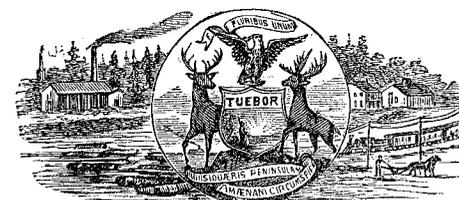


ANNUAL REPORT
OF THE
COMMISSIONER
OF
MINERAL STATISTICS
OF THE
STATE OF MICHIGAN,
FOR 1880.



BY AUTHORITY.

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OFFICE OF COMMISSIONER OF MINERAL STATISTICS, }
Marquette, Michigan, June, 1881. }

HON. DAVID H. JEROME, *Governor of Michigan*:

SIR,—Herewith, in compliance with law, I have the honor to submit the annual report of the Commissioner of Mineral Statistics, for 1880.

Part I is taken up with the copper district. Commencing with the earliest period the development of the region is traced to the present time. An account, historical and descriptive, is given of all its copper mines and other important industries and resources. Much pains have been taken to make the sketches of the copper mining companies as complete and accurate as possible. In collecting the requisite information, aside from a personal examination of the mines, recourse has been had to the printed reports of the companies, to published accounts relating to the early history of the country, to geological reports, etc.; also numerous facts have been furnished by the old residents and mining men.

In order to render the report on the copper district more satisfactory and complete, longitudinal sections of many of the copper mines have been added. These sectional maps are drawn to a scale and each one shows the underground workings of the mine represented up to the close of 1880. These maps thus brought together in this accessible form will be found, it is believed, to be exceedingly valuable as a matter of comparison. They also illustrate, in a measure, the written descriptions, and will enable those who are familiar with this most interesting and important industry to better understand the methods pursued in the prosecution of underground mining work. This portion of the report was prepared by Prof. C. D. Lawton, who spent several months for me in the copper district.

Part II relates to the iron industry and includes a description of nearly all the iron mines of the State. To Prof. Lawton was also allotted the task of examining and writing up some of the iron mines.

At the close of Parts I and II will be found statistical tables of the copper and iron ore mines.

There has also been incorporated some pages of statistics taken from the preliminary report upon the Iron and Steel Industries of the United States from the tenth census of the U. S. These statistics were collected and published by Mr. James M. Swank, special agent of the census office, and are herewith given with his consent.

I am, very respectfully, your obedient servant,

CHAS. E. WRIGHT,
Commissioner.

EARLY HISTORY.

Prior to the admission of Michigan as one of the States of the Federal Union, the Territory claimed as a valued portion of its domain a strip of land bordering on Lake Erie, in which was included the now flourishing city of Toledo. The right of possessing this parcel of land was insisted upon with equal strenuousness by the State of Ohio, and when, in 1835, a convention assembled at Detroit and formed a constitution defining the boundaries of the proposed State, and comprised within them this disputed territory, so great did the excitement become that men upon both sides began to arm and to organize for a conflict, that for a time it seemed must inevitably occur. The matter coming before Congress on the application of Michigan to become a State, that body passed an act admitting her into the Union upon condition that she should relinquish her claim to the disputed territory.

A sugar-coating was given to this bitter pill by offering to her people, in lieu of the coveted territory so strenuously claimed, the isolated and little regarded region known as the Upper Peninsula.

A convention being called soon after, these conditions were indignantly rejected; but a second convention, acting upon the matter in December of the same year, concluded discretion to be the better part of valor, and reluctantly accepted the proviso, and in January thereafter (1837) Michigan was admitted into the Union.

Thus it is exactly 44 years since the Upper Peninsula was given to Michigan by Congress as the final settlement of a serious dispute; it was thrown in, not as possessing intrinsic value, but to soothe the pride of an irritated people. The magnificent territory thus acquired was given as an offset to a mere strip of land insignificant in comparison, yet which was nevertheless regarded as of far greater value. But slowly the people of our State have awakened to a knowledge of the magnitude of their gain in the exchange which was thus thrust upon them. We are coming to realize that our State possesses in this northern peninsula one of the most wonderful and valuable regions within the limits of the national domain. Rich it is in minerals in an unparalleled and almost to an incredible degree, producing ores of iron unsurpassed in quality and unequalled in richness, and native copper in an abundance and of value found nowhere else.

The possession of this country, known as the region of Lake Superior, as a portion of the territory of the United States is said to be due to Dr. Franklin, who, while in Paris, in the days of the American Revolution, representing the interests of the struggling colonies, became acquainted through the records of the government departments to which he had access, with the reports that had been made concerning the existence of copper along the margin of the Great

Lake; and thus conceiving the region to possess a possible mineral value that would be available at some future period, he subsequently in arranging the treaty with England, in which she acknowledges our independence, drew the boundary line so as to include the south shore of Lake Superior within the limits of the new nation.

Remote as this region comparatively yet remains, even after the lapse of two centuries and a half since it was first visited by the zealous representatives of the French nation, it was in fact the earliest discovered portion of our great Northwest. But while other and apparently more favored sections became the marts of commerce and teemed with civilized life, it was two centuries after the advent of the white man before the waters of the Great Lake bore other than the canoe of the red men or of the venturesome *voyageur*; And the primitive solitude of the sombre forests which skirt its borders remained equally unbroken. The motive that stimulated the early discoverers to penetrate to this far-off coast was other than mercenary. They came simply as the representatives of the cross, and sought only the spiritual conversion of the Indians. Zealous to spread the faith among these rude savages, the Jesuit fathers explored the rock bound coast of the Great Lake upon which they were the first to enter and fearlessly penetrated the trackless wilderness which surrounds it, meeting innumerable dangers and perils—even death itself—with simple but undaunted courage.

Vain and futile as their efforts proved to be in behalf of the cause which they labored to promote, they yet builded better than they knew. The record of their adventures and discoveries, inscribed by their own hands, constitutes an imperishable monument to their memory. The volumes containing the manuscripts of these Catholic missionaries, who traversed the shores of Lake Superior during the time of French supremacy, comprise all that is known of the early history and discoveries in the Northwest.

The religious impressions which the teachings of these worthy missionaries made upon the savage mind faded and disappeared when the presence of those who had inculcated them was withdrawn. These pious doctrines found no sustaining element in this uncongenial soil, and the church which the missionaries had sought so zealously to establish, like the house that was built upon the sand, soon crumbled into fragments. And were it not for the written accounts which have been given of their undertakings there would be naught to show that their efforts had ever been made.

But while the priests met with no measure of permanent success in behalf of the immediate object of their labors, they yet, fortunately for the historian, transmitted to writing accounts of their journeys and of their observations, and these "relations," which were preserved and have been published, are justly esteemed among the most invaluable contributions to the early history of our country.

The first exploration of the country bordering on Lake Superior was undertaken by Charles Raymbault and Isaac Jogues, two Jesuit priests, who, with a party of Hurons, landed at the Sault de Ste. Marie in the fall of 1641. Here they met a large body of Indians encamped upon the banks of the river engaged in catching fish in the rapids, and from them they learned that these waters were the outflow of a great lake lying beyond, which they designated as Kitchigummi, or Big Lake, as it exceeded, as they declared, in dimensions any other of the great lakes.

In the following year, Raymbault, having died at Quebec from the effects of his previous exposures, Jogues set out with some Huron attendants to revisit

the Sault, and to extend still further his knowledge of the country and his intercourse with the tribes who inhabited it; but almost at the outset of his expedition, himself and party were captured by the Mohawks, and after suffering the most cruel torments, short of death, and witnessing the burning of his companions at the stake, he was finally ransomed by the Dutch, at Albany, whence he proceeded to France, but soon after, with unabated zeal, he returned to the scene of his former labors.

Pierré Mesnard set out from Quebec in 1660, and having arrived at the Sault, proceeded in his canoe along the south shore of the lake to the head of Keweenaw Bay, where he remained through the winter, laboring to promote the spiritual welfare of the Indians. In the following summer, accompanied by a single Indian, he entered Portage Lake intending to cross the peninsula and to push westward along the shore beyond; but while his guide was engaged in conveying the canoe across the Portage the good father wandered into the woods and no trace of him was ever afterwards obtained.

In 1666 Claude Allouez established a mission at La Pointe, in Chaquomegon Bay, where he remained for two years extending his travels and his teachings among the Indians who gathered in great numbers to listen to his wonderful disclosures.

Allouez makes mention of the veneration in which the lake is held by the savages who worship it, he says, as a divinity, and he also states that he has observed that they have in their possession pieces of copper, which are sometimes of a considerable size, which they esteem as domestic gods.

Claude Allouez returned to Quebec to secure aid for his mission, but such was his zeal that in two days thereafter he again started to go back to the scene of his labors.

Two years subsequent to the establishment of his mission at La Pointe, James Marquette and Claude Dablon founded a permanent mission at the Sault de Ste Marie, and from this period the place dates its settlement, making it thus the oldest within the State. A grand council with the Indians was held and formal possession of the country was taken in the name of the King of France.

In 1690 two of the Jesuit fathers made a map of the Lake which was published in Paris three years later. A copy of this map is contained in Foster & Whitney's report, and shows with what care these men must have explored the coast which they thus represented. Since considering the great extent of the coast to be traversed, and their utter want of facilities to accomplish such a task other than their own almost unaided powers of observation, this graphical delineation of the outlines of the Great Lake is indeed a marvel of accuracy.

Mesnard, Marquette, and Dablon were overtaken by death while in the midst of their labors and their bodies became mingled with the dust of the rude land they had discovered; but their names deserve to be cherished with the memory of those who gave all in their zeal to promote the welfare of the poorest of their fellow men.

The occurrence of copper was one of the objects that early attracted the attention of the Jesuits, and its presence, so frequently met with among the Indians, naturally excited their curiosity and wonder. Frequent mention of it is made, and in some instances the descriptions relate to masses of considerable size. But long prior to this period, the metal that attracted the attention of the missionaries and early *voyageurs*, and which now forms the basis of a great and growing industry, had been sought and mined for by a people who have left no record but the implements which they used and the excavations which

they made. These excavations the slow accumulations of debris during the years which have since elapsed had obscured from view, and the Indians, whom the good fathers labored to christianize, had no knowledge whatever of the matter. No suspicion that any such work had ever been performed occurred until within a recent period, after the country was thrown open to settlement and actual mining had begun. Then it became known that this ground had been previously occupied, and that these metalliferous veins had been long ago extensively worked and apparently large amounts of copper obtained; but when and by whom is a mystery. But that this mining work is of a high antiquity is evident from many facts; the pits and tunnels which had been made had become filled up with rubbish and with decayed vegetation and grown over with forest trees. If the depressions were ever observed they were naturally regarded as those made by overturned trees or as hollows in the rocks, and it was not suspected until the discovery was actually made, so late as 1847-48, that here, too, men had formerly delved in search of metals. These ancient excavations are found in all portions of the Mineral Range and in Isle Royal. So general is this fact, that there is scarcely a vein or outcrop of mineral in the whole copper district but the evidences are found of their ancient workings, extending into the solid rock from a few feet to sixty feet in depth. In these pits, when cleared of the accumulated dirt and rubbish, have sometimes been found large masses of copper which these primitive seekers had unsuccessfully endeavored to remove. Masses of copper of many tons' weight have thus been discovered surrounded with stone hammers in great numbers, pieces of burnt wood and other evidences of former labor. The method of mining which these people apparently pursued was to heat the rock with fire and then by pouring on water and pounding the rock with their stone hammers to disintegrate and separate it.

Quantities of these stone hammers are nearly always obtained from the bottoms of these ancient pits. They consist of small boulders of hard trap rock of from three to thirty pounds in weight, around which a groove has sometimes been made for the purpose of holding a withe which fastened on the handle. Copper tools and other utensils and materials have also been found, but no indications that would lead to the identification of the race to which these miners belonged, have been, as yet, discovered.

These ancient "diggings," as they are locally called, are everywhere so abundant and have now become so well known and familiar to those engaged here in mining as to be no longer a matter of surprise or wonder. In one respect they have undoubtedly been of great service, serving as guides which have led to the discovery of lodes, which were thus shown to have been previously worked and as indicative of the value of such lodes.

As in the iron region, the magnetic needle has guided to the discovery of many valuable deposits of ore, so in the copper district these pits of the ancient miners extending along the surface outcrop of the copper bearing veins, have silently betokened to the eager explorer where was hidden the object of his search. But to the Indians who roamed the country at the time of its discovery, to the Jesuits, and to the early *voyageurs* and explorers this fact of ancient mining was wholly unknown. The evidence of the existence of copper in this region—a knowledge which had already become wide-spread—was derived from the specimens in the possession of the Indians and from seeing the erratic boulders of that metal which were sometimes found in traversing the country, and from observing the copper bearing veins which outcropped along the streams and near the shore of the lake.

Among those who early visited this country was Alexander Henry, who came to Mackinaw in about 1760 for the purpose of traffic with the Indians. Henry was a man of intelligence and education, and spent many years in this country, meeting with numberless adventures and actively engaged in various undertakings. He subsequently published a well written and interesting narrative of his experience and his observations in the country. Henry became familiar with the fact of the existence of copper in the country, and, as he thought, of more precious minerals also. He describes the great copper rock, an erratic boulder or mass of native copper which lay in the margin of the Ontonagon River, about 20 miles above its mouth, at the foot of a high bluff, from which it had rolled down or had been brought to the spot by some transporting agency, and which he describes as probably weighing five tons. Ten years thereafter Henry was chosen the agent of a company organized in England to conduct practical mining work in Lake Superior, and after some preliminary examinations elsewhere, selected this location as the seat of his operations. To this place he proceeded in the fall of 1770, with a small party of miners, in a vessel which he had previously built at the Sault. He himself soon after returned to the Sault, leaving his men to work through the winter. In the spring he sent his barge with provisions to the relief of his men, but was soon after surprised to see the vessel return with the whole party aboard. They had drifted into the bluff a distance of about 40 feet, and failing to secure the work, in the spring, when the frost went out and the ground became loosened, the walls fell in, and the miners, realizing the futility of the undertaking at that point, decided to abandon the work. Some copper was obtained, possibly chipped off from the great boulder. A second attempt was made, equally unsuccessful, but conducted upon the north shore of the lake. Here they punctured the rock to a depth of 30 feet in a vein that rapidly narrowed as they proceeded downward, until it nearly disappeared. Satisfied that nothing was likely to be gained here, and his associate members refusing to advance any more money, further effort was relinquished. What copper had been obtained was sent to England, and the vessel and other company property were sold to pay the debts. The parties to this enterprise, the first mining undertaking in the Lake Superior country within historical times, were His Royal Highness the Duke of Gloucester, Mr. Secretary Townshend, Sir Samuel Touchet, Mr. Baxter, Consul to the Empress of Russia, Mr. Cruickshank, Sir William Johnson, Mr. Bostwick, and Alexander Henry. A charter was applied for and granted, but never taken from the seals office.

Henry, in reflecting upon the matter, states that the country must be settled and peopled before mining can be carried on to advantage. He avers that the soil is productive and will grow good crops, and cites some facts to corroborate the statement, among which he says he distributed seed corn among the Indians, which they planted and which yielded well, though he thinks them too improvident to preserve their seed from year to year.

Capt. Jonathan Carver published in 1796 an account of three years' travel in this country, in which he speaks of the Ontonagon River as a stream of considerable size that flows into the lake, the head of which is composed of an assemblage of small streams. He declares the river to be remarkable for the abundance of virgin copper, which is found near its banks, and states that this metal is also met with elsewhere in the country. He opines that at some future period it may furnish the basis of a profitable industry, and relates how the metal may be carried in vessels to the Sault, thence around the rapids and

re-shipped to Niagara Falls, here another portage to a point below the Falls, whence it may be conveyed to Quebec or elsewhere.

It was not until 1796 that Michigan came into possession of the American government, and the uncertainty of affairs, the trouble with the English government and with the Indians prevented any effort being made towards the exploration or settlement of the Territory, much less of the Lake Superior country. In 1818-19 the survey of Michigan was begun, a delegate was sent to Congress, some important Indian cessions made, and the lands thrown open to sale. And in the latter year Gen. Lewis Cass, the Governor of the Territory, proceeded, under directions from the War Department, on a tour of inspection, which included the south shore of Lake Superior. This expedition was accompanied by Mr. H. R. Schoolcraft in the capacity of geologist, etc., and he had for his object an especial purpose to determine as far as possible the truth of the reports regarding the mineral value of the country. In 1820 Mr. Schoolcraft published an account of the journey, and this volume, now rarely met with, contains much interesting matter.

The party entered the mouth of the Ontonagon River in July and proceeded up the stream a distance of twenty miles and upwards, to view the celebrated copper rock previously spoken of, the fame of which had reached their ears. He speaks of finding copper along the banks of the river, and that La Houton, Charlevoix, Carver, and McKenzie have successively noted the same remarkable fact and published accounts thereof which had given to the stream a notoriety which it would not otherwise have possessed. Many of the reports regarding the minerals found in the country referred especially to this river, but nothing very definite was known and it was for the purpose of endeavoring to determine the facts that they entered the river.

The party experienced excessive difficulty in ascending the rapids and in climbing over the range with the thermometer indicating at 90° in the shade, and with the swarms of mosquitoes and flies attacking them. The General, who remained in the boat, became exhausted; however both divisions of the party finally reached their destination and found the object of their search.

The size of the rock scarcely met their expectations, still Mr. Schoolcraft thought it a remarkable object and one well worth the journey to see. It evidently had been frequently visited since it bore the marks of much pounding and many cuts, and broken tools lay strewn about. The mass had apparently been removed some distance from its original bed as the adhering rock, mainly serpentine, was foreign to the vicinity; its whole appearance, the intimate association of the metal and the matrix, pointed to a common and contemporaneous origin.

This mass of native copper, which up to the period of its removal was the largest known in the world, was, in the spring of 1842, taken to the mouth of the river by James Paull who came to the country from the lead mines of Wisconsin for that purpose. Paull prepared a truck car upon which he hoisted the rock and succeeded in drawing it over the range by using a windlass, taking it to a point below the rapids and thence conveying it to the mouth of the river on a flat boat. The mass was soon after sold to a Mr. Eldridge who in turn sold it to the U. S. Government, and it has since been on the grounds of the War Department, at Washington. Paull claims to have bought of an Indian a second mass of copper of about 800 lbs. weight, which was found on the west shore of the peninsula, above the Portage, and which he took to Copper Harbor, whence, he thinks, it found its way into the cabinet of Yale College.

Paull remained at Ontonagon where he still resides, and was thus the first permanent resident in the copper region.

By a succession of treaties made with the various Indian tribes in 1836, 1837 and 1842, the lands comprising the Lake Superior district were ceded to the United States, and all Indian claims thereto were finally extinguished. Immediately thereafter large numbers of persons proceeded to the country with authority from the Government to mine on the lands of the newly acquired territory.

Public attention had been recently awakened to the copper deposits of the northern peninsula through the first published report of Dr. Houghton, who, having been appointed geologist of the newly made State, eagerly entered upon the active prosecution of his labors extending his geological observations to the shores of Lake Superior, and in 1841 submitted to the Legislature the results of this preliminary examination. In this report the prominent geological features of country were ably outlined, and the first definite information regarding the occurrence of copper and the character of the deposits was given to the world.

Dr. Houghton, a few years later, entered upon the prosecution of a detailed survey of the entire Upper Peninsula, upon a plan which he successfully inaugurated, but the fulfillment of which was unfortunately prevented by his untimely death, by drowning, which occurred on the 13th of October, 1847, near the mouth of Eagle River, in Keweenaw Co. With him was thus lost to the world the valuable results of his extended observations, and the system which he had devised of combining with the government linear survey of the country, geological and other scientific work was gradually abandoned.

But his previous announcements had already drawn the public attention to the country. The copper district was now swarming with speculators, prospectors and explorers, and the rocks were being everywhere perforated with incipient mining.

The first operations were undertaken under grants or permits obtained from the War Department, of which about 1,000 in all were issued, and 960 locations actually made. The essential conditions of these leases were that the lessee, or his assigns, etc., should, during the first three years, pay to the government six per cent of all metal produced; at the expiration of that period the lease could be renewed, at the option of the holder, for an additional three years on condition of payment to the government of ten per cent of the mineral obtained, at the end of which time the lease could be further extended for the same length of time on the same conditions, unless Congress should otherwise dispose of the lands. Very many of these locations were made along the Keweenaw peninsula, and this portion of the country became the seat of the earliest mining work, and for some years before operations were conducted elsewhere to any extent this immediate region was teeming with active industry.

KEWEENAW COUNTY.

The mineral range in this county, which begins at the extremity of Keweenaw Point and trends westerly a distance of about twenty miles, and thence southwesterly, is characterized by the occurrence of a broad belt of green stone or semi-crystalline trap, which forms the southern escarpment or wall in this portion of the range. This greenstone formation terminates at about the south line of the county, and does not again appear throughout the further prolongation of the mineral range. The greenstone has a northerly and northwest-

erly dip, corresponding with the other belts of this portion of the range, of about 24° to 30° to the horizon, and attains an elevation above the lake of about 800 feet. From the top of the range the land slopes with a general gradual descent to the north and to the west to the lake, which is distant in this direction from two to three miles. On the south side the elevation drops abruptly a distance of one to two hundred feet to a low lying plane which forms the valley of the Eagle River and other streams, and which reaches to the east till it meets the foot of a second range of hills having a trend generally parallel with the principal elevation, and known as the Southern or Bohemian range. This portion of the range, as far as the greenstone extends, is frequently crossed by veins having a nearly vertical dip and a lateral direction generally at right angles to the formation and a width of from one foot to three feet, and have been found to carry copper sometimes in extraordinary quantities, some of them having proved among the most remarkable deposits of copper that the world has revealed.

Both north and south of the greenstone are numerous amygdaloid beds, which are crossed by the fissure veins, and which usually carry a greater or smaller percentage of copper. There are also found in some portions, immediately underlying the greenstone and further to the south, beds of conglomerate, which in some instances contain copper in workable quantities. But surpassing all these, except the fissure veins, the most important of the copper bearing deposits of this district is what is known as the ash bed, a scoriaceous amygdaloid bed lying north of the greenstone, having a varying width of from five to twenty feet, and yielding at favorable points about one per cent of copper.

This ash bed, as it is called, through the invention and use of the compressed air drill, high explosives and greatly improved stamping and washing apparatus, seems likely to become the basis of the future mining prosperity of Keweenaw county, although in the past all attempts to work it at a profit have proved ruinous to the companies engaged in the undertaking.

In the earlier period of copper mining on Lake Superior, the fissure veins, yielding copper in masses, were the ones which gave to the country its celebrity, and the ones in which the mining operations were attended with profit, and of these the most noted and the most productive lie south of the greenstone—an important feature of this region geologically as well as geographically.

As before remarked, what has proven to be, thus far, the great copper-bearing belt of Keweenaw county, lies immediately south of greenstone and pitches beneath it. In this belt are situated the Cliff, Phoenix, Central, Delaware and many other noted mines which have produced the greater portion of the copper obtained.

South of this copper-bearing range which underlies the greenstone, is another belt having a parallel direction but of an entirely different character, and too lean in copper to have afforded to the companies that have worked it any degree of prosperity. Of these are the South Cliff, Manhattan, North American, Boston & Northwestern, and other companies, all of whose operations have resulted unprofitably.

The same transverse veins which have proved so abundantly rich beneath the greenstone in crossing this belt, are poor and of a character in keeping with the country rock.

Still further to the south is another belt quite distinguishable in character, within which are several beds of amygdaloid exposed at the surface, but the working of which has proved equally unprofitable.

The ash bed, to the north of the bluff, is crossed by the fissure veins which have here also yielded, in the aggregate, a large amount of copper, but occurring in pockets and not in any degree of certainty or with the comparative richness or regularity pertaining to the ground underneath the greenstone when crossed by the fissure veins. Underlying the greenstone and in contact with it, occurs a belt of conglomerate which at some points is utterly barren of copper, at others becomes a mere slide, while at the Allouez and at the Conglomerate Mining Company's location it becomes a distinct workable deposit. The fissure veins crossing the greenstone have never proved sufficiently rich in copper, in this formation, to be profitably mined.

As before stated, immediately succeeding the final treaty extinguishing the possessory rights of the Chippewas to the lands in the Upper Peninsula in 1842, and the decision of the General Government to issue to applicants exploring permits, the country became at once flooded with searchers for mineral who made locations and obtained Government leases therefor which they subsequently sold to eastern capitalists.

A person by the name of Raymond secured, thus early, several of these leases, three of which he disposed of to parties in Pittsburg and Boston. These leases comprehended: First, three square miles including Copper Harbor—a name given to this point by the early *voyageurs* by reason of the cupriferous vein which conspicuously outcrops here; second, three miles square on the west side of Eagle River, in which tract is included the Cliff mine; and third, a like tract in the next township west. Work was begun by these Pittsburg and Boston gentlemen in 1844, consisting of sinking a shaft to the depth of forty feet, on Hog's Point, under the direction of Charles Avery, the president of the association. This was the first mining shaft that was sunk on the lake.

Soon after a continuation of this vein, with much more favorable indications, was discovered on the opposite side of the harbor near the site of old Fort Wilkins. This vein contained a deposit of black oxide of copper, a remarkable fact, since it has proved to have been the only similar deposit that has thus far been found, excepting, perhaps, traces of the same vein which has occasionally been observed elsewhere in this vicinity. The mining work was immediately transferred to this point, and two shafts were sunk at a distance apart of about 100 feet. The pocket of black oxide proved of brief duration; about 40 tons were obtained and sold for \$4,500. The main shaft was carried down a distance of 120 feet and levels were driven each way from the shaft, in the vein, without finding any more of the ore.

THE CLIFF MINE.

In the meantime an important discovery was made on the Eagle River location by a party of explorers, under the direction of Mr. Cheney, in the greenstone bluff in the s. w. $\frac{1}{4}$ of sec. 36, T. 58 N., R. 32 W., being about three miles distant from the lake, which is what became known as the Cliff Mine. This celebrated vein was first discovered in 1845 on the upper surface of the greenstone, where it is narrow and gave little indication of the enormous wealth concealed below.

It was examined by Dr. Jackson and Mr. Whitney, geologists, who advised, as the vein became wider and richer as it was traced downward on the wall of the bluff, that it would be well to uncover and examine it at the foot. The rocks at the foot of the bluff were cleared away in the winter of 1845, and indications obtained which stimulated to increased activity. An adit was driven

a distance of about 70 feet, when it intersected a mass of copper—the first mass of native copper that had been found in place in the Lake Superior region. This discovery was one of the most important that has been made in the copper district, since it determined the fact that the erratic boulders which had been previously found had their origin in the region itself, and since it was but the precursor of a continued succession of masses that astonished the world and gave confidence to investments in the country and enthusiasm and zeal in its investigation.

After the discovery of the Cliff Mine the Eagle River location was purchased of the government and the other leases were abandoned. About the time the first work was done the gentlemen holding these leases entered into articles of agreement for the formation of a company; these parties were H. G. Hussey, T. M. Howe, and five others. The association was formed May 13, 1844, as the Pittsburg and Boston Mining Company, and under that name was incorporated by a special act of the Legislature of Michigan, approved March 18, 1848, with a capital stock of \$150,000, divided into 6,000 shares. The number of shares were subsequently increased to 20,000, without any increase in the capital stock.

The cost of the lands purchased from the government—about 5,000 acres—was \$11,600.

The Cliff vein, an amygdaloid trap, was from the start remarkably rich in mass copper, and subsequently also afforded a considerable amount of stamp rock obtained especially from the beds of amygdaloid, or the amygdaloid floors, which intersected the vein at right angles, having a varying thickness, and which were of frequent occurrence, and dipping and running with the formation, and some of which were found to be highly productive in copper. These amygdaloid beds are shown in the accompanying longitudinal section of the mine. They occasioned some trouble from the crumbling character of the rock, tending constantly to close up the shafts and the levels, making it frequently necessary to enlarge the shafts and lower the tramways in the levels. The rock did not crumble off in fragments to any great extent; it was hard and sufficiently difficult to mine, but the pushing force was stronger than any timbers were able to resist.

Work was fairly begun in 1846, and during the seven years thereafter the vein was penetrated to a depth of 462 feet and a range of about 1,200 feet, and sufficient copper taken out to realize in net sales the sum of \$1,328,406 83. It may be safely asserted that nowhere in the world had there previously been produced so large an amount of copper from the same amount of ground. The mine was paying to the company a net profit of \$20,000 per month.

The dividends paid during this period aggregated the sum of \$462,600, or \$77 per share, the first dividend, \$60,000, being paid in 1849, and the total assessments had amounted to \$18.50 per share, \$110,000; at this time the stock and the quotations of the stock in the Boston market, June, 1854, was \$175 per share.

To illustrate how little was definitely known regarding the geological structure of the country at this time, the opinion was entertained that the greenstone would, in itself, prove productive in copper. It was also thought to be possibly an overcap, or to compose a basin, and thus did not extend far into the earth, so that the lower levels, if extended northward, would pass under it. With a view to settle these conjectures, the upper levels were driven into this formation, but all the workings in this direction went to establish the fact that the veins in the greenstone do not carry copper in paying quantity, and

equaled it. For years there was scarcely a foot of ground that did not fully pay the cost for excavating, yielding in 1856 for each fathom of mineral ground broken the unprecedented amount of 1,851 pounds of mineral, yielding 67 per cent. refined copper.

The business of mining, especially for the more valuable metals, is at all times precarious and uncertain, but the owners were confident, and surely they found in their mine an abundant reason for the faith that was in them. During each year explorations were being made to discover additional workable deposits on the company's property, but without any conspicuous result. The number of men employed had increased to about 460 in 1856, at an average wage per month of \$32. The mining work was generally done on contract. The cost per ton for hauling to Eagle River was \$1 to \$1.12.

The number of shares, in 1858 was increased to 20,000, and the market value of the shares was about \$300 per share.

In this year the company set off a portion of its estate lying north of the greenstone to the lake and organized the North Cliff Mining Company. The amount of land ceded to this company comprised 1,000 acres, and a cash appropriation was also made to it of \$50,000. The capital stock of this new organization was divided into 20,000 shares of \$25 each.

In 1857-58 a new No. 1 shaft, denominated the Avery, was sunk vertically a few feet distant from the original shaft, and off the vein, to the 90 fathom level, and it was supplied with the necessary machinery for hoisting. This work was done to escape the constantly increasing difficulties and delays which characterized the working of the shafts sunk in the vein, which had become very perplexing. The Avery shaft was made of an increased size so as to admit of large skip buckets, and being furnished with improved machinery it greatly facilitated the working of the mine.

Heretofore there had been a large accumulation of waste rock which a want of facilities had prevented being hoisted and got rid of. This accumulation of rock naturally impeded the prosecution of work in the lower levels. The peculiar geological formation of the mine and the character of the vein were always formidable obstacles at the best, and began to be felt more and more as greater depth was attained together with increased extension to the northward. The copper being largely in great masses, a considerable force of men was continually employed in cutting them up, a slow and expensive operation, since no better method has been devised than the one early adopted, which consists in using chisels having a narrow face and of different lengths to answer for the increasing depth of the cut. One person holds the chisel and guides it along the line of cut, while a second man strikes with a sledge hammer. The mass is thus crossed and a chip equal in length to the width of the mass is removed. This operation is repeated until a complete separation is effected. The cost of cutting and removing was estimated to be \$12 to \$14 per superficial foot. The cutting up must be done in the level where the mass is found in order to reduce it to portions which the miners are capable of moving to the shafts with such appliances as may be brought into requisition.

As before stated nearly two-thirds of the product of the Cliff was in form of mass copper, and about one-half of the remainder in what is termed barrel work, which is simply the aggregate of all the smaller pieces, not exceeding usually a few pounds in weight. As most of the supplies are brought into the country from "below," the mining companies cause their imports, as far as may be, to be brought packed in barrels, and thus in turn these packages answer to contain the so-called barrel work of the mines.

In the days of the Cliff and of the great mines of that period stamp work had scarcely a tith of the importance which it has since attained, and these early stamp mills were comparatively crude affairs. At that time it was found necessary to calcine the vein rock before passing it beneath the stamps. The object of calcining being to facilitate the breaking of the rock into small fragments, and was accomplished by piling it upon a layer of logs or of wood, which, on being fired, should create a sufficient degree of heat to disintegrate the rock without oxidizing the metal which it contained. This operation was usually performed in kilns—structures of stone or brick made for this purpose.

At the present time the process of calcining is little resorted to, the rock being prepared for the stamps by passing it through the Blake crushers, the large portions having been first shattered into fragments by being placed beneath heavy iron hammers (rock hammers they are called) worked by machinery.

The total current expenses of the Cliff mine for the first ten years were \$517,108, and the total number of fathoms stoped during that period were 9,188, making the average cost per fathom to be \$55½. The stoping cost about \$4.72 per ton of rock. The tramming, burning, stamping and washing cost \$1.30 per ton; superintendence and clerk hire 27 cents per ton; surface expenses and smelting, cost \$1.29 per ton; estimated cost of opening the mine \$1.29; pumping and hoisting, etc., \$50; making the total current expense of vein matter per ton, from its position in the mine, through all its processes and manipulations till the product appeared in shape of ingot copper, between \$10 and \$11.

The same difficulties which had attended the working of the mine previous to the building of No. 4 shaft, and which had necessitated its construction, were again felt as the lower levels were extended to the northward under the greenstone, and led to the serious consideration of the question of sinking another shaft still further to the northward, or of carrying down an incline to reach the lower levels under the greenstone; but the immense expense which in either case would attend the carrying out of such an undertaking, caused the matter to be deferred and the work was never undertaken.

Up to 1858 there had been for several years but little variation in the annual production of the mine, and during these years it was at its maximum; thereafter some anxiety began to be felt and an appreciable falling off in the product was noticeable. Explorations to the south, after reaching a few hundred feet from the greenstone, did not develop any considerable amount of copper, and as greater depth was attained under the greenstone, a lack of the same degree of richness which had been experienced in the upper levels, was met with.

The working out of the amygdaloid floors, particularly No. 9, which latter "floor" was large and comparatively productive in stamp rock, together with the working up the stamp rock previously accumulated, contributed to keep up the yield of the mine; but for the first time in 12 consecutive years the company was unable to declare its accustomed dividend.

The shafts were provided with skips operated in guides in place of buckets, each skip holding about 2½ tons of rock. These were susceptible of much more rapid motion than could, with safety, be given to buckets. Ten skips per hour could be elevated from the 90 fathom level. The rock breaker, which has since come into general use in the mines, was first employed at the Cliff in 1860.

In 1860 the company purchased the estate, comprising 2,300 acres, together with the mining plant, etc., of the North American Mining Company, paying

therefor the sum of \$100,100. This mine adjoined the Cliff, and had been worked extensively on two veins, but with poor success. Its pecuniary resources being exhausted the company was obliged to sell out, a good thing for them to do but proving a poor investment for the Cliff Company, since all their subsequent efforts in the way of explorations failed to develop anything of value.

The new North American—South Cliff it was called—was a mine opened in 1852 on the southerly prolongation of the Cliff vein, which at the time of the purchase was leased on tribute at a royalty of one-fifth of net proceeds. This arrangement was continued, the amount of royalty paid by the tributers averaging \$15,000 per year.

In the early history of copper mining on Lake Superior it was generally held that in the true veins the deeper they were penetrated the richer would be the deposit; but the experience at the Cliff, Minnesota and National mines seems to indicate that the lodes instead of increasing in richness with increased depth become, on the contrary, greatly impoverished. However this question may be settled with further experience, it is a fact that the Cliff mine attained a depth of 1,200 feet from the surface at the base of the bluff, and the area of the copper bearing ground had been gradually diminishing as the mine increased in depth, until from the many thousands of feet possessed nearer the surface it had dwindled to a few hundred, and the company regarding it as inexpedient to prosecute the openings to any greater depth, and having failed to discover any very promising ground elsewhere on the property, although continued explorations had been carried on, resolved that after July, 1870, further work should be discontinued and that the property be sold as soon as a purchaser could be found.

The estate at this time embraced about 11,435 acres of land, not including the 1,000 acres set off to the North Cliff and the 1,100 acres embraced in the American Mining Company's territory. The stock of the latter companies had been distributed pro rata to the stockholders of the Cliff.

The company was one of the pioneer companies of the region. As before stated it sunk the first mining shaft in 1844, at Copper Harbor, and afterward acquired at the Cliff mine the greatest degree of success heretofore experienced by any company, and while the stockholders were well compensated in dividends for their enterprise, their experience and success contributed greatly to aid and encourage others, and thus indirectly resulted in developing the material interests of the country. The whole amount of the capital stock paid in was \$110,905, and from 1848 to the cessation of work in 1870 the Cliff mine had not only sustained the expenses of the company, but had paid to the stockholders the net sum of \$2,627,660, or a little over 2,000 per cent. of the capital paid in. The capital stock paid in does not, however, represent the total expenditure incurred in bringing the mine to the dividend paying point; it sufficed to open the mine to the extent that the product met the expenses. Over half a million of dollars were expended before any dividends were paid. If it had not been for the excessive productiveness of this mine this preliminary expenditure would have been a failure. The wonderful success of this mine occasioned the starting of many others in similar situations, with apparently as reasonable prospects of success, but with perhaps the exception of the Central it has had no rival among the mines that have worked underneath the greenstone.

A considerable amount of land had been got under cultivation, producing annually several hundred tons of hay and oats, a large amount of potatoes and

other root crops. A flourishing village had grown up on the location, containing three churches, good school building, etc., with a population of about 1,500 people.

The action of the company in stopping was severely criticised by outside parties at the time, and it is still held by many that such action was unduly precipitate and not necessitated nor warranted by the product or condition of the mine.

But it seems to have been the policy of Dr. Hussey and the gentleman associated with him in the control of their several mining properties on Lake Superior, to take as few chances as possible. They put in sufficient money on the start to determine the fact, in their estimation, whether the mine was sure to pay or not, and to continue work so long as the mine remained self-supporting, but suspending operations before assessments were called for. Their object seems to have been to conduct mining as a legitimate business *per se*, and not to engage in it for the purpose of selling stocks. It is said of Mr. Charles Avery, who remained president of the company until his death, which occurred in 1858, that he never bought nor sold a share of stock in his life; and it may be safely stated of these gentlemen, Messrs. Avery, Hussey, Howe, Cooper, etc., that the management of affairs of the several mining companies which they controlled, have ever been conducted with a just view to the best interests of the stockholders, and to the advancement of legitimate mining enterprise.

Work was stopped in 1870, and in the following year the mine was sold for the sum of \$100,000; from the sales of property and funds on hand, two dividends were made in 1871 of \$100,000 each, leaving a balance in the treasury of \$98,296.99. But this sum was reduced by losses and litigation to \$38,620, which amount was finally divided in 1879, thus exhausting the entire assets of the old Pittsburg and Boston Company.

The mine was sold in 1871 to Marshall H. Simpson, of New York, for \$100,000, including all the lands in Keweenaw county that the company owned except the North Cliff property and North American property, and in 1872 a reorganization was made, under the general mining laws of the State of Michigan, under the title of the Cliff Copper Company, with a capital stock of \$500,000 in 20,000 shares. The mine has since been under the management of Mr. O. A. Farwell, an experienced mining man, who resumed work in April, 1872, the first 14 months thereafter being consumed in pumping the water out of the mine and in getting out some copper in the upper levels. During the first year after the new organization began work the product was wholly mass copper and barrel work. Numerous masses were found between the 150 and 180 levels and north of No. 4 shaft, in the portions opened by the old company in ground which had been left, supposed to be too poor to pay for stoping, but proved to be very rich, yielding frequent masses of 20, 30, 40, and 50 tons weight.

In 1872, 92 men were employed; in 1873, 250 men; in 1874, 225 men; in 1875, 112 men; in 1876, 106 men; in 1877, 100 men; since which time a smaller force has been worked, in 1878, 40 men; in 1879, 50 men.

The mine was lowered to the 220 level prior to 1876, the work being done north of No. 4 shaft. Between 180 and 190 levels a little copper was found, but from 190 to 210 levels the ground proved barren. During the past year the main portion of the product has been got in the 210 level, 1,200 to 1,400 feet north from No. 4 shaft. The company now employs 75 men.

The stamps have, since four years ago, until recently, remained idle, but during the present season they were again set to work, working part of the time, and stamping about 75 tons per day. The water is obtained from a dam in the Eagle river, 300 feet from the mill, and is conveyed away from the mill through a long launder. The mine has now been explored to a vertical depth of 1,800 feet from the surface at the top of the bluff, and the indications are not promising. The rock is hoisted from No. 4 shaft, and after being broken is trammed to the top of the bluff, a distance of 1,000 feet, and then dumped down a chute into cars at the bottom, and is thence trammed 200 feet to the mill. The stamps are the old Cornish pattern, 36 in number. The pumping is done through No. 1 shaft, directly beneath the bluff. The vein is exactly vertical.

The company own the old South Cliff mine, and also a part of North Cliff property, extending to the lake, and during the past year borings have been made with a diamond drill in the South Cliff, down to 266 feet in depth; the work was undertaken with the hope of finding copper bearing belts, but only trap was found. Since April last a party of men has been kept at work on the ash bed, north of the bluff. Two shafts have been sunk to a depth of fifty feet, and the developments are declared to be extraordinarily good—the ash bed showing an unusual width, and a more than average richness. Some of the rock has been brought to the stamp mill and worked up for trial. If the mine is opened, and work prosecuted to a large extent, a stamp mill will be built on the lake, and the mine probably opened with an adit. The accompanying section shows the workings of the old Cliff mine to date, and the vertical depth:

The following are the shipments, etc. In recent years a portion of the copper has been obtained from tribute working:

Years.	No. Pounds Mineral Produced.	No. of Pounds Refined Copper.	Yield Per Cent.	Average Price Per lb. Sold for, Less Cost of Smelting.	Value Realized from Sales.
1844.....	30 tons Bl. Oxide.				\$4,500 00
1845.....	33,171	19,903	60	15c	2,968 70
1846.....	108,774	41,625	38.1		8,870 95
1847.....	729,848	410,783	56.3		70,937 32
1848.....	1,655,304	996,467	60.2		166,407 02
1849.....	2,285,050	1,282,127	56.1		155,227 04
1850.....	1,521,391	714,643	46.9		177,044 36
1851.....	1,528,465	846,486	55.3		174,931 96
1852.....	1,660,330	829,356	49.9		161,917 08
1853.....	2,253,182	1,071,288	47.33	27.32c	292,647 05
1854.....	2,332,614	1,315,308	56.35	24.38c	320,783 01
1855.....	2,995,837	1,874,197	62.56	25.33c	475,911 26
1856.....	3,291,239	2,220,934	67.48	24.12c	535,843 67
1857.....	3,363,557	2,363,860	70.28	20.44c	497,870 47
1858.....	3,183,085	2,331,963	71	21.03c	475,321 89
1859.....	2,199,632	1,415,007	64.35	20.50c	290,097 97
1860.....	2,805,442	1,843,393	65.70	18.93c	349,095 59
1861.....	3,103,641	1,928,011	62.13		401,223 73
1862.....	3,104,908	2,004,960	63.40		514,338 42
1863.....	3,010,539	2,100,354	69.76		694,944 12
1864.....	2,116,000	1,351,234	63.86	45.97c	626,302 50
1865.....	2,255,877	1,443,825	64	33.76c	562,000 00
1866.....	2,506,119	1,603,916	65.53	28.33c	469,472 00
1867.....	1,693,256	1,148,885	66.24	23.63c	268,000 00
1868.....	1,875,050	1,227,746	65.47	23c	285,054 00
1869.....	1,180,067	725,247		21c	154,973 00
1870.....	727,134	444,381			
1871.....		141,238			
1872.....		118,306			
1873.....	773,113	651,203	75½		
1874.....	1,398,879	1,052,901	73		
1875.....	1,649,341	1,162,873	73.41		
1876.....	988,884	908,146	76		
1877.....	234,220	161,319	74		
1878.....	316,687	414,415	74		
1879.....	206,672	134,336	75		
1880.....	122,378				

In 1861 the mine yielded \$7,265.56 in silver; in 1862, \$2,921.69; in 1863, \$1,171.19.

The mine has yielded, as have all the Lake Superior copper mines, annually an appreciable amount of silver, from 25 to 50 pounds, in value from \$1,500 to \$5,300. In an early day a good deal of excitement was occasioned by the occurrence of silver, associated with the copper; but experience has shown that it cannot be depended on as a source of revenue. Its occurrence is similar to that of the copper, that is in a pure, unalloyed state. Bunches of native silver and copper are found intimately blended together, but never alloyed; sometimes the particles are so small that they cannot be separated, and the percentage being light, it is smelted with the copper. The silver which is saved separately is in the form of pieces of a few grains weight. It is understood that but a portion of the silver actually found finds its way into the coffers of the company; not unfrequently the miners regard such "finds" as their peculiar prize, and so appropriate it to themselves.

Officers of the Cliff are: M. H. Simpson, President; J. W. Blake, Secretary; office, No. 7½ Beacon street, Boston, Mass.; O. A. Farwell, Agent, Clifton, Mich.

NORTH CLIFF.

As previously noticed in the history of the Pittsburg and Boston Company, a company was organized in 1858 under the general mining laws of the State of Michigan, with a capital stock of \$500,000, to work that portion of the estate lying north of the greenstone. One thousand acres of land and \$50,000 in cash were donated to this new organization by the parent company. C. G. Hussey became the first president, and Thomas M. Howe the first secretary and treasurer, with the office in Pittsburg, Pa.

The purpose of this organization by the Pittsburg and Boston Company was to push forward more effectively and rapidly the development of the extensive landed property which the company possessed.

Mr. Samuel W. Hill, a gentleman very early and favorably known in connection with the Lake Superior copper interests, was employed to make a geological examination and exploration of the property, and his report to the company was sufficiently favorable to justify further examination and working. A consolidation was made in 1859 with the Swamscott Mining Company; the North Cliff property was conveyed to the Swamscott Company, and by a special act of the legislature the name was changed to North Cliff Mining Company. The same gentleman held the majority of the stock in both companies.

Mining work was regularly begun in the same year, and progressed until 1861, at which time the funds, with which the company had been endowed, were exhausted, and the general depressed condition of the affairs of the country, together with the fact that nothing very encouraging had thus far been developed by the mining operations, caused a temporary suspension of work. In 1863, stimulated by the rise of copper and the increased business activity, an assessment of fifty cents per share was made on the capital stock, and work was again begun under the direction of Mr. James Watson as superintendent.

The total mining work which was done comprised an open cut and adit 1,700 feet in length, which connects with the surface at the south end through an inclined shaft sunk in the ash bed. At a distance of 300 feet further to the south, No. 4 shaft was sunk 135 feet to the adit level; and 965 feet north of this was No. 3 shaft, which was down to the fourth level. Besides these three were two other short shafts, some winzes, drifts, and stopes, but the product was wanting; the result of all the work done was simply disappointment and pecuniary loss. It soon became evident that a paying mine was not likely to be had on the location, at least with such facilities as were then in vogue for separating the copper from its matrix, in the low percentage of rock which was obtained; all work was abandoned, and has never, until recently, been resumed. The fissure veins, like the old cliff, which proved so productive south of the bluff, have in no instance been found to be equally so when attempted north of the greenstone. The owners of the Cliff expressed a good deal of faith in the anticipated results from working the vein north of the greenstone, but unfortunately for their interests they failed to be realized. Since April, 1880, the Cliff Copper Company, who now own the property, or the portion of it north of the old Cliff mine, have been at work on the ash bed, as previously described, and have encouraging prospects.

NORTH AMERICAN MINING COMPANY.

Among the investments made by the Pittsburg and Boston Company, as before described, were the purchase of the property and franchises of the

North American, a company which was organized under a special charter from the State of Michigan, in 1848, with a capital stock of \$300,000, divided into 6,000 shares. By successive amendments made in 1851 the charter was altered so as to increase the number of shares to 10,000, the capital stock remaining as before. The office was in Pittsburg, Pa. Thomas Bakewell, President; Waterman Palmer, Secretary and Treasurer.

The company held 2,400 acres of land, and the original mine was opened on the east $\frac{1}{2}$ Sec. 2, T. 57, R. 32. A mine on this property had been opened in 1846 in a fissure vein under the south bluff of the greenstone. The vein has a bearing of north 58° west, and is thus not parallel with the Cliff and with other productive lodes. The vein is irregular and variable in width, and although it was worked to a depth of 415 feet it was nowhere found to be of a sufficiently favorable character to create very sanguine hopes of remunerative results. The lode seemed to be split up into three parts, and it was hoped that they would find the main lode into which all the branches united. The sum of \$200,000 was expended on the location and in the mine by the company during the four years that they prosecuted work there, and the following amounts of copper were obtained: In 1849, 77,000 pounds; in 1850, 256,000 pounds; in 1851, 257,000 pounds; and in 1852, 77,000 pounds—yielding in the average 66.8 per cent of ingot, = 446,000 pounds refined copper.

A part of the company's estate comprised the N. E. $\frac{1}{4}$ sec. 1 adjoining the Cliff Mine on the south, which is crossed by the Cliff vein, and in 1852, the company having made explorations to determine this fact, transferred their mining operations to this place.

Here their efforts were at first attended with a success which imagination magnified into a hope of soon rivaling its northern neighbor. In the first level, only 40 feet below the surface of the rock, an immense amount of copper in masses was found, one of which weighed nearly 200 tons, being 40 ft. long and 20 ft. wide and 2 ft. thick. At this time this was the largest mass of copper that had been discovered on the lake, or in the world. In this stope, in the first level, 300 tons of copper were obtained. But the pleasing hopes raised by this temporary success were doomed to be eclipsed by the disappointing mists of subsequent failure. Sinking and drifting, however earnestly prosecuted, failed to develop another such deposit. The vein is covered heavily with drift. The first shaft passed through 10 feet of gravel and then through 42 feet of quicksand, when the rock was struck. A shaft was carried down into the rock 22 feet, and cross-cutting disclosed the vein 14 feet distant, carrying a width of $3\frac{1}{2}$ feet. A pumping engine and a hoisting engine were put into operation. A considerable amount of agricultural products were raised, in value, in 1853, \$3,500. As the levels were pushed to the south the ground grew poorer, until it became impossible to work the mine at a profit. In 1858 the company's affairs had reached a crisis, their funds were exhausted as was also their capital stock, and either productive ground must be found or the work must stop. It was thought of surrendering the charter and reorganizing under the general mining laws of the State, with a capital stock of \$500,000, and of setting off a portion of the property and organizing another company and thus secure funds by selling the stock. Capt. W. E. Dickinson, the superintendent, advised that further working of the mine be discontinued. He claimed that it had been thoroughly cross-cutted and every reasonable effort made to find the original lodes, which he thought had been heaved or thrown at the slide, which occurs in the formation to the south of No. 1 shaft. He suggested that the mine be worked on tribute, without risk or cost to the company, and in the meantime such funds

as could be secured be expended in the direction of endeavoring to discover other and workable lodes on the property.

But the finances of the company prevented the adoption of any but that portion of the agent's recommendations which related to the letting of the mine on tribute, and work was thenceforward discontinued on company account.

The company had thus far expended during the period of its operations the sum of \$733,805.15, of which amount \$233,864 had been raised by assessments, \$38,827 by sale of stock, and \$426,988 by sales of copper produced, and the balance remaining as indebtedness. The underground workings in the South Cliff mine comprised 190 feet of sinking, and 230 feet of drifting, and the surface improvement included a large number of houses, three hoisting engines, shaft house, and 150 acres of land under cultivation, which produced excellent crops.

The sale of the property for \$100,100 to the Pittsburg and Boston Company was made in 1860, and the proceeds were used in liquidating the company's debts. The managers of the old Cliff mine believed that the mineral vein, which had proved so enormously productive beneath the greenstone in their own mine, really traversed the extent of the North American property, and perhaps only required extensive exploration to discover it. It is difficult to realize, especially for those chiefly interested, that a vein which has held such great mineral richness at one point should become comparatively barren in the brief distance of 2,000 feet, which intervenes between the bluff and No. 3 shaft of the South Cliff mine.

The operations of the North American Company on this vein were limited to the first few hundred feet adjoining the Cliff; they had opened with encouraging success, and having apparently exhausted the deposit upon which they were working, were unable or unwilling to prosecute for further discoveries to the south. This task the Pittsburg and Boston were abundantly able to undertake, and immediately after the purchase a party of men were put to work to sink a shaft at a point 2,000 feet south of the previous workings. Lateral drifts were made in the expectation of cutting the lode at that point, but no favorable result was obtained. This country to the south is covered with a heavy drift, rendering the task of exploring perplexing and expensive work, and all the efforts in the direction of sinking, driving, and cross-cutting failed to reveal copper-bearing ground of much apparent value.

Mining experience on Lake Superior, as elsewhere, has shown that a vein does not generally prove equally productive throughout its extent—a change in the mineral composition of the inclosing rock, whether mechanical or chemical, is apt to be accompanied by a variation in the richness of the vein. Variations in the formation, perhaps sufficient to give to it a distinct character when arising from a change in its mineral composition, are not always apparent to the unaided eye or to the unskilled apprehension, and can perhaps be only determined by the trained expert, aided by the lens of a powerful microscope. At the Cliff the productive portion of the mine was found to be between the greenstone on the north and the slide—which will be seen marked on the section of that mine—on the south. At this point a distinct change is apparent in the mineral composition of the trap lying on the north and south side of the slide, but it was precisely here that a great diminution in the richness of the vein appeared.

The work done on the property by the Pittsburg and Boston Company was only in the way of exploration, and after a few years' trial was discontinued. At the time of the purchase the mine was let on tribute for a term of years,

and as stated in the history of the Pittsburg and Boston Company this work paid to the company about \$15,000 per year.

After the sale of the Cliff mine all work here ceased, and the limited explorations with the diamond drill have equally failed of important results. These two mines of the old North American Company are now marked by a few ruinous shaft-houses and rotting buildings.

THE MEDORA MINING COMPANY.

The Medora is another one of the Keweenaw county mining properties that was controlled by the Pittsburg and Boston Company. The company was first organized under a special charter granted by the legislature of the State of Michigan in 1851. The property comprised 320 acres of land, being the E. $\frac{1}{2}$ of Sec. 17, T. 58, N., R. 29 W.; situated immediately south of the Greenstone. Work was begun by the company, and prosecuted for a few years, but attended with poor success. The company having exhausted its available funds, and the stockholders failing to respond to further assessments, operations came to a rather premature close; the property and assets of the company passed into the hands of the Pittsburg and Boston Company. Nothing further was done until 1860, when the owners determined to further prove the mineral value of the property. With this view explorations were undertaken under the supervision of Mr. John Slawson, the agent of the Cliff mine. The mine had been opened on a fissure vein, and developed the existence of amygdaloid floors, similar to those observed at the Cliff, and Mr. Slawson's purpose was to ascertain the productive value of these. He sunk two shafts, east and west of the lode, at a distance apart of 47 feet, and connected them with a drift. He believed to have found paying ground, but the work was not followed up, and little further was done until 1864, when by some transfers of stock and a reorganization of the company, the sum of \$20,000 was realized in available funds, and immediately expended in further work. An assessment of one dollar per share was made, to which but a portion of the stockholders responded, and the money being used up matters again came to a stand still. It was found that but little could be accomplished without the aid of a suitable stamp mill, the estimated cost of which, in that period of high prices, was \$80,000, to which must also be added the additional sum of \$40,000 for a working capital. The directors, admonished by their previous failures to raise money by assessment, did not hesitate to decline entertaining the project of the immediate erection of a stamp mill.

The total expenditures for mining, etc., amounted to the sum of \$32,000. The officers were: Thomas M. Howe, President; James M. Cooper, Secretary and Treasurer. The property is said to be still owned by Dr. Hussey and his associates—men whose habitual caution prevented them from going beyond opening up the mine without thoroughly proving it. The houses and other buildings remain monuments of unavailing expenditure and labor.

PHENIX COPPER COMPANY.

Contemporary with the Pittsburg and Boston Mining Company, and really ante-dating it by a few months in the time of organization, was the old Lake Superior Copper Company, the progenitor of the present Phoenix Company. The originators of this pioneer enterprise, one of the most important ever undertaken on the lake, were among the first who proceeded to Lake Superior after the relinquishment of the Indian rights to this country in 1843. They

represented mainly gentlemen from Boston, who selected seven three-mile square locations, and afterward secured them by leases obtained from the War Department, and in 1844, February 22d, organized a company, dividing the capital stock into 1,200 shares of \$100 each, 400 of which shares were assigned to the proprietors of the locations in payment for the lands conveyed to the company; these purchase shares were to be exempt from assessment. In addition to the 400 shares, the original holders of the leases were to receive compensation for the expenses incurred in locating the lands, etc., to be paid out of the first earnings of the company. The conditions on which these leases were granted by the government have been heretofore given, and were very advantageous to the lessees, as it gave them several years in which to explore the lands and to determine as far as they deemed requisite their mineral value before deciding to purchase; they were virtually long options, in which the government only secured to itself a percentage of the mineral products which should be removed.

The trustees of this early organization were David Hanshaw, Samuel Williams, of Boston; D. G. Jones, of Detroit, and Col. Chas. H. Gratiot; the latter recently from the lead mines of Missouri.

Several veins had been discovered on the property, and Dr. C. T. Jackson, who was employed to examine them, found them so favorable that he recommended the prosecution of mining work, which was begun October 22, 1844, in the east bank of the Eagle river, near the center of the line between sections 19 and 30, T. 58 N., R. 31 W. The preliminary work was directed by Dr. Jackson, but when he left the country late in the season, for his home in Boston, the charge of affairs was given over to Col. Gratiot, who had had previous experience in the lead mines. A brig, with supplies for the men, during the winter was lost on the lake, and the miners were consequently kept on very short rations; but Col. Gratiot, with fifteen men, managed to pull through till spring, when measures were taken to enlarge the operations. A stamp mill was decided upon, and the necessary machinery contracted for in Detroit, which, on completion, was transferred to the lake and got ready for work in August, 1845. This was the first attempt at a stamp mill on Lake Superior, but it proved unsuitable for the purpose intended, and was of little service. The building is yet standing in which this stamping work was thus early begun. But little mining was really done; the men were kept mainly at work putting up houses, stamp-mill, saw-mill, etc.; but the shafts had been sunk to a depth respectively of 75 feet, 30 feet, and 20 feet; the distance apart of the extreme shafts being 1,739 feet. An estimated product of 550 tons of mineral was taken out. An assessment was originally made of \$35 per share on 800 shares, and it was supposed that this sum would be sufficient until the mine began to produce enough to meet the current expenses. The vein was traced in the bed of the river above the point where the openings were made, and showed a direction of N. 17° W., dipping slightly to the east.

During 1845-46 the work was prosecuted with considerable vigor, but the failure of the stamp mill was a serious drawback, and the extravagant yield which it was anticipated would be realized, based upon the analysis made by Dr. Jackson, failed to be realized. The main shaft was sunk on a pocket of copper and silver, which soon became exhausted, and efforts were made to recover the vein; with this view a tunnel was run under the river at a depth from the top of the shaft, of 90 feet. In the prosecution of this work beneath the bed of the river a crevice was discovered, which had apparently been at some time the bed of the stream, since it showed all the indications of the

action of water under such circumstances. This apparent bed was filled up with gravel and accumulations all showing the evident action of water, and in a deep hole made by the water, mingled with other accumulations, were discovered a considerable amount of native copper and silver; of the former, 18,000 pounds were taken out, while the silver was mostly appropriated by the miners, and it was thus never ascertained how much was found; one piece, however, weighing 8½ pounds—one of the largest ever yet discovered in the copper region, came into the possession of the company, and is now in the possession of the Philadelphia mint.

A further sinking to the depth of about 90 feet in the vein, which was found in this underground bed of the stream, completed the mining work of the company at this point. This was in 1846.

A good deal of dissatisfaction was felt with the agent, Mr. C. C. Douglass, who was discharged and Mr. Coryell appointed in his stead. The miners were also discharged on the suspicion of confiscating the silver found beneath the river. About 1,000 tons of rock had accumulated, and it was thought desirable to devise some way of working it up; accordingly a contract was made with a Mr. Taylor, of Detroit, for stamping machinery, but the managers, mindful of their previous failure, stipulated that if it did not do the work as recommended they were not to pay for it, and it failed to work. The agent began some work on a vein south of the greenstone, stimulated thereto by the great success of the Cliff.

The estate, which originally comprised about 40,000 acres, was reduced by the sale of 5,500 acres, the company obtaining therefor the sum of \$33,000. Congress passed a law giving the lessees the opportunity of purchasing the lands which they held for \$2.50 per acre, but the Lake Superior Company being out of funds concluded to renew their leases, as they had the option of doing on such lands as they desired to retain, for another three years.

In March, 1847 it was found that the total expenditures to date amounted to \$98,790.50. The 800 assessable shares had been called upon to pay in \$75 per share, and it began to be felt as a grievous burden; those holding these shares began to think that they had the worst end of the bargain.

Under these circumstances it was resolved to settle up the affairs of the company and sell out to a new organization. Accordingly arrangements were made by which the entire assets of the company were transferred to a new company organized for this purpose and chartered by the Legislature of Michigan, March 31, 1849, under the title of the Phoenix Copper Company. Its capital was limited to \$300,000, divided into shares of \$100 each. The incorporators were Joseph W. Ward, Richard Pitts, and Benjamin Graves. The charter was amended in 1851, making the shares \$30 each. The board of directors was composed of A. W. Spencer, J. W. Ward, Mark Healey, B. W. Balch, all of Boston; Simon Mandlebaum, of Eagle River; A. W. Spencer, President; Horatio Bigelow, Secretary and Treasurer.

The old company had expended in all \$105,833.40.

There were no less than five distinct veins at that time known to exist on the property, but practically very little was known as to their value, or as to how many other veins might exist. The five veins discovered were designated by the new company as the Phoenix, East Phoenix, Armstrong, Ward, and one south of the greenstone as the Robbins vein. These veins, with the exception of the last named, were all found in section 19, having a general direction of 12° to 17° N. W.

In the fall of 1850 work was renewed by the new company, under the supervision of Simon Mandelbaum as agent, at the mine.

No company on the lake has worked more persistently or had a more checked career. Its stockholders, through a period of 30 years, have paid the frequent assessments and hoped in vain for dividends, which the management frequently declared they were just on the eve of paying. From the several mines on the property a great amount of copper, in the aggregate, has been obtained, and a vast expenditure has been incurred; but, with the exception of one small dividend, no return has ever been made to the stockholders. The estate is a very large one, and on it are found indications of copper occurring in every form of lode that exists in the country, and it is to be hoped that in some of these numerous veins or beds the company will yet find an abundance of metal that shall amply compensate for all the previous outlay and disappointment.

The mining work begun in the fall of 1850 was upon a vein which crosses the east line of the section, but not much was done, and in the spring of 1851 work was resumed in the old mine under Eagle river, and continued for two years. The vein proved too narrow to be profitably worked. The main shaft was sunk to the depth of 264 feet, and three levels were driven a length of nearly 600 feet. During this time some additional work was done on the new Phoenix, in the N. E. $\frac{1}{4}$ of the section (19). The first work done on this vein consisted in cleaning out some ancient pits, in one of which, at a depth of 10 feet, 1,200 pounds of copper were taken out; an adit was driven in the vein a distance of 900 feet, and a mass of copper weighing 2,390 pounds was found. The vein was found to be regular but narrow. The whole amount of copper shipped in 1851 was 13 tons, of about 60 per cent ingot. A record of the company's working shows that there was a constant changing from one point to another, first to one vein for awhile and then to another vein, or to some other point on the same vein. There was no persistent work done in any locality. Shafts were sunk 40 feet, 50 feet, or 75 feet, and a little drifting done and then abandoned; adits were almost indiscriminately started and carried forward 150 feet to 900 feet, and then the work given up on some pretext and a beginning made elsewhere. In 1853 the best outlook was in the old vein, south of the old workings, where it was found to be at that time 3 feet wide and showing well in copper, and the company expressed the hope that they would soon rival the Cliff.

In June of that year the charge of affairs was placed under the direction of Mr. S. W. Hill, with instructions to examine the tract geologically, and to report to the stockholders the most available points for mining. At this time the company owned 1,701 acres of land, chiefly lying north of the greenstone ridge. Mr. Hill recommended that the adit, started in the old vein, be continued until the ash bed should be intercepted, and that the shaft should be sunk further on the old Phoenix vein south of the greenstone, to determine the value of the lode in that position.

All the rocks of supposed igneous origin in this region are found to contain copper in the veins traversing them, and these veins are very numerous, but it has taken the expenditure of large sums of money to demonstrate the fact that too many of them were not rich enough to be sufficiently remunerative to pay the cost of production, particularly by the methods that have heretofore obtained. The body of the lands held by the Phoenix Company are admirably situated, having a gentle slope towards the lake, rising in the greatest altitude to about 550 feet, and having a soil adapted to the production of the leading products required

at a mining location. The Eagle river runs across the property, and at its mouth the company laid out the village, which afterwards was selected as the seat of Keweenaw county. From the sale of the lots the company realized a considerable profit. It became evident that the company were not likely to find on the north slope ground sufficiently productive in mass copper to be a main dependence for profit; the ground, so far as explored, indicated chiefly the occurrence of a low percentage of stamp rock.

The product for 1852 was 17,662 pounds of mineral in masses and barrel-work yielding 72 per cent ingot=12,651 pounds refined copper. In 1853 the product was 138,520 pounds mineral in masses and barrel-work yielding 64 per cent, = 91,737 pounds ingot. In 1854, 3,083 pounds, yielding 65 per cent ingot, and sold for \$539.44. This shipment was sampled by Dr. C. T. Jackson, and assayed by Dr. A. A. Hayes, and found to contain \$100 to the ton, of silver.

From this and other data the directors made a showing, that with their inefficient stamp mill, which had been repaired up and got to working, they could, with eight miners, turn out $2\frac{1}{2}$ tons of mineral per month, yielding 80 per cent to 85 per cent of ingot copper, worth, at the mine, \$500 per ton, = \$1,250. The cost of production was estimated at \$800 per month, thus leaving a profit of \$540 per month. This estimate was put forward in contrast to the previous annual assessments of \$20,000, for the encouragement of the stockholders, indicating what they might expect in the future. In addition to this it was stated that the lands under cultivation would yield an annual profit of \$2,000, and the lots at Eagle river would bring \$30,000 in addition to the \$6,000 already received from such sales. Mr. O. A. Farwell, the president of the company, under instructions from the directors, visited the mine, and spent two months investigating matters in 1855, and it was under his superintendence that the old stamp mill of eight heads, built by the former company, was repaired up and set to work, and the mine, by the aid of an old engine, freed of water. Mr. Farwell decided to confine the work to the ash bed, and during the two following years it was continued, but instead of meeting expenses by the product, assessments were called for, amounting to \$22,500. Additional stamps were added, making twelve in all. The directors determined, in 1858, to let the mine on tribute, and Mr. Farwell, the president, who was also acting as agent at the mine, was so instructed, but not being able to find parties to take it on a suitable lease the president continued work on company account. Two dollars and a half per share, additional assessment, was called for, and two of the directors visited the mine to investigate matters. This committee undertook to ascertain, by a continuous running of the stamp mill for a limited period, the yield of the ash bed, and the expense of obtaining the product. The intention was to find out, with the machinery then in use, whether it would pay to incur the heavy expenditure to put in greatly enlarged and improved machinery for the purpose of working this bed. But the committee did not succeed in making the tests to their satisfaction; they found many obstacles to contend with, and a project that seemed simple and feasible enough at home was found to be difficult to practically carry out at the mine, and they came away with the expressed opinion that the mine was undoubtedly valuable, and the ultimate success highly probable, but not perfectly sure. They estimated the profit of five months' work with 21 miners and a mining captain, running the stamps, 24 heads, 24 hours each day, for two months out of the five, to be \$1,713.47. They found some gratification in the fact that the mine had increased in product from year to year since 1855, when work began

on the ash bed. In 1855 the yield was 10,847 pounds; in 1856, 25,445 pounds; in 1857, 39,351 pounds; and 1858, 65,800 pounds. The mining expenses for 1855 were \$8,375.37; in 1856, \$9,158.71; in 1857, \$10,916.11; in 1858, \$12,359.71; indicating that the ratio of the increase of product was greater than the increase of expenses.

The committee found that the mine could not be let on tribute on any fair terms; they had spent two years in opening the mine, and \$22,000. The mine appeared to be rich enough to pay a profit for working, but had not been sufficiently tested to fully determine the fact. The conclusion reached was, that the better policy would be to continue to work a small force in as economical a way as possible, and not let the property pass into other hands.

The result of 10 days' trial with 12 heads of stamps, made in November, 1858, for the purpose of determining the yield of the ash bed and the profit to be derived from working it, was the production of $1\frac{1}{2}$ tons of copper, estimated at 80 per cent. The speed attained by the stamps was 48 strokes per minute. The water power by which the stamps were run was found to be insufficient for the 24 heads to be run at that rate. If all the stamps were started at the same time it was found that two-thirds of them would have to be stopped, and they would be running only 8 heads after a few hours had elapsed. Steam power must be resorted to, they concluded. The committee also reported that they found, in examining the mining work which had been done on the location in previous years, the ground burrowed into with holes, numerous shafts and adits, but little evidence of persistent effort in any one locality, a great deal of scattering but not enough concentration, too many short shafts, shallow adits, and limited drifts; with these the ground seemed to be honey-combed, and they were led to the melancholy reflection that possibly the much-enduring stockholder would have been spared a portion of the burden which was laid upon him in the matter of assessments if the past work had been concentrated upon one promising vein; at least they might have had the satisfaction of knowing whether that vein were rich enough to pay—a degree of knowledge which they did not then possess in regard to any vein on the location.

In the following year it was determined that the mining should be pushed forward with greatly increased vigor. Accordingly, as the primal requisite in working the ash bed, a new stamp-mill was built and 48 heads of Wagner's stamps were put in and a new engine procured of sufficient power to run 100 stamps—the heaviest engine at that time, it was claimed, on the lake. Other corresponding improvements were made, rendering necessary an assessment of \$2.00 per share, which, with the others that followed, was promptly paid. The work on the ash bed was prosecuted exclusively for the three years succeeding, but was attended with no great measure of success, the yearly product varying from 20 tons to 35 tons of refined copper.

In 1863 mining was begun on the Phoenix and Robbins veins, south of the greenstone. Some previous work had from time to time been done in these veins to ascertain their value. The Central mine had recently opened on a fissure vein, similarly situated south of the greenstone, and was working very successfully, as had, for many years, the Cliff. The Phoenix decided to try its fortunes in this same locality. The old vein, south of the ridge, crosses the west line of the northeast $\frac{1}{4}$ of section 31, at a distance north from the $\frac{1}{4}$ post on the east side of about 1,100 feet, and had a bearing of N. 20° W., corresponding to the direction of the Cliff, Central, etc., which had proved to be productive veins. The further extension of the vein to the south was across the west

$\frac{1}{2}$ of section 32, owned by the Bay State Mining Company, which company also owned the south $\frac{1}{2}$ of section 29, crossed by the east Phoenix vein.

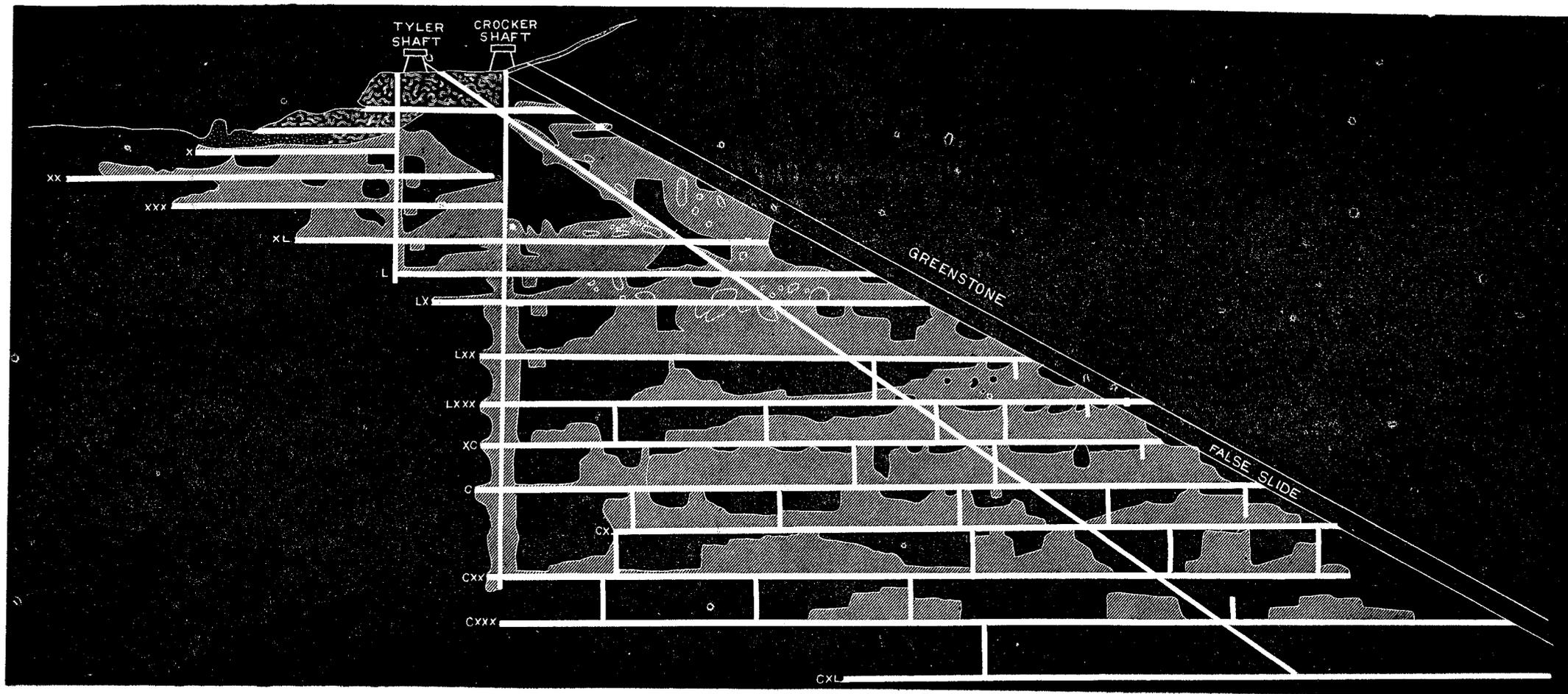
The Eagle River is formed by two branches, one coming from the east and the other from the west along the foot of the south slope of the northerly range, which unite near the southeast corner of section 30, and runs thence, crossing the range, northwesterly to the lake. Through this opening made in the bluff by the stream runs the road from the south side to Eagle River, and it has been especially convenient to the Phoenix Company in the conduct of their mines on the opposite sides of the ridge. The frequent assessments which were made finally exhausted the capital stock, until, in order to secure further funds, it was concluded to make a new organization, thus creating a new capital stock on which demands could be made for the further prosecution of the work. And so in 1865 the old company was consigned to its grave and, Phoenix-like, arose from its ashes a new organization, full of zeal and the hope of success, but unfortunately doomed, as the sequel has shown, to a career more brilliant but thus far as unavailing to the stockholders as its predecessor. The ingot product in 1865 was 244,158 pounds, which sold at an average price of 29 $\frac{1}{2}$ c per pound net. The per cent of yield was 66. The product of the ash bed was dressed to a purity of 80 per cent.

Unfortunately for the revenues of the company the Phoenix vein pinched at a time when copper was at the highest market price, bringing 50c per pound. This narrowing of the vein occurred in the 30-fathom level, and continued pinched and barren, so that for the years 1866-'67-'68 the product for those years respectively ran down to 101 tons, 98 tons, and 130 tons ingot. But the vein again widened out and proved productive in large masses, yielding in 1869 nearly 400 tons of ingot, increasing in 1870 to 500 tons, and in the following year in an equal ratio. In these years were found the largest masses which the mine ever yielded, one of which weighed several hundred tons. It has been claimed to have been the largest mass ever found on the lake, and perhaps if all the portions which were attached together be considered, it was; but it lacked the compactness and boulder shape of the great Minesota mass, found a few years earlier. The number of tons of rock stamped in 1870 was 6,326, yielding 72 $\frac{1}{2}$ pounds to the ton. In 1871 the mine yielded 1,758,629 pounds of mineral, which smelted gave 74.54 per cent ingot = 1,310,350 pounds refined copper, that sold for an average price of 23 $\frac{3}{4}$ cents per pound. The cost of mining, transporting, smelting, etc., was estimated at 15 $\frac{1}{2}$ cents per pound ingot. The cost of the ingot per pound ready for shipment, including all items except interest on the indebtedness, was 19 $\frac{1}{2}$ cents. The yield of copper per ton of rock stamped was 144 pounds.

The product from this and some adjacent mines was shipped at Eagle river, but a good deal of trouble was experienced, owing to the filling up of the channel with sand. The copper had to be taken from the dock in a scow to the vessel, which was obliged to lie outside. Great trouble was also experienced in hoisting the rock to the surface through the inadequacy of the hoisting power, and the increasing length of the levels to the northward under the greenstone. The matter of a new shaft, new machinery, and harbor improvement were seriously entertained by the officers of the company. The Bay State and Phoenix companies were mining on the same vein, which adjacent to the line of division of the properties had proven productive, masses of copper frequently occurring, lying on both sides of the line, naturally occasioning some dispute in the matter of division. A purchase had been for some time talked of, and was finally consummated in 1871, by which the Bay State property passed to the

LONGITUDINAL SECTION OF THE PHOENIX MINE, JAN. 1, 1881.

Scale, 300 ft. to one inch.



ANNUAL REPORT OF THE

ny. Some dissatisfaction was felt with the agent, and Mr. Frank G. White appointed his successor, on condition of matters, large accumulations of machinery in bad condition, etc. Mr. White resigned and Phoenix mill on the ash bed to the Bay State had been for some time before discontinued. was thus effected, and resulted in a good one. pronounced to be unserviceable by the previous mill to be adequate to the present use. The work previously, was confined exclusively to this one mill, which had been cleared off its indebtedness—for the first time in its history. In this year the shaft was begun, inclining to the north at an angle of 34 degrees. The product for the year was 960,521 pounds of refined copper, at a price of 34 71-100 cents per pound.

In the year 1880, 304 feet of sinking, and 212 feet of cross-sinking, and 932 feet, and of drift, were sunk, and the product was 640,555 pounds of refined copper, at a price of 30 62-100 cents per pound. The results of the work accomplished in the way of improvement in the mine, costing \$50,000. In this year a shaft was sunk, killing six men, among whom succeeded by Capt. Ed. Parnell, as mining superintendent.

made in the way of profit, although the work was done at a large cost, yet \$25,000 of surplus was obtained. Unhappily, work was again undertaken on the mine that for several years thereafter absorbed a large amount of the Phoenix mine. The inclined shaft was sunk, and the Robbins' vein, which had been discovered at the level, was pumped out, and the work of the mine had been provided with a stamp mill, and other surface improvements sufficient for the year.

In the year 1881, 1,796,390 pounds of mineral, yielding 440 pounds refined copper, which sold at an average price of 22 5-100 cents, and 20,000 dollars were expended on the inclined shaft. Measured vertically, the shaft was 10 feet on the incline, from the surface before the shaft was sunk. In the tenth level a large shaft was sunk south from the greenstone. The year's work was 960 140-2000 tons of mineral, yielding 440 pounds refined copper, which sold for an average price of 22 5-100 cents, and 20,000 dollars were expended on the inclined shaft. The profit for the year was \$75,000, \$20,000 of which was expended on the year's work.

The mine was opened in the mine than there had been in the year's work gave a surplus of \$107,186.00,

from which a dividend of \$1.00 per share was paid, the first and only dividend the company has ever declared. The product, however, was smaller than was obtained the year before, being in 1876, 839 1060-2000 tons of mineral yielding 76 52-100 per cent, which sold for 20½ cents per pound. This falling off in the product was due to the pinching up of the vein that soon after widened out as the work progressed. The ground north of the incline shaft and below the 8th level did not yield any profit until the 11th level was reached, so that the diminished product of 1876 was duplicated in 1877, occasioning a falling off in the receipts of \$90,000 as compared to the previous year; added to this was an expenditure for improvements amounting to \$26,000.

The mine did not look promising, and although the work for the coming year seemed almost certain to result in loss, it seemed still more ruinous to stop. The only way was to push forward as the safest horn to the dilemma. The ground was poor and the vein had a tendency to pinch up. In addition to this, and in verification of the adage that troubles never come singly, the company met with a serious loss in the burning of their hoisting and pumping engine houses. They were rebuilt, and in a much more substantial manner than before. The Robbins vein yielded about 80 tons of mineral, mainly stamp work, obtained by selecting one ton from every four that were hoisted. The total mineral product for the year was 671 385-2000 tons, yielding 73 84-100 per cent ingot, which sold at an average of 18 44-100 cents per pound.

The surplus was reduced to \$40,436.39, which was entirely obliterated the succeeding year, 1878, leaving at its close a deficiency of \$3,870.91. The yield of the mine for this year was less than it had been for five years. The mining force was reduced and work at the Robbins mine was suspended. This vein has a bearing N. E., while the productive veins of the country bear N. about 20° W. The mine was well opened ahead in accordance with the general policy of the company in this respect. The product for the year was 336 1930-2000 tons of mineral, yielding 74 63-100 per cent ingot, that sold for 16 41-100 cents per pound. The ground in the 12th level, north of the inclined shaft, worked in 1878, was very poor, and has continued poor in the levels below. A noticeable feature, especially south of the incline, is that the ground above was broken and disturbed, the texture of the rock being soft and friable. It is a supposition that there is a connection between this disturbed condition and the poverty of the vein. When the rock becomes harder and resumes its normal condition there is a tendency to a return of productiveness. The inclined shaft, which started at the surface 120 feet east of the vein, is sometimes crossed by the tortuosities of the vein, so that it is first upon one side of it and then upon the other. Its cost has been about \$200,000, and it is an open question whether it has not been a useless expenditure. All the hoisting from the mine is done in this shaft, passing into the rock-house which stands on the east side of the mouth of the shaft, where it is sorted and broken. From the breakers the rock passes down a shute into the cars, which tram it along the track laid on a trestle 400 feet southwesterly to the stamp mill, that stands adjacent to the highway. The stamp mill might be more advantageously placed under the bluff, directly east from the shaft and rock-house, thus saving the tramping and cost of trestle, and be equally accessible to water. Its present position is due to the desire to utilize the old Bay State building. By being placed in the position indicated the shute which takes the rock into the cars would have carried it directly into the stamp mill.

The water for the mill is obtained from a pond made by damming the Eagle

at any one time in its history, and the year's work gave a surplus of \$107,186.00,

river, and is brought in a launder one-half mile to the mill; a second dam across the stream forms a pond near the mill, from which the water is pumped when it is required.

The company now own 2,477 acres, the mineral land being in sections 19, 20, 29, and 30; the situation of the mine now worked being, as before mentioned, in the S. E. $\frac{1}{4}$ Sec. 30, and in 29; the old original mine being in the S. E. $\frac{1}{4}$ Sec. 19.

The product for 1880 was 2,971,450 pounds to the close of navigation, yielding 76.5 per cent ingot. The cost of stamping and washing is about 75 cents per ton of rock; the cost for breaking and tramping is 20 cents per ton. The product of this mine is about one-half mass and barrel work, and one-half stamp copper. The number of men employed is about 125, of whom 65 are miners.

The tendency of the vein towards possible exhaustion rendering it desirable that some more profitable ground be opened elsewhere, together with the great encouragement lately given by the recent workings of this or similar formations by other companies, have induced the Phoenix to resort again to its old ground on the ash bed, where for so many years it burrowed in vain. Here they are driving up an adit to the south to intersect an old shaft at the second level, 150 feet below the surface; the mouth of the adit is 90 feet above the lake, and is distant from the shaft 2,300 feet, and from the lake one-half mile. They are also driving east and west in the ash bed from the adit, and it is said to be showing a remarkable width. About 1,500 tons of the rock were hauled to the stamp mill and treated for the purpose of a trial. It gave a little upwards of one per cent refined copper. A stamp mill will be built on the north side for the use of this mine.

Mr. M. A. Delano, the efficient agent, has been in charge of the company's affairs at the mines during the past six years, having succeeded Mr. White in that office. The eastern business office is in Boston, No. 8 Olive street; Wm. P. Hunt, President; Wm. C. Coffin, Secretary.

NORTHWESTERN MINING COMPANY.

Among the parcels of lands sold by the old Lake Superior Company, and which became at an early period the seat of mining enterprises, was the location of the Northwestern. The estate comprised a tract of 1,600 acres of contiguous land, situated on sections 24, 25, 26, 35, 36, T. 58 N., R. 31 W., the mine being opened on the west $\frac{1}{2}$ of section 24. The proprietors were Messrs. Howe, Hussey, Cooper, and Moorhead, of Pittsburg, and H. N. Walker, of Detroit—the same gentlemen who controlled the Pittsburg and Boston Company,—and the local affairs of the mine were directed by Mr. Slawson, the superintendent of the Cliff mine. Work was begun here in 1845 on a fissure vein south of the greenstone, bearing N. 23° W., and dipping slightly to the west. The copper was disseminated through the vein stone, and occurred in shutes and in bunches, and continued in a small way for two years. The vein was opened about the same time on the north side of the range by the Copper Falls Company. On the surface it did not present a very favorable appearance, and no great confidence was entertained regarding it, but as greater depth was attained a good degree of width was found, ranging from one foot to four feet, averaging about one and one-half feet, subsequently widening to three feet, and also showing a sufficient amount of copper to excite a reasonable hope of future profits. The company, which had been originally organized in 1845 as the Northwestern Mining Company, was in 1848 reorganized as the North-

western Mining Company, of Detroit, with a capital stock of \$300,000, with office in Pittsburg. From this time the work at the mine was prosecuted with considerable vigor; a force of 60 miners was employed; an adit was driven in from the south 1,250 feet to the greenstone, and four shafts were lowered that attained a depth in four years of from 60 feet for the shallowest, to 215 feet for the deepest. A stamp mill with 12 heads, erected in 1852, was put in operation, supplied with water for washing purposes, pumped from the mine and from the small branch of the Eagle river. A hoisting engine with winding machinery was erected at No. 4, the most northerly shaft. The stamp mill engine had an estimated power of 24 heads, with a surplus for a saw-mill, which latter also was built and in operation in 1853, much to the convenience of the neighboring mines. An engine of sufficient power, with a lift of pumps was procured the same year at a cost of \$6,000.

The policy of the company was to open the mine to a sufficient extent to determine its probable value, and with this view the levels were well extended, but while some small masses were found, sufficient to give encouragement, the product amounted to little as a whole, being only, up to October, 1852, at which date the first shipment was made, 16 barrels of mineral, weighing 10,568 pounds, and four masses, too large for barrel work, weighing 3,268 pounds, = 13,836 pounds in all, from which was smelted 8,622 pounds of refined copper, selling for 23 cents per pound delivered at Cleveland.

In 1853, the mining force was increased to 80 men, and the product for the year was 61,165 pounds of mineral, which yielded in smelting 72.2 per cent = 44,166 pounds of refined copper.

In 1854 the product of the mine was 139 barrels of stamp copper = 77,375 pounds; 96 barrels of barrel rock = 43,594 pounds; 99 masses = 129,794 pounds; total of mineral, 250,763 pounds. This copper when smelted produced 9,584 ingots, weighing 154,900 pounds, and sold for \$39,206.68 = 25 $\frac{1}{2}$ cents per pound. The charges for freight, smelting, labor, cartage, and insurance were 10 per cent on the net products. The masses averaged about 1,300 pounds each in weight.

The buildings and machinery were estimated at \$26,475; 1,776 bushels of potatoes were raised on the farm in that year, 400 bushels of turnips and 20 tons of hay, and a large amount of lumber—several hundred thousand feet—produced. The average number of men employed about the mine was 100, the miners receiving \$27.50 per month clear, and the others an average price \$18 per month. The indebtedness was \$16,500. The directors make no predictions for the future. Four additional stamps were put in the mill, making 16 heads in operation, and several houses built, making 24 in all on the location.

But the mine could not be made to meet the expenses, and the stockholders were yearly called upon for assessments, a demand which the Pittsburg and Boston men submitted to with very ill grace. So that in 1857, following the great financial revulsion, the company suspended work, having expended \$218,000, \$168,000 of which were paid in assessments. In the meantime the Central mine on the E. $\frac{1}{2}$ of sec. 23, adjoining the Northwestern on the west, and working on a similar fissure vein, was meeting with great success; and stimulated by this fact, as well as the prevailing high price which copper bore in the market, a resumption of mining work was determined on in 1863. An assessment amounting to \$60,000 was made and operations were renewed, at first conducted with the view to discover the Central vein on the Northwestern property, since the company owned the land for a mile immediately south of

the Central. A shaft was sunk at a point on the course of the Central lode at a point 70 feet to the south of the south line of the Central property and about 800 feet south of the south level of the drift in the Central mine. The shaft, after passing through 45 feet of quicksand, intercepted a belt of hard, dry, chloritic rock. After cross-cutting in the rock, east and west 126 feet, to a depth of 12 feet, the vein was found, being distant east from the shaft 78 feet; but upon examination it was not found to carry copper in sufficient amount to encourage working. Other explorations had been undertaken and carried forward in the meantime, resulting in the discovery of what was deemed a promising vein, being about 100 feet to the west of the old Northwestern mine. It was thought to be the best way to prove this vein by cross-cutting from the old mine; accordingly the pumps were started and the old mine was freed from water, and the effort begun to determine the relation of the new vein with the one formerly worked. This exploration, however, was not thoroughly consummated. It was, in fact, but fairly commenced when the \$60,000 which had been called in had been expended. A good deal of discouragement was also felt over the failure of the work to the south on the Central vein. So that there was but little disposition to go on any further, by a renewal of assessments, in a work that afforded as yet only uncertainty. The company had thus far expended \$228,000 of its capital stock, leaving only \$72,000 that could be called in to exhaust the amount authorized by the charter. Under these considerations it was concluded to suspend, which occurred in January, 1865.

The total expenditures of the company to that date aggregated \$308,759.74, of which, as above given, \$228,000 were got by assessment, and the remainder, a little upwards of \$75,000, derived from the sales of copper. There was a small amount of copper,—6,651 pounds mineral, yielding 2,161 pounds ingot—obtained in 1864.

The total workings in the old mine comprise four shafts of a depth, respectively, numbering from the south to north: No. 1, 109 feet; No. 2, 201 feet; No. 3, 215 feet; No. 4, 225 feet; an adit level, 1,226 feet long; No. 10 level, 994 feet long; 20 level, 1,057 feet long; 30 level, 124 feet, with a number of winzes and several cross cuts. But a small amount of stoping was done in proportion to the ground opened; several thousand fathoms were left unbroken.

The same officers and board of directors were continued from the organization of the company: J. K. Morehead, President, and James M. Cooper, Secretary and Treasurer. The location is marked at the present day by the ruined buildings and shaft houses,—the natural result of years of neglect.

COPPER FALLS MINING COMPANY.

Cotemporary with the Northwestern, and working originally on the same vein, was the Copper Falls mine. The vein takes its name from the falls in the creek, in the bed of which stream it was first discovered. From the top of the falls to the bed of the stream below, the vein was observed to double in width, becoming from a foot to 18 inches wide, and lumps of copper were found in the stream below the falls, and a little digging and blasting, which was done, revealed a considerable amount of copper. An adit was driven in on this vein, and four shafts were sunk in it. The proprietors were filled with the most sanguine hopes of success, for in many parts the vein appeared exceedingly rich in small masses and pieces of copper, and in one instance a mass weighing seven tons was found at a distance from the surface of 50 feet; this was in 1846, and at the time was the largest mass that had been found on

the lake. Considerable silver also was found in this vein, both in a pure metallic state and also in some of its combined forms, more than a ton of which ore was sent to Paris for examination and sale. This vein was somewhat irregular, being barren in some places and, as before said, yielding abundantly in others, and it was hoped that as greater depth should be attained the vein would prove uniform and rich; with this hope the work was prosecuted vigorously, for that early day, during two years. During this time the four shafts reached a depth, commencing with the most northerly one and going south, of respectively 47 feet, 208 feet, 45 feet, and 83 feet, and the adit had been driven in a distance of 265 feet, and a winze had been sunk 66 feet below the adit level; all of these shafts were connected with levels at suitable distances. A good road had been built to Eagle Harbor, which was distant from the mine two and one-half miles. Some dwelling houses had been built, and mining plant secured. At this time it was found that the workings had been carried on in a bed of trap, between two beds of sandstone. The vein bore well in the trap, but was barren and split up in the underlying bed of sandstone, down through which the work was continued. To ascertain whether the vein would again be found productive in the trap underlying the sandstone, a shaft was lowered 40 feet through it, and some cross-cutting done to recover the vein, but without success,—doubtless for the reason the cross-cuts were made too near the juncture of the beds where greater disorder would naturally exist. The vein was subsequently found on the surface, crossing this underlying bed.

This work was done under the auspices of an association formed October 16, 1845, and known as the Copper Falls Company, who purchased of the Lake Superior Company, government lease No. 9, paying therefor the sum of \$11,060.97. The lease had been granted to David Henshaw by the War Department, and embraced 4,261.5 acres of land, comprising sections 11, 12, 13, 14, 15, and fractional sections 1, 2, 3, 10, T. 58, N., R. 31 W., being bounded on the north by the lake, on the east by the Eagle Harbor property, on the west by the Lake Superior Company's land, and on the south by the Dana, Winthrop and Northwestern Companies' lands; on the south line the lands rise to an elevation of about 700 feet above the lake. The mining work done by this association was mainly confined to the vein, as above described, on section 11, and the expenditure incurred amounted to \$100,000, \$40,000 of which had been drawn from assessments, and \$15,000 derived from the sales of the copper which the mine had produced, and from sales of stock. In 1848 a special charter was obtained from the State of Michigan by the association, and for its benefit, the shareholders being designated as the incorporators under the act, giving to each one as many votes in the new company as he held shares, and by vote of the stockholders the stock,—1,000 shares of \$30 each—was issued share for share to the members of the old associations upon surrender of the old certificates and payment of dues. The new organization was designated as the Copper Falls Mining Company, and to it was transferred all the assets, real and personal, of the former association. In the following May the lands, which up to this time had been held only on lease, were entered at the government land office, and a patent for them obtained. In July thereafter an amendment to the charter was granted by the legislature, increasing the number of shares to 10,000. The former certificates of stock were called in, and new ones, of proportional amounts, were issued to the shareholders in accordance with the increase in number.

John T. Heard was chosen president, and Horatio Bigelow, secretary—office in Boston. Work was continued in the old mine until the summer of 1850,

but not having proved profitable, and the mine not appearing favorable for a continuance, the agent was directed to discharge his force and to suspend work.

A short time previous, however, some work had been done in continuance of what had been begun in 1847 by the former company, on a vein lying 40 rods to the east of the one principally worked. In this vein a shaft had been previously sunk, and it was decided to drive an adit to intersect it. This adit was driven in the fall of 1849 a distance of 250 feet, mainly in dirt and decomposed rock, until within 30 feet of the shaft, when the rock became compact and the vein well defined, with a width of 18 inches, carrying considerable copper. The adit completed, a cross-cut was made to the southwest from the shaft 80 feet, but, as before stated, the outlook was not sufficiently favorable under the existing financial condition of the company, to warrant a continuance, and so matters were brought to a stand still.

In driving the adit and cross-cut it was expected to arrive south of the sandstone; on the contrary the end of the work proved to be to the north of it. Under these discouraging circumstances the directors concluded that it would be well to know something more of the location geologically. Accordingly, soon after Mr. Samuel W. Hill, who had recently been connected with the geological survey of the Lake Superior region, was employed to make a thorough examination of the property and determine as near as possible the most suitable point at which to resume mining.

Mr. Hill determined the existence of six distinct transverse veins, designated as the Jacobs Creek vein, the Hill vein, Copper Falls vein, old Copper Falls vein, Child vein, vein No. 3—the latter the most easterly one—and subsequently a longitudinal lode which he named as the ash bed, from its volcanic, scoriaceous, ashy character. These several veins are nearly parallel with each other, being about N. 22° W.

In June, 1851, Mr. Hill was engaged as superintendent, and under his direction the work of opening a mine was commenced, in accordance with the recommendation which he had previously made, on the Copper Falls vein, situated about a half of a mile to the west of the old mine. Here a new location had to be made, the land cleared, some houses erected, shops, office, etc.

A year later work was begun on the Hill vein, to the west, intending to connect the two mines where opened by galleries driven across in the ash bed.

The Copper Falls mine was opened with an adit 2,350 feet in length and with seven shafts.

The Hill mine was opened upon a much more extensive scale, exceeding anything previously attempted on the lake. A deep adit was started from a point in the vein 50 feet above the lake and driven in the vein, to be connected with the surface by seven shafts, No. 1 being 2,320 feet from the mouth and No. 7 6,400 feet, at which point, when completed, it would be 700 feet below the surface. In the prosecution of this work the discovery of the so-called ash bed was made. This important metalliferous deposit is included in the formation similarly with the metalliferous beds found in Houghton and Ontonagon counties, and underlies a fissure vein running east and west along the plane of contact. The discovery of this bed was due to the extensive ancient workings, which were found to mark the surface outcrop for a great distance. Some of these near the Copper Falls mine, on being opened, proved to be 70 feet in length and 37 feet in depth. So greatly did they exceed in dimensions any works of this character which had been previously observed in this district that their artificial origin was not at first suspected. But the heaps of earth and of rocks which had been thrown out, and the stone hammers and copper arrow-heads

and the bits of charcoal and rotten wood and the other evidences which, upon examination, were found in the bottom of these pits, determined their nature. The mine on the Hill vein had been started on a plan of such magnitude that it was deemed best to secure the possession of its southerly extension; accordingly the adjoining one-fourth section of land to the south, to wit: The N. W. $\frac{1}{4}$, Sec. 23, was purchased for the sum of \$8,000, thus making the estate 4,421.5 acres. The company endeavored to arrive at as clear a knowledge as possible of the mineral value of the property—of the character and productive capacity of the veins. Feeling assured of remunerative results the directors planned to operate on an extensive scale. Up to the close of 1853 there had been expended about \$220,000. \$180,000 of which had been derived from assessments. Up to March 1, 1852, the total cost at the two mines for labor was \$17,924.87. The average net wages paid to miners, exclusive of board and other fees, was \$37.35.

From March 1, 1852, to March 1, 1853, the total mining expenses for sinking, drifting, etc., were \$32,912.37, and for a corresponding period to March, 1854, they amounted to \$40,784.28; for that year the average number of miners employed was 65, who received average net wages of \$34.58 per month. The surface expenses during the corresponding previous year were \$35,066.09, and the average number of surface hands employed was 69. The cost of sinking per foot, including all expenses at mine, was \$14.04; drifting per foot, \$5.44; and stoping per fathom, \$14.26.

The product for 1852 was 17,662 pounds mineral, yielding 72 per cent ingot = 12,651 pounds refined copper, and the product for 1853 was 138,520 pounds mineral, yielding 64 per cent = 91,737 pounds ingot.

The surface improvements made during the year comprised four and one-half miles of graded wagon road to Eagle Harbor, to which work several of the adjoining companies contributed, 27 dwelling houses, two boarding houses, office, shops, engine house, boiler house, a stamp mill, a saw-mill, etc. The stamp mill contained 24 heads of stamp, with an engine of sufficient power to drive 48 heads.

The mines were opened with the view to secure drainage through the adits. In the Hill mine four adits were started, the lowest being at the seventh level; and in the Copper Falls mine there were two adits, the lowest at the fourth level.

The agent, at first, expected to realize a considerable yield of mass copper, as well as, if extensively opened, an almost unlimited amount of stamp rock. During the summer of 1854 a force of 24 men was engaged in stoping, and 80 men were employed in extending the drifts and shafts. It was found that very little mass copper was obtained, while much more stamp rock was produced than there were means of working up.

There were opened about 11,000 fathoms of ground for stoping, of which nearly one-half was considered as worth removing, much more than would be needed with the facility then possessed, for some time to come. The agent recommended that the number of stamps be immediately increased to 64 heads; in fact, he gave it as his opinion that 100 heads were needed, and that with this number the mines could be profitably worked. He thought it would be settled that the future of the mine would depend on working the stamp rock. The occurrence of mass copper could not be expected in sufficient quantity to afford a large amount of income. The ash bed rock he considered could be stamped and washed for from 40 cents to 50 cents per ton, yielding

one per cent of ingot; and if only enough were mined and worked up a sufficient profit would be assured.

The full extent of the recommendations of the agent were not adopted by the directors; a medium course was chosen. The number of stamps was doubled, making the number 48, and improved washing apparatus was introduced; but owing to the failure in getting the materials on the ground before the close of navigation the completion of these improvements was not brought about until the summer of 1855. It was also decided to stop the further extension of the mine, and to reduce the labor and expenses as far as possible. Mr. Hill was succeeded by Wm. Petherick, as agent of the mine. The stamp rock was found to be exceedingly variable, yielding from nothing to 1,000 pounds, and even as high as 2,000 pounds per fathom, and it was estimated that from 80 pounds to 100 pounds per fathom would cover expense.

The total mining expenses for 1854 were \$50,260.43, and the total surface expenses for 1854 were \$44,843.62. The cost of drifting 4,157 feet was \$5.61 per foot; for sinking 821 feet was \$14.85 per foot; for stoping 1,000 fathoms was \$14.73 per fathom. The average number of miners employed was 96; number reduced at close of the year to 62. The average net wages for miners was \$34.63 per month. The average number of surface men and other employes was 112, and the average wages received per month was \$25.89 clear of board and doctor's fees. Total expenditures for the year were \$238,152.55. The product was 258,876 pounds, yielding 55½ per cent = 144,269 pounds ingot. Some preliminary work performed during the year on the Owl Creek vein developed an apparent productiveness, which appeared highly encouraging, and which subsequent operations proved to have been not at all misleading. The mining work on company account came gradually to be confined to this vein and to the ash bed, and the Hill mine and Copper Falls mine were let on tribute.

In 1855 the capital stock of the company having become nearly or quite exhausted by assessments, the company was reorganized with a capital stock of \$500,000 in 20,000 shares.

The product of the mines in 1855 was 282,733 pounds mineral, yielding 60 per cent ingot. The annual product continued to increase from year to year, and in 1859 it had become double the previous year's yield; the expenses had also somewhat diminished, so that the outlook for the future became more encouraging. This favorable result was due to the company's increased facilities for manipulating the vein rock, although the yield was only 1 1-10 per cent. The average cost per ton of rock for mining, raising, tramming, breaking, stamping, washing, etc., was \$3.64, and the average yield per ton was, for three years, 21.7 pounds, and the average price received was 22.2 cents per pound. An accurate account of the work was kept for a period of three years and eight months, for the purpose of ascertaining the profit of working the ash bed, resulting in the averages above given. The results for each year were:

	Ton of Rock Stamped.	Pounds of Cop- per Produced.	Copper per ton of Rock.	Average Sale per Pound.
8 Months, 1858.....	6,217	126,369	20.3	0.23.40
1 Year, 1859.....	15,880	372,985	23.5	0.22.12
" 1860.....	15,590	399,877	20.4	0.21
" 1861.....	24,068	486,108	20.5	0.23

In 1861 the company set off 1,200 acres of its estate—adjacent on the west—so described as to include the Copper Falls and Hill mines, to a new company which it organized—the Petherick. On these mines the sum of \$300,000 had been expended, and the Copper Falls Company received for the property 10 per cent of this amount.

The company has ever manifested a liberal and progressive spirit, disposed to keep up with the times by introducing such new machinery and improvements as had been proved to be advantageous, and to incur its share of the labor and expense of testing new machinery and new methods; in 1861 one head of Ball's stamp was introduced into the stamp house, and was found to work very satisfactorily. From 1858 to 1861 \$60,000 in assessments were called in, and in the same time the sum of \$86,173.23 was expended in surface improvements and machinery.

The cost of the mine to December 31, 1862, was \$960,000, but there was a profit on the year's work (1861) of \$30,000.

In 1862 there were stamped 19,752 tons of rock, which yielded 20 3-10 pounds of copper to the ton, or 339 pounds per cubic fathom of ground stoped, being an increase of 62 per cent over the yield of the preceding year. Two heads of Ball's stamps were in use, and the cost per ton for stamping, washing, and for barrels, materials, labor, repairs of machinery, etc., was \$1.12 per ton. The total number of tons taken from the mine was 21,345, and total number cubic fathoms stoped was 1,181. Number of pounds of mineral produced was 468,624, which yielded 85 per cent. The average mining force employed was 78 men; in all, 102 men.

It was found that there had been a fraudulent over-issue and sale of stock amounting to 3,700 shares, which were bought up and cancelled by the new board of directors, and the number of shares made to conform to the requirements of the law.

In 1865, in sinking from the adit, which was 1,500 feet in length, to the levels below in the Owl Creek mine, to secure ventilation, a fissure vein was discovered, which proved very rich in copper, and greatly augmented the output, which became, in 1866, 538 1109-2000 tons of ingot, and in 1867, 1,128 1485-2000 tons ingot. In this year the company was able to pay its first dividend. The Owl Creek is the only mine north of the greenstone that has ever paid any dividends.

This greatly increased product, which began in 1865, was due to the discovery of a magnificent deposit of masses, which occurred in the 40th, 60th, 70th, and 80th levels in a compact space; in all, obtained about 4,000 tons. In the 90th level the masses ceased to occur. In 1873 and 1874 the mining was done in rich ground, and the product was consequently large. In the latter year its reported assets were \$99,045.17, and its liabilities were \$48,046.29, leaving a surplus of \$50,198.39. A terrible accident occurred, occasioning the death of several men, due to the falling of a large portion of the hanging wall.

So long as this good ground lasted the company continued reasonably prosperous, but after 1874 the product declined, and in 1875 was reduced to a few tons; the good ground that had been opened was worked out. In 1876 and 1877 the product continued to be equally light, and the capital stock was so far exhausted that it became necessary to increase it or to surrender the charter; the company accordingly reorganized in 1877; the value of the shares was increased to \$50 per share, making the capital stock \$1,000,000. In 1878 the stamp mill was totally destroyed by fire, thus cutting off the product entirely. Instead of rebuilding on the old site, it was decided to open the mine on a new

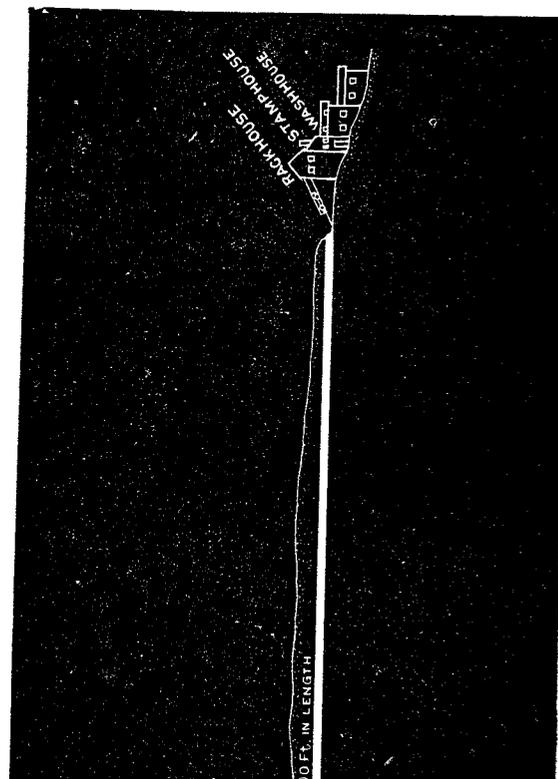
plan. A deep adit that was begun some years ago has been pushed forward. It starts in the vein, at a point about 50 feet above the lake, and has since been driven in to the Spencer shaft—the heretofore main hoisting shaft—a distance of 5,300 feet, and has recently been completed and laid with T rail track. It has a descent to the north of four inches in 100 feet, and intersects the shaft at about 500 feet below the surface. During the present year (1880) the company have built a new stamp mill, rock house, and wash house at the mouth of the tunnel. The loaded cars, after being trammed to the mouth of the tunnel with mules, are drawn up an incline into the rock house, the incline continuing upward after entering the building, so that at the extreme end it has an inclination of about 10° from the vertical; reaching this position the car dumps from the tail end onto a bar screen that inclines about 45° ; the smaller portions of rock pass through into the rock bin below, and the larger portions slide down the bars to the floor, whence they are thrown into the breakers and the fragments drop into the bins. From the bins, which have a capacity of about 600 tons, the rock is drawn under the stamps, of which there are two—Ball's latest improved pattern—15 inch cylinders and 7 inch rod, and 450 pounds pressure. There are two tracks entering the building, two separate dumps, and two Blake's crushers. The washers are Collum's, with the latest appliances, and there are two large Evans' slime tables. The capacity of the mill is 300 tons per day—so estimated.

The entire arrangements, from the rock house to the slime tables, are under one roof, practically, and everything is admirably arranged with a view to convenience and efficiency, and is of the most complete and substantial character. The mill is built against the north side of the bluff, which rises from the low land that extends to the south from the lake shore, and a ravine that exists on the east side of the mill affords a very convenient receptacle for the coal, the bottom of the ravine being on a level with the boiler house floor. Three locomotive boilers are in place, and room for the fourth when needed; they are supplied with water by hydrostatic pressure, the water coming from a pond 1,500 feet distant to the southwest, being brought in a pipe laid underground. The water for the stamps and the washing is obtained from two sources—from two ponds, situated at different points on the property. One of them, made by a dam in Owl Creek, up on the bluff above Spencer shaft, catches the drainage from several hundred acres of marshy, meadowy land, forming the plateau of the bluff. The water from this pond will be conducted down the shaft, giving a head of 500 feet, which will be utilized in compressing the air for the power drills, and for such other work as it can be made available to perform; and thence, with the drainage of the mine, it will be conducted under the track, along the bottom of the tunnel to the wash house.

The other source of supply is from a dam across Trap Creek, in the N. W. $\frac{1}{4}$ of Sec. 7,—a piece of land that was recently purchased by the company for this purpose, and thence the water is brought in a launder 7,500 feet in length to the mill. This launder is an open one, and has a very slight fall; it may be found necessary to make it a closed one to prevent filling with snow, etc. A track runs out from the adit over the edge of the bluff for dumping the waste rock. The blacksmith shop, machine shop, etc., are also connected with the tunnel and with the stamp mill by horizontal tracks, for convenience of running on cars machinery to be repaired, and drills to be sharpened, etc.

The machine shop, standing to the east of the stamp building, is well supplied with lathes, planers, etc., requisite to make all repairs that may be necessary; also a new warehouse has been built near by, and four excellent dwelling

, 1881.



REPORT OF THE

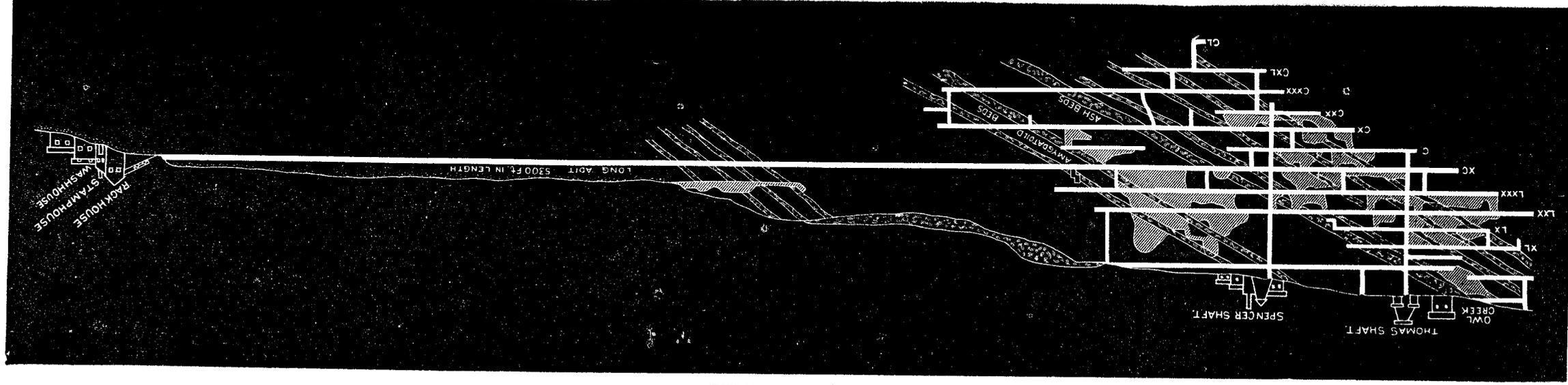
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LONGITUDINAL SECTION OF THE COPPER FALLS MINE, 1881.

Scale, 500 ft. to one inch.



houses are in process of construction. The ground plan of the stamp mill, which includes the rock house and the wash house, is 128x44 feet, and the rock house is 48 feet in height. The washing floor is 84x44 feet, and slopes three-fourths of an inch to one foot.

No copper has been produced since the stamp mill burned in 1878, but considerable mining has been done, in addition to driving the tunnel, and several thousand tons of stamp rock lie in the mine ready to be worked up. The stamps were started the 18th of December last. The tunnel, although driven on a fissure vein, was all dead work, as but very little paying ground was intercepted. The plan of operations is to work the ash bed, as this company was the pioneer in its discovery, and was the first to introduce the Ball stamp on the lake, and has ever continued to work this bed more extensively than any other company; the result of its present enlarged operations are regarded with much interest. The ash bed has, in this mine, an average thickness of about seven feet, and slopes to the north at about 28°, and as it extends east and west indefinitely there is an abundance of ground to work, being 700 feet of track from the level of the tunnel. The same cars will be used in the levels that go to the mill. They will be filled from the stopes and run out to the inclined shaft onto a turn table, and thence up or down to the adit level. The main shaft in the mine will be fitted with a double track, gravity road, so that the down cars will draw up the empty ones. An inspection of the mine reveals some very rich ground, and also broad stretches of ground that is very bare or utterly barren, so that an important fact connected with the profitable working must apparently be to open as little poor ground as possible. It is now definitely known what percentage of copper the rock will yield, and the problem reduces itself to simply bring the cost of production within this limit, and to work up the greatest possible amount of the rock. Mr. B. F. Emmerson, who for eight years has been agent of the mine, has studied the situation thoroughly, and has labored indefatigably to bring matters to the present hopeful condition, and it is safe to conclude that no effort will be spared in the future.

The present force of men employed is 94 surface men and 102 men in the mine. The officers are: President, David Nevins, Jr.; Secretary and Treasurer, John Brooks; office, Boston, Mass; Superintendent at mine, B. F. Emmerson; Mining Captain, Wm. Ludlow.

PETHERICK MINING COMPANY.

As previously stated the Petherick Mining Company was organized in 1861 by the Copper Falls Company. It having become evident to the managers of the Copper Falls that they had more mining territory than was necessary, and more mines opened than one company could properly work, it was first suggested by their agent, Captain Petherick, that a new company be created—organized—to work the Hill mine and the Copper Falls mine, the latter named company confining its operations to the veins further to the east, which had been sufficiently explored to demonstrate their equal value. The ash bed extends northeast and southwest across both properties. Accordingly, the company was organized, and the western part of the Copper Falls location purchased for \$30,000, and the mining work continued as it had previously been done, under the direction of Captain Petherick, who acted as agent for both companies. For several years the stamping was done at the Copper Falls mill. Work was continued for a few years in a limited way, and shut down on company account. In 1873 the stamp mill of the Indiana Company was purchased and work was

again resumed, so that in the following year, 1874, the company shipped 167,976 pounds of mineral, which yielded 84 per cent = 141,199 pounds of ingot copper. The expenditures were \$49,809.66, and the estimated assets, in excess of liabilities, at the close of the year were \$7,324.08. The number of tons of rock stamped was 5,115, which yielded 1.08 per cent mineral; and the yield per fathom was 425 pounds; but it was found that there was insufficient water for stamping purposes; the mill could only run a portion of the year; the expenses greatly exceeded the income; indebtedness accumulated, and in 1877 the property was closed out at a sheriff's sale, and purchased by Mr. Delano, agent of the Phoenix, for Boston parties, who, as the property was not redeemed, have the present year organized a new company called the Ash Bed Mining Company, with a capital stock of \$1,000,000 in 40,000 shares. The company have begun to open a mine on the same plan as the Copper Falls. A deep adit has been started on the Hill vein, which will reach 2,700 feet, when it intersects the ash bed, and is 600 feet below the surface, on the lay of the bed. The stamp mill will be built below the mouth of the adit, and the water pumped from the lake. The intention is to open with a capacity of 500 tons of rock per day, expecting to obtain a yield of 10,000 pounds of copper per day therefrom. There are about 25 men employed at work on the adit. The old stamp mill has been repaired, but no product has been shipped. There are about 20 dwelling houses on the location, and some other buildings. The estate comprises 1,100 acres of land in Secs. 2, 10, 11, 14, 15, and 23, T. 58 N., R. 31 W.

Wm. P. Hunt, President; Wm. C. Coffin, Secretary and Treasurer; office, Boston, Mass.; Mr. M. A. Delano, Agent.

THE NORTHWEST COPPER COMPANY.

The Northwest Copper Mining Association was formed in 1847, and held a large body of lands in Keweenaw county, comprising Secs. 13, 14, 15, 24, and half Secs. 10, 11, 12, 23, 25, and $\frac{1}{2}$ Sec. 26, T. 58 N., R. 30 W.; in all, 4,320 acres, lying south of the greenstone range. Mining work was begun in a limited way on section 15, and so prosecuted for two years, when in 1848 it was deemed best to organize with sufficient capital to enable them to prosecute mining on a scale of increased magnitude. Accordingly a charter, procured from the legislature of Michigan, granted March 9, 1849, under which the Northwest Mining Company was organized on the 15th of May thereafter, and the surrender of the shares of the old company, and the substitution therefor of the shares of the new company duly effected. The president and secretary of the preceding company were William Pettit and James G. Clark, of Philadelphia. Associated with them were a number of well known names of that city and of New York, among whom were Horace Greeley, Oliver Johnson, Geo. H. Thompson, and Charles Schaffer, who were also the corporators of the new company, and James G. Clark became president. The capital stock was placed at \$200,000, divided into 1,000 shares, and work was undertaken with a degree of zeal that foreshadowed a better result than was eventually realized. There were three mines opened on fissure transverse veins south of the greenstone, called respectively the Stoughtenburgh, Hogan, and Kelley. The former bears N. 16 $\frac{1}{2}$ ° W., and the two others bear N. 19° W. The Stoughtenburgh vein—the one shown in the longitudinal section given in this report—was opened with four shafts and an adit. The total length of the shaft had reached, in five years, 1,130 feet, and the levels an aggregate length of 5,450

feet. The deepest—next to the greenstone—being down 500 feet, and the longest level being 1,000 feet in length, and these levels had stoped about 3,000 fathoms. The vein did not produce a large amount of stamp rock, but masses weighing from a few hundred pounds up to several tons—the largest 11 tons—were frequently met with. They were generally found outside of the lode, but adjacent to it and isolated, with no other copper in the immediately surrounding rock. The lode has a variable width averaging about 12 inches, and as at the Cliff, crosses a series of amygdaloid floors, which had a marked influence on the vein, and from them was afterwards obtained the greater portion of the stamp rock.

The Hogan vein was also opened, but less extensively worked than the former, and some work was done in what was called the Clark vein, and a cross-cut from the Stoughtenburgh to it was nearly completed.

The first stamp mill was put up in 1849-50 and run by water, but proving entirely inadequate, from want of power, a new stamp mill was erected with 24 heads—operated by steam power—in 1852. Soon after this stamp mill was started the agent, Mr. Wm. Petherick, kept an account of the result of the work—the first of the kind on the lake: Total number of tons stamped in three months, 1,451; yield of copper, 39,693 pounds; per cent of copper, 1.34; pounds of copper in ton of rock, 27.4. The total cost per ton of rock, including all incidentals of every description, from its place in the mine to the finishing up in the work house was \$4.42. The market value of the copper was \$6.97, leaving a net profit of \$2.55 per ton of rock. The average yield of mineral per fathom up to this time was estimated to have been 225 pounds; at the same time in 1852 a heavy engine with pumping and winding machinery were put in to operate the Stoughtenburgh mine. It illustrates the vexation and cost of mining on the lake at that early day, in the fact that four months' time was consumed in transporting this machinery from Pittsburg to its destination at the mine. In three years' time there was produced as follows:

	Pounds Mineral.	Pounds Fine Copper.	Per Cent.	Sold For.
1849	44,196	34,322	77 $\frac{3}{4}$	\$ 5,672 71
1850	270,873	195,020	72	35,786 66
1851	434,993	393,199	67 $\frac{1}{2}$	53,360 46
Total	750,062	522,541	69 $\frac{3}{4}$	\$94,819 83

But the expenditures for the same period were \$172,183.96. An agent was sent to England to negotiate the sale of the property, but the London parties were unwilling to purchase unless the company retained a part interest, which they declined to do, and the negotiations fell through. The product of the mines, notwithstanding all the effort that was made, could scarcely be brought above 100 tons per annum; but the agent, Mr. H. H. Beecher, being strongly impressed with the richness of an amygdaloid belt cut by the veins, urged upon the directors the importance of increasing the stamping facilities, which in reality were very meager, owing to a want of water during a great portion of the year. It was decided in 1859 to build a new stamp mill, and the site chosen was on the bank of the Montreal river, where it was thought there would be no lack of water. Forty-eight heads of Wayne stamps were purchased; the

engine was esteemed of sufficient power for a greater number when required, and it was also intended that water should be pumped from the new mill to the old one to eke out its supply. A railroad—double track, 1,200 feet long—was laid, connecting the mill with the mine, having a grade of 94 feet, so that the descending cars draw up the empty ones.

It was found to be extremely difficult to adjust the finances of the company to provide for the expenditures; advances had to be obtained from the consignees of the copper, and not unfrequently the directors were obliged to give their individual guarantee; but, notwithstanding, it was announced that the company had arrived at a position where the stockholders would be soon amply compensated for their previous patience and expenditure. The agent reported the property to be worth millions.

The company had laid out the village of Wyoming (now locally called Hell Town), and sold the lots, and up to this time 77 houses had been built there.

But with the two stamp mills, by the aid of which so much was anticipated, the condition of matters did not seem to improve; they could not, and never did in any year produce copper enough to meet the cost of obtaining it.

The amygdaloid bed was said to be 10 to 15 feet thick, and was opened with an inclined shaft, and believed to extend indefinitely east and west, and probably hold equally rich. The rock was found to work up easily, and it seemed that all that was required was sufficient facilities to get out and to stamp 100 tons per day to make it the richest mine on the lake.

At the close of 1859 over \$611,000 had been expended, and the receipts from the sale of copper had amounted in all to \$328,000. The indebtedness continued to increase until the company was finally threatened with overwhelming financial disaster. The excess of the company's liabilities amounted to \$130,000, and there was no longer any means of meeting them; the capital stock was exhausted and even the interest on their bonds was unpaid.

PENNSYLVANIA MINING COMPANY.

In this emergency a meeting of the stockholders was called, who resolved to reorganize under the general mining laws of the State of Michigan, with a capital stock of \$500,000 in 20,000 shares, to which organization, when perfected, the Northwest should sell all its estate, real and personal, in consideration of the new company assuming its liabilities. This plan was carried into effect, and in November, 1861, the Northwest Mining Company ceased to exist, and in its stead there was created a new organization to be known as the Pennsylvania Mining Company of Michigan, with the office, as had been that of the previous company, in Philadelphia.

Joseph G. Henszey became president, and S. M. Day, the former secretary and treasurer, continued in that office.

The lands comprised 2,880 acres of mineral land in Keweenaw county, and 6,000 acres of timber land in the same county were soon after purchased. The actual results of the experience of the Northwest, notwithstanding the numerous statements which had been made, based upon limited tests to the contrary, showed that the old mine had not been worked with profit. Only 260 pounds of copper could be obtained per fathom from the average ground in the vein, while the cost had been more than \$100 per fathom for working it. It seemed that a sufficiently thorough trial had been made, and in view of the unfortunate results, it was thought advisable to seek a new location. Mines were opened on what were called the Eagle vein, Branch vein, and the Trotter

vein, and the underground workings were made to conform to those of the Cliff and the Central. Mr. S. W. Hill was engaged as agent, and his sanguine reports regarding the mineral value of the property served to imbue the members with much confidence, and a successful future seemed to be certainly assured.

A new stamp mill was built—the largest on the lake—and provided with the most approved appliances; a large amount of surface improvements were made, consisting of buildings, saw-mill, road to Lac La Belle, the stamp mill, railroad from the mine—gravity incline—1,300 feet in length, new engine for hoisting and winding apparatus, etc. In these improvements there was expended over \$126,000, and no copper had been produced.

THE DELAWARE MINING COMPANY.

In 1863 the Delaware Mining Company was organized and 720 acres from the west side of the estate were set off to it, for which the Delaware paid the sum of \$100,000 in stock. In other words there was divided among the stockholders of the Pennsylvania Company 4,000 shares of the new company's stock.

These two companies worked largely and expended in mining and improvements nearly \$2,000,000. Two large stamp mills were built costing \$200,000. Among the projects inaugurated—and although never accomplished, is still a favorite one with the successors of these companies—was the construction of a railroad to Lac La Belle. The latter had been made so that vessels could enter, and it could easily be made one of the best harbors on the lake. The Pennsylvania and Delaware were strenuous in their efforts to secure the construction of this road.

But there was, comparatively to the surface outlay, but little mining done, and the companies failing to meet their pecuniary obligations, the properties were taken possession of by the bondholders in 1866, and in the following year work was begun by the bondholders and the mines put under the charge of Mr. W. H. Spaulding as agent. This was continued for two years, when the bonds were purchased by Ed. M. Davis, of Philadelphia, who took possession of the property and assumed the direction of affairs in person. A new organization was made including both properties in one company, called the Delaware Copper Mining Company, which arrangement was consummated in 1876. Under this organization work has continued up to the present time.

Work was begun under the charge of Capt. A. P. Thomas, formerly of the Copper Falls mine, on the Delaware vein. The shafts were refitted with new skip and tracks and sunk to several additional levels, but the result was not any more encouraging than it had been in former years, so that it was concluded to reopen the old Stoughtenburgh mine. A new shaft house was built over the north shaft (No. 1), a substantial building for the hoisting engine and winding machinery built, a good steam boiler house built, etc. During the past season a fine rock house was built, 63x40 feet, and 53 feet in height. An elevated trestle work carries the railroad track from the shaft house to the rock house, and a second horizontal track connects with the stamp mill. The rock, after being manipulated at the rock house, passes through shutes into the cars which convey it to the stamps. The depth of the main shaft is 550 feet from the surface, and the levels are opened in length in the vein from 500 feet to 1,200 feet, and east and west drifts in the amygdaloid beds extend from 200 to 400 feet.

Some explorations and discoveries which were made a year or two ago in the

conglomerate belt, which underlies the greenstone, are deemed by Agent Thomas, who is a mining man of much intelligence and of long experience in the copper region, as of great importance. He has recently begun the sinking of four shafts in this bed, east from the mine and distant apart about 400 feet, and thus far the indications are favorable; the bed shows a good width, the vein matter appearing well charged with copper. Captain Thomas feels confident that this belt will afford a return that will redeem the unfortunate financial past of this old mining location. Under this promising outlook a new change of base has been determined on, and a new company organized,

THE CONGLOMERATE MINING COMPANY,

to which the Delaware has sold its entire property, real and personal, for 50,000 shares of the new organization, the company being organized with 100,000 shares of \$25 each. The remaining 50,000 shares have all been subscribed for, and an installment of \$2.50 per share has been paid in. The officers of the new company are Henry C. Davis, President; Chas. M. Foulke, Secretary and Treasurer, Philadelphia; A. P. Thomas, Superintendent at the mine. This organization was consummated in October last, and goes into effect in January, 1881.

The entire estate comprises 20,000 acres of land, in which is included the lands surrounding Lac La Belle formerly owned by the Mendota Company. The estate is the largest held by any company in the copper region.

In opening the new mine on the Conglomerate, the shafts will be worked by the present engine and machinery as now placed at No. 1 shaft. Work on the Conglomerate is now going forward and the deepest is down 40 feet (December, 1880), but no product has yet been taken out.

The number of men employed by the company is 250, of whom 100 are miners. Rand's compressed air drills are used. The product for the present year is less than it would have been, owing to the fact that the rock house was not completed until October. They are now stamping 160 tons per day, yielding 1 per cent, or about 40 tons per month. The stamps are Gates' pattern, 48 heads, each 1,200 pounds weight, and with 36 inches fall. The washers are old style, and the water is pumped from a pond made by a dam across the Little Montreal river. The size of the stamp building is 100x120 feet. The boiler house is of stone, 30x100 feet, with four cylinder boilers.

The amygdaloid bed extends east and west across the property, and dips with the formation, and has a thickness of from 20 to 30 feet. The location is certainly favorable for working to advantage, and if the Conglomerate mine proves successful it is intended to build the long-talked-of railroad to Lac La Belle, where the stamp mill will be placed.

The accompanying section shows the Stoughtenburgh mine, which was opened in 1846, and worked, as has been previously related, until 1861, when it was abandoned and the machinery removed. Work was resumed again in 1878, and if it is continued in the future it is intended to sink an inclined working shaft in the amygdaloid level.

Some explorations were made at the Delaware with the diamond drill in 1877 with the following result: The aggregate depth of ten holes was 1,612 feet, with an average cost per foot of \$1.35½, itemized as follows, to wit:

Labor.....	\$1,125 28
Supplies.....	44 36

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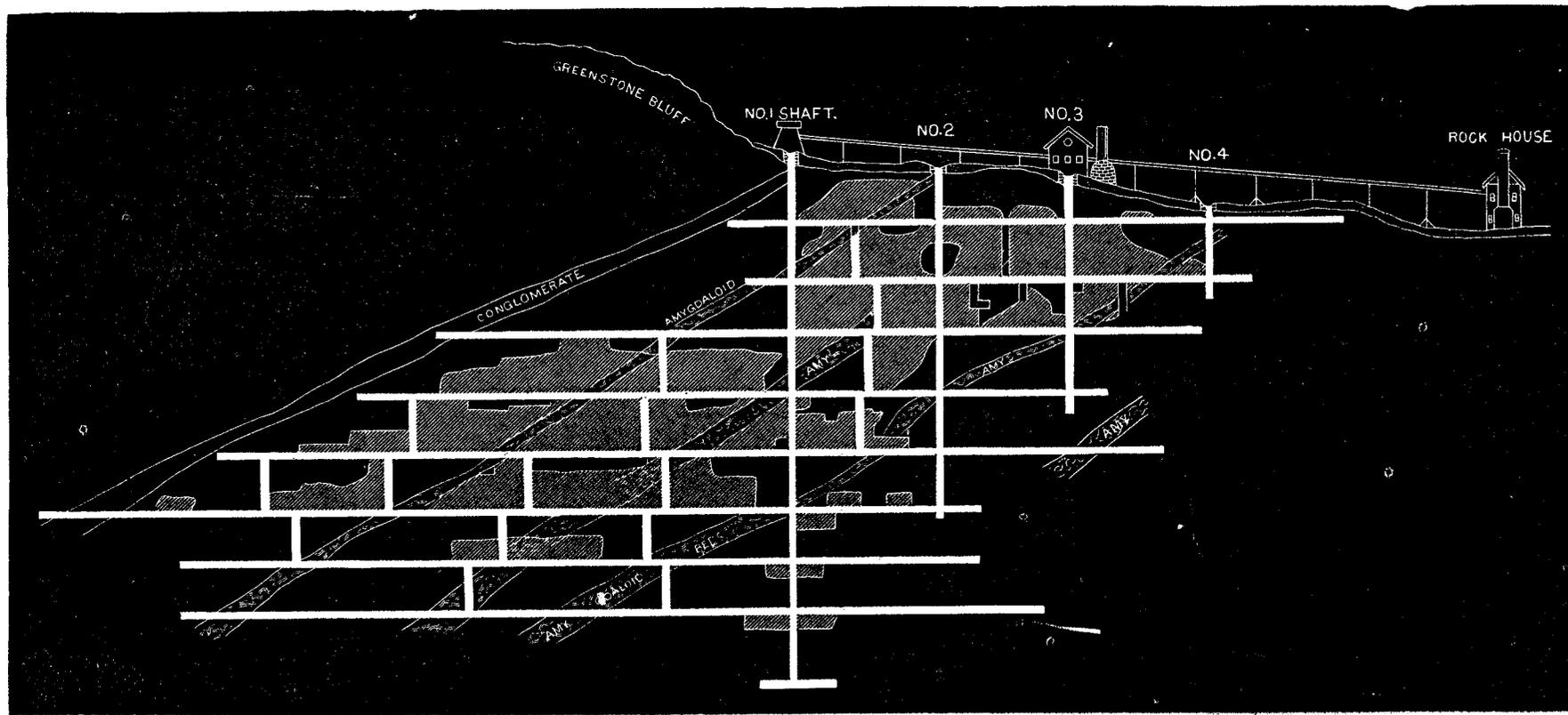
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VERTICAL SECTION OF THE DELAWARE MINE (CONGLOMERATE MINING Co.), JAN., 1881.

Scale, 240 ft. to one inch.



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Diamonds.....	\$827 20
Freight, etc.....	67 06
Fuel.....	123 20
Total.....	<u>\$2,187 20</u>

An effort was made in 1863 to establish an independent company—the New Jersey—to work the land adjacent on the east. Six hundred and forty acres of land were here set off, and some outlying lands also included, but the project never came to anything and the lands fell back to the original owners.

Another company, the Maryland, was started by three gentlemen, but had only a name. The location was section 24.

The owners of the Pennsylvania and Delaware in 1865 organized the Wyoming Mining Company, location sections ten and fifteen, bordering on the south side of Musquito lake. Several transverse veins bearing northwesterly are here exposed, lying south and north of the greenstone, and it was proposed to open with a deep adit starting from Musquito river to secure drainage. The prospectus announced most extraordinary prospects and inducements, but the anticipated finds were not realized.

MINES ON THE POINT—CLARK MINE.

East of the Delaware there are a great number of locations on which, in the early period of mining on Lake Superior, more or less labor and money was expended, but none of them prospered or made any money and all have for many years been practically idle. The elevated and exposed position of the rocks rendered this portion of the range easy to explore, and the frequent occurrence of copper bearing veins afforded irresistible opportunities for mining venture.

Among these enterprises are the mines of the French Copper Mining Company of Lake Superior, comprising the Agate Harbor, the Clark, Montreal and Bell. The former location comprised 2,500 acres, being parts of Secs. 5, 6, 7, 8, T. 58, R. 29, and parts of Secs. 1 and 12, T. 58, R. 30, lying north of the greenstone. There are a number of veins crossing the tract, but are not believed to possess particular value, and but a small amount of mining was done. The ash bed here may be ultimately shown to have value. The location of the latter three mines consists in all of 2,500 acres bordering on the south of Lake Fanny Hooe, and only one-fourth of a mile from Copper Harbor, one of the best ports on the lake. The location extends both north and south of the greenstone and is thus crossed by the ash bed and the amygdaloid formations. The Clark mine, so called, has been worked on two different veins, and work has been more continuously prosecuted here than anywhere else in this portion of the copper district, and much money sunk in a determined effort to achieve the success that has been unfortunately wanting. The mine is on the N. E. $\frac{1}{4}$ of Sec. 9, T. 58, R. 28, and the veins bear N. 10° W. and have been mined on both sides of the greenstone.

The Montreal mining property originally comprised portions of Secs. 8, 9, 17, T. 58, R. 28, and the principal vein is the continuation of the black oxide first opened at Copper Harbor, and subsequently at Lac La Belle.

In the two veins at the Clark mine were opened each with an adit and three shafts, provided with engines for hoisting and pumping, and the mine supplied with a stamp mill. Small masses have been frequently found; enough to give

encouragement, but not enough in the aggregate to pay the cost and make the mine self-supporting.

The Original Company was organized in Paris, France, May 14, 1858, and dissolved June 15, 1860, the property advertised to be sold, and the proceeds applied to liquidate the debts. The mine was purchased by Edward Estivant, of Paris, and is now in charge of Leon Lauraux, resident agent. The present estate comprises the original Clark, Montreal, and Bell locations.

The stamp mill was built in 1872 at Lake Manganese, and was run by water power with 16 head of stamps. The water is conducted through 15-inch pipe a distance of 1,800 feet. The rock-house is provided with Blake's crushers, and a railroad connects the stamps with the mine. The mine is closer to the greenstone than any other in the district. Since 1878 but little or no work has been done at the mine. The organization is known as the Copper Harbor Mining Company.

EAGLE HARBOR MINING COMPANY.

Eagle Harbor and Waterbury Mining Companies originally held a large body of lands, comprising 7,000 acres, out of which territory, from time to time, several mining locations have been made. These, early worked to a limited extent, were the Waterbury mine, comprising the E. $\frac{2}{3}$ of Sec. 17, T. 58, R. 30, and the Eagle Harbor property was comprised in Secs. 4, 5, 6, 7, 8, 9, 18, and W. $\frac{1}{3}$ of Sec. 17; the Connecticut the W. $\frac{2}{3}$ of Sec. 16.

All the above, together with an additional stretch of ground extending two miles to the south, and of one and one-half miles width, now belongs to the Eagle Harbor Company.

Mining was prosecuted on the Waterbury location to a limited extent from 1850 to 1854, but without any favorable result.

The Connecticut opened on a fissure vein south of the greenstone in the W. $\frac{1}{2}$, S. E. $\frac{1}{2}$, Sec. 16, and continued work for several years, getting out a moderate product, but not enough for profit; in 1857 work stopped on company account, and was continued for a time on tribute.

The old Eagle Harbor mine works were on section 9, north of the greenstone, on the same vein afterwards worked by the Connecticut.

In 1864 an effort was made to organize three mining companies to work the lands south of the greenstone; this territory was divided into three strips, each one-half mile east and west, and two and one-half miles north and south, situated between the Amygdaloid Company on the east, and the Madison on the west. These divisions were called, respectively, the Sussex, Middlesex, and Essex, the latter the east division. The company was the original proprietor of the village of Eagle Harbor. Office of the company, No. 4 Exchange Court, N. Y. W. Hart Smith, Secretary and Treasurer.

STAR MINING COMPANY.

The Star is one of the old companies located on the point that preserves its organization. The mine is situated on the E. $\frac{1}{2}$ of Sec. 9, T. 58, R. 28, and was opened on a fissure vein south of the greenstone. Mining work was begun in 1851, and continued until 1857; two shafts were sunk—No. 1 to the depth of 300 feet, and \$70,000 expended. Work was resumed in 1864, and a small amount of copper was taken out. Recently some interest has been awakened in regard to the discovery on the property of a deposit of black oxide of

copper, but probably it is the continuation of the same vein originally opened at Copper Harbor, where it was soon worked out.

EAGLE RIVER MINING COMPANY.

The Eagle River Mining Company was organized under the general mining laws of the State, February 5, 1853.

The company held 680 acres of land in sections 28 and 29, T. 58, R. 31, in Keweenaw county, being two and a half miles south from Eagle river and adjoining the Phoenix. The owners were Cleveland parties. A. H. Barney, President; Clinton French, Secretary and Treasurer; Col. Chas. Whittlesey, Superintendent.

Mining was begun in what was called the Babbitt vein, crossing the W. $\frac{1}{2}$ of Sec. 29 and bearing N. 25° W. The vein extends about three-quarters of a mile on this property, and was opened by two shafts 275 feet apart, No. 1 close to the outcrop of the greenstone, and by an adit started from high water mark of the Eagle river, giving drainage for 300 feet elevation. The vein was a good deal split up, and it seemed doubtful if the mining was being done in the main vein. In 1855 a small stamp-mill was put up, run by water, with eight heads of stamps. A small amount of copper was shipped for several years—about 25 tons in all.

DANA MINING COMPANY.

The Dana Mining Company's location was bounded on the west by the North-western, and on the east by the Summit, and on the north by the Copper Falls, extending from the top of the greenstone ridge, one and a quarter miles to the south, being the E. $\frac{1}{2}$ of Sec. 24 and the N. $\frac{1}{2}$ N. E. $\frac{1}{4}$ Sec. 25, T. 58 R. 31.

An examination of the location was begun in 1851. Several transverse fissure veins were discovered and mining was begun in the most northwesterly one by an adit and three shafts being driven and sunk, No. 3 shaft being started near the greenstone and No. 2, 371 feet south, No. 1, 282 feet south; the adit was 780 feet. This vein proving poor, as depth was attained, was abandoned in 1853 and work begun on another vein, which proved somewhat better. Work was continued until 1857, and then abandoned.

SUMMIT-MADISON MINING COMPANY.

The Summit Mining Company was organized in 1852-53, owning Secs. 19-30, T. 58, R. 30, and began mining work by opening two veins south of the greenstone, on the W. $\frac{1}{2}$ Sec. 19. The veins are about 200 feet apart. In the prospectus the directors announce that the true plan in opening a mine is to start with sufficient capital in the treasury to fully equip and prove the mine; and thus, having provided the funds in advance, they proposed to bring the Summit to a paying point sooner than had ever been done with any mine in the copper district.

Starting with a working capital of \$100,000 in cash they deemed themselves well provided to develop the mine and make it productive in a very brief period, and expressed the confident belief that the Summit would soon rank with the best mines in the country.

The location, as are nearly all those along the south side of the greenstone, is a favorable one for opening with an adit for drainage, and the Little Montreal river, which flows east along the base of the bluff, supplies a moderate amount of water. There were subsequent additions to the property so that

the estate extended upwards of three miles north and south, and one mile east and west. The amygdaloid beds, apparent in other mines opened south of the greenstone, also occur here.

Mining work was continued until 1856, but contrary to confident predictions of the officers at the outset, the mine did not pay, and work was suspended and not again resumed until 1863. In the meantime, in 1859, the concern had been reorganized as the Madison Mining Company. Eight years had elapsed since the location had been abandoned, and no attention had been given to it.

The houses were renovated, the stamp mill repaired, a saw-mill erected, an engine house was built, a shaft house at No. 2; hoisting and pumping engines were procured, and the necessary winding and pumping machinery added and the mine relieved of water. No. 2 shaft was furnished with a skip, and a launder, 1,500 feet in length, built from a dam in the Little Montreal river to the stamp mill. The first assessment, \$1.00 per share, was made in 1863, in March, but in the following months of May, September and October three additional assessments of \$1.00 each were made, and in July and in August, 1865, two more assessments, \$1.00, were called in, making \$140,000 expended and only five tons of copper got out which yielded 68 per cent. A change in the local administration was made and Capt. John Uren was engaged as agent. He reported that he found very little productive ground, not enough to keep the 16 stamps at work, but as so much money had been expended, he thought it unwise to suspend until the mine had been proved at greater depth, especially as by stopping and allowing the mine to fill with water much of what had been done would be lost.

The most judicious plan, in his opinion, would be to open the mine on the east vein below the 20 fathoms level. About \$8,000 remained in the treasury, and it was hoped ere that sum was exhausted something would turn up to advantage. But not much more was done by the company. The mine was leased to Capt. Uren on tribute, and he took out 40 tons of mass copper in 1866. Capt. Uren wanted to lease it for three years, but the company would only lease for one year, which would not give sufficient time to warrant extending the necessary openings for profitable work. The mine thus lay idle until 1876, when the company again began work and expended \$15,000, and called upon the stockholders for an assessment which they refused to pay. An indebtedness had been incurred, and the property in 1878 was sold at sheriff's sale, but the company redeemed it, and in September, 1879, the concern was again reorganized with a capital of \$1,000,000 in 40,000 shares, 10,000 of which were held to be sold to raise a working capital. In September last (1880) work was again resumed under the charge of Capt. Joseph Snell, agent. Only a small force is at work, working in the east vein in the north end of the mine. The conglomerate belt which underlies the greenstone is here only about six inches wide, while at the Delaware, three miles to the east, it becomes of sufficient width to encourage the hope that the working of it will give a great profit.

The company now owns three sections of land. Work has been done on three veins, but the west vein dips to the east at an angle of about 75° and the east vein dips to the east, so that they will intersect at about the 150 fathom level. They are now sinking from the second level, below the adit, which is 80 feet below the surface. The formation is similar to the central, but does not carry mass copper like the central vein. It is probable that the mine will be worked more cautiously than it has been in its previous history. In the first prospectus of the original company, issued a quarter of a century ago, it

is announced that they were in possession of the experience of other companies and could profit by their mistakes. In making this new start the new Madison needs, perhaps, no better warning than the experience which is afforded by the old Madison.

The office of the company is in Boston, Chas. H. Ward Secretary and Treasurer.

BLUFF MINING COMPANY.

The Bluff Mining Company, location N. W. $\frac{1}{4}$ Sec. 15, T. 58, R. 29, opened a mine on a fissure vein of about 12 inches in average width, with two shafts, and sunk to the third level and drifted 600 feet. This work was begun in 1852 and continued for two or three years thereafter, and finally abandoned.

THE IRON CITY MINING COMPANY,

worked during the same period on the adjoining section to the east—14—T. 58, R. 29. Two shafts were sunk 300 feet apart, No. 1 to a depth of 300 feet and connected by levels. The vein proved to be wide but failed to yield copper in any amount. The company also held the section to the north—11—and sunk several shafts and did some drifting in a narrow vein that proved unproductive.

ALBION-MANHATTAN MINING COMPANY.

This company worked during the period of its existence two locations. The first, on which work was begun in about 1848, was on Sec. 11, T. 58, R. 32, west of the cliff, adjoining the old North American. Here a shaft was sunk 115 feet, through the greenstone; an adit was driven in from the south to intersect the shaft, which was carried down 200 feet below the adit level. The vein is said to have been 2½ feet in width, but proved barren in copper. The location was abandoned in 1852 and subsequently came into the possession of the Manhattan Mining Company in 1856, who sunk a shaft 70 feet, near the greenstone and obtained about five tons of copper. In 1857 the work came to a stand-still and was not again resumed until 1862 when an effort was made to build up the enterprise. A little work was done for a few years and then the location was again abandoned and no work has since been done. Some ruins now mark the location.

GARDEN CITY MINING COMPANY.

This company was organized in 1855 with a capital stock of \$500,000 in 20,000 shares, holding 720 acres of land in two tracts, distant apart about 12 miles, but the mining location was in the N. W. corner of the S. W. $\frac{1}{4}$ Sec. 11, T. 58, R. 31.

Two shafts were sunk in the ash bed in 1856. A large stamp mill was built, 60-horse power engine and 32 stamps, furnished with water by the Eagle river. The washing was at first done in hand buddles, but the process proved too primitive and slow, but want of funds prevented the purchase of more improved apparatus, and work ceased in 1858, but was resumed again in 1859. In 1860 the two shafts were to the depths of 148 and 60 feet, and each was intersected with an adit, of lengths 115 feet and 92 feet respectively. An incline had also been driven down in the vein 75 feet to intersect the No. 1 shaft, and from the bottom of this shaft a level had been driven west 115 feet. The inclined shaft

was provided with a skip road and shaft house. A rock house had been built furnished with Blake's washers, and a gravity road connected it with the stamp mill. A sufficient number of dwelling houses, shops, offices, etc., had been erected, forty acres of land got under cultivation, 2,500 pounds ingot copper obtained, and a total expenditure of \$66,500 incurred. The proprietors were Chicago parties and the office was in that city. The total product has been about forty tons of refined copper. No work has been done since 1866.

In 1879 the company was re-organized as the Caton Mining Company, but no work has been done on the property.

FULTON MINING COMPANY.

The Fulton Mining Company began work in 1853 on the S. E. $\frac{1}{4}$ Sec. 33, T 57, R. 32, a location that had been worked six years previously and then known as the Forsyth mine. The company held in all 3,000 acres of so-called mineral lands.

The mine was opened on a fissure vein with four shafts and an adit level. Near the surface the vein, which has a width of eighteen inches, yielded considerable silver, and between shafts three and four several tons of copper in small masses were found. The company hold sections 26, 27, 33, 34, 35 and parts of sections 22 and 23, T. 57, R. 32. The Kearsarge conglomerate and the Kearsarge amygdaloid cross the northwestern portion of the property.

Shipped in 1853 1,255 pounds refined copper.

SENECA MINING COMPANY.

This company own Secs. 20, 21, half of 22, and 23, Secs. 28, 29, 32, in all 3,240 acres near the south line of Keweenaw county and at the southern extremity of the greenstone ridge.

Some work was done 15 years ago on the N. E. $\frac{1}{4}$ Sec. 32, on what is called the Kearsarge conglomerate, lying south of the Calumet conglomerate and between it and the Kearsarge amygdaloid. The ground here is low and somewhat wet, being at the head waters of the Trap Rock river. Work at this point was renewed early in 1880 under the direction of Capt. Daniels, agent of the Osceola Mining Company, with a view to thoroughly prove the value of the lode. The work to the present time comprises the sinking of two shafts in the conglomerate belt to a depth of about 200 feet each; hoisting and pumping engines have been erected, suitable shaft houses and about a dozen good dwellings have been built. The property is controlled by the president of the Osceola, Joseph W. Clark, who owns the majority of the stock.

The organization of a new company to work this mine was decided upon in March last, and it is proposed to set off to it about 800 acres of the Seneca estate. The matter has not yet been fully consummated. If the mine proves sufficiently favorable a railroad will be built to Torch Lake, seven miles to the south, where the stamp mill will be put up. The company are now employing 30 men. President, Joseph W. Clark; A. S. Bigelow, Secretary and Treasurer. Office 198 Devonshire street, Boston. The new mine is called the Ahmuk.

THE ARNOLD ET AL.

During the winter of 1879-80 a large number of defunct mining companies were resuscitated, some of them under the old name and some were re-organized and assumed new names. Among them, all owned in Boston, are the

Arnold, comprising 1,200 acres, adjoining the Petherick on the west, and having the ash bed formation across it; the Atlas—west of the Phoenix—between the Phoenix and the Cliff, and south along the greenstone. A fissure vein was formerly worked on this property, and some of the houses and mining plant still remain.

THE CALUMET BELT MINING COMPANY.

Organized in Boston, with a capital stock of \$250,000. The property is situated between the Cliff and the Central mines, and comprises 1,800 acres of contiguous mineral lands. The amygdaloid and conglomerate belts extend two and a half miles on the property. This company has yet done no mining work.

MEADOW MINING COMPANY.

The Meadow mining location is the N. E. $\frac{1}{4}$ of Sec. 20, T. 58, R. 31, adjoining the Phoenix on the east. This quarter section is crossed by the ash bed, and was first explored in 1851 and a few years after some mining done. The property is also crossed by transverse fissure veins which when first discovered were lined with ancient pits, in some of which considerable copper was obtained. The company was organized under a special charter in 1853.

AMYGDALOID MINING COMPANY.

This company was organized in July, 1860, with a capital stock of \$500,000 in 20,000 shares. The owners were mostly Philadelphia men. Mining work was begun on the S. E. $\frac{1}{4}$ of Sec. 16, T. 58, R. 30, and prosecuted on an extensive scale. A large number of houses for miners, etc., were built, and expensive mining plant procured, which latter included the erection of a stamp mill furnished with 32 heads of stamps of Gates' pattern. Three fissure veins were worked, but the main mine is in what was called the Drexel, south of the greenstone. Up to the close of 1862 the company had received from the sales of copper the sum of \$44,458.88, and from sales of silver, \$558.50. During that year an inclined railroad was built from the mine to the stamps, a distance of 1,600 feet. Winding and pumping machines were put in also in that year, together with engine of ample power; seventeen log tenements, each 18x22 feet, and costing each \$155; also office, rock house, furnished with six rock breakers, drum house for the gravity incline, were built the same year. The shipment for 1862 was 190,514 pounds mineral, yielding 72 $\frac{1}{2}$ per cent ingot=138,124 pounds ingot, which sold for 32.82 cents per pound.

In the following June, during a period of dry weather, the company's surface improvements were nearly all destroyed by fire. The stamp mill, saw-mill, tenements, change house, etc., were burned. The fire originated in the woods, where it had been running for several days, and a gale of wind arising and blowing in the direction of the settlement soon obliterated it. This unfortunate mishap was a serious set-back, but the energetic agent, A. C. Davis, went to work with so much vigor that by November of the same year he had constructed 41 tenement houses. The saw-mill had been rebuilt and furnished the lumber, shingle, etc. In addition were built an agent's house, smith's shop, change house, barn, office, etc. A stamp mill building and boiler house, both of stone, were built and the stamps got in June, 1863. The destruction by the fire, especially of the stamp mill, and the necessity of devoting a large proportion of the force to repairing the loss, necessarily crippled the mining

work. The shipment for 1863 was 109,590 pounds, yielding 70.63 per cent=77,406 pounds ingot, which sold for \$24,499.46. The cost of smelting at Philadelphia, including freight, insurance, barrels, commission, etc., was 2.89 cents per pound. Some additional lands were bought, making the estate 1,760 acres.

In 1864 another great misfortune was met with. The new stamp mill, which had been but recently completed, and which was deemed to be substantial enough to bid defiance to all elements of danger, was, after two months' run, again brought to a stand-still by the bursting of both boilers—happening when copper was at its maximum price. An opportunity was thus afforded for the expectant stockholder to reflect upon the vicissitudes of human hopes and to moralize upon the evil results of a too free indulgence in the use of intoxicating liquors, and the advantage of having in future a sober engineer. The mine was reported as presenting the most excellent prospects for a future yield.

The improvements made in 1864 comprised the completion of the stamp mill, the construction of 3,000 feet of railway, laid on trestle work, a portion of which was covered, rock crushers; some dwellings, shops, barns, roads, etc., were built.

From the greenstone slide at the amygdaloid, south, the ground has very little descent compared to the Cliff and some other locations, so that strong, high foundations had to be built to the engine-house that worked the shafts, and the shafts were run up to an increased height to give space below for the waste rock. The great scarcity of men in 1864 on the lake led the agent to try the experiment of importing from Canada, but the men ran away as soon as they arrived in order to avoid paying their fares and their board; so that instead of deriving advantage the company was out a few hundred dollars. The shipment for 1864 was 195,664 pounds, yielding 69 per cent,=135,795 pounds. The total cost of packing, shipping, freight, insurance and commission was 4 35-100 cents per pound of ingot, and the product sold at an average price of 48 $\frac{3}{4}$ cents per pound.

The copper that was produced in the winter of 1864-5—when labor was excessively high—could not, of course, be sent to market until navigation opened in the spring, at which time the price had declined from upward of 50 cents per pound to 28 cents per pound. The price, however, advanced later in the season, but did not reach a market value at all commensurate with the continued high price of labor, cost of transportation and of materials. The product for 1865 was 584,092 pounds, yielding 418,964 pounds ingot.

The Amygdaloid based its hopes of success chiefly on working the amygdaloid belt which had appeared so favorable in the adjoining Delaware mine and in the Pennsylvania and even at the Cliff, etc. It was claimed that the amygdaloid belt would prove an enduring source of profit; masses, as at the Cliff, Minesota and National, would play out, but this amygdaloid on the south slope and the ash bed on the north slope could be depended on for a permanent yield.

A cubic fathom containing 216 cubic feet, and estimating the weight at 175 pounds per cubic foot, the weight of a cubic fathom would be 37,800 pounds, which in an average vein 18 inches wide would be 113,400 pounds for each six feet of vein in depth and in length, and estimating the percentage of copper to be 1 $\frac{1}{2}$ per cent, there would result 1,984 pounds pure metal, which at 21 cents per pound would give \$416.64. The items of cost for mining, stamping, smelting, etc., were estimated at about \$200 for each fathom, as above; thus leaving a clear profit of \$216.64 for each fathom of vein rock. Such reasoning sold stock and kept up the flagging hopes of reluctant stockholders and induced the

payment of assessments, but down to the present time the results have been the reverse of all this.

The mines yielded their maximum product in 1865. The following year the product diminished to 170 $\frac{1}{4}$ tons of ingot, and the company shut down. From this time, for the next four years, the mine was worked on tribute, producing in 1867, 80 1375-2000 tons; in 1868, 61 644-2000 tons; in 1869, 16 $\frac{1}{2}$ tons; in 1870, 23 1610-2000 tons. In 1872 the company raised a final assessment of \$10,000, which exhausted its capital stock, and expended it in an effort to again resume operations, and in the two following years a small product was obtained,—in 1873 14 250-2000 tons, and in 1874 7 1840-2000 tons. In 1878 1,259 pounds were taken out on tribute, since which time no copper has been taken from the mine. The tribute work has consisted in hunting for barrel-work, and has resulted in leaving the underground workings in bad shape. The total product of the mine is 770 1180-2000 tons ingot copper, and the assessments have been in amount \$500,000, the full sum of its capital stock.

The location now presents a melancholy aspect, with the large number of buildings, long railroad trestle, great shaft houses, engine house, stamp mill, and other extensive mining plant, and surface improvements, neglected and going to ruin. The office is No. 324 Walnut street, Philadelphia. Geo. L. Oliver, President; F. K. Womrath, Secretary and Treasurer.

NATIVE COPPER COMPANY.

Adjoining the Delaware on the north, Sec. 10, T. 58, R. 30, is the location of the Native Copper Company, which worked in a vein crossing the ash bed in 1852 and for a few years thereafter, in a limited way, with the same results as other companies similarly situated.

And the Winthrop—S. W. $\frac{1}{4}$ Sec. 23 and W. $\frac{1}{2}$ Sec. 26, T. 58, R. 30—adjoining the Central on the west,—began work on a fissure vein in 1852, and expended in assessments \$90,000 without any very encouraging result.

On the S. W. $\frac{1}{4}$ Sec. 12, T. 58, R. 28, a mine was opened in 1846, and worked again in 1852 and 1853 by the New York and Michigan Mining Company. The mine was opened to a depth of 150 feet on a vein 20 inches wide. 1,800 pounds of copper were shipped in 1852.

The Humbolt, also located on the ash bed, Sec. 21, T. 58, R. 31, worked on several veins, commencing in 1853, and made assessments to the amount of \$100,000.

Several companies holding contiguous locations of 240 acres each, in T. 57, R. 32, were organized in 1863-64, but did very little mining work. Of these are the Providence, Home, Hope.

THE HANOVER

was formed in 1860 to work an old location, the W $\frac{1}{2}$ Sec. 8, T. 58, R. 28. Two fissure veins were opened here and \$20,000 expended and the location abandoned.

MENDOTA MINING COMPANY.

Mining in the vicinity of Lac La Belle was inaugurated at a very early day. The situation affords every opportunity for economical working. Here are found veins of sulphurets of copper, gray and black and copper pyrites. Previous to 1850 the Lac La Belle Company had driven a tunnel into the hill in the vein 400 feet, and found the vein 18 inches wide, bearing sulphurets of cop-

per. A deep adit was also driven in the same vein a distance of upwards of 1,000 feet. This work was done in the base of the Bohemian mountain, which rises above the beautiful little lake at its foot, a distance of 864 feet. No further work was done on the location until 1866, when the Mendota Mining Company, owning 4,320 acres of land surrounding Lac La Belle, did some additional work to the amount of 308 feet of sinking and 740 feet of drifting. The location of the veins on which this work was done is Sec. 29, T. 58, R. 32, and Sec. 29, R. 29.

This company undertook the construction of a ship canal connecting Lac La Belle with Bete Grise bay which it completed in the fall of 1866 so that vessels entered. This work cost about \$100,000. The company received from the United States government a grant of lands—100,000 acres—which were located in Schoolcraft county.

Lac La Belle is about two and a half miles long east and west, by one mile to a half-mile wide north and south. The lake lies on the line between townships 57 and 58 N., R. 29 W., and the east end is about three quarters of a mile from the shore of Lake Superior, with which it is connected by a tortuous channel. The waters of the lake are deep and pure, and when once entered becomes a safe and commodious harbor for the largest vessels. The canal is simply a channel cut due east and west between the lakes, and was so far completed as to allow vessel drawing 11½ feet of water to enter in the fall of 1866. The company was authorized to collect tolls at a rate fixed by the county board of supervisors.

In anticipation of future growth and importance a village—Mendota—was surveyed out and lots to the value of \$13,600 were sold and some buildings erected. The Pennsylvania and Delaware companies built a road to the lake costing \$12,000, and constructed there a dock and warehouse, expending \$10,000. The Lac La Belle smelting works expended, it is said, in construction here \$43,000.

A railroad company was organized to build a line from the Cliff mine along the range to Lac La Belle, but the failure of the mining companies to furnish a sufficient product to make business for such a road, prevented the construction of it being undertaken. The work on the canal was never fully completed. The proper piers extending out into the Bete Grise bay were not constructed and soon the channel became choked up with sand so that vessels could no longer enter, and the harbor ceased to be used. If the harbor were rendered available it would be of great value to the commerce of the lake, since vessels could enter with safety in all weather; and now there is no port of any description between Portage Entry and Copper Harbor.

When the mines situated south of the greenstone, in Keweenaw county, shall have become sufficiently prosperous to render the proposed railroad a necessary adjunct, both its construction and the improvement of Lac La Belle harbor will be accomplished.

ST. CLAIR MINING COMPANY.

The St. Clair Mining Company owns the S. E. ¼ of N. W. ¼, and 30 rods wide off west side of the E. ½ of Sec. 29, and a strip 33 rods wide off from the east side of the S. W. ¼ of Sec. 29, all in T. 58, R. 31, 133 acres, and adjoins the Phoenix on the west and the Eagle River Company on the east.

The mine is opened on a transverse fissure vein, which bears north about 20° W., and has an average width of about 18 inches. The shafts are upon the south-

erly slope of the greenstone bluff, which here, as elsewhere along the range east from the cliff, has a more gradual descent. At the working shaft are a hoisting engine and rock crusher, whence the rock drops down a chute into cars in which it is trammed to the stamp mill, situated a short distance to the south at the foot of the bluff. The water comes from a pond, about 600 feet to the southeast of the mill, brought in a launder. A second pond is made by a dam close to the mill.

The company was originally formed in 1863, and the mine was worked to the depth of 300 feet. Four levels were drifted, a small product in mass copper and barrel-work were annually obtained, and in 1872 the stamp mill, containing twelve head of stamps, with wash-house, was put up, but was not used, as about the time it was finished the panic occurred and the work was suspended. The property then went into the hands of the creditors, who held it until the winter of 1879-80 and organized a new company with capital stock of \$1,000,000, and assessed 37½ cents per share and began work in the old mine. About eighteen miners are employed and a fair amount of small masses and barrel-work is being got out. In addition to the improvements above stated there are fifteen houses on the location.

A shaft was formerly sunk 600 feet to the east on a vein, but it was not thought to have looked very favorable. The work is in charge of Mr. Delano, agent of the Phoenix Copper Company.

Office in Boston. John Brooks, Secretary and Treasurer.

CENTRAL MINING COMPANY.

In the early period of mining on Lake Superior the wonderful occurrence of the great masses that were found in such quantity at the Cliff mine stimulated mining enterprise in an extraordinary degree, and concentrated the attention of explorers and of investors in mining stocks to endeavor to find and to develop similar veins. The search was not in vain, nor the opportunity wanting; the great greenstone range that extends the length of Keweenaw county afforded innumerable fissures, traversing its formation, that apparently seemed equally favorable to the existence of the ponderous masses which the great bonanza continued to yield. But barely one among the scores of the mines that have been opened in this region since the discovery of the Cliff has proved to be a source of revenue and profit to its owners. The hundreds of shafts that have been sunk have, unfortunately, rather become receptacles for burying treasure instead of avenues through which it should flow out. And why the many veins should be comparatively barren and the limited few so enormously productive is a problem that is far from being satisfactorily solved. The owners of the Winthrop, the Northwestern, the Dana, the Northwest, and of many other locations in like situations, had perhaps as much reason to expect a favorable result to their undertakings as did the proprietors of the Central. It illustrates the uncertainty of mining enterprises. The hope is sustained by faith in what may be hidden from view. The few rich veins which have been found establishes the fact that such do exist, and it is the expectation of discovering such a store of wealth that stimulates to ever renewed search and expenditure.

The Central mine, which has proved to be one of the most valuable deposits of mineral that has been discovered in Lake Superior, comprises the E. ½ of Sec. 23, T. 58, R. 30, situate between the Winthrop on the west and the Northwestern on the east. The location lies well up on the bluff, so that the greenstone formation passes east and west through the north half of it at an elevation of 700 feet above the lake. The descent to the south is steep, but

sufficiently gradual for convenient mining work. It is distant, by good road, about four and a half miles southwest from Eagle Harbor, and is supplied with water by the east branch of the Eagle river, which runs along the foot of the bluff, westerly, through the property.

The greenstone and the alternating beds of granular and amygdaloidal trap which lie to the south of it have been, as at the other mining locations, heretofore described, situated on the south side of the greenstone range, a uniform dip to the north of 25°. The vein, a vertical fissure, running at right angles with the formation, with an average width of about 20 inches, was first discovered in the summer of 1854 by Mr. John Slawson, agent of the Cliff mine, at a point about 600 feet to the south of the greenstone. Here an ancient excavation was opened by a party of men under charge of John Robingson, and in it was found a mass of pure copper in a well defined vein bearing to the northwest. Further opening of this vein developed the existence of copper in unusual quantity.

Immediately after Slawson's discovery, however, and previous to the developments made by Robingson and his party, the property had been purchased by some Lake Superior men, residents in the vicinity. In November the first shaft was begun at a point 70 feet north of the mass of copper found in the ancient excavation, and on the 15th of the same month the company was organized, the board of directors, consisting of S. W. Hill, John Slawson, A. A. Bennett, John Robingson, and Waterman Palmer, duly elected, and an assessment of ten cents per share voted to be raised.

Water proving too troublesome to carry forward the work of sinking, an adit was made to secure drainage, and the shaft was continued down 53 feet below it, disclosing the existence of a large amount of copper. The use of the buildings and other improvements at the Winthrop mine was secured and the services of A. A. Bennett as agent were engaged for the ensuing year.

In the year succeeding the first discovery of the vein there was taken from it 84½ tons of mineral, which yielded 80 per cent of pure copper. Up to this time—July 1, 1855—including every item of expense and of liability, the expenditures were \$29,711.29, which sum was exceeded by the value of the product \$7,251.07—the first instance of a mine being opened in the Lake Superior district which produced and sold during the first year of its operations copper enough to more than pay all the expenses of the company.

During this year the mining work done consisted in sinking No. 1 shaft to the depth of 156 feet and a second shaft, No. 2, to the depth of 105 feet, and in opening a gallery 525 feet in length in the 10-fathom level and one 63 feet in the 20-fathom level, and in addition to the above an adit 153 feet in length for draining. The surface improvements were three houses and a horse whim.

The average cost for smelting the copper in Detroit was \$18.32 per ton. In the meantime the controlling interest had passed into the hands of the owners of the Cliff, and in the second board of directors, elected July, 1856, are found the names of C. G. Hussey, Thomas M. Howe, James M. Cooper, John Slawson, Waterman Palmer, William Bagley, and A. A. Bennett. The business office was removed from Eagle Harbor to Pittsburg. Dr. C. G. Hussey was made President and Waterman Palmer Secretary and Treasurer. These gentlemen continued to control the mine until 1859, when a majority of the stock having been purchased by New York men, a new board of directors was elected, with Jordan L. Mott, President, and James M. Mills, Secretary and Treasurer, and the office was removed to New York. Up to this time but little

surface improvement had been made; houses and other buildings had been rented of the Winthrop and the Northwestern, and these were sufficiently accessible for the purposes of the Central. The Northwestern stamp mill had also been used at an annual rent of \$2,000, so that but a small portion of the receipts had been diverted from sustaining mining work.

Up to 1860 the sale of the copper produced from the mine had brought the total sum of \$156,000, and the total assessments amounted to \$47,000, of which \$34,000 were accounted for in the assets. The total expenditures had been \$203,000, leaving but \$13,000 for dead work, which sum the drainage adit, 1,600 feet in length, would much more than account for. The mine had been opened with caution, the stoping ground was but little in advance. Four shafts were down to the 20-fathom level, and the levels opened to connect the shafts, the whole work having been done with but little cost to the stockholders. The product for 1857 was 105 tons, 487 pounds.

The new board determined on the construction of a stamp mill, which was not completed, however, until 1861. It was also determined to push forward the mining work more vigorously and open a large amount of ground as rapidly as possible. The product for 1859 was 172 599-2000 tons, yielding 70½ per cent ingot=120 1622-2000 tons refined copper, which sold at 22½ cents per pound; product for 1860, 81 1558-2000 tons, yielding 72.67 per cent; for 1861, 204 5-2000 tons of 79.1 per cent purity. The low price to which copper fell on the breaking out of the war,—17½ cents per pound,—and the apprehension of assessments, caused the Central stock, in common with many others, to fall to a very low price. The purchase of additional machinery, building of a stamp mill, and other contemplated improvements, were necessarily deferred, and the officers of the mine were enjoined to keep the expenditures within the value of the product. In 1862 the price of copper had so advanced, and the product of the mine had so greatly increased, that the directors were enabled to begin to carry out the plan which the managers had previously determined on, and many needed improvements were made. The additions included twenty new houses, a new pumping and hoisting engine with hoisting machinery and pumps, sixteen additional stamp heads, and additional machinery to run them, and also two rock breakers.

The product for the year 1862 was 304 1132-2000 tons, yielding 79.58 per cent=242 764-2000 tons of refined copper, which sold for an average price of 36¼ cents per pound. The stoping cost \$24.70 per fathom; the sinking of shafts and winzes, per foot average, \$17.22; the drifting, per foot, \$7.84; number of miners employed 69, and the average contract wages per month, \$36.51; average price per month for surface men, \$29.95; for stamp mill men, \$27.32.

No. 4 shaft was sunk at the south edge of the greenstone, and as increased depth was attained and the levels were extended northward under the formation, the same trouble began to be experienced as was felt in all the mines working under the greenstone that had got to a sufficient depth.

It was decided at the Central that instead of sinking vertically from the top of the bluff, as had been done at the Cliff, an incline shaft could be more cheaply constructed, and that the subsequent cost of operating would also be less, and the convenience would be greater. A vertical shaft from the top of the bluff to the north would bring the rock to the surface at greater distance from the stamp mill, increasing the cost for surface tramming. Accordingly a double track inclined shaft was begun in 1863 from the surface at about mid-

way between No. 3 and No. 4 shafts. It was carried down in the vein with an inclination to the north, conforming to the dip of the greenstone. Considerable surface improvements were made during the year, rendered necessary from the fact that the company was no longer able to use the buildings of the Northwestern Company. In this work the sum of \$44,000 was expended. A purchase of a large body of land was made, consisting of 7,000 acres, for the timber, it having been found to be almost impossible to obtain the timber and the wood necessary for the purposes of the mine.

The product for the year was 805,545 pounds of mineral, yielding 76.87 per cent = 619,268 pounds of ingot, which sold at an average price of 34 3-10 cents per pound. Out of the proceeds the company paid its first dividend of \$2.50 per share, and from that year forward it has never passed its annual dividend. A serious fire occurred at the mine destroying the engine house and shaft house and doing much other damage, and as mechanics were very scarce in the country at that time, a good deal of delay was thereby encountered.

The deepest shaft was down 520 feet; the total depth of shafts was 1,594 feet; and the total amount of drifting done was 8,206 feet. The cost for mining work for the year was, for stoping, per cubic fathom, \$24.36. The cost per foot for sinking was \$21.83, and the cost per foot for drifting was \$9.58. The average yield of mineral per cubic fathom was 724 pounds, an increase of 53 pounds per fathom over the previous year. The average number of miners employed for the year was 93, and their average rate of wages was \$48.55 per month. The total mining force was 207. Some extraordinary large masses were found.

Additional improvements were made in 1864-65. Houses were built, machinery added, a dock at Eagle Harbor built, the stamp mill enlarged and the number of stamps increased to 32 heads; but the water was found to be greatly insufficient. Dividends of \$2.50 per share were made each year. The product for 1864 was 502 877-2000 tons, yielding 77.55 per cent; 1865 the product was 802 778-2000 tons, yielding 77 per cent = 713 1659-2000 pounds, two-thirds of which was mass copper. The yield per fathom of ground was 849 pounds. The product sold at an average price of 32.78 cents per pound; the highest 40 cents and the lowest 28 cents.

During 1864 and 1865 copper mining labored under great disadvantage, since, owing to the high price at which copper had sold in the previous year, wages had become correspondingly high, as had also materials. The mines found it impossible to reduce the price of labor, which was scarce, and mining materials, to conform to the reduction in price of copper. Very much was therefore produced at a cost exceeding its value. Nevertheless the company was enabled to declare a dividend of \$50,000 in 1866.

No. 2 and No. 4 shafts were straightened and furnished with guides and skips. The production of copper for the year 1866 was 876 1160-2000 tons, which yielded 79.44 per cent of refined copper. The product was equally divided between mass copper and stamp rock. The percentage obtained from the stamp rock was 2 = 40 pounds per ton of rock. The cost of stamping, washing, etc., was \$1.10½ per ton of rock; cost of labor for tramming, breaking the rock ready for the stamps was 21.13 cents per ton. Total number of men employed at mine in 1866 was 267, of whom 191 were miners, who received an average price of \$56.32 per month. The surface men received \$49; stamp mill men \$43 per month, average. The inclined shaft was completed to the 20-fathom level and provided with a double track 335 feet from the surface.

In 1867 the directors declared a dividend of \$2 per share. The product for the year was 783 859-2000 tons, yielding 79.39 per cent = 1,244,441 pounds refined copper, which sold at an average price of 24½ cents per pound.

The yield of mineral per fathom of ground was 510 pounds ingot copper. The rock yielded 2.41 per cent mineral, and cost 93 cents per ton of rock for stamping and washing. The proportion of mass and stamp rock were about equal. In the stamp copper is included the barrel-work. The company also operated a saw-mill.

In 1870 the mine produced 873 1737-2000 tons of mineral, yielding 76.37 per cent of ingot = 1,327,156 pounds refined copper, which sold at an average price of 20.47 cents per pound. A dividend of \$70,000 was paid in 1869 and \$80,000 in 1870. The average yield of mineral per fathom of ground broken was 601 pounds of mineral = 464 pounds of ingot copper. The stamp rock yielded 2.99 per cent mineral; number of tons of rock stamped per cord of wood consumed was 10 65-100; number of tons of rock stamped per stamp head per 24 hours, 4 22-100; total cost of stamping and washing per ton of rock, 81.22 cents; total cost for labor in tramming and breaking per ton of rock, 15.44 cents; average number of miners employed, 167, at an average price per month of \$50.55. The population at the mine amounted to 950, and the number of pupils in the school was 200. At this time the aggregate length of the shafts was 3,492 feet, and the total length of the levels was 20,504 feet. The yield of the mine in masses amounted for the year to but little more than one-half of the yield of the stamp work.

In 1871 the amount of copper shipped was 922 575-2000 tons, yielding 77.669 per cent = 1,432,662 pounds ingot copper, which sold at an average price per pound of 22.66 cents, out of which the company paid its annual dividend of \$50,000.

In 1872 the mine produced 863 1123-2000 tons of mineral, which smelted yielded 77.14 per cent = 1,331,610 pounds refined copper, which sold at an average price of 30 43-100 cents per pound. The net earnings were largely in excess of previous years, owing to the high price of copper and the low scale of the company's expenditures. Out of the surplus a dividend was declared of \$80,000. The number of tons of rock stamped during the year was 18,942, yielding 2.87 per cent of mineral; amount of rock stamped per head of stamp in 24 hours was 4 31-100 tons; amount of rock stamped per cord of wood in 24 hours was 10 13-100; cost of labor for breaking, tramming rock to the stamp mill was 14.96 cents per ton; total number of men employed in 1872 was 223, of whom 149 were miners. The inclined shaft was completed down to the 100-fathom level.

Some trouble was experienced in the copper region in 1872 with the miners, culminating in strikes and exciting a feeling of uneasiness in all classes. Governor Bagley ordered the State troops from Detroit into the copper districts. But there were no outbreaks, no serious acts of lawlessness beyond the power of the local authorities to control. The miners shifted frequently from one locality to another, to the great detriment of themselves and of their employers and to the disturbance of the peace of the country.

The general expenditures to date were \$2,958,132.22; the total sales of copper were \$3,904,496.51; the average cost for sinking shafts and winzes was \$24.86 per running fathom; the average cost for drifting levels was \$13.16 per running fathom; the average cost for stoping per cubic fathom was \$18.71; the average yield in mineral per cubic fathom was 614 pounds = 473 pounds refined copper. The total depth of shafts was 4,180 feet; total length of levels

was 22,979 feet. The total cost per ton for breaking and tramping to mill was 14 86-100 cents; the cost per ton for stamping and washing was 98 34-100 cents. The average wages for miners was \$61.88 per month; the average wages for surface men was \$48.54 per month, 35 men employed; the average wages for stamp mill men was \$47.72, of whom there were 18.

The increased depth of the mine rendered it necessary to procure machinery of greater power, as the work to be performed had outgrown the power of the engines then in use, to fulfill the requirements. Accordingly, in 1875 a powerful hoisting engine, horizontal, with two 24-inch cylinders, four feet stroke, was erected, together with two adequate winding drums for working No. 2 and No. 4 shafts. The engine house is of stone, 50x60 feet, with steam boiler house attached, very substantially built. A new engine for pumping and for working the main engine shaft was also procured, 18-inch cylinder, 8 feet stroke. In addition to the above improvements, fourteen new dwelling houses were built. But notwithstanding all this expenditure, a dividend of \$5 per share was declared. The product for the year was 1,466,952 pounds of ingot copper, being 70.82 per cent of the mineral product, which sold for 22.56 cents per pound.

A belt of conglomerate was intersected in the 150-fathom level, but it did not prove to be as productive of copper as at first was anticipated. The general expenditures to January 1, 1875, was \$3,741,262.42. The total dividend paid to that date was \$1,200,000. Two hundred and twenty feet of sinking done, which cost \$32.88 per foot; 1015 feet of drifting done, which cost \$12.07 per foot.

The average number of pounds of mineral per fathom was 746 = 528 pounds ingot copper. Number of tons of rock treated in the stamp mill, 17,118, yielding 3.78 per cent of mineral. The cost for tramping and breaking, 15.33 cents per ton of rock; cost for stamping and washing, \$1.00 per ton. Average number of miners, 138; wages per month, \$52.65. Surface and stamp mill men, 54; average wages, \$44.

Total depth of shafts, 4,695 feet; total length of the levels, 26,104 feet. In 1876 the product was 1,403 183-2000 tons, yielding 71.22 per cent = 2,161,400 pounds of ingot copper, for which was realized the sum of 20.86 cents per pound. The general expenditures to that date were \$4,016,827.71; the total receipts from the sales of copper were \$5,487,313.51; a dividend of \$7 per share was declared. The total length of shafts was 4,856 feet; of levels, 27,137 feet. The cost of sinking was \$32.84 per foot; for driftings in vein, \$12.41; in conglomerate belt, \$16.23 per foot; cost of stoping per fathom, \$20; yield of mineral per fathom, 863 pounds = 614 pounds ingot copper. Total number of tons of rock stamped, 12,658; yield per cent, 53-100 of mineral; cost of breaking and tramping to mill, 15.88 cents per ton; stamping and washing per ton, \$1.02; number of miners employed, 184; average wages paid, \$49.80; number of surface and stamp men, 50; average wages paid, \$45; the expenditures for the year were \$280,060.46; the receipts for the year were \$425,026.46; the profit for the year was \$144,966.

It had been contemplated for some years to provide a man engine for convenience and safety in ascending and descending in the mine; accordingly, No. 4 shaft was furnished with one.

In 1877 the product of the mine was 1,408 862-2000 tons, which yielded 71.39 per cent = 1,995,609 pounds of ingot copper, for which was realized the sum of 18.36 cents per pound = \$368,644.33. The expenses for the year were \$216,882.39, leaving a profit of \$105,297.01; \$13,385.96 were expended in the man engine, and a dividend of \$5 per share was declared. The

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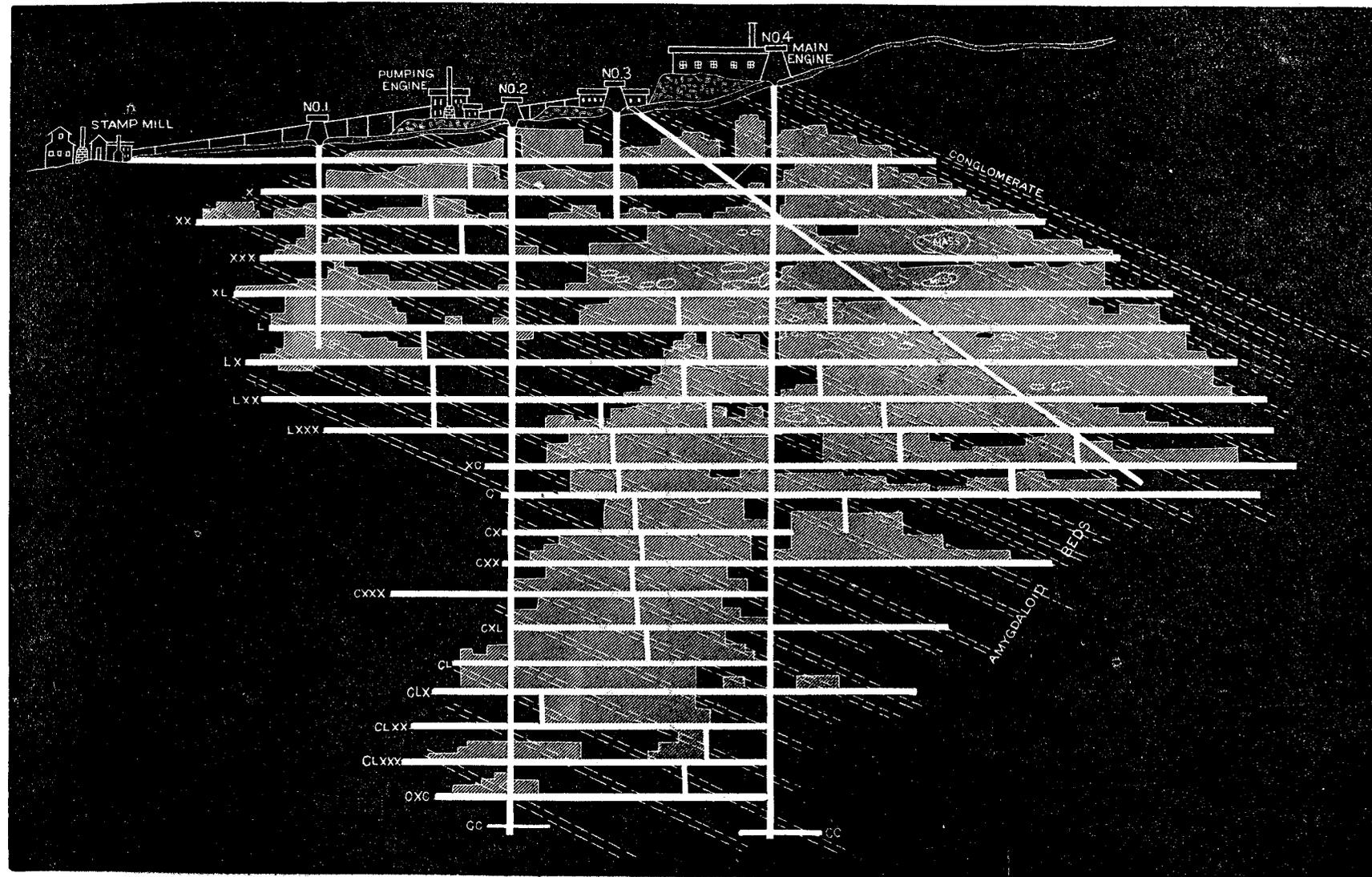
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total expenditures to date amounted to \$4,270,017.41, and the total receipts were \$5,853,745.15. The total length of shafts, 5,018½ feet; of levels, 28,857 feet; number of tons of rock stamped, 14,119, yielding 4.21 per cent of mineral; cost of breaking and tramping per ton of rock, 14.85 cents; cost of stamping and working per ton of rock, 82 cents; number of miners employed, 195; average wages paid, \$49.80 per month; number of other employes, 47; average wages paid, \$43.50 per month. The average cost per foot for sinking was \$33.60; the average cost per foot for drifting was \$10.50; the average cost per fathom for stoping was \$18.61 in the vein, and \$20.73 in the conglomerate. The stoping in the conglomerate extended east and west; average yield of mineral per fathom of ground stoped, 862 pounds = 615 pounds of ingot copper. No. 4 shaft was timbered to the 170 fathoms level, and fitted with a skip road, and No. 2 shaft was finished down to 180th level.

In 1878 the product of the mine was 1,358 1112-2000 tons, which yielded 71 per cent of ingot = 1,891,013 pounds ingot, for which was realized the sum of 15.84 cents per pound; a dividend of \$4 per share was paid. The total expenditures to date were \$4,541,087.57, and the sales of copper amounted to \$6,153,735.05; the number of tons of rock stamped during the year was 13,858, yielding 3.65 per cent of mineral; total cost of stamping and washing per ton of rock, 69.70 cents; cost of breaking and tramping per ton, 10 cents; average cost of sinking per foot, \$32.22; average cost of drifting per foot, \$10.25; average cost of stoping per fathom, \$25; yield of mineral per fathom, 1,001 pounds = 711 pounds of ingot; average number of miners employed was 179; average wages, \$45.67 per month; average number of other employes was 45; average wages \$38.10 per month. There was a less number of men employed than in the previous year, and a less product obtained. The conglomerate belt yielded well for a short distance, but did not continue to hold up.

The Madison mine was sold at sheriff's sale and bought by the Central company, but the property was redeemed the following year.

The product of the mine in 1879 was 1,198 1088-2000 tons, yielding 75 per cent = 1,799,495 pounds of refined copper, which sold at an average price of 15½ cents per pound = \$278,892.54; receipts for silver sold, \$672.03; total sales, \$279,564.57.

The net surplus January 1, 1880, was \$332,200.34, out of which a dividend of \$5 per share was declared. There was a slight falling off in the product owing to the occurrence of unusually large masses, requiring increased labor and time in cutting them up.

The total receipts to January 1, 1880, were \$6,543,531.72; the total dividends, including the dividends declared, \$1,440,000; the total capital advanced by stockholders, \$100,000. The product embraced 289 masses, weighing 1,038,497 pounds; stamp work, 829,205 pounds; kiln work, 455,340 pounds. Average cost per foot for sinking, \$35.23; average cost per foot for drifting, \$11.26 in vein; average cost per foot for drifting, \$12.74 in conglomerate; average cost per fathom for stoping, \$18.57 in vein; average cost per fathom for stoping, \$27.51 in conglomerate; total amount of ground in mine, 2,537 fathoms; the average yield of mineral per fathom of ground was 915 pounds = 686 pounds of refined copper; the number of tons of rock stamped was 12,478; the yield of rock in mineral was 3.32 per cent = 2.49 per cent ingot; cost of stamping and washing per ton was 64.27 cents; number of tons stamped per head each 24 hours, running time, 5.49; number of tons

stamped per cord of wood consumed, 10.79; cost per ton for breaking, selecting and tramping to mill, 10.69 cents. Number of miners employed, average 168; average wages paid, \$47.05; number of surface men employed, 33; average wages paid, \$35.63; number of stamp men employed, 10; average wages paid, \$36.00. Total length of shafts was 5,419 feet; of levels, 31,571 feet.

The conglomerate belt proves to be well charged with copper to a distance of from 15 to 25 feet either way from the vein, and then it becomes poor. Eighteen men were employed in the 19th level in cutting up a 300-ton mass, and another was found thought to be equally as large.

Mr. C. B. Petrie, who had been agent since 1859 resigned his position and was succeeded by Capt. James Dunstan, who had been mining captain since 1866. Capt. Dunstan's predecessor in charge of the mine was Capt. William Tonkin, the present efficient agent of the Atlantic mine.

The general expenditures of the company to January 1, 1881, including stock on hand, bills receivable, dividends paid, etc., amounts to the sum of \$6,932,347.25; the total of sales of copper and silver to the same date amounts to \$6,806,249.82; sales of copper in 1880, \$242,530.38; value of amount on hand, \$129,584.70. Silver produced in 1880, \$835.12. Total value of product for 1880, \$372,950.20. The total assets of the company are placed at \$640,593.77, exclusive of the real estate comprised in the mining location; the available assets are \$355,094.45. Total liabilities, including balance of assets (\$355,094.45) = \$398,669.55.

The production of mineral for 1880 was 1,271,560 tons, and the quantity smelted was 1,321 1220-2000 tons = 76.6 per cent.

A dividend of \$3 per share (\$60,000) was paid in February, 1881, and a further dividend will be paid to the stockholders from the profits of the year's business as soon as the copper now on hand shall be sold.

The product was divided as follows: 733 barrels, weighing 899,977 pounds; 127 hds. kiln, weighing 387,682 pounds; 286 masses, weighing 1,254,901 pounds; total, 2,542,560 pounds.

The average yield of mineral per fathom of ground broken was 778 pounds. The average yield of copper per fathom of ground broken was 596 pounds. The total amount of ground in openings and stopes was 3,267 fathoms. The average cost of sinking in shafts and in winzes was, per foot, \$27.58. The average cost of drifting was, per foot, \$12.78. The average cost of stoping on vein, per cubic fathom, was \$40.00.

The total number of tons of rock stamped was 14,520. The yield of rock in mineral was 3.09 per cent; yield of rock in ingot was 2.37 per cent. Cost of stamping and washing, per ton, was 72.25 cents. Rock stamped, per head, in 24 hours, running time, was 4 4-5 tons. Rock stamped and washed per cord of wood consumed, 11.22 tons. The cost per ton for breaking and selecting rock, and tramping it to mill, was 11.20 cents.

Considerable increased outlay, due to repairs which were made, have made the expenses at the stamp mill greater than they were the preceding year. The force employed consisted of 179 miners, who received average wages of \$56.79 per month; 36 surface men, who received average wages of \$42.27 per month; 10 stamp mill men, who received average wages of \$46.33 per month. The number of men now employed at the mine is 243. It has been necessary during the past year to make an unusually large expenditure for repairs and additions to machinery and buildings.

The building in which the pumping engine was placed having become unsafe was taken down, and a new stone building erected in its stead, without interfering with the working of the machinery.

The hoisting is done in No. 4 and in No. 2 shafts; the former is fitted with a skip road down to the 200-fathom level, and is also furnished with the man engine; the latter is fitted for hoisting the heavy masses in addition to general hoisting work, and is also the one through which the water is pumped. Nos. 1 and 3, and the inclined shaft are not used. The longitudinal section of the mine shows the working of the mine to the present time, and the position of the amygdaloid and conglomerate beds, etc. A geological examination of this mine was made by Prof. Pumpelly, and a scientific description with an accompanying map will be found in his report of the geology of the Lake Superior copper region for the State of Michigan, 1873.

The mine has now attained a depth, vertically from the surface, of 1,700 feet, and the mine continues to look well, and to yield bountifully. The future of the Central will be regarded with increased interest, from the fact that the theory prevails, based upon the apparent failure of the Cliff, Minnesota, and National mines, that fissure veins will not continue productive to any great depth. Whether this opinion be sound or erroneous, it is a fact that the Central has already attained to a greater depth than was reached by either of the mines above mentioned, and still continues to yield up its ponderous masses as freely as at any period in its history. The Central justly bears the reputation of being a carefully and conservatively managed company. The location shows that everything has been done with reference to use and permanency, but nothing for show. A double track incline, laid on elevated trestle, connects the shafts with the stamps.

There are 130 dwelling houses on the location, all of which are occupied, and much want is felt for a greater number. The population is about 1,200. In addition to the usual mining force, about 90 men are now employed in cutting and hauling the year's supply of wood for the mine. The company have built a fine school building, and a well graded school is maintained.

The officers of the company are: Geo. A. Hoyet, President; John Stanton, Jr., Secretary and Treasurer; office, 76 Wall street, New York. Officers at the mine: James Dunstan, Agent; Samuel Bennett, Mining Capt; J. F. Roberts, Clerk.

THE ONTONAGON DISTRICT.

Mining work in the Ontonagon district was carried on contemporaneously with work upon Keweenaw point, and in both it had attained to considerable importance, and become widely known before any mines had been opened on Portage lake, or that region was claimed to possess any great degree of mineral value.

The prospectuses of early mining enterprises in the Keweenaw district, inviting the attention of capitalists and of investors in mining stocks, to the probable value of the shares, which were offered, were not unfrequently embellished with a display of the profitable results obtained at the Cliff, and in Ontonagon the fame of the great Minnesota proved to be a force equally attractive and potent.

The remarkable results of these two mines established the reputation of the districts to which they respectively belonged. However frequent and great might be the failures at other locations, the profits which these mines yielded

were certain facts, and demonstrated the great wealth of at least a portion of the cupriferous deposits of the country; and this knowledge undoubtedly sustained the flagging hopes in many a forlorn mining enterprise, and stimulated to renewed endeavor to achieve success at many less promising mines.

The geographical division of the copper region of Lake Superior into three districts is borne out and sustained by the distinct character of the metalliferous deposits, which occur in the different districts. In Keweenaw county, as has been described, the copper is found mainly in fissure veins, which cross the formation at nearly right angles to its course, and in the ash bed on the north, which runs with the formation, and conforms to it in dip.

In the Portage Lake district the copper is found in regular beds that have a well defined course upon the surface, wherever observed, and which may be clearly determined in the underground workings. In these beds, which are either amygdaloid or conglomerate, the copper is found to be distributed with considerable uniformity, though frequently in a small percentage, but it is not found to occur, to any great degree, in large masses.

In Ontonagon county the copper occurs in veins and in belts, which run with the formation. The copper-bearing veins, while conforming in direction with the strike of the inclosing rock, frequently dip at a greater angle, but always in the same direction. The beds which have been mined for copper are frequently distinguished by their irregularity, rendering it extremely difficult or impossible to define them. The product, which has been mainly in the form of masses, is in some portions of the range found scattered in the trap rock in a manner that sets at defiance any method of determining their location other than mere chance; blind, persistent work may lead to the discovery of an isolated mass or of a collection or a succession of masses, but it is frequently blind luck, and not the result of following any well defined clues. In many of the mining locations in Ontonagon county copper really exists in a good degree of abundance, and were it concentrated into a vein, would form a mine well worth working, but it is scattered so promiscuously that to obtain it, a system of mining, which partakes of the nature of irregular excavation, has been to a great extent practiced. In some instances, in the Evergreen Range, where the copper is really confined to a vein, the deposit appears as if it had been originally a rough irregular seam that became filled up with boulders of trap and the usual vein matter, among which is scattered the particles and masses of copper. These boulders are frequently so large as to form great "horses" in the vein.

Transverse fissures occur, but never contain copper or the vein matter that is associated with the occurrence of copper, as in Keweenaw county: they become here only cross-courses or slides filled with clayey matter and soft rock. These cross courses are generally selected as points in which to drive in adits from the north or south side of the bluff, crossing the lode at right angles.

In the Porcupine mountains the copper-bearing beds occur between the trap and the sandstone, having the latter for a foot wall, and at the Nonesuch mine, in this portion of the range, the hanging wall becomes a so-called slate.

The first great impetus given to the mining interest in this county was through the discovery of the Minesota mine in 1847 by Mr. S. O. Knapp. He was led to the discovery by examining the indentations, which were plainly discernable along the surface outcrop of the vein, and which proved to be ancient mining excavations. This was the first discovery of the "Indian diggings," which have since been found to exist everywhere in the copper region. One of

the principal pits opened by Mr. Knapp was found to have penetrated the vein to a depth of 27 feet, and was filled up with an accumulation of dirt and partially decayed vegetation; but at 18 feet from the surface a mass of nearly pure copper was found, weighing upwards of six tons. This mass had been raised from its original bed, a distance of five feet, and secured there on timbers, which had been placed under it. The timbers, however, had decayed, and the mass remained in its place, supported by the soil, which had imbedded itself around it. The mass had been hammered all over until its surface was entirely smooth and the adhering gangue, or rock crystals, was almost wholly removed. In this pit, as in others when cleared of the rubbish which filled them, was found great numbers of stone hammers, bits of burnt wood, a copper chisel with a socket for holding a handle, etc. Directly over this mass, deriving its support from the soil and debris which nearly filled the pit, stood a hemlock, which showed, when cut, 325 distinct annual rings of growth; and this was standing by the side of a much larger stump of a tree that had grown up and gone to decay since this pit had been excavated, and the mass of copper found beneath its roots had been raised from its bed, and the brands which were found beneath it had been burned, and the long period of time had elapsed necessary for the accumulation of the soil that filled the pit and supported the organic growth.

The rich promise afforded by the discovery of this mass of copper was greatly increased by the speedy results which further explorations immediately developed, and was subsequently in the highest measure fulfilled in the abounding prosperity of the company.

Four years later the National Mining Company began its prosperous career, and opened its mine on the adjoining location. These two companies, among the most profitable mining enterprises ever organized on Lake Superior, gave to the Ontonagon mineral district a wide celebrity, and for nearly twenty years it enjoyed a comparatively high degree of material prosperity. The remarkable success of the Minesota and of the National stimulated mining enterprise in this district, and innumerable companies were formed, some of which prosecuted mining work with considerable zeal and with lavish expenditure, but, unfortunately, at little profit. During the past two years comparatively but little mining has been done, and Ontonagon has become almost a synonym in the copper region for stagnation; but recently there are many indications denoting a probable revival of its business prosperity.

In the early days of mining in this region the vessels which brought the supplies and necessary materials and bore away the product were obliged to stop outside the bar, which formed across the mouth of the river, and to load and unload by aid of lighters. Much of the freighting with the mines was accomplished in flat boats that were propelled up the river ten or twelve miles to the "Minesota landing." But the water was too shallow and flowed with too strong a current in some portions of the bed, and the occurrence of rocks was too frequent to render this channel a desirable avenue for accomplishing the necessary transportation. The necessity for better facilities for carrying to and from the mines led to the construction of a plank road thirteen miles to Ontonagon village, and subsequently to the building of another plank road, which connected the Rowland mines—those in the eastern part of the county—also with the harbor at Ontonagon.

The want of a better harbor also began to be seriously felt, and the first work of improvement of Ontonagon harbor was undertaken by Mr. Charles T. Har-

vey of New York, who had superintended the building of the ship canal at the Sault de Ste Marie in 1856, under a contract with the county board and with the mining companies, by which Mr. Harvey was to receive a certain compensation while the work was progressing and to be entitled to a certain royalty or toll on all copper shipped. The contract was never completed, and the work which was done proved of but little permanent value. The matter was brought to the attention of the general government, and in 1866 an appropriation was made by Congress for the purpose of improving this harbor, and in the following year the first crib was sunk, since which time the piers have been extended 2,100 feet, through the expenditure of successive appropriations, amounting in all to the sum of \$200,000.

As a result of this important improvement, steamers can now enter the harbor without difficulty and unload at the docks, instead of as formerly stopping outside and transferring by lighters. The intention is to continue the extension of the piers into water of sufficient depth to prevent the filling up of the channel by the deposits of sand. The river carries a considerable volume of water, and it is thought that by the aid of dredging it can be rendered sufficiently deep to enable vessels to pass to some distance up the stream.

The principal claim heretofore set forth by the petitioners for appropriations has been the importance of the harbor as a place of refuge, since the amount of freight which for some years has been received at and sent away from this port has hardly been of a sufficient magnitude to justify a claim for a large appropriation; but in future when it shall have become a railroad terminus, and the valuable forests of pine and other timber which are naturally tributary to it are brought into requisition; when the rich farming lands of the county shall be cleared and cultivated, and its great mineral interests shall again revive and flourish, then the business of the harbor must sufficiently increase to render it one of the most important of the lake, and thus occasion the demand for expenditure that shall suffice to make it as complete as possible.

An important advantage in the harbor of Ontonagon arises from the fact of its remaining open in the fall and winter long after nearly all the ports on the south shore of Lake Superior are closed with ice. At the present writing, December 1st, Ashland, Bayfield, Portage Lake, L'Anse, etc., are completely shut, but here at Ontonagon a vessel could freely enter and lay at the dock.

The county of Ontonagon comprises a total area of upwards of 1,500,000 acres of land, and undoubtedly possesses natural advantages and resources which are surpassed by few counties in the State. Situated at the western extremity of the Upper Peninsula, it is at present, with the exception of Isle Royal, perhaps the most isolated county in the State. The only road suitable for summer travel which penetrates its borders is one along the Mineral Range from Houghton. A county road is building from the western terminus of the Marquette, Houghton & Ontonagon Railroad at L'Anse westward a distance of thirty-five miles to Greenland. This road has been completed from the L'Anse end nearly one-half the way, and in the winter, during the period of sleighing, a daily stage carrying the Ontonagon county mail passes over the entire route; but in summer, the mail is now carried from L'Anse to the end of the wagon road with a team, and then for the remainder of the distance it is packed through by an Indian.

Travelers from the East must reach Ontonagon by boat; or, if desirous of exercise, may depend upon their perambulatory powers to bring them through. In these days of walking matches, such an attempt might, on occasion, per-

haps, be putting to a practical use one's ability in this direction, and in a way he would be likely to appreciate before he got through, and possibly have good reasons for remembering for some time afterwards.

The supplies for the mining district of the county are brought in by boat to Ontonagon, and are thence hauled in wagons over many miles of rough roads to the several locations; and in case of navigation closing before the necessary supplies have been got in, they must be sent to L'Anse by rail, and thence hauled through the woods with teams. Such an alternative occurs the present season. A large portion of the supplies were sent to Ashland and to Duluth to be brought into Ontonagon, and into Portage Lake by boat; but unfortunately the advent of unusually early severe weather closed the harbor of Ashland and the Portage Lake canal before the freight at Ashland and at Duluth had been got away. So that country is thus compelled to bring a great portion of its winter supply of provisions and materials around by rail to L'Anse, at a greatly increased cost. The hauling by sleigh with teams from L'Anse through to the Ontonagon mines costs for freight one dollar per hundred, and passenger travel five dollars per individual.

The mines of this county labor under the disadvantage of being obliged to haul all their product and supplies, or whatever materials, a dozen miles or upwards, to or from Ontonagon harbor, and also of generally possessing an insufficient amount of water for the purposes of stamping and washing their rock. These drawbacks cannot be regarded as permanent obstacles, since when a railroad is in operation between the mineral range and the harbor, they can be effectually removed.

It is easy to understand how, that a region so isolated and inaccessible, without railroad or telegraphic communication, combined with a rigorous climate, should be slow of settlement. And yet, to offset its many and serious obstacles to improvement, the country possesses resources and advantages that must ultimately secure to it a great degree of prosperity. The mineral range, which starts from the northern extremity of the Keweenaw peninsula, and runs southerly, parallel with the coast line, through Keweenaw and Houghton counties, extends beyond the southern limit of Ontonagon; and if the Minesota and the National be taken as an index, and the not unreasonable hope of the revival of these great mines to a productive capacity approximating to their past be entertained, or the future discovery of productive lodes, such as these have been, be accepted as the basis of conjecture, there are certainly grounds for the hope, which the most confident may entertain, of the future mining prosperity of the county.

The indications of the existence of valuable deposits of iron ores, which are found in the southern and southwestern part of the county, may become, at no distant day, the basis of prosperous industry in iron mining.

But aside from its mineral resources, which here, as elsewhere, must always be, in a degree, speculative and intangible, this portion of our State is exceedingly valuable for its timber and for its soil. There are large areas of excellent pine land, which are as yet untouched, and which will afford millions of feet annually for many years to come, while the great forests of birdseye, yellow birch, cedar, etc., must at least possess an equal value and be in demand for manufacturing purposes, when suitable facilities for transportation shall render them available.

Off the mineral range the country is comparatively level; very much of it is gently rolling, hard wood land, which is well watered by frequently occurring

streams and lakes. Of these the Ontonagon river and Lake Agogetic are the largest. The latter is a lake about 15 miles in length and two miles in breadth, and is situated in the center of the county, in the midst of beautiful hard-wood forests which surround it and fringe its borders; its crystal depths abound in speckled trout, and in other scarcely less esteemed members of the finny tribe. Altogether it presents to the amateur idler as many advantages for the successful indulgence of piscatorial and primitive habits as can anywhere be found.

The soil is generally a strong clay loam, whose productive capacity is fully evinced in the annual crops, which are obtained by the limited and somewhat crude farming that has been practiced in the vicinity of the mines. The climate and soil are exceedingly favorable to the growth of pasturage, hay, oats, wheat, buckwheat, barley, potatoes, cabbage, turnips, and other roots.

The testimony of a number of farmers who were visited for the purpose of eliciting facts pertaining to this important industry, as applicable to this section of the country, was of the same uniformly encouraging character. A few of the results that were thus obtained may be here given to illustrate how, with market facilities, improved appliances, avenues of communication, a population devoted to farming might easily flourish.

Mr. L. Stannard, who is also a merchant at Rockland, has about 80 acres under cultivation, on which he raised 35 acres of oats the past year, which yielded 1,232 bushels; six acres of spring wheat, which yielded 30 bushels to the acre; one acre of potatoes, which yielded 200 bushels (has had 400 bushels to the acre); and he cut 46 tons of hay. He finds one acre of pasturage sufficient for a cow for the season, and he had single potatoes (Early Rose) which weighed three and one half pounds.

Mr. James E. Hoyet farms 40 acres; is also agent of the Rockland mine, and he had 100 bushels of sound corn on two acres, and exhibited at the county fair two squashes, grown upon the same vine, one of which weighed 100 pounds and the other 82 pounds. He also exhibited yellow pumpkins weighing 40 pounds and heads of cabbage that weighed 40 pounds.

Capt. Parnell, agent of the National mine at Rockland, tells me that he had three pailfulls of potatoes planted, which produced 52 bushels. He raised ruta бага turnips of an almost incredible size and of an excellent quality. Wild red and yellow plums are abundant, and some of the cultivated sorts flourish equally well.

Mr. Hoyet raised in his garden last season about seven bushels of this fruit, some excellent pears, and a quantity of choice apples. One long keeping sort, and, apparently, in all other particulars, valuable variety, is a seedling of his own raising.

Currants, raspberries, strawberries, etc., are readily produced in any degree of abundance, and it is found that apples can be raised with but little trouble and with much certainty. Duchess of Oldenburg, Red Astrachan, Fameuse, and Ben Davis trees grow and produce well. There are already, west of the Ontonagon river, and near the lake, orchards which yield more than the proprietors require for their own use, and thus have a surplus to sell.

The little farming which is done in this county is mainly in the vicinity of Ontonagon village and Rockland village and along the roads connecting them. It has grown up out of the necessities of the situation, and has seldom been taken up here from choice. No one ever went to this country with the intention of making farming a vocation. The early mining companies

were compelled to improve and cultivate a portion of their lands to aid in providing themselves with supplies. Men have gone to the Lake Superior country for the purpose of speculation,—to engage in mining or in trade,—to explore for minerals, but seldom to make a home, or with the expectation of remaining longer than suited some immediate purpose. It is difficult to induce people, now-a-days, except for a temporary object, to settle very far from the sound of the locomotive whistle, and a revival of the stagnant industries of Ontonagon county can scarcely be looked for, until railroad communication is secured, which shall extend from the harbor to the mines, and thence connect with some thoroughfare beyond. During the past summer a company was formed by some responsible Saginaw gentlemen to build a road from Ontonagon to the Wisconsin State line. For this purpose a grant of lands of six sections to the mile was made by Congress in 1856, and a line for the road was surveyed and the requisite amount of lands were withdrawn from the market and reserved to aid in its construction.

The line of this survey extends southeasterly from the mouth of the Ontonagon river, terminating in the State line, in the head waters of the Brulé river in the south line of town 42 N., R. 35 W. The grant of lands above referred to has been provisionally conferred by the State Board of Control upon the company, which has organized to build this road, and the matter only awaits Congressional action to designate the time within which it must be built, and a resolution of the Legislature confirming the action of the State Board, in order that operations shall actually begin. Great hopes are entertained by the people of the county that the undertaking may prove a speedy success. The road when built will naturally connect with the Northwestern branch, which runs along the Menominee iron range and must also be crossed by the easterly extension of the Northern Pacific, the construction of which is said to have already been begun from Duluth, to be built along the south shore of Lake Superior, crossing the Upper Peninsula from its southwestern boundary to the Straits of Mackinaw. These railroads, with the Detroit, Marquette & Mackinaw road, soon to be completed, will open up to settlement the best farming and timbered portions of the Upper Peninsula, and must necessarily result in a greatly improved condition of its business interests. The reserved railroad lands in Ontonagon county comprise very many valuable sections of pine, and already steps have been taken by some of the parties who propose to build the road towards preparing to manufacture lumber at Ontonagon on a large scale. The river with its numerous branches afford excellent facilities for floating and booming the logs, and Duluth and the great northwestern prairie country open a ready market. The Rich brothers, who for some years have been engaged in the manufacture of lumber at this point, are now building a mill of a capacity of about 15,000,000 feet annually to replace one which was unfortunately recently burned.

The line of the proposed railroad will afford admirable locations for blast furnaces for the manufacture of charcoal pig iron. The proximity to the iron range should reduce to a minimum the cost of the ore; the railroad and the harbor will afford the facilities for transportation and the abundance of hard-wood along the line can be turned into charcoal, thus facilitating the settlement of the farming lands by furnishing to the settler a market for his cord wood, giving to him employment and profit while clearing his land and getting it ready for crops.

The present population of Ontonagon county is about 2,600, of which num-

ber 854 are in Ontonagon; 876 in Rockland, and the remainder principally in Greenland.

THE MINESOTA MINING COMPANY.

The manner of the discovery of the celebrated Minesota vein has already been related, and the effect of this discovery was to spread the fame of the region over the whole world. Accounts of the monster masses of pure native copper which the Minesota mine yielded were everywhere published, and the reality almost staggered belief. Masses of copper weighing thousands of pounds were purchased and taken to Europe to be exhibited as curiosities. The mine is located on section 15, T. 50, R. 39, and the company originally owned the north half of a three-mile square government lease (No. 98), consisting of 3,000 acres. The organization of the company was made in 1858 under a special charter granted by the Legislature of Michigan in that year.

The direction of the vein conforms to that of the rock formations, being N. 65° E., and is at No. 4 shaft 645 feet above the Ontonagon river, from which it is distant about 1½ miles, the river being to the west of the location. The vein is irregular, but generally of good width, from two feet to eight feet, and with well defined walls of trap. The dip of the shafts, which follow the vein, vary from 52° to 64° to the north. The rock formation dips at about 44°. The mine was at first opened on what was called the north lode, but four years later the workings of the National developed the value of a conglomerate and sandstone belt, lying but a short distance to the south, and work was immediately begun here, and as it follows the formation, dipping 44°, the two mines intersected in an irregular line at about the 40 level. This is shown in the cross-section herewith presented. The gangue of the vein is quartz, calcite and epidote. Large crystals of quartz, weighing several pounds, with pyramidal terminations, were met with, incrusting with crystallizations of feldspar. Many very beautiful specimens of crystallized minerals, including copper, have been found.

The first shipment of copper was made in 1848, consisting of 6½ tons, which sold for a net price of \$1,700, and assessments were made in amount \$10,500 the same year. The company continued to work under the old charter until 1855, when a reorganization was made under the general mining laws of the State of Michigan, the capital stock being placed at \$1,000,000 in 20,000 shares. Up to this time the entire under-ground workings aggregate upwards of 2½ miles; total length of levels 10,728 feet; total length of shafts 2,516 feet. The longest level was opened 1,663 feet, and the lowest, the 60-fathom level, 436 feet in length and 447 feet below the surface. At this time the yield of mineral per fathom was (1855) 890 pounds, which was an increase over previous year of 25 per cent, from which it was concluded as the mine had constantly increased in richness it would continue to do so. The mining population was (1855) 596, an increase of 74 in the year; 471 were men, 56 women, 69 children. The average number of miners during that year was 178, an increase of 43; entire force 463.

An addition to the estate of 470 acres was made, making the company's whole territory consist of 2,120 acres. Besides this there were 115 acres adjoining the mine, on section 16, the title to which was being contested in the courts with the National Company, a further notice of which will be made in connection with the history of that company's operations.

About 200 acres of land were under cultivation. Twenty-five acres of pota-

atoes yielded 6,500 bushels=260 bushels to the acre; 15 acres of turnips, yielding 3,000 bushels. Thirty-two acres were sown to oats, producing 50 tons of straw and grain, and 70 acres were in meadow. These agricultural facts are given to show the productive capacity of the soil.

The mining plant was for some years greatly inferior to the wants of the mine, and the product was, no doubt much less in consequence than it might have been if enlarged facilities had been provided. Up to 1854 the hoisting was done in dribbles, and it was not until then that the shafts were fitted with skips and an engine and hoisting drums set up.

A small stamp mill with 12 wheels of old Cornish stamps was erected, but there was a want of water to run except in seasons of rainfall.

The yield of the stamp rock was about four per cent.

The first dividend, of \$30,000, was paid in 1852, the fifth year of working, and they were continued yearly thereafter.

The result of each years' work, from the commencement up to the time of the reorganization of the company, are as follows:

YEAR.	No. of men employed.	Expenditure.	Mineral Product.	Net Value of Copper.	Assessments paid.	Dividends Paid.
1848....	20	\$14,000 00	6½ tons.	\$1,700 00	\$10,500 00	.....
1849....	60	28,000 00	52 "	14,000 00	16,500 00	.....
1850....	90	58,000 00	103 "	29,000 00	36,000 00	.....
1851....	175	88,000 00	307½ "	90,000 00	3,000 00	.....
1852....	212	108,000 00	520 "	196,000 00	.....	\$30,000 00
1853....	280	168,000 00	520 "	210,000 00	.....	60,100 00
1854....	392	218,000 00	763 "	290,000 00	.....	90,000 00
1855....	471	281,000 00	1,434 "	550,000 00	.....	200,000 00

Notwithstanding the great financial revulsion of 1857 the company realized its usual profits and paid heavy dividends to its stockholders. The product for 1857 consisted of mass copper, 3,015,581 pounds; barrel copper, 819,900 pounds; stamp copper, 280,512 pounds; total product, 4,115,993 pounds; yielding 74.1 per cent ingot copper. This was an increase of 198 tons over the product of 1856, which product was 1,434 tons, of which 73 per cent was in masses. The total cost for mining, raising and preparing for shipment the whole product of the year, made up from the monthly returns from the mine, was \$279,401.51, an increased cost per ton over previous years owing to the expense of cutting up the great masses which were found. The great riches of the mine at this period, 1857, is set forth in the following statement by Mr. Geo. D. Emmerson, mining engineer:

"It was against the established rule that a vein could lie between two kinds of rock so dissimilar as trap and conglomerate." * * "But they are finding immense masses of copper in the conglomerate under the vein. A few days ago this was showing in the most marked manner in several points. In the 20 fathom level, east of No. 5 shaft, in the south lode, the regular sheet of copper had been taken from the foot wall, and the yield at this point had been very great. The masses were from 12 to 18 inches thick. Strings of copper were cut off that seemed to branch into the conglomerate. These were followed and led immediately to very large masses, some of which were of the thickest copper ever before taken from the mine. One piece which was cut off presented a face of bright copper cut by the chisel three feet and nine inches

in thickness. It was so thick that it could not be handled in the mine without again dividing longitudinally, or splitting. Thus the mass showed two flat surfaces, at right angles with each other, of bright copper cut by the chisel. This point in the mine has been extremely productive. Some 200 tons of large masses have been taken out of the conglomerate under the lode, besides the enormous yield of the vein itself overlying it. In one place the copper extended into the conglomerate as far as 16 feet south of the foot wall.

"An occurrence of copper in all respects similar is found to the west of No. 5 under the adit level. Besides the masses in the regular vein, which was also extremely rich at this point, they had taken only 40 or 50 tons out of the conglomerate, the foot wall was perfect as in the other case, and strings leading into the conglomerate were quite small, and very slightly attached. But by trifling labor they uncovered a series of masses going up and down, with an eastward indication, for the height of 70 or 80 feet and going out of sight both above and below. It was at once apparent that they had something very valuable, but they had no conception of the immense thing which a few days' work disclosed. At one convenient point they broke away behind the copper so as to get in a sand blast of five or six kegs of powder. They stripped the mass further and again fired without result. Again they fired nine kegs of powder and the mass remained unmoved. Bucking the rock around for a considerable distance 18 kegs of powder were shot off without effect, and again 22 kegs, and the copper entirely undisturbed at any point. After further clearing, 25 kegs were shot off under the copper, and it was thought with some effect. But a final blast of 30 kegs, or 750 pounds, was securely tamped beneath the mass and fired. As soon as the smoke cleared away, a mass of copper 45 feet long and three to five feet in thickness, apparently very pure and which will probably weigh 300 tons had been shot out and was ready for cutting up. The blast had torn the immense body from its bed without exhibiting a sign of breaking or bending in any place, so great was its thickness and strength. It was torn off from other masses which still remain in the solid rock. About 100 feet to the east from this is another large mass which several parties are exposing, and from present appearances, it may exceed in size the last named one. These are near the point of the great counter lode from which 300 to 400 tons of copper have been taken; and the ground in the vicinity has unquestionably yielded the greatest amount of mineral ever taken from the earth in the same space. Its occurrence has been in three distinct forms: 1, In the counter lode; 2, in the regular vein; and 3, in the conglomerate rock under the vein.

"At No. 2 shaft they are sinking below the 60-fathom level, and are experiencing great difficulty in getting through the copper which they encounter. It was feared that they would be compelled to turn the shaft entirely out of the vein to enable them to sink. There are 1,000 tons of copper in sight—much of it ready for cutting."

A further extract, dated March 7, 1857, says: "There is now in the Minnesota mine, between the adit and the 10-fathom level, a single detached mass of apparently pure metallic copper, which is some 45 feet in length, and in the thickest part as much as eight or nine feet in thickness. It contains probably more than 500 tons of pure metal, and is worth, as it lies, more than \$150,000."

This is believed to have been the largest complete mass of native copper ever discovered. The exact weight was not ascertained, but enough of it was weighed to ascertain that the total would not fall short of 500 tons. Its greatest length was 46 feet, and its greatest breadth, 18½ feet; greatest thickness, 8½

feet. The main width was 12½ feet, and the main thickness four feet. It took 20 men 15 months to remove it from out the rock. Some of the cut faces measured 16 square feet. The cutting up afforded 27 tons of copper chips.

The product of the mine in 1858 was: Mass copper, 2,429,989 pounds; barrel, 903,871 pounds; stamp, 333,352 pounds; total, 3,667,212 pounds, yielding 70.1 per cent ingot. There was also obtained 70 pounds silver, which sold at \$8.54 per pound. The total proper cost of production was \$273,746.02.

In 1858 the company laid out 80 acres into a village plat, and commenced to sell lots. The company also purchased the south half of location 98, making the total estate 5,305 acres. The long pending suit with the National Mining Company was decided by the U. S. Supreme Court in favor of the latter. The entire population in 1858 was 910, of whom 85 were women. There were 36 births; 3 deaths by accident—7 deaths in all. The stoping cost \$11.88 per fathom, and the yield in mineral was 945 pounds per fathom, average. The available surplus at the close of the year 1858 was \$240,583.28.

The product for 1859 was: Mass copper, 2,040,454 pounds; barrel, 929,571 pounds; stamp, 282,092 pounds; total, 3,252,117 pounds, yielding 71 per cent = 2,305,204 pounds ingot, which sold at an average price of 22 cents per pound; dividend paid, \$180,000. Two boiler explosions occurred, causing important damages to the pumping and other machinery. New boilers were procured from Detroit. Net earnings were \$131,391.32; the average cost of sinking was \$12.26 per foot; the average cost of drifting was \$5.70 per foot; the average cost of stoping was \$29.87 per fathom. The total length of underground openings was 31,893 feet; greatest depth, 698 feet, and greatest length, 2,077 feet. There were four hoisting engines and winding machinery, one pumping engine at No. 3 shaft, engine at stamping mill, with saw mill and feed mill. At two other shafts the hoisting was done by horse whims; another engine was required at Nos. 9 and 10. A warehouse was built; there were 400 acres of land under cultivation, producing 2,200 bushels of potatoes, 1,200 bushels of turnips, 170 tons of hay, and oats. The company had built a warehouse at Ontonagon, and a substantial dock at an early period of the work. A small steamer had also been put on the river to ply between the harbor and a point 6½ miles below the Minnesota landing, between which latter points the flat-boats were propelled up stream by setting poles.

The profits for the year 1861 were \$195,216, from which a dividend of \$3 per share was paid. There was a falling off of 16 per cent in production from the figures of the year before, but the directors announced that they did not think it was due to any permanent decline in the productiveness of the mine, but only to temporary cause. The mine, however, was not showing heavy masses; there continued to be an abundance of smaller ones.

The product for the year 1861 was, mass copper, 2,402,226 pounds; barrel, 972,239 pounds; stamp, 223,132 pounds; total 3,597,597 pounds, yielding 72.94 per cent, and 195 pounds silver. The copper sold at an average price of 20.05 cents per pound. Expenditure on mining account, \$401,281.39. Total receipts, \$647,346.69. Investment in mining plant to date (1861), \$267,561.81. Extent of mine opened—total length of shafts, 7,916 feet; deepest, 975 feet; shallowest, 200 feet. Cost for sinking per foot, \$12.51. The total length of drifts, 34,987 feet; greatest length, 2,479 feet; lowest level, 120 fathoms; total length of underground openings, 42,863 feet. Cost per foot for drifting, \$5.10. The cost per fathom for stoping was \$8.16, and the average yield of mineral per fathom was 404 pounds, a great falling off, as will be observed,

from previous years. The average number of miners employed was 313; average monthly wages, \$39.03. The entire force comprised 808 men.

The company found that by laying out the village of Rosendale they obviated the necessity of building dwellings, etc., by selling lots and furnishing lumber for sale; men built their own houses. Nos. 3, 5 and 10 shafts were furnished with skips and cars for hoisting, and substituting wire ropes instead of chains.

During several succeeding years the company suffered no diminution in its prosperity; the ratio of increase of yield was far greater than the increase of expenses, showing a degree of prosperity and a rate of progressive increase, which up to that period had been hardly paralleled in the history of mining enterprises.

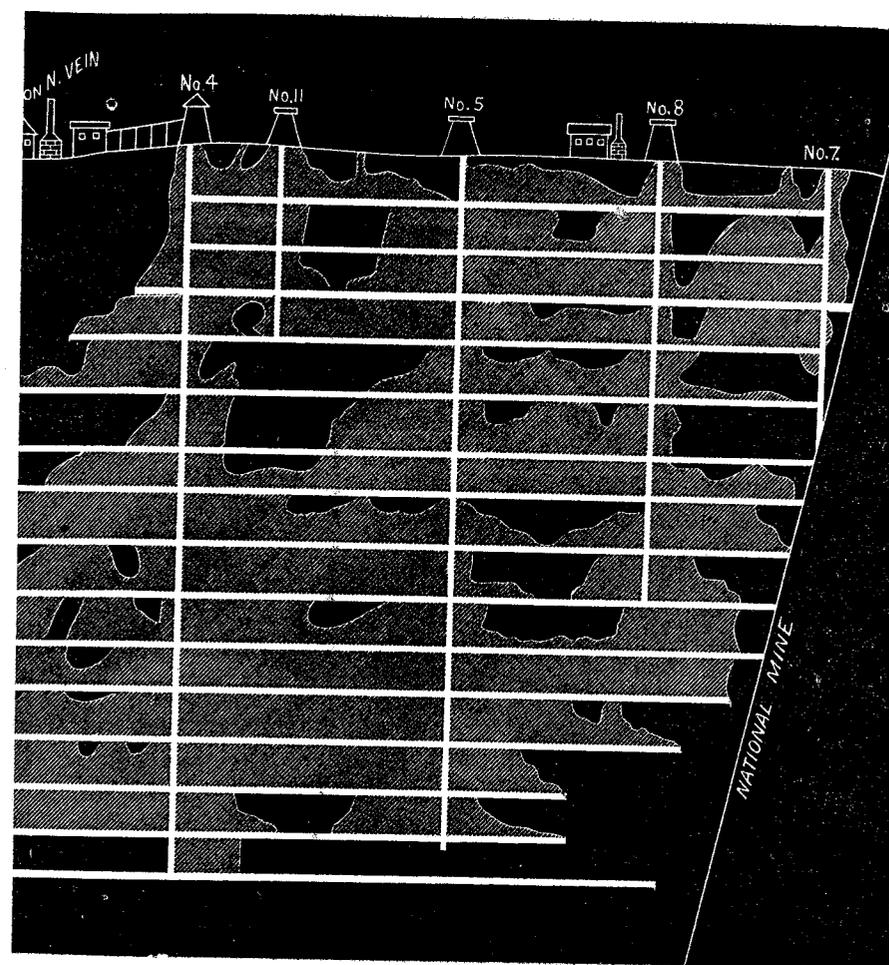
The mine produced its maximum yield in 1860, and from that date began to fall off. But it had cost the original stockholders only \$60,000. They were fortunate in having a rich mine from the start, which provided the means to procure the capital necessary for completing the improvement and for opening the mine. Upwards of \$400,000 were expended before the company was enabled to pay dividends. It is seldom in the history of mining or of any other undertaking where the enterprise to be developed so nearly furnished its own capital to develop itself. The Minesota affords an instance of an extraordinary profit for a small investment, which it cannot be expected will be very often repeated, even in so remarkable a region as Lake Superior copper district. For every dollar paid the stockholders have received back nearly \$30.

In 1866 the product had fallen to 285 tons. Work continued, however, in a moderate way until 1870 when the pumps were stopped in the old mine. But some previous effort had been made on the south bluff and was continued there but without developing anything of much apparent value. During the period of work in the old mine, the upper levels had not been worked out very closely, only the richest ground had been broken, and there was much left that would well pay for stopping. As the product in masses began to fall off there was more attention given to the stamp rock. A good deal of it had been neglected that contained a good percentage of copper, and by working it up the product of the mine was kept up pretty well for some years. In 1861 the stamp work was only six per cent of the total product, and the mass copper was 67 per cent. Five years later, in 1866, the stamp work was 43 per cent and the mass copper 36 per cent of the entire product. The old stamp mill, which was a crude affair as compared with those of later construction, was entirely unequal to accomplishing the work required of it. In 1865 the experiment was tried—an expensive one as it proved—of pulverizing the rock by use of rollers, but the attempt was an entire failure. The machinery was not properly designed nor constructed, and the work sufficiently demonstrated the fact to the satisfaction of the directors that no system of rollers, however devised, was adapted to the reduction of rock containing such masses of native copper.

In connection with this machinery an expensive launder was built, which also proved useless. This unavailing work was done at great cost, at a time when the company could not afford any useless outlay.

It seems to be difficult for a great mine like the Minesota, that for so many years had been working on a liberal scale, deriving an immense income, to suddenly circumscribe its affairs to conform to a greatly reduced magnitude; very much that is superfluous will remain that ought to be cut off. It was a good while before the managers realized the necessities of the situation. For some

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LONGITUDINAL SECTION OF THE MINNESOTA MINE.

Scale, 300 ft. to one inch.

