industry alive and generally in fair health. The trying period was not without its lesson, stern necessity having brought much to the aid of the mine owner and the miner many features that were not applied in the time when higher prices for ore and labor were obtainable.

During the year 1896 Michigan sent to market 5,448,969 gross dons of iron ore, making a grand total for the State of 83,360,681 tons. This was 614,298 tons less than shipped during the year previous, and is accounted for in the stoppage for several months during the year of the Norrie and Tilden mines, the largest producers on the Gogebic range. The value of the marketed product is estimated at $17,549,146.

In the beginning of the year the principal operators of mines of the several ranges possessing ore of bessemer grade, held a meeting at which there was an understanding arrived at concerning the product of each mine, and the price at which the different grades would be sold. This agreement was honorably kept by the Michigan miners, and resulted in great good to the industry in that it prevented overproduction and insured a price at which all could work, giving to the laborer a living wage. The ores of the Norrie mine were scheduled at $3.40 per ton, a trifle high, in the estimation of the consumer, but whether this was true or not the property was discriminated against in the buying, and the result was that its stockpile room was filled and it was forced to suspend, this entailing hardship upon the company and its employes.

Several meetings were held in the spring of 1897, and at this writing, April 15th, there has been an understanding reached between the producers of bessemer ores of all Michigan ranges, and all others on Lake Superior with the exception of the Mesabi, Minnesota. The final understanding was only secured after numerous meetings and after the Mesabi interests had withdrawn. With so many different grades of ore, and different conditions as met with upon the several ranges, it was not an easy matter to fix prices and allotment of product for the mines, but, after much labor, it was accomplished. The price agreed upon is the lowest yet quoted upon the bessemer ores of the Lake Superior region, and was purposely made so in order that prominent operators in the Mesabi range could not take possession of the market.

In the figuring out of the relative value of the different ores the greatest pains were taken so that now each mine has its price fixed according to the chemical content of its ore, so that even the fraction of a cent is allowed. With from forty to fifty different ores the miners were forced to give to each its proper price and place, and they worked from a suppositious ore, the Norrie, of the Gogebic, to obtain the base. The ore is supposed to contain 63% of iron, .045% phosphorus, and 10% natural moisture. Moisture was taken into account and freighting to a point midway between lake shore and Pittsburg was considered, basing the price on a dried ore at furnace intermediate between those on the lake shore and those at Pittsburg. The iron value and phosphorus value are given closest attention and a table has been prepared showing rates of progression and values that is eminently fair. If the agreement cannot be kept in force under this plan then it is useless to attempt it, because a better could not be offered. It will effectually do away with all the talk of discrimination that was advanced by many miners during 1896.

The great care taken in making up the schedule of values of bessemer ores, the following table will well illustrate:

PHOSPHORUS TABLE

Percentage.	Rate of Progression.	Phos. Values.	Percentage.	Rate of Progression.	Phos. Values.
.070	$0.0200	$0.3500	.037	$0.0115	$0.0780
.069	.0195	.3300	.036	.0120	.0900
.068	.0190	.3105	.035	.0125	.1025
.067	.0185	.2915	.034	.0130	.1155
.066	.0180	.2730	.033	.0135	.1290
.065	.0175	.2550	.032	.0140	.1430
.064	.0170	.2375	.031	.0145	.1575
.063	.0165	.2205	.030	.0150	.1725
.062	.0160	.2040	.029	.0155	.1880
.061	.0155	.1880	.028	.0160	.2040
.060	.0150	.1725	.027	.0165	.2205
.059	.0145	.1575	.026	.0170	.2375
.058	.0140	.1430	.025	.0175	.2550
.057	.0135	.1290	.024	.0180	.2730
.056	.0130	.1155	.023	.0185	.2915
.055	.0125	.1025	.022	.0190	.3105
.054	.0120	.0900	.021	.0195	.3300
.053	.0115	.0780	.020	.0200	.3500
.052	.0110	.0665	.019	.0205	.3705
.051	.0105	.0555	.018	.0210	.3915
.050	.0100	.0450	.017	.0215	.4130
.049	.0095	.0350	.016	.0220	.4350
.048	.0090	.0255	.015	.0225	.4575
.047	.0085	.0165	.014	.0230	.4805
.046	.0080	.0080	.013	.0235	.5040
Base .045	.0075	.0075	.012	.0240	.5280
.044	.0080	.0080	.011	.0245	.5525
.043	.0085	.0165	.010	.0250	.5775
.042	.0090	.0255	.009	.0255	.6030
.041	.0095	.0350	.008	.0260	.6290
.040	.0100	.0450	.007	.0265	.6555
.039	.0105	.0555	.006	.0270	.6825
.038	.0110	.0665	.005	.0275	.7100

For 1897 the price of Norrie standard bessemer has been fixed at $2.65 per ton, this for the ore delivered at Lake Erie ports. The same ore was scheduled at $.340 per ton in 1896. An ore that brought $4.25 in 1896 is listed at $2.92½; of Lake Angeline fancy grade that sold at $4.50 last year, $3.11. By this it will be seen that fractions of a cent are figured in making the price, the base being understood and from which a fair determination can be made. Chapin ore is listed at $2.40 this year, a big reduction from 1896 price, and Chapin is a desirable ore that gives better than 60% in iron and is very steady at .065% in phosphorus. The price is fully 75 cents per ton less than secured in 1896,

and is too low for comfort. Non-bessemer ores are not included in the agreement, but standards like the Queen mine, Marquette range, are expected to bring from $2.25 to $2.30 per ton. In the market there is a differential of about 25 cents per ton between the Mesabi and “old range” ores in favor of the latter. In the mining of the ores of bessemer grade the Mesabi meets with considerable non-bessemer that has to be hoisted, or shoveled, and in this way has a certain amount of it that can be sent to market even at the very low price stated, but it could hardly find a profit were it to engage wholly upon ore of such class. There is a rail freighting charge of 80 cents per ton from mine to lake port, an additional 80 cents lake freightage from upper to lower lake ports, which, when added to the royalty and cost of mining and selling, could scarce leave anything for the miner.

Michigan evidently occupies the favorable position for the furnishing of non-bessemer ores by reason of the nearness to market as compared to other States, and those of Michigan nearest market are in the best position as compared to herself. It costs as much to mine the non-bessemer ores as it does the bessemers; the freighting charge is the same, and the only difference is in the amount of royalty charged the miner by the owner of the fee. A majority of the mines of all ranges pay royalty, and in many cases the latter is excessive. Considering its fine quality, and the price now being quoted there is little danger of Michigan’s product not being popular in the market. Furnacemen know just what the ores will do in the stack, are familiar with the proper mixtures for certain grades of iron or steel, and with the price now presented will not hesitate to buy when ore is needed. The fault is that the ore is being offered for less than it is worth. The companies are selling the cream at skimmed milk prices. The low-priced battle is being forced too vigorously, and when the time comes for an increase it will be found difficult to make it. The ore once taken from the earth cannot be replaced; mining is subject to many chances, and the margin is not sufficiently large to give the investor a fair percentage for the risks he takes. Indeed, with the present condition of things, it is only the most powerful that can live. The contest of the “survival of the fittest” can be said to be fairly begun, and the present year, 1897, will find active at its close only those that Nature and Fortune have smiled upon. The price cannot be met except by those having exceptional facilities for the mining and marketing of their products.

There is still a demand for ores high in silica and low in phosphorus, these being principally used as mixtures for the Mesabi ores. Two ranges, the Marquette and Menominee, are furnishing these, which they alone are able to do by reason of their fortunate geographical location. The price during 1896 was about $2 per ton. No quotations have been made for these ores for ’97, but I find preparations are under way to resume their production at the several properties that have furnished the bulk of this class of material for the past three years, within which time the demand has sprung up. There is an unlimited amount of this ore in the Marquette and Menominee ranges, millions of tons being exposed, and it promises to be of considerable importance in the market.

In writing of the iron ore producing districts I shall take them up in chronological order, associating the mines with the towns nearest to which they are located so that the reader may more readily follow.

THE MARQUETTE DISTRICT.

The Marquette iron ore bearing range is one of the most extensive in the Lake Superior region as well as the most attractive to the mineralogist and geologist. It was the first discovered, and greater interest has probably attached to it than to any other due to the fact that it was the first to prove to the world the rare value of the iron ores of this State. Of its discovery and subsequent development there is nothing that has not already been told over and over again until all are familiar with its earlier history. It has been a wonderful district in a mineral way, and still enjoys prominence in the limited list from which ores of high grade are mined. No other Michigan range yields the hard ores for which the Marquette is noted, and the Vermillion, of the Minnesota fields, is the only other producing hard ores in the Lake Superior cuntry. Its great variety of product adds attractiveness to its mineral possessions, it giving plentifully of ores that are needed for any desired brand of iron or steel.

Years ago the hard ores were the favorites with furnacemen, and it was not until about twenty-five years since that the softer hematites were looked upon as possessing any great value. I well remember when ores of the softer class, the "hematites," as they were locally termed, were used for the grading of highways. When crushed finely they made a very firm, although dusty, street, and at many places in this county are still to be seen the hematite roads that have well withstood the hard usage to which they have been subjected. The softer ores are now the ones most sought after, it being claimed for them that they smelt more readily than the harder, and that the iron manufactured from them is fully equal to that made from the latter. The hard ore, the speculars and magnetites were certainly more attractive to the eye of the early explorer. It looked more like iron, and for many years it was the ore sought and wrought. Now, the hard ores are greatly in the minority of the amount mined and shipped, and much of that secured has to be reduced by crushers located at the mines in order that a market may be had. Once crushed it is popular, as it has very little moisture and is generally richer in iron than are the softer ores. These crushing plants are now in operation at the Cliffs Shafts, Ishpeming; at Champion mines, Champion, and one is now being constructed for the Lake Angeline mine, Ishpeming. These, with one reducing flag ore at the Traders mine, and one at the Millie mine, Iron Mountain, Menominee range, are the only crushers in use at the Michigan mines. Others will Undoubtedly be added in

the near future, one point being at the Republic mine, Marquette county.

The variety of product and their nearness to lake ports is of inestimable value to the mines of the Marquette range. The importance of this is shown by the fact that an engine and single crew can make three round trips per day between the mines of Ishpeming and Negaunee, the present ore centre of the county, and lake port, whereas one trip is all that can be made from other districts. With the modern cars and engines and docks this means the handling of about 6,000 tons of ore per day with a single engine and crew.

There have been important additions of ore deposits made since the publication of my last report which will be described in treating of the different mines, and the district generally is well prepared for a big output in case the market calls for it. The Marquette range is not the easiest to prospect, it being more irregular than any other in the State. There has been a great disturbance on the earth's crust throughout the entire length of the iron ore-bearing formation, and this is apparently more pronounced where the deposits are the largest and richest. There has not only been a lateral pressure from north to south but there has also been a buckling by reason of an end pressure, these forming inclinations in the trough of fold, and it is due to these causes that we have the iron ore deposits and mines.

It is generally conceded that these are sedimentary deposits, and in order to possess them there must have been a place for the deposit to be made—some big depression the bottom and sides of which were impervious to water. In the Gogebic ore range the ore has been concentrated upon immense dikes cutting the older formation at nearly right angles, this forming a V-shaped trough in which the ore is found. In the majority of cases on the Marquette range the bottom of the ore-bearing troughs are diorite, while in others the union of dikes with the diorite form the troughs. That these dikes have served a most useful purpose in this district, as the Gogebic, is very apparent. (Covering these immense troughs were what are locally termed the Upper Marquette and Lower Marquette series, and from which the ore is supposed to have been, extracted. These upper series of rocks were badly shattered, filled with cracks through which the water entered and ran to the bottom, of the troughs where it was stopped because it could not escape. It is a well-known fact amongst miners and mining men that a few inches of soapstone effectually resists water penetration, and that the folding of the formation did not crack the soapstone as it would the flinty rocks, so that the soapstone footwall afforded just the place desired for the collecting of the water containing the ore in solution. The surface waters, charged with oxygen, flowed down through these crevices of the Marquette series decomposing the iron carbonates with which they came in contact, and were thus carbonated. These carbonated waters were then capable of taking other carbonated waters into solution. The oxides or carbonates of iron, may also have been taken into solution through, the agency of organic acids. The union of this with other surface waters would cause precipitation of the iron oxide, and the abundant waters would also dissolve the silica which would be replaced by the ore. It is noticed, that where the shattering of the rocks has been most violent there the biggest ore deposits have been found because there was better opportunity for the surface waters to penetrate plentifully to the bottom of the folds or troughs.

The explorer for ore should therefore seek places in the iron formation where there are pitching troughs in which the water of past ages would naturally flow. The ores may rest upon a dike, the shale, a diorite or slate—anything that will be impervious to water. In the case of the Teal Lake mines, Negaunee, the ore is concentrated upon a slate that has a decided pitch to the east and south, and in looking for ore in this formation the outward swing of the line between the slates and the iron bearing formation should be sought. As the ore rests upon this slate, or upon it in conjunction with a dike cutting through the slate, it is very evident that the outer boundary is the proper in which to search.

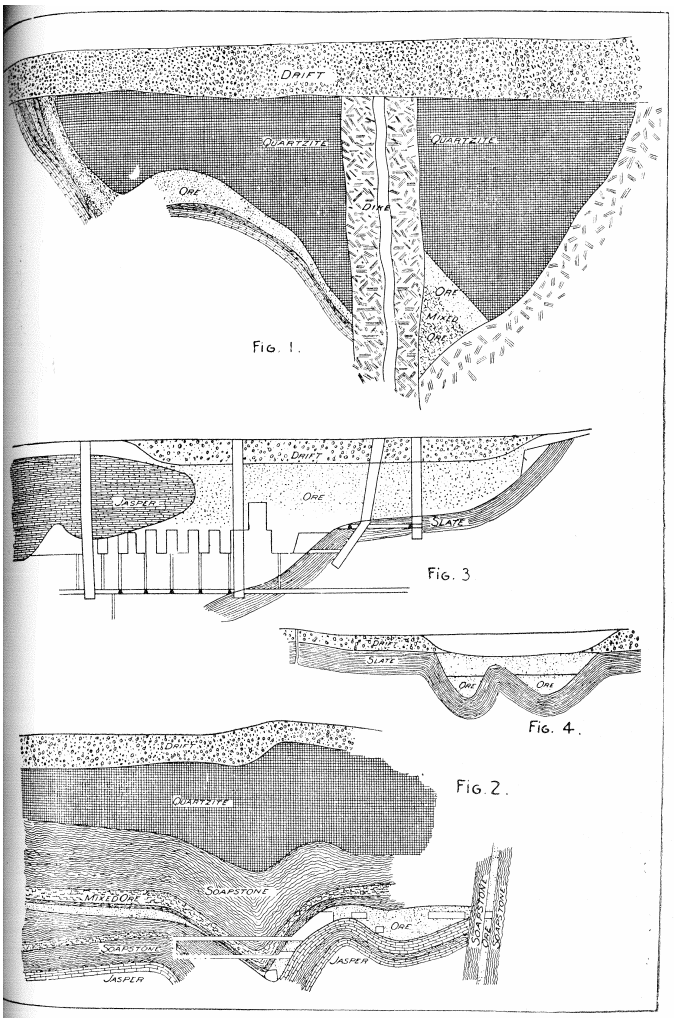
In the troughs wholly within the intrusive rocks, and in which the Ishpeming mines are held, the ore may be found almost anywhere there is a pitching trough, and may rest upon dikes or the diorite. These ore deposits may not outcrop, and often they do not, and then the diamond drill or other plan of exploring has to be resorted to.

The hard ores are always found near the contact of the Negaunee formation and the Ishpeming quartzite, and generally occur in a fold of the formation. The Republic mine is in one of the plainest folds in the district, is about seven miles in length, and the parallel sides are from one-half to one mile apart.

The principal discoveries of ore made since my report of a year ago have been in the Ishpeming and Negaunee basins, where considerable of value has been revealed. These additions make up in part for ore bodies found many years since and which have been mined out.

There is a very promising field for exploration to the east of Negaunee city where the folding of the formation is marked and where ore has plenty of change to have been deposited. To the westward of Ishpeming city the formation extends westward in two wide arms, and is covered by a very heavy drift that is difficult to penetrate without the expenditure of considerable money in diamond drilling or shaft sinking.

The plates that appear in connection with the ore occurrence of this range are from the 15th annual report of the geological survey of the United States government, the most of them being prepared by Mr. J. R. Thompson, who was formerly identified with the mining interests of the Marquette range:



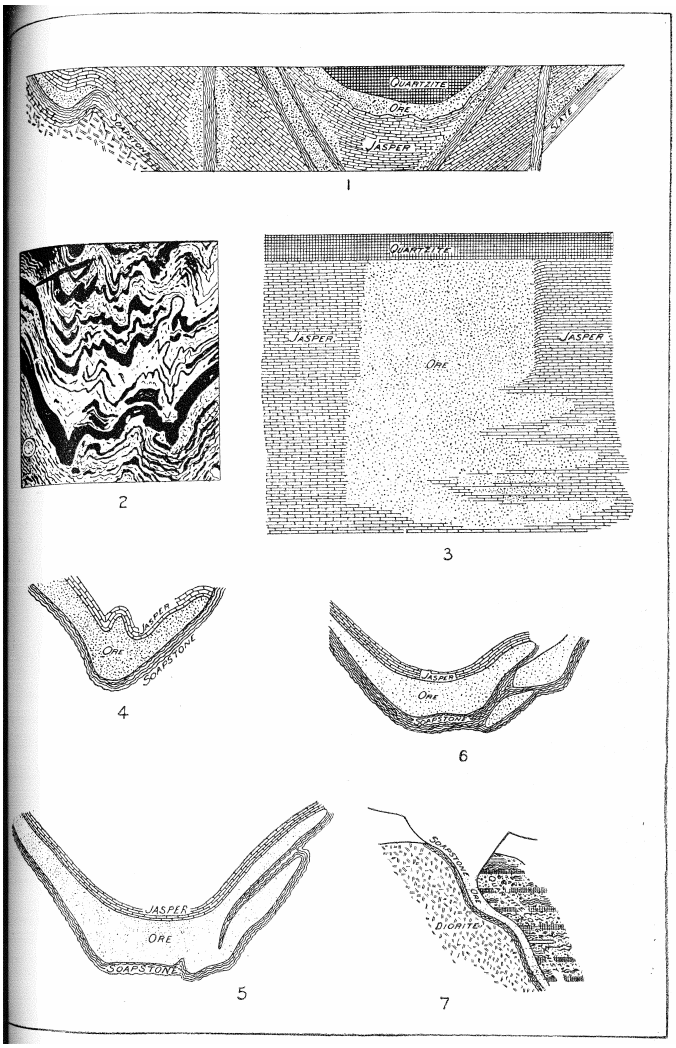
ORE DEPOSITS OF THE MARQUETTE DISTRICT.

FIG. 1. Cross-section of Section 16 mine, Lake Superior Iron Company. On the right is a V-shape trough made by the junction of a diorite mass and a dike. The hard ore is between these and below the Ishpeming quartzite. On the left the hard ore again rests on soapstone, which is upon and interstratified with jasper, and is overlain by the Ishpeming quartzite. Scale: 200'=1".

FIG. 2. Cross-section of the Barnum mine showing hard ore resting either upon folded soapstone or upon jasper, and overlain by soapstone. At the right of the figure is seen a layer of ore between two soapstone dikes. Scale: 200'=1".

FIG. 3. Longitudinal section of the Queen, Prince of Wales, and South Buffalo mines, showing the soft ore resting upon an impervious foot-wall of Siamo slate, and grading upward into jasper. Scale: 200'=1".

FIG. 4. Cross-section of same showing how the slate is folded into two troughs, which is shown by the longitudinal section (fig. 3) to have a western pitch. Scale: 200'=1".



ORE DEPOSITS OF THE MARQUETTE DISTRICT.

FIG. 1. Generalized section showing relations of all classes of ore deposits to associated formations. On the right is soft ore resting in a V-shape trough between the Siamo slate and an eruptive dike of soapstone. In the lower central part of the figure the more common relations of soft ore to vertical and inclined dikes cutting the jasper are shown. The ore may rest upon an inclined dike, between two inclined dikes and upon the upper of the two, or be on both sides of a nearly vertical dike. In the upper central part of the figure are seen the relations of the hard ore to the Negaunee formation and the Ishpeming quartzite. At the left is soft ore resting in a trough of soapstone which grades downward into diorite.

FIG. 2. Sharply plicated jasper (black belts) and ore (white areas) showing shattering of the jasper and concentration of the ore. The ore is proportionately greater where the folding has been sharpest. Drawn from photograph from southeast corner of Republic horseshoe.

FIG. 3. Horizontal section of chimney ore on east side of Republic horseshoe. The left side of the ore is bounded by cross-joints. The The right side is bounded in part by a sharp flexure passing into a joint, and in part grades into the lean banded jasper and ore. Scale: 20'=1".

FIGS. 4, 5 and 6. Three cross-sections of ore in trough of soapstone grading downward into diorite. In fig. 4 the ore deposit is solid. In fig. 5 a dike offshoots and nearly separates this ore body into two parts. In fig. 6 the two dikes divide the same ore body into three parts. Scale: 200'=1".

FIG. 7. Cross-section of National mine. On the left is soapstone grading into diorite. Above this is hard ore, and overlying the hard ore are interstratified conglomerate, quartzite, and schist. The ore is here plainly due to a replacement of the silica of the different sedimentary bands by ore, although the original conglomerate was heavy ferruginous. Scale: 200'=1".

The Marquette district sent to market during the year 1896, 2,605,152 long tons of ore, exceeding by 509,986 tons its record for 1895. The total production of the district up to and including the year recently ended is 46,542,662 long tons, or about 55% of all the ore sent form the State of Michigan. The production of 1896 can be duplicated for many years to come, and it could nearly be doubled if there was the market for ores of non-bessemer grade that was present a few years since.

Marquette producers of ore are more favorably situated concerning royalties than those of other districts, the mining companies, with but few exceptions, owning their own mines and large tracts of land besides. This is of great advantage. It may be true, too, that it costs Marquette miners more to produce their ore than it does those operating upon some of the other ranges. In the hard ore mines the tonnage per man is certainly not as great as is secured in such mines as the Norrie and Tilden, of the Gogebic, or of the Chapin of the Menominee range. The hard ores have not always to be timbered like the mines yielding softer ores, but the difference in the cost of winning a product is in favor of the softer ore mines nevertheless. Nearness to lake port assists with the owning of the fee. A new railroad, the Lake Superior & Ishpeming, to which I referred in my last report, is now completing its line from Marquette to Ishpeming, and will be ready to take the ore of the Cleveland-Cliffs and Pittsburgh & Lake Angeline companies, Ishpeming, as well as that of the Queen mine, Negaunee, the line being owned and operated by the two companies first named. This insures handling of the product readily and at the lowest possible price. It also assists other mines in securing favorable rates. With their own railroad, boats, and in some instances furnaces, the big concerns of the Marquette range can continue in business and can meet the keenest competition from other states and countries.

Work upon the Marquette range was steady throughout the year with the possible exception of the Queen and Lake Angeline mines that were idle several months in the fall. At this writing, April 15, '97, all are busy, and expect a lively season although with prices that offer but little inducement for the exhaustion of the mines.

MINES OF NEGAUNEE CITY.

The city of Negaunee, a bright town of something like 7,000 people, is one of the principal attractive mining places in this district. It possesses fine residence and business houses, excellent highways, good schools and churches, electric lighting, water works, sewerage, a street car line, and has three lines of railroad. Its entire population depends for a livelihood upon the mines located within its city limits, and it is pleasing to note that the prospects for a considerable improvement in the volume of ore sent from this place is flattering. There have been important discoveries made within the year, valuable territory has been added, and the Negaunee basin is destined to take on still greater attractions. I consider the territory to the eastward of this city to be of the most promising nature for the holding of ore deposits, and believe intelligent exploration will prove the correctness of the opinion. I know of no other place in the State where the conditions pointing to this conclusion are more favorable. The most easterly of the mines of Negaunee are those of

THE QUEEN MINING COMPANY.

located on section 5, Town 47, range 26, and described in my last report under the title of "The Buffalo Mining Co." and locally known as the Queen, Prince of Wales, Buffalo and South Buffalo. These properties sent out, during 1896, 325,571 tons of ore, making a total production up to and including that year of 2,379,276 tons. The well-known firm of Corrigan McKinney & Co., of Cleveland, Ohio, are the operators, and the local affairs are well looked after by the superintendent and general manager, Mr. T. F. Cole, of Negaunee.

The operators of the Queen group of mines have also acquired possession of the majority of the shares of the Blue mining company, whose property adjoins the Queen immediately upon the west, the transaction concluded in January, 1897.

The history of this group of mines, is interesting, but so well understood that to give it would simply be repetition. It has certainly had a career of the "checkered" kind, but is now in good hands, and will be important in the market for many years to come. The property was operated rather spasmodically during 1896 due to the changes in the market. There was also a period of idleness pending the settlement of royalty differences. Work of mining was stopped at the Prince of Wales mine and at the Queen mine No. 1 shaft on the 7th of last September since which time nothing has been done at these places. No levels have been added in these shafts since the publication of my last report, a year ago, but both have had old levels opened up to the westward, and the Prince of Wales has also been carried west and northwest. There are fine stopes showing that can be attacked whenever the market demands it, and everything below and above ground is in readiness for resumption at a day's notice. The ore of this portion of the property is non-bessemer, high in phosphorus, and admirably adapted to the making of foundry irons. Each

of these properties have reached a depth of 450 feet. The deposits of the South Buffalo have been exhausted, their pitch carrying them upon the territory to the west. At the Buffalo there is ore still in sight but nothing in the way of mining it was done during the year.

As I have before described, the ore of this group of mines occurs in troughs made by the folding of the slates. These troughs have a westerly pitch, the one to the north holding the Prince of Wales, one next in order going south, the Queen, and a third of the same direction has what is called the “Regent” lens. It is upon this latter ore body that the company is confining its operations at the present time.

They are mining this, as we described in a former report, on the caving plan which here works to perfection. They have mined out the ore for four levels, taking it clean and safely. There is no waste, and the figures show that there has been an excellent handling of all matters pertaining to the property. Costs have been kept down remarkably low, and the wages of the miners have been good, no cutting having as yet been announced.

They are now mining on the fifth level, where they have a body of ore 360 feet long by 180 feet wide. There are many rock intrusions in this, however, soapstone and jasper being frequently met with. They are sending to surface daily from 1,150 to 1,200 tons of ore from this level, and the force of men all told is about 325, so that excellent results are being obtained. The product per man is what tells the story, and it is as satisfactory here as in any mine in the district. The ore is soft and mines easily, the caving plan having its advantages here, and it tells in the stockpiles. The deposit is wide and many men can. be gotten into a single level. They hurry the work through as rapidly as possible, timbers being used that will care for the burden but a short time. The use of small pieces tends to lower cost. They adhere to the method of working described in my last report, it being on the caving, or wrecking plan, sub-levels being opened and many men given place in a level. At the west end of the workings the capping grows heavier, owing to the pitch of the ore, it being 240' thick, but thus far it has broken off readily.

They have the double skip road shaft down to the sixth level, 348 feet from surface, have cut out the plat, .and are going downward for the seventh level. Opening work is kept well ahead here, it being the practice to have plenty of available territory, this being an advantage in the better draining of the ore and in case added product is needed it can readily be secured.

The pitch of the ore body which is about 45° to the west will carry the Queen ore to the Blue line at about the eighth level, and they expect to make connection, between, the two mines at this point. On this level, or at a depth in the Queen of 450 feet there is a rock drift reaching to the Blue. Through this the water from the Blue is conducted to the main pumping station at No. 1 Queen shaft.

Some years ago the Queen company sought for the ore in the direction where since the Regent lens was encountered, but they put in horizontal borings from the lower levels of the Queen, and the latter passed under the Regent lens, at the eastern end of the latter. This shows how easy it is to miss a good, big mine with a diamond drill exploration. Vertical holes caught the deposit some years later.

In the capping of the Regent lens they found a pocket of ore, and have mined it from the fourth level. They are driving for it from the fifth level, but have not reached it as yet.

The shaft of the Regent lens follows down with the angle of the foot, and there is little variation in the latter. Before starting it they took pains to get correct bearings with the diamond drill. They use hand tramming here, as the distances from stopes to shaft is short. The skips hold sixty-six cubic feet of ore and are operated in balance, five-foot drums being used.

Just how the Blue will be handled has not been decided. It will depend upon the conditions met with when they get into that territory. At the second level there are a few pillars left that will be taken before anything in the way of actual mining is done. They are now establishing points in the Queen from which operations will be conducted in the connecting of the two mines, which will undoubtedly be worked as one at no very distant time in the future.

To the west of the Queen and Prince of Wales there is considerable rock encroachment in the ore deposit, the latter being pinched up closely in places, but further on the ore gives signs of widening again, and may open out wide and clean. The chances favor this I believe. If this proves to be correct they will break through the rock to the west of Queen No. 1 shaft, and this would then be one of the principal hoisting shafts. The territory added in the acquiring of the majority of the stock in the Blue mine is an important one. It gives the company 1,640 feet of land to the west, in which direction the ore is pitching, and being directly in the valley holding the mineral. The Blue deposit has been opened on its trend for 320 feet west of the Queen’s west line. The lowest level in this property is 460 feet from surface, and the shaft has been extended 80 feet below this. Nothing has been done in this property since October of 1804. There is a substantial shaft in the south foot-wall. The ore is similar to that of the Recent lens, Queen mine, yielding 62% iron and .100% to. 120% phosphorus. There is an adequate plant of machinery and the mine can be gotten in readiness for active mining upon a few days' notice.

The mines of the Queen company would be able to produce 600,000 tons annually could a market at fair price be found for the product. All the different branches are looking well. The mines are thoroughly ventilated, have many places of egress, are safe, and are well equipped with machinery. Nothing has been added in the latter line for some time past, it not being needed. The company has a valuable possession and will diligently carry on the task of its exploring and

developing. The ores, while generally of a non-bessemer grade, are desirable. A spur of the Lake Superior & Ishpeming railway is now (April 15, '97) being run to the stockpiles of the company, this giving three lines over which the latter can ship its ores.

The underground development at the properties of the Queen and the Blue gives great encouragement for added discoveries in the same valley. There is no reason why ore will not be found still further west and up to the active portion of the city. Because a few testpits and diamond drill borings have not shown satisfactory results, it does not follow that ore does not occur in sufficient amounts to pay for its extraction. As has frequently been shown, it is an easy matter to miss a mine in the haphazard method of exploration that has been conducted here in the past.

The first instance of working cages in balance with a single engine is credited to the Prince of Wales. Mr. Cole, upon taking charge of this group of mines, found a hoisting plant at the Prince of Wales shaft consisting of one 18"x24" slide valve engine geared to drive two six-foot drums possessing face of five feet. There was a fly wheel eight feet in diameter on the crank shaft to steady the engine. The ore deposit widening out on the 450-foof level of the mine necessitated increased hoisting facilities. They had a rope haulage plant to convey the ore through a rock drift 465 feet from the deposit to the shaft, a double track being used, and something better for hoisting the ore through the shaft was desired. The drums were of the old-style band-friction kind, and the depth of the mine made the load too heavy for safety, it amounting, with skip, wire rope and ore, to 7,800 pounds. It was decided to attempt to work the skips in balance. Another eccentric with link and tumbling block was added, the work being satisfactorily performed by the Lake Shore Iron Works, Marquette. To reduce the strain on driving frictions a rope was passed over the sheave at the top of the shaft house with each end fastened to the bale of skip in either compartment of the shaft and sufficiently taut to take the weight of the load off the friction. Cages were put in to take the place of the skips and the weight so reduced that the friction clutches would hold with safety. This plant has hoisted 800 tons daily and there has been no trouble from the engine's centreing. A boiler 5'x16' provides steam for the hoist, besides heating a one-story building 12'x36', a dry house 24'x160', driving a No. 7 Cameron pump in the bottom of the shaft, and operating the rope haulage plant underground where 800 tons daily are handled a distance averaging 680 feet.

Richard Roberts is mining captain; J. Kellerschon, mining engineer and chemist; Thomas Carmichael, cashier.

THE ROLLING MILL MINE.

This property is immediately south and west of the possession of the Blue Mining company, and occupies the south half of the northeast quarter of section 7. Since 1887 nothing has been done upon it in the way of mining. Previous to that time there had been mined and shipped 234,025 tons of ore, the first cargo having been sent to market in 1871, this coming principally from a large open cut that was carried down to a depth of 220 feet. Later on a shaft was sunk to the south of this pit, it being put down 150 feet, and it was from this shaft that the ore sent out from 1884 to 1887 was obtained. The property was owned by the Beecher estate, of Detroit, and was last worked under contract by Capt. George Berringer, of Negaunee. The Beechers, not being mining men, and not wishing to operate it themselves, shut up the mine, those who sought for a lease being unable to secure one on what they considered favorable terms.

In January, 1897, Capt. Samuel Mitchell, of Negaunee, secured possession of the property, purchasing the fee and mineral right, and has been conducting explorations in a quiet way since then. During the winter several testpits were sunk, and at this writing, May 1st, he is putting a diamond drill hole under the old open pit. It was reported that there was an excellent showing of the marketable ore in the bottom of the pit when it was closed down, and it is Captain Mitchell's idea to prove the correctness of the statement by putting a boring beneath the old workings. Upon the angle at which the hole is being bored the distance necessary to go to pass under the old bottom will be about 450 feet.

The old shaft above referred to has caved in, there having been no timbering employed to support the upper portion of it at the time it was sunk. From the mouth of the old shaft samples of ore give better than 40% iron and are low in phosphorus. If the market offered better inducement they would do something in the way of re-opening the shaft.

The property is in an excellent locality. To the west is the Milwaukee mine that produced an excellent grade of ore, while to the east is the old Green Bay mine. The formation covering the ore deposits here is identical with that of the Queen and Blue mines, and everywhere the lean ore is showing. This gives about 40% iron, and is of bessemer grade. There are millions of tons of ore of this class exposed. What Captain Mitchell is after is ore of higher grade, and he thinks it should be found here. He will make a systematic exploration of the property with this aim in view, and as he is well versed in formations and the knowledge of mining, he will do the correct thing in endeavoring to prove the existence of such ore bodies as he is in search of. The property has long been looked upon as a favorable one by the mining men of this section. If a sale can be made, there will probably be shipments of the low-grade ores of this place during the season of 1897.

THE NEGAUNEE MINE.

This mine is located on the northwest quarter of section 5, lying immediately north of the mines of the Queen Mining company, and is one of the prominent producers of this city. The first shipments were made in 1847, after a long and expensive flight to get a shaft through the

quicksand to the ledge. It has sent to market 823,672 tons of ore, of which 175,393 tons were sent out for the year 1896. The Negaunee is one of the interesting properties in this range because of its flat deposit, the latter being about 34° on its upper side and about 32° on its lower. As will be remembered in my description of the mine, one year since; there is one shaft, this being vertical to the third level, after which it conforms to the dip of the foot, being so flat that the miners walk up and down upon ordinary stairs. The sixth was then the lowest level, but they have added three others, the lowest now being the ninth, the vertical depth from surface of which is 713 feet.

In the three upper levels the hanging was very stable, permitting the working of large rooms with but little timber, and in these levels the ore has been pretty well mined out. Below the third there has been nearly as much ore left in pillars as has been taken from the rooms, it having been the practice to take three sets wide of ore, 21 feet, and to leave pillars of 21 feet. Some of the pillars have been "thinned," but there is considerable ore left as retaining ground, besides the shaft pillar, which is 112 feet thick. At some time in the future there will probably be a new shaft sunk to take the ore in the pillars. In the lower levels the hanging is less firm than in the upper ones, and in places it is nearly flat. At one place on the 7th level there was a stretch of ground twelve sets in length where the hanging was perfectly flat. It rolls considerably, and the thickness of the vein between hanging and foot averages about 35 feet. There are frequent dikes of paint rock, these being of varying thicknesses from one foot to twenty feet. They have no sustaining power, and afford no protection to the hanging.

A cave of ground between the fourth and sixth levels, due to weakness, of the hanging, occurred during the year, and delayed mining somewhat. They are doing some cleaning up on the fourth at this writing, and the principal mining is being done upon the seventh and eighth levels, from which the bulk of the product is coming. They are observing the same method of working as described in my last report, driving their main drifts on the foot and putting in main and wing drifts from foot to hanging. Where the paint rock is met with and has to be removed they store it in the worked-out rooms, placing it upon 16-foot lagging, and lagging sides of drifts so as to prevent its running out. Heavy, square sets are employed in the mining, and the ore is drilled by hand. To facilitate the handling of timber, raises have been put in at each side of the shaft from the bottom to the third level, where the shaft assumes the perpendicular. These also afford ventilation and a means of escape for the men in case of accident.

With the flat deposit the new level necessitates longer crosscuts to the ore the shaft having been carried down at an angle of 35° and the vein making considerably flatter than this in places. On the eighth level they have run a drift from No. 1 room east of the shaft 1,100 feet to the northwest, development work since then showing this was almost exactly in the centre of the ore body, which is here considerably diminished in size, and is also of inferior grade to that found in the upper levels. As stated in my last report, the ore averages considerably higher in phosphorus as they go down upon it, the percentage of non-bessemer being fully one-half, whereas in the upper levels it was not one quarter of the ore deposit. They find, too, that the high and low phosphorus areas are very irregular, and so changeable is the ground in this respect that constant analyses are necessary. Every leg bears a tag to denote the percentage of phosphorus, and, by this plan of close watching they are enabled to keep the product very steady at the guaranteed point. It prevents the haste in mining, however, that could be attained were it not for this feature. They make two grades of ore, bessemer and non-bessemer, these running between 61 and 62% in iron.

Of importance to the company is the addition of a new lens of ore to the northeast of that which has thus far been worked upon. This is evidently a continuation of the old mine deposit being separated from the latter by a crossing of rock, a mixture of quartzite and jasper and lean ore, a sort of chert, that has a thickness of 60 feet. They located this ore last summer, putting a drift into it for 250 feet, and driving a few crosscuts, but before they had time to thoroughly test its size the cave above referred to took place, shutting them out from this portion of the mine. They are now going around the caved ground, and will soon be to the ore again. They are also putting in a drift on the third level in the hope that it may strike the new deposit. This drift is now in 200 feet. The new deposit, while it gives signs of being an addition of value, has yet to be proved. Should it turn out satisfactorily it will be simply taking the place of other deposits that have simply been mined out, and it will be needed to keep up the present rate of production. The finding of the ore from the third level would certainly be encouraging, and the management is watching this exploration with considerable interest. Should the ore continue to make on the present strike of the formation a new shaft would be necessary to take care of it. One could be sunk in the slates near which the ore appears to be making, and in which solid ground could be had.

While the Negaunee has but a single shaft the latter is well provided with means to insure against accident. A large block of ground has been left to protect it from collapse, water runs over the timbers so that danger from fire is avoided, and even should fire start, which seems impossible, they have connections with pumps by which a stream of water could be instantly secured.

The adherence to the square set of timbering in a deposit that is so flat will be better understood when it is known that overlying the ore deposit is the drainage from a very wet swamp, and to cave the surface would permit the latter to enter the mine. Captain Mitchell has an idea that the watershed is directly connected with the outlet of Teal Lake, and believes the formation is a continuation of the Teal Lake iron range. But for this wet ground

oveylying the deposit, the position of the latter would be well suited to the caving system.

The mine has a new hoisting plant, the manufacture of Webster, Camp & Lane, of Akron, Ohio. There are two 8-foot drums, these greatly facilitating the work of hoisting as compared to the old machinery. A force of 230 men is employed, and the mine was worked steadily throughout the year, it being one of the few in the region to operate continuously. The Negaunee pays a royalty to the owners of the fee, it being more than present prices for ore warrant.

Samuel Mitchell is agent; Alfred Newcombe, mining captain; C. G. Mason, mining engineer; Thos. Pellow, cashier, all of Negaunee. The company's headquarters are in Cleveland, Ohio. Wm. Chisholm is president; E. S. Page, secretary.

Lying just east of the Negaunee mine is the property of

THE BARASSA MINING COMPANY

that has been working for several years past to reach a deposit of ore which was originally found by drilling, and a shaft was started to open it up, this being sunk in the overlying sand. The abundance of water and sand prevented the object from being accomplished, although more than a year was spent in trying and a large amount of money was used in the hope of reaching the ledge. The company finally gave up in despair, and then the hard times of '94 came on and nothing was done until the past summer when a shaft was started in the foot wall slates to the north, where there is solid ground, and where the shaft should have been started at the outset. They have been sinking here with a small force of men and at this time, April 15, '97, have reached a depth of 280 feet, the shaft having been in the slates for this distance. They will continue downward until a depth of about 350 feet has been attained when they will drift south for the ore that was found in the drill boring. The new lens found by the Negaunee Mining company the past summer is certainly promising for the Barassa people, it going to show that the ore formation is making in that direction and that clean ore bodies may be expected upon this property. The borings made with the drill showed ore of bessemer grade, but such tests are not always satisfactory, as nothing more than the sludge of the holes could be secured. The company has shown great persistence in trying to find a mine, and deserves success for the enterprise it has displayed even if it has not always been well directed.

Those principally interested are residents of Marquette county, the majority residing in Marquette city. Jno. Mack, of that place, is one of the heaviest shareholders and has charge of the work at the property.

THE U. S. GRANT

occupies a position just east of the Negaunee mine property. It has not attained the distinction of being a mine, but considerable was done upon it a few years since, and favorable indications for ore deposits are present. A shaft was sunk, crosscuts put in, and many thousands of dollars expended. The location is a promising one, and clean ore should be found there. At the present time nothing is being done.

Further east there was the Black Hawk exploration and others upon which pits were sunk and the formations tested to certain extent. The territory is a favorable one, but the ground is swampy and wet, and it will require money to properly explore it.

OPEN PIT, JACKSON IRON MINE.

THE JACKSON MINE.

Historically, the Jackson is of greater interest than any other iron ore producer in the Lake Superior region, as it was here the first ore was discovered, and from the ores of which the first iron from a Michigan mine was made. From the excellent record secured from that early discovery a great train of successes have followed, and a wonderful industry has resulted. Since 1844 the Jackson has been prominently before the people, and it is pointed to with no small degree of pride by the local residents as the mine that first told to the world that Michigan possessed iron second to no other state or country on earth.

Since its discovery the Jackson has produced 3,461,685 long tons of ore, and has been one of the mainstays of the city of Negaunee, in which it is located. In earlier times the mine was noted for its immense outcroppings of ore upon which large open pits were sunk, and the product raised to surface by derricks. It was peculiar that both hard and soft ore occurred in the same pits, and that these ores were indiscriminately found in the pits. As the pits grew deeper it was found impractical to carry them downward further in the old way, when shafts were sunk and the mine worked as an underground one. The immediate enclosing rocks are jasper, firm and strong, and little or no timber was necessary for the protection of the mine and miner. With each succeeding year the shafts grew deeper and the territory invaded by the miner extended over a greater length until finally the most eastern workings extended over a greater length until finally the most eastern workings extended under the business portion of the town near Iron street, and the western was three-fourths of a mile further west. The purchasing of the property by Captain Samuel Mitchell gave it a most active management, and one thoroughly

familiar with the business of mining. The diamond drill was brought into use, and new territory added to the west of the old. It was upon this that work was concentrated for many years past, but in July of the past summer the underground mine was abandoned, the pumps withdrawn and the several shafts are now filled with water. The deposits, as depth was attained, grew smaller, were scattered, and considerably mixed with rock so that further operation was not warranted under conditions prevailing in the market.

There was considerable ore showing in the west end of the mine, where a depth of only 300 feet had been attained, but there was no money in its mining. While nothing is being done underground at the Jackson there is considerable activity being again displayed in open pits upon surface. Captain Mitchell, in his exploring, found a deposit of ore east of the old "Sand Shaft," at the west end of the mine and to the north of the old No. 5 pit, long ago abandoned. Three pits have been opened here, these occupying folds in the jasper, which here is twisted and contorted to a wonderful degree. These pits are now about 50 feet deep, and are providing a healthy product per day with a force of 80 men employed. There is considerable rock mixture, jasper and soapstone coming in plentifully, but these seem to be diminishing as they proceed downward. The ore is very massive, many charges of black powder often being necessary to shake it, and after blasting there has to be much done in the way of block-holing the large pieces thrown out by the blasts. This is expensive, and the quality of the ore will not permit of much in the way of extra costs. The ore runs about 56% in iron and is generally of bessemer grade. Were its content of iron improved it would be a desirable product, but the power drilling, block holing and sledging adds much to the cost over the ordinary soft hematite mining, the ore being of the hard variety that needs drill and high explosives constantly. Great amounts of ore are dislodged from the sides of the pit at a single blast, however, which helps. The ore is hoisted from the pits by derricks, buckets being swung into the pits, now that the latter arc sufficiently large, so as not to threaten the safety of the men working below. During the winter the ore raised was placed in stockpile, but now, at the opening of the shipping season, they are loading the ore directly from the mine into railway cars. There is a very convenient arrangement for the raising and handling of the ore.

What will be found in the way of cleaner ore as the pits attain greater depth is probmatical. There has been no work done under this territory from the old workings of the underground mines, and there is a chance for the continuance of the deposit to a considerable depth, although the management is not figuring upon this. One thing of importance with reference to the mine is that there is no royalty to be paid, the company possessing the fee of the lands upon which it is located. The company also possesses its own boats, a point of vantage. Capt. Wm. Penglase looks after the work at the pits.

The Jackson owns 160 acres well located and is looked upon as valuable outside of the ore deposits already disclosed.

Capt. Samuel Mitchell is agent, Thos. Pellow secretary, C. G. Mason engineer, Chas. Jennings cashier.

THE GRAND RAPIDS MINE

located west of the old Milwaukee mine, has been idle since my last report, legal entanglements regarding the ownership of the fee having been brought on early in 1896. There is nothing to add to what I had to say at that time. The ore is a non-bessemer, and there is little inducement to produce it at present. Just who is in control is the point at issue, and, strange to say, it is not a fight as to who has possession but to see who has not got it, the object being, so far as I can learn, to avoid certain claims against the property.

THE LUCY.

The Lucy is idle. In 1896 a portion of the old workings was pumped out by Samuel Hoar, of Negaunee, but was permitted to refill almost as soon as unwatered. The product is largely manganiferous, and is salable, but the royalty charges are so high that none can afford to operate it at such prices as the last few years have offered for iron ores. The Pendill Estate, Marquette, Mich., possess the fee. At this time there is no talk of resumption.

THE TEAL LAKE RANGE.

The Teal Lake range is one that has received considerable attention from mining men and explorers in years gone by, and much money has been expended in the endeavor to locate paying mines. The Cleveland Hematite mine, the property of the Cleveland Iron company, of Ishpeming, conducted active mining here for many years, but gave up two years since, due to the pinching out of the deposit, or a narrowing of the ore lens to such degree that further mining was not warranted. A depth of 1,000 feet wan attained in the workings, and a vein fifteen feet thick was in the bottom level when operations ceased, and the property was abandoned.

The Detroit mine, after a short existence, also gave up the fight for a paying deposit, so that now but two properties are showing any sign of activity, and but one of these doing actual mining, the other confining operations to the exploring of its ore deposit.

THE CAMBRIA MINE

operated by the Cambria Mining company, is busy, as it has been since 1876. Those who have looked after its development have shown much energy and courage in the following of the erratic formations, and in the securing of the annual product of something like 40,000 tons, a great deal of work has been performed as compared with many other mines.

The ore occurs generally in small pockets in the foldings of the formation, and contrary to the mines of other

ranges of this field, has a southerly dip and easterly pitch. The true foot is a slate, and there are intrusions of jasper everywhere throughout the ore bodies. There is a large amount of lean ore, too, unmarketable, that has to be cut through in the following of the formation in the search for new and desirable lenses.

Since my last description they have added another level, now opening up the ninth, the vertical depth from surface being 730 feet. The shaft is nearly to the tenth level, and drifting to open out this will soon be commenced. On the eighth level they are taking out pillars, all the work being to the east of the shaft as it is now throughout the mine.

On the ninth level they followed a small lead of ore to the southeast of No. 2 shaft, (the principal one), and at 200 feet it opened out to a width of thirty feet, but did not continue for any great length. They raised it in four sets, coming to the capping. This lens or pocket has been exhausted upon this level, and they are sinking a winze in the center of the deposit that has reached a depth of forty feet, and is in ore. They will drift for it from the next level as soon as the latter is started. The ore, while not making a large deposit, is of excellent quality, running from .018 to .026 in phosphorus and about 65 per cent, in metallic iron. To the northeast of this pocket, and 300 feet nearly west of No. 2, they are developing another pocket of ore that bids fair, to enlarge into something good. They are opening it up with drifts and have the latter in about 100 feet both east and south. They are driving from the north of the deposit to connect with a winze from the eighth level, it being the intention to open up a sub-level and to handle the timber for this portion of the mine through the winze and the “sub," saving the labor of raising it up in the rooms as they now have to from the ninth. The timber used here is heavy, they employing the square set plan of protecting the ground.

It is in the east end of the property that the company looks for its future encouragement. The ore bodies pitch in that direction, and the showing at present is certainly more favorable than any that has appeared for some time, both in size of ore body and in quality of mineral. However, it is well to remember that the formations here are very treacherous, and while everything may be ore today, tomorrow may encounter rock cutting off the deposit and bringing consternation to the miners. So frequent have these unpleasant surprises been met with that one scarcely dares to predict a continuous stretch of good fortune. It certainly is to be hoped that the new find may prove big and regular. The company deserves it, and it would be a good thing for the city of Negaunee in which it is located. In the opening up of this ore body they are carrying double drifts.

On the eighth level they are drifting to the northeast of No. 2 and hope to find something in that direction. The drift is about 200 feet north and 200 feet east of the shaft, the breast of the drift now being in lean ore that is too poor to mine. It is also high in phosphorus. At about 500 feet northeast of No. 2 shaft a diamond drill boring was made some time since which shows twenty-one feet of blue ore at a depth of 312 feet from surface. The drift on the eighth, may be too deep to catch this deposit, but it is considered favorable territory. This drill boring was about 150 feet south of the lake shore.

No. 2 shaft has been improved by the sinking of a new shaft from surface, to connect with the old one at the third level. The new portion is now being equipped with stringers and skip rail, and will soon be ready for business. They had to change the face of the shaft to conform to the newer portion. They are building a substantial ore pocket, and will have a high stockpile trestle.

At the old No. 3 shaft they are doing a little work, but the ore is not of good quality. In former years it was of better grade, but at present the product is not up to standard, and but little is being done.

In the old open pit to the west of No. 2 they are still scramming, eight men being employed. They have a neat little stockpile of ore of high grade. Great care has to be taken by the miners, as they are in the old workings and constantly encountering the timber and openings made years ago. They meet with occasional bunches of ore that appear like new ground, and there may be a chance of opening up something good.

Something like 300 feet east of the old pit a diamond drill boring was attempted but the ground was so badly broken that the hole caved and had to be abandoned. They were in lean ore at the time of the stoppage. To the east of their furthest workings in that direction is the Hartford property, and there is also good chance for the finding of other parallel troughs further north. It is quite likely that the trough holding Teal Lake is as rich in ore as is that which formerly contained the waters of Lake Angeline, at Ishpeming. There is also plenty of room to the south, before encountering lands of the Cleveland Iron company.

The Cambria is at present employing 170 men, and has been worked steadily for some years past. Mr. A. W. Maitland, who has charge of this property, and its neighbor, the Lillie, is one of the conservative, careful mining men of this district. It is due to his foresight that this mine has been kept up throughout the trying times of the past few years. It must have had careful management in order to have lived in the face of low prices for the product and the many obstacles met with the underground. Captain John Deacon still looks after the underground workings which he is so competent to do, and B. LaLonde is doing excellent service as engineer and chemist. Assays are frequently taken and the careful sorting is one of the wise features. Fred Nightingale is cashier.

The mine sent out 95,086 tons in 1896, making a total for all years of 846,346 tons.

THE LILLIE MINE.

The Lillie adjoins the Cambria immediately upon the west, and is under the same management as the Cambria. It is practically idle and has been for many months past. Twelve men are engaged in the driving of

drifts on the sixth level, the lowest, and exploring the ore deposit.

There is one shaft. It is in the foot, and is substantial. For a distance of 333 feet it is vertical, and then inclines in the foot at an angle of 53° until, at a depth of 600 feet vertically, it reaches the fifth level, the main one of the mine. The sixth level is 677 feet vertically from the surface. The ore deposit inclines to the south at an angle of 45°, pitching east. The ore of the fifth level is secured on the caving plan, which here works admirably, but the inferior quality of the product brought about a suspension of mining operations in March, '96. There was no living price for ores of non-bessemer class which this property yielded. The showing of ore was satisfactory, the mine looking healthier than at any time in its history.

Since the suspension they have been working twelve men, two eight-hour shifts being put on. Drifting to the southward was first conducted, but they were too far east, and found nothing but rock. Turning slightly to the west, in starting a drift in the latter direction, they found clean ore in a few feet just inside the drift, and, what is pleasing, it is of considerably better quality than that of the fifth level. To the south the drift met with a great deal of water, and lath had to be closely driven to prevent the moist ground from shutting up the drift. They have left this drift for a time to give it a chance to dry out. They have drifted west, and have met with encouraging ground, considerable ore having been developed. They have opened upon the trend of the formation for something like 300 feet. The shaft is being sunk for the seventh level.

There is a stretch of ground of something like 2,000 feet between the workings of the Lillie and Cambria mines, this being on the trend of the formation, so that there is a chance of finding something between the two.

The Lillie is getting into shape for active production whenever market conditions warrant. They should have a heavier hoisting equipment. They have a single skip road with skip holding 1½ tons. It is quite probable that they will increase this in the near future. The satisfactory enlargement of the ore bodies on the lower levels will give incentive to a heavier equipment.

The shipment for 1896 was 107,326, making a grand total of 537,272 tons.

THE HARTFORD MINE

immediately east of the Cambria, did but little in 1896, sending out 1,532 tons of high silicon ore that were obtained above the water level. The mine is filled with water, and I hear of nothing that indicates immediate resumption. The Hartford certainly enjoys a favorable position, the showing at the Cambria, and the easterly pitching troughs being in its favor. They have two shafts, the deeper, measured on the incline, being 460 feet deep. The fee is owned by the Teal Lake Iron company to which the operators pay royalty. The total product is 14,489 tons.

Benjamin J. Neely, of Negaunee, is president and manager; S. R. Bell, of Milwaukee, Wis., is secretary.

MINES OF CASCADE RANGE.

Four and one-half miles south of Negaunee City is the village of Palmer, headquarters for the Cascade range. The latter has been prominent in the history of iron mining in Marquette county since the earliest work done in the mineral development of the region. The outcroppings of iron-bearing rocks are most pronounced, and the early explorer found much here to interest him. The iron-bearing rocks are plainly followed through sections 29 and 30, and half way across section 8. They are also distinct on the north half of section 31. The range has been looked upon with great interest by mining men, and, while there have been many failures in the mining way, there is still retained an idea that the range is well worth giving closer attention to than has been devoted to it for many years past.

Just now, May 15, '97, there is nothing being done on the range, every property having suspended awaiting the advent of better conditions in the market. Of the properties located on the Cascade,

THE VOLUNTEER MINE

is the best known, and has been the largest shipper. It is probably better known as the "Palmer" mine, under which name it was wrought for many years, until purchased by Gen. R. A. Alger, and others of Detroit, Mich., when the name was changed to "Volunteer." It has sent to market 1,073,087 tons of ore, 53,532 tons of which were shipped from ore remaining in stock last summer. Nothing in the mining way has been done since the spring of 1894. The past summer some exploring was conducted at a point about 500 feet southwest of the main engine house. One of the pits came down upon ore of excellent quality, better than the old mine produced, but it gave out in six feet, the pit bottoming upon quartzite. The latter rock was found in all the pits. What is needed is deeper holes, and the company may see fit to bring the diamond drill to their assistance. The Volunteer is a fine property, possesses 1,800 acres of land, and has excellent chance for the finding of ore aside from that which they have developed in the mine. The latter possesses fine stopes, the most of them yielding ore of non-bessemer grade. The ore gives from 56 to 62% iron. The mine has reached a depth of about 700 feet, and has excellent shafts and a fine equipment of machinery.

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

THE STARWEST MINE,

better known as the "Wheat," or "Prout," occupies the southeast quarter of the southeast' quarter of section 29, town 47, range 26. The fee is owned by the Home Iron Mining & Manufacturing Co., Cleveland, Ohio. The

property laid idle from 1891 until 1894 when work was resumed upon lean ore that outcropped upon surface. In the following year the old workings were pumped out, and the property fell to the Starwest Mining company, of which S. R. Kaufman, Marquette, is the president and treasurer, L. G. Kaufman, secretary. The work of cleaning up the old levels was completed, and during the year 1896 a force of 60 men were working in June developing the south deposit of the mine. There are what are locally known as two "runs" of ore in the mine, these being separated by diorite. Of these the southern deposit was the better, and it was upon this that work was being conducted. They had a level opened underground, and were breaking ore from an open cut, sending the broken material to the level where it was trammed to the shaft and sent to surface. The shaft used was the most western of the two that the mine possesses. They stripped the surface from a portion of the deposit to the west of the open pit, and heavy burdens were being thrown out at a single blast. The ore of the pit gave about 56% in iron. There is a big open pit to the south of the one at which mining was done last summer but nothing ahs been done at this since the summer of 1895. The ore is pitching to the west, makes under the tracks of the Chicago & Northwestern railway, and pillars will have to be left for the protection of the road.

Work at the Steward had but nicely begun last summer, when orders were received to suspend. The pumps were withdrawn, and since then nothing has been done.

East of the Wheat, on section 28, there is a strong outcropping of lean ore extending east and west, and upon which more or less work has been done during the past twenty years. There have been many changes of ownership, or proprietorship, of the leases, but there has been no continuous operation, at any one of them. There is enough showing to encourage the expenditure of money, but thus far no workable deposits of clean ore of high grade have been found. Since the demand for ores high in silica and low in phosphorus has sprung up this range has been given some attention, as there is an abundance of such material here, millions upon millions of tons outcropping. Indeed, this range alone could supply the wants of the consumers for ores of this class for many years to come. Going eastward from the Star west the first of these properties met with is

THE RICHMOND,

upon which something has been done by Negaunee, Mich., parties, A. W. Maitland being prominent. They have obtained a lease, and have done a little work in the way of testing the ledge of ore, sending samples for trial to consumers so that the latter may be convinced of its excellence. The product for 1896 was 1,088 tons. The company has not yet been formed, but one soon will be in all likelihood. The ore of the Richmond is characteristic of the range, flaggy, blueish, and readily broken. It is of the hard variety, but goes to pieces readily under the blow of the hammer. Lying back of this is an ochreish ore, unmarketable. Rising to a considerable height above the surrounding country, this ridge of lean ore is readily loaded into cars at the foot of the hill, where the Chicago & Northwestern put in a new track last summer, and has made it convenient for all who have properties on this range. Next east of the Richmond is

THE PRIMROSE VALLEY,

where more was done last summer than at any property upon this range, and from which a trial lot of 6,040 tons were secured. An open cut was run into the side of the hill and a breast of ore having a height of 47 feet was secured. The bottom of this stope is considerably above the level of the railway track, and a pocket has been built to which the ore from the stope is trammed and from which it can be loaded direct into cars. The ore is readily drilled, and broken. Two men with small steel drills can make nine feet in four hours. Should a crushing plant be necessitated one can readily be put in at a level above the railway tracks, and there should not be many delays from crusher stoppages, the ore not being of a refractory nature. There could be automatic handling of the ore from stopes to crusher and from crusher to cars. During the summer there was considerably done in the way of cleaning the land of undergrowth, building a dry, a smithy, and putting in the property in shape for doing business. Operations were suspended in the fall, and have not since been resumed. Wm. Polkinghorn, of Negaunee, had charge of the work, and the Messrs. Kirkpatrick, of Palmer, are interested.

The first to call attention to the lean ore of this range was

THE CONSOLIDATED MINING COMPANY,

next west of the Primrose Valley on section 28, where they have 120 acres on the range. They were the first to get the ore into the market, sending out their first lot of 5,503 tons in 1895. In 1896 they sent to market 10,540 tons, since which time little has been done. The ore thus far secured has come from an open cut in the deposit and they have put in a second cut from which a large tonnage can be obtained the coming season in case it is demanded. The ore gives about 47% iron, 026% phosphorus and 28% silica, a most desirable mixture for ores needing silica and low phosphorus iron. On ores yielding less than 58% iron the company pays a royalty of 10 cents per ton. The ore can be very cheaply mined, it being a matter of quarrying rather than mining. They are well equipped with railroad and other conveniences, and only await sales of the ore to start the property again. They do not mine in winter, it not being warranted by the conditions, as the ore can be almost as readily taken from the ledge as from the stockpile, and then the low price received would not warrant any extra handling. During 1896 this ore commanded $2.00 per ton, delivered at Chicago or at Lake Erie ports, but no prices have been made as yet for 1897.

August Beerling, of Ishpeming, has charge as mining superintendent; J. H. Quinn, is president and treasurer; T. J. Dundon, secretary, all of Ishpeming, Mich.

THE PLATT MINE,

located on the northwest quarter of the southeast quarter of section 29, 47, 26, has been abandoned, the final decision resulting in this action being taken in the spring of 1896. The ore deposit became so small, and broken up that it was too expensive to follow further. There was considerable done in the way of exploring, but nothing promising was located. The property was operated by the Eddy Bros., of Bay City, Mich., who were enterprising men, and who have since purchased a promising mine, the Penobscot, on the Mesabi range. The Platt stockpile, 11,296 tons, was shipped the past season, making a total of ore produced since the mine was opened of 73,844 tons.

THE PITTSBURGH & LAKE SUPERIOR CO.,

is one that possesses important lands on the Cascade range. They were the former owners of the Volunteer mine, and have lands lying immediately east of the latter, upon which they have done some exploring with diamond drill and found ore of excellent quality. Nothing in the way of sinking for the deposit has been done, however. Mr. Jos. Kirkpatrick, who for many years superintended operations at the Palmer, has charge.

THE MARQUETTE EXPLORING COMPANY,

that conducted explorations on the east half of the southwest quarter of section 19, 47, 26, have ceased work but talk of resuming again. They have secured an extension of the option from the owners of the fee, the Cleveland-Cliffs company, and hope to be able to do something the coming season.

MINES OF ISHPEMING.

Ishpeming is one of the leading mining towns of the state of Michigan. It possesses a population of 12,000, has modern improvements, and is wide-awake and progressive. Its mining corporations are powerful ones possessing the fee of large tracts of lands, own their own boats, and have an advantage in three lines of railroad. The distance to Marquette port is 15 miles, to Escanaba, 65 miles.

THE CLEVELAND-CLIFFS COMPANY

was the first to engage in the mining of ore in the city, it beginning before the city was, and it did much in calling the attention of the outside world to the rich deposits of iron ore held among the hills of this location. Immense knobs of diorite rise upon all sides, the basins made by their foldings containing iron ore or small lakes, and in some instances both are found in the same depression. Prominent outcroppings of jasper also occur, and it was these that first attracted the attention of the early explorer. The Cleveland-Cliffs company was made up of a consolidation of the Cleveland Iron Mining company and the Iron Cliffs company, this being effected in 1891. The properties owned are the Cleveland Hard Ore mines, the Cleveland Lake shafts, the Salisbury, the Cliffs Shafts and the Foster. These have produced a grand total of 8,791,288 tons, of which amount 512,460 tons were sent out in 1896. In the equipment of the company is a fine fleet of steel steamers for transporting their ores from lake port to market. They have also a half interest in the Lake Superior & Ishpeming railway operating between Ishpeming and Marquette, and own and operate the Pioneer blast furnace located at Gladstone, Mich. The concern is one of the most progressive, is liberal and business-like, and one of the mainstays of the city in which its mines are located.

THE HARD ORE MINES.

The hard ore mines were the first upon which the company did any mining, these being located in the eastern portion of the city, and upon the cast side of section 10. Years of constant working has nearly exhausted the old shafts of their ore so that to-day there is but little being done, and this consists of the taking of pillars in what is locally known as the “sawmill” pit. To the southwest of this the “Moro” and “No. 3” shafts have been idle since the depression of some years since. There is ore in them both, but it is not profitable to mine it under existing conditions. The Moro mine is 708 feet deep, the No. 3 is 635 feet below the surface. The product of the hard ore mines for 1896 was 33,906 tons.

THE CLEVELAND LAKE MINE.

Since my last report there has been no new levels added at this property. They have produced about 320,000 tons, all of which has come from the levels already opened up and described at length in my report for 1895-6. As then stated they are operating the mine on the caving plan, and here the practice meets with some discouragements that are distinctly the mine's own. The ore deposits were reached by pumping the water from the lake that covered them, and with the water removed there still remained anywhere from 10 to 40 feet of soft silt that is sufficiently liquid to flow readily into any opening that is presented. It has been due to this that the property had to be wrought slowly, as too great haste might ruin it effectually. There are two troughs in the diorite that formed the lake bottom, one being upon the north side of the lake, the other upon the south side, the tongue of intervening diorite having a width of about 635 feet. The two deposits are connected by a drift that was put in from the second level of the north deposit, the distance from surface being 250 feet. Overlying the ore of the north deposit is a wedge-shaped piece of jasper, with the sharp end downward, this making in the upper level, a hanging for both sides of the trough. In some places this jasper appears to be missing altogether, and it is in such spots that the caving plan meets with considerable opposition in that it permits the mud to enter the levels. The mud is gradually becoming firmer, and trees are springing up in the old lake bottom. It is also possible to walk over considerable of the surface, a feat that was impossible three years ago. The silt is still sufficiently soft, however, to require the greatest care in the mining, and had less ground been opened up before beginning the caving it would have been better. As it is they have 2,600 feet of ground blocked out on the first

level and have 72 rooms opened out upon the second. At the third they have done but little, fourteen rooms, having a combined length of 588 feet having been opened. In the mining they have taken rooms 21 feet across the vein and have left 21 feet, three sets being taken and three left for support. On the second level considerable ore was taken out on square sets, the rooms being tilled with waste. Now they are trying to cave the ground beginning at the top level, and have, as I say, met with considerable trouble, but seem to be gradually getting the better of the mud.

The quality of the ore of the north deposit is not as good as was expected when they first began operations here, being lower in iron and 85% of the product has been of non-bessemer grade. The electric motors continue to be used for the handling of ore underground and give perfect satisfaction.

The south side deposit of the company to which I referred at length in my last report, is now in litigation, the Pittsburgh & Lake Angeline company having contested the ownership of the lands containing the ore. They claim that they have a right to go to the centre of the lake once the water was removed, and have brought suit to test their right to the claim. The matter will be argued in the Marquette circuit court in May, 1897. Should the company be forced to relinquish possession of this deposit it will be a severe blow to them, as the ore is of high grade, and there is a large body of it. No levels have been added here since my last report, the company giving all its attention to those already laid out. There have been no additions in the way of machinery equipment, and the shaft that was proposed for the west end of the south side deposit a year since has been delayed awaiting the outcome of the suit soon to be tried. The case will unquestionably be taken to a higher court no matter how decided in the local circuit, and some time will have elapsed until a final settlement of the discussion is arrived at. It is a most amicable difference of opinion, the parties concerned, entering into the matter good naturedly. Both companies have interests in common, and are upon the most agreeable terms personally. There is a different opinion concerning the ownership of the lands holding the valuable ore and this will be settled in a proper spirit. The ore of the south side of the lake is similar to that of the East End Lake Angeline mine, of which it is a continuation. It gives about 67% iron and 025 phosphorus.

At the east end of the lake basin the company is working an open cut, stripping the deposit, there now being about 20 feet to remove. The ore is milled to the first level of the north deposit being taken to shaft by electric motor.

The contract miners at the Lake range work eight hours, three shifts of eight hours each being observed. All company account men work ten hours.

The company has been under considerable expense in preparing stocking-room for its ore at the Lake shafts, it having to cut a place from the side of the high diorite hill that rises immediately north of the shaft on that side of the lake. More will have to be done in the same line if the company desires to gain more room than the present affords them. Capt. Thos. Buzzo has charge of the underground workings of the mine, Thos. H. Bargh, being clerk.

THE SALISBURY MINE.

The Salisbury mine has been an active producer since 1872, and is still healthy in its ore reserves. It is one of the important properties of the Cleveland-Cliffs company, and bids to be one long into the furnace. Its ores are of excellent quality and are popular with furnacemen. Since my last report no new levels have been added, the product coming from those places most active last year. It consisted of 131,635 tons of ore.

A new shaft has become a necessity and preparations for one are now under way.

There has been a gradual, steady settling of the ground, a mass 759 feet in thickness being on the move. The main engine house has been following with the subsidence, it being located on top of the settling territory. The diorite hill which was supposed to give ample assurance against such danger makes the hanging of the ore body to the lowest depth thus far attained in the mine, the 16th level. The face of the bluff upon the side where the engine house is located is schistose, the schistosity being unfavorable for permanency of foundation, it causing a breaking off of the rock upon that side almost perpendicularly and running from east to west.

Every precaution possible has taken for the retention of the shaft, the openings about the latter having been rock-filled, the shaft heavily reinforced with timbers. The engine house roof and walls have been reinforced with heavy pieces of timber, and no accidents have occurred, nor are any expected. Formerly, the ore deposits occupied the territory upon the north side of the shaft, but now the main lenses are to the south and west. Mining of pillars in the older territory has been going on the past year as well as upon the levels south. Little or nothing has been done upon the bottom level south.

The need of a second shaft has long been apparent, but the company has been awaiting developments with the diamond drill to determine the best locality for the new opening. This work has revealed the fact that there has been a faulting or a folding of the formation, the diorite foot upon the north and west making a pronounced throw or turn. Enough has not yet been done to determine whether it is a fault or fold, but they have learned that the foot projects something like 100 feet further south on the west end of the old open pit to the north and west of the main shaft, and the new shaft will have its mouth near the west end of the old pit.

It will incline southward, with the formation at an angle of 53° being in the diorite. It will have three compartments, one for pipe and man way, 5'6" by 6', one for skip, 5'1" by 6' and one for timber 6x6'. The shaft opening outside of timbers will be 9x22'.

Drifts from the 5th, 8th, 12th, 14th and 16th levels are being run west to intersect the line of the shaft, and the latter will be made by raising from these levels, this system being less expensive than that of sinking. The longest drift will be from the 14th level, which is about 500 feet east of the proposed line of the new shaft. When the drifts are in to the desired point it may be found that some change will be necessary, but this is hardly expected.

It is hoped to have this shaft completed the coming summer. This accomplished, the engine house and plant at the old shaft will probably be removed to the new one, when the ore now retaining the old shaft can be secured.

Diamond drill borings made in the bottom of the mine, in the west end, show a large deposit of ore of fine grade, which will be available as soon as the new shaft is down and equipped.

The old incline shaft from the open pit north of the present workings, has been reopened so as to afford another outlet for the miners in case of accident to the main shaft.

In the office of the company is a model of the Salisbury gotten up in very neat shape. The different levels are represented by drawings upon glass, there being sixteen plates in all, one for each level. It shows the workings admirably, is drawn to scale, and has been valuable in directing new work in the mine. With improvements completed at the Salisbury that have been commenced the property will be in excellent shape for rapid and permanent business. A. E. Buzzo is mining captain, Walter Sterling clerk.

THE CLIFFS SHAFTS.

There has been nothing done underground at this property since the summer of 1894. There has been a considerable tonnage in stock at the mine, but this is being gradually reduced, the ore being crushed at the mine, and sent to the furnace at Gladstone and to other points of consumption, and it is hoped the coming season will see the pile all removed. There are two crushers, with 18x24-inch openings, one weighting 55,000 pounds, the other 82,000. They have worked satisfactorily throughout the year, being stopped at the close of the shipping season. It is the intention to resume the reduction of the ore with the opening of the shipping season in 1897.

As I stated in my last report, the Cliffs Shafts possess magnificent stopes of ore in so far as their size is concerned. The quality of the product is non-bessemer, is of the hard variety, very satisfactory when crushed, and under modern methods of working the mine should be made to pay a profit, as the ore could be cheaply procured. While the ground is hard and needs power drills and high explosives, there is no timbering required, and there is every means at hand for conducting the work economically. There are two fine shafts to the 511-foot level. A product of 250,000 tons annually could be readily secured for many seasons to come. There are excellent buildings and the equipment is perfect in all particulars.

THE FOSTER MINE.

The Foster mine, the property of the Cleveland-Cliffs company, is one that has been operated in a spasmodic sort of way since 1868, its ores being employed for foundry purposes, they being well adapted to such use. The location is on the famous Cliff drive, and about five miles from Ishpeming, on section 23. The old open pits, worked in the earlier history of the property, are objects of interest to those who pass near them on the Cliffs driveway. The spot is a beautiful one, the scenery being fine, and all that is lacking to complete the picture is a mine that will pay a reasonable return for the labor of getting the ore to surface.

The Foster, years ago, possessed large lenses of ore, these being found upon surface, but gradually, as they have worked downward the pockets have grown smaller until now, at the tenth level, they are about ten feet in thickness, less than one-fourth the size at surface. The formation here, lean ore and jasper, is a wide one, and there is chance of finding parallel lenses. The hanging thus far followed downward is not considered a "true" one, and Agent M. M. Duncan will put a drift to -the west from the lowest level in the hope that other lenses will be found in that direction. There is plenty of room for ore to make, and the pitch of the formation is to the west. Mr. Duncan argues that a dirft can be run as cheaply as a diamond drill boring can be made, as drilling with carbon at $36 per carat is expensive business. If the drift finds ore the latter can be attacked at once, saving some time.

Nothing is being done in the mine above the seventh level, the territory from surface down to this point having been exhausted of its ore. On the seventh, southwest of the shaft about 100 feet, they found several feet of fine blue ore, this being as good as anything ever struck in the mine, but it does not appear to lead to anything important, although they are still working upon it. At the eighth and ninth they are mining on each side of the shaft, the better ore being obtained upon the south side. The lenses are gradually shortening, however, so that with decreased length and thickness the securing of a product cannot be attended with profit. It is probably due to the hope of locating something better that mining is persisted in. At the tenth level they have just commenced to open out, the vein being narrow, three or four feet. It will probably be from this level that a drift will be started west.

The walls in the mine are principally jasper, very stable, not requiring the use of timber to maintain. In some of the upper levels immense rooms have been stoped out without a stick of timber being used, these serving to show the firmness of the hanging. The water charges are somewhat heavy, due to the fact that the water is handled by three separate lifts. Should a marketable deposit of ore be found in the lower levels a single pump

taking; all the water would be put in, which would reduce the water charge materially.

The mine is equipped with machinery taken from the brownstone engine house at the Cleveland hard ore property, and is ample for. the call made upon it.

There is a neat little stockpile at the mine, much of which will be used at the Gladstone blast furnace. Shipments will be made as soon as the railways can take care of them.

Capt. Alfred Colleck has charge of affairs at the mine and gives them able attention. Everything above and below is well kept, showing careful supervision.

Of the product of the mines of the company the properties formerly owned by the Iron Cliffs company, the Salisbury, Cliffs Shafts, and Foster, 25% was hard ore, 75% soft ore of which 15% was bessemer and 85% non-bessemer.

Of the mines formerly operated by the Cleveland Irom Mining company, 13% was hard ore and 87% soft. The bessemer ores averaged 36% of the product, the non-bessemer 64%. The mines of the latter are the Cleveland Hard Ore, and Cleveland Lake Shafts.

The Cleveland Hematite mine, as stated in my last report, was abandoned in July, 1895, the deposit being considered too small to give further attention to.

M. M. Duncan was appointed agent of the mines and mineral department of the Cleveland-Cliffs company in January, 1897, taking the place of F. P. Mills, resigned. J. E. Jopling, is mining engineer; J. N. Esselstyn, assistant; A. J. Yungbluth, auditor; J. M. Vickers, master mechanic; Thos. Martin, clerk. W. G. Mather, of Cleveland, Ohio, is present; the general offices being in Cleveland, Ohio.

The company has a thorough equipment of machinery at all its properties, and is well prepared to Jill the wants of consumers. It has been in the iron ore mining business for forty-two years, and well understands it in all its branches.

THE LAKE SUPERIOR IRON COMPANY

has been in the business of mining and selling iron ore since 1858. It has been a busy concern, one that has gone along uninterruptedly ever since its beginning. Night and day, winter and summer, it has been active, employing large forces of men, paying them promptly, and being important in the maintainance of the city in which it is located. It is a careful, conservative corporation, giving close heed to the conditions that affect markets and labor, and it is to the fore in all that pertains to competent handling of affairs.

The Lake Superior, like other Ishpeming companies, produces both hard and soft ores, and owns the fee of its lands. It has a magnificent estate, possessing many acres in the iron-bearing formation, and bids fair to remain in the mining business for a long time in the future.

Since it began operations here it has sent to market 7,204,389 gross tons of ore, being credited with 450,575 tons in 1897. This exceeds the shipment of any other company that has not consolidated with other concerns since their organization.

THE LAKE MINE.

One of the principal points of interest in the mines of the Lake Superior is just west of the Cleveland Lake mines, under the bottom of the old lake. I referred briefly to it in my last report, the task of opening it up having been commenced about that time.

Like the Cleveland and Lake Angeline companies, the Lake Superior possesses a portion of the territory once covered by the waters of Lake Angeline, and in which they have been operating for several years past in a quiet sort of way. The eastern extension of the old mine hematite deposits carried them under the northern side of the old lake, the ore making at considerable depth below the bottom of that body of water. There was no danger of the waters of the lake finding its way into the mine, as a strong capping-of rock possessing a thickness of fully two hundred feet covered the ore body.

In this eastern end of the mine the ore was followed to the property line dividing them from-the Cleveland Iron Mining company. Work was conducted from the 444 foot level upwards, and nearly all that could be secured by rooming was obtained.

At this station I found changes inaugurated to assist in the more rapid handling of the product. On the hanging side, the south, of this deposit, they have cut through the old pillars and have their main drift upon that side. They have rigged up a power tram to take the ore from stopes to the shaft, the extreme distance east from the latter point being something like 600 feet. They have given a gentle slope from a point in the drift near the shaft to the east line of the property that permits the cars running from the mouth of the drift to the stopes by gravity, the loaded ones being drawn to the shaft by a small portable hoist located near the shaft. This power tram is a great improvement over the former system of hand-tramming observed here.

They are working in the extreme eastern end, in what the miners term "Chicago." This portion of the deposit produces a manganiferous ore, and attention is being given this. Nothing was done here for the past nine months, up to December, 1800. All work in this mine is now above the 300 foot level, and the ore to be secured is mostly in pillars. They mine upon g square timbers, the capping being too heavy to employ the wrecking, or caving plan. They have taken out rooms two sets in width and left as much ground in the pillars as has been secured from the rooms, so that there now remains in pillars an amount of ore equal to that already secured from the rooms.

At the extreme eastern end the vein or deposit has a width of something over 140 feet, and while there is plain evidence of a swinging to the south of the foot,

narrowing the deposit very much, it undoubtedly extends upon the lands of the Cleveland-Cliffs company, and is farther north than anything the latter have encountered at their Lake shaft workings. The drift in the hanging, through which the ore will be sent to the shaft, is a substantial one, the hanging being hematite jasper that is solid and safe, showing no signs of weakness anywhere. This will be maintained as long as needed without any trouble from caving ground. The power applied for the tramming will easily take two cars, the latter holding two and one half tons each.

During the summer of 1805 Mr. Hall decided to do some prospecting with the diamond drill in the territory to the south of their Lake shaft, the result being that ore was found in several of the borings made. The quantity and quality was considered sufficiently encouraging to do something in the way of opening upon the ore body. Accordingly, on the third day of November of that year, a drift was started from the 300 foot level of the Lake Shaft mine to tap the new lens. This drift was carried 8x8 feet, and was in hematite jasper and diorite its entire distance. At 830 feet from where they began, the ore of the new find was struck, and the date of the completion of the drift was June 7th. This, considering the very hard nature of the ground that was cut; was an excellent record. For the greater portion of the distance the miners did their own tramming. The drift ran a little east of south, striking the ore body about midway on its length, judging from what has already been proved up. It was thought that this drift would pass under the ore body, the latter being held in a fold of the diorite, but there was some incorrect reading of the diamond drill hole and the drift entered the ore near the bottom of the trough. Just how much ore is under the drift has not yet been learned, but there cannot be many feet. From the 300 foot level they rose 75 feet and opened the 225 foot level, cutting drifts upon both sides of the ore body, upon its trend, and putting in several cross-cuts. They wer4e met with a deluge of water. The wetter side was the north the opposite being comparatively dry.

Fifty feet above the 225-foot another level was opened, drifts being run along the walls as upon the one below, and 32 feet above this another level was added, which takes the ore as far upwards as it reaches.

Work thus far done proves that the ore occupies a position in a roll or fold of the diorite, it having two foot walls, the one upon the south standing nearly vertical, and the one upon the north having a flatter dip. They have opened up the length of the ore something like 500 feet, and its thickness is probably 140 feet. Through the center of the ore body and conforming to the dip of the north wall, is a tongue of “paint rock.” This has a considerable thickness in the upper levels, being about 16 feet, while in the lower one it cuts out entirely. This does not make the hanging of the deposit, as the lean hematite did at the old mine, but is simply a tongue of rock occupying the position described, and running through the ore deposit as far as the latter has been tested. Bunches of rock are met with in the ore besides the one mentioned. The ore in place has a dull brown, often earthy appearance, and mines readily. With the opening of the different levels by drifts along either side and numerous cross-cuts the ore has been drained of its water rapidly and is now in excellent condition for mining.

They are observing the caving plan of winning the product. They are now to the top of the deposit, and have begun caving the hanging, the first important settling taking place the latter part of April, '97. They will slice from the top downward, covering the bottom of the cut with lagging that will catch all the rock, sand or gravel that may come upon it after the cut has been completed. Above the ore is something like 90 feet of sand and gravel and hardpan, and lying upon the top of this is mud that has an average thickness of 15 feet. It is the mud that has given most cause for care in the mining of the lake deposits. It is still too soft to stand without close lagging, and once it starts into a place it does not stop until it has completely filled the workings. The Lake Superior management believes that by taking off one cut at a time from the top of the deposit and letting the surface come down evenly and gradually, the mud will not find its way through the material that is beneath it. With the first few cuts taken, and with the accumulated gob that will be formed by leaving in the light drift timbers and lagging, there will be no way the mud can get through it, and each succeeding slice taken from the ore will add to the safety of the top. It might be that when the mining had been carried down a considerable distance the sides of the pit would be drawn, making breaks that would let the mud find a way in, but Mr. Hall has an idea that he can do some good work with a steam shovel at such a time, using material from some of the old rock dumps near by. The south wall, as has been explained, is nearly vertical, and the break here, when the settling begins, will be quite abrupt. They have placed bulkheads in the levels to hold the mud in case it comes in, and raises have trap doors that can be closed to keep the enemy out. Every precaution against damage by the mud has been taken.

All the ore is being sent to the 300-foot level. Raises have been put in at intervals of 75 feet, and each of these is provided with ladder road, affording numerous avenues through which men can go in case there is need of them. The drift connecting with the Lake shaft, to which the ore is now sent, ahs a fall of one foot to the hundred from the mine to the shaft, so that cars are run out by gravity and returned by power furnished by a small underground hoist, this doing the work rapidly and cheaply. The distance now traveled by the cars is one thousand feet to reach the shaft.

Numerous diamond drill holes were put into the deposit from surface at the time the exploring of the deposit was under way, and these now serve as avenues through which the water of the ore body is carried, it leaching into them, and being carried downward, this greatly facilitating the drainage of the ore and mine.

The trend of this ore body is northwest and southeast. Whether it is a continuation of the ore found upon the south side of the lake by the Cleveland company is a point not yet decided. Should it be, then the Cleveland has something to expect on the strike of its ore body.

It is not a difficult matter to figure how much ore the Lake Superior has in its new mine. The latter is not a very big one, but it helps take the place of other lenses that are worked out. It is valuable to the company and town in this respect. Some of the ore is of excellent quality and much of it is non-bessemer, being very high in phosphorus. The deposit is not a deep one, but the ore will all be taken, if the mud does not hinder, and I do not see how it can with the excellent precautions that are being taken to prevent.

A new shaft is being sunk for this mine, one being needed to handle timber. It will also be an added precaution against accident, and will assist in the better ventilation of the mine. All the timber now used has to be sent down the Lake shaft and handled through the long drift, and pulled to the top of the ore deposit after the latter has been reached. This takes much time and costs more than it should. The location of the new shaft is the west bank of the old lake, and they are sinking and rising, putting it through at a lively rate. It is vertical to the ledge and will follow the angle of the dip of the formation from this point. The ledge was reached May 5, '97, and a contract for the remainder of the shaft has been let.

A great amount of work has been done since the drift was started in November, '95. Since last June they have put in fully 3,000 feet of drifts, have opened up the different levels, put in cross-cuts, winzes, tracks, and gotten everything in shape for business. There has been some lively hustling at this place.

A force of 137 men are employed at the lake mines of this company. Contractors on ore work by the foot entirely. Trammers work on company account. There will soon be place for many more men if the company decides to push work at this portion of their property. It will take a few weeks to add more rooms on the top level, but if they wish it that can readily be done. The completion of the new shaft will greatly assist in facilitating matters, as the present plan of handling timber causes delay.

They have attached the skips to the twelve-foot drums at No. 1 engine house, giving better power and more rapid hoisting.

In point of quality the ore averages well, a considerable percentage of it being of bessemer grads. This deposit will take the place of the Old Mine hematite, which deposit has been mined out.

They are making three grades of ore from the two lake deposits bessemer, non-bessemer and manganiferous.

THE HARD ORE.

What is known as the hard ore mines of the Lake Superior are located just west of the Old Mine Hematite. They have reached the bottom of the fold and the principal work of late years has consisted in the removing of pillars, a large amount of ore being left in the mine in this shape. But little was done here during the year, and at this writing, May 1st, ’97, nothing is being done.

SECTION SIXTEEN MINE.

There have been no levels added in this property since my report of a year ago for the reason that the ore made so narrow in the bottom that they did not think that was sufficient encouragement to do so. They have been doing some work on the hematite deposit, but the quality of the ore is poor, running low in iron. The principal product of this mine is a hard specular ore, of excellent quality, being identical with the high grade ore of the Lake Angeline mine that adjoins immediately upon the east. The formation rolls considerably, and in the natural order of things the ore should make to the west, in which direction it pitches for a considerable distance. The formations incline one to such belief, and the chances certainly favor other lenses being found in that direction. The mine is not exhausted of ore by any means, but the management would like to find something encouraging in the direction of the pitch.

The sixth level is the lowest, but they are sinking the shaft 100 feet for two additional levels. The big winze to the west of the shaft where the ore has been raised by underground hoist for several years, has been holed at the 530 and 580-foot levels.

To the north of the main shaft about 1,000 feet, is the big diorite hill, extending east and west, that separates the old mine hard ore and hematites from those of section 16 and Lake Angeline. The company has an idea that hematite should be found lying against the south wall of this hill as well as upon the north side of it. Several attempts have been made to reach the diorite from the underground levels with a diamond drill boring, but the ground proved so broken that the holes caved, and it has been given up. They are now putting in a rock drift from the 310-foot level and are in about 3,000 feet, the ground being lean ore. The chances for finding hematite against the diorite are certainly favorable.

They have added a fine new hoisting plant consisting of two eight-foot drums with 24x48-inch engine, drums being Webster, Camp & Lane’s manufacture. A Worthington compound condensing pumping engine has also been placed in the mine, and is a needed improvement. It has 33⅜-inch low pressure and 19¾-inch high pressure cylinders with water end 10x24-inch. Capt. James Trebilcock has charge of underground affairs at the mine as well as at the Lake Angeline deposits of the company.

The hard ore mines of the Lake Superior are idle, as they have been for most of the year 1896. There is

about 50,000 tons of ore in stock that was not shipped for the year, and it was decided best to do nothing here until this surplus was disposed of. The work consists largely in robbing the pillars when the mine is in operation, although they have a few stopes in new ground that are promising. The mine has reached a depth of 920 feet, nos. 6 and 7 shafts being now the principal ones. Capt. John McEncroe has charge of underground work at this proderty.

SECTION TWENTY-ONE MINE.

This possession of the Lake Superior Iron company is located two miles south of their Ishpeming properties, adjoining the Winthrop mine immediately upon the west.

There is a big ore formation here and one that has not been regular as to its mineralized portions—those carrying merchantable ore. The deposits have been irregular in shape, size and quality.

The ore in the upper levels was in lenses of varying size. In one level it would look promising, and in the succeeding one would cut out altogether. The walls were much contorted and there was an abundance of water.

In the present lowest level where the active mining is being done, the 640-foot, the ore is more regular and has improved somewhat in richness, although it is a non-bessemer, giving from 60 to 61 per cent. iron.

Operations are principally confined to the east end of the mine on the 580-foot level, where the ore has been followed for a distance of 600 feet before coming to rock. They did some diamond drilling to the east and north end of the level, striking ore in the holes to the northwest, which ore will be taken from the next level.

In following this ore the latter made a gradual turn to the northeast from the shaft, while to the west of the shaft it runs slightly north of west, making a horse-shoe curve, the dip of the ore being to the north. The 580-foot level was near the cap rock when they first began, and it was the idea to work from the top downward. As they worked west, however, it was found that the capping made decided folds and that the ore went up to the roof in the shape of chimneys. In one they were ten tiers of timber high, and in others from two to eight. They will secure the ore in these chimneys that rise in the back by undercutting them, letting the ore come down, and then taking another cut in the level as the first until all of it has thus been obtained. The back is very solid and there is no danger of it coming down. Pillars will also be taken, going to the extreme east of the level and working back towards the shaft.

The Lake Superior is using the old Mitchell shaft which is to the 580-foot level, and from the bottom of which they have sunk another shaft to their 640-foot level on an inclination of 45°, the purpose being to go down at the same dip as that of the formation, but the latter has straightened up a little, which is not a bad thing. They have an idea that the hanging is not the correct one. Further west there is a known body of ore, but the intervening ground is very wet. They will connect with their east shaft when proper drainage can be had. The distance to be cut is about 100 feet.

With the 640-foot level started in the east end, a drift which is now in several hundred feet, they will work on the caving plan.

At the extreme west end of the mine nothing in the way of securing ore has been done. The west shaft is 1,100 feet from the east shaft, so that a considerable territory intervenes that may hold ore. At a distance of 200 feet north of the west shaft they have ground which promises to be an extensive ore deposit. It was located by numerous diamond drill borings. In the upper portions the ore is badly split up by rock intrusions, the hematite jasper in which the ore occurs, being badly shattered, but it shows more regular at greater depth where the ore sometimes shows a thickness of 100 feet. In one place the drill showed about 40 feet of ore of bessemer quality, but what the actual extent of this piece of ground will be can only be told by actual development. It is somewhat encouraging, although where the ore deposit was drifted into from the 350-foot level the quality was inferior, giving about 59 per cent. iron, and non-bessemer. They drifted 200 feet west in ore and 100 feet east from the point where the cross-cut from the shaft struck the ore.

A peculiarity of the mine is that all the water comes in from the hanging side. To avoid it they drift along the foot in opening.

The company has excellent shafts and a fine equipment of machinery. A force of 75 men is employed. John Trebilcock is mining captain. C. H. Hall is agent of the Lake Superior Mining company; W. H. Johnston, superintendent; C. E. Hendrick, engineer; Jas. Clancy, master mechanic; J. C. W. Chipman, cashier; D. J. Sliney, assistant; Ishpeming.

W. D. Rees, of Cleveland, Ohio, is treasurer and managing director.

THE PITTSBURGH & LAKE ANGELINE MINE.

The Lake Angeline has been a good property for the people of the city of Ishpeming. For thirty-four years it has delved in the little valley formed by the squeezing of the diorite, a trough-shaped hollow that has yielded 3,694,811 gross tons of ore, giving healthy dividends to those who possessed its shares, employed a large number of men, and paid to them the best wages in like kind of work of any similar mineral yielding property upon which the sun shines. Its earlier days were not noted for any great activity, its annual shipments for many years being very small, due to the fact that the main ore body had not been discovered.

Nothing more clearly shows the great gain made in the development of the property than the rise in its shares, the latter increasing in price from $8 to $136, and this in a very few years after the additions to its former stores of ore, as above referred to. The company has the reputation of mining ores of wonderful purity, but it does much to secure this, because there is an indiscriminate

mixture of ores of high phosphorus kind amongst the low, and to separate this requires the greatest skill and care.

The past few years has seen the opening up of a new mine of this company, locally known as the "East End Mine." When I last wrote of this property they were engaged in taking the ore of the first level. The caving system is here employed, being inaugurated by Captain Walters when opening was first begun. They have been working here constantly since that time and have mined out the ore with the exception of that in the extreme west end of the levels. Towards the east the ore rises, inclining to surface, and they are following up on the top of this, slicing and caving in the manner before described. Several rises are being worked, these having a height varying from 16 to 50 feet.

There is a rock capping upon the ore here, this settling into the ore deposit, if you will, with the point of the "V" down. This separates the deposit in its upper horison, making what they call their “North” and “South” veins, the hanging wall of the lens being formed by the sides of the shaped capping that extends for the entire length of the run of ore.

Upon the south vein they have mined out the level with the exception of 100 feet to the east of the shaft, and in the extreme end of the level in this direction, and for 150 feet in the west end of the level, where the ore is non-bessemer. In the west end the raises are short due to the fact that the capping conies down upon it. The pitch of the ore is to the west so as they carry out the level in that direction the ore grows thinner due to the coming downward of the capping. The next level will find the ore of the thickness of the level, of course.

The length of the mined-out portion on the south vein is something like 900 feet. On the north vein there is a stretch of ground having a length of 700 feet that is being worked, while to the west the ore has been all sliced out.

All the ore is sent to the second level, where it is sent to the shaft and hoisted to surface. The tracks and motors have been sent to the second level, and from this all work of tramming is being done, excepting some short distances from stope to mills on the level above.

These mills or raises are put in every 100 feet. Each mill is three compartment. The centre is for ladder-way and timber-way and upon each side is an ore-way. These mills are expensive to put in, but they serve an excellent purpose. As the bessemer and non-bessemer ores occur in a haphazard sort of manner, it is necessary in order to secure perfect separation, that every means be provided to assist in the sorting. Two grades of ore are made, bessemer and non-bessemer, and where two classes are mined from the same locality one side of the raise is used for the bessemer, the other for the non-bessemer. Should the ore in the immediate vicinity of the raise be all of one grade or the other, both mills are employed in case they are needed. At every mill iron tags are kept with which to label the cars so the skip-tender sees just at a glance just what class of ore is being sent up. Samplings are constantly being taken and the number of determinations made is very great. These mills are generally put in with the angle of dip of the formation, which is about 60°. The double ore-ways are convenient even if but one grade is being sent to them, because both can be employed preventing the ore piling up too high-in either one, and reducing the chances for packing and clogging. When a mill becomes too full it is often hard to get the ore to run well from it.

On the second level they are taking a slice from the top of the level immediately under where the ore has been mined out above, this being on the south vein.

A pecularity of the formation is the occurence of dykes running from the foot into the ore deposit, and transversely with the strike of the latter. These are soft, rotten and soapy, and thin out to a point on their extreme ends. They well understand these now and cut through them, or around them, leaving them as they are, the weight of the capping easily crushing them down when the ore has been removed. In the extreme west end is a tongue of rock running in the ore. On the south side the phosphorus shows something like .150% and upon the north of this rock intrusion it is not half that. The phosphorus, as has been said, is higher in the west end of the levels, and nearer the capping, the junction of the ore and the jasper seeming to show more of this undesirable element than at any other point. They expect to have better results in this respect upon lower levels in the west end when the capping will he further removed. Their theory is that the phosphorus has been washed out of the cap rock into the ore, and percolating waters have carried it downward into the ore body, and that the upper portions of the latter have taken up the most of it. Were the deposit to be mined regardless of the high and low phosphorus areas, the product would be non-bessemer. but the sorting gives fully three-fourths bessemer this adding at least a dollar per ton to the value of the stockpile, an item of no mean proportion.

The ore pitching to the west will make that end of the mine the deeper. How far it will extend downward is not known, but if one can form any opinion from surface indications, the dip and pitch of the formation, etc., it is safe to guess that it will be a deep one. There is certainly assurance that the Lake Angeline will last for many years to come.

The caving system as here applied has been a pronounced success. The capping comes down evenly and the timbers bind together firmly, affording excellent protection to the miner, and permitting all of the ore being obtained. It is the very best plan that could be observed for a property possessing such conditions as this. The men have become familiar with the plan, and would have none other. The ore of the lower level is somewhat softer than that of the upper, the latter having shown some stretches of ground where the ore was of flinty hardness, power drills making but slow headway in them.

Two electric motors are employed, and results obtained by their use are most satisfactory. The tramming distances are long, and power other than man is needed. The electric motor handles five two-ton cars at a train, this number having been found to be the most convenient. The motor is 30-horse-power, and could take twenty cars as readily as five, but the latter number is one that works well. There are many places to reach and the shorter train permits of keeping all the raises free from ore. There have been no delays due to burning out or breakages. There is an auxiliary motor, but it is seldom needed. The operators have become familiar with the use of the motor, and the duty performed is excellent. The Lake Angeline would not exchange for any other plan or power of which it has it knowledge.

Besides tramming ore the company also handles its timber with the motor. Much of the timber is conveyed to the raises by the regular ore-carrying motor, but they have another that also performs this duty as well as being used to hoist the timber through the raises to the level above. It has a small hoist, a drum, winding manilla rope in this instance, and it jerks 5 timber through the raises in a manner that shows it can perform a big task every day. The company gives the men the option of using the motor or pulling the timber up by hand. It makes a charge that is less than the men could do the work for, and the result is that all have the timber hoisted by the machine. The latter is a money-maker to the men and company also, it lessening the cost over the hand-pulling plan by considerable. This timber hoisting motor is also a self-propeller, moving through the levels at a lively rate of speed.

The timbers used are generally of small size, this being permitted, by the plan of mining employed, the ground having to be sustained but a short time. The object is not to hold the hanging up, but to let it come down, the timbers used being strong enough to retain the burden until the ore has been removed. Sometimes the hanging does not follow readily, in which case they go to some other raise, leaving the stubborn one for a few days when it surely will come down. This is one advantage of having so many raises.

A very neat arrangement is had for sending timber into the mine. They have an inclined timber shaft, one of the most perfect as to lines in the country. It is in the footwall of the south vein. The timber skip is balanced by a dummy that runs upon an independent track, the loaded skip running down by gravity and held in check by the dummy, and the dummy hoisting the unloaded skip. It works smoothly and easily, and one man can operate it. Nearly all the timber used comes into the mine by this avenue, the rest, used to the east of the hoisting shaft in a few places, coming down through that shaft.

The miners all work on the contract plan at so much per foot. The eight-hour system, first introduced here on this range, is still emptied and works satisfactorily. Three shifts are worked, the men relieving in place.

The electric motor is used to carry the ore from the shaft house dump to the stockpiles as well as to handle it from stopes to shaft. The main trestle has a length of 300 feet from the shaft to stockpile, and two motors are stationed here, one of which is held in reserve in case of accident to the other. They handle the two-ton cars easily and rapidly. By the use of the motor the stockpile can be gradually raised in height as it is built up on its length, this giving an advantage in securing bigger piles than under the old way. Electricity is playing an important part at this mine, and pleases the local management greatly. All the power to operate the different motors is provided from one engine and dynamo that is capable of accomplishing more in this direction.

The company has been doing a little more exploring work on the hillside some 400 feet east of their timber shaft. A pocket of ore in the diorite has been found, and they have drifted into the hill to tap it. The drill followed it for about 96 feet. It is flat in position and not thick enough to suggest a very big deposit. The quality is fine, the ore containing 68% iron and is low in phosphorus, about .025%. Similar occurrences of ore, or probably similar ones, were found some distance east of the main ore body at the East End mine, the ores occupying bowl-shaped depressions in the diorite at a considerable elevation above the old lake level.

At the old mine, to the extreme west end of the company's possessions, they are doing little else than robbing pillars, securing them in the following way: Starting upon a pillar on a level they rise in it one set of timbers wide, going through to the top and through the old floor above. Then they take out this floor clear across the top of pillar and half way across the worked out room adjoining the pillar. Then they proceeed to work downward upon the pillar, letting the top follow, on the ordinary caving plan. Then they rise up in the next pillar, when this one is exhausted, and going to the top take out the floor that was left over the old room and also go half way across the top of the old room upon the opposite side of the pillar. They raise one set wide from hanging to foot, and then slice from the top down, a combination of square timbering and caving. They secure the old floors and pillars, taking all the ore, and the plan works well.

A new shaft will be put in between A. and B. At the two latter there remains considerable ore in shaft pillars and this cannot be obtained until there is an outlet provided for it. The distance between these shafts is 800 feet and the new shaft will be midway between the two. Drifts will be run from the several levels and the shaft will be "raised."

The company mines about 90,000 tons annually from their hard ore lens in the old mine, and are raising it from the lower levels to surface, the ore giving evidence of extending upward to the overlying sand. They have ordered an ore crusher from the Lake Shore Iron Works, Marquette, and will soon have it in position. The opening is 24x36 inches, and the weight of the crusher

will be about 80 tons, one of the heaviest in the iron region.

The company has done some exploring the past summer in Tilden township, on lands possessed in fee by them. The work done was upon the old Howell-Hoppic property. A shaft was sunk 70 feet and crosscuts put in. Plenty of low grade ore was found that ran about 40% in iron and .030% in phosphorus, but none of high-grade located that was of sufficient size be valuable.

The company has about 600 men on its pay roll. Alfred Kidder, agent, Marquette; Thos. Walters, superintendent; E. F. Bradt, mining engineer; Wm. Tregambo, mining captain; Geo. R. Parsons, cashier; C. T. Kruse, assistant; R. D. Smith, master mechanic, Ishpeming; Jas. Laughlin, Pittsburg is president; W. G. Pollock, Ohio, secretary and treasurer.

THE EAST NEW YORK MINE,

located within the city limits, has not been wrought since my last report. There are stopes of ore still remaining in the levels, but the East New York company became financially entangled, and the property is now in the hands of F. B. Spear, Marquette, Mich., who has secured an option from the fee owner, A. M. Bigelow, of New York. There has been some talk of resuming operations but nothing has yet been done. The mine is full of water.

THE WINTHROP MINE.

This mine is well known in the list of shippers of the Marquette range, it having sent to market 1,974,450 tons, of which total 149,437 tons were shipped in 1896. Since my last report they have discontinued operations at their No. 2 shaft, which is on the south side of the diorite hill to the north of which the old mine was so long worked. They followed the ore west for several hundred feet, when it became pinched and pockety, and the cost of securing a product was more than the condition of the market would warrant. There is ore still showing in the end of the drift, and further work in the direction of the pitch, the west, might find valuable deposits, but the company, like many others, decided to do no dead work until an improvement in the market appeared.

To the south of No. 2 they have stripped a lean ore deposit at the old No. 3 shaft, and have this in shape for a large output whenever there is a call for it. At the old mine workings they have the large open pit from which the product of the past year was principally derived, and this is now being wrought, about 40 men being employed. All work was stopped at the mine during a considerable portion of the past winter. The open pit, as the ore makes westward, has considerable stripping to be removed, the latter becoming heavier as they follow on the trend to the west. They secure very high stoping faces in the ore, and use heavy sand blasts that dislodge hundreds of tons at a single explosion, so that once the stripping is removed the ore comes very readily. In point of quality the latter gives about 46% iron and is of bessemer grade. There is an immense amount of ore of this class upon the company's lands, and it bids fair to be the principal product. There is no royalty to pay, and the low rail freight makes the property valuable even at the low price at which the ore must be sold.

F. Braastad, Ishpeming, is vice-president and general manager; C. T. K Fairbairn, Ishpeming. superintendent: M. A. Hanna, president: A. C. Saunders, secretary and treasurer, Cleveland, Ohio.

THE CHAMPION MINE,

The Champion is the most westerly of the mines now working on the Marquette county range, and in line with the formation found in the Ishpeming and Negaunee fields.

The Champion has been a most interesting property from the time of its discovery up to the present. Its ores are slate, specular and magnetic, all of bessemer grade and some of them of wonderful purity. These ores occur in the only true vein to be found in the iron mines of this county. The walls are regular and continuous for a great distance, and while the ore is found in lenticular masses and while there are many barren stretches separating them, the vein is always plainly marked, and readily followed.

As stated in my last report, the Champion does not possess the magnificent stopes that marked its earlier history, and from which a large annual product was readily secured. The ore is of a very hard nature, and, with the great reduction in price, together with the necessity that arose for its reduction by crushing, the competition with the softer ores was too keen, and a stoppage resulted in 1893. Previous to this time, however, there had been considerable development work done and additions made to the equipment of machinery, so that the property was in excellent shape to resume business if the cost of placing a ton of ore upon surface, or in the market, was sufficiently low to meet the figures of other concerns favored with conditions that permitted cheap products, and which the market demanded. Mr. Walter Finch finally prevailed upon his company to let him make a trial in the spring of 1895, and since that time the mine has been constantly busy.

For a time after the resumption, work was wholly confined to the robbing of pillars in the east end of the mine, the older portion, and when this was well started attention was given to the western end of the property where new territory was opened up, and additional lenses were gained.

The strike of the vein is nearly east and west, and the pitch of the ore is to the west, the lenses inclining rapidly in that direction, so that the hope of the company for new ore-bearing ground is in the western end of the mine. Something like a mile further west than they have yet driven underground, the ore formation seems to be lost, the jasper cutting out, or disappearing, so there is some speculation as to how far the ore measures will be found

to the west, but a mile can be productive of much, and present indications give much encouragement to the finding of valuable lenses for some time yet to come. The work of the past year has proved considerable of satisfactory kind in the extension of the ore bodies to the west, and another gratifying feature is the improvement in the quality of the ore found, the greater portion of that broken now being of first-class, whereas it was formerly, and in recent years, of the lowest grade. In the product of 113,375 tons of the year just ended the bulk was first-class. But two classes of ore are now made instead of four of former years. One reason for this is that all the selecting is dune underground, instead of upon surface, the latter being the system of the past. It is found desirable to do the selecting where the ore is filled into the tram cars, as the cost of keeping up four grades was considerable.

No. 7 shaft, the most westerly is about 2,400 feet from the most easterly shaft of the old mine. It is to the 12th level, and is sinking for the 13th, the start for the latter having just been made. They will wait until the 13th has been reached before timbering from the 11th. The bottom of the shaft was in ore at the time of my visit, the rolling of the formation finding the shaft at times in the ore and again out of it. They would prefer to have the ore to one side in order that it could be all taken. At the 9th and 11th levels this shaft is connected with No. 6, which is located about 450 feet to the east. Between these levels they are mining to the east of No. 7, working upon what they call their eleventh level lens that comes from No. 6, and which has been a very satisfactory stretch of ground. This same block of ore was worked upon its eastern side from No. 6 shaft, but the remainder is now nearer No. 7, and will be taken to surface through this avenue. They are stoping down this ground now, a succession of benches being worked, the ore being permitted to roll down to the 11th level. At the 9th level of No. 7 they have a drift 175 feet to the west, while one in that direction at the 11th level is in 125 feet.

No. 6 is down to the 17th level and they are drifting west upon the 16th to reach a point under No. 7, when they will rise to meet the sinkers in that shaft. A part will also be set at work sinking from the 16th, and will go downward until the work of connection above the 16th is finished, which will be about the first of the coming year, 1898. At this time the shaft will be well along towards the 18th level, and will give a fine chance to drift west at that depth to prove what is there awaiting the miner. This work will be watched with much interest as considerable depends upon the result of the explorations in that quarter. It is confidently expected that No. 7 will be the principal hoisting shaft in the near future. The shaft, while an old one, in the upper levels, is in excellent shape, firm and strong, and will be an admirable and safe way as long as it is needed. They will erect no shaft house here, but will pull the ore to the crushers on an inclined road, which will save the cost of building a house. The ore has all to go to the crusher plant located at No. 5 shaft.

At No. 6 shaft, which is to the 17th level, they are doing no sinking as the ore has been carried westward by its pitch and will be taken from No. 7. They are working in No. 6 from the 12th to 17th levels inclusive, and some very fine stopes are showing. While the vein is regular as to its general course, the walls contract and expand frequently. At places the ore will narrow down to only a few feet and as suddenly will widen out to twenty feet or more. Those familiar with the old mine will remember that in the east end there were parallel lenses of ore known as the “north” and “south” deposits, but these are not found to the west, only one run of ore being seen. They have done some crosscutting in the hope of finding the second deposit, but while small lenses sometimes make into the foot, no regular run of ore occurs.

The walls in the west end of the mine are remarkably stable, and the ore is entirely removed, no pillars being needed for support. Mr. Fitch believes that he could even take the floors from the top to bottom without danger of letting the hanging down. The walls are almost vertical and there are frequent barren stretches that act as pillars or supporters.

In winning the ore in the west end of the mine, at Nos. 6 and 7 shafts they observed the method of drift stoping that has always been in vogue at the Champion. They take stopes 45 feet high, going in at the top with drift and underhand stoping the balance. The levels are 60 feet, so that 15 feet are left for floors. All the drilling is done by the foot, the drillers having to blast their own holes and to provide their own powder. The plan works well here, and they would not change it for any other. The miner knows every night just what he has earned, as it is a very simple matter to measure the number of feet drilled and the amount of powder used in the blasting. In sinking, the men are given the regular company account base, and a premium is given for any excess of this. They are paid so much per day for accomplishing a certain amount of work, and anything in excess of this they are given a premium for. It gives an incentive to greater exertion on the part of the men, and both the company and employe are pleased with this method.

In driving their rock drifts the miners put in five holes to a depth of eight feet. These are put horizontally into the breast of the drift, three inches being left between them and the holes being located one under the other. They change the second and fourth holes from the top of the row, and the blast breaks the ground between all of them so that with the machine they readily gouge out the fractured material. This gives a channel through the centre of the drift, and they next proceed to square the drift up. The space made by the set of holes is found to give the side holes an excellent chance to break, and the miners informed me that they could make from 45 to 50 feet per month by this plan, whereas they could do little better than half that by the old one, and the one commonly used at all mines. They said they doubted it at first as it seemed to them that the boring of five holes one under the other, and with but three inches between the outside circumference of each was throwing time

away, but they soon learned that the eight-foot channel in the centre of the drift was valuable for the squaring of the drift, and they would not return to the old way. Holes are two inches in diameter and drifts are 8x8 feet.

At No. 5 shaft, located 450 feet east of No. 6, they are to the 22d level, and are 80 feet below, sinking for the 23d. This latter will be 100 feet thick, forty feet greater than those above, the reason for it being found in the unstable hanging wall. There has evidently been a water course here that has decomposed the hanging rendering it schistose and slippery and very dangerous. They have to use great caution to prevent accidents. Instead of taking stopes 45 feet high they will take them 18, and the balance they will secure upon timbers, milling the ore down. Ore is showing here from the 18th to the bottom on the west side of the shaft, but the ground to the east is barren below the 17th level. They are running a drift east on the 21st level to explore the ground. They know of 12 feet of ore, that will be encountered opposite No. 4 shaft as it was struck with the diamond drill. No. 4 is about 350 feet still further east.

East of No. 5 there is nothing being done in the way of developing new territory, as there is none to work unless it may be at a greater depth than is at present attained. They are still robbing the pillars, and a considerable product will come annually from this source for several years to come. The work of "thinning" pillars that was going on here a year ago, has been discontinued. They are working from the bottom of the mine upwards, taking all the ore as they rise. At the 14th level they have put in a substantial way, built up strongly of timber, and weighted down with ore to prevent damage in case of any big fall of ground. Upon this timber there are probably twenty thousand tons of ore, and this they will secure from a drift they are running at this same level in the hanging wall. They will break through the latter in places, permitting the ore to rill into the drift, where it will be sent to No. 4, to which the ore now sent through this timber drift is delivered. They have mined out the pillars to the 12th level, and have a great deal of ore above that point, it extending to the top of the mine. All this ore is of excellent quality. The walls are very firm, and Mr. Fitch believes they would stand if the floors as well as the pillars were removed. As in the west end, there are many places where rock fills the vein instead of ore, and this offers substantial support to the hanging. The wrecking plan has worked admirably, and will be kept up until all of the ore has been secured. The miners break immense masses of ore that roll to the 14th level, they being caught by the timber drift. They will be blockholed from the hanging wall drift referred to, and can readily be handled to the shaft.

Four-ton skips and cars are used above and below ground. To secure the desired stockpile height, 50 feet, there will be cages used at the crushing station, to lift the ore from the latter to the top of trestle. These cages will be operated by the device common to the ordinary elevator. They will work in balance, will carry four tons each, and will be provided with automatic stop at both top and bottom of shaft. Cages are now being built in the company's shop.

The crushing plant of the Champion is one of the best in the region. They have consolidated the temporary and permanent plants at No. 5 shaft, and have now three 55-ton crushers placed side by side. They are of the Blake pattern with openings 24x24 inches. They are run by manilla rope transmission by a pair of Corliss engines, ropes running over ten foot wheels. The tightening of ropes is accomplished by a coupling that permits the rope being twisted, a ratchet serving to retain the twist in place. This works well on the size of rope here used. A traveling crane with track extending far enough from each end of the crusher room to permit of the handling of the heavy parts of the machinery, is a great convenience. The crushers have a large amount of refractory ore to reduce, and breakages have not been infrequent. Jaws have been steadily increased in size until now they are getting them of steel, the breaking capacity being about four times as great as those formerly used, so they expect greater freedom from stoppages due to broken parts. All the ore that comes from the mine is run through the crushers, cars coming to the crushing plant by gravity from the several shafts. From No. 7, as before stated, they will pull the ore to the shaft on an inclined trestle, and thus do away with the need of a shaft house. To handle the ore by gravity from No. 7 would require a shaft house of great height and expensive to construst.

The foundations for the machinery at the crushing station is of concrete, made according to a well-tried formula of the United States government. The proportions of material used is: 1 part cement, 2½ parts sand, 5 parts rock. There was first laid two feet of concrete for the foundation proper, and upon this was formed the concrete piers. In the latter are 4,000 cubic feet of concrete. The concrete was poured into forms, packed firmly, and alternate forms were first filled. Between the several forms a sheet of felt paper was placed, this separating them sufficiently to permit of a slight expansion or contraction, and it is thought better practice not to have so large a mass united as one. The foundation gives evidence of being very substantial, and will continue to increase in hardness for eight months after being formed. There is ample room to reach all the foundation bolts, the arrangement being a convenient one.

The mine makes but little water which is removed with a bailer that has shown excellent results. No additions have been made to the plant of machinery the past year, and none will be needed for some time to come, as they are well supplied with the best.

The Champion has ever been a progressive concern, and has kept well to the fore in all things pertaining to its business. At no other place I visit is there evidence of more skill in operation or care in looking after all details. It is a model property, and one that, considering the hardness of its ores and the great depth of the mine, is

making an excellent record. Iron mines that reach downward 1,300 feet are exceptional in any of the districts of the Lake Superior region, and it certainly costs more to equip for this distance and to operate also, than for the properties where the ore is not so deep-seated.

Should the hope of the management be realized in the finding of rich ore bodies in the western territory to which attention is now being directed, it will prove a great blessing for the bright little village in which the mine is located, and which has been so important a business factor in this country for so many years.

The Champion's product for 1896 was 12,978 tons greater than that of 1805, and its total product to the first of the year amounts to 3,083,715 gross tons. There are now employed at the mine 230 men.

Mr. Walter Fitch is agent and superintendent; G. S. Barber, surveyor and chemist; A. Fitch, cashier.

The general offices are located at Boston, Mass. Henry B. Fay, president; W. E. Stone, treasurer; W. B. Bosson, secretary.

THE DEXTER MINE.

The Dexter mine is located six miles west of Ishpeming City on section 3, 47, 28. Its deposits of ore have been small, and but for the fact that they were manganiferous would not have been in the market for several years past. The manganese made the ore salable, and the hope of larger lenses and better in quality spurred the management to pay assessments and keep the mine active. Many thousands of dollars were paid by the shareholders with the idea that lower levels would give them increased ore vein and better chance for dividends. The ore did improve in size but the quality did not, and in September of 1896 the mine was closed, the pumps withdrawn, and there is little hope of revival for some time to come. One level has been added since my last report, this being the eighth, and is 560 feet from surface. Here they had a vein 60 feet thick, and much larger than anything before shown in the mine, but it gave only 56 to 57% in iron and contained considerably less in manganese than upon the levels above. It was also non-bessemer, and for this there was no market.

In my last report it will be remembered that the quartzite is described as having made a decided turning at the seventh level. At points above this it was the footwall, but upon the eighth it gives evidence of assuming its true dip, and this should be encouragement to sink another level in the hope of finding ore of better quality. For a considerable distance the ore was from 8 to 14 feet thick, so the gain at the eighth level is a big one. It would be no trouble to mine 50,000 tons from this level in a single season if it could be sold. The fee of the property is principally owned by the Conrad estate whose interests are being locally looked after by P. P. Chase, Dexter, Mich.

The product for the mine during 1896 was 18,930 tons, and the total tonnage produced is 117,385.

THE REPUBLIC MINE.

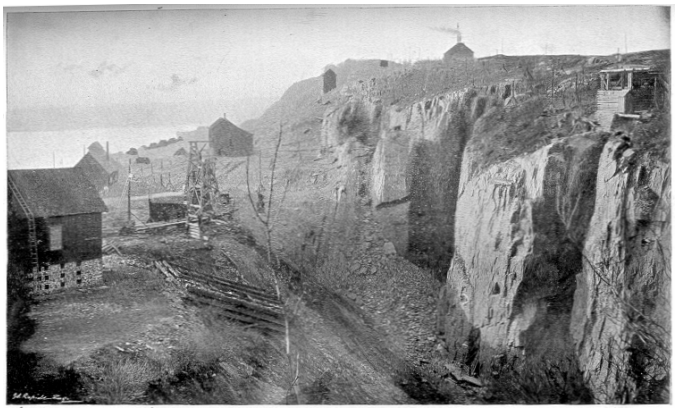
The village of Republic continues to depend more wholly than ever upon the operation of the Republic mine, the only one worked within its limits or the only one for many miles from the town. In former years there was considerable done in the way of lumbering, but the timber has been nearly all cut and but little remains of this industry. The town enjoys a magnificent site upon the shore of Smith's Bay, a swelling out of the Michigamme river.

The fold in which the ores of the Republic mine occur is a long one, having a length of about seven miles and a width of from one-half to two miles. Its course is at contrast with that of the Ishpeming and Negaunee formations, being northwest and southeast, making for seven miles the valley in which runs the Michigamme river. The Republic mine occupies the southeast end of the fold, and upon the turn of the formation the ores are found. It is separated from the Ishpeming ore-bearing rocks by six and a half miles of granite. The dip of the formation is towards the bay which lies to the north and west.

It was in the western portion of this great horse-shoe curve made by the bending of the formation, in which work was principally carried on during-the earlier history of the mine. The property was first given attention in 1871, the immense outcroppings of jasper attracting notice to the deposits. In this end of the fold were the famous, Morgan, Pascoe and Ely pits, well known to all iron miners all over this country. These contained magnificent stopes of both specular and magnetic ores, and from which the principal product was secured for many years. Gradually the ore grew less in size. and three years ago saw the closing of the old pits. At the present time, however, they are doing something at the Morgan pit, mining on small lenses that can be secured without doing any dead work. They have a neat little stockpile of both specular and magnetic ores awaiting shipment. They have also done something upon the West Republic territory still further west in the fold. Upon the ore here obtained they pay a royalty to the owners who reside in Toledo, Ohio. The West Republic offers but little encouragement, the deposit found being small. There may be a chance to find something better, but there is little inducement at the price now offered for the ore. The Republic company owns the fee of all its workings with exception of those on the West Republic lands.

At the Pascoe and Ely pits nothing is being done. Years ago, when the stopes were big, and when the price received for the product was anywhere from $6 to $12 per ton, everything that looked like rock was run out into the dump pile, so that now there is an immense amount of ore of low grade that lies in the big pile that came from the old pits. It was to treat this pile of waste that the Republic Reduction company was formed some years ago and tried to separate the ore from the rock by crushing. This proved a failure and the attempt was abandoned. The pile of waste will probably average

better than 40% iron, and Mr. Morgan believes it could easily be brought up to 45% by a little selecting. This great pile of waste containing more than 125,000 tons, may be shipped. The ore is very low in phosphorus, and it certainly would be better than much of the low grade stuff now being gent to market. On the west side of the pile there could soon be a face of 50 feet high secured in the pile. The tracks are upon the east side where the height of the dump is considerably less, but a change to the west side could readily be made in case the company can sell the ore.



EAST SIDE FOLD, REPUBLIC MINE.

No. 6 shaft, further north on the curve, and which caved in several years ago, is being given attention. It is to the bottom of the ore deposit and about it are large pillars of ore that assisted in retaining it in position. To secure the pillars a new shaft was sunk immediately behind it, and it is to the 9th level, known as the old cage level. They are taking the pillars working from the bottom upward, having but fairly started. They are securing the ore by backstoping, putting in heavy timbered drift, and establishing mills from the drift upward, using the same plan observed in their regular mining further north on the vein. They will stope out two levels and then put in another drift, it is not being thought advisable to put in a drift at each level. This will give stopes 120 feet high. They will take ore on north side first and afterward secure the south side ore. There are two lenses, or "runs" of ore in this portion of the mine. There is enough ore here to last for several years in the ordinary course of mining providing the upper levels have not crushed. The lower ones are intact, being as perfect as when work was suspended in the shaft some years since.

At No. 1 shaft they have added another level since my last report, making the vertical depth 1,221 feet, and are sinking for a new lift in addition to this. The ore at No. 1 is secured by underhand stoping, and some immense stopes have been worked. It is not uncommon to carry them to a height of 180 feet. The ore of No. 1 shaft has been of excellent quality, their "Special" grade running 67% iron and .020% phosphorus. A considerable percentage of the product is of this class. Just now there are bunches of jasper coming in and mixing the ore somewhat, but this is not unusual, and has been met with often in the downward course of the shaft.

No. 8 shaft is the principal one, as it has been for the past three years, it and No. 1 furnishing the bulk of the output of the mine. It is a long way from the ore deposit, the latter being 800 feet north of it. To relieve the long tram a new shaft is being sunk, it having been commenced at the time of my last report. It has reached a depth of 382 feet. It is three-compartment, vertical, and will have two skip ways and a cage way. The size is 6x18 feet. It is in the foot, and has been in the hardest kind of jasper. It is a line shaft, one of the most substantial in the district. In but few places is timber needed in the work of sinking. In the bottom at the time of my visit a few streaks of ore were showing, these having a thickness of a few inches, but all the rest of the bottom was jasper hard as flint.

They are raising in the shaft from underground. From the 758-fool level they are up 50 feet, and from the 911-foot level they have raised 24 feet. They will sink from these levels as well as raise, so that the work will be rapidly pushed.

The need of the new shaft is urgent, as the tram to No. 8, a distance of 1,200 feet from the extreme north end of the vein, is too long for economy. They have power to do the tramming, but it is too long a distance, and they do not care to open new levels because the cost of the long rock drifts is too great. They have been working upon the same stopes here for the past three years, no additions having been made in that time, so the need of new ones is now demanded. The deposit is a fine one. There is a length of ore of over 400 feet, by 25 feet thick, and it is of excellent quality, all of bessemer grade, and all of the specular class, no magnetite having yet been found here. They hope to have the new avenue ready by February, 1898. No. 8 is connected with the new deposit at but three levels, the 644, 758 and 911. There is a drift from the 1,153-foot level in now about a thousand feet, and ore is daily expected. The pitch of the ore is to the north, so that in this deepest level it has been carried a considerable distance further in that direction than in the upper openings. They have encountered rocks such as immediately inclose the deposit and look for the ore every day. With the new shaft completed they can open out at the different levels and save the long distance now necessitated on account of No. 8 shaft being so far away.

At No. 8 deposit they are using the backstoping method described in my last report, and it continues to give satisfactory results. They first take a drift stope 15 feet high. This they secure with heavy timber, lay their tram tracks, and then go above the timbers and back stope. On the hanging is a rotten soapstone that shells off as soon as the ore is taken. They waste this in the level, placing it beneath their feet using it to build upon so as to reach the back. The broken ore is sent down through substantially timbered mills that are carried up as the work proceeds. For fifty or sixty feet the mills stand well, but as greater height is attained the ore, which is sharp and massive, is severe on the timbering, splintering it, and knocking it out of place. The great height to which

the mills have been carried, due to the few levels opened up, has necessitated considerable extra work in the keeping of the mills in proper shape.

The new territory now being developed is a promising one. There has already been sufficient done to warrant the statement that the mine will be an active one long into the future. The ore formation continues northward for a long distance, and there is no reason why other lenses may not be found when the one now wrought is exhausted. That there is ore further north has been proved with the diamond drill.

All the hoisting at the mine is now done from the main engine house, No. 5. At this station they have added a new engine, 26x48-inch, that will furnish power for some time to come. There is enough power developed at the company's hydraulic works, located upon the Michigamme river, to drive all the machinery for the greater portion of the year, and in times of low water they have a reserve of steam. At No. 6 shaft they raise the ore from the shaft to surface by trolley, carrying a bucket. The mouth of the shaft is at the bottom of the old open pit. The mine makes but little water, a Cornish lift located at No. 8 shaft, easily taking care of it by working nine hours out of the twenty-four.

There are three lines of railroad over which the company can send its product to lake port and it owns its own fleet of ore carriers, six steel; steamers, valued at $600,000. It is an enterprising concern, takes excellent care of its property, and has made money in the pinching times of the past few years. Its ores are of the finest produced anywhere, and command the highest market price. They are easily reduced, contain little or no moisture, are very high in iron and low in phosphorus, and they will be popular as long as they are mined. A force of 290 men is employed.

David Morgan is agent; Peter W. Pascoe, mining captain, Republic. W. D. Rees, is president and treasurer: W. B. Castle, secretary, of Cleveland, where are located the general offices.

MINES OF HUMBOLDT.

Humboldt was once one of the liveliest mining camps in the iron ore producing region of Lake Superior. The old Washington was considered the mineral wonder of its time, and the Humboldt and others have since received considerable attention. At the old Washington many of the prominent mining men of this district were once employed in the capacity of common miners, and here received instruction in the science of mining hard ore; that has stood them well ever since.

The exhaustion of the stores of ore of the Washington was in part re-r placed by what was later found at the Humboldt, but this property has been idle for many years. It had large stopes of ore when it suspended, but the "quality was not sufficiently good, and then the cost of mining was considerable, the ground being hard to drill, and the price of ore fell to so low a point that the company did not care to try to compete with the miners of soft hematites that came readily from the deposit and needed no reducing in crushers after being raised to surface. The company still keeps up its buildings, and there is a chance that some day they may use them. Time may call for ore of this class, and they have the ore when it is demanded at a price that will permit of its extraction. Mr. J. B. Maas, of Negaunee, has charge of the property.

The Samson made an experiment a few years since, sunk a shaft and did considerable exploring, but gave up the flight after spending considerable money and finding but very little to show for it.

Edison, the "wizard," tried his hand at treating the lean ores of this place by electricity. The separation was effected, but there yet remained something to be accomplished before the method was pronounced a success. Before the desired object was attained fire destroyed the plant which has not since been rebuilt.

The Foxdale, a hard ore mine, located a short distance west of the Humboldt, was opened by Ishpeming parties one of whom was Capt. Thomas Buffalo, of the Cleveland Lake Shaft mine. Considerable work was done, and a vein of ore found that would have yielded a considerable tonnage annually, but the quality was not such as would sell for a price at which those interested could make a dollar. About this same time the hard times came on, and it was not deemed best to equip the property with such machinery, etc, as would be needed for a large output. So the Foxdale has joined the others that have been silenced by various causes principal of which is low price and too much phosphorus.

About a mile and a half north of this hard ore range is one of limonite, strongly marked, and holding deposits of large size. Upon this, six years ago considerable was done on the E ½ of the S W ¼ of section 25, 48-27, by Negaunee, Mich., parties, who sunk a shaft, mined 850 tons of ore that was shipped, after which nothing further was done, the mine being shut down awaiting more favorable conditions. There was no railroad to the property, and the companies did not care to make the outlay necessary to securing one. The Duluth, South Shore & Atlantic and the Chicago & Northwestern area bout a mile distant, the latter being on the north, the former on the south side of the mine. The ore that was shipped was hauled by teams from mine to railroad. The mine is known as "The Bessie."

There is one shaft that has a depth of 100 feet. It is sunk in the ore formation, is vertical through the capping a distance of 20 feet, and then in clines south at an angle of about 60° following the dip of the rocks. Two levels have been opened one, the first, at a depth of 60 feet, the second at 100 feet. On the first level a small bunch of ore was found, and on the second the vein has a width of 27 feet, with no proper hanging or foot. The ore thus far found has been of low grade, giving about 58% iron and is very high in phosphorus.

In January, 1897, the Commonwealth Iron company secured an option on the mine and unwatered it, employing a force of twenty men for six weeks cleaning up the levels. The ore did not prove sufficiently rich, and it was considerably scattered, and they gave up the trial after a brief examination of the underground workings. I believe there is plenty of ore here, but the price received for the grade is not sufficient to pay for the expense of securing it. In quality is is much like that of the Beaufort and Titan mines, of the Michigamme field, properties that have been idle many years.

THE SWANZY MINE.

This property is located sixteen miles southeast of the city of Negaunee and is the property of the Escanaba River Land & Iron company. It is in town 45, range 25, and the company possesses the fee of 703 acres of land all lying within the mineral belt. There was nothing done during 1896 aside from keeping the mine free of water. The mine is opened to the 5th level where the records of the company show there is a body of ore 340 feet long, 80 feet wide, and at the time of the closure there was a stoping face of 45 feet in height. The ore is of bessemer grade for the greater part, and yields from 60 to 65% iron. The company began business without sufficient capital to carry the work of mining on as it should have been done, a mistake was made in not separating the different grades, this resulting in securing a much less price than would have been obtained had care been taken in the sorting and stocking. A new shaft was started and sunk 285 feet. It is three-compartment, and about the time it had reached the depth stated the hard times came on, the funds of the company were exhausted, and an attempt was made to dispose of the property. An offer of $85,000 for the forty acres containing the mine was refused by the stockholders, a mistake that was apparent soon after. Since then the property has been advertised at public sale by the receiver, T. M. Wells, of Negaunee, Mich., but no offers of any value were made, and the sale has been again advertised for the 27th of May.

There is a complete plant of machinery, the mine could be made ready for active operation in a few weeks, and the property is certainly a valuable one well worth a trial from ore miners. There is a large and unexplored territory here owned by the company that is now offered with the mine in the advertised sale, all the lands of the company being included with the mine.

EXPLORATIONS.

There has been but little done in the way of exploring upon the Marquette range the past year. When mines producing high grade ores cannot find a ready market at a profit there is little inducement to look for others. The Pittsburgh & Lake Angeline company sank a test pit 60 feet at the old Howell-Hoppic location, just south of the Winthrop mine, finding lean ore that would do to ship for the class was high in silica and low in phosphorus.

Ishpeming and Negaunee parties have done something at the old Ogden mine, located on the east shore of Iron Mountain lake, on section 13, and will probably ship a trial cargo the coming summer. They have done some stripping, finding a large amount of ore of the low-grade kind. Mr. E. F. Bradt,of Ishpeming, is interested.

THE MENOMINEE RANGE.

The Menominee range for the year 1896 sent to market 1,409,595 tons of ore, this being 285,209 tons less than were shipped for 1896. The product referred to as coming from the Menominee range is from the Michigan mines of the range. The shipment for the last year from the Wisconsin mines of the Menominee were 128,643 tons.

The Menominee is not favored with as many mines producing high grade ores as are the Marquette and Gogebic ranges, but while it lacks in this important features it possesses others of value, one being the nearness to market, another the regularity of iron and phosphorus in the different properties, and yet another the fact the vessels can be loaded to their fullest capacity, which is not possible from upper lake parts, due to the lack of sufficient water at the "Soo" canal.

In the western portion of the district the ores are very high in phosphorus this having the effect of closing many of the mines, there being no market at living price for such ore as they can produce.

The Menominee range paralles the Marquette, being about fifty miles to the southward, and it varies considerable from the latter in its rock formations. The order is: Granite, siliceous limestone, clay slate with iron ore, quartzite, and Potsdam sandstone. The ore-bearing strata form basins the edges of which are very sharply tilted, often assuming a position nearly vertical. The limestone folds have played an important part in the concentration of the ores as have the diorites and dikes of the Marquette district. The important mines have been found in folds of the limestone, and prospectors keep a sharp lookout for such places in their search for paying deposits. The range is one that has received much attention from prospectors, and an immense amount of money has been expended in looking for new mines, much of it, as in all fields, having been very badly employed. There are immense outcroppings of lean ore in this district, and millions of tons of ore high in silica and low in phosphorus are exposed to view in the range of hills near Norway, Quinnesec and Iron Mountain, and some of the largest properties shipping this grade of ore are here to be found.

In former years there was considerable work done upon the eastern end of the range, in the vicinity of the village of Wauceda where two mines were worked, these being the Breen and Armenia, located on section 22, 38, 28. The deposits were small and nothing has been done upon them for several years. Numerous attempts were made in the way of locating profitable lenses, but all were unavailing, and there is nothing now being attempted in a revival of this end of the Menominee. The most easterly property now active upon this range is

THE LORETTO.

The Loretto mine is located on section 7, town 39, range 28, about six miles east of the town of Norway, Mich. There is a railway station named in honor of the place, and an effort is being made by land owners in that vicinity to create a boom in town lots.

The mine occupies a position near the junction of Pine creek and the Sturgeon river, both streams of considerable size. The ore makes beneath these streams, but has not been worked where there would be danger of letting the water in. During the past year the company has been opening up a new mine 300 feet south of the old and has shown considerable of promising kind. It will be remembered that the old mine possessed but two levels, the ore occupying a bowl-shaped trough that cut out at the lower level. The shaft was sunk in the hanging of this deposit, and eventually passed into the foot. A large pillar of ore had been left to retain the shaft and in order to secure this the engine house had to be removed. This was done, and the work of mining the ore thus left has been going on. The first level of the mine was 80 feet thick, the ore making upward to the overlying sand. The second level has a thickness of 100 feet, and is to the bottom of the ore deposit. They did considerable drilling to find an extension of this deposit without success, the pocket seeming to be an isolated one.

A drift was started north from the second level of the mine, and at 300 feet ore was encountered, the intervening ground being jasper and slate and observing a very sharp dip, about 85°. A shaft to reach this was started in April, 1896, and is in the ore body. The latter dips to the south and has beeen opened up for about 350 feet in length, showing a thickness of 30 or 40 feet. The trend is nearly east and west at the shaft, and this led them to try an exploring shaft on the opposite side of the river. This was put down 50 feet in red slates, and a drift from the bottom was continued in the same formation for 25 feet. This proved to them that there has been a bending of the formation to considerable extent, and the shaft they had supposed would be in the foot was on the opposite side, and they abandoned work until more is developed in the new deposit. From what has been shown at the exploring shaft it appears that there is a decided turn or fold of the formation here, it making out under Pine Creek and then turning south and east under the Sturgeon.

They are taking the ore of the new deposit on timbers, mining out rooms three sets in width and leaving pillars of four sets wide, and have but fairly begun mining at this north deposit. To the north the ore formation thins out in waves or rolls, and to the south of the ore is slates succeeded by limestone. The Loretto is evidently in a fold of the limestone as is the Pewabic, Aragon and other mines of the Menominee range. From the second level they have a winze 54 feet in ore. The new shaft is one compartment, 7' 6" square, is vertical, and can readily be enlarged in case more room is needed. They are making three grades of ore here two corresponding with their "Loretto" and "San Jose," and a third being a trifle higher in phosphorus than these. The "Loretto" grade gives 62% iron, .020% phosphorus; the "San Jose" 65.80% iron and .015% phosphorus.

Care has to be taken in the working of the ore deposits where they make near the rivers overhead, and they have kept away from such territory, as they do not yet know what is above them at the new deposit where it makes under the stream. They will take every precaution for the safety of men and mine, rock-filling all mined-out rooms.

The Loretto was not operated steadily throughout the past year, it closing down on the 26th of August. At this time it had shipped 34,335 tons of ore and had not sold a pound of it. Two hundred men were being employed at that time. Resumption took place on the 22d of February, 1897, a force of 270 men being now, (May 12, '97), engaged.

The rare purity of the ore of the Loretto encourages the company to do considerable in the way of exploring their lands, as the product, in ordinary times is salable, and at the highest figures paid in the market. Outside of the new deposit now being developed nothing of importance has been located, although there is a considerable territory yet to be looked into.

In the first level, east end, of the old deposit, was a piece of ground heavily charged with sulphur. In September, shortly after the closure, this began heating, due to settling ground, probably, and threw off dense volumes of smoke, the fumes being right disagreeable. So heated did the mass become that some of the timbers of the mine were charred. The smoke was noticed for several weeks and finally ceased.

D. F. Bremner is president; W. A. Arnberg, treasurer; W. H. O'Brien, secretary, Chicago. Harry Truscott is mine superintendent, S. McRoberts, cashier; Robert Murray, mining engineer.

The Appleton mine just across the river from the Loretto, and owned by the same parties, has been idle since 1894. There is ore upon the property but the grade is not equal to that of the Loretto. They would need a new boiler house and boilers in case they decided to resume. There is one shaft and three levels. These had been nearly exhausted of ore, but just before closing a new and promising lens had been found.

MINES OF VULCAN AND NORWAY.

Leaving Loretto the next scene of activity upon the Menominee in going westward, is at Vulcan and Norway villages, two miles from Loretto, and that have maintained a thrifty population for many years. Here are located the properties of

THE PENN IRON MINING COMPANY,

of which the West Vulcan and Curry are the present active ones. The East and Southeast Vulcan, Briar Hill,

Norway and Cyclops properties, the possession of this company are idle.

The Penn Iron company is one that has played an important part in developing the iron mining industry of the Menominee range. It has valuable possessions in the iron-bearing formations, and has been enterprising in exploiting them, and in bringing into prominence many fine iron ore deposits. Assisting in the marketing of its mineral product is the ownership of several furnaces, an advantage of no mean proportion in these days of active competition and sluggish markets.

Of the formations and physical characteristics of the West Vulcan I have frequently written. There are two "veins" so-called, of ore, the "north" and "south", upon the former of which all work is at present concentrated. The ore bodies are very irregular in shape, jasper cutting through them everywhere. There has been great contorting of the walls, and the following of the ore lenses from one level to another, or upon a single level, is often accompanied by no little trouble. Few mines show so erratic a condition as here met with, and the skill of the directors of the work is often well tested. Years of association with the peculiar conditions found here have enabled those in charge to take advantage of the "tricks" of the rocks and to make the best of the obstacles presented.

Besides the irregularity of the deposits, the latter furnish many different grades of ore, these being regulated by their contents of iron, phosphorus and silica, so that at the No. 2 shaft stockpile, just started, I saw five different grades. This separating adds something to the cost compared to the making of a lesser number of grades, requiring very close inspection and assaying. The West Vulcan ores are not generally as rich in iron as those of some other mines of the Menominee range, but a considerable percentage is of bessemer grade which is an advantage assisting in its sale. Some of it also contains lime in just the right quantity to make it popular with furnacemen.

In the eastern end of their workings there are evidences of a folding of the formation such as is seen at the Loretto, Pewabic, Aragon, and other properties on this range. There is a turning of the formation, the finding of the same rock upon either side of the ore deposit, and it may be that a fold common to the range has been located. Should this be true it might result in a greater ore body than any yet found here, and the ore might prove of higher grade than found generally throughout the mine. More of this will be known in the near future when mining has been carried on further in that end of the property.

The West Vulcan is taking its ore from the 12th level upward. Most iron ore mines are observing an opposite, course, but the Vulcan was so planned many years ago, and it would not be an easy matter to now change it were the management so inclined. Their lowest level is the 12th, a depth from surface of 1,000 feet. They are mining upon this and upon all levels above up to and including the 7th.

In winning the ore they employ square sets to protect the ground, taking rooms three sets wide and leaving nearly the same amount in pillars. The rooms are rock-filled. The pillars are also taken in square sets and replaced with rock, working from the hanging back to the foot.

The rock, at the time of my visit last March, was being secured from the slate walls, but the practice has been discontinued, and the filling material is now being milled down from surface. There is an old waste dump of large size that is being utilized, sliding into the funnel-shaped opening leading to the mouth of the mill, by gravity, and rushing down into the mine where it is conveyed into pockets. From the latter it is trammed to rooms and pillars where needed, power being furnished by four mules. That the mules tram the ore and rock at a price considerably less than that of the old style man power is certain. The number of men formerly engaged in this work has been considerably reduced, and the cost of keeping the animals is but little.

The tramming is done by contract, the men engaged in the filling from pockets, and dumping where needed, being paid so much per car. The company charges them a certain price per day for the use of the mules. Two cars, containing about two tons each are usually taken by a single mule per trip.

This filling material is composed principally of slate. It picks up considerable moisture, on its way downward, this probably coming from surface water, so that it is quite wet when it enters the tram cars. This is no disadvantage, however, as it assists in the more ready spread of the material in the mined-out rooms and pillars. The mass soon leaches out after being run into the places, and cements together very firmly, standing so well that no lagging is needed to prevent mixture with adjoining ore.

The plan is one that works well, and it is also safe for the miner and insures taking the largest possible percentage of the ore. Where the filling can be obtained so readily as here there is much in favor of the system. The filling material slides down the chutes where distributed at advantageous points, very readily. In some of these raises or mills, the underside is laid with hardwood boards. That the slaty, moistened mass polishes this, I can attest to. having slid through one of them, and, while it had a curve of several degrees in it. a firm grip on a friendly rope was needed to prevent a speed threatening one's bodily welfare. I know the chutes will let anything down that can get into them.

The ore of the West Vulcan varies considerably as to firmness, being remarkably hard in places. The fact that the mine is being wrought from the bottom upward insures freedom from water in the upper levels. An interesting point is a decrease of about 100 gallons per minute in the amount lifted to a surface, a late test showing a volume of 900 gallons per minute as against 1,000 gallons formerly noted.

The big pump on the 12th level still works satisfactorily. They talk of a triple-expansion pumping engine to be introduced at some time in the future. The one now used is a compound condensing.

There has been considerable work done on surface in the vicinity of No. 2 shaft. A long trestle has been constructed from which the ore is dumped onto the foundation below. This trestle at its extreme western end has a height of 56 feet. In its length there are several openings through which the ore is dumped from the tram car. The latter is drawn over the trestle by a small engine located at C. shaft. It is the intention to so arrange the car that it will be automatically dumped at the opening corresponding to the grade of ore it contains by the lander at the shaft, setting the mechanism of the door so that it will be tripped at the desired place. This will do away with the service of one man who now rides on the car, stopping it and dumping it where it belongs. They have worked out the plan for this, but the car has not yet been equipped. The work of grading for the stockpile foundation at No. 2 shaft has been completed. Much has been done here during the past summer and they are now well prepared for securing the ore and for taking care of it when it comes to surface.

A sawmill does the framing of all the heavy pieces of timber, and is a great convenience. The smaller pieces for lagging, etc., is prepared by hand. The company has been employing 400 men, but this number will be reduced by 65 at the close of navigation. Stocking is already under way at C and No. 2 shafts. The labor works ten hours and all mining is conducted on the contract plan. Sunshine is used by the mines as an illuminant, and now that they have become familiar with its proper handling, they prefer it to candles or coal oils.

The Penn people have a promising territory, and, if the market conditions warranted would probably do considerable in the exploring of it. They are finally prepared to conduct the business engaged in, and everything in and around the mines is admirably handled and managed. Wm. Kelly, is general manager; F. C. Copeland, assistant; Wm. Bond, mining captain.

THE CURRY MINE,

located immediately west of the West Vulcan, is presenting nothing new, and no additions have been made since my last report. The mine has reached the eighth level, 800 feet from surface, one vertical, two-cage shaft caring for the product. There are two "runs" of ore here as are found in the West Vulcan, but the one to the north has thus far been barren of clean lenses. The West Vulcan's best lenses are upon the formation, and hope has been entertained that they would develop similar ones on the north deposit of the Curry. They crosscutted from the lowest level north from the shaft, finding the proper formation, and did considerable drifting upon it. At 320 feet west a small seam or ore was struck and with the final came a flow of water that drowned them out for several weeks. Additional pumps were put in and the water was cared for. The north vein or formation makes about 300 gallons of water per minute. They have not found whether this water comes from an ore deposit or not, the work of exploring having been delayed. Orders have been received from the company to close the mine upon the first of next June, which is discouraging. Capt. Thomas Oliver, who has charge of underground affairs here, has worked persistently to locate new and improved ore bodies, but without success. Four grades of ore were made, two being of bessemer grade and two of non-bessemer.

At the Norway mine of the Penn company nothing is being done, work having been stopped in the winter of ‘96.

The mines of the Penn Iron company have shipped 4,148,547 tons, of which 179,917 tons were sent out during 1896.

Going westward from the Penn company's mines the next active property met with is

THE ARAGON MINE.

Since my last visit to the Aragon mine, Norway, Mich., there has been a great deal done both above and below ground that tends to make the property more valuable to the company and to those who look to it as a place to secure work. Increased depth has added considerably to the former size of the ore bodies, to their regularity, and, in many places, to the quality. Increased depth, however, has not been gained without some cost both of money and worry. As is generally well known to those familiar with the mine, it is located in a swamp, a depression thoroughly saturated with surface water requiring extraordinary cost in pumping. Besides this there is a layer of quicksand overlying the ledge that has to be stubbornly fought, inch by inch, to put the shafts through it. Mr. Per Larssen, who has had the management of the mine since its early history, has had a great deal to contend with that might have discouraged a less determined man, but he has had faith in the merit of the property, and this, with his skill and patience, has finally been crowned with success.

The upper levels of the mine were disappointing. The ore was found in small pockets, the rock came in everywhere, and it was not until the sixth level was reached that a satisfactory condition was met with. Since then the gain has been gradual for the better, the deposits have been more regular, and there has been less of the rock that cut the ore out in the levels above. It is characteristic of several mines on this range, notably the Pewabic and Loretto. It appears to have made a place for the concentration of the ore, and the bigger the fold the bigger the ore can be. There is yet much to be learned about the ore formations of the Menominee range, and considerable information is constantly being added to that before acquired.

The principal mining is being done upon the 6½ level, where there are some magnificent rooms, some of them between twenty and thirty sets long. They still adhere to the sand tilling of rooms. The sand is conveyed to the

underground workings through a large steel pipe in No. 2 shaft, and another inlet is now being prepared for its introduction at a point further west and near the most active points underground. The filling material is conveyed from a large sand hill located a few hundred feet from the mine. Is pulled to the shaft by rope haulage, a small, cheap, home-made plant that works well. Mr. Per Larssen prefers the sand to rock for filling because it is more readily secured, and is easier to run into the mined out portions. Where shoveling has to be done, as is often the case, it has a decided advantage over rock and it packs very firmly. They do not side lag the rooms to prevent mixture with the pillar ore. The sand soon becomes quite damp, packs very solidly, and I am told that no trouble is had with mixing when the pillars are removed. With improvements completed that are now under way, the sand will be still more cheaply obtained. There is any amount of the material to replace the ore taken for many years to come.

They observe three plans of winning the ore in the Aragon: 1st. rooming on square sets and sand-filling rooms leaving pillars to support the hanging; 2d, where the vein is narrow, taking all of the vein on timbers one set wide; sets agreeing with width of ore. and afterwards filling with sand: 3d, slicing pillars and afterwards filling with sand. The filling plan makes a safe one for the miners. There are very few accidents. There are no great openings overhead to threaten the lives or limbs of those working beneath by falling masses. The filling is always kept close up to the ore being attacked, giving no opportunity for accidents from the cause suggested. It may be a little more expensive than the caving system, where the surface is permitted to come down, but conditions vary greatly in different mines, and conditions must be met. In the case of the Aragon they have a great amount of surface water, about 750 of the 1,500 gallons made per minute coming from above the ledge. It is argued that this, in the case of the breaking down of the surface, would come Into the mine, making much trouble. It is one of the serious obstacles in the way, according to the figuring of the local management, and as they are apparently draining the entire country, it is thought advisable to adhere to the sand-filling plan until conditions may change. Then, too, the water raised that comes over the ledge is used for town purposes, the mine pumps delivering it into a tank from which the village secures its supply.

While the 6½ level is the one upon which the principal mining of ore is at present being done, they have reached the 8th level, which latter is now, being opened up with drifts preparatory to developing for future active operation and product. This level is 750 feet from surface, and gives evidences of being the best yet encountered. More of it will be learned of it in the near future. This is at No. 3 shaft.

This shaft has been sunk 30 feet below the 8th level, being 780 feet to the bottom. The object of this is to make a place for the stocking and loading of ore from the 8th level when there is no need for it. In this thirty feet below the 8th level pockets will be put in that will have an outlet in a drift put in from the shaft below them or at the depth of 780 feet in the shaft. This will be a great convenience that will assist in the more rapid handling of the ore.

Up to within a short time No. 2 shaft has been the principal one, but the new No. 3 will be active from this time on. It is 700 feet west of No. 2, is vertical, has two compartments, and is 6½x9 feet. Two cages are operated in balance. The shaft was made purposely small, it being figured that it could be more easily retained than a larger one. It is not intended as a permanent shaft, being really in the hanging, but was put down to take care of the ore in that particular locality and to give some better idea of the real position, etc., of the ore deposit.

It was very rapidly put through, being attacked from four points at the same time. One party raised from the 7th to 6th levels, another from the 6th to 4th; one sunk from surface to the 4th and another from 7th to 8th, so that the time of completing this avenue was remarkably short. It is the intention to locate a permanent shaft at a point where the greatest good can be obtained from it, but this will probably not be done for some years yet.

Some distance north and east of No. 3 shaft they are putting in a raise through which sand is to be run into the mine. They are also sinking to meet the party raising, and had 40 feet to hole at the time of my visit. The sinkers had encountered quicksand, and were putting in an iron caisson in the hope of being able to get through it. A little ore was struck in this raise, which is in the hanging of the fold, but they have not developed it as yet. This raise will have a ladder-way, be substantially timbered, and wall be used as a permanent way for the sending down of sand. It will deposit the latter centrally in the most active portions of the underground workings, and will be much more convenient than the present depositing point at No. 2.

There is a vein of ore making westward with the regular formation. This has been followed in that direction for a distance of 925 feet from No. 3 shaft, and is within 400 feet of the company's west boundary line. This is nearly under Nelson street in the town of Norway. The vein is narrow as compared with the ore in the fold, but it is generally of bessemer grade. At the time of my visit they had encountered jasper in the breast of the drift, and work was stopped until a place could be found for wasting the rock underground. Mr. Per Larssen was of the opinion that the jasper would soon cut out and ore be found again.

At the new No. 3 shaft, the surface is very springy, full of moisture, and something like 150 piles were driven for shaft and pocket foundations. It was intended to stock the ore near the shaft the coming winter, but they decided to go upon firmer ground to the north, and a trestle has been accordingly constructed for that purpose. The surface about the shaft is peat for a thickness of between thirty and forty feet.

At No. 3 shaft there is a new equipment of machinery, of Webster, Camp & Lane manufacture. There is a hoisting drum with 9-foot face by 6-foot diameter, eighteen inches of one end of drum being attached to the very heavy friction driving band, the other seven and a half feet to drum being keyed upon the driving shaft. This split pattern is the first of Mr. Pitkin's, of the firm of manufacturer named, and gives excellent satisfaction.

There are two boilers manufactured by Burt, of Hancock. These are each 72 inches in diameter, with flues 16 feet long. Including fire box and smoke flue the length is 28 feet. Instead of the ordinary iron crown sheet, boilers have ten water tubes with a single course of fire brick above. In case of a shortage of water a single flue would burst, the damage thus resulting being insignificant as compared to the old style of rupture. The boilers each have 92 3½ inch flues. They give excellent satisfaction.

They have a new Prescott pump that lifts the surface water a distance of 80 feet. There is a new engine and boiler house, frame, iron-sheathed, substantial and inexpensive.

A force of men of 300 are employed. The miners work three eight-hour shifts and all others ten hours.

The company has sent considerable ore throughout the winter by all rail, some of it going as far south as Alabama. It is enabled to do this for the reason that its mine is located nearer to the points of ore consumption than many others, and for the further reason that the ores are peculiarly adapted to certain kinds of ore making.

The analysis of the shipment from the Aragon mine the present year average as follows:

Grade.	Metallic Iron.	Phosphorus.
Castile	65.45	.0105
Aragon	64.53	.023
" No. 2	65.51	.0474
Granada No. 1	63.41	.056
" No. 2	63.88	.192

This is an important improvement over the past few seasons and indications point to still better results. The amount of rail shipments from Nov. 1, 1895, to May 1, 1886, was 17,387 tons.

The Aragon company has as yet done nothing upon their south formation. Like the Vulcan, their neighbor, they have both a north and south formation. The latter is about 400 feet from the north. The Penn Iron company did some work near this, putting a shaft down on what is known as the Harrison property, to a depth of 200 feet, and running a crosscut 280 feet. The latter found lean ore running about 40% in iron and being low in phosphorus. It would be suitable for such purposes as the lean ores of this range are now being mined for. Just when the company will do something on this south formation they have not yet decided, but they have hopes that something of value may be possessed in that direction, and will undoubtedly do something in the way of exploration of that territory at some time in the future. Just now the Aragon has plenty of ore in sight, enough to supply any call that will probably be made upon it.

The mine is looking finely, greatly improved over the conditions of even eight months ago, and it is pleasant to note it, the company having richly merited the gain.

Since the above was written a strike of the miners employed at this mine 3 took place upon the 15th of December, '96, since which time nothing has been done aside from keeping the water out of the levels. A raise of 10% in the wages was demanded and refused. Since then the miners have offered to return at the old rate, but the mine is still idle. Several parties have been talking of purchasing, the principal owner, Angus Smith, of Milwaukee, Wis., desiring to sell.

Per Larssen is vice president and superintendent; Gustaf Hellberg, mining engineer; Daniel Stewart, cashier.

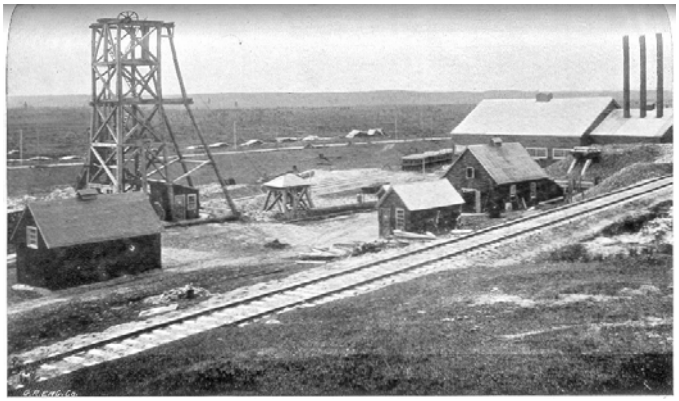
The total product of the mine amounts to 858,346 tons, the shipment for1896 being 95,809 tons.

MINES OF QUINNESEC.

Four miles west of Norway is the village of Quinnesec, one full of busi-life but of late years almost deserted. Within the past year, however, there has been an improvement, and at least one active property is to be reported, this is

THE CUNDY MINE,

the property of the Illinois Steel company, who have secured possession of the Quinnesec townsite forty in addition to eighty acres immediately west, upon section 3. Ore was originally found here by diamond drill borings, and in 1895 J. R. Wood, of Appleton, Wis., began the sinking of a shaft to explore the deposit, but sold the property to the present operators in the summer of 1896. The shaft has been carried down to a depth af 300 feet, and a promising body of blue hematite has been exposed. At 300 feet from surface a drift was 49 feet in ore. across the vein, at the time of my visit. At 260 feet the level shows about 40 feet of ore. while at 192 feet a short drift shows the ore to be badly mixed. Small bunches of magnetite are met with in the ore body, a rare occurrence for the Menominee range, but they are here of no commercial importance.



CUNDY MINE, QUINNESEC.

The shaft is two-compartment, only one of which is being used and is in the ore formation. Just what method will

be employed in the mining of the ore has not yet been decided upon. Capt. Cundy desiring to learn more of the ore formations before settling this important point. Close at hand is an immense hill of sand that could be used for filling; in case they decide to fill the rooms. A second shaft to be in the foot is desired but its location had not been fixed at the time of my visit, they being desirious of learning more of the deposit before beginning another avenue. Neat mine buildings have been erected and everything in and about the property is in fine shape. The machinery is second-hand, having been procured from New York state. There are three six-foot hoisting drums, compressor, shop tools, etc., some of which is in fairly good condition, but if a mine is developed a better equipment will be needed. James Cundy is superintendent. About 30 men are employed. There were 3,892 tons of ore shipped in 1896, this coming largely from the drifts and openings that were made in the. work of preparing for mining.

THE QUINNESEC MINE,

at one time an important producer of the Menominee range, but which has been idle for many years, received some attention, in the fall of 1896, Jacob Harper, of Dexter, Mich., and E. A Gott, of Detroit, being principally interested. There were eighteen men employed for a few months, the old workings being unwatered, and work devoted to an old shaft in the footwall. Here a bunch of fine blue ore was encountered, but it gave out soon after being found. The parties who were to have taken an interest failed to do so, and the mine was stopped and is again filled with water. The ore here found is of excellent quality, and would sell readily. John L. Buell, of Quinnesec, is interested in the fee.

SECTION SIX EXPLORATION.

Between Norway and Quinnesec, on section 6, the northeast quarter of the southeast quarter, exploring has been going on for several years past, from two to four men being engaged. The work is superintended by Benj. High, of Norway. There is a strong outcropping of lean ore running east and west through this section and rising to a considerable height above the surrounding country. Into the north side of this ridge they have driven a tunnel 170 feet, and have drifted east from the end of this 75 feet, and from the end of the drift have started a winze, it being in lean ore. The latter is jointed and fractured, is very hard to drill, and but slow progress is made in it. Several test shafts have been sunk east and west of the tunnel all finding ore of low grade, samples giving about 40% iron.

MINES OF IRON MOUNTAIN.

Iron Mountain, located four miles west of Quinnesec, has the next group of mines. The city is an important one, is well provided with modern improvements and possesses a wide-awake, enterprising people. Its mines are of the most important, and it bids fair to be an active producer of iron ore long into the future. Of greatest attraction in the city is

THE CHAPIN MINE,

one of the largest in the Lake Superior region, and surpassing in size all other properties of the Menominee range. While it pays royalty on the ore produced, and while its ores are non-bessemer, its performance per man is excellent, and the product is very close to the bessemer requirement, and so regular is the phosphorus content that furnacemen like it knowing just what can be done with it. Its nearness to the Chicago consumer is an advantage, and nature has provided a magnificent water fall upon the Michigamme river which furnishes power for driving the greater portion of the mine's machinery. This is an item of great importance, and the advantage is one that will ever be present.

The ore lenses of the Chapin are large, occupy a position nearly vertical, the hanging that has always been unstable and slippery, is now permitted to follow down, the settling plan being observed throughout the mine. This change has taken time, skill and money, but now that it has been perfected the company is reaping the benefit of it. In its history the Chapin has experimented with the ideas of many, has been at enormous cost to test the judgment of various "experts," and has finally succeeded in securing a mining man to look after its operation who has practical ways of putting them into execution.

Of greatest interest in the operations of the Chapin for the past year is the addition of the Hamilton and Ludington mines, possession of which was acquired early in the year 1896. These mines had been idle since 1892, due to financial difficulties. On the 4th of May the work of their unwatering was begun, and the task completed upon the 5th of July during which time 122,464,787 gallons of water had been raised. At the Hamilton shaft, which is 1,460 feet deep, sunk in the limestone pit, and having four compartments, two bailers were used. These were 18 feet deep, and each contained 2,574 gallons. The bottom of the bailers is wedge-shaped so as to permit its entering the water rapidly, and each has two inlet and one discharge valve. They were worked in balance, one being discharged of its burden as rapidly as the one at the shaft was filled. The total weight of bailer, rope, and load was 21 14-100 tons. The time consumed in discharging the water from bailer was 26 seconds. At the Ludington shaft there was a smaller pair of bailers, the combined capacity being 1,528 gallons. The work here performed proves that bailing is an admirable way of unwatering a mine, but it is expensive. It removes the water rapidly, but the wear and tear upon wire ropes and machinery is great.

To take care of the water in the new end of the mine a fine new pump has just been placed in position at the 1,325-foot level of the Hamilton shaft, where a room 60 feet long 35 feet wide and 22 feet 6 inches to the arch of the roof has been cut in the solid limestone. The pump is a 6⅞x9⅝x30-inch differential Riedler, driven by a 32x36x30-mch horizontal, tandem engine, a Corliss compound condensing. The weight of engines and condensors is 346,000 pounds, one of the heaviest

underground pumping engines in the world. The engine is so constructed that any one of the three may be run independently of the other, or any two may be worked together, or all three, the danger from stoppage due to accident to any one thus being reduced to a minimum. Its normal capacity is 1,800 gallons per minute against a 1,700-foot head, or a maximum capacity of 2.200 gallons against the same head, this being attained with a speed of 65 revolutions per minute. This engine is working smoothly and satisfactorily and in every way pleases the management of the mine. It is using but 8⅓ tons of coal to do the work that necessitated 30 tons in the running of the bailers. The water column is 13 feet in diameter, the weight of water in the column being about 37½ tons.

From the 16th level of the Hamilton they were driving a drift to take the water from the Ludington, the distance being 895 feet. Between Nos. 1 and 2 Hamilton shaft there was a drift, but it had been crushed together during the idleness of the mine, and this is being re-opened. From the 10th and 12th levels of No. 2 Hamilton shaft they are driving crosscuts to reach the north lens of the Chapin mine. This north lens is a new one, and was briefly referred to in my last report. They found the ore with a diamond drill boring and have put in crosscuts from the main lens of the Chapin to the new deposit at the 8th, 9th and 10th levels, the distance between the new lens and the main one being 50 feet, the intervening material being chloritic slates. The new ore body is a line one, having been tested for more than 400 feet in length and its width is about 100 feet. It point of quality it is equal to the best the mine has given. The walls are standing at an angle of 70° the dip being to the north, as in other portions of the mine. In this new lens they have done little aside from the opening of levels, the putting in of raises and running of sub-levels. In all there has been about 2,700 feet of this sort of work performed. The intention is to send this ore to surface through the No. 2 Hamilton shaft, for which purpose the crosscuts from the latter place are being put in. Power to do the tramming will be employed, and will probably be operated by air. A crosscut from the Chapin side of the property is also being run to connect with the crosscut on the same level being driven from the Hamilton, there being about 230 feet yet to go to connect the two. Just how high up the new lens will go is a point that interests the management. Should it be found above the 7th level the upper portion of C shaft, Chapin could be used to care for a portion of the product. Above the 7th this shaft is in limestone, safe, ground, while below it is in the ore formation, and so badly crushed that but one skip could be pulled through it. From the strength of the deposit where opened, it would be safe to predict that the ore will make upward a considerable distance above the 7th.

The main workings of the Chapin are to the 11th level, and a winze is 100 feet below this from the bottom of which a crosscut shows the ore to be still holding as strong as ever, about 90 feet wide. During the summer they did considerable mining upon the 8th level where they had an ore of inferior grade for which there was a demand. They observe the plan of mining described in my last report. Putting in drifts to cut the ore into blocks, cutting horizontally by sub-levels, and settling the surface as the ore is removed, taking the ore of the upper levels first.

At D shaft the big pumping plant is still running, and no pumping engine in the district gives better results. The worst feature about this plant is that it ties up about a million and a half tons of ore that has to be left to retain the shaft and plant. It is probable that the plant will be removed, and it may be that another underground pump will be placed at the timber shaft that is sunk in solid jasper. The settling plan of working the mine will gradually draw the big pumping plant and shaft after it, and the removal of the engine is only a matter of time.

The discovery of the new lens to the north of the main one, shows that the territory to the north is productive of rich ores, and large lenses may be found anywhere in the rich jaspelites of this formation. There is a large territory lying within the limits of the limestone that has been searched but little, and the company has excellent chance for the finding of new deposits to the north of those already encountered.

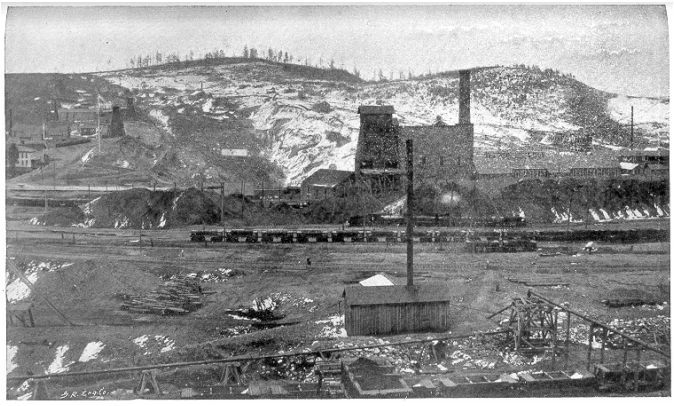
In the east end of the mine but little is being done, the pitch of the ore to the west having gradually carried mining work in the latter direction. They are working upon a lens of ore 200 feet from B shaft. It is of bessemer grade, and while small there is a hope that it will increase in size.

No mining has been done at the Hamilton. They have not yet reached a sufficient depth to begin such work. It is well known that there is a large lens of ore at the bottom of the shaft, as it was being mined when a great flood of water drove them out. There is but one shaft at this property, the No. 2, and in which the big new pump is located. The old No. 1 shaft has gone together and they have torn down the shaft house. There is an excellent plant of machinery at No. 2, a flat rope hoist that was lifting ten-ton skips when the Hamilton closed.

At the Ludington there has been a start made in mining, work thus far done consisting in going through a portion of the old workings in the upper levels, taking pillars, and learning something of the condition of things. They have unwatered B shaft to the 10th level, and work done has been principally on the 4th and 5th levels. Here they have a grade of ore that equals "Chapin," giving about 64% iron and from .070% to .080% phosphorus. They began in this portion of the property in October, '96, and have secured about 85,000 tons since that time. They find many bunches of ore that were left by former operators, and while these have to be taken carefully, as little can be told from the old maps, they manage to make excellent headway. Many bunches of jasper are encountered which they work around, leaving undisturbed, and secure considerable ore in ground that was never before touched. They observe the settling system of winning the ore, the same as employed at the Chapin, and find it works satisfactorily. B shaft has a double skip-way and is down 1,350 feet. There is little

doubt but that there will be excellent lenses of ore encountered as they proceed downward. That the ore of the Chapin property extends upon the Ludington is already known, as they have worked upon Chapin territory from the upper levels of the Ludington, finding ore. The old No. 5 shaft pillar of the Ludington is being taken, the ore being raised through B shaft.

It will be some time before the company gets below the old levels of the Ludington, the latter having greater depth than the Chapin, but as they proceed downward they will carefully look through the old workings, taking all the ore that is accessible. Judging from what they have already found it is certain that they will meet with enough to pay for the trouble. The Ludington was not well handled, a fact generally understood by mining men familiar with it. This is more clearly proved now that the old levels are being re-opened.



CHAPIN MINE, LOOKING EAST.

With the ore lenses of the Chapin pitching west, the Ludington and Hamilton properties should be most valuable. The western end of the Chapin is very promising for future products. Not only are the ore deposits large and clean, but they are of better quality than in the levels higher up.

The mine is employing at this time about 600 men, has large stocks of ore upon surface, and is in shape to largely increase its present rate of production if sales can be made. The Chapin could find place for 1,500 men if market conditions would warrant. The output for the year 1896 was 421,681 tons, being 196,908 tons less than the amount shipped in 1895. The total product of the property is 6,132,643 tons.

The general offices of the company are located at Cleveland, Ohio. M. A. Hanna, president; L. C. Hanna, vice-president and treasurer; A. M. Robbins, secretary, Cleveland. Jas. MacNaughton, superintendent; L. B. Sutton, mining engineer; Martin Goldsworthy, mining captain; M. Lonergan, cashier, of Iron Mountain.

Immediately south of the Chapin, and occupying place in the jasper foot of the latter, is

THE MILLIE MINE.

This property is now idle, having suspended operations in the spring of 1897, owing to the low price offered for its ores. The latter are of wonderful purity, being among the best found in the Lake Superior region, but the lenses are small and the annual product runs between 10,000 and 20,000 tons. Up to within the last year the royalty has been excessive, 60 cents per ton, but a reduction has been secured from the fee owners. The property also lacks proper railway facilities, having to tram its ore to the Northwestern tracks several hundred feet from the mine. Underground there is an extra handling of the ore, too, so that considerable extraordinary expense is incurred in the working. There is a vertical shaft to the 4th level in the main workings. Upon the 4th level, and 150 feet west from the shaft an incline shaft has been sunk following the ore to the 7th level, necessitating a transfer although the hoisting through both shafts is done from surface. In winning the ore they employ the common form of square sets, mining upon timbers. The lenses have a length of about 140 feet and are 20 feet thick. To the east of the main shaft, which is known as "C," is A shaft, which was unused for many years. They retimbered this the past summer with the idea of sinking it deeper and exploring the territory adjacent to it. This shaft has a depth of 200 feet. From the 4th level of C shaft they bored several holes with the diamond drill to the north and south, holes being-horizontal, but found nothing of importance. A stockpile foundation was constructed and at one time a force of 60 men were employed. Simon Dessau, of New York, the operator, informs me that he has little hope of doing anything in the mine during the year 1897. Chas. McGregor, Iron Mountain, is superintendent. The mine sent to market in 1896 21,815 tons of ore and has sent out in all years 161,702 tons.

Next south and east of the Chapin mine, on section 32, 40, 30, is

THE PEWABIC MINE,

one of the best known in the market of the country by reason of the richness of its ores. It has shipped many cargoes that have yielded 68% in iron and averaged .008% in phosphorus, surpassed by no other mine I have any knowledge of either in this or in foreign countries. The mine has not been 4 an easy or satisfactory one to handle due to the twistings of the formation and the frequency of jasper that comes in too generously to suit the operators. There has been a large flow of water, but this has been fully cared for by the new triple-expansion pump mentioned in my last report, as well as by a dam in the east end of the property from which portion of the mine the heaviest volume seems to come.

In the year past the company has been doing considerable in taking the pillars of the upper levels. Of the “Pewabic” grade, their best, mined during the year about 150,000 tons came from this source. They are working from the top level downward and are confining operations to the second and third level, the first level having been exhausted of its ore. They are observing the same system of winning the ore as described in my last report. They have done considerable during the

year in the securing of a high-silicon ore that gives 40% iron and .006% phosphorus. This ore lies about 250 feet east of No. 1 shaft, beginning as a thin sheet and increasing in thickness as it goes west until it is finally cut off at about 300 feet from the starting point. On the south side the ore is about 50 feet less in length than upon the north. In securing this ore they take rooms of 70 feet, putting in 7-foot cuts, and afterward undercutting the pillars letting the whole mass settle down. The plan has worked admirably. The ore comes readily from the roof and in the settling it self-crushes so finely that no further reduction is necessary. There are many cross courses, and joints, and the ore breaks up by the weight of the burden. The thinness of the strata assists in the more ready breaking of the ore, too, so that when it reaches surface it is ready for the blast furnace. Mr. E. F. Brown, the superintendent, hit upon the very best plan for the securing of this ore, as it comes safely and they get it all. The pillars give a very ready product, as high as 15 tons per man per day being secured from some of them, which is an extraordinary result. In this work not a man has been killed or a limb broken. The work done the past year on this ore has been principally at the third level. The lean ore extends to the fourth level where it is larger in dimensions than upon the level above. There is ore enough of this grade to give work to the mine for several years to come, and will assist in paying the way in opening up new levels in the mine. The ore is dry because of the mine having been opened to a considerable depth below where it is being secured, and the item of moisture gives but little trouble.

No. 1 shaft continues to be the principal working one and the sixth level has been added during the year. The old Worthington pump replaced by the new one, will be located at this level, the two insuring a dry mine and permitting sinking and opening up of new levels. As the ore bodies incline to the west, the management hopes for a continuation of the lenses in that direction. The mine is not a deep one and there is an excellent territory at greater depth and further west that they have not yet reached. The additional pumping facilities will enable them to reach this new field which they have been unable to do in the past owing to the tremendous amount of water met with.

Besides having added a new level the Pewabic has done considerable exploring upon the adjoining property to the north on the old Walpole property that they have recently acquired, and upon which much has been done in the past by different parties in the hope of finding a mine. In the search many thousands of dollars have been expended with but little in the way of merchantable ore to show for them. The Pewabic company is in better position to develop any ore deposits that the property may hold, as they can do exploring work from their Pewabic mine to better advantage than it could be carried on from any other point. The jasper formation of the Walpole is about 450 feet wide so there is plenty of room for ore lenses to make, and it would be remarkable if they do not occur in the light of what similar formation has shown at the Chapin and Pewabic mines.

There was an old shaft on the property east of the Chapin mine, east end, and, this has been sunk by the Pewabic company to a depth of 318 feet, which corresponds to the 400-foot level in the Pewabic mine. From the bottom of this shaft an exploring drift was run eastward 1,300 feet, and from which several crosscuts were put in to prove the formation. In the east end of this drift they have encountered limestone which they believe to be the east end of the famous Chapin mine fold. They found some ore here and believe there is a chance for finding more to the west, the geological conditions being favorable to such conclusion. The ore found here is in small pockets, is of excellent quality, but there is not enough of it to pay a profit for its extraction. They have found a lens of ore of about 40 feet thick further west on the Walpole, and have done some drifting from the Pewabic levels also. In all something like a mile of drifts and crosscuts have been run. To secure the ore found upon the forty just west of the Pewabic a shaft has been sunk to a depth of 424 feet, at a point 1,200 feet west of Pewabic No. 1 shaft. The new shaft is two-compartment, 6x12 feet inside timbers, is vertical and will be equipped with cages. This is to secure the ore in the upper portion of the territory. The ore here is not of high grade such as the Pewabic produces, but there is a market for it, and a product will be secured for the coming shipping season. In this ore has been found detached pieces of limestone, a singular occurrence reported from no other property on this range. About 1,300 feet east of this find upon the Walpole the Pewabic company has found a lens of ore in its first level that they were following upward at the time of my visit, having risen about 60 feet, in ore of excellent quality. In iron it gives 66% and .006% in phosphorus. They hope to secure more of it going west, and as it is in line with the find upon the Walpole it may be connected with the latter.

The Pewabic company is a progressive one, and has been active in exploring lands owned or controlled by it. During the past year it has done considerable diamond drilling at the old Indiana mine, located on section 27, 39, 20, just west of Lake Fumea. Nothing of importance was discovered. This was done under the direction of the Inter State Mining company, of which N. P. Hulst is manager, and E. F. Brown stperintendent. They are now operating one and one-half miles east of the old Indiana on lands belonging in fee to the Canal company from which they have an option for lease.

On section 18, 42, 35, nine miles southwest of Iron river, the company is exploring its own lands. One diamond drill hole has been bored ending in limestone, and the standpipe for a second hole is being put down. There is a very heavy drift here, being from 220 to 260 feet thick, and making diamond drilling very slow as well as expensive.

On section 24, 53, 36, they sunk a shaft and put down a diamond drill boring in black slates.

Mr. Hulst, president of the Pewabic company, is a geologist of note, and one who has been prominent in

the development of the Menominee range. He has actively searched for ores upon the lands of his company and will continue doing so until he is satisfied that there is no more to be found.

The Pewabic is at this time, May, ’97, working 280 men, much less than its regular force. Its shipment for the past year was 276,130 tons, making a grand total of 1,215,207.

Geo. VanDyke, is president; Nelson P. Hulst, manager, both of Milwaukee, Wis.; E. F. Brown, superintendent; Jas. Holland, mining captain; J. H. McLean, cashier, Iron Mountain.

THE ANTOINE ORE COMPANY.

This company is now known as one of the important shippers of high silicon ores of the Menominee range. Their scene of operations is on section 17, about a mile and a half east of Iron Mountain. Here they have two large open cuts one of which is known as "the Traders." the other as "the Clifford." These are a few hundred feet apart, and the Clifford received the greater attention during the year. There is a strong belt of this silicious hematite running through the property, and rising to a considerable height above the general level of the surrounding country. There is an incline shaft upon the south side of the belt that has been used to take the ore from the pit. This has been continued downward below the present bottom of the pit, and a winze 55 feet has been sunk in the pit just ahead of the shaft, and connected by drift to the bottom of the latter. Further east and south a shaft has been sunk that taps the ore lower down. They have a Gates ore crusher located at this pit which can treat 3,000 tons in 24 hours, the ore being soft and flaggy and readily reduced. A small pump cares for the water that makes in the bottom of the pit. From the two pits there have been mined 115,444 tons, the most of which comes from the Clifford pit. The ore yields about 45% iron and .025% phosphorus. There is an abundance of the ore, the formation having a width of 350 feet. There are bands of jasper and seams of soap rock, but these are readily separated. The pits have been idle through the winter of 1898-7, and they are now getting the tram tracks in shape for business in case sales can be made. At the Trader pit there is a Lake Shore Iron Works crusher, but it is little used as the ore of this pit is not equal in quality to the Clifford.

John T. Jones, Iron Mountain, is president; Reuben Williamson, Sharon, Pa., is secretary and treasurer.

THE CUFF MINE.

The Cuff Iron company did some work the past year on the southeast quarter of section 22, on the same lands formerly explored by the Appleton Land company, adjoining the old Indiana mine, north of Quinnesec. Welcome Hyde and B. Ramsay, of Appleton, and C. H. Jones, of Menominee, were principally interested, Jno. Thomas, of Ishpeming, looking after the mining work. An old shaft had been sunk 156 feet. This was un watered and a drift put in on the trend of the formation southeast by northwest, a distance of 120 feet. A winze was sunk from this 53 feet and a crosscut put in north 44 feet. This work was commenced the first of October, 1898, and was stopped in April of '97. The pumps have been taken out and the workings are again filled with water. Ore was found, it being in a fold of the formation. There was considerable rock mixture, but an ore formation 28 feet wide was shown. It was an encouraging exploration, but those who were conducting it decided the outlook in the way of profitable lenses was not sufficiently bright to give excuse for doing anything more at such a time. During the time of its activity the mine gave employment to 30 men.

MINES OF IRON RIVER.

At this time, the spring of 1897, there is not a mine operating in the vicinity of Iron River, whereas a few years ago there were several that were sending big tonnages to the shipping port, at Escanaba. The town of Iron River is kept up by farming and lumbering, the former industry having thriving proportions.

The ores of this particular district are high in phosphorus and generally lower in metallic iron than those of many other places on the Menominee range. This has been against their mining, because the market has demanded a far greater percentage of bessemer ores of late years as compared to the percentage used in the past. When furnaces are established here then Iron River will smile again, and its slumbering lodes awaken and take on new life.

THE DOBER MINE

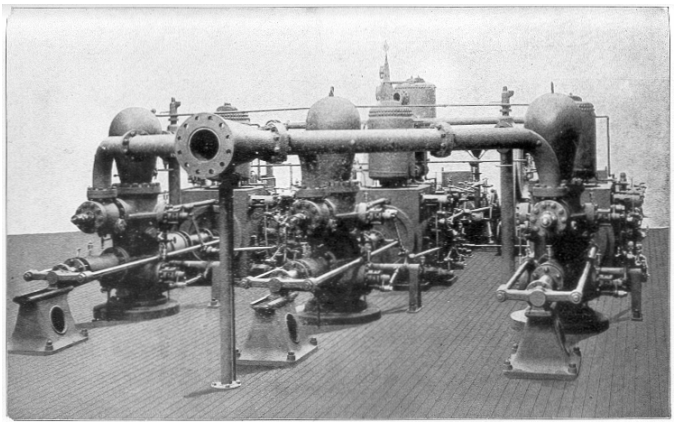
was the last given attention. Upon all sides of it are the silent monuments of the better days that have passed. The Iron River and Isabella are close neighbors, both of which possess large ore bodies.

The Dober is located upon section 1, town 24, range 35. The ore deposit was first discovered by Mr. Dober, after whom it is named. This gentleman owns a portion of the fee. But little was done, and just what the deposit held was largely a matter of conjecture, the churn drill being unsatisfactory in securing fair tests of the quality of the ore. The test pits sunk were few, and the boundaries of the deposit were not located. The Mastodon Iron company, that had operated the Mastodon mine at Crystal Falls, until the ore gave out, came here the 3d of February, ’96, Captain E. S. Roberts taking charge. They began the sinking of a shaft about the middle of the month. Twelve feet of drift covered the ledge, and they were soon in the latter. The shaft, which is 6’x8½’, was sunk to a depth of 74 feet, being in the ore formation. From the bottom a drift was run to the southeast, which has now reached a point 165 feet from the shaft. This is nearly all in ore, the latter being somewhat changeable as to quality, and of a very hard nature, requiring the use of drill and explosives to cut it. Thus far the drilling has been by hand power, but they have compressors and power drills ready to introduce, these having been removed from the Mastodon mine. At a distance of 100

feet from the shaft crosscuts have been put in. One to the north is in 48 feet. This was stopped at the time of my visit, the ore having grown very hard and somewhat mixed, and attention was given to opening up the deposit in another direction. A crosscut to the south was in 43 feet, the ore of the last few feet having changed to a somewhat softer nature. The ore in the main drift gives by assay from 49% to 60% in iron. In the south crosscut, for ten of the fifteen feet first cut, the ore averaged 60.20%, and on the north side the first fifteen feet from the main drift shows ore giving 60.36% in iron, which is a good quality for this range. Ore is high in phosphorus, as is all that is mined upon this end of the range, excepting at the Mansfield, Crystal Falls.

The walls of the Dober deposit have not been found, and nothing can be told as to the future shafts that will have to be sunk until the boundaries have been shown up. The shaft is really to explore the property. There is certainly a large amount of ore here, and considerable of it is of a quality that should warrant a market, it being needed for many kinds of iron making. There is considerable water coming into the openings, and the signs are that the place will be a wet one until the surrounding low ground is drained of its water. The ore deposit is apparently making in the direction of the river, from which it is not now far away, but no trouble is expected from this source, the formation being so hard and firmly in place that the back of the workings can readily be protected.

The company is well equipped with machinery, having all it needs from the Mastodon mine, and has an excellent mining man in charge in the person of Captain Roberts. The company is a substantial one. Work was suspended in the spring of ’97, awaiting a market for the ore.



CHAPIN MINE PUMP.

THE SHERIDAN MINE.

owned principally by Escanaba people, is full of water, and there is little to warrant resumption at an early date. The company lacks money to prosecute the work in a way that would give a profit were the market right, and the property is in need of an entire new equipment of machinery. They added another level last winter, upon which the ore bodies were larger and more regular than upon any found up to that time. Some portions of the deposit were not of as good grade as the average of the level above, sulphur being the trouble, but the conditions were not discouraging as compared to workings on other levels. The mine is made up of small pockets, and these have been so numerous that there has been no trouble to secure a product fully equal to the calls for the ore. There is between 3,000 or 4,000 tons of ore in stock at the mine. Captain Gulgren is still in charge. 3,419 tons were shipped during the year.

THE HIAWATHA MINE,

producing the finest ore mined in the Iron river district, stopped work in the middle of September, being possessed of the same disease that has thrown many bigger concerns into idleness—a shortage of money. The ore of this mine gives between 62% and 63% in iron, and should be a favorite amongst ores of the high-phosphorus class. It reduces readily in furnace, and those who have used it highly recommend it. Since the time of my last visit they have added another level 50 feet thick making the shaft now 156 feet deep. They have done some stripping near the shaft, uncovering the vein, the ore so disclosed being broken and milled to the first level, from which it was sent to surface. From the bottom of the shaft, on the new level, they drifted north 56 feet, a portion of which distance was in ore, and at twenty feet from the shaft on this north drift they drifted west for twenty feet, this crosscut being in ore. A deposit of ore was cut in the sinking of the shaft for the lower level, first showing a thin seam, and gradually widening out to the north as they went down until at the bottom of the level the drift north shows its thickness at that point to be about twenty-five feet. Further north they encountered a slip of soapstone through which they drilled, finding ore again. About this time work was stopped for the reason given. They figure that another level will find this soapstone entirely cut out, and believe they will show a fine lens of ore. Mr. Morrison, the secretary and treasurer, informed me that they figured that the next level would show 100 feet of clean ore. They have sunk but a short distance as yet, hardly sufficient to escape the surface mixtures. They believe they are upon the east end of a lens of ore, and with a resumption of operations, will hasten to prove the correctness of their theory.

The mine makes considerable water, but they are well equipped to take care of it. Since my last visit they have added a new hoisting plant, secured from the Penn Iron company, that is adequate to take care of the work for some years to come. This plant was installed last March. They have built a new ore trestle, and have a small stock of ore now on hand. The company lacks the convenience of a railroad to the mine, the ore shipped having to be hauled by teams to the Northwestern road, something like a mile distant. This adds greatly to the cost. With another level sunk to and opened up, and should the ore continue to hold its present good quality, there would be sufficient inducement for the railroad company to build a spur track to the mine, which would

add greatly to the value of the latter. There is a very wide ore formation at this point, and plenty of room is had for big deposits. The property, considering the little that has been done, has shown up well. The company expects to resume as soon as money and market can be obtained.

THE IRON RIVER MINE,

is in local charge of Mr. Crippen, who has no idea as to when they will be active again, that depending upon conditions of the market and apparently now some distance in the future. There was a partial dismantleing of the plant of machinery pending some questions of royalty, but this was adjusted before the entire work of demolition was concluded. A portion of the machinery still remains upon the bank where it was left. These properties contain large deposits of low-grade ore for which, there is not now a market at a price that would warrant a resumption of mining operations, but the time will come in the history of this country when they will be demanded and furnish place for many men in the task of their extraction from Mother Earth.

MINES OF CRYSTAL FALLS.

There has been one addition to the mines of this portion of the Menominee range since my last report, and one to which considerable interest attaches. This is

THE MANSFIELD MINE.

The greatest mining horror that ever occurred in the Lake Superior mining region took place on the 28th of September, 1893, at the Mansfield iron mine, located seven miles east of the village of Crystal Falls. Without warning the roof of the mine gave way and the waters of the Michigamme river poured in with, such rapidity and volume that a few moments sufficed to fill the underground workings and to drown twenty-eight men. There was no chance of escape, the water rising with such rapidity that the miners could not climb the ladders fast enough to get out of its way. Indeed, none reached the shaft, being caught in the drifts leading to it, or in the stopes at which they were engaged when the roof gave way. Escape was impossible and the men were caught like rats in a trap.

I visited the Mansfield property in May, ’97, and found great changes had taken place since the fatality above referred to. The river is no longer a menace to mining, its course having been changed so that it no longer flows over the ore deposits. During the past summer an organization was formed under the title of “The De Soto Iron Company,” to take hold of the mine. E. E. Crepin, Chicago, is president and treasurer; F. Scadden, of Crystal Falls, vice-president and general manager; M. S. Sanders, Chicago, secretary. In May they began the task of diverting the channel of the river to a point several hundred feet south of the old course. They have dredged out a cut 2,650 feet in length by 100 feet wide and eighteen feet deep. At the upper end of the new channel a coffer-dam containing 14,000 cubic yards of earth has been constructed, and where the waters join the old outlet several hundred feet below the mine another embankment has been constructed across the course of the old bed that has 8,000 cubic yards of earth. This task was a very expensive one, and it has been well completed, the old channel being perfectly dry.

The turning of the river's course brings out with startling distinctness the criminal negligence or carelessness of those who were working the mine at the time of the accident. The upper tier of timbers in the mine are plainly seen, as also the ground that had been cut out to receive the set that was being gotten into place when the waters broke through. This shows the miners had worked up to within twelve feet of the water of the river. A great crack in the formation shows where the water first gained entrance. The ore made up the bed of the stream—was a portion of the bed in fact—and the walls of the mine were nearly vertical. The ore deposit had a width of about twenty feet. The water pressure must have been considerable, and the blasting of the ore (as it is hard and explosives are needed to loosen it) shattered the thin protection over the miners, permitting the water to find ready and unimpeded entrance into the mine. An engineer could not have been employed and the wildest sort of guessing must have been done by those who had the work in charge. No sane man would have permitted the opening of the deposit so near the river's bottom. Someone is responsible for the death of the miners who perished there. The accident was one that must naturally follow such work as was done at this place. The body of one of the unfortunate victims has been recovered and all will be found, as the company is to unwater the mine, and open up in all the old levels, going to the bottom, 465 feet. They have un watered the mine to the 286-foot level, and are going through the old drifts. Some time will be necessary to get everything in shape.

Where the water broke into the mine there is now a large depression, and upon the south side of this pit they are preparing, May 12, '97, to break this ore down and to tram it to the shaft to the north. They were cutting a way for the tram tracks at the time of my visit. This ore can be readily and cheaply obtained.

The changing of the stream revealed the fact that the ore deposit continued in the old bed of the stream upon both sides of the mine. Work thus far done in prospecting indicates a number of lenses or pockets of ore of varying size from ten to forty feet wide. In places the ore outcrops and at no point thus far tested is there to exceed three feet of stripping to be wasted. They were cleaning the sand and gravel from the deposits at the time of my visit, and showed ore in several places in a length of 400 feet in the old bed. A pit that is forty feet deep has been sunk north of the old shaft. Near surface there are rock intrusions in the ore body but lower down it is free from them. This deposit or chimney is narrow and is in the slates, as are all the lenses, black slates being found upon the foot and red upon the hanging.

In point of quality the ore is the best found in the Crystal Falls district, giving 62% iron and .030% in phosphorus. It is yet too early to form an opinion as to the extent of these lenses, but the showing is certainly a promising one and satisfactory when the amount of development is taken into consideration. The company has done an immense amount of work in changing the channel of the stream, and in other measures preparatory to active mining. A new shaft house has been built, an old one remodeled, ore pockets constructed that will hold 800 tons, two 6-foot drums put in the engine house and a general overhauling of the plant engaged in. The company is well equipped with machinery and has much to show for the money it has expended.

F. Scadden superintends the mining work, while E. C. Scarles is the cashier.

The finding of these promising deposits of bessemer grade ore in the Michigamme river valley suggests that other valuable deposits should occur in the same range. It offers a new field for the explorer, and may provide the means for the revival of Crystal Falls, one of the most beautifully located towns in the upper peninsula. The Mansfield mine has produced 206,956 tons of ore and bids fair to be an important shipper for many years to come.

THE COLUMBIA MINE.

The Columbia, which has been known as the "Shafter," "Shelden," and "Union," operated for the greater portion of the year 1896. It was closed for a short time pending some settlement of royalty questions, but is one of the few properties now active in the Crystal Falls district. The mine is operated by the Huron Iron company, of which John Crera, Chicago, is president; Frank Scadden, Crystal Falls, vice-president and general manager; M. S. Saunders, Chicago, secretary.

Since my last report they have completed the opening out of the fifth level, and have added the sixth, 520 feet from surface. This is upon the south ore formation, they having two parallel runs of ore in the property. Upon the north formation there is a shaft 250 feet, no sinking having been done here since the summer of 1895, There are indications that these parallel deposits will merge into one as greater depth is attained, the dip of the north formation being 15° flatter than that of the south. The main working shaft of the south formation is vertical, four-compartment, and is in the foot wall. They are observing the same manner of winning the ore by driving crosscuts from the foot wall drift, rising in the ore and backstoping. They have left an abundance of pillars none of which have yet been touched.

While the upper levels of the mine were very pockety, jasper coming in everywhere causing much trouble in the following of the lenses, the bottom level is large and clean, and showy wonderful improvement. Indeed, the last level in the mine is of wonderfully promising proportions, the ore showing a thickness of several hundred feet. They are in shape to mine a large tonnage if there is call for it. The Columbia never looked as well as now. Its ore lenses are larger and cleaner, and the walls are more regular. It promises to be one of the pillars of support to the people of Crystal Falls for many years to come. They have added a 500-horse power Corliss engine and two eight-foot hoisting drums, an improvement greatly needed. A force of from 125 to 150 men is employed.

The mine sent out 87,202 tons in 1806, making a grand total of 445,416 tons.

THE DUNN MINE.

There is but little to add to my last report in the Dunn mine. It has been operated in a spasmodic sort of way during the year, and shipped but 47,081 tons. There is still considerable ore showing in the northwest end of the mine tributary to their No. 2 shaft, but the mine is now (May ‘97), idle this being the result of an injunction served by the owners of the fee, the Shelden estate, Luke Welsh and others, the claim having been sent up that the present operators, the Dunn Iron company, are threatening the safety of the property by the robbing of pillars. As a result of an injunction restraining the company from mining the latter has pulled up its pumps in the lower levels, the latter having filled with water, and the chances are that the mine may remain idle during the year. The ore of the Dunn is of low grade, giving about 58% iron and from .150% to.500% in phosphorus, and the price obtained for it is very low. In order to meet the price there must be very close work done in the mine. The latter needs no timber, which has been a help in the keeping down of costs, and has permitted the property to keep active. The ore has to be transferred from an incline shaft sunk from the 9th level, and 350 feet from No. 2 shaft. The pitch of the ore carried the work too far from No. 2, necessitating another shaft following the incline of the formation. The tenth level has been opened in this during the year, and the showing of ore is equal to that of the level above. F. E. Woodbury is general manager, Ironwood, Michigan.

THE HEMLOCK MINE.

The Hemlock mine, located at the village of Amasa, occupies the southwest quarter of section 4, 44, 43, and is operated by the Hemlock River Mining company. The property was operated continuously throughout the past year, and was one of the few upon the range to do so. No levels have been added since my last report. There are two shafts, A, to the 150-foot level, is not in use. Operations have been confined principally to the lowest level, the fourth, during the past year. There is but little change in the size of the ore bodies upon this level as compared to the one above, the lenses averaging about 15 feet in thickness and being of good length. The ore has become considerably harder in the lowest level, the former hand-drilling method of working having to be discarded for power drills.

The ore extends beneath the Hemlock river, from which the mine is named, and there has been some figuring upon a flume to carry the water of the stream across the ore formation. With the water above them care has to

be used in operating the mine, and ore will unquestionably have to be left to retain the surface. The low price of ore has stopped intended work upon the construction of a flume. They have the plans for the improvement ready and can commence the work at any time when it is considered advisable. They use the same plans of winning the ore as previously reported, working large rooms without pillars where the ground is firm, employing square sets where ore is soft and ground unstable, and upon one lens they have been using the settling plan. A force of 75 men is being engaged. The total output of the mine is 209,029 tons, and the shipment for the past year was 95,767 tons, the largest for any season in the mine's history. The ore yields 61% to 62% iron and from .100% to .300% phosphorus.

The president. Col. Jas. Pickands, died during the past year and his place has not yet been filled. Chas. E. Lawrence, of Amasa, is superintendent; Chas. Hughes, milling captain. J. H. Hoyt, Cleveland, Ohio, is secretary.

Near the Hemlock, on section 9, the Michigan .mine still remains idle although there has been considerable talk about resumption. The property possesses a large amount of ore and could send out a big tonnage if sales could be made.

THE CRYSTAL FALLS MINE.

This property is located upon the east half of the northeast quarter of section 21, 43, 32. During the year it shipped 44,526 tons, and was operated in a very quiet way, being idle several months during the year. It was but an exploration up to a year since, having mined but 18,352 tons prior to 1896. There was a shaft No. 1, sunk 150 feet, this exposing ore high in silica. I t has been from this deposit that the work of the past year has been principally done. The property is in the hands of Corrigan, McKinney & Co., of Cleveland, Ohio, Mr. T. F. Cole, of Negaunee, having the management. S. C. Bennett is mining superintendent. During the year two additional levels were added and No. 2 shaft sunk to a point 150 feet from surface. The property can produce 75,000 tons annually with present development.

THE GOGEBIC RANGE.

The Gogebic iron ore district continues to be one of the important on of Michigan as well as of the United States. It is rich in its mines of ore suited to the making- of bessemer steel, and its product will continue popular as long as the ore is found. Compared with the past the Gogebic is as promising in large stores of pure ore as at any time in its history. During 1896 it sent to market 1,799,884 tons, this including 365,062 tons from the Wisconsin end of the range. This was 332,513 less tons than were shipped during; the year previous, and is accounted for in the article on the Norrie which follows. The total output from the mines of the Gogebic reaches the magnificent sum of 20,451,390 tons, of which 3,039,869 tons have come from the mines upon the Wisconsin side of the range. The formations, which I referred to in my last report, are regular and easily followed. The dikes are one of the interesting features, and the question as to whether or not there is ore beneath them is one that has received no little attention and is a vital point in the future development of the properties upon this range. The Metropolitan Iron & Land company has proved that ore does exist upon their property beneath the dikes, a deep diamond drill boring having conclusively proved this. In the description of the mines this question is frequently referred to. Should all the ore of the range be concentrated upon the top of this big main dike that traverses the range from east to west, it would not be a difficult matter to estimate the tons or the life of the district, but it has been found that faults and breaks occur that permitted the downward flow of the mineral-bearing waters to a point below the main dyke, and in this lies the hope for the future of the district. There is an immense amount of ore above the big dyke, or the dikes, as several are found, and many years would be required to secure it, but the end could be seen and each added year would considerably lessen the value of the range. With ore occuring beneath the dikes the end of mining is not a question of one generation, and there are signs that the ore will be found beneath these water-holding intrusive rocks when the latter have been penetrated by shafts.

During the year there was a very irregular operation of the leading mines, some of them suspending altogether for a time. The producing capacity of the district cannot be measured by the amount of ore sent out, as the properties were operated spasmodically. The performance of the year could easily have been added to by one-half had the market warranted it. In nearly every instance the mines of the Gogebic pay royalty to the owners of the fee for the privilege of extracting the ore. Overcoming this extra cost of production the ores are generally soft, mine readily, and the record of tons per man is excellent. Then the ores command the best price, being generally of bessemer grade, so that in the race for place the district is well equipped by nature to compete with other fields. There are two ports to which the ores can be shipped, Ashland and Escanaba, and the district has two lines of railroad to carry the product of the mines to the ports.

THE ASHLAND MINE.

The Ashland is the most westerly of the mines on the Michigan side of the Montreal river, the boundary line between the states of Michigan and Wisconsin. It was one of the first properties of the range to receive attention, and has been prominent since its earliest history as a shipper of ore and employer of labor. It has produced 1,990,033 tons of ore, of which amount 91,149 tons were shipped in 1896. It is the property of the Penokee & Gogebic Development company who also control the Aurora and Tilden mines of the Gogebic range.

While the Ashland has been one of the prominent mines of the Gogebic, it is today doing nothing aside from the taking of the pillars in the mine. Its known deposits have been exhausted and two years will see the mine

practically worked out. The ore deposits have been followed across the forty upon which the mine is located, leaving fine stopes upon the Norrie side of the property. Numerous dikes cut through the deposits, it appearing as if the several dikes of the range had taken this as a starting point. They are doing nothing below the 7th level, and above this point are keeping the water out of the workings. At No. 5 shaft they are taking the shaft pillar that extends from the 7th to the 4th level. The capping is very hard here, but it is now slowly settling and drawing the surface. At this place there are two dikes cutting through the pillar, and a horse of rock is also found. Two raises have been put in, one upon each side of this rock, the ore being milled to the 6½ level. There is a traveling way upon the foot side so that there is no danger of being caught while working the pillar. In winning the ore of the latter they put in sub-levels every eighteen feet and work off slices in three drift sets, working from the top of the pillar downward. After a few cuts are made they find the overlying burden very heavy and troublesome. At No. 7 shaft they are taking out a little ore lying upon the foot and dike, in the trough. In the fall of '96 a shaft was started to secure the No. 3 shaft pillar, but work was stopped when a depth of 167 feet had been reached, and they have yet to sink forty feet before reaching the dike upon which the pillar rests. This shaft is about 700 feet from the west line of the property and there is chance for finding ore in the upper levels of this territory. About 75 men are employed. Capt. T. H. Davey has charge of underground affairs and gives them excellent attention.

Adjoining the Ashland mine upon the west is

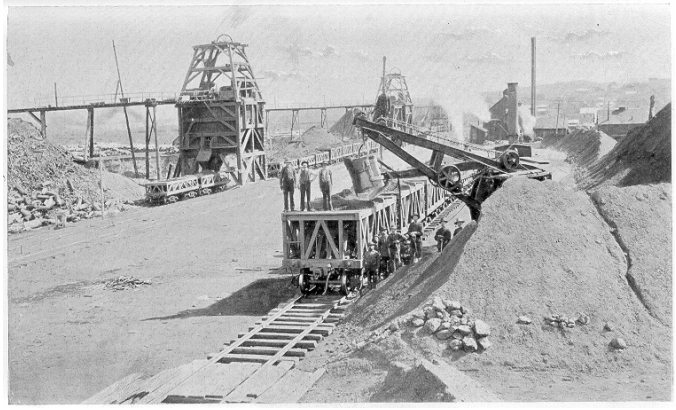
THE NORRIE MINE.

The Norrie is one of the most familiar properties to the iron mining trade of the great northwest. For years it has practically made the price at which ores are marketed, and for the season of 1897 it is taken as the base upon which all other ores are sold. The price, $2.65 per ton for the ore delivered at Lake Erie ports, is the lowest it has ever made, and it has decided to maintain this very low figure so as to save to Michigan the trade that is rightfully due her. Mr. S. S. Curry, the president of the Metropolitan Iron & Land company, operators of the Norrie, East Norrie and Pabst mines, is one of the most familiar figures in the iron mining circles, having for many years been associated with the development of the ore deposits of the Marquette, Menominee, and Gogebic ranges, being enterprising and progressive. He has mined ore to sell, and has generally managed to give his company some return for the money invested. That the Norrie will continue to dispose of its ores is certain, they being rich in iron and safely within the bessemer limit as to phosphorus. There have been numerous reports circulated to the effect that there had been a combination made against the mine by big consumers of ore to force the price down and to obtain possession of the property, but there is little foundation for such rumors. In 1896 the price of Norrie ore was about $4 per ton, and the furnacemen found they could obtain certain mixtures that would bring the cost lower than to employ the Norrie's product. In the fixing of a price early in the season the ore men did not take the pains they should, and the result proved that Norrie was placed at too high a figure as compared to other ores, the consumers finding they could save money by mixing with other grades. There can be no such claim set up in future, as the ore men have made a schedule that is absolutely fair to all miners, and based upon the physical properties of the ores.

The big stockpiles have made it very uncomfortable for the workingmen of the city of Ironwood, however, as the properties of the company were operated but feebly throughout the year, and were entirely suspended, for a portion of the time. There was no room upon which to stock more ore and sales had to be made before resumptions could take place. The company was anxious to keep its mines active, but circumstances they could not control prevented. Business suffered, as this was the greatest employer of labor in the city, and the year was a decidedly unsatisfactory one to the company and those directly and indirectly associated with it.

The Norrie has the distinction of having made the greatest output in a single season of any mine in the United States. Indeed, we believe it is not equalled by any other mine in the world. Its total tonnage produced since it began business is 6,275,843, and for the year 1896 it was 329,070, a falling off as compared with the year previous of 413,098 tons. Its biggest output was in 1890 when it shipped 906,728 tons. At this time it is working but half time, having laid off its night shift the first of May, 1897, and is engaging not to exceed 520 men, whereas its usual working force is from 1,300 to 1,500. There is plenty of room in the mine to work 1,800 men if there could be a ready market for its ores, for the Norrie presents immense stopes, and could equal its biggest year if it could find excuse to. It was the late Major Pickands, of Cleveland, who said to Mr. Curry some years ago that he had secured a map of the mine and knew just how much ore there was left. When asked what his estimate was he said "two and a half million tons." After the Norrie made its big shipment, and after several years succeeding had witnessed three millions of tons shipped, the major said to Mr. Curry, "where does all the ore in your mine come from? Four years ago I estimated two and a half millions was all you had, and you have shipped about twice that. How much have you in the mine now?" And Mr. Curry replied, "about two and a half million tons."

The Norrie possesses a great stretch on the vein, and the latter is generally of fair width, from 40 to 275 feet. There is room for many millions of tons upon the big main dike that runs throughout the entire length of the property, and the visible end is yet far in the future. All the work thus far done has been above the big dike. They have sunk through the dike and have found ore beneath it, but they have done no mining under it for the very good reason that there is plenty above it that should, be first secured.



SHAFTS AT EAST NORRIE MINE.

Since my last report of the mine there have been no new levels added. None have been needed to supply the customers, as there is a stretch of about 2,500 feet opened, in ore besides which there is still further ground in the west end of the property and adjoining the Ashland that is receiving no attention, but which possesses ore that can be got with but little in the way of preparation. The principal working shafts are now the east side of the Norrie and the East Norrie, where six shafts are in excellent shape, ready to send to surface a million tons annually for several seasons to come if there is call for it.

The new work done the past year was but little. A drift was put in from No. 6 shaft, Norrie, east to No. 7. No. 7 is only to the seventh level, where it is bottomed upon the dike. From the end of drift that is in line with No. 7, No. 7 shaft will be raised, opening it out from the seventh to eighth level. On the tenth level at No. 2 East Norrie shaft a drift was run west to connect with No. 1 shaft. From the eighth level of No. 3 East Norrie, a drift was run east to the boundary line of the company's property. Nothing was done in the mine from the 1st of July until the 20th of December, 1896.

In the west end of the property they have constructed a dam that keeps out the water from that portion of the property, which is a wet one. There are several old shafts in the western end of the mine, some of which have come together, being in the ore measure, and at all of them large pillars of ore remain that can be secured when desired. In this western end of the property they meet with three dikes, whereas further east but one is encountered, this having a pitch to the east. There is an exception to this between No. 1 and 2 East Norrie where there is a vertical dike extending downward from surface and cutting through the main one at the eighth level.

The Norrie has many years work ahead in ore already proved up, and it has shown by deep diamond drill borings that there are lenses to the north that are extensive and of marketable quality. To the north they have started two immense shafts that I referred to in my last account of the mine, but no work was done upon these since that time, the company thinking there was not sufficient inducement for it in the condition of the iron trade. These shafts will be the future important ones if the reading of the diamond drill borings have been correct. The most western of the shafts is 800 feet north of No. 2 Norrie and is down 400 feet. It is four-compartment, vertical, 9x22 feet. The eastern shaft is 500 feet north of No. 8 shaft, Norrie, and is to the 350-foot level, being connected with No. 8. It is intended to make this the main pumping station when it has been carried downward to the desired depth. It is of similar size to the west shaft. No. 6 is now the principal pumping station.

There has been no change in the system of winning the ore here. The surface is gradually settling, due to the taking of the ore, as the plan is to have it follow down. They run crosscuts to the hanging, take rooms three sets wide to the hanging, beat back towards the foot, leaving three sets of ore for pillars. Pillars are secured upon the same plan. There is constant settling of ground, and much care is needed to keep the drifts open. The ore gives about 62.20% iron, and .020% phosphorus. The mines are electrically lighted, as are nearly all the properties of Ironwood.

S. S. Curry is president; C H. Munger, superintendent; William Trebilcock, mining captain; J. H. Goudie, mining engineer; F. L. Barrows, cashier, of Ironwood. H. S, Hasleton, of Milwaukee, is secretary.

THE PABST MINE.

The Pabst mine presents little new since my last report. It has been operated in a very quiet way, and from June until October was idle. On the west side of No. 4 shaft at the sixth level they have cut out the ore to the hanging, the distance to the capping being nine sets of timber high in places. They are working rooms and pillars there upon the foot. Between C and 4 shafts they have brought down a large piece of ground that they had been trying to settle for some time, so as to permit of safer working. It has a length of about 176 feet. There is a fine showing of ore in the Pabst upon this level, over 200 feet wide. Indeed, the Pabst is the best property the Metropolitan Land & Iron company possesses. It is now well opened up, and is ready to prove its importance as a shipper if the market will give it the opportunity. The ore is of excellent quality, equal to that of the Norrie. The shipment for 1896 was a small one, 68,983 tons, and the total product is 1,220,398 tons. In 1895 the mine sent out 219,960 tons, and it certainly could have exceeded that record by considerable in the past year if there was a call for the ore. The mine never was in such excellent shape as the present finds it.

It will be remembered that in the upper levels of the mine the capping comes down in wedge-shape form, making two veins, but at the present active levels it has cut out, giving a wider body of ore, due to the pinching out of this rock intrusion. No levels have been added within the year, and none will be needed for some time to come. There is plenty of ore opened out that can be readily mined when the call comes for it, and there is also considerable now in stock. There are the three shafts that are the ones through which the ore is principally

hoisted. C is at the west end of the mine, is in the hanging, and is vertical. It is to the 560-foot level. No. 4 is in the footwall of the south formation and is to the eight level, 625 feet. It is 700 feet east of C. No. 2 is 450 feet east of No. 4, is an incline, 555 feet.

The big dike makes a deep basin here, pitching east as it comes from the Aurora and observing an opposite pitch at the east side of the property this giving chance for a big deposit of ore. In winning the ore they observe the same plan practiced at the Norrie mines. The mine is well looked after as are all of those of the Metropolitan company. Those in charge are experienced men, and no better properties are better cared for. D. R. Bundy is superintendent; John Tregambo, milling captain.

Since the above was written the Norrie has made a second sale of 100,000 tons of ore, and has resumed the night shift, a most welcome change.

THE AURORA MINE,

occupies a position between the East Norrie and Pabst. It has been a line property for many years, having a product that is desirable by reason of its purity, it being high in iron and low in phosphorus. Its ores have been popular and it has ever found a ready market at highest price. Its total output is 2,103,391 tons, and the shipment for 1896 was 187,168 tons. During the past two years there have been several accidents that have delayed the development of new territory. A caving of the eastern end of the property shut up that portion of the mine, necessitating the sinking of a new shaft. This is to the 7th level, and they are opening out upon new ground that was being taken before the shut up came. The settling was probably partly due to the operations of the Pabst mine, they working upon the settling plan. The dike in the east end of the mine is very flat, rolls, or waves, considerably, so that at several places the ore will not run upon it, but has to be shoveled by hand and transferred. At places it is handled as many as three times before reaching the shaft. They use small train cars to convey the ore from one chute to another in its conveying to the shafts.

In the west end of the mine near the East Norrie line they have added two levels during the past year, being now to the 12th. They have constructed a dam that holds back considerable of the water from the west, they being several levels below the present bottom of the Norrie. The new levels of the Aurora are promising ones, there being large stopes of ore, and diamond drill boring in the bottom of the mine proves the ore extends a considerable distance below the 12th insuring them a product from this portion of the property for many seasons to come. The ore is also of better quality than in the upper levels in this end of the mine, as for the past few years there has been some mixture of sand and lean ore that has bothered.

Last August they were driving a crosscut from the east end of the mine, and east of No. 1 shaft. They were in about 40 feet when they cut a volume of water that forced them out of the mine and raised in the level 80 feet. Additional pumps were procured and after several weeks the water was beaten down. At No. 3 shaft, upon what the miners style the "half-past ten level," they have encountered ore that promises to develop into something of value. It is making east and lies upon the main dike. There was some trouble with No. 3 shaft during the year, the miners becoming afraid of it. There is a rotten slate of a few feet in thickness upon the hanging side that comes away readily, rattling down and making miners uneasy. The trouble has been averted, and the shaft is working steadily again, the fears of the men having been allayed.

Capt. N. B. Roscorla, who has charge of milling affairs at the Aurora, has done excellent work, and has brought the mine from a very bad condition into a good one. The present force of men is 200, considerably less than generally employed.

THE NEWPORT MINE.

The Newport mine lies immediately east of the Pabst. It is a valuable property, producing excellent ore, a portion of which is high in manganese. It has mined 1,105,331 tons, its shipment for 1896 being 142,368 tons. There are six shafts upon the south formation and one upon the north, but at the present time, May, 1896, they are doing nothing except in the extreme east end of the property, at K shaft, where they have an ore rich in manganese. At this shaft they are down to the 9th level, having added three levels since my last report. The dike was passed through at the 7th level, and indications are that they have considerable ore beneath the dike in this shaft. They are opening out, and the showing is encouraging. The finding of ore beneath the dike is favorable not only to this property but to others upon the range. This shaft is the eastern one. At 1,100 feet west of K, they sunk an exploring shaft during the year, and at 120 feet struck ore of fine grade. It proved to be a small pocket, however, and they have ceased exploring at that point.

At C shaft, which is third in order going from the west end of the property, there was a cave in the ground about the upper portion that has closed that avenue. The shaft is in the hanging for 100 feet after which it enters the foot. The ore surrounding this shaft is taken out through B shaft, the one next west, square sets being employed in the mining of all the ore. They make three grades of ore containing 1%, 3% and 7% manganese, respectively. There are now, May, '97, about 100,000 tons of iron in stockpiles.

An ore sampler used here, the device of V. B. Sherrod. mine chemist, is a neat one and gives satisfactory results. The pulverized ore is placed in a hopper from which it runs upon revolving troughs, of tin, set at an angle that will carry the ore to a deposit box underneath. The revolving troughs, eight in number, catch 480 portions per minute, and 100 pounds of the ore can be run through in a minute.

The Newport possesses a line territory, and has been doing some work with the diamond drill, but reports

nothing important in the way of new finds of ore. J. R. Thompson, the superintendent, is skilled in formations and will prove up all the lands hold. Wm. Stephens is mining captain; M. E. Russell, cashier.

The foregoing embrace all the active mines in the city of Ironwood. The Davis and other small properties have been closed for several years and there is no talk of their being re-opened. Ironwood is one of the progressive cities of the upper peninsula, possesses modern conveniences and improvements, and occupies an excellent position with reference to the mines.

MINES OF BESSEMER.

Bessemer, the county seat of Gogebic county, is located six miles east of Ironwood, and is a thriving town that has excellent support in the surrounding mines. Of these the largest and present most important one is

THE TILDEN MINE.

The Tilden mine is located upon section 15 and is operated by the Penokee & Gogebic Development company, of which W. J. Olcott, Duluth, is general manager. It is one of the biggest mines in the Lake Superior region, and could treble its present rate of production if it could, find a market for its ores.

During the past year the property has been operated in a very quiet way, Nos. 6, 7 and 8 shafts having been closed since early spring. In December they resumed work at No. 9, which had been closed, and are driving drifts to connect with No. 10 shaft, and are in 1,100 feet east in this direction. They are carrying two drifts, one upon the hanging, and one upon the foot, and have opened upon the ore with several crosscuts. They find an immense deposit of ore here, which gives encouragement for the opening of a big mine at the eastern end of their property. No. 10 is the most easterly shaft, it being 1,300 feet from the east line of the property. This shaft was sunk 150 feet since my last report, being now 575 feet deep, and from this point they have started their first level. Work was stopped here last July, and nothing has been done since. They found the ore. having a crosscut 120 feet, and are satisfied the shaft will prove an important one. Nos. 8 and 9 shafts are the only ones being given attention at this writing, May, '97. About 35 men are employed at No. 8, and 250 are engaged at the mine all told. They are observing the same method of winning the ore as described in my last report, it being the "drawing" system, and a large product per man is secured.

The big dike upon which all the mining has been done at the Tilden, gives evidence of pitching to the east, forming a deep basin, being similar to the fold made between the Pabst and Newport mines, at Ironwood. There is an immense amount of ore resting upon this dike. For 4.000 feet there is practically a continuous ore body, the position of which assures a great depth, and big products annually for many years to come. The mining under the system employed, is a simple matter, and the trammer here is of as great importance as the miner, it being a question of tramming rather than mining, the ore "mining itself," as Capt. Piper puts it. In quality, the ore being secured at the eastern shafts is better than that further west, it giving from 64% to 65% iron and .035% phosphorus. This makes their "Newark" grade the best.

"Rand" ore gives 60% to 63% iron and from 2% to 3½% manganese; "Tilden," another grade, giving 62% iron and from 1 to 1½% manganese. The ore is entirely free from rock mixture, an advantage of no small proportion in the mining. The ore is very soft, too, augurs being often used in making holes for the explosives.

The company is finely equipped with machinery, etc., to carry on its work. The mine is well managed, and is valuable to the people of Bessemer, it being the principal labor-employing concern in the town.

The shipment from the mine for 1896 was 250,205 tons, and the total for all years is 1,274,259 tons. Chas. F. Rand is president. Howard Morris, secretary; W. J. Olcott, general manager; Jas. Piper, mining superintendent; N. O. Lawton, mining engineer; Geo. H. Durkee, cashier.

THE COLBY MINE,

immediately west of the Tilden, has done but little during the year, there being no encouragement in the market for activity. It is the property of Corrigan, McKinney & Co., who re-opened the old No. 5 shaft in the summer of 1895. There were shipped 48,493 tons of ore, an excellent record considering the time the property was active, and the amount of work which had to be done to get it into shape for mining. T. F. Cole, of Negaunee, has charge of the property, and Peter Ramquist is mining captain. Years ago the Colby was one of the big mines of the Gogebic, and has shipped 1,437,067 tons. There is a portion of the product containing manganese, and there is a chance for the securing of a considerable stockpile for many years to come in case there can be sales made.

THE PALMS MINE

lies immediately east of the Tilden. Its most westerly shaft is partly the property of the Tilden operators, who possess one of its three compartments, the shaft having been sunk by the two companies for the purposes of exploration. At one time, the Palms was operated by the Penokee & Gogebic Development company, who relinquished the lease in 1894. The property is now worked by the Dunn Iron company under the general management of F. E. Woodbury, of Ironwood. At the time of my last report they were doing something in the way of exploring the eastern end of the property, they possessing the Anvil, immediately upon the east. Nothing of importance was found, and they have since been confining their efforts to the opening of the main lens at their west shaft. No. 5. on the line dividing the Palms and Tilden properties. At the No. 4 shaft, 400 feet

east of No. 5, a little ore was secured upon the 10th and 11th levels.

At No. 5 they are opening up the 13th level, having added two levels since my last report. It will be remembered in my last account of the mine that I referred to the hanging as being very strong. General Manager Woodbury hesitated about trying the settling plan of mining fearing the capping would not follow down as the ore was removed, but he finally decided to make the attempt, and the mine is now being worked upon the caving system. The hanging instead of proving solid, is loose and rotten, evidently not the true wall, and it follows down nicely. They have worked out everything above the 13th level and are now in excellent shape to carry on mining upon the new plan that is working so well. They put in sub-drifts and take the ore as at the Chapin and other mines. Mr. Woodbury deserves credit for what he has accomplished in the way of changing the old system to the better and less expensive one. The ore upon the 13th shows about the same proportions as upon the 11th and 12th, being 50 feet thick, and of excellent quality. The Palms has made improvement, and gives promise of developing into a fine producer. They have placed a new Prescott pump, compound condensing, in No. 5, and have improved their hoisting plant. A new coal trestle was constructed during the year. The shipment for 1896 was 113,412 tons, the largest for any year in its history. The total tonnage produced for all years is 432,543. The mining force consists of 235 men.

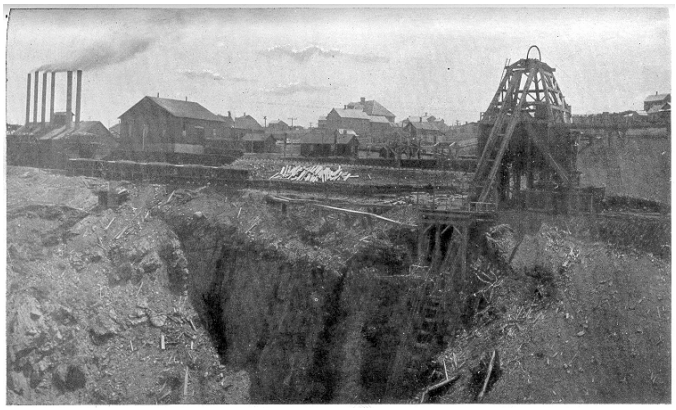
F. E. Woodbury, general manager, Ironwood; L. W. Powell, chief clerk, Bessemer. Wm. Rowe, mining captain.

THE EUREKA MINE,

located next east of the Anvil, was idle during the year, as it has been for the past two seasons. There is ore in the mine, but it will take money to open the property up for paying products.

THE JACK POT.

This property lies just west of the Colby on section 16. For several years it was explored and considerable money spent in trying to find a paying deposit of ore. There is a shaft following the inclination of the ore formation that is 380 feet deep, measured on the incline. The fifth level is the lowest and something over 5,000 tons of ore were shipped when this work of opening was under way. Last fall Ishpeming and Negaunee parties took hold of the property, unwatered the shaft and placed Capt. John Sincock, of Ishpeming, in charge of underground affairs. They did some work upon the fourth and fifth levels, finding small pockets of high grade ore, these giving 60% to 66% in iron and .030% in phosphorus. The work of exploring the mine was begun on the 20th of October and suspended on the 1st of the following December. To test the merit of the property the shaft should be continued to greater depth, and the property next adjoining upon the north should be possessed. There is no doubt but that the Tilden and Colby mine vein extends across these properties, but they will have to sink to find it.



SHOWING PORTION OF AURORA MINE.

THE VALLEY.

immediately just north of the Jack Pot, is an exploration that has been in progress for some time. There is a shaft near the line of the Jack Pot property that has reached a depth of 300 feet. It has shown lean ore formation for some distance, and occasional small seams of clean ore have been found. Work was discontinued in May, '97. Capt. E. D. Samson is interested, and was looking after the work, Ashland, Wisconsin, capital being principally interested.

THE PURITAN

also known as the Ruby, has received a little attention during the year, Captains Sampson and Christopher doing a little test pitting. A lens of ore was found but not enough to determine its value.

The Federal, Lowell, Benjamin and other small properties continue idle, and there is no talk of a resumption of exploratory work. There is a promising territory lying between Bessemer and Ironwood that will some day receive attention.

To the east of Bessemer after passing the Eureka there are the Gogebic, East Dangler and United, all idle. Next in a state of activity is

THE MIKADO MINE.

This property has one shaft that was unwatered the past summer. Its depth is 573 feet. This work was performed by the Dunn Iron company who afterward released it and it was secured by George Curry, M. P. O'Brien and other men of Ironwood. There is a lens of ore 100 feet to the north of the bottom of the shaft which is receiving attention. There is an adequate plant of machinery, a Prescott pump, and everything needed to do mining with. Sandy Sutton has charge of the property, and the company styled the "Bessemer Ore Co," will give the property a thorough exploiting.

Going westward from the Mikado there is nothing being done until Wakefield is reached. Here

THE SUNDAY LAKE MINE

is being operated in a very quiet way by Corrigan & McKinney, of Cleveland. The Sunday Lake mine is a very wet one, and particularly so since the Brotherhood located on the adjoining property, is idle. The Sunday Lake is the deeper, and naturally has to do the most of the pumping for the two. Some time since there was an understanding arrived at between the managements of the two companies to the effect that each should open levels corresponding in depth, so that the pumping of the water might be equally divided between the two, but the Brotherhood met with a heavy loss by the failure of one of its customers, and the low price offered for the balance of its product induced them to close. This was unavoidable, and has made a very hard load for the Sunday Lake. The latter has added one level of 65 feet since my last report. This addition is the 12th and is 575 feet measured on the underlay of the shaft.

They observe the caving system, the ore being soft and mining readily. Excellent work has been done in the way of keeping down the cost of the product. The lenses are small, there is a heavy royalty, and a big pumping charge. In the face of all this the mine has managed to live, but the present big flow of water, due to the cause mentioned, is a severe addition. The mine sent out 88,735 tons for 1896, a very good record, and has a credit for all years of 324,367 tons. T. F. Cole is general manager; Jas. Trezona, mining captain.

THE BROTHERTON MINE,

lies just west of the Sunday Lake. It has been idle since June of 1896. It met with financial losses, and also had unsold ore in stock. They have three shafts down 460 feet, and work on the settling plan which has here given excellent satisfaction. There has been no dead work done in the year, and everything is in shape to proceed when there is a demand, at living price, for the ore.

Jos. Sellwood, Duluth, is president; Richard Bawden, Bessemer, mining-superintendent; Geo. Strong, Bessemer, cashier.

To the east of Wakefield nothing is being done in the mining way. There are a few small prospects but these have been idle throughout the year, and there is no likelihood of their being revived until a better price can be obtained for the ore.

IN WISCONSIN.

Upon the Wisconsin end of the Gogebic range there is being little done. The Iron Belt, the furthest west on the range now working, is not looking well. At the old mine they are taking the pillars and they are doing something in the way of developing a new lens to the west of the old. It is not proving up as well as they would like to see it.

The Montrael continues to be the leading mine upon the Wisconsin side, and presents an excellent showing underground. The ore has also improved in quality, it now being of excellent grade. They are working two shafts, and Mr. Abeel, the manager, is making an excellent record.

The Careys and Superior that were operated by Ironwood parties, were closed down in May, '97. An effort was made to further test the ore formations of the Germania, one of the first mines to receive attention on the Gogebic range. A portion of the mine was unwatered, but the levels had all gone together, and the task was too expensive, due to the condition of the mine, to be carried out as they had intended. There is a likelihood that the ore found in the deep diamond drill hole at the Norrie extends to the Germania, but it will take time and money to prove the correctness of the theory. The Shores mine, operated early in the year, was closed down, and will probably not resume, as the ore deposit was small and expensive to work.

SHIPMENT OF IRON ORE.

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

Shipments of iron ore from Marquette Range for season of 1896 and for all years:

Name of Mine.	1896.	Total.	Name of Mine.	1896.	Total.
American (Sterling)	.....	112,933	Michigamme	.....	880,362
Ames	.....	6,298	Milwaukee	.....	375,451
Bay State	.....	16,637	National	.....	150,216
Bessie	.....	847	Negaunee	175,393	823,672
Beaufort	.....	90,217	Negaunee Con. Works	.....	12,708
Blue	.....	90,120	New York (York)	.....	1,113,102
Boston	587	62,544	N. Y. Hematite	.....	37,587
Braastad { Winthrop / Mitchell }	149,437	1,974,350	North Republic	.....	289
Cambria	95,086	848,538	Northwest	.....	1,687
Champion	113,375	3,082,715	Norwood	.....	5,753
Cheshire (Swanzy)	.....	217,089	Nonpareil (St Lawrence)	.....	23,395
Chicago	.....	9,012	Palmer	1,041	4,474
Cleveland	266,872	5,877,442	Pascoe	.....	59,806
Columbia (Kloman)	.....	94,813	Pendill	.....	45,993
Curry	.....	16,671	Phoenix (Dalliba)	.....	59,114
Detroit	.....	140,841	Pioneer	.....	15,409
Dexter	18,930	117,385	Pitts. & Lake Angeline	342,351	3,694,811
Day	.....	2,709	Platt	11,206	73,844
East Champion	.....	76,002	Quartz	.....	491
East New York	.....	166,243	† Queen	325,571	2,379,276
Edison	.....	893	Republic	127,360	4,378,386
Erie	.....	8,136	Republic Red. Co	.....	47,274
Etna	.....	1,691	Richmond	1,088	1,088
Fitch	.....	31,817	Richards	.....	1,374
Gibson	.....	16,357	Riverside	.....	16,160
Goodrich	.....	49,754	Rolling Mill	.....	234,625
Grand Rapids (Davis)	.....	110,596	Saginaw	.....	451,424
Hartford	1,532	14,480	Sam Mitchell	.....	17,780
Hortense (No. Champion)	.....	39,574	Samson (Argyle)	.....	267,805
Humboldt	2,207	723,961	Schadt	.....	1,261
*Iron Cliffs	245,588	3,606,306	Sec. 12	.....	21,887
Imperial	.....	64,206	Spurr	.....	164,244
Iron Mountain	.....	393	Starwest (Wheat)	9,658	181,004
Jackson	80,716	3,461,685	Taylor	.....	32,970
Lake Superior	459,575	7,494,389	Titan	.....	90,371
Lillie	107,326	591,557	Volunteer	.....	1,073,487
Lucy (McComber)	.....	494,280	Webster	.....	14,108
Manganese	.....	6,359	West Republic	.....	133,077
Marquette	.....	152,907	Whetmore	.....	50,870
Mesabi (Consolidated)	10,540	16,043	Wheeling	.....	10,555
Totals				2,605,152	46,542,662

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

Shipments of iron ore from Menominee Range for season of 1896, and total shipments for all years:

Name of Mine.	1896.	Total	Name of Mine.	1896.	Total.
Antoine	83,676	115,444	Lee Peck		2,844
Appleton		12,102	Lincoln		36,589
Aragon	95,809	858,346	Loretto	34,334	151,608
Armenia		78,969	Ludington		1,001,518
Beta		4,211	Manganate		6,844
Brier Hill		14,981	Mansfield		206,956
Calumet		38,713	Mastodon		425,648
Chapin	421,681	6,132,643	Metropolitan		707,027
Claire		66,964	Michigan Explo. Co		1,653
Columbia	87,202	445,416	Millie (Hewitt)	21,815	161,702
Cornell		6,630	Monitor (Lamont)		128,909
Crystal Falls	44,526	62,878	Nanaimo		127,566
Delphic		33,718	Northwestern		17,206
Dunn	47,081	969,145	Paint River		222,371
Fairbank		8,500	*Penn Iron Mining Co	179,917	4,986,515
Great Western		373,100	Perry		3,138
Groveland		1,049	Powabic	276,130	1,215,207
Half and Half		7,524	Quinnesec		284,084
Hamilton		96,072	Shafer		6,315
Hemlock	95,767	209,129	Selden		2,092
Hersel		955	Sheridan	3,419	76,986
Hiawatha		2,884	South Mastodon		8,203
Hollister		4,098	Seephenson		39,350
Hope		17,818	Sturgeon River		18,408
Indiana		17,871	Walpole		19,089
Iron River		904,587	Youngstown		150,764
Keel Ridge		88,291			
Totals				1,409,595	19,988,422

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

Shipments of iron ore from mines of Wisconsin located on Menominee Range for 1896 and grand total for all years.

Name of Mine.	1896.	Total.
Commonwealth	93,507	1,729,588
Florence	35,136	1,127,432
Totals	128,643	2,857,020

Table showing iron ore sent from the Gogebic Range for 1896 and total shipments to date:

Name of Mine.	1896.	Total.	Name of Mine.	1896.	Total.
Alpha		2,010	Iron Chief No. 2		551
Anvil	55,009	305,974	Ironton		58,368
Ashland	91,149	1,990,033	Jack Pot		5,595
Aurora	187,168	2,103,991	Mikado	4,048	8,872
Blue Jacket		1,799	Newport	142,368	1,105,331
Brotherton	50,490	539,510	Norrie	329,070	6,275,843
Colby	48,493	1,437,067	Odanah		77,124
Comet		89,191	Pabst	68,983	1,220,398
Davis		48,714	Palms	113,412	432,543
Eureka	4,542	128,717	Ruby (Puritan)		86,525
Father Hennepin		184,928	Sparta		4,862
Federal		27,928	Sunday Lake	88,735	324,367
First National		1,997	Tilden	250,205	1,274,359
Imperial		8,515	Valley		1,878
Iron Chief		12,199			
Totals				1,434,222	17,411,521

Iron ore shipments from mines of Wisconsin on the Gogebic Range for 1896 and total for all years:

Name of Mine.	1896.	Total.	Name of Mine.	1896.	Total.
Atlantic	60,727	136,941	Pence	14,000	41,261
Bessemer		20,889	Section 33		258,590
Cary	38,821	536,722	Superior		121,627
Germania		330,633	Shores	12,423	12,423
Iron Belt	81,461	655,834	Trimble		25,931
Kakagon		71,904	Tyler's Forks		10,683
Montreal	131,531	644,054	Windsor	26,699	145,736
Nimikon		28,635			
Totals				365,662	3,039,869

Shipments from the Mesabi Range, Minnesota, for 1896 and all years.

Name of Mine.	1896.	Total.	Name of Mine.	1896.	Total.
Adams	234,562	293,703	Genoa	17,136	17,136
Aetna (Lowmore)	17,723	19,368	Hale	70,006	128,793
Auburn	131,478	616,658	Lake Superior	67,659	125,782
Biwabik	242,565	731,182	Mahoning	167,245	285,129
Canton	16,261	643,550	Minnewas		15,998
Cincinnati	57,324	100,883	Mtn. Iron (& Rath)	142,021	1,210,798
Cloquet (Vega)	96,280	149,608	Norman	77,523	209,914
Commodore	12,063	94,413	Ohio	69,925	98,868
Duluth		37,626	Oliver (1)	898,291	1,937,638
Fayal	248,645	385,246	Sellers	153,037	200,470
Franklin	231,086	787,525	Willlams (N. Cin'ti)	11,249	14,295
Totals				2,882,079	8,074,583
Miscellaneous				2,293	

1—Mesabi Mountain and Lone Jack.

Shipments from the Vermilion Range, Minnesota, for 1896, and for all years:

Name of Mine.	1896.	Total,
Chandler	471,545	3,793,007
Minnesota	448,707	5,169,071
Pioneer	149,073	210,013
Zenith	18,765	48,144
Totals	1,088,090	9,220,235

Shipments from the several ranges and ports of Michigan, Wisconsin and Minnesota for 1896 were as follows:

BY RANGES:

From Marquette	2,605,152
From Menominee	1,538,238
From Gogebic	1,799,884
From Mesabi	2,884,372
From Vermilion	1,088,389
Total	9,916,035

BY PORTS.

From Escanaba	2,316,862
From Marquette	1,568,056
From Gladstone	216,363
From Ashland	1,573,334
From Two Harbors	1,714,406
From Duluth	2,358,355
By All-Rail	268,659
Total	9,916,035

In the handling of this immense tonnage the railroads and boat lines are well equipped for the business of transportation. There has been a great addition made to the number of ore carriers upon the lakes, and the railroads have been steadily increasing their rolling stock and facilities at lake docks. Improved cars and docks are noted upon all the roads engaged in the business of ore-carrying. The cost of handling ore from mines to lake ports for the year 1896 was as follows:

COST OF RAIL HAULAGE OF ORE:

From mines of Marquette range east of Republic and Michigamme to Escanaba, per gross ton	52 cents
From mines of Marquette range at Michigamme and Republic, to Escanaba	67 "
From mines of Marquette range to Marquette	32 "
From mines of Marquette range to Gladstone	52 "
From mines of Menominee range east of Mastodon to Escanaba	52 "
From mines of Menominee range west of Mastodon	57 "
From mines of Gogebic to Escanaba	97 "
From mines of Gogebic to Ashland	52 "
From mines of Minnesota to Duluth and Superior	80 "

For the season of 1897 a reduction of 7 cents per ton has been made by the Michigan roads, but Minnesota lines have not changed their rate, which is 80 cents.

LAKE TRANSPORTATION OF ORES.

The ruling rates for the lake transportation of ores for the season of 1896 were: From the head of Lake Superior, 80 cents; from Marquette, 75 cents; from Escanaba, 50 cents. For 1897 a still lower rate is expected.

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 "
Ashland to Cleveland	774 "
Duluth to Cleveland	823 "
Escanaba to Chicago	192 "

PRICE OF IRON ORES.

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

YEAR.	PRICE.	YEAR.	PRICE.
1856	$ 8.00	1889	$5.50
1866	9.50	1890	6.75
1868	9.75	1891	6.00
1873	12.00	1892	5.50
1876	6.75	1893	4.00 to 4.50
1881	9.00	1894	2.50 to 2.75
1886	5.50	1895	2.75 to 3.50
1887	7.25	1896	3.15 to 4.50
1888	5.50	1897	2.40 to 3.18

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

PRODUCTION OF IRON ORE.

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

In 1891 all states produced	14,591,178	gross	tons
In 1882 " " "	16,296,666	"	"
In 1893 " " "	11,587,629	"	"
In 1894 " " "	11,879,679	"	"
In 1895 " " "	15,957,614	"	"
In 1896 " " "	14,650,000	"	"

For the year 1896 Michigan sent to market 5,448,969 tons, and the Lake Superior region contributed 9,916,035 tons.

IMPORTS OF IRON ORE.

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

1892	806,585	tons
1893	526,951	"
1894	167,307	"
1895	524,153	"
1896	776,283	"

The importation comes principally from Cuba, although Greece sent 45,325 tons; Italy, 54,141 tons; Spain, 151,768 tons, and French Africa 79,557 tons.

CONSUMPTION OF IRON ORES.

The consumption of iron ore in the United States is estimated as follows: For 1892, 17,400,000 tons; for 1893, 13,480,000 tons; for 1894, 12,235,000 tons; for 1895, 17,253,000 tons: for 1896, 15,525,000 tons.

ORE ON DOCKS.

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

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

The big increase credited to 1896 is one of the reasons why the demand from the mines has been so limited and the price so low.

WORLD'S PRODUCTION IRON ORES.

The following figures, secured from the most reliable sources, show the world's production of iron ore for the past five years:

1891	53,568,000	tons
1892	54,995,000	"
1893	50,855,000	"
1894	54,041,000	"
1895	59,035,000	"

This shows the important part the Lake Superior region takes in the world's supply, it furnishing one-sixth of the total.

COPPER.

For many years Michigan held first place in the union in the production of copper, but that honor has of late been conceded to Montana, which possesses immense mines of copper ore, the cost of treating which is assisted by the association of silver with the ores. While its place in the rank of producers has been lowered a point, Michigan still has credit for procuring the purest metal the world knows, and Lake copper is known everywhere as superior to all others where strength, toughness and conductivity of electrical current is desired. The amount of refined copper secured from the Michigan mines for 1886 was 138,396,760 pounds, this being 8,822,904 pounds more than were produced for the year previous. In the several items that go to make up this grand total the Calumet & Hecla report for their fiscal year, which ended the 30th of April, '96. An increase over the figures reported would probably have resulted had the production of this company been shown up to the end of 1896. The gain is a large one, however, and shows that Michigan is capable of adding considerable to the excellent record of the past.

The following table shows the amount of mineral, its percentage and the pounds of copper produced from the Michigan mines during 1896. All but the Calumet & Hecla company's output was reduced by the Lake Superior Smelting company. The Calumet & Hecla has its own smelters located at Lake Linden, Mich, and at Buffalo, N. Y. Of the refined copper it reports 34,569,830 pounds were from the Michigan smelters and 50,982,926 from its Buffalo works.

For the year 1896 Montana produced 227,700,000 pounds of refined copper; Arizona, 71,000.000 pounds, and 13,500,000 pounds were contributed from other states and territories, the total production amounting to 450,596,760 pounds. Of this grand total 251,204.000 pounds were sent to foreign countries. While electrolitic treatment of copper ores has improved the quality over what it used to be prior to this modern method, Michigan copper continues to command from a quarter of a cent to one-half cent more per pound in the markets, an item of

considerable importance when figured upon the entire output of the mines of this state. The average price at which Michigan copper was sold during the past year was 10.88 cents per pound, this giving a value to the product of the mines of this state of $15,057,567.48.

Mineral smelted and copper produced for year ending December 31st, 1896.

NAME OF COMPANY.	MINERAL lbs	PER CENT.	COPPER lbs
Tamarack Mining Company	23,798,152	67.421	16,045,039
Osceola Con. " "	7,434,662	84.083	6,251,304
Quincy " "	21,001,919	80.231	16,850,140
Franklin " "	3,367,218	81.553	2,746,076
Atlantic " "	6,497,394	75.326	4,894,228
Tamarack Jr " "	2,561,844	74.081	1,897,845
Kearsarge " "	1,588,648	86.691	1,377,226
Wolverine " "	2,540,996	86.398	2,195,383
Central " "	696,922	67.331	469,242
National " "	62,440	75.854	47,363
Ridge " "	19,042	77.844	14,823
Evergreen Bluff Mining Co	5,713	71.381	4,078
Knowlton " "	2,277	76.636	1,745
Hilton " "	3,669	84.000	3,107
Adventure " "	10,612	72.744	7,720
Mass " "	56,354	68.645	38,684
Total	69,647,892	75.873	52,844,004
Calumet & Hecla			85,552,756
			138,396,760

Great interest attaches to the copper mines as nearly all of them are listed upon the Boston, Mass., stock exchange, and there is a great deal of speculating in their shares. There is constant buying and selling not only throughout the east, where much of the stock is held, but in the mining towns of Michigan as well. The record of the leading mines in the dividend-paying way is a wonderful one, the successes being immense ones, encouraging traffic in the stocks and keeping the industry constantly before the public.

In the brief time that the development of the copper region of Michigan has been going on, the successful copper properties have paid to their shareholders the enormous total of $74,860,375.00. This earning has come from fifteen mines as follows:

Atlantic	$ 740,000
Calumet & Hecla	49,350,000
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	2,122,500
Pewabic	460,000
Phoenix	20,000
Quincy	9,070,000
Ridge	100,000
Tamarack	4,830,000
Total	$74,860,375

In this amount there are several dividends that have been paid in the spring of 1887, and one of $1,000,000, included in the list, has been announced by the Calumet & Hecla company that has not yet been paid. The money has been earned, however, and it is proper to include it in the table showing the accomplishment of there properties. As against these dividends there have been paid in assessments by the mines above mentioned, $7,869,500, leaving an earning in excess of dividends of $66,990,875. During 1896 there were five mines that declared dividends, and within the twelvemonth they divided among their shareholders $4,400,000. Seven of the mines that have credits for dividends in the list here printed are idle, and have been for many years. These are the Cliff, Copper Falls, Minesota, National, Pewabic, Phoenix and Ridge. There is a little tributing done at a few of them, but they can be properly classed as idle. This list printed tells only of the successes. There have been failures, and many of them. Thousands upon thousands of dollars have been spent in trying to find paying lodes, and money has been freely paid in the hope of locating another Calumet & Hecla or another Quincy. Much has been illy directed, and the amount of money squandered has been large. This is but the repetition of what is met with in all mining fields, however. Few regions can show as large a percentage of success for the money legitimately employed as here, and while considerable has been done in the way of looking for new mines without airy important additions except in the immediate vicinity of the active properties, there is an extensive field that should offer encouragement to capital in its proper exploiting. The territory covered by the working mines is a very limited one as compared to the copper-bearing range. At Houghton and Hancock and at Calumet in the whole of Houghton county, and at Central, in Keweenaw county, are the only points where activity is seen. The territory stretching for forty miles south and west from Houghton has promising indications for copper. Little has been done, there being a lack of exploration principally because the region needs a railroad over which to pull supplies. The extending of the Chicago, Milwaukee & St. Paul through this copper-bearing belt would be a great incentive to the exploration of this range, and that there would be mines found is indicated by the little that has been done at several places along the range, where, years ago, pits were sunk, and copper in encouraging quantity met with. As in all other branches of mining, there has been something learned regarding the better mining and treating of copper rock. Advancement has been steady, and concerns are now making money with rock that yields but twelve pounds of copper per ton, a feat that would have been regarded as impossible in the early history of this range. From Calumet to the north and west the range extends for fifty miles. The district is dotted with the ruins of mine buildings long in disuse, and marking sites where dividends were earned in the past when primitive methods prevailed. There is much to suggest reason for a revival at many of these old locations, and the time will come when enterprising men will prove the value of the lodes that have been abandoned as worthless. There will have to be a combining of the old properties in order that sufficient territory may be had to permit of the treatment of a large tonnage, and that will insure a rock product for a sufficient length of time to warrant the outlay that modern operation demands.

The scenes of the most active operations upon the copper range are in happy contrast to these that have accompanied other kinds of mining in the state of Michigan for the past four years. While the iron districts have been struggling along trying to keep alive through the dull times by cutting of wages and restrictions of

product, the copper country has not experienced any of the annoyances consequent upon the harsh measures enforced by the conditions of their neighbors. The people have thrived, the towns have grown, prosperity is evidenced upon every hand, and the district has much reason to be happy over the good fortune it has been blessed with. It has been one of the few bright spots to be found not only in Michigan but in all of this vast union during the unfortunate financial depression of this nation. The fact that much of the copper has been exported has assisted in the keeping up of the mines, the growth of electrical machinery, etc., having been of great value to them. The consumption of the metal has been heavy and there are many reasons for believing it will continue to increase largely with each succeeding year. The cheapness of the metal has encouraged its use, as well as its great value in the electrical world. It is destined to be popular and to find ready market at a price that will pay the mine owner and miner a fair return for their enterprise and skill.

MINES OF HOUGHTON.

In my last report I made mention of the fact that an effort was being-made to re-open the mines near the village of Houghton, N. F. Leopold, of Chicago, having secured an option upon them in the hope of interesting parties in their purchase. The properties were the Isle Royale, Grant Portage and Huron, all located immediately south of Houghton in sections 1, 35 and 36. The securing of these properties under option was finally followed by their sale to eastern capitalists, the purchase price has been paid and the preliminary steps looking to the re-opening and equipping of the old mines will soon be commenced. Some time was consumed in clearing up the titles of the properties, but all was satisfactorily accomplished, and at this writing. May, 1897, an organization has been perfected under the title of "Isle Royale Consolidated Mining company." The capital stock is fixed at $2,500,000, 100,000 shares having a par value of $25 each. The board of directors is composed of C. H. Bissell, C. H. Altmiller, W. A. Chrimes and P. K. Demaresq, of Massachusetts, and W. E. Parnal, of Calumet, Michigan. The latter director has charge of the local affairs of the company, and the capital interested is practically the same as represented in the Clark-Bigelow group of mines. Surveys are being made for the purpose of establishing a site for a stamp mill in case one will be needed, and the probable location will be at Pilgrim river. Final decision has not yet been reached on this point, however.

The Isle Royale mine was the pioneer copper mine wrought on Portage Lake since the operations of the prehistoric miner. It may have been the first given attention by the latter, as the work done by the ancient diggers first attracted attention to the lode. The first work done was in 1852, and the name was given by a company that had first paid attention to exploring Isle Royale, located in Lake Superior, who failed to find anything of value upon the island and who afterward came to Houghton to test the worth of the lodes in that vicinity. In 1853 they had eight stamps at work, which number grew to forty in after years. Work was suspended in 1857, after which time a little tributing was done. In 1863 the company again assumed the aggresive and continued until 1870. Since then but little has been done, this being in the line of tributing. There are three veins upon the property these being about 200 feet apart, but aside from the central one, known as the Isle Royale, nothing of value was found. The belt is amygdaloid, of brownish color, and epidote has been the healthiest mineral for copper. The lode, like all amygdaloids, was bunchy, and in the time the mine was worked it yielded 9,204,071 pounds of copper. The trend of the lode is 60° east of north, and the dip is 60°. The vein is a large one, between 12 and 20 feet thick. There was much opening done upon the property the work covering a length on the lode of about 1,800 feet. Ten shafts were sunk of which four were the principal ones, these being Nos. 1, 4, 5 and 8. No. 1, 4 and 8 were put down to the 9th level, while No. 5 was sunk below the 10th. In the days when the mine was wrought they lacked the improved machinery, etc., of present times. There was considerable barren ground, and dikes of trap rock were frequent. The copper secured was principally In the shape of small barrel work. The estimated length of lode of this property is 3,500 feet.

The Grand Portage mine, occupies a position immediately north of the Isle Royale and has wrought the same lode as the latter and another 200 feet west known locally as the Portage lode, the latter having given the better results in copper. Upon the Isle Royale lode the mine is to the 6th level, 400 feet from surface, and they have opened upon the vein for about 1,050 feet. There were three shafts, No. 1 and No. 3 to the 4th level and No. 2 to the 6th.

Upon the portage lode the principal shaft was down to the 7th level, 500 feet from surface, measured upon the underlay. Another shaft was to the 4th level, and yet another to the 2d. The work extended over a distance upon the lode of about 1,000 feet. The Portage lode is a heavy one, being from 20 to 40 feet thick, and the poorer part in copper was generally in the central portion, the lode showing copper upon foot or hanging throughout the entire length opened up. Little was done since 1883, the total product of the property being 3,226,434 pounds of refined copper. The Isle Royale and Grand Portage had gained but little depth when they were closed. In these days 500 feet, on the underlay the inclination of which is 55° or 60°, is not considered even a fair start for a shaft in a copper-bearing lode. That barren ground was met with should be no detriment to going into the old mines and sinking to such depths as other properties in this region have attained. Poor lode is the rule in the amygdaloids. It is found plentifully at the Quincy, Franklin, Osceola, Kearsarge and Wolverine. Were it all good, there might be too much copper for the health of the market. That these old mines, in the little ground that was opened up found good lode, ought to be encouraging. There certainly is enough to warrant the

proper equipping of the properties for development and underground search. Those in possession are business people, have the money and knowledge of how best to spend it, and the territory will be given a fair prospecting.

The Huron mine, lying next south of the Isle Royale. and opened upon the Isle Royale lode, was the last of the three making up the possession of the Consolidated to receive attention. The last work done there was in August, 1883, at which time it was being operated by Mr. Graham Pope, of Houghton, upon tribute. In the last fifteen months when Mr. Pope handled the property he secured 6,000 tons of copper, and informs me that he is certain the rock will yield one per cent ingot. Like its neighbors, the Huron was badly handicapped for want of better machinery, and if a profit could be made with such apparatus as it possessed, it certainly gives reason for thinking that with such improvements as are now to be had, the property might make a much better showing. There were no less than ten shafts opened upon the lode, two of which, Nos. 5 and 8, reached the 16th level. No. 10 was sunk to the 11th, and the remainder were from the 1st to the 6th.

With the three properties the Consolidated possesses a great length of lode. Should the latter prove remunerative it assures plenty of territory upon the extension of the lode in its downward course to give food for the stamp mill long into the future. Should success attend the effort that is being put forth to develop a paying mine it will be a grand accomplishment for the village of Houghton as well as for the entire copper range. It will bring to the former increased business and to the latter fresh capital in the search for other mineralzed lodes. It is a work in which great interest is being manifested, and its success is everywhere desired.

THE ATLANTIC MINE.

The Atlantic Mining company is one that has achieved a national reputation in mining circles by reason of the extraordinary results obtained in mine and mill. Its rock is the poorest in copper of any now feeing mined in the Lake Superior region. Indeed, we know of none other that attempts a operation whose rock does not give more value per ton than this. For the year 1896 the amount of copper in each ton was only 13 19-100 pounds, and yet with this extraordinary lean material the company earned $71,951,71, out of which a dividend of $40,000 was paid, making the total dividends among its shareholders since the mine was first opened of $740,000. The amygdaloid belt of the Atlantic is one that may be a little more readily broken than that of some other mines, and they take all of the lode in working, it all going into the mill. The copper is generally well distributed throughout the vein, so that to secure it all the rock must be taken from foot to hanging. This permits of the lowest possible mining, and makes it possible to keep many heads of stamps at work. The quantity of rock stamped in the year was 371,128 tons, which was 40,070 more tons than treated during the previous year, and the cost of each ton treated was about 5 cents more than for 1895, due to an increase in the wages of the men employed in and about the mine and mill. During the past ten years the yearly average yield has been between 12 3-10 pounds of copper per ton of rock as the minimum and 14 6-10 as the maximum. I am informed by Mr. F. McM. Stanton, agent, that there has been an improvement in the spring of 1897, and at this time, May, '97, the rock, is giving about .15% better than the average of the past year. While slight, this is a big gain for the Atlantic which makes much of little things. There is an excellent management of the affairs of the company in all of its branches of its business. The fact that it has paid dividends with rock of such low grade is sufficient guarantee that nothing is wasted.

There is constant deepening of the shafts and extension, of the drifts. The great tonnage secured is evidence of this. No. 1 shaft is now to the 17th level, having added one level since my last report. At this station they are enlarging the shaft so as to make room for two skips that can be operated in balance. The shaft, like all the rest at the mine, had room for only a single skip, and the need of additional hoisting facilities is apparent. There was room for a "dummy" that used to operate in connection with the skip, a counterbalance, and there has to be only two feet of cutting down-to-do in order .to make room for the second skip. No, 2 shaft has added a level, being to the 21st. No. 3 is sinking for the 27th level. It was to the 24th at the time of my last report. This is a new shaft, is in substantial ground, and has cost considerable to put down and equip. Much of the money earned the past year has been devoted to this improvement. The old No. 3 shaft is being fitted for a timber and man shaft. Timber will be sent through this avenue for Nos. 2, 3 and 4 shafts, and a man car will be used that will also be employed for the sending of timber into the mine. The car will be 17 feet long and will accommodate thirty men, and will also be used for carrying timber. It is desired to use the same car for both purposes in order to do away with the expense and time necessary to change from man car to skip. Mr. Stanton is working upon a plan for a car to serve this purpose and has his model nearly ready. The using of the old shaft for timber and men will be advantageous in that it will not interfere with rock hoisting at the principal working shafts, as at present. An engine at old No. 4 shaft has been changed to do the work in the timber shaft, being geared to run slowly and assuring safety to the miners who ride up and down. No. 4 shaft is to the 23d level, having added one within the year. At the new No. 3 shaft a combination shaft and rock house has been erected and supplied with two Blake rock crushers having openings 18"x24".

The enlarged shafts and the using of a new way for timber and men will result in a considerable increase in the product of the mine. With the present milling facilities there is insufficient rock to keep all the heads in commission. At the mill there are six heads which are capable of treating 200 tons each in 24 hours, an increase of 45 tons each as compared with the results achieved in the old mill. The new heads weigh five

pounds more than the old, 105 pounds, and the number of blows struck per minute is from 96 to 100 the average being 98. The number delivered by the old heads was from 92 to 94 per minute. Two of them have solid foundations.

They observe the same plan of winning the rock as described in my last report, putting in main drift which is timbered heavily for tram way, and then going above and overhand stoping letting the broken ground accumulate upon the timbers and giving miners chance to work upward to a point near the next level. Levels are opened every 85 feet. In taking the broken rock they go to the end of the drift farthest from the shaft and draw it down from the end always working back towards the shaft. This has taken the place of the old plan of putting in numerous mills through which the rock was funnelled down. The hanging being extremely rotten, they used to lose considerable rock, which is now avoided by the system employed The Atlantic has a long stretch of lode and has opened upon the latter about 4,800 feet, the present richest portion being 800 feet upon each side of No. 3 shaft.

During the year there was 227 feet of shaft sinking costing $20.09, net, per foot; 75 feet of winze costing $6.70 per foot, net; 5,189 feet of drifting costing $4.44 net; 18,482.5 fathoms of ground stoped at an expense, net, of $3.72 per fathom.

The construction account at mine amounted to $20,771,46; at mill $20,668.37; at railroad, $4,067.98. An addition was built to the compressor house at the mine, and a new 16½x30" Rand duplex compressor placed in commission. At the mill an electric lighting plant was installed, and two 150 horse-power boilers added, completing the plant as originally designed, eight boilers in all.

The company shows assets in the shape of cash, copper, supplies, merchandise and accounts receivable of $225,839.04 and liabilities amounting to $46,553.66, leaving a balance of assets of $179,285.38.

In summarizing the achievements at the mine and mill during the year the company presents the following:

Ground broken in opening and stopes	20,629	fathoms
Rock stamped	371,128	tons
Product of mineral	6,449,600	lbs
Product of refined copper	4,894,228	"
Yield of refined copper per cubic fathom of ground broken	237	"
Yield of rock treated, 13.19 per ton, or	0.66	%
Gross value of product, per ton of rock treated	$1.43	
Cost per ton of mining, selecting and breaking, and all surface expenses, including taxes	.7643	
Cost per ton of transportation to mill	.0496	
Cost per ton of stamping and separating	.2487	
Cost per ton of working expenses at mine	1.0626	
Cost per ton of freight, smelting and marketing product, including New York office expenses	.1747	
Cost per ton of running expenses	1.2373	
Total expenditure, including construction, per ton of rock treated	1.3599	

The Atlantic company is one that gives complete reports to its shareholders as well as one that devotes closest attention to economical features. It possesses an admirable location for its mill, the site being at Salmon Trout river where the water comes into the top of the mill by gravity. A large sum of money was expended in the construction of a dam so that nature's power might be utilized, and now that the work has been about completed they will reap the benefit of the wise selection of site and the money it has cost to build the mill. The mine looks as well as at any time in its history, and the slight gain in percentage of copper per ton or rock is gratifying. With the present price of copper the Atlantic can live and pay fair dividends to those who possess its shares.

Joseph E. Gay is president; John Stanton, secretary and treasurer, both of New York. F. McM Stanton, is agent; Wm S. Trethaway, mining captain; A. D. Edwards, cashier, Atlantic Mine, Michigan.

SIX-MILE HILL.

Six miles south and west of Houghton, upon the northwest quarter of the northwest quarter of section 21, town 54, range 34, on lands belonging to the St. Mary's Canal & Mineral Land company, an effort is now (May, 1897), being made to develop a copper mine by Capt. A. W. Dunn, a gentleman who has had a wide experience in the mineral fields of northern Michigan. Thirteen years ago, Capt. John Ryan put down several test pits and a shaft, (the latter to a depth of 90 feet), upon a wide belt of amygdaloid, the thickness of which is said to be 30 feet. One pit is now to be seen, and about its mouth there is considerable copper showing in the rock that was taken from the outcropping ledge, there being but a few feet of drift covering the lode at this point. The shaft is about 300 feet north of this pit. It was sunk at an angle of about 45°, and its course carried it out of the lode into the hanging, the vein being more upright. They drifted back at a depth of 90 feet, finding the copper-bearing rock again in about 15 feet. From the lode at this depth they took several tons of heavy copper which was placed at the mouth of the shaft. Much of the metal has been stolen, but there still remains many pieces of copper which attest to the fact that the lode was productive of barrel work in considerable quantity. No stamp rock is seen upon the old pile, but then little was done in the way of searching for it. The single shaft is the only exploration of any real value, and this was not sufficiently extensive to tell much about the value of the property. The work done should certainly have been encouraging to the continuance of operations. The amygdaloid is of a dark, brown color, looks healthy, and gives sufficient promise to warrant the expenditure of money in testing its richness in copper. There is enough of the latter lying about the mouth of the shaft to encourage developments. Capt. Dunn is placing machinery at the shaft, and will proceed to unwater the latter, sink and drift, and get some idea as to what the lode contains. There is a long stretch of territory here that would soon become alive with prospectors should the Six-Mile Hill prove satisfactory.

There has been considerable test pitting of the country between Houghton and this location, as well as for twenty miles beyond, but thorough exploration has probably been engaged in but little. It requires money to

open copper mines, more to equip them, and there are few who have cared to engage in the task. With the revival of the old mines before referred to, and with copper selling at between eleven and twelve cents per pound, there will be activity shown all along this copper-bearing range by men who believe the metal has a bright future for many years to come.

Further on the Winona and other properties have shown fine specimens of copper-holding rock, yet little has been done in the way of developing the veins. The time is coming, and it probably is not far off, when all this country will be receiving attention. There is a likelihood that many paying properties will be located, and instead of one active mine upon this side of the canal there will be many. The developments at the Six-Mile Hill will be eagerly watched, and its success will mean a general revival of exploration all along this range.

MINES OF HANCOCK.

Hancock, located upon the north shore of Portage river, is one of the thriving towns of the copper district, having been such for many years. Its location is directly across the river from Houghton, the two being connected by a new steel bridge. Of the properties that have made it possible for the continued prosperity

THE QUINCY MINE

takes the lead. It is the second important mine producing copper in this region in the amount of dividends paid, the total reaching the respectable figure of $9,070,000. Of this $1,000,000, was distributed during 1896 and an extra of $400,000 was paid in the spring of '97. Since April, 1896, the number of shares of the company has been increased from 50,000 to 100,000, 50,000 shares of script that were issued several years since, being converted into stock in April, 1897. This script was used in the purchase of adjoining mineral territory, stockholders being given a share of script entitling them to one share of stock, for $25, which was paid in four annual installments of $6.25 each. In addition to the lands of the Pewabic company there have been recently acquired the Pontiac and Mesnard properties occupying a position on the strike of the Quincy vein, being further north and east of their present developed territory. The Quincy Mining company has been alive to its future, and now holds lands that assures it activity for many years. There has been careful consideration of the interests of the shareholders, and the local management is one of the best to be found in Michigan. There is a common-sense way of doing things here, and both underground and upon surface there is an intelligent, enterprising and conservative direction of the affairs of the company that must be pleasing to those directly interested as well as to those who depend for a livelihood upon the successful operation of the property.

The company has expended, all told, in its task of opening and developing its territory, the erection of stamp mill, buildings, etc., $21,319,538.84, and has earned from the sale of copper, etc., $30,917,103.16. This was up to and including the year 1896. During the year the company produced 20,370,725 pounds of mineral, yielding 16,863,477 pounds of refined copper for which it obtained the gross sum of $1,842,117.19. In addition to this there was realized from the sale of silver, $22,080.42, making a total obtained from the product of the mine for the year of $1,864,197.61. The running expenses at the mine were $893,696.52, to which is added $214,872.62 for smelting, transportation and other charges, making the total expense $1,108,569.14, which left a mining profit of $755,628.47. The balance of assets January 1, '97, was $927,564.32. The summary for the years shows:

Average force employed	1,042	men
Number of miners	379	"
Average wages of miners per contract per month	$52.00	
Yield of mineral per fathom of ground broken	576	lbs
Yield of refined copper per fathom of ground broken	477	"
Total rock mined	637,113	tons
Total rock hoisted	577,024	"
Total stamp rock treated	555,543	"
Product, mineral from stamp mill	15,251,410	lbs
Product mineral from rock houses	5,119,315	"
Product refined copper	16,863,477	"

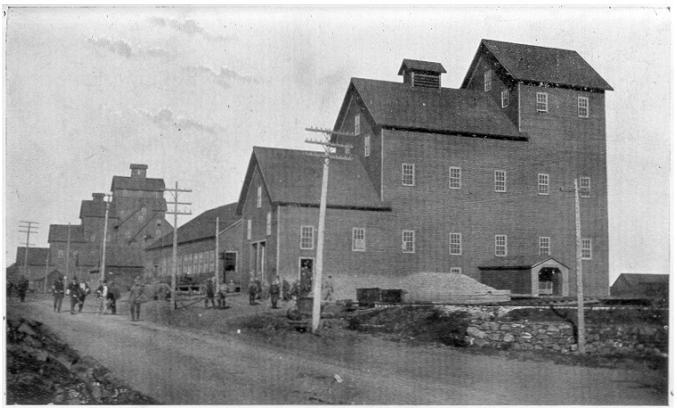
The product of refined copper was 558,756 pounds more than for the year previous, and the silver exceeded that secured in 1895 by $18,334.89. The reason for this large increase is found in the fact that certain grades of the copper contain silver in fine particles that cannot be extracted by hand, but which is obtained by electric process by eastern concerns. The copper is cast in sizes and shapes to suit the extractors of the silver, there having been several changes in the form of anodes cast by the Lake Superior Smelting company during the past year. Heretofore all the copper secured was by hand-picking in the stamp mill.

The Quincy has produced, since it first began business, 199,388,521 pounds of copper. At the present rate of production this would be obtained in less than a dozen years, and the Quincy has been mining since 1854, forty-three years. But its early days were not the scene of such improvements and activity as now noted. It was a competitor with the Huron located upon the opposite side of the river, and the credit for having accomplished the greatest results in a month was frequently shifted from one side of the river to the other. The advancement of the Quincy dates from the time that Capt. S. B. Harris took hold of the property. Since then the strides have been long ones, and the gain has been steady and satisfactory.

In my last report I wrote at length upon the characteristic of the Quincy lode, the manner of winning the rock, and the treatment of coarse and fine copper. A dozen years ago the daily output of rock from the mine was about 300 tons. During the past year there were stamped 555,543 tons.

There are three shafts following the incline of the vein, these being numbered, 4, 2 and 6. No. 4 is the most southern, No. 2 is 600 feet north of No. 4, and No. 6 is 1,900 feet north of No. 2. No. 2 is down 4,085 feet, measuring on the underlay, the lowest level opened

being the 39th. They are 30 feet below this, sinking for the 50th. During the year it was sunk from the 48th. No. 4 shaft is 4,073 feet deep, is 30 feet below the 49th level, having been sunk 30 feet below the 47th level during the year. No. 6 shaft is 3,920 feet deep, 30 feet below the 47th level and was sunk from 30 feet below the 45 level in the past year. The total depth of shaft sinking in the year was 587½ feet; of winzes, 634 7-10.



SHAFT AND ROCK HOUSES, QUINCY MINE, HANCOCK.

At No. 2 drifting was done upon the 45th, 46th, 47th, 48th and 49th levels north and at the 47th and 48th levels south. At No. 4 drifting was done at the 47th and 48th levels, connecting with similar levels from No, 2 shaft. From No. 4 shaft south drifting was done from the 42d to 48th levels, inclusive. At No. 6 drifting was done from the 40th to 47th levels inclusive, to the north of the shaft and at the 45th, 46th and 47th levels south. The total amount of drifting done during the year was 12,468 7-10. The longest level in the mine is the 42d which possesses a length of 5.350 feet, being about 18,000 feet south of No. 4 shaft and 1,300 feet north of No. 6. The 39th is extended farthest south, 2,285 feet south of No. 4 shaft. The most northern level is the 41st, it being in 1.485 feet north of No. 6 shaft.

During the year the principal stoping done at No. 4 shaft was distributed in the territory between the 28th and 48th levels north and south. Between the 10th and 28th levels there was considerable rock that was mostly low grade. This was from the north of the shaft. At No. 4 stoping was done at and between the 36th and 48th levels north and south and between the 18th and 20th levels south. At No. 6 shaft the most of the stoping was done upon the north between the 32d and 46th levels.

There is no prominent change in the lode. The latter is healthy as it has ever been, showing no diminution in the percentage of copper held as the mine increases in depth. As in all amygdaloids, there are stretches of barren ground, and the mineralized portion of the belt runs from a few feet to thirty feet in thickness. The percentage of copper obtained from the rock houses that does not go to the stamp mill, but is in masses of various sizes, was over 33 for the year. This is an advantage the company possesses, as the saving in transportation, stamping, etc is important. The masses run from a few pounds up to three hundred tons in weight. Steam hammers in the rock houses clean the rock from the copper with great rapidity, and the smaller masses are most profitable. In the handling of the large masses there is considerable expense attached in their cutting up in such sizes as permits of their being handled through the levels and shaft. Long-handled chisels are used, these being held in the manner of a drill by one miner while another strikes the other with a miners' hammer, the cutting of the narrow channel through the mass being both tedious and expensive. Nothing has yet been invented to improve upon the old style of mass cutting. The Quincy has used the diamond drill freely in the exploring of its ground, having bored, since they adopted this plan, over 54,443 feet of holes. The Quincy has two "runs" of copper-bearing ground of which the one they term their "East Branch," is in the footwall formation. This necessitates constant searching, as it is an easy matter to miss a chimney of pay ground in such immense stretches of lode as here exist. The amygdaloid belt is a very wide one, too, and only carries copper for a portion of its thickness, so that the drill has been a great assistance in proving where the rich and lean places are. No timbering is required in the mine, the walls being generally so firm that none is needed. In a few places where the vein makes wide, and where the dip is flattened, some support is needed, and is used, but the amount of timber employed is little. The shafts are now all using two skips holding six tons each, having been widened for the accommodation of the second skip. There is little water, this coming mostly from the upper portion of the mine. It is lifted to the adit level, the seventh.

The Quincy added no new machinery during the year. It is finely equipped and will need but little in this line for many years to come. A handsome mine office has been constructed, being of Lake Superior reds tone, and finely finished. It is a two-story building, 45x56 feet, and is the most complete as well as handsomest mine office in the Lake Superior region.

At the stamp mill there has been no change in the plant. The five heads have been running almost constantly and the amount of rock stamped by each head in twenty-four hours, actual running time, during the year was 385 tons 403 pounds. This is certainly a wonderful result, and shows great efficiency per head per day. It also suggests that the plant is of the best and is well handled.

There is no doubt but that the Quincy will continue to increase its production for many years to come. It is constantly opening up new ground upon the trend of the lode so that it has greater territory to secure a product from; it has valuable possessions yet untouched; it has excellent reserves in the mine insuring regularity of output; and it has a competent and business-like management. The mine is growing deeper steadily, yet 4,000 feet, measured with the dip of 50° is not so far down as are other mines in this region. The Tamarack is working at a vertical depth of 4,450 feet the Calumet & Hecla at 4,900, and shafts at the latter property, on the underlay, are to the 56th level. When we compare the

Quincy with these it will be seen that it has but fairly commenced going downward.

The main offices of the company are at Boston, Massachusetts. Thos. F. Mason, president; William R. Todd, secretary and treasurer. At the mine S. B. Harris is agent; Thos. Wittle, mining captain: John L. Harris, mining engineer; E. D. Johnson, clerk.

THE FRANKLIN MINE

lies next north of the Quincy. It has been an active producer since 1857, and has yielded a total of 111,499,184 pounds of mineral, giving 90,544,069 pounds of refined copper. It is a well known fact that the Franklin has reached its limits in so far as depth is concerned, it having worked up to the Quincy mine boundary, and because of this many people have expected the abandonment of the property at an early day. This looked-for closing down has been talked of for the past five years, yet the mine still continues to keep active and to send copper to market. While bottom has been reached at 3,000 feet, there has been considerable exploring done in the upper levels long ago passed by, but which are found to contain copper rock that will pay for the mining and milling. They have obtained a neat product from territory long since given up as unproductive of copper, and the excellent skill of Graham Pope, the agent, is seen in the aggresive way in which the former workings have been entered and opened up. There is every reason for believing that the old Franklin will be producing copper for many years to come. For 1896 the product of refined copper fell 290,857 pounds below that of the year previous, which shortage is accounted for in the suspension of mining operations throughout the entire month of January, when the replacing of the old plant of machinery which had been destroyed by fire, was in progress. The results, barring this stoppage, was about equal to the accomplishment of the previous year. There are two shafts that are in excellent shape. The Franklin certainly “dies hard.” It is good for many years to come, and will assist in furnishing the means for prospecting and developing lands owned in the immediate vicinity by the company.

During the year the amount; of mineral produced was 3,367,218, which yielded 81.553% refined copper, or 2,746,076 pounds.

The amount of rock hoisted during the year was 135,156 tons. The total amount of rock stamped was 122,079. Pounds of mineral per ton of rock stamped, 27.58. Per cent of mineral in ton of rock stamped, 1.379. The amount of mass and barrel work for the year was 961,930 pounds.

After deducting all expenses of mining, milling, transportation, exploring, construction, etc., for the year there was a mining profit of $20,658.29. The surplus, at the end of the year, was $153.487.45.

The Franklin stamp mill is the only one located on the river dividing Hancock and Houghton, all others having been removed because of the fact that the stamp sand was interfering with navigation. The United States government still permits the Franklin to run, and it probably can find room for its sand for many years to come. The rock is conveyed from the shafts to the mill by gravity, there being a fall of several hundred feet between mine and mill. The mine has a capacity of about 500 tons daily.

THE FRANKLIN JUNIOR

is located northeast of the Franklin mine. It is the property of the Franklin Mining company, 1,359 acres having been purchased by them in 1894. The lands are located in sections 7, 8 and 9, 55-34. This property was formerly known as the Albany & Boston, and later as the Peninsula. Much money had been expended by various organizations in trying to find a mine, but without success. Its excellent neighbors lent sufficient encouragement, and an extension of the paying lodes npon adjoining territory were sought, but unsuccessfully. The Franklin Junior lands contain all the prominent copper-bearing lodes of this region. The Pewabic, upon which the Franklin and Quincy are wrought, is the most westerly. Next going east is the Allouez conglomerate, distant 475 feet; then the Calumet conglomerate 1,420 feet east of the Allouez. From the Allouez 605 feet in the Osceola amygdaloid, and still further east of the latter 646 feet is the Kearsarge conglomerate.

It was upon the Allouez conglomerate that the Peninsula company did considerable work, finding encouraging indications at many points but not sufficient copper to pay. The Franklin company has been conducting explorations energetically here to test all the veins ever since securing possession of the lands. The Junior is included in the Franklin mine organization, and is not an independent one as has sometimes been said. A shaft was sunk 156 feet to test the Osceola amygdaloid. It showed some copper, and they drifted upon it from the bottom of the shaft 90 feet, and sunk a winze 50 feet. Heavy copper was met with, but there was not enough stamp rock to please, and they have suspended the work here until more promising territory now being proved is fully explored. They have not given up hope that the Kearsarge lode is valuable and deserving more attention.

In my last report I stated that a crosscut was being driven to find the Calumet conglomerate and other veins. The Calumet lode was struck and they drifted upon it for 90 feet, but nothing of value was found. Several crosscuts were put in to test the vein. The crosscut was also continued to the Osceola amygdaloid, and they drifted upon the vein 360 feet, testing the lode with numerous crosscuts, but finding nothing that would suggest pay ground. The work of driving the long crosscut was stopped in June and resumed in November. It is now in over 2,600 feet.

In May they commenced the sinking of a shaft to test the Kearsarge amygdaloid. They sunk a vertical shaft 77 feet from the bottom of which a crosscut encountered the lode in a distance of 223 feet. An inclined shaft, following- the lode, was started and is down 90 feet, finding but little copper. It is enough to prove that the lode is productive to a certain degree, and at some other point it may prove remunerative. They are driving a crosscut westerly which is now in about 350 feet.

It is at the Pewabic lode where the greatest activity has been noted and where the most reason for activity is warranted by the showing of copper. At this writing, May, '97, they have one shaft down 750 feet, 50 feet below the seventh level and have started a second. No. 1 shaft has made steady improvement in the showing of coppery ground since it was struck. At the 4th level they have drifted 300 feet each side of the shaft, the lode here having a thickness of from 6 to 7 feet, and is strong in copper. At the 5th level drifting has been carried for 500 feet each side of the shaft, and for the most part shows satisfactory copper ground, in places very rich. At the 6th level they have drifted north 300 feet, the ground being fully as good as upon the level above. A trial stope shows the lode to be 12 feet wide and strong in copper. At the 7th level they have drifted 100 feet south of the shaft, the copper is heavier than found above this point and the showing is very encouraging. The shaft, below the 7th improves steadily, and is richer in copper than at any point above. From the 4th level 600 tons of rock were taken which were sent to the mill. This test gave 1 71-100% mineral, equal to 1 4-10 refined copper, which was certainly pleasing to the management and shareholders.

No. 2 shaft was started in May, '97. It is in the lode, and is 1,050 feet south of No. 1. Work on both shafts will be carried on actively, it being the intention of the management to secure the addition of copper rock from this end of the property so that the stamps may be kept going to their fullest capacity. A contract has been let for the construction of a spur railway track from the location to a point where the main county road crosses the company's property. The management is satisfied they have shown up enough to warrant the additional shaft as well as for all else that will be required in opening up and developing a big mine.

As there was some question about this work being done upon the Pewabic lode, a crosscut was put in from the fifth level west at a right angle to the lode. It encountered nothing that would give any other than the impression that this was the Pewabic. A crosscut was put in 54 feet east, finding-nothing to change their opinion. Measurements upon surface also were made, so that Mr. Pope can say to the wise ones who think he is geologically lost that he is sure of his ground.

The finding of such rich ground at this location is a fortunate thing for the company. Should it continue to improve as it has in the past few months it will not be long ere the Junior will be sending a large amount of rock to the mill. There is a stretch of territory 7,000 feet long upon the strike of the lode, and they can follow the latter down ward 10,000 feet before leaving their boundaries. The lode at this point has a dip of about 52°. Mr. Pope deserves much praise for his persistency in his efforts at the Junior. He has had both faith and skill, and his judgment has been excellent in all that has been projected and carried out under his direction. Should the new mine result in developing into what it is confidently expected of it, there will be need of a considerable expenditure in the way of machinery, mill improvement, etc. During the year 1896 $64,835.24 were spent at the Franklin Junior, which was paid out of the company's surplus, this leaving a net surplus at that time of $153,487.45.

The main offices of the company are located at Boston, Massachusetts. D. L. Demon is treasurer and acting director, Boston; Graham Pope, agent, Houghton; Thos. Dennis, chief mining captain; Arno Jaehnig, chief clerk.

Aside from the properties mentioned there are none others working in the vicinity of Hancock upon this shore of Portage Lake. Should the lands to the northeast of the Franklin prove as valuable in copper as present indications warrant there will be additions of value. There is an extensive tract of territory here yet to be explored, and if the Franklin Junior succeeds it will be an incentive to the renewal of operations at other points upon the strike of the mineral-bearing lodes.

MINES OF CALUMET.

Calumet, with its neighbor Red Jacket, the two places being practically one, is the most flourishing of any in the mining districts of Michigan. One can go further and say it is the liveliest mining town in the United States. It has been remarkably successful, because of the large number of wage earners here constantly employed and whose monthly earnings are paid promptly each month. One sees steady growth of the towns, buildings being constantly increased in number, highways extended, improvements of modern kind supplied, and the whole giving evidence of substantial increase and thrift. Of the mines that go to make up this prosperous condition

THE CALUMET & HECLA

takes prominence as the biggest and best. It is the exception to all other mines in the copper district of Michigan. It lode is richest, its extent of copper-bearing vein the greatest. Where others have had to economize and plan with their utmost skill to keep alive, the Calumet & Hecla has gone on unruffled. Its undertakings have been of wonderful kind in the way of equipments of machinery. Its experimentings have been constant and valuable to others as itself, and the cost has been no drawback to the desire of the management to test the many plans that have been suggested in the improvement of things above or below surface. There has been the copper to pay for it all, and despite the liberal expenditure the shareholder has not been forgotten. He has received a fair interest upon the

money he invested whether he purchased stock at $6 or $395 per share. There has been much fault-finding by the shareholders because of the large amount of money put into the mine's equipment, and in what is generally referred to as "wasteful expenditure," but the Calumet & Hecla must do things upon a large scale in order to carry on the work of mining and milling and smelting as a big property demands. They are looking ten thousand feet ahead in the following of their vein, and they desire machinery that will lift the rock from such depths. They should, and do, carry on their work in a measure commensurate with their natural advantages, and the people who comprise the population of Calumet have no reason to complain thereat. The company has been an excellent employer, has been liberal in its treatment of men, and the merchant has felt the good effects of this in his trade. The rents are ridicuously low, there are no charges for water; this year. 1897, there are no charges for doctor, no mine club dues. A fine new public library is under way for the people to use at will; a manual training school has been commenced, and the advantages that the company has extended to the community are many and valuable. It is a big concern, but not a grasping, grinding one. It is one of the corporations possessing a soul, and its acts prove it.

The Calumet, in all the years it has been doing business here, has confined its operations to the Calumet conglomerate, of which it owns about two miles in length the greater portion being rich in copper. It has been said that the conglomerate ceases to be valuable as a copper holder north and south of its boundary section lines, but an attempt is again being made to prove the statement incorrect. The belt of conglomerate has been a wonderful one upon the lands of the Calumet & Hecla company. In its two miles of territory twelve shafts following the incline of the lode have been sunk, and one vertical shaft has entered the lode in its downward inclination of 38° at a depth 3,287 feet. This belt of conglomerate upon the lands of the Calumet & Hecla company has produced 1,092,391,551 pounds of copper since first opened by the company, the product of refined copper for the past five years. (ending the 30th of April of each year), being as follows:

YEAR.	POUNDS.
1892	56,495,211
1883	60,427,913
1894	73,944,889
1895	79,485,509
1896	85,552,756

This shows a steady annual increase in product, and the gain is one that can be kept up in similar ratio for some years to come. During the time the company has been in business it has paid in dividends $49,350,000, $2,500,000 having been paid in 1896, and thus far in 1897 it has paid, or declared for payment, $2,500,000. Its stock reached its highest point in the spring of '97, the quotation being $395.00 per share, giving the property a value of $39,500,000, it possessing 100,000 shares. Its surplus amounts to several millions. This is in wonderful contrast to the time when its 50,000 shares were being sold for $6.00 each, and so-called "experts" were claiming that the conglomerate vein could not hold copper in paying quantity.

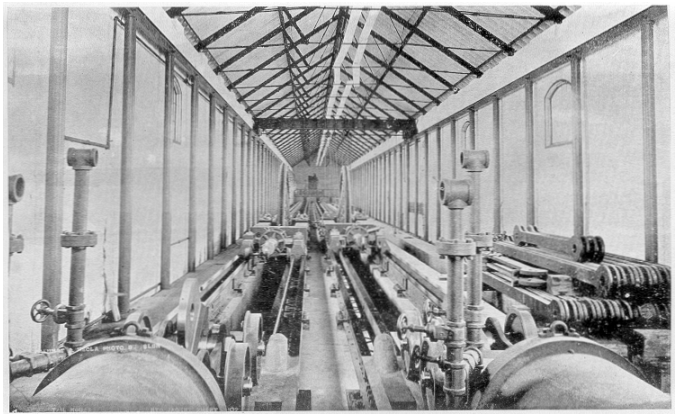
Beginning at the northmost shaft of the company in its operations upon the conglomerate is No. 5 shaft, Calumet branch, which is two-compartment, and is to the 52d level. No sinking was done here during the year, as there is an abundance of ground opened above that level and not yet stoped. It has its own shaft and rock house, as have all the shafts of the company, and it is also one of the shafts through which men are lowered into and taken out of the mine.

No. 4 shaft next in order at the Calumet branch, is to the 55th level, and is the deepest of the inclined shafts. No sinking was done here during the year for the reason that additional stoping ground was not needed. At this station men are also sent into the mine, there being a man car for their accommodation. These stations where men are lowered and raised have special engines for that purpose so that the liability to accident is reduced to a minimum.

No. 2 shaft, Calumet branch, is next in order going south. It is a two-compartment shaft and is sunk to the 46th level, no new levels having been added since my last report for the reasons assigned in the case of the shafts to the north.

Next comes the Hecla branch where No. 2 shaft, the first met, is to the 42d level where it was a year ago.

No. 3 Hecla, a single-skip shaft, is to the 39th level, no sinking having been done during the year.



TAIL HOUSE, RED JACKET SHAFT, CALUMET & HECLA.

No. 4 Hecla is a shallow shaft, to the 9th level, the ground at this particular point not having been promising in copper. It is a single-compartment shaft, and was re-built during the year, and equipped with hoisting engine to assist in exploring the territory adjacent to the conglomerate from the bottom of the shaft east. This makes a convenient point from which to do the work and does not interfere with regular mining.

No. 6 Hecla comes next. It is a single-skip shaft to the 44th level, having been sunk from the 41st level since my last report.

No. 7, Hecla, a single-skip shaft was deepened by three levels during the year, being now to the 44th.

The South Hecla shafts are next. No. 8 being first in order going south. It is a man car station, and added six levels in the past year, being now to the 40th.

Nos. 9 and 10 are two shafts in one and have been sunk five levels during the year, now reaching the 31st.

No. 11 South Hecla is to the 24th level, is single-skip, and may be sunk deeper in the near future if ground to south comes in well in the next shaft south. No sinking has been done here for some time.

No. 12, South Hecla, is to the 40th level, five levels having been added during the year. The shaft has accommodation for one skip.

By the above it will be seen that the sinking has been in the north end of the mine the past year. The most southernmost shaft has shown excellent ground, and there is chance for an improvement, at greater depth all through this territory, which was not always encouraging in the upper levels. The showing of rich copper is excellent generally throughout the mine, the property never looking better than at the present time. There are immense reserves of fine stoping territory which assure a steady and large output of copper for many years to come.

The system employed in winning the rock was fully described in my last report. Blocks of ground 150 feet long are left as shaft pillars, drifts are put in, enlarged by cutting-out stopes, upraises made and the ground beaten back from the end of the drift to the shaft pillar. The hanging is very treacherous, requiring close attention in barring and timbering. The timber used is square pine, 12x12". Batteries consisting of three pieces form the base of the support and to these interlocked timber is plentifully used for two-thirds of the distance up the level, when a line of heavy round-timber stulls are used, being set closely together, with spaces left at intervals for the rock to come down between. The square timber is treated to a coating of zinc chloride and whitewash to prevent accidental fires. The engravings made from flash light photographs, herewith presented, give an idea of the plan of timbering. In places they can cut out sufficient ground to give room for three sets of timber before having to insert the latter, and often they cannot open any more than enough to permit of a single set before putting in the support to the hanging. The vein has an average width of 16 feet, being wider in some places and narrower in others. Small portable hoists are used for pulling the round timber up into the stopes, and similar engines do the tramming of rock through the levels to the shaft.

It needs but a glance to show that these twelve shafts tie up considerable ground that will be available in years to come. At each shaft is a block of conglomerate 150 feet long on the strike of the mine, this giving, for the dozen shafts, 1,800 feet. Continuing this to a depth of from 5,000 to 10,000 feet and computing the thickness of the lode, 16 feet, it will be seen that the Calumet & Hecla will have a neat little mine even after bottom has been reached.

The shaft and rock houses are all of the same pattern, frame, sheathed with corrugated iron. In each there is a 24x36" rock breaker upon the upper floor and a 17x24" upon the next lower floor. Westinghouse engines, 60 horse-power drive the breakers. Cars are run directly under the rock bins, the latter having place upon each side of the rock house so that two cars may be loaded at a time, there being a double track under each, building. The machinery providing power to operate the shafts is of the finest to be found anywhere. The most prominent plants are:

At the Red Jacket shaft 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 10-inch plungers.

At the shafts of the Hecla branch is the compound engine Fontenac, 24¾ 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 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.

The buildings containing these plants are of stone, are substantial, roomy, well lighted and ventilated.

The Calumet & Hecla has credit for possessing the deepest shaft to be found in the world. This is its "Red Jacket shaft," located several thousand feet in front of its No, 4 Calumet shaft. This, shaft, which is six-compartment, and 12½x25' inside of timbers, is 4,900 feet from top to bottom, is vertical, and encountered the Calumet conglomerate lode at a depth from collar of shaft of 3,287 feet. At this shaft a magnificent shaft house of steel has been erected, being completed in the spring of '97. The different compartments have been supplied with stringers, a no inconsiderable task, as it required 58,800 feet, over ten miles, of them to cover the entire distance. The hoist at this shaft is new to Lake Superior mines. The engines drive direct on a small grooved drum, which is connected to a similar drum in front. The front drum is set at a slight angle to the horizontal, so that the rope may lead straight to the proper groove of the other drum, and cause no chafing. The rope, after several turns around both drums, leads back behind the hoisting engine and around an anchorage grooved pulley fixed on a tension carriage which runs upon a trail track, and is adjustable as to distance from a hoist by steam winch. This tension carriage controls, by its position, the depth from which

hoisting is to take place from time to time. It is fitted with grips which clamp the carriage to the rails while hoisting is in progress and which are released when new adjustment of the depth of hoisting is desired. Any stretching of the rope can be immediately remedied by the tension carriage adjustment. The tail house provided for this shaft is 412x32', ample room for the fleet gear being provided. The main engine house is 220x70'. With this hoisting arrangement a load of ten tons can be lifted through the shaft at a speed of 60 feet per second. The boiler house will have ten boilers of 1,000 horse-power each. The smoke stack is 250 feet high, with an inside bore of 12½ feet. This shaft will be an important one in providing another exit from the mine in case of lire, and it was largely for such purpose that it was sunk, although there will be considerable mining done from it. and a big product secured from territory tributary to it. It is connected with No. 4 shaft, Calumet, at the 36th, 39th and 42d levels, this giving excellent ventilation.

The rock temperature at the bottom of the Red Jacket shaft. 4,900 feet underground, is 87.6° Fahrenheit. Careful tests are being made of the temperature of the conglomerate lode from surface to the deepest point attained at No. 4 shaft. The result of this interesting experimenting will be announced as soon as completed by Prof. Alexander Agassiz, under whose direction the tests are being made. The atmospherical condition at the bottom of the deep shafts upon the Calumet conglomerate, as well as at other deep mines in this region, is the source of considerable surprise to mining men of the west and in foreign countries where similar depths could not be reached on account of the heat. Some offer explanation in the statement that the rock strata, dipping beneath Lake Superior, is cooled by the water of the latter, the rock being an excellent conductor. The collar of the Red Jacket shaft is 601.75 feet above the level of the lake. The datum line is one secured from the mean height of the sea, lines having been taken at the sea, thence along the Hudson river find the Great Lakes, bench marks having been established so that the readings can be readily made. Preston C. F. West, the mining engineer, has completed a very thorough and systematic map showing the elevations at different portions of the mine above sea and lake levels. Besides points established at the main engine house, they have others upon the three tall chimneys and water tower so that in case of the loss of one another can be readily had.

A work that has been under way, but just now suspended, at the Red Jacket shaft is the driving of two crosscuts towards the western boundary of the company's property and towards the Tamarack new No. 5 shaft. One of these crosscuts is being put in from the 78th level, the other from the 81st level, and they are in about 2,150 feet. The distance, at right angles to the strike of the mine, to the Tamarack company's line is 2,300 feet. As soon as the shaft is in shape for hoisting they will resume this exploratory work. The lode where pierced by the deep shaft is very rich in copper, and it is very probable that the crosscut to tap it upon a greater depth will find it full of copper, as this copper course has been very regular and strong in mineral for a great distance in No. 4 shaft.

In my last report I made mention of the fact that the Calumet & Hecla company were doing something in the way of testing the Osceola amygdaloid, lying from 700 to 800 feet of the conglomerate upon which their shafts are located. At No. 4 shaft, Calumet, 21st level; the 31st, at No. 2 Calumet; the 9th level, of No. 7, Hecla, and the 14th level, of No. 11, South Hecla, crosscuts were put in to the amygdaloid. They did considerable drifting upon the vein, crosscutted in many places, the most promising ground for copper being found in the crosscut from No. 11 shaft, where the amygdaloid was struck in a distance of 773 feet. The explorations underground decided the company to put down three shafts upon the lode, following the latter from surface. This work has just been commenced in May, '97, No. 13 shaft is 270 feet north of the Osceola, mine northern boundary, measured upon the strike of the mine. No, 14 is 2,800 feet north of No. 13, and No. 15 is 2,350 feet north of No. 14. All of the shafts, which are now fairly into the lode show copper, and the task of sinking is being vigorously pushed. In preparing for this work but one of the company's residence buildings had to be removed.

The little thus far done upon the Osceola amygdaloid where it crosses the Calumet & Hecla Mining company's property has shown enough of copper to lend the hope that an entirely new mine will be developed upon this vein. The latter extends across the lands of the Calumet & Hecla, and should it prove as productive as where the Osceola has been working upon it, then a great gain will-have been made to the company as well as to the people of the town in which it is located. The new shafts are big enough for two skip roads, and are following the lode. Should these shafts find copper in sufficient quantity to pay for its mining and treatment, other shafts will undoubtedly be started. The work is a very important one and will be watched with great interest by the many who are concerned directly and indirectly. Its success would mean much.

The Calumet & Hecla location is a model of neatness. It has excellent drainage, water obtained from Lake Superior, fine streets, and everything is well kept up.

Thos. Hoatson, the chief mining captain, has been in the employ of the company 26 years. Capt. Jas. W. Milligan, his assistant, has been here 24 years. Under them Capt. Thos. Hoatson: Jr., has charge of underground affairs at the Calumet branch; Capt. Thos. Wells, of the Hecla branch; Capt. Wm. Stephens, at the South Hecla branch, and Capt. Jas. Hoatson at the Osceola shafts. James Ramsey has charge of the machinery, and in his capacity as master mechanic has much to do. The company is erecting forty new buildings for its employes. These are of neat appearance, commodious, and are rented at less than three per cent. of their cost.

At the stamp mills of the company there have been no changes during the year, the equipment being ample to treat the immense rock output of the mine. There are 24 Leavitt heads in the two mills, these having a capacity of 250 tons each in 24 hours. The engine raising the water for the stamps has a capacity of sixty million gallons in 24 hours, besides which several auxiliary engines are ready in case of accident to the big one. Two artesian wells supply pure water for the boilers and other purposes. F. G. Coggin is superintendent.

Two new locomotives have been added to the company's equipment of rolling stock, making eleven in all. There are four hundred rock cars.

At the smelting works no change is to be noted. Mr. James B. Cooper is in charge and gives excellent direction to everything in his department. During their fiscal year 34,569,830 pounds of refined copper were smelted here and 50,982,926 at the company's smelters in Buffalo, N. Y. About 4,200 men are employed.

At the close of their fiscal year, April 30, '96, the company had a balance in the treasury amounting to $6,045,744.53.

The main offices are at Boston, Massachusetts. Alexander Agassiz is president; George A. Flagg, treasurer. At the mine S. B. Whiting is general manager; S. D. Warriner, superintendent; John Duncan, assistant superintendent; Preston C. F. West, mining engineer; J. H. Lathrop, chief clerk.

SHOWING TIMBERING IN CALUMET & HECLA COPPER MINE.

THE TAMARACK MINE

is the second important one whose operations are practically confined to working upon the Calumet conglomerate, it taking up the mining of the lode where the Calumet leaves off. Its property is immediately west of the Calumet & Hecla. The latter's shafts are in the outcropping of the lode, following the latter down in its inclination to the northwest at an angle of about 38°, and this necessitates deep shafts by the Tamarack Mining company before the vein is reached upon their lands. The task of piercing the lode has been one of extraordinary kind. It has taken courage, time and money. Years were consumed in putting down the initial shaft, and the final reaching of the conglomerate was an achievement heralded far and wide. It was looked upon as one of the mining wonders of the day, which in reality it was. The pleasant thing in the reaching of the desired goal for the company was that the conglomerate was well charged with copper. That first shaft was near the southeast corner of the company's property and has been a prominent producer, but has reached the limits of its territory, the Calumet & Hecla possessing the land upon three sides of it. Since this shaft struck the lode three others have also been sunk to it and another has been well started. The sinking of these shafts has been a great work, and with their equipping for the conducting of mining, has taken an immense amount of money. For the enormous outlay, there has been some return, however, the company having paid to its shareholders $5,010,000 in dividends. Its total product of refined copper amounts to 137,041,961 pounds, so, that the Tamarack company has been doing considerable business and giving substantial returns for the money consumed in putting it Into shape for mining work. The Tamarack can be said to be yet in its infancy. It has a great territory on the strike of the lode as well as upon its dip, and in the latter direction can go as far as atmospherical conditions will permit.

For the past two years the Tamarack has been unfortunate in having encountered poor rock. it is not an unusual occurrence in the conglomerate. The Calumet & Hecla people have many long stretches of unprofitable lode and the Tamarack has been working in one that closely approaches this for about two years past. They have seen fit to take the lean rock, rather than leave it. There is a small profit in its treatment and it was wisely concluded to take it all, which has been done. The ground between the 12th and 21st levels has been generally low grade, the percentage of mineral contained, being about 2.42%, whereas in 1890 it yielded 3.87%, and the least for any year up to 1893 was 3.18 %. This plainly tells the story of decreased earnings. It was due to natural conditions which could not be changed. The present finds a great improvement, underground, however, the gain in percentage of mineral being about .15%, which is important.

For 1896 the amount of line copper produced was 16,045,039 pounds, this being a gain over the year previous of 1,144,723 pounds.

No. 1 shaft is to the 18th level, 3,232.9 feet deep. It will be sunk no deeper, being to the boundary of the property.

No. 2 shaft, 600 feet north of No. 1, is 3,649 feet deep, and is the present principal producer. It is showing well in rich copper ground, and a great improvement is noticed in the lowest levels over those of a year ago. It looks as if the company had gotten through its low-grade territory and had entered one of promising kind. The

lode is wide and well charged with copper. This shaft, like all others upon the property, is vertical. It has two cage ways and a timber and man way.

No. 3 shaft, 4,200 feet north of No. 2, is 4,450 feet deep, to the 12th level. There has been much attention given this shaft by the mining and copper-speculating people: Its great distance from No. 2 as well as the great depth it had to go before piercing the lode, gave rise to much talk as to the probable outcome of the undertaking. When the lode was finally encountered at a depth from surface of 4,185 feet, it proved to be poor. This was a sad blow to those whose hopes had been built upon the finding of the vein well charged with copper. The effect upon the company's shares as upon many shareholders was depressing. Coupled with the lean ground being-found in the southern end of the mine it was truly discouraging. No. 4 shaft, 700 feet still further north of No. 3, also reached the lode and found it entirely barren of copper, and the croakers had much to talk about, and lost no opportunity to give their opinions as to how the work should have or should not have been done. Capt. Parnal was too old a miner to be discouraged by such disappointment, however. He understood the characteristics of the lode, knew there was some lean with the fat, and began forthwith looking for something better than the bottom of No. 3 held. Drifts were started north and south from the shaft, and at this writing, May, '97, No. 3 is furnishing about two-fifths of the rock being sent to the mill. They are stoping from the 4th to the 11th levels south of the shaft, and the lode is improving steadily as they go in upon it. There has been a wonderful change for the better in a very short distance south of the shaft, and No. 3 will soon be the most important producer of the mine. The lode here is very wide, running above 20 feet at many points, and requiring very long timber to properly protect, the hanging wall here, as in all conglomerates of this section, needing support to prevent its falling. All of the drifts going south are in excellent ground, and the mine is producing more copper today than at any past time in its history. On the 12th a level is being driven north on the foot side of lode to connect with No. 4. This is in 150 feet and shows patches of ground containing copper, "splatty" spots that are certainly better than no copper at all.

No. 4 is to the same depth as No. 3, but has not shown much in the way of copper as yet. Upon the 12th level south, they are driving a drift, are in 75 feet, and three or four feet of lode upon the hanging side shows copper all the way, this being a marked improvement over anything yet struck at this shaft. They began drifting upon the hanging side, but finding this barren of copper changed to the foot where they are encouraged by the showing thas for made. Increased depth will probably find pay ground here as it has at most of the shafts sunk upon the conglomerate. They were unfortunate in piercing the lode at points where it contained but little or no copper, but that copper will be found at No. 4 is believed by the management that has had the best opportunity of studying the lode.

The new shaft, No. 5, located 3,300 feet north of No. 4 is going downward at a rate of about 100 feet per month, and is now 1,430 feet from the collar. This shaft is to go to a depth of 5,000 feet, so that its completion will not be reached for some time in the future. They have arranged for a hoisting plant, the latter to be built by the Norberg Manufacturing company, of Milwaukee. There will be four engines, set at an incline, and so arranged that there will be no possibility of their centreing so as to interfere with constant operation. The manufacturers claim excellent results from this type of engine, particularly when a heavy load has to be started and raised at a rapid rate. The drum will be double, cone-shaped, 18 feet at end, 25 feet at middle, of latest model, and the responsibility for satisfactory operation of the plant will be assumed wholly by the manufacturers, who guarantee perfect and efficient service. It will be the first plant of this kind introduced in the copper district of this state. It will raise five-ton skips. Two compartments will be first equipped. By the time the new plant is in position it will be needed, as the greater depth in the shaft will soon get behind the capacity of the present inexpensive hoist that was introduced to keep the sinkers busy until a better could be procured.

No. 5 is one of the most interesting of the several shafts of this company. Should it find rich lode where it pierces the latter it will be a great thing for the company, and the chances certainly favor a rich lode. The new shaft is directed towards the same copper course that has been followed in No. 4 Calumet mine, and is a continuation of the lode cut by the deep Red Jacket shaft of the Calumet & Hecla. At these points the lode has been exceptionally rich, the percentage of copper being as high as anywhere found in the mine. It is almost certain that the No. 5 shaft will find it equally as rich as it has been proved higher up on the vein, and if this occurs then Tamarack is going to awaken new interest in the copper world. The crosscuts from the 78th and 81st levels of the Calumet's Red Jacket shaft which has been started towards the No. 5 Tamarack will be of value to the Tamarack company when completed, as it will show what the lode contains but a short distance from the new shaft. The chances favor rich copper ground.

The Tamarack Mining company also possesses upon its lands the Osceola amygdaloid, and have been doing more or less exploring of it from time to time. In my last report I spoke of crosscuts to the lode from their Nos. 1 and 2 shafts at the 14th and 18th levels. Since then they have crosscutted to the amygdaloid from the 11th, 12th and 13th levels from No. 1 shaft. They find occasional bunches of copper and some promising stretches of lode, but as yet it is not an important addition. As an exploration it has been worthy of attention, but the amount of work thus far done has hardly been sufficient to prove the value of the amygdaloid at this point it its downward course. There is chance for striking rich ground, however, and as the lode traverses the entire length of the company's lands they will probably test it at points further north.

During the year the company hoisted from its conglomerate vein 575,960 tons of rock, of which amount 42,219 tons were from crosscuts and winzes, the balance being broken from the lode. Of the total tons raised 490,625 tons were stamped. The total cost per ton of rock stamped was $2.28 and of the rock mined $1.94.

The opening work for the year was: 91.5 feet of sinking at No. 2 shaft; 846 feet at No. 5; 1,065 feet of winzes; 7,154.1 feet drifts on the conglomerate; 671.5 drifting on the Osceola amygdaloid; 2,105 feet crosscuts drifted, making a total opening of 11,933.1 feet.

The running expenses at the mine, and the smelting, transportation and other charges amounted to $1,377,491.71 and the receipts from the sale of copper were $1,746,188.36, leaving a mining profit of $368,696.75. The balance of assets, less the dividends paid during the year and construction account at No. 5 shaft, was $783,304.77.

An important addition to the company's property is a new stamp mill. This was begun last July, and is now, May, '97, completed and in operation. It is a steel structure, located directly across the street from the old mill, and has been supplied with two 20-inch cylinder heads of the Ball type. This mill, with the two stamps, has a capacity of 600 tons per day. As vet there is not sufficient rock from the Tamarack to keep both mills running-the new mill being run on Tamarack rock three days in the week, the balance of the time treating rock from the Tamarack Junior and other mines. The record of the old mill the past year was an excellent one, the average amount of rock stamped per head per day being 290 tons. The company possesses one of the finest mills on the lakes, and has competent men in charge.

The new coal dock near Dollar bay has been finished. The building is of steel 480x175'. Eleven railway tracks run through it. Arrangements for the rapid unloading of vessels have been perfected, and the loading of cars from the house is done by steam shovel.

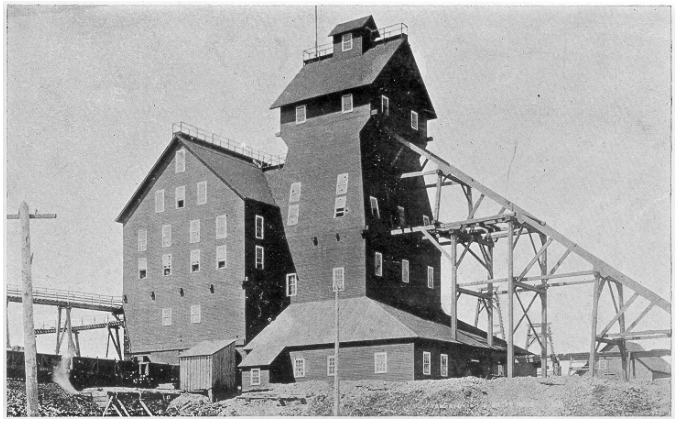
The Tamarack is now in excellent shape for future operation. With its No. 5 shaft down it will give to the shareholder something substantial for his investment. The company's affairs at the mine are admirably handled, nothing is wasted, and the best of care is given all departments. About 1,500 men are employed in mine and mill.

A dividend of $3.00 per share has been declared, the first for 1897. There are now 60,000 shares.

The main offices of the company, are in Boston, Massachusetts. A. S. Bigelow is president; Thos. Nelson, secretary, and treasurer. At the mine Wm. E. Parnall is superintendent; John T. Rider, clerk; R. M. Edwards, mining engineer; Thos. Maslin, chief mining captain.

THE TAMARACK JUNIOR MINE.

This property occupies three forties, lying north and south, and described as the E ½ of S E ¼ and the S E ¼ of the N E ¼ of section 11, 56-33. Two shafts were sunk to the lode, these reaching the latter in 1890 and '92 at a depth of about 2,450 feet. The Calumet & Hecla owns the lands to the north, south and west, the Centennial lying to the east. They are operating upon the Calumet conglomerate, the shafts sunk being vertical. The Junior is a half mile east of the No. 4 Tamarack, and the property was purchased from the Tamarack Mining company. The company has 40,000 shares and has levied assessments to the amount of $640,000. It has never issued a report to its shareholders, evidently awaiting a time when it can present them with a dividend. The shafts are about 800 feet apart, No. 1 being three-compartment, No. 2 a four-compartment. No. 1 has for some time past been the principal producer, as tributary to it the richest copper ground has been found. It is 2,893 feet deep. To the south of the shaft they are working at the 1st, 2d and 3d levels. At the first level they are stoping near the southern boundary of the property, and at several other places nearer the shaft. At the 6th they are stoping a few hundred feet from the southern and western boundary. The rock obtained is very rich in copper, and the mine never presented a better appearance than at present. This shaft has been sunk 105 feet since my last report.



NO. 2 SHAFT, TAMARACK MINE.

No. 2 has been stationery for some time, the most attention having been given to the territory tributary to No. 1, but the hoisting has been principally done through No. 2. At the latter shaft they are 3,042 feet deep, and are working upon the 9th and 10th levels south. They are working in the extreme end of the 9th and have fine stopes. The copper-bearing ground shows a decided flattening out to the north, so that they have resumed sinking of No. 2 shaft, feeling satisfied that the rich lode will be carried to No. 2 in depth. There is a winze between the 9th and 11th levels, south, opening out new territory. The developments of the past year have been decidedly satisfactory. Should the copper continue to flatten out going north as it has for the past few months, as revealed by their work underground, No. 2 will be as active as No. 1 is the furnishing of rich rock. Much

interest has been taken in the property the past year, and its shares have increased: considerably in price. The mine is really an off-shoot of the Tamarack Mining company, and is similarly officered. James Chynoweth is mining captain; Wm. M. Harris, clerk.

The rock is treated in the mill of the Tamarack Mining company. During the year the amount of mineral produced was 2,561,844 pounds, giving 1,897,845 pounds of refined copper, which was 650,016 pounds less than produced the year previous.

THE OSCEOLA MINE.

The Osceola Consolidated Mining company is one of the best known of the copper producers of the state. It has been a favorite property upon the Boston stock exchange, and its dividends have been satisfactory, the company having paid since my last report $100,000 in two dividends half of which was distributed in July, 1896, and the other half in February, 1897, making a total paid for all years of $2,122,500. The property consists of 760 acres of mineral lands located in sections 26 and 27, and being immediately south of the Calumet & Hecla. This gives four forties in width on the dip of the mine. Work was first started upon the Calumet conglomerate near the north side of the property, but as they worked south the copper grew scarcer until they decided to abandon it altogether. Since then they have devoted their attention to a development of the Osceola amygdaloid, and have been well repaid for their trouble. Once since leaving the conglomerate they put in a crosscut from the 16th level of the amygdaloid, to the conglomerate, but found nothing of value. It may be that at some greater depth, or at some point further south they will find pay rock, and there is talk of another crosscut to prove the ground further south. The work has not yet been commenced, however. From what has been shown in the operations of the mines of this section, the copper chutes of the conglomerate appear to pitch north, while the copper courses of the amygdaloid incline in the opposite direction. There is a possibility of finding rich conglomerate to the south of the Calumet & Hecla's south line. It would be very strange if rich ground does not lie in that direction, but as yet it has not been discovered, nor has it been very energetically sought, as the amygdaloid has given plenty of territory upon which to keep the company busy. The conglomerate traverses the lands of the Osceola Consolidated, and at some time in the future it will probably receive attention.

The Osceola mine has produced 95,617,308 pounds of copper, its product for 1896 being 6,251,304 pounds, falling 19,069 pounds behind the previous year. The dividends paid were not as great, as $63,000 were put into the sinking of a new shaft, repairs to No. 3 shaft, and erection of buildings, etc., for the new shaft. There have been three principal shafts, Nos. 3, 4 and 5. No. 3 is the most northerly, and is the one in which the serious loss of life, due to accidental fire in the shaft, occurred in September, 1895. Suits to recover damages against the company have been commenced and will come up in. the county circuit court in the near future. While it is generally believed that the complainants have little ground for winning-the suits have had a depressing influence upon the stock. No. 3 shaft is to the 30th level, no sinking having been done since the fire. It has been re-timbered, and is in excellent condition. No. 4 shaft is sinking for the 35th level, 208.5 feet having been added within the year. No. 5 shaft is sinking for the 36th level, and was sunk 289.5 feet in 1896.

No. 6 shaft, the new one. is a point of much interest at Osceola. It is the farthest south, on the strike of the mine. It is now, in May, '97 2,220 feet deep, and has shown excellent vein all of the distance. It is not exaggerating to say that this is the best shaft for copper of any yet sunk. It opens up a new territory and one that promises to result in a great gain in the former product of the mine. A hoisting plant has been ordered for this shaft. It will consist of a pair of Nordberg engines, set at an inclination of 60°. Engines will be 32x72", and will drive a cone-shaped drum running from 16' at the smaller to 18' 6" at the larger end. New buildings for engines and boilers have been constructed, these being of stone, solid and substantial. A rock house and other improvements will all be ready as soon as the shaft is completed. It is the intention to sink to the 32d level. Connections are being made with No. 5 shaft to correspond with all the levels of the latter, so that by the time the new shaft is to the desired depth there will be plenty of territory from which to derive a product. No. 5 shaft levels are too far away from the shaft for economical tramming, and No. 6 will take much of the rock that now goes to No. 5. There has been no opening to the south of No. 6, but the character of the lode met with in the shaft is a guarantee that when it is made there will be excellent rock encountered.

During the past year there has been considerable opening done in the mine from the 22d to 35th levels, inclusive, the total number of feet added to the different levels being 7,284.2 for the year 1896. Of this 78.5 feet were added to the 9th level. On the 32d, 2,259.2 feet were added during the year, and the 33d was increased 1,198.6. There is now far more ground opened up and ready to stope than at any past time in the property's history. As the character of the lode is "bunchy," there is now plenty of territory to select from and to keep the product near a certain point.

What promises to be an interesting discovery is the finding of several bunches of copper in the footwall of the lode, that had been overlooked in the past. From the 29th to 31st levels during the past few months, there has been considerable rich rock found in the pockets making into the foot-wall. These may be found all the way to surface, which would increase the Osceola product largely.

The yield of refined copper per fathom of ground broken was 404 pounds. The percentage of refined copper in stamp rock was 1.26. The cost per ton of rock hoisted

was $1.86, and the cost per pound of refined copper for the year was $9.64.

The balance of assets at the end of the year was $257,171.76.

At the stamp mill the new boiler house has been completed and two new boilers placed in position. The new building is 142x69', is of steel and stone, and railway cars run through it in front of the boilers. At the stamp mill 248,062 tons were stamped during the year, the cost being 24 783-100 cents per ton.

The Osceola is under the same management as are the Tamarack, Tamarack Junior and Kearsarge mines. W. E. Parnall is superintendent of all, M. P. Richards is mining captain at Osceola; Wm. Veale, clerk.

THE TECUMSEH.

This property lies immediately south and west of the Osceola mine. There are 520 acres located in sections 27, 32, 33 and 34. They have been working here for two years in a quiet way, and have in view the development of both the Calumet conglomerate and Osceola amygdaloid. Two shafts have been started, the first begun being upon the Osceola amygdaloid. This has opened up the lode for 600 feet. The second shaft upon the Calumet conglomerate has opened upon that vein for 300 feet. Nothing of value in the way of copper-ground has been encountered, but they hope for something better at greater depths. The most southerly shaft of the Osceola is a rich one, and it is not expecting too much to expect similar ground upon the Tecumseh. The company has called an assessment of $1.00 per share payable in July, '97, and with the $40,000 thus raised will deepen the shafts and do something in the way of developing the veins. They are well equipped with the machinery necessary for the conducting of the exploration.

John C. Watson is president; D. L. Demmon, treasurer, Boston; Graham Pope, agent, Houghton. The title of the company is "The Tecumseh Copper Company."

To the south of the Tecumseh nothing is being done in the way of exploring the range until the Franklin Junior is reached. Next north of the Calumet & Hecla lies

THE CENTENNIAL MINE.

This property comprises all of section 12. It was formerly known as the "Schoolcraft." Mining operations were suspended in July, 1893. Up to this time there were many stoppages of several months' duration. There had been expended something like a million and a third of dollars in the attempt to develop a paying mine without success. Upon the Calumet conglomerate seven shafts were sunk, these running from the south side of the section to two-thirds the distance across the property going north. Nos. 1 and 2 shafts were shallow ones reaching only to the second level. In none of these was anything found that was encouraging. No. 4 shaft, next in order in going north, is down 1,100 feet, and at the 9th, 10th and 11th levels shows a streak of copper-bearing ground about 15 inches wide. No. 5 is only to the 2d level. No. 6 gave more encouragement than any of the shafts sunk. It was put down to the fifth level, showing considerable copper in going north. The copper chute had increased in length from a few feet upon surface to one hundred feet at the fifth level. No. 7 shaft is only to the first level.

Upon the Osceola amygdaloid two shafts had been sunk, No. 1 being 350 feet down on the lode, and No. 2 500 feet, the shafts being connected at the 1st and 2d levels. Upon this lode considerable copper had been found, but the former company devoted its principal attention to the development of the Calumet conglomerate, thinking it offered greater chances for success.

During the summer of 1896 a re-organization of the company took place. An assessment of $2.50 per share was called, or it amounted to this, the Old Colony Trust Co., issuing shares in the Centennial Copper Mining company for this sum. This assessment paid a mortgage of $70,000 and leaves, a neat balance in the treasury to begin the task of re-opening the mine. There are 80,000 shares in the company.

On the loth of January, 1896 work of unwatering No. 6 shaft on the conglomerate was begun. This has been completed, and they are now driving north towards No. 7 shaft on the 5th level, being about 400 feet from the shaft in the drift north of No. 6. In the last fifty feet of this drift they have met with a lode from 6 to 7 feet wide carrying copper in many places and giving promise of increasing as they go to the north. At 811 feet north of the shaft on the fourth level a winze has been started for the fifth level, is down 60 feet, and shows considerable copper for the greater part of the distance. Indications point to better ground as they work north, which should this prove correct, will make No. 7 shaft an important one. The sinking of this shaft will probably receive attention in the near future.

The unwatering of the shafts upon the Osceola lode has also been accomplished, and sinking and drifting will soon be commenced. They have also in prospect the sinking of a shaft to the Kearsarge amygdaloid, that lies further east. A vertical shaft will be necessitated at the outset in order to strike this lode upon their lands. The Centennial is crossed by the principal copper-bearing lodes of this district, and is well worth a systematic exploration, which the present company intends giving it. Great interest is being manifested in the work now fairly begun. Capt. Jas. Chynoweth, superintendent, has been connected with the property for some time, is thoroughly familiar with its peculiarities, and if there is copper to be had he will find it. There is a Ball's stamp, nearly new, and there is plenty of power to run the drills and do the hoisting. The equipment of machinery is all the present needs of the property demand. John Pentecost is mining-captain. Henry F. Fay, Boston, is president.

THE WOLVERINE MINE.

Just east of the Centennial is the Wolverine mine, one of the popular properties of the copper district of Michigan. Its management is a wise, conservative one, being practically the same as overlooks the affairs of the Atlantic and the Central mine, both of which have excellent records in the way of economical handling. Work was first begun by the Wolverine in 1884, at which time there was a re-organization of the old company, giving place to a more progressive one. The title is “The Wolverine Copper Mining Company." The number of shares is 60,000, having a par value of $25 each. The purchase of three forties in addition to the former possession, was noted in my last report. The cost was $60,000. This had been paid for out of the earnings of the company, and at the end of the fiscal year, June 30, '96, there was a surplus of cash amounting to $94,679.62. The mining-profit for the year amounted to $50,930.38, over $4,000 per month, so that at the end of their fiscal year the company should have a surplus of something-like $150,000. There has been a little better price for copper, and the product of the mine has somewhat increased.

For the year 1896 the amount of mineral produced was 2,325,875 pounds, which yielded 2,011,638 pounds of refined copper, the mineral giving 86.490% ingot, it being one of the best in this respect of the lake mines. This was accomplished with a single head of stamps, the record being one of the best to be recorded in the history of copper mining.

The rock hoisted for their fiscal year was 100,190 tons, the amount stamped, 85,155 tons. The yield of rock treated was 33.62 pounds or 1.181%. The total cost per pound of refined copper, including mine expenses, smelting and transportation and New York office expense, amounted to 8.36 cents.

During the year there was 311.5 feet sinking, 3.824 feet of drifting and 5,429 fathoms of stoping. The net underground expense was $101,622.41; rock house expense. $8.294.79; stamp mill expense, $24,086.71; surface and incidental expense, $7,777.81, a total running expense of $142,731.72.

The vein upon which the Wolverine has worked is the Kearsarge amygdaloid, located 2,750 feet east of the Calumet conglomerate. Like all the amygdaloids of this district, the lode is very bunchy in its holding of copper. There is a great deal of rock that is left, and considerable is hoisted that is not treated in the mill. It requires constant attention to select the good from the poor, and a great deal of "dead" work has to be performed in the winning of the product. The lode is of dull, brownish color, and the rock richest in copper is a porous epidote of light green color.

There are four shafts. No. 1 is the most northerly and is only to the first level, the copper course carrying to the south of it. No. 2 is 400 feet further south and is to the 14th level, one level having been added since my last report. At this shaft they are stoping at the 12th and 13th levels and are driving a drift upon the 13th south to connect with No. 3, which is 700 feet south of No. 2.

No. 3 is sinking for the 13th level, having been sunk from the 11th since my last report. This is the principal producer of the mine at the present time. They are drifting upon the 6th, 7th, 11th and 12th levels south. For some distance to the south of this shaft they had a poor stretch of ground, but there has been a great improvement during the past few months, and indications are that they have entered one of the rich courses for which the mine is known.

No. 4 shaft, 8x17', is sinking-for the 7th level. It is located 1,385 feet south of No. 3. It is connected with the latter at 2d, 4th and 5th levels, and the 6th, 7th, 11th and 12th levels of No. 3 are being pushed to meet it. Ground opened to the south from this shaft, shows considerable rich lode in the lowest levels. In the second a short drift encountered poor territory, but as they go down they find a great improvement. The shaft has cut several promising copper deposits. To the south of the shaft in recent opening's they have met with a very soft amygdaloid that is heavily charged with copper, the epidote, as is characteristic of the mine, being the richest. The spar here carries nothing, whereas in many other properties it is rich in copper. There is a stockpile of several thousand tons of rock that is ready for the mill, and will yield well.

There will be an excellent equipment of machinery at this shaft, work upon foundations for the necessary buildings being now under way. To the east of the shaft they are getting ready for the boiler and engine house. This will contain two Sterling boilers of 200 horse-power each; a duplicate Corliss engine, 24x48", connected direct to hoist; a new Rand drill, one of the latest patterns, having a capacity for driving 25 drills, has been ordered. They have constructed a dam for the containing of water that is to be used for the boilers. They have used the waste rock that came from the shaft as an embankment in front of which is packed earth so firmly that the water cannot find its way through it. They are grading for a railway track that is to convey the rock to the Allouez mine mill, it having been decided to use this. This will give the company two heads with a capacity of between 500 and 600 tons of rock daily. In the present mill the single stamp, which has solid head and 18-inch cylinder treats 300 tons daily. A combination shaft and rock house will be constructed.

With the improvements now under way completed the Wolverine will be able to nearly double its present product of copper. They will have the territory from which to draw the rock, and the stamping facility has been doubled. The Wolverine's cost for producing a pound of copper is 8-36 cents. If eleven cents can be obtained for it, and the annual product reaches 4,000,000 pounds, the net earnings will be something like $105,000 annually, or $1.75 per share. At this rate the stock would pay 10% upon $17.50. The new work under way will cost $60,000, but there is plenty of money in the treasury to pay for it all and to leave a comfortable

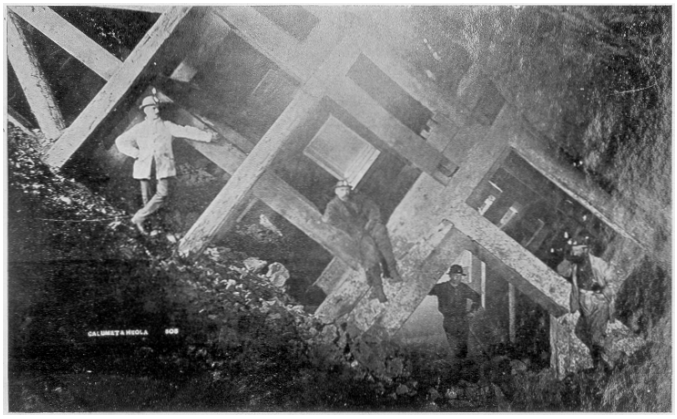
balance. They are producing now from 9,000 to 10,000 tons of rock per month, that raised from the new shaft being stocked there awaiting the completion of railroad and stamp mill. There is a force of 175 men employed.

Since the present organization the company has received $857,262.88, and has expended $762,583.26. The product of copper for the past five years has been as follows:

1891-2	500,074	lbs
1892-3	218,855	"
1893-4	1,611,857	"
1894-5	1,744,079	"
1895-6	2,011,638	"

The increase during the past three years has been large, and the mine gives promise of being able to repeat the performance for several years to come. Everything in and about the property is kept well. The location is a neat one, and many new residence buildings are being erected on the company's lands by men who are employed in the mine.

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



TIMBERING IN CALUMET & HECLA MINE.

THE KEARSARGE MINE

adjoins the Wolverine immediately upon the north, and its single shaft is connected with the northern workings of the latter. It is a single-skip shaft and is to the 20th level, having been sunk from the 17th level since my last report. The product of refined copper for 1896 was 1,377,226 pounds, and the total for all years is 8,406,887 pounds. The mine has paid dividends amounting to $120,000, the last of $1.00 per share, $40,000 having been distributed in December, 1895. The product of 1896 fell short of that of the year previous by 568,936 pounds, which is accounted for in the lack of stamping facilities, the increased rock output at the Tamarack having used the heads that were employed to treat the rock of other mines of this group. The new mill is now in commission, however, and there will be no delay from this cause in future. During the first five months of the year 22.863 tons of the 34,587 tons treated during the entire year were stamped, the latter portion of the year finding the increase from the Tamarack before referred to. But while there was not the amount of rock treated that should have been, the mine has been busy, the same force of men employed, and underground developments pushed vigorously, so that the present finds a greater amount of copper-bearing territory opened up than ever before seen in the mine. There are many fine stretches of excellent stoping ground ready, and now that ample stamping facilities are provided the Kearsarge should make a fine showing for 1897. The extension of the levels wrought in the mine were as follows during the year:

6th level, north. 443.7 feet.

8th level, north, 579.1 feet.

9th level, north, 481.5 feet; south, 421.6 feet.

10th level, north, 581.5 feet.

11th level, north, 468.9 feet.

12th level, north, 864.5 feet.

14th level, north, 34.0 feet.

15th level, north, 183.0 feet.

16th level, south, 309.3 feet.

17th level, south, 640.8 feet.

18th level, north, 23.0 feet; south, 34.8 feet.

The total extension of levels amounts to 5,067.7 feet for the year. The 6th, 8th, 9th, 10th, 11th, 12th and 16th levels north of shaft show many good stretches of lode. The 14th, 16th and 17th, south of shaft have not encountered anything of value as yet. In sinking the shaft several bunches of good ground were encountered, and lends the hope that something valuable will be found below the 17th. There has been no opening done as yet below this point. The lode of the Kearsarge, as of its neighbor, the Wolverine, is very bunchy in its content of copper. There is much barren ground, and the lode is very changeable.

The yield of refined copper per cubic fathom of ground broken was 449 pounds; the percentage of refined copper in stamp rock, 1.99. The total cost per pound of refined copper for the year was 9.76 cents. The excessive cost of the pound of copper is accounted for in the restricted product. The results for the present year, 1897, should show a considerable decrease from this figure. The mine is in excellent shape to obtain rock readily and cheaply; there is an adequate equipment of machinery, no outlay will be needed in construction, and the affairs of the company are excellently handled.

B. S. Bigelow, Boston, is treasurer; W. E. Parnall, Calumet, superintendent; John Hosking, mining captain; Wm. M. Harris, clerk.

The foregoing embrace all the active properties in the vicinity of Calumet. The Allouez is still idle, and there is no likelihood of its resumption for some time in the future. There was an exhaustive trial of the lodes of the

property and the owners have no desire to carry it further. The mill is to be used to treat the rock of the No. 5 shaft of the Wolverine mine.

IN KEWEENAW COUNTY.

In years agone the mines of Keweenaw county were looked upon as of the best the copper district possessed. Some of them were exceptionally rich in copper, and several have records of big dividends to their credit. As one travels from Calumet northward the eye is greeted with many abandoned mining locations that years since were full of life and activity. The Cliff, that paid over two and a half millions of dollars in dividends, the Phoenix that gave $20,000, are among them. The equipments were crude, the shafts small, the methods expensive, and all have succumbed to the low price of copper as compared to the time when they were busy and profitable. Topographically the country is one of the most interesting. From a scenic point of view it is of the grandest. Commercially, it is sorrowful. At some time in the future, when the market demands more of the metal, there may be a resumption of the search for paying copper deposits. They probably can be found. No man, in the light of what has been revealed at other places can say there is no copper here. The first active property met with, and one that has been the exception to all the idle ones of the county up to within a few months, is

THE CENTRAL MINE.

The Central is one of the conspicuous copper producers of the Lake Superior region. At one time it was noted for the exceptional richness of its lode, from the working of which $1,970,000 were earned in dividends, and from the surplus in the treasury the mine has been kept open for several years when operation was conducted at a loss. The total copper product amounts to 51,247,353 pounds. For 1896 it was 469,242 pounds, for 1895, 379,020 pounds, so that some gain resulted during the past year over the previous one.

The Central is worked upon a true fissure vein which crosses the formation at nearly right angles. No. 2 shaft has been the principal one for some years. It is a deep one, 2,765 feet to the 32d level. The shaft is vertical, and as there is a slight dip of the lode to the east, it requires 360 feet of crosscutting at the bottom to reach the vein. No levels have been added for some years, however. In opening the Central vein all the prominent copper-bearing belts of the district are exposed to a point 1,536 feet south of the Kearsarge conglomerate. The Central vein is faulted where it encounters the Kearsarge conglomerate, being carried 250 or 300 feet west. Upon this conglomerate they find a brecciated material that gave the most of the copper for 1895. Nothing was found under the conglomerate, and early in 1896 they abandoned the bottom of the mine, and have since been devoting attention to territory further south. They went into the old 21st level, re-opened it and drove it south. At 90 feet from the breast of the old drift they struck a productive piece of ground, and from this level the principal product of the year was secured. They have been pushing the drift ahead, it now being in about 900 feet. The 20th level has also been reopened and is in 675 feet, showing a narrow vein carrying considerable barrel work and stamp rock. A winze sinking below the 21st also shows considerable copper. They are re-opening the 16th, 17th and 19th levels, having but fairly commenced at these points. It will require some time before all these levels are pushed ahead to a point where the productive ground is making southward and upward. Following the present inclination of the new copper-bearing territory it would carry the upper portions of the vein about a mile south of the mouth of No. 2 shaft. Until the drifts are well into the territory to the south the product cannot be largely increased, but with several drifts in the vein and all pushing ahead, the Central should show a decided gain in production. In the 21st level the yield of mineral per fathom of ground broken has been about 745 pounds. A mass of 55 tons, one of 40 tons, and one of 20 tons, were taken from the stopes of this level. The productive ground is running upward and parallel with the dip of the formation, which is favorable. Other levels will undoubtedly be added as rapidly as possible.

For the year 1896 the expenses were $68,104.33, and the receipts amounted to $53,223.22, showing a deficiency of $14,881.11. The present cash surplus amounts to $50,259.02.

The company is well equipped with machinery, and there will be no need of an extra outlay for some time to come. The improvement of the underground condition at the Central is most pleasing. It is a property with many friends. It is surrounded by people who have spent a lifetime at the mine, and who are much attached to the place. The company has kept at work when the prospects were discouraging in the hope of finding something better. They have been enterprising, and they deserve ample reward for the much they have done to keep the mine going. A force of 104 men are employed.

The principal offices are in New York. John Stanton is secretary and treasurer; F. McM Stanton, agent; John F. Robert, clerk; John Trevarrow, mining captain.

Directly north of the Central mine, and on the north of the greenstone is located

THE ARNOLD MINE.

This property has recently been mi watered, and they will give the ash bed a trial. There are two veins here the "Owl Creek" and "Ash Bed." Considerable work was done upon both these at the Copper Falls mine, which immediately adjoins the Arnold, but which has been idle for some years. The ashbed lode is a narrow one, about 7 feet thick, and is very flat, lying at an angle to the north of 27°. The Arnold began by driving an adit south to the ashbed, worked two years, and stopped operations in

1892. There was a shaft sunk 518 feet. At the 2d level they opened on the vein for 80 feet east and west of the shaft. At the 3d the opening was stopped at 80 feet east. At the 4th they drifted 300 feet west and 350 feet east of shaft. They have resumed the sinking of the shaft and will add another lift. The bottom of shaft shows considerable copper, and looks as well as at any point yet found. Should the vein prove rich another shaft will be sunk about 1,200 feet west, as it is in this direction that the most profitable ground is looked for. Work thus far done in 1897 has met with sufficient encouragement to warrant the company in proceeding vigorously with the task of developing the lode to the west. They have also started drifting to the west of the shaft. The ashbed is generally considered a better copper holder than the Owl Creek, the Copper Falls having determined this in the many years of its operation. Wesley Clark has charge of the mine.

There has been some talk of resuming work at the Copper Falls but the start has not yet been made.

IN ONTONAGON COTNTY.

There has been a great deal of talk during the past year about the consolidation of the leading mines, (or those which used to be) of Ontonagon county. Several parties have attempted to bring all the properties together and to dispose of them to capitalists, but thus far the efforts of the pro-motors have been fruitless, although there is an excellent chance for the development of a big mine were consolidated effected. The difficulty with a revival upon modern plans, of the old properties, is that singly they do not possess sufficient territory upon the strike and dip of the lode to warrant a big expenditure in the way of deep shaft sinking, modern equipment, etc. In these days it requires a great deal of ground to give sufficient rock for economical operation. It is by treating a large amount of rock that the properties are enabled to meet the lower price of copper. When the old mines of Ontonagon were undergoing active development the price of copper was 100% higher than now. Conditions have materially changed, and the mines will have to be equipped to meet them. There has been considerable talk the past few months concerning

THE RIDGE MINE.

There was a re-organization of the company during 1896, H. C. Willis, of Boston, being elected president and Philip Highley, of the same place secretary and treasurer. Alfred Meads, of Marquette, Mich., is superintendent. An assessment of $50,000 was called for the purpose of unwatering the shafts in the west end of the mine, and for the sinking of shafts and driving of drifts. A start was made, and about the time the new company was ready to start the pumps they found the lands upon which the mine was located had been purchased under tax title by Marquette, Mich., parties, who ask $25,000 for that which cost them only a few hundred. The matter has not yet been decided, the case having been taken to the courts. It is greatly regretted that this delay has been occasioned, as valuable time is being lost. In the west end of the old mine, where the work is to be done in future, if the Ridge Copper company retains possession, there are two shafts 300 feet apart and opened out to the fourth level. This territory has yielded about 5,000 tons of copper. The old No. 1 shaft was started forty years ago. It is this that the company was to first unwater, and sink. They figured to put in an air compressing plant to operate power drills, and to hasten the work of getting into new territory in the western end of the mine.

For several years the mine has been worked upon tribute, but in this time and under this plan, it has been well cared for. Of course all the work done was above the adit level, no pumping having been done. There has been no robbing of levels to the detriment of the mine, and all the old workings are in shape to be entered and work proceeded with in a very short time. Nothing will be done until the settlement of the tax case now in the courts.

At the National, Minesota, Evergreen Bluff, Knowlton, Hilton Adventure and Mass mines tributing has been going on in a quiet way for some years. The amount of copper smelted from these properties the past year was as follows:

Ridge	14,823	lbs.
Evergreen Bluff	4,078	"
Knowlton	1,745	"
Hilton	3,107	"
Adventure	7,720	"
Mass	38,684	"

The National was one of the last of the old mines to cease active work. Its neighbor, the Mass, is still a producer and is one of the richest properties. It has a credit for dividends paid of $1,820,000, and can be joined with the National for future working. The National paid to shareholders $359,255. The Minesota was noted for its mass copper, about 10% of the product being copper of this class. The remainder was principally barrel work, the percentage of stamp copper being very small. On this Minesota, or "North Range," are located the National, Minesota, Toltec, Penn, Hazard, and other mines, and upon the south range, or "Evergreen," are the Ridge, Knowlton, Ogima, Evergreen, Adventure, Merrimac, Belt and others. About one-half mile separates them. Both these ranges have shown excellent copper ground and at no place has the depth necessary to thorough exploration been reached. Where the deepest shafts of Ontonagon county are from 600 to 1,000 feet deep, those of Houghton are five times this depth, and are showing ground rich in copper. This but goes to prove that there may be far richer territory to be had in the Ontonagon properties by sinking than was revealed near surface. Lodes that were so abundant in copper near surface are certainly worth following to a far greater depth than has yet been here reached, and I know of no place where there is more to warrant the liberal expenditure of money in the hope of finding paying mines of copper than in the Ontonagon district. With copper at its present price, and with the great

amount of idle capital throughout the country there is every reason why those directly interested in Ontonagon's mines should endeavor to consolidate their properties, placing a reasonable price upon them in the hope of attracting favorable attention to them. The county, which was among the first to be given attention in the mining of its copper, has plenty of metal yet to be extracted. It is still rich in copper, and all that is needed to prove this is actual exploration and development of its principal lodes.

In the Porcupine Mountain district, sections 27 and 28, 51-42, the Halliwell Copper company, of Cleveland, Ohio, did some work during this year, suspending operations in the fall, since which time they have not resumed. They put in a steam hoisting plant, steam power drills, and started a shaft in the country rock to cut all three of the veins upon their property, the incline of the shaft being directed across that of the lode, so as to cut the latter in its downward course, and at nearly right angles to the dip of the veins. It is a new way of exploring in the copper district. Some copper was found, and A. A. Atwater informs me that the prospects for a mine are encouraging.

At the Carp lake, whese Cleveland parties intended doing something, nothing was accomplished, and the title has reverted to the original owners, Alfred Meads and others.

THE NORWICH MINE.

Messrs. Jos. Davis, Dr. Moore, A. Hazeltine, and others of Iron wood, Michigan, have recently acquired possession of this property, the location of which is section 1, 49-50. The mine was worked in the fifties, and produced 486½ tons of copper. In 1858 active mining ceased, after which time a little work was done upon the tribute plan. The mine was also known as the "Essex." There are 600 acres in the fee of the property, in which are the Norwich, Pressure and Indian Digging veins. It is also likely that the Minesota and Evergreen veins may be found, and the latter ranges continue southwesterly through this district. The mine is upon the west branch of the Ontonago river. There is a five-stamp mill, stamps being of the Cornish pattern, and the machinery is in a fair state of preservation. The new owners talk of unwatering the property and prosecuting mining work actively.

At the property of the Diana (formerly Belt,) nothing has been done during the year. It is in the hands of Cleveland, Ohio, parties who secured the property a few years since hoping to be able to stock it and dispose of its shares, the object being purely speculative.

Ontonagon county is better off than in the past with reference to rail facilities, the Chicago, Milwaukee & St. Paul road now entering Ontonagon village, passing through Rockland and other places prominent upon the range. The extension of the road to Houghton would be a grand thing for the district, however, and the people are hoping for such service in the near future.

In Gogebic county, upon the western end of the range, where the copper-bearing formation almost meets the ferruginous rocks, there has been found amygdaloid to the north of the city of Ironwood, and a little time copper has been discovered in the rock. No work has yet been done, however, in the way of proving the value of the vein.

ISLE ROYALE COPPER LODES.

Isle Royale, a beautiful strip of land in Lake Superior and fifty miles from the south shore, opposite Houghton. has been the scene of considerable work in the way of searching for copper in days gone by. It is an attractive district, and gives enough encouragement for the search for the metal, although as yet no profitable veins have been located. The island has been attached to Keweenaw county, this being done by the present state legislature. Prior to this it was a county in itself.

Concerning the work done upon the Island, the following letter- from Jacob Houghton, brother of Michigan's first state geologist, and a gentleman who has long been prominent with the development of our mineral industries, will prove interesting and valuable:

DETROIT, Nov. 22, 1896.

George A. Newett, Esq., Ishpeming, Michigan:

MY DEAR SIR—So far as economical results are concerned, not much can be said of Isle Royale. Adventures in a mining way have been unfortunate, and the failures have given the Island a black eye and almost everyone in the copper region will shake his head at the suggestion of workable deposits there. I think otherwise, and believe that some time in the future very productive mines will be wrought there. Discoveries have been difficult from the surface conditions, as I will make more clear further on.

Locations were made and mining operations commenced at Rock Harbor, I think, in 1846 and were continued two or three years into the 50s. The work was done in small fissure veins in the rock which overlies the Greenstone range, corresponding with that range on the south shore of the lake. The only mine, in those rocks, that has ever paid a dividend, is the Atlantic. The Copper Falls mine produced well, but was handicapped in "costs" from its fiat dip, but on the other hand was helped by the mass and barrel work from the "Owl Creek Vein," which is a fissure that crosses the ash bed. The fissures which were wrought at Rock Harbor were very small and occurred in very tight rocks. The gangue of the veins was really rich. All of the big producers and dividend payers lie under the Greenstone and between that belt and the Kearsarge amygdaloid. I am speaking of the present, and do not wish to be considered as even hinting that, in the future, successful mines may be wrought in other belts of the Trap range.

After the abandonment of the work at Rock Harbor nothing was done on the Island until commenced by the Minong Mining company some twenty or twenty-five

years ago. The Minong amygdaloid is nothing else than the Kearsarge amygdaloid—is situated about the same distance from the Greenstone, i. e. one and one-half miles, and has for its main footwall the same hard, close-grained trap, carrying quite a percentage of magnatite. On the Island this belt is such a pronounced and continuous feature that it is called the "Minong trap." The amygdaloid rests immediately on the trap, but I have been informed that in the case of the Kearsarge there is a small or rather *not thick* intermediate belt.

The mining work done at the Minong was of the very worst. The incline which was sunk ran off the bed and then resort was had to gophering the surface with pits of all sizes, and one will wander among them at the risk of his life through the dense brush that has grown up since the abandonment. Something over two hundred tons of ingot copper was produced. Too little capital was provided and those who furnished it became tired and quit.

Mr. Samuel Brady, a thoroughly competent mining engineer (he had charge of the Michigan mining exhibit at the World's Fair in Chicago), was at the Minong during a part of a summer when it was in its last gasps, and he unhesitatingly says that the Minong belt can be worked to profit. He also says that a peculiar feature of the belt is that it is intersected by innumerable cross fissures in which the greater portion of the copper is found.

The existence here of extensive ancient, mine work led to the discovery of the Minong belt. Those ancient pits covered a width of from 300 to 400 feet and extended for a distance of one mile and three-fourths southwesterly from McCargoe's cove. At this point the belt lies under a wet swamp. Six miles further southwesterly small ancient pits again are seen on the belt near the southerly shore of Todd's Harbor, and are scattered along for about two miles. The belt here is hardly fifty feet above the lake while at the Minong it is probably two hundred feet above. Southerly from Todd's Harbor the amygdaloid belt is covered by drift but the well known footwall belt constitutes a prominent range.

During the war of the Rebellion the North American Mineral land company purchased the larger portion of the land on the Island from the government. Early in 1889 that company sold out to an English company which subsequently added to the acreage by purchasing a school section from the state of Michigan.

In round numbers the English investors now own 68,000 acres out of 140,-000 acres, which latter figures represent the whole acreage of the Island.

The English company carried on explorations during the summer of 1889, during the years of 1890 and 1891 and through most of October, 1892.

The first explorations were by costeans in the summer and tunnels or drifts in the winter and were projected for finding bedded veins which now are all the go. In the summer of 1889 the work done was in the vicinity of Todd's Harbor. The balance of the explorations were made in the vicinity of Washington Harbor. The results were not satisfactory, though two amygdaloid belts were found that probably would carry one half of 1 per cent. Their flat dip of 13° would make them too expensive to work. They were of good thickness. In these explorations we found more float copper than I have ever found in making explorations on the south shore. Subsequently I became satisfied that most of the floats were from fissure veins.

The explorations were conducted by S. S. Robinson, formerly superintendent of the Quincy mine, myself acting as consulting engineer.

Finally, in the winter of 1890-91 Mr. Robinson suggested that a line of diamond drill holes be put down across the Island and I approved the plan. Two drills were purchased and work was commenced with them about the middle of July, 1891, and was continued for a year.

Along a stretch of five miles nineteen holes were bored to depths of from 400 feet to 1,050 feet one only being of the shallowest depth while there were three of the deepest ones. A good many amygdaloid belts, showing copper, were cut, only a few of them showing mineralization of desirable percentage. One fact became apparent, i. e., that the conglomerates between the Greenstone and the Kearsarge were very much thinner than on Point Keweenaw.

At the termination of this drilling came the Barring Bros.'s failure in England (the commencement of a financial depression which we are not yet through with) and the English investors called a halt.

At last my thoughts reverted to my early explorations in 1846 and 1847 on Point Keweenaw, and I became convinced that we must look for fissure veins instead of bedded ones. Isle Royale presented the same characteristics of great faults and deep breaks of canons as Keweenaw Point and the natural thought was to look to those breaks and faults for workable deposits. The familiar phrase of past years, "the faults (fissures) have robbed the beds" came back to me. The result was that I examined the breaks (faults) which cross the Minong trap between Washington's and Todd's Harbors. In a distance of seventeen miles there are thirty of the breaks or faults with widths at bottom ranging from 50 to 800 feet and the heights of walls ranging from 50 to 500 feet. I reported these facts to the company but the directors took no action.

As I own 800 shares out of the 10,000 in the company I felt a deep interest in developing the breaks. I therefore selected the most favorable one for exploring and obtained an option for purchase based on the result of exploration. I was required to raise $25,000 for the purpose. For two years I raked Boston, New York, Detroit and Chicago to find parties who would join me in the explorations without avail. The times and the black eye of the Island were against me. Finally I determined to spend $3,000 of my own money with the hope that I might find sufficient to encourage others to join me and

believing that the company would waive the point of my starting without $25,000.

I went to work the latter part of June this year and had expended $1,400 when the bank in which I had deposited my money in Duluth collapsed and my $1,600 was tied up, for how long a time no one can tell. Then I fled, and shall not "go it alone" again and shall not hunt very diligently for anyone to "go it" with me. Still, I believe that some time in the future workable veins in some of these breaks will be found and developed into first class producers.

In the palmy days of the mass mines, Minesota in Ontonagon and Cliff in Keweenaw, the owners thereof used to deride the struggling efforts of the workers at Portage lake by the fling that "stamp mills could never be made to pay." Where now are those two mass mines and how are the stamp mines in Houghton county?

Later on the word was often passed that there was no use to look for a mine between the Quincy, Pewabic and Franklin and the Cliff in Keweenaw. Yet there midway is the third largest copper mine in the world. Thus does present thought and sight presume in judgment.

Yet in my short work on Isle Royale this summer I learned much. The break that I worked on crosses the widest part of the Island and can be traced for eight miles. Its course, as is the case with all of the breaks, is north and south.

Blake's Point, on the north end of the Island, is the Greenstone and the course of that range is quite direct in a course S. 60° W. and terminates at Grace Harbor, the faultings seeming not to have disturbed the strata in their alignment. The faultings are vertical, the east side being the higher.

On Point Keweenaw the faultings to the north keep swinging to the east, which has given that peculiar horn shape to the point. At the Humboldt mine (on the north side of the point) in 1861 E. J. Hulbert showed me a minor fault coming into a main fault, showing that the changing courses of the faults produced the minor faults.

The physical characteristics of the valleys between the Greenstone and the Kearsarge amygdaloid on the point and between the Greenstone and Minong amygdaloid on the Island are identical. This is the result of glacial action. This is well shown on the point by the Eagle river and the Little Montreal river, and on the Island by Washington creek and the stream running into Duncan's bay.

The Canadian geologists have shown that the movement of the glaciers all along Lake Superior was from NE to SW very nearly in line with the strike of the rocks on Isle Royale. As the rocks between the Greenstone and the Kearsarge-Minong footwall are much softer than their bounding rocks, they were scoured much deeper. On Isle Royale the scouring has been on a tremendous scale and the deposited soil in the valley is of great depth.

In the first place as the waters receded the chloritic materials, derived from the destruction of the basic traps and held in suspension by the waters, were deposited in a sheet of hard pan to a depth that I have as yet been unable to determine. On top of the hard pan lies a variable depth of soil, the result of erosion subsequent to the disappearance of the glaciers. Not only is this the condition of the main valley but it is the case in all of the gorges coming into the valley from both sides. Thus you see the difficulty that I had in making explorations. I struck the hard pan everywhere. Had not the Duluth bank bursted I might have known something further about it, as I should have continued the work until this month. I would not undertake an exploration of one of these gorges with a less amount than $25,000. With that amount I could sink a shaft and crosscut and prove up. The work might not cost that amount but I would want to know that I could have it if needed.

The characteristic and workable fissures of Point Keweenaw apparently terminate in the great breaks through which flow the Gratiot river and Hill's creek. I send you a map (in a book) with which I had something to do a half century ago, on which I have marked those streams. Fissures, however, do occur to the south and west of that point, but they are barren. One each occurs in the Quincy and Atlantic and undoubtedly there is one under Portage lake.

JACOB HOUGHTON.

DIVIDENDS.

The amount of dividends declared by Michigan copper mines for the year 1896 is as follows:

Calumet & Hecla	$2,500,000
Quincy	1,000,000
Tamarack	360,000
Osceola	125,000
Total	$3,985,000

SHARES.

The following shows the number of shares in the different active mines of Michigan:

NAME OF MINE.	NO. SHARES.
Atlantic	40,000
Calumet & Hecla	100,000
Centennial	80,000
Central	20,000
Copper Falls	20,000
Franklin	40,000
Kearsarge	40,000
Osceola	50,000
Quincy	100,000
Tamarack	60,000
Tamarack Jr.	40,000
Wolverine	60,000

PRICE OF COPPER.

The average price of copper, per pound, for the years below enumerated will be interesting:

YEARS.	CENTS.
1860	22½
1865	36¼
1870	20⅝
1875	22½
1880	20⅛
1885	11⅛
1890	15¾
1891	12 3-5
1892	11½
1893	10¾
1894	9 9-16
1895	10¾
1896	10.88

UNITED STATES PRODUCTION.

The year 1896 exceeded all former ones in the production of copper, the amount being made up as follows:

Montana	227,700,000 lbs.
Michigan	138,396,760 "
Arizona	71,000,000 "
Other States and Territories	13,500,000 "
Total	450,596,760

EXPORTS.

The export of copper for the year 1896 amounted to 251,240,000 pounds, over one half the amount produced. The foreign demand kept up well, and there has been a gradual diminishing of the visible supply.

IMPORTS.

The imports of copper to the United States for the year amounted to about 4,800 long tons.

WORLD'S PRODUCTION.

The estimated production of copper for all countries for the year 1896 is 373,208 long tons, the greatest in the world's history. In 1888 the production was 258,026 tons; in 1892, 310,472 tons; in 1894, 324,505 tons; in 1895, 334,285 tons.

COPPER SMELTING.

The amount of copper smelted by the different works in Michigan, as well as at the Calumet & Hecla's smelter, in Buffalo, will be found upon page 107 of this report. The total for 1896 is 8,819,291 pounds in excess of 1895. The works are all well equipped for reducing the mineral economically and rapidly, no additions of imporance having been made to the plants within the year.

COPPER MANUFACTURES.

The Michigan rolling and wire drawing mills manufacture annually about 1,250,000 pounds of sheets and 3,000,000 pounds of wire. Besides this a large amount of copper is cast into cakes for export and for eastern manufacture.

PIG IRON.

Michigan is first in the list of states in the production of charcoal pig iron. For 1896 the product of charcoal pig; for all states was 310,244 tons, this being a gain over the previous year of 84,903 tons. In years gone by charcoal irons were the favorites in the market. The iron was unquestionably superior to that manufactured from coke, a condition that time has not changed. But the coke irons can be more cheaply manufactured, and the trade takes it. As long as superiority of the iron is not taken into account, and is not demanded by the consumer, charcoal iron cannot greatly increase in this country. Michigan has sixteen furnaces, eight of which were in blast during the year. The amount of pig manufactured was 146,869 tons as against 88,700 tons for 1895. The furnaces contributing to this with the amount made by each are as follows:

Antrim Iron company	32,134
Elk Rapids Iron company	16,885
Excelsior Furnace company	17,906
Gaylord Iron company	10,563
Peninsula Iron company	6,542
Spring Lake Iron company	25,610
Pioneer Furnace company	23,849
Union Iron company	13,380
Total	146,869

The Antrim furnace, located at Mancelona, was in blast the entire year, having a very successful run. There were no improvements made in the plant, everything being in excellent condition.

The Elk Rapids furnace was in blast seven and one-half months, making no improvements or additions in that time.

The Gaylord Iron company, of Detroit, operated their plant continuously throughout the year, adding nothing in the way of improvements.

The Union furnace, of the same place, was operated for twelve months without any changes in the plant.

The Peninsula furnace, also located in Detroit, was run for eight months in the year, making no changes in its plant.

The Spring Lake furnace, located at Fruitford, worked steadily throughout the year, and reports no additions or changes.

The Pioneer, of Gladstone, the property of the Cleveland-Cliffs company, has been worked steadily since it went into blast about one year ago, it starting up April 16, 1896.

The Excelsior, located at Ishpeming, was in blast for eight months, it going out in September having completed a contract with the Lake Superior Iron company. It is now repairing its hearth and expects to blow in again about the first of May, having taken a contract to smelt ores of a local company.

The Western Furnace company, located at Manistique, writes us that they expect to go into blast early this summer, having everything in readiness for doing so.

The Michigan furnacemen, with the exception of those of the Excelsior furnace, Ishpeming, have formed an association known as the Superior Charcoal company, of Detroit, Michigan. It is announced that after April 1st, 1897, all sales of eight iron-making concerns will be in the hands of this company. The officers of the company are: W. G. Mather, of Cleveland Ohio, president; F. B. Gay lord, of Detroit, Mich., secretary and treasurer: J. C. Holt, of Mancelona, and William Gerhauser, of Detroit, sales agents! The office will be at 66 Newberry building, Detroit. It is the aim of the company to assist the purchaser of charcoal irons, the company furnishing such brands as may be needed, and being in position to give immediate attention to the wants of the trade. The different locations of the furnaces finds some of them making special brands of iron. Some are low in phosphorus, some are high, and the product of each being well known to the company, the latter will be well able to suit the wants of those who are looking-for special irons. It will be the aim to extend the use and field of these irons. Of late there has been a growing demand for charcoal iron, and by a concerted, well-directed advertising of their "wares" the company hopes to be able to assist the industry in this state. More attention will be paid than formerly to careful analyses of the irons for all service for which Salisbury, Southern and Swedish irons are used.

In the way of new furnaces there is always more or less talk. At Munising, in Alger county, where there are immense tracts of hard wood, an effort is being made to secure furnaces by those who are principally interested in the new town. The location is an admirable one, the fuel supply being ample to last for several years, there being also a snug harbor jutting out into Lake Superior from which the product could be cheaply transported.

The extremely low figure at which pig iron is now selling offers little inducement to the building of new stacks, but ore can be cheaply secured, and the site should have an advantage in the obtaining of cheap fuel.

At Gladstone the Pioneer's by-products amount to considerable, they consisting of wood, alcohol and grey ascetate of lime. The price of the alcohol has fallen considerably in price the past few months, quotations being seventy instead of ninety cents per gallon, which is a drop of no small proportions.

The consumption of our iron ores within our own state is an industry that should grow to vast proportions. The question of fuel is the important one. The operation of stacks using coke for fuel would add wonderfully to the importance of this mining region. Figures prepared by different people incline to the feasibility of the plan, but recent changes in the price of iron ores and in the freighting of ores from lake ports to the great manufacturing centers have probably somewhat changed the margins of a few years since. The matter is one that should receive earnest attention from those interested in the welfare of this iron ore-producing country. We have an unlimited quantity of lean ores that cannot stand transportation charges. Could these be reduced at home it would give employment to many thousand men, and increase the natural wealth of the region to a wonderful degree.

The amount of pig iron of all kinds produced in the United States during 1896 was 8,623,127 gross tons, as against 9,446,308 tons in 1895. Production greatly exceeded the consumption, the stocks unsold in the hands of manufacturers increasing from 444,332 tons at the beginning of the year to 711,649 tons at the years close.

Of the total production of pig iron in 1896 54% was bessemer. In 1891 the percentage of bessemer was 41.9, this showing the great increase favoring bessemer pig.

The production of basic pig for the year amounted to 336,403 tons.

The amount of steel rails manufactured during the year was 1,102,892 tons. The price was never so low in the history of the world as quoted in the spring of 1897, being $19.00 per ton.

The United States is now in the lead of all other countries in the production of pig iron and manufacture of steel. Owing to the very low price quoted for rails and other forms of steel, a considerable quantity of rails, etc., are being exported.

SANDSTONE.

The quarrying of sandstone was not as extensively engaged in for 1896 as during the previous year when 431,554 cubic feet were produced. The amount quarried for the year recently ended was 342,511 cubic feet. The prevailing depression in business has prevented the erection of as many fine, fireproof buildings as were constructed when business was more active, the sandstone quarrymen having shared in the prevailing dullness shown in nearly all industries.

The Michigan sandstone has received considerable attention of late, due to the investigation it received at the hands of a committee of Wayne county gentlemen who were interested in the building of a new court house for their county. The contract was secured by the representatives of the sandstone, and afterward was rescinded, the stone for the building being finally ordered outside of our state. In this contest for the contract by representatives of different stone producers, the charge of unstability of the Michigan stone was frequently made, but whether it affected the final result or not I do not know. In justice to the Michigan stone it is only fair to say that it has been employed in hundreds of heavy buildings in this country and Canada and everywhere, and in every instance has justified the claim that it has great sustaining power and does not suffer from disintegration upon exposure to the air. The following test, which, is a characteristic one, will be valuable in showing the strength of the stone:

MATERIAL TESTING DEPARTMENT
ORDNANCE SECTION WAR DEPARTMENT
EXHIBIT, WORLD'S COLUMBIAN EXPOSITION.

CHICAGO, Oct. 27, 1893.

Compression test of Portage sandstone specimen furnished by Kerber-Jacobs Redstone Co., Red Rock, Michigan:

Dimensions.	Area.	Load at rupture.	Load per sq. in.
5.98" x 5.98" x 5.98"	35.76 sq. in	199,800 lbs	5,587 lbs.

REMARKS—No indications of weakening till final rupture. Wet card board used on compression surfaces. Tested on Riehle Bros.' 200,000 lbs. machine.

H. H. TRACY,
Operator.

Approved,
A. H. RUSSELL,
Captain of Ordnance U. S. A. in Charge.

The stone has stood the severest test in fires. Many instances are known where, in large conflagrations, sandstone walls have stood intact while those of other stone crumbled to the earth. The following analysis gives reason for the stability of the material:

	PER CENT.
Silica	94.63
Protoxide of Iron	2.74
Aluminum	0.36
Carbonate of Magnesia	0.75
Carbonate of Lime	0.69
Water	0.74
Loss, etc	0.09
Total	100.00

With the excellent record the stone has made in cases of fire, and in buildings where it has long been in place, the Michigan producers naturally combat the statement that the stone is unfitted to enter into the composition of the largest and heaviest structures, and point to a long list of buildings throughout this country and Canada that have stood the elements satisfactorily.

The stone is one that works readily under the tool when first quarried, but which soon hardens upon exposure to the atmosphere. Its ease of cutting is a point of great advantage in its favor, this lessening the expense of construction, as the finishing of stones of harder nature is a slow, expensive task. Nor does the Michigan sandstone stain by exposure to the air as is the case with many stones of lighter color. The Michigan sandstone most in use is either the raindrop or red. The brown, so deep and rich in color, is not as extensively used as in years gone by for the reason that the supply has grown less, the beds being comparatively few and of small extent. The brighter and more cheerful reds are more plentiful, however, and any amount of them can be furnished upon short notice.

The marketable sandstones are generally found upon the western shores of Keweenaw bay, Lake Superior, and five concerns are equipped for its quarrying and marketing. Aside from these quarries many prospects have been worked upon and many failures have resulted. It often happens that the sandstone sheet, while it looks perfect to the uneducated eye, is unfitted for building purposes, and, while much has been done, from time to time, in exploring the shores of the bay, but few valuable areas have been located and developed. During 1896 there were but four shippers, the names and products of whom were as follows:

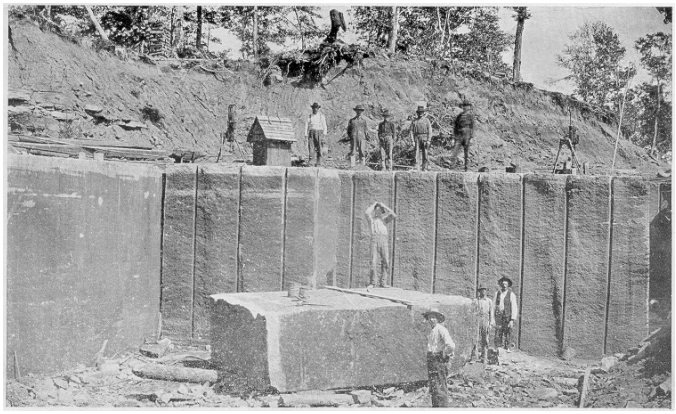
	CUBIC FEET.
Kerber-Jacobs Redstone Co.	125,000
L'Anse Brownstone Co.	21,000
Portage Lake Quarries Co.	176,511
Traverse Bay Redstone Co.	20,000
Total	342,511

The value of the stone varies, according to the quality and size, running from forty to sixty cents per cubic foot. It is readily quarried, there being anywhere from ten to twenty feet of overlying burden that has to be stripped from the marketable sheet. They are busy in the quarries about eight months during the year, the stone not being taken from the sheet in hard-freezing weather, as the frost is apt to injure it when "green."

THE EXCELSIOR REDSTONE COMPANY

did nothing in 1896. The year previous it quarried 45,000 cubic feet, and made their first shipment of 18,000 feet in 1894. They have a strata of marketable stone averaging eight feet in thickness, the quality being of the best. They are well equipped for conducting the work of placing the stone on dock, but there was little inducement for production during the year, the company supplying its customers from stock already on hand.

J. H. Seager is president; F. W. Rogers, secretary; J. B. Seager, local manager and superintendent, all of Hancock, Michigan, F. L. Smith, Detroit, Michigan, is general manager.



KERBER, JACOBS & CO'S REDSTONE QUARRY.

THE KERBER-JACOBS REDSTONE COMPANY

is one of the prominent ones, its general manager, Mr. J. H. Jacobs. Marquette, having been an active operator for many years in this state. During the year 125 men were employed for nine months at the quarries, and considerable development work was done. They added one forty-ton derrick, making four now in use of similar capacity; two Rand drills, making four in all, and one channeling machine, making two now in use. The

company has 424 acres of land favorably located in the sandstone area tributary to Keweenaw bay, and has at the present time 121,000 cubic feet of stone at Chicago, Cleveland, Buffalo and Detroit for general delivery. The quarry is at Redrock, Portage Entry. J. H. Jacobs, Marquette, is president and general manager; S. W. Goodell, Detroit, secretary; E. H. Towar, Marquette, treasurer.

THE L'ANSE BROWNSTONE COMPANY.

This company completed the enlargement to its dock that was under way at the time of my last report, and added another derrick, making two. The quarries are located at L'Anse, the stone being let down from quarry to lake shore by a double drum hoist. There is sixteen feet of water at the dock, and the company has everything to do business with. Owing to the dullness in the market during the year but 7,000 cubic feet of stone were shipped, leaving a stock on hand at the quarry of 14,000 cubic feet. The stone is of excellent quality and the firm is an enterprising one. Thirty-eight men are employed for four months in the year. Neil J. Dougherty, of L'Anse, is superintendent; W. A. Amberg, president; W. H. O'Brien, secretary, both of Chicago.

THE PORTAGE ENTRY QUARRIES COMPANY.

This is one of the oldest quarrying concerns in the state. Their quarries are located at Portage Entry and at Marquette, the greater product coming from the Portage Entry. They are well equipped for the business of producing stone, and have quarries of great value, being the largest producer in the business in this country. No additions in the way of machinery were made during the year 1896. The average number of men employed was eighty-five.

E. T. Malone, Security Building, Chicago, is secretary. This company, like others in the business, has a large stock of stone of all sizes on hand.

TRAVERSE BAY REDSTONE CO.

This company, one of the newest in the sandstone business in Michigan, shipped 6,500 cubic feet of stone in 1895, its first year, and produced 20,000 feet for 1896. Its quarries are located in Houghton county, Town 56, Range 31, and show sandstone of excellent quality covering an area of 120 acres. They have constructed a railroad eight miles in length from the quarries to lake shore and have a dock 1,100 feet long, 100 feet of which were built in 1896. They employed fifteen men for four months during the year.

Charles Hebard, of Pequaming, Mich., is president.

The sandstone business of the state of Michigan is destined, to assume much larger proportions than now. While creditable advance has been made during the past fifteen years, the excellence of the stone as a building-material, the many advantages it possesses, principal of which are its cheapness, durability, fireproof quality and beauty, entitle it to more general use. The quarrying and marketing of this stone will become an important labor-employing industry in the state, and add much to its value as a mineral producer.

MICHIGAN MARBLE.

Michigan has one active marble quarry, this being operated by the Northern Michigan Marble company. It began work in 1894 in a small way, sending out a few carloads of its products for the information of workers in the stone. The latter is a very bright, sparkling, carbonate of lime, very hard and tenacious, making it desirable for building or monumental purposes. In color some of it is pure white, some shading from white to pink, green, gray and purple, the latter making beautiful slabs for wainscotting and other interior work. It is somewhat granetic in nature, and the tests ordinarily given New England marbles will not tarnish the highest polish, the latter being almost equal to onyx. The price received is from $3 to $4 per ton for the rough rock produced in opening the quarry, and from $2 to $5 per cubic foot for sound, square-channeled rock. They have furnished marble for several large buildings, the users being well pleased with it. A school building at Marinette, Wis., is one of the structures most recently employing it. The location of the quarry is in Dickinson county, Sec. 26, Town 42, Range 28. There is a spur track connecting with the Chicago & Northwestern railroad. During 1896 the company erected a mill 50x300 feet, and they have a full equipment of boilers, engines and saws ready for installation as soon as business warrants. This industry, like many others, was injured by the business uncertainty of the year. Nothing has been done since September, 1896, at the mill or quarry. There were fourteen men employed for nine months in 1896, and 50,000 cubic feet of rough stone quarried.

A. L. Foster, of Foster City, Mich., is the superintendent; Edwin Porter, of Joliet, Ill., is president, and F. G. Wilcox, of the same place, is secretary and treasurer.

The company is capitalized at 50,000 shares, the stock being held by six persons. Work will be resumed as soon as the market will warrant.

Of the Ishpeming serpentines I hear but little. There is a constant inquiry concerning the different properties upon which the marble has been found, and the time will come when the field will be actively worked. Nowhere in the United States are such beautiful marbles found as here; nowhere else in this country are the verde antiques met with, and they are in such quantity that the supply is unlimited. With an improvement in business generally the serpentines will be given the attention their rare beauty deserves.

SALT.

Of the mineral of the state of Michigan salt commands a prominent place. Its total product amounts to 74,184,374 barrels. Were these barrels stood upon end the line would encircle the globe and there would be several thousand miles of barrels that could not be gotten into the big circle. This gives the reader some idea of the immensity of operations in the salt-producing district of this state. For years Michigan has been at the head in the amount of salt manufactured, and while the quantity realized from the operation of the wells during the year 1896 was considerably below that of the year previous, there is no diminution in the flow, the shortage being the result of the stoppage of wells for the business reason that the manufacture was found unprofitable. In the majority of cases the salt blocks are run in connection with saw mills, the latter providing fuel for the steam necessary, and as the mills have been reduced in number due to the denuding of the country of its timber, the active salt wells have also been lessened in similar ratio. At the low price at which the salt is disposed of in the market many of the wells could not be operated profitably unless in connection with the saw mills, and mills and blocks have both shown a decided falling off in numbers as compared to former years.

The average price of salt for the year was thirty-five cents per barrel, this including the cost of the barrel. Since the first of 1897, however, there has been an increase of ten cents per barrel in the price, the association having made two advances of live cents each. The business is in the hands of an association which has been in force since 1876.

The state is divided into nine districts composed as follows: District No. 1, Saginaw county; No. 2, Bay county; No. 3, Huron county; No. 4, St. Clair county; No. 5, Midland county; No. 6, Iosco county; No. 7, Manistee county; No. 8, Mason county; No. 9, Wayne county. All the salt of the state is inspected, and the amount of product above referred to is the amount inspected. The actual amount produced for the year was 3,968,344 barrels, there being 632,102 barrels in bins at the close of the year that were not inspected and were produced during the year.

The quantity inspected for the different districts for the year was:

	Bbls.
District No. 1	428,495
" No. 2	365,034
" No. 3	2,265
" No. 4	310,917
" No. 5	24,356
" No. 6	139,715
" No. 7	1,416,709
" No. 8	546,843
" No. 9	110,508
Total	3,336,242

The inspection as to grades during 1896 was as follows:

Fine, barrels	2,677,489
Fine, bulk	585,210
Packers, barrels	11,066
Fine packers, barrels	6,829
Solar, barrels	28,869
Second quality, barrels	26,779
Total barrels	3,336,242

Three salt plants were destroyed by fire in 1896, and none of them will be rebuilt. The new plants are: Buckley & Douglass, Manistee, grainer and vacum pan process, estimated capacity 2,000 barrels a day; Carter Salt company, Wayne county, open pan block, capacity 150 barrels a day; Tecumseh Salt company, Wayne county, two vacum pans, capacity 1,500 barrels per day. Indications are not favorable for an increased production in 1897, and there will probably be a considerable falling off as compared to the past year.

The total number of firms engaged in producing salt for the year was sixty-nine. Blocks, seventy-three, solar salt covers, 3,000. Total manufacturing capacity 6,500 barrels. The number of active firms was forty-one less than for the year 1895.

Salt was first produced in Michigan in the year 1860, and its development was largely due to the efforts of Dr. Douglass Houghton, our first state geologist, who called attention to the favorable indications in the Saginaw valley, and who secured the consent of the state legislature to sink a shaft for salt, a work that was begun in June of 1838, at a point about half a mile below the mouth of Salt river and upon the west side of the Tittabawasse, on Section 24, town 15 north, range 1 west. The shaft was abandoned, by recommendation of the legislature, after the appropriation for its sinking was exhausted. The shaft had reached a depth of 139 feet, and the objective point was 700 feet deep. In the year 1859 another attempt was made at reviving the work for salt-producing areas, and the legislature offered a bounty of ten cents per bushel for all salt made, and exemption from taxation from all capital employed in the business. The bounty law was soon afterward repealed. A well was commenced at Grand Rapids in the summer of 1859 and was sunk 259 feet. It was a failure, as but little chloride of sodium was found in the water. In the same year a company was formed to manufacture salt in Saginaw, and a boring was made to a depth of 647 feet, finding brine of great strength. A second well was put down, two blocks completed and the packing of salt began in 1860. Up to 1870 the industry was a losing one. There was a lack of knowledge concerning the manufacture, and the brine was not properly handled. It contained iron that caused rust, bromide of sodium which made it bitter, and gypsum which made it cake. Improper methods did not tend to assist the good name of the Michigan product, and the legislature in 1869 passed a law by which an inspector was chosen, and the salt manufacturers imposed upon themselves a tax covering the expenses of conducting the office. The quality having thus been protected, the matter of sales of the product was next improved by forming an association, in 1876, for the handling of the manufacture

of the united concerns of the state. This has been kept in force ever since, and has operated to the good of the industry, so that today Michigan is known for the excellence of her salt, and it finds a prominent place in the market.

On the Saginaw the wells are from 700 to 1,000 feet deep. On the St. Clair river rock salt was found 1,700 feet, and at Manistee, on Lake Michigan, it was found at a depth of 2,100 feet. In making the boring a casing from five to six inches in diameter is first placed to the ledge, below which point the size of the hole is reduced to 3 or 4 inches. The purpose of the larger casing is to exclude the surface water. If rock salt is found at the bottom of the hole fresh water is forced down from surface. The water dissolves the salt, and picks up about 24% of the latter, and is forced to surface in an inside pipe by the pressure of the fresh water being sent into the boring. This is the method observed on the St. Clair river.

On the Saginaw rock salt has not been encountered, the borings never having been made deep enough to find it. The valley is an old ocean bed, very deep, and in the lower portion of the basin rock salt undoubtedly lies, but it is too deep for practical recovery. The salt of the Saginaw is found in "waverly" rock, coarse and porous, that retains the brine. This "waverly" rock outcrops along Lake Huron's western shore and undoubtedly under the lake, where the fresh water of that body find it way through the porous stone to the bottom of the basin, dissolving the rock salt and forcing it upward, filling the "salt rock" with brine, and forcing it in fractures of the rock so near surface that fresh waters come down to meet it and the salty water rises to surface, on the principle of the syphon, making salt springs.

The salt wells yielding from 400 to 600 barrels of brine per day, will become clogged in time, the pores of the rock becoming filled by constant pumping. The remedy for this trouble is the lowering of a cartridge of nitro-glycerine into the hole and its explosion by dropping an iron weight upon it. The same plan is adopted for the reviving of oil wells. The brine is run into tanks sufficiently high above the ground to permit of "settlers," a lower tier of tanks inside of the "salt block." These outside of the upper tanks are made of three-inch plank securely bound together and caulked to prevent leakage. They hold about 25,000 gallons of brine. On top of these tanks are boxes holding about a barrel of water, and into which, with the fresh water is placed freshly-burnt lime. When the big tank is filled this "cleanser" is emptied into it, the whole being freely stirred. The lime takes up the carbonic acid, releasing the protoxide of iron which falls to the bottom of the tank. The pipes that draw off the brine from the tank are inserted into the latter six inches above the bottom, so that the iron falls to the bottom, the clear brine only being drawn off. The latter then goes into the "settlers" in the block. The latter are heated by steam, which passes through galvanized iron pipes, creating a heat of 175° Fahrenheit. The heating throws down the gypsum which exists in the brine as a sulphide, and it evaporates the water, 75% of this having to be gotten rid of before crystallization takes place. Then the salt is run off into the "grainers," that occupy a still lower position, and through which galvanized iron pipes fourteen inches in diameter are run. From these grainers the dried salt is run into the bins from which it is packed for the market.

GOLD AND SILVER.

GOLD.

Despite the fact that there are many promising gold-bearing tracts in Michigan, there is but one mine working. Gold has been found from time to time for the past forty years in this region, but little has been done in its mining. There are many quartz veins that have shown gold at grass roots, but there seems lacking the proper spirit to delve for the precious metal. Mines of copper and iron ore have been sought energetically, failures have been numerous, but little time has been spent in the development of veins carrying gold. The single property being wrought, and one that has been active for the past thirteen years is

THE ROPES MINE.

This is the property of the Ropes Gold & Silver company, the word "silver" finding place because a small percentage of that metal forms a portion of the product of the mine. The location is five miles north and west of Ishpeming. The Ropes has been striving, in a modest sort of way to give something back to the shareholders for the money they have contributed in the equipping and starting of the enterprise. As yet it has been unsuccessful in this, and has a small indebtedness that it is trying to liquidate. This has not been an easy task because of the fact that the mine has not been operated in a way to obtain the best results from the lode. There has been a scarcity of funds with which to properly conduct underground work, this rendering the latter more expensive than it should have been, and preventing the opening of territory ahead of actual stoping ground from which a product of uniform volume could be maintained.

The Ropes has a single shaft which is to the 15th level, 850 feet from surface. It is well located, as ore bodies occur both to the east and west of it. For some years all the mining has been done to the east of the shaft, the lenses that the shaft was sunk through near surface and continuing downward to the 9th level, having given out, and their places have been taken by new lenses found furrier east. To the west of the shaft a short distance a grossing of limestone occurs. This belt of lime has a thickness of 25 feet, and has been found from surface to the lowest portions of the shaft. The former management believed that this cut off all other ore bodies in that Section, so devoted their energies to the lenses upon the opposite side of the shaft. Last winter

Mr. Rood, the manager, thought it would be well to test the ground to the west, and put in a few men to extend the fifth level drift. This passed through the limestone and encountered a fine lens of quartz, which has been sunk upon for about 30 feet, and has a width of about 30 feet, ten or twelve feet of which is rich in gold. Assays taken during the past few months show from $9.00 to $12.00 per ton, the gold being free milling. They have not been able to get much of this to the mill as yet, but are preparing to open it out so that they may stope to advantage. They started a drift to find the lens from the 7th level, but it has been discontinued owing to lack of money for doing anything in the line of dead work. This lens of ore has a slightly northerly pitch, but is almost vertical. Where encountered upon the 5th level is about 200 feet west of the shaft, being 150 feet further in that direction than any quartz bodies thus far located in the mine. The addition is certainly a promising one, and there is no reason why it will not continue upward to surface. Other lenses undoubtedly will be found to the west of the limestone, as the ore formation is wide, and similar to that to the east of the shaft.

The shaft having run out of the ore was stopped at the 15th level, and at 300 feet east, where the ore body lies, an incline was started. This was carried downward 100 feet, the hoisting being done from surface by a suitable arrangement of pulleys. The sides were then stoped down, and they have sunk a winze about 25 feet below the bottom of the incline, carrying it downward in V-shaped form and afterward trimming down the sides. They have opened out upon this lens of ore for about 300 feet in length, and the quartz vein will average 12 feet thick, varying considerably in its holding of gold, but all being "pay." The walls are very regular, there not being a break in them for this distance. The formation is more uniform than at any other place in the mine, and the vein looks as if it might go downward indefinitely.

The transfering of the rock necessitates the employment of several extra men, adding considerably to the cost. They are simply working from hand to mouth. If there is a poor stretch of ground it has to go to the mill, as there are no reserves to draw from. What is needed is to sink the main shaft several levels, to open up ground ahead, and to have a chance to select when poor territory is encountered in the stoping. The ore body being sunk upon west of the shaft is gradually making closer to the shaft, and eventually will probably reach the latter. The sinking would bring the shaft to pay ground lower down in the western extension of the pay chute. Could the mine be so opened up it would certainly pay a profit. The rock is rich enough if it could be mined and hoisted as cheaply as it should. Twenty-thousand dollars put into opening up new levels and sinking the shaft would be a great help to the mine. The property is well equipped, has forty heads of stamps in excellent condition, and the air compressor and hoist is ample for some years to come. No water is found in the lower levels, and very little in the upper. The pumping charges amount to but little. The walls in the mine need no timbering.

The fact that the vein is found so regular and strong at a depth of 975 feet is certainly favorable to the property, and suggests that there is a future for the mine that will not be as full of trouble as the past. It needs a little help, and a very little. With its indebtedness relieved and a few thousands to sink and open its property it could pay dividends. The Ropes has developed but a small portion of its lode, 500 feet on the strike having been reached by underground openings. Good ground is known to exist 1,500 feet further east.

There is an abundance of water, this being secured by a pump that is driven by water power from the Carp river, the plan being inexpensive and one that insures a constant supply.

For the fiscal year ending March, 1897, there were treated 16,686 tons of rock that gave a ground yield of $2.32 per ton, and a net yield, after paying smelting and transportation charges of $2.04 per ton. The gross yield exceeded that of the previous year by $2,633.57, it amounting to $38,845.42. The bullion amounted to $29,747.61, the yield for the different months being as follows:

March	$2,534.59
April	2,750.49
May	2,875.49
June	1,648.36
July	2,668.03
August	1,928.46
September	2,171.18
October	2,562.83
November	2,172.70
December	2,654.88
January	3,117.28
February	2,663.32
Total	$29,747.61

The bullion gave a net product of $29,627.61, the mint charges for the year being $120.00. The gross concentrates amounted to $8,977.81, and the net concentrates to $4,401.01. The concentrates for the beginning of the year ran very low. For April there was a gain in production, and for May a much greater advance is expected, due to the rich rock that is being found.

The Ropes rock is not the easiest to stamp. There is considerable talc that acts as a cushion under the heads, and has a tendency to clog the screens. In the latter line mesh has to be used, it being 50 to the inch. There are 20 stamps weighing 750 pounds each with 7-inch drop, striking 63 blows per minute. These treat about 1¼ tons in 24 hours. The other twenty are heavier weighing 850 pounds, have 8-inch drop, and treat about 14 tons every 24 hours. The batteries have self-feeders that handle the rock satisfactorily. The wire screens are 7 inches wide by 4 feet 10 inches long. Considering the disadvantages under which the Ropes has operated it, the wonder is that it has held on so long and done so well. It has now an excellent management, skillful and economical. W. H. Rood is general manager; Thos. Robbins, mining captain, Ishpeming, Michigan. A force of 35 men is employed. The total gross yield of the mine amounts to $643,902.37.

There is nothing new to report at the Michigan gold mine. I call it "a mine," because it is generally so referred to, although it was nothing more than an

exploration when it was closed down. Two shafts 50 and 70 feet, were sunk. From these some of the finest gold specimens ever seen were exhibited. Pieces of rock weighing several pounds were as full of gold as the richest conglomerate is in copper. These specimens were much discussed, and led to the buying of many shares in the company at prices ranging from $1.00 to $3.00 each. The rich pockets gave out at the depths in the shafts indicated, and nothing has since been done in following downward upon the vein in the hope of finding pay chimneys again. Had such a find been made in the west the country would have gone wild over it, but here, in staid old Michigan, it was not considered an event particularly worthy of excitement. People are not yet properly educated to the full value of the meaning of such rock as the Michigan yielded. The lands are owned in fee by Peter Gingrass, of Ishpeming, and the Michigan Mining company is still in force as an organization, but doing nothing in the way of mining. At no place is greater encouragement offered for systematic exploration than here. In the immediate vicinity several pits were sunk a few years since and gold found, but there was not the money to properly develop the veins and they have been abandoned.

To the east of Deer lake, upon section 36, C. T. Fairbairn and Wm. Brooks, of Ishpeming, did some exploring the past summer. A shaft was sunk 20 feet and specimens of rock showing free gold were found. The average yield of the rock was not satisfactory, however, and the property is now idle.

The Dead River district, a separate one from the Ishpeming, and one of the most promising, is idle. Several prospects were worked for a short time and one of them, operated by the Fire Centre Gold Mining company, gave $2,063.00 from a shallow shaft. The vein appeared to pinch out, and was not sought further. The quartz here is in the granite, wheaeas the ore bodies of the Ropes are in the serpentines. The Michigan and neighboring veins are in diorite.

Upon the Menominee iron ore range, near Pine creek, some testpitting was done and specimens showing well in gold were taken from them. No work is being done in the way of developing the veins. The latter are in the granite.

With the increasing interest being taken in gold mining, Michigan will probably receive more attention in future than in the past. There are many promising fields deserving of investigation.

The silver produced in the state of Michigan is obtained in association with the native copper, and in the ores of the Ropes gold mine. It is all native metal. About $60,000 per year are obtained from these sources. There are no mines working silver alone. In association with lead it is found in several places, but not sufficiently plenty to give a profit from the working. Silver lead is found at many places in the upper peninsula, but no deposits are being wrought.

PRODUCTION OF GOLD AND SILVER.

The Ishpeming gold field has produced of gold and silver, fully 80% being gold, to the value of $664,484.73, made up as follows:

Ropes Gold & Silver Co.	$643,902.37
Michigan Gold Co.	17,699.36
Fire Centere Gold Mining Co.	2,063.00
Various Prospects.	820.00
Total.	$664,484.73

For the year 1896 the United States exceeded all other countries in the production of gold, the value being $52,886,200. The leading states contributing to this grand total, were California with a product valued at $15,235,900; Colorodo, $14,867,971; Montana, $4,324,700; South Dakota, $4,919,000. The production of silver for the United States amounted to $39,245,991, the average value being 65 cents per ounce. The great gain in gold production is due to improved methods and a better knowledge of the mining and milling business. Old mines have been re-opened and where failure attended the effort for success in years gone by they are now earning neat profits. In the very shadow of Pike's Peak, where failure attended the early struggles, there is now one of the most prosperous gold mining districts in the world, this having sprung into prominence in a very few years. Michigan will yet be prominent as a producer of gold. The rocks are here, they hold gold, and all that is needed is for competent men to search and spend money in systematic exploration.

COAL.

Michigan, while it has coal mines, is not a large producer of this mineral. The trouble has been that the seams are too thin to permit of a product that would permit of competition with other states where better natural advantages for ready and cheap production are had. Many attempts have been made at different sections throughout the central and southern portions of the state to secure coal in greater quantity than heretofore found, but little improvement over the old seams has been made. The coal veins of Michigan run from 2 to 4 feet in thickness, and the strata is found at a depth from surface of from 125 to 150 feet. Where worked, the coal is generally disposed of to railroads running close to the mines, and is also retailed to those who live in the immediate neighborhood. Much of the coal is of excellent quality, a little being suitable for cokeing. The price secured for the product at the mines is about $1.35 per ton, this being paid by the railways which are the heaviest consumers. In a retail way about $2.00 per ton is secured. The wages paid the miners run from $1.00 to $1.50 per day, much of the labor being performed by farmers who live near the mines and who have a certain amount of time they can spare for such work.

At Bay City two new mines have been opened these being the properties of the Bay Mining company and the Monitor Coal company. The mines are located five miles

from Bay City, and the product has been carried to town by teams, an expensive method. The companies are talking of securing a spur track from the mines to Salzburg to connect with the Michigan Central and Grand Trunk railways.

The Monitor's product for 1866 was 8,000 tons, it working but eight months of the year. It has one shaft 140 feet deep to the coal seam, which latter is 3½ feet thick. Forty men are being employed. They talk of putting down a second shaft and equipping it with a modern plant of machinery. It has doubled its capital stock having this object in view. They believe they have a mine that will warrant the expenditure proposed.

The Bay Mining company has been working but a short time, only two months during 1896, it being a new concern. It has been employing 27 men getting a shaft down and opening up the seam. The shaft is 140 feet deep and the coal seam is 3½ feet thick. They expect to mine as soon as they get in shape, 400 tons per day. They lack railway facilities as yet.

The Sebewaing Coal company is the largest producer, its product for 1896 amounting to 27,996, the mine being worked on about half time, the force of men employed when the property was working consisting of 65 men. They have one shaft to the coal seam, it being 125 feet from surface. The seam here is thicker than at other properties, being 4½ to 5 feet. No improvements in the way of machinery were made during the year.

The Corruna Coal company produced 14,221 tons of coal during the year.

The total product for the year of the mines wrought amounts to 50,953 tons as against 50,764 mined in 1895.

At Williamston, Michigan, some work was done during the year in exploring for coal in that vicinity. A seam 30 inches thick was found 18 feet from surface, and a second seam larger than this was encountered at 45 feet, slate forming the hanging of both seams. An effort will be made to develop the property during 1897.

Should Michigan develop a sufficient quantity of cokeing coal to provide fuel with which to smelt her iron ores, it would be a wonderful gain to the iron business of the state, as the distance between the iron ore fields and the cokeing coal districts is great. As yet there have been no mines discovered that would suggest an adequate amount of coal for such purpose. Could they be had they would be of great profit to the owners and to the iron men as well.

GYPSUM.

The gypsum products fell off considerably in 1896 as compared to the year previous, this being due, the manufacturers inform me, to the great competition in the business. The amount of the mineral produced was 56,000 tons as against 75,300 for 1895. The most of the product was in the shape of calcined plaster.

The mills operating in Kent county are The Grand Rapids Plaster Co., Grand Rapids Gypsum Works, F. Godfrey & Bro., Alabastine Co., and Gypsum Plaster & Stucco Co.

In Iosco county, the Western Plaster Works is the only concern now in the business.

The mining is all done in two or three months during the year, and it takes but few men to operate the mill, so that the industry, so far as the employing of labor is concerned, is not of great importance. In point of quality the gypsum equals the best found anywhere. The value of the product is diminished very much from former years, the production being so general throughout the United States. The Michigan quarries are sufficiently large to meet the greatest call that can possibly be made upon them.

TALC.

This mineral is found in Marquette county, in the serpentine range of hills to the northward of the city of Ishpeming. As yet it has not yet been mined, but there is talk of beginning work at several points where the showing is remarkably good. Specimens shown me have fine, white, long fibre, fully equalling the New York state mineral which now is principally used in this country. It finds its way into the sizeing of paper and as an adulterant.

ASBESTOS.

Michigan has several districts where this mineral occurs, but generally the quality is not first-class. In a few places, however, the quality appears to be all right, and tests are to be made of it by consumers. In Marquette county, sections 29 and 30, town 48, range 27, on lands owned by the Deer Lake company, of Ishpeming, fine specimens are found, the fibre being from one inch to one inch and a half long, and equalling the Canadian product that furnishes the principal supply in our country at this time. The price ranges from $50 to $200 per ton, according to quality. It finds place in packing for steam joints, in the manufacture of fireproof clothing, etc.

GRINDSTONE.

In Huron county are found large deposits of stone suitable for grindstones and whetstones. Grinstone City, on the shore of Lake Huron, has a national reputation for its grindstones and blue whetstones. The principal manufacturer is the Cleveland Stone company that produces about $45,000 worth annually.

At Bay Port, twenty-four miles southwest from Gindstone City there, are grindstone quarries, but they are worked but little.

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.

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 generally distributed throughout the entire state of Michigan. The manufacture of lime is carried on at several points, Bellevue being noted for its line 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.

MARL.

Marl is extensively found throughout the state, generally in swamps underlying the muck, or peat. In the lower peninsula in early days it was burned in kilns for quicklime. At the present time there is springing up a new industry in which marl is playing an important part, viz. in the manufacture of cement. The product of the combination of marl, clay, and other materials makes the strongest and best cement known, and the manufacture is going to be an important industry in this state. For the purposes of cement-making there must not be too much magnesia or aluminum, as an excess of these minerals is injurious. The United States manufactures but 8fo of the cement it uses, so that if the marl can be employed and furnishes an article equal to the best imported, (which it is claimed for it), it will be an important gain for this state. Several concerns have begun making the cement this year, 1897, and at least two companies have been projected to carry on the business in Michigan. A marl that is physically well adapted to the cement making is found on section 31, town 47, range 27, Marquette county, upon lands owned, by the Cleveland-Cliffs company. There is a large deposit of it, sufficient to insure supply for a cement mill for a great many years. Steps are now being taken to erect a plant for the manufacture. The business at the present time is said to give large profits, and this is an encouragement for capital to invest in the enterprise. The marl of the section above mentioned contains about 1½% magnesia, which is not undesirable, and it is also right as to aluminum. The marl is finely ground, subjected to great heat in a rotary oven, and the process of mixing, etc., requires considerable skill. One of the leading professors in chemistry of Cornell university has been engaged at a high salary to take charge of a New York manufactory.

Besides its value as the base for cement, marl is also an excellent fertilizer for soils in case it contains phosphate. The Michigan deposits do not always possess this element, and are therefore not used for fertilizing purposes.

GRAPHITE.

Baraga county possesses the only deposit of graphite that is worked, and it is operated in a spasmodic sort of way, the demand for the mineral not keeping the property active. For five years it has been idle.

The location of the mine is eight miles south of L'Anse, occupying section 16, 49-33. It is operated by the "Detroit Graphite Manufacturing" company," a Michigan corporation with office at Detroit. R. A. Parker is president; A. A. Boutelle, treasurer and. manager. There has been mined in all about 1,000 tons of the mineral which has been largely used in the manufacture of paint. Mr. Boutelle thinks they will need about 600 tons during 1897, which amount will be shipped to the company's mill at Detroit. R. R. Williams, of L'Anse, has had charge of the mining work whenever the latter has been engaged in.

No other use than the one referred to has thus far been made in the Baraga county graphite. There are several other deposits than the one given attention, and at some point the quality may be better. The mineral is found at several places in Dickinson county, and small seams occur in Marquette county.

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.

RAILROADS.

The railroads of the upper peninsula are finely equipped for the transportation of iron ores and copper rock, etc., from the mines of this region.

The Chicago & Northwestern has five docks at Escanaba with a total capacity of 151,218 long tons. At Ashland, Wisconsin, they have a dock with a capacity of 61,500 long tons. The road hauls ore from the Marquette, Menominee and Gogebic ranges to Escanaba and from the Gogebic range to Ashland, handling more than any other line. The shipments from Escanaba, which are shown upon page 102 of this report, are all over this line. The distance from the mines of Ishpeming. on the Marquette range to Escanaba, is 65 miles; from Crystal Falls, on the Menominee, 82 miles; from Iron Mountain, Menominee range, 52 miles; from Ironwood, on the Gogebic range, 184 miles. At Escanaba there is plenty of water to float the heaviest ore carriers weighted to their utmost capacity. The company has 3,500 cars on its Peninsula division, and 1,100 on its Ashland division.

The Wisconsin Central has one dock at Ashland with a capacity of 40,000 tons, being one of the finest docks upon the lakes. The ore business of this company is all secured from the Gogebic range. The distance from Athland to the principal mines of the Gogebic range is 45 miles.

The Marquette range has four lines over which it can ship its product, these being the Chicago & Northwestern; Duluth, South Shore & Atlantic; Lake Superior & Ishpeming and the Chicago, Milwaukee & St. Paul. The L. S. & I. is an ore line running between Ishpeming and Marquette, a distance of 15 miles. It was completed to the Ishpeming mines in the spring of 1897. It has a fine equipment of rolling stock and one dock at Presque Isle, near Marquette, with a capacity of 30,000 tons. It is the property of the Cleveland-Cliffs company and the Pittsburgh & Lake Angeline Iron company, whose mines are located at Ishpeming, and who furnish the principal business for the road.

The Duluth, South Shore & Atlantic has three fine docks with a capacity of 70,000 gross tons. It is well prepared to take care of the business of the mines. They possess 3,500 ore cars and have fifty miles of side tracks for the facilitating of the iron ore traffic, and the value of property used for ore transportation, including the docks, is over four millions of dollars. The distance to Ishpeming, the principal centre of the Marquette range ore business, is 15 miles.

At Gladstone there is one dock the property of the Minneapolis, Sault Ste Marie & Atlantic railroad company. This has a capacity of 16,000 tons.

The great bulk of the ore is hauled to these docks and loaded into lake ore carriers. There is about 250,000 tons annually carried direct from mines to furnaces by all-rail.

In the copper district there has teen no building of new lines. Spur tracks at the Franklin Junior and Wolverine mines are under way, there have been repairs and improvements, and there is talk of widening the gauge of the Mineral Range from Houghton to Calumet, which is now a narrow one.

The Huron Bay railway, built between Champion, Marquette county, and Lake Superior, has never been operated. There was an ore dock constructed at the lake terminus, but it has been unused. There are also docks at St. Ignace. the property of the Duluth, South Shore & Atlantic railway, but no ore is now sent to them, the company handling all its ores from Marquette.

FATALITIES IN MINES.

Mining is a precarious vocation, and despite the greatest care upon the part of men and officers fatalities continue to occur. Many are from falling ground, many are the result of carelessness on the part of men, and the accidents occuring to inexperienced men are not infrequent. Nearly all of the mines are well lighted, many of them with electric lamps, nearly all are well ventilated, and there are now mine inspectors for each county where ruining is prosecuted in the upper peninsula whose duty it is to look over the underground workings and to correct any faults they may be able to find. In all instances, so far as I have been able to learn, these officers have given excellent attention to their duties, and have been given every assistance by both companies and men.

The total number of men killed out of about 18,500 employed during 1896 was 83, the following being the number reported from the different ranges:

Houghton Co.	19
Marquette Co.	25
Dickinson Co.	13
Gogebic Co.	16

This exceeds by eight the number that were killed during the year 1895.

The inspectors for the different counties are as follows: Houghton, Josiah Hall; Marquette, Jas. Rough; Dickinson, Wm. Trestrail; Gogebic, J. H. Taylor; Iron, A. Gulgren. These officers are chosen by the boards of supervisors of the different counties, and hold until their successors are appointed, there being no term of office given in the law which created it.